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CONTENTS

Cultural symbol value in animated advertisement model: systematic review

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Abstract. At present, animation has a wide range of applications in the field of advertising, and more cultural levels drive greater advertising effects. Cultural value with different cultural backgrounds, there are different consumer behaviors for advertising. Therefore, we conducted a systematic review to identify the most common dimensions of animated advertising presented in recent publications and to determine whether there is sufficient evidence for the effectiveness of cultural values in animated advertising. Through electronic search of the database, a total of 1829 citations were identified, of which 14 publications included models. Empirical data were included in 13 studies, and the focus of the review was around the visual perspective, the challenges faced due to the growing cultural diversity, but the lack of cultural value, which led to the dilemma in the cultural perspective of animated advertisement. This review will help researchers explore cultural value as one of the research variables that influenced the results of the study.
Keywords: advertisement; cultural; model; value.

1. Introduction

Culture has been commonly defined as collective beliefs, attitudes, and values that guide individuals' communicative behaviors. Values are qualities that are the core elements of a culture, whether it is good or bad, pretty, or ugly, heroes are real or imagined people who become role models in a culture [1]. Cultural values as the governing ideas and guiding principles for thought and action in each society was conducted by Sriram [2]. Different cultural groups have distinct values, objectives, customs, and other elements that influence how advertising messages are developed and received [3]. International advertising campaigns sometimes overlook cultural values in foreign markets [4].

The differences and similarities between Western and Eastern countries' advertising appeals have long captivated researchers and advertisers [5]. Many academics think that as pictures are easier to understand, more succinct, and absorb faster than spoken information, they effectively communicate the power of advertising [6].

With the advancement of technology, advertising has become increasingly reliant on animation [7]. Character-based animation is a popular form of dynamic visual statement in advertising, greatly enhancing the efficacy and content of many media [8]. Animation aims to convey cultural values in addition to being entertaining. Thus, an animated commercial advertisement that is successful can change customer preferences, attitudes, and habits, which in turn can impact culture.

Traditional holiday commercials in international advertisement, particularly those for the Chinese New Year, enhance the emotional bond between brands and consumers by presenting stories and emotions that resonate with and elicit empathy from viewers.

In addition to highlighting the visual symbols used in animated advertisements, this study describes and summarizes the relationship between cultural value and these forms of media. It also aims to address the relationship model between these two types of media.

Animated advertising has the potential to reach a large audience in a variety of contexts, particularly content with cultural significance. The majority of individuals are consequently exposed to this fascinating area of study. The following summarizes the primary goals of this systematic review:

1) To illustrate the influence of cultural values and animated advertising.

2) To describe different approaches and strategies based on studies on animation advertising and cultural value.

3) To illustrate current trends and public issues of cultural values on animated advertisement.

4) To elucidate the future research direction of cultural value in animated advertisement.

2. Literature Review

Values are used to measure actions based on habits or customs in a particular society [9]. Values have been seen as fundamental components in the description of culture and the distinctions between cultures, as well as significant components in explaining individual motivations and subsequent actions [10]. Certain essential traditional Chinese values encountered challenges in recent decades from a variety of modernization and social movements.

Consumers understand advertising messages by relating them to culture was conducted by Frith [11]. Significant differences in key cultural values between Western and Eastern cultures reflected in advertising was mentioned by Frith and Frith[12]. Cultural values play a central role in the advertising content and advertising content plays an integral role in transmitting and shaping cultural values [13]. The most common cultural values manifested in advertising include individualism-collectivism[14], high and low context cultures and language[15], power distance[2], uncertainty avoidance[2], and cultural preference for written versus oral communication[16]. China was a vertical collective culture, and the US a vertical individualistic culture was conducted by Shavitt et al. [17] Numerous studies have demonstrated that different nations have distinct cultural values that should be taken into consideration when evaluating advertising (Table 1).

Table 1. Value in advertisement

Reference	Value
18	Adventure, Convenience, Economy, Effectiveness, Enjoyment, Family Integrity, Health, Leisure, Modernity, Neatness, Popularity, Safety, Sex, Social Status, Technology, Uniqueness, Wealth, Wisdom，Youth
19	Beauty, Hardworking, Loyalty, Nature, Quality
20	Veneration for the elders, Tradition, Independence, Competition
21	Thrift，Perseverance，Filial Piety，Benevolence
22	Interdependence，Harmony with Others，Face-saving
23	Wealth, wisdom, youthful spirit

Source: Authors' elaboration

The transmission of low context culture originates from the material context, whereas the majority of the information in high context culture exists in a high

material context [24]. A variety of social and cultural symbols are revealed through images in the transmission of contextual culture to produce an image expression, particularly in animation. The integration of values and culture in the Malay folklore animation was thought by Rahim et al. [26]. According to a study by Che Yaacob and Abd Rahim on the importance of kindness in Malay folklore, morals are intended to be expressed to readers through the stories themselves. Meanwhile, the importance of animated cartoons in the social values they convey were mentioned by Bilis and Bilis [27]. There are also many studies in which cultural values are evaluated with animation, as in Table 2.

Table 2. Value in animation

Reference	Value
28	Beauty/youth, Collectivism, Equality, Family, Friendship, Friendship, Hierarchy, Humanitarianism, Nature, Perseverance, Pleasure, Romanticism, Self-interests, Wisdom, Others
29	Kindness, Self-reliance, Good manners, Respect, Affection, Justice, Courage, Physical and mental hygiene, Honesty, Hardwork, Cooperation, Awareness, Gratitude, Rationale, Spirit
30	Appreciation, Kindness, Good relationship

Source: Authors' elaboration

Meanwhile, Empirical studies on motion in advertisements have explored its psychological effects [58], stressing that motion could influence human cognitive processing and increase viewer attention to advertisements [59]. While advertising researchers have created a variety of hierarchical models to account for different scenarios in which consumers make decisions, they all agree that the three fundamental principles of the hierarchy of effects model are crucial. many researchers have tried to develop the tripartite attitudinal dimensions (i.e., cognition, affection, and conation).

In short, there are more literature on cultural value and advertisement, more literature on cultural value and animation, and more models of animated advertisement itself. However, there are few literatures on the model of the combination of cultural value and animated advertising. Therefore, this paper discusses the model of cultural value in animated advertising through systematic literature review.

3. Data and Methodology

This study utilizes a systematic literature review approach. This method enabled the researchers to identify and summarize past studies. This research utilizes the Pre-recording Systematic Reviews and Meta-Analysis (PRISMA) technique, a widely accepted standard for conducting systematic literature reviews. This section also covers key subsections such as identification, screening, eligibility, and data extraction.

3.1 Identification

Two significant multidisciplinary databases were chosen for the article search in order to thoroughly cover the corpus of relevant research: Web of science, Scopus. Find relevant articles by utilizing single or combined keywords in the search. Identify related terms and generate search strings for the database, as in Table 3. The search was dated 22 March 2024.

Table 3. The search strings

Web of science	ALL=((animate* OR animation OR (computer animation) OR (animation value)) AND (advert* OR advertisement OR advertising OR (animated advertisement) OR commercial OR (online advertisement) OR (advertisement value)) AND (culture* OR (cultural representation) OR (cultural element) OR (Chinese New Year) OR (Chinese zodiac symbol) OR festive* OR (cultural value)) AND ((visual language) OR (visual symbol) OR (visual analysis)))
Scopus	(animate* OR animation OR (computer animation) OR (animation value)) AND (advert* OR advertisement OR advertising OR (animated advertisement) OR commercial OR (online advertisement) OR (advertisement value)) AND (culture* OR (cultural representation) OR (cultural element) OR (Chinese New Year) OR (Chinese zodiac symbol) OR festive* OR (cultural value)) AND ((visual language) OR (visual symbol) OR (visual analysis)) AND (research model)

Source: Authors' elaboration

3.2. Screening

At this stage, inclusion and exclusion criteria including language of publication, year of publication, type of article, and publication were used directly from the database. For the Chinese New Year theme of Chinese traditional festivals, the review is limited to English and Chinese publications. Publication years are limited to three years, and since there are only three months in 2024, it is restricted from 2021. The types of articles reviewed do not include books, series, chapters Sections, Review, and conference proceedings, mainly include journal papers (Table 4).

Table 4. Selection criteria

Criteria	Selected criteria	Exclusion
Language	English & Chinese	Non-English & Chinese
Year of publication	2021 -2024	<2021
Source types	Journal (Article)	Conference, Book, Review
Document type	Academic articles such as a published thesis or peer-reviewed articles	

Source: Authors' elaboration

3.3 Eligibility

The third stage involves screening essay qualifications. Export the two database search results to the software ravvan and remove duplicate data. And a careful review of the title and abstract of the literature has determined that these articles meet the inclusion criteria.

Obtain the latest data from ravvan and screen the complete literature for download. Literature that fails to be downloaded will be excluded. The literatures with high relevance and in line with the objectives of this study will be selected.

4. Results

4.1 Selection of the Study

The number of articles filtered and excluded from the accessed search database is derived from the search string. Shows the number of articles retrieved from both databases and shows that the largest number of articles retrieved from Scopus (n=1814) and the smaller number retrieved from Wos (n= 15), as shown in Fig. 1. The procedure flow for selecting articles for the study is depicted in Fig. 1, which shows the elimination procedure.

Identification of studies via databases and registers

Identification

Records identified from Scopus:
  Databases (n =1814)

Records identified from wos:
  Databases (n = 15)

Eligibility

Records screened
  (n =440)

Records removed *before screening*:
Records marked as ineligible by automation tools
  (n = 1389)

Articles assessed by
  (n =79)

Articles excluded (n =361)

Reports sought for retrieval
  (n =48)

Reports not retrieved
  (n =31)

Reports assessed for eligibility
  (n =27)

Reports excluded:
  Reason 1 (n =6)
  Reason 2 (n =7)
  Reason 3 (n =5)
  Reason 4 (n =3)

Included

Studies included in model
  (n = 14)
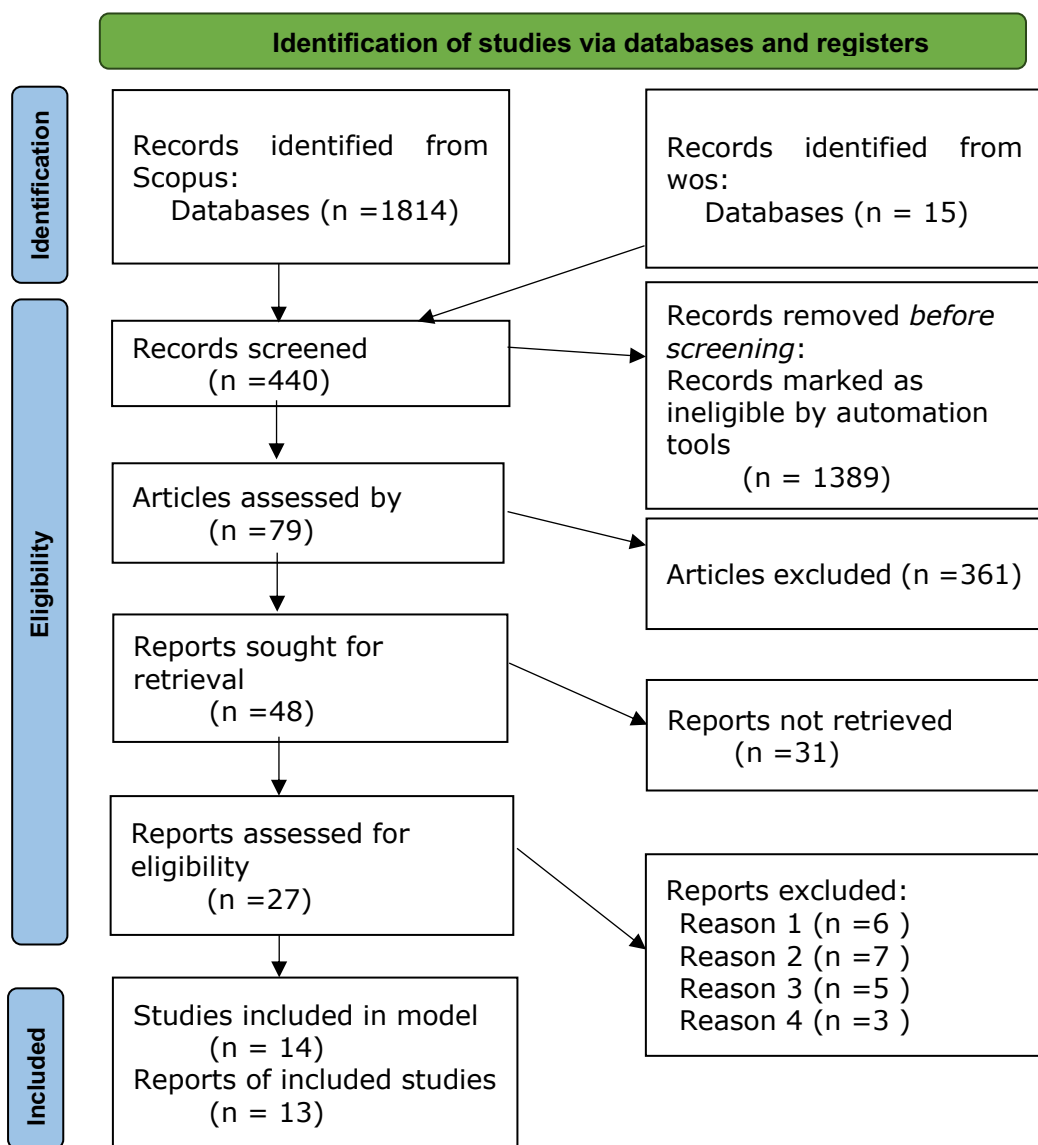Reports of included studies
  (n = 13)

Fig. 1. PRISMA protocol.
Source: Authors' elaboration

Screening and eligibility in Prisma agreement. The program reduces the number of searches from the search database:

1) Delete articles based on language, article category, and time (n=1389), as well as duplicate articles in two databases (n=0). Resulting in a reduction from 1829 to 440;
2) The deletion of the article after reviewing the abstract and title resulted in the article being reduced from 440 to 79;
3) After reviewing articles that could be downloaded full text, the non-downloadable articles were removed, resulting in a reduction in articles from 79 to 68;

4) The number of thoroughly read articles was reduced from 68 to 27. These articles were removed for the following reasons:
   (a) Marketing strategy
   (b) Product packaging
   (c) corporate visual identity systems
   (d) game

4.2. Data items

A shortlist of 25 articles have been selected for the systematic review based on the selection process. Every article was examined, and the data extracted was totalled. Most of the research included animation (n=11), followed by advertising (n=8) and culture (n=6), with the rest of the research including endorsers and visual angles (n=2).

Of the 25 papers, only six were about China. The youngest sample age in the study was 15, while the largest was 41. From the perspective of methods, the methods used are experiment (n=12), investigation (n=5), survey (n=3), content analysis(n=2), Eye-Tracking(n=2).

Among them, 14 publications meet the first inclusion criteria, 13 articles meet the second criteria, and the list of papers meeting the first criteria is listed in Table 5 and Table 6, titled Model, in which the conceptual models including culture, animation, and advertising are described. While some of the models have been proposed and used by developers in different papers, most of us cite papers that provide the model in schematic format. Table 9 lists publications that meet the second criteria, animated advertisements under cultural.

4.2.1 Correlation model

In this review, conceptual models are divided into two categories: Animated advertising and culture. All models mainly focus on consumer behavior, especially Stimulus Organism Response (SOR), Theory of planned behavior (TPB), Attention, Interest, Desire, and Action model (AIDA model), which mainly analyses images (visual, aesthetic). As shown in table 5. However, there is only one culture-related model that validates cultural identity and adolescent perception from a narrative perspective, as shown in Table 5.

Cognitive

Based on the ideas of cognitive load theory, cognitive dimension framework, and multimedia learning cognitive theory, an adaptive animation environment is used to adjust to the various cognitive needs of process model users.[17] Animation has the potential to greatly reduce cognitive load and enhance users' cognitive abilities when compared to static text, graphics, and audio. For this reason, it is a better fit for the instructional materials and visual aids of mindfulness meditation, which aim to maximize the benefits of meditation 35.

Attitude

The online atmospheric cue of animated (vs. static) images leads to more positive website attitudes. Animated images can effectively impact consumers' approach-avoidance behavioural responses32 When a static advertisement is directly compared to a fully dynamic one, consumers tend to prefer the static one and, ultimately, have a more positive attitude towards it. Regarding layout complexity, it was anticipated that the more complex advertisement would have a on average more negative attitude than the more straightforward and minimalistic one 36.

Perception

When marketing tourist destinations, marketers must make sure that the information is credible and authentic. Advertisements for destinations that appeal to customers' senses can increase their intention to visit. perceived credibility and perceived usefulness can affect visit intention only through the mediation of perceived attractiveness. 38

User-perceived pop-up ad entertainment, credibility, incentives, personalization, and audio aesthetic to positively affect perceived ad value, signaling their importance to videogame-as-a-service developers. 39 Process simulation and outcome simulation had distinct mediating roles, and haptic cues in metaphorical visual language (MVL) may encourage consumers to purchase tactile salient attribute products. There was a boundary mechanism to the impact of haptic cues in MVL on consumers' purchase intention and mental simulation, and product types had a moderating effect.41 Computer-generated imagery (CGI) primates, resulted in positive audience reception via gross profit and critic scores. Those in live-action films have decreased throughout the past two decades and occur in less popular films, especially compared to CGI portrayals34.

Intention

The characteristics of animation and Visual effects (VFX) courses can influence attitudes, social norms, and perceived behavioral control, all of which have an indirect impact on student intention to train 33. The more product image created to be attractive, the more consumer attitudes toward the product being promoted. The influence of font on consumer attitude is significant 37. However, combined information contrast and aesthetic contrast designs have the strongest effects than any other combination of assimilation and contrast designs of information and aesthetics. Attitudes toward the ad and the brand are significant mediators between contextual factors and intention to purchase 40.

When ad viewers are exposed to a less imagery-evoking advertisement, the lack of clarity in the visual stimuli makes viewers rely on mental shortcuts – the quantity dimension of the mental imagery, which further affects purchase intention56.

The user-centric advertisement reduced boredom and stimulated desire for sustainable clothing by emphasizing concerns for affordability, self-expression, and style. The main social impact of our research could be to promote consumers' intentions to buy sustainable clothing without making them feel as though their environmental concerns are being compromised 56.

Table 5. Summarize the model literature of animation and advertisement

Refer	Journal	Methodology	Elements of model	Model	Participants
[31]	Information and Management	Experiment	Signalling principle, Attention guidance mechanism, enabling function, Facilitating function	Process model	Netherlands, graduate courses in the Netherlands and Turkey, and consultancy companies and university research groups
32	Journal of Retailing and Consumer Services	Investigation	Animated vs static images, arousal, pleasure, website attitude, purchase intentions	Stimulus-Organism Response [SOR] model	150 participants from Amazon MTurk, between 26 and 41 years old [55.4%].
33	Thammasat Review	Experiment	Attitude toward the behavior, subjective	Theory of planned	606 participants from schools in Kamphaeng

			norm concerning the behaviour, perceived behavioral control	behavior [TPB]	Phet, Phitsanulok, and Pathum Thani provinces Women is 63.50 percent with 70 % of aged 17 to 18.
34	Animals	Investigation	Accuracy, anthropomorphism environment captive or living in an anthro-like society, agency. Medium，audience reception		USD worldwide, IMDb audience scores, Rotten Tomatoes audience scores, and Rotten Tomatoes critic scores.
35	Psychology	Experiment	Mindfulness Flow, positive affect, Creativity		95 employees working in the creative industry in China.
36	Electronic Commerce Research	Experiment	Attitude towards the ad, Dynamic vs Static, Complex vs Minimalist Chromatic vs Achromatic	Stimulus-Organism-Response (SOR)	149 participants are all Portuguese. Females representing a total of 63.09%. 45% respondents were between 18 and 25 years old
37	Contemporary Management Research	Investigation, survey	Color, product image, design, typography, consumer attitudes, purchase intention, actual purchase	Theory of planned behavior （TPB）	496 valid data points are from Java, female (70.6%), aged 23-27 years (30.6%)
38	Asia Pacific Journal of Tourism Research	Questionnaire	Perceived sensory stimulation, perceived usefulness and credibility, perceived attractiveness, visit intention	AIDA model	314 valid respondents, from all over China 59.6% of respondents were female, most (89.8%) were aged under 34 years 79.3% held an undergraduate degree or above.
39	Journal of Services Marketing	Survey	Informativeness, Entertainment, Irritation, credibility, incentives, personalization, audio aesthetic, visual aethetic	Ducoffe's advertising value model	321 respondent are from two universities and one high school in Islamabad, Pakistan. Male about 233
40	Journal of Research in Interactive Marketing	Experiment	Information design, aesthetic design, attitude toward ad, attitude toward brand, purchase intention		70 undergraduate students (55.9 per cent female] at a North American university
41	Frontiers in Psychology	Experiment	Haptic cues, process simulation, outcome simulation, purchase intention, product type		40 undergraduates from a university in China
56	Journal of Marketing Communications	Experiment	Vividness, quantity, valence, airline ad:imagery-evoking vs less imagery evoking ad, purchase intention		18 years or older in the UK
56	Sustainability	Experiment	Modality:visual, textual, textual with		344 participants were 30–35 years old in the U.S

| | | | visual, involvement with environmental issues, routes of persuasion, affective response toward sustainable apparel, purchase intentions for sustainable apparel | | |

Source: Authors' elaboration.

All the results of the search, only one paper was on cultural models, the article said several themes emerged as factors that influence the uptake of human immunodeficiency virus (HIV)self-testing among young people in Nigeria. Among the themes of enablers, animation as "existential," social media as "positive," and service as "negative." For the nurturers theme, the family's community was positive, family-centered was "existential," but partners and family were negative. From this, we can see that the PEN-3 cultural model (Person extended family neighborhood, positive existential negative, perceptions enablers nurtures) is useful when exploring cultural context among Nigerian youth narratives and when promoting HIVST (HIV self-testing] [42]. （Refer to Table 6）

Table 6. Summary cultural model

Refere nce	Journal	Method ology	Elements of model	Model	Participants
42	PLoS ONE	Thematic content analysis	Cultural Identity：extended family neighbothood, Relationships and Expectations: perception enablers, nurturers, Cultural Empowerment	The PEN-3 cultural model	769 eligible entrants. (n =183) between 15 and 19 years

Source: Authors' elaboration.

4.2.2. Empirical studies on animation and advertising

The subjects of nine out of the thirteen papers that met the second inclusion criterion were advertising and animation. Through the use of characters, narratives in visual communication design, masculinity, and animation features, the relationship between advertising and animation is examined. They will also impact the customer's mood, perception, and level of visual focus. Only one paper combined cultural value with advertising, and even then, the differences were based on persona. （Refer to Table 8）

Different regions have different cultures and values, and Japan has different TV advertisements that are broadcast. Comparing advertisements from different regions and seasons may help us determine how traditional or modern cultures influence TV advertisements. According to research on cultural differences in commercials, the degree of differentiation between male and female roles is a sign of a culture.[49]

Character

In animation, a number of Western-Hemisphere Indigenous (WHI) male characters exhibit positive aspects of their masculinity, such as their strong spiritual beliefs, bravery, and appreciation of community and family. While these films feature

characters of an ethnic group rarely seen in the media, theatrically released Disney films continue to engage in the symbolic eradication of Indigenous male characters. [43] The significance of looking at female referents as symbolic models who can support leadership learning in animated films. The protagonists of the most recent animated movies are strong, independent, and assertive; they take charge of their lives, even if doing so means going against convention [45].

Visual

In terms of the aesthetic performance of animated movies, it is mainly shown in three aspects in Table 7. From the perspective of creative design methods of animated movies, visual communication design needs to start from four design methods, so as to better enhance the creative effect of animated movies.[44]

Table 7. Animated film aesthetic performance

Animated film	visual communication design	Reciprocity
		Debris
		Virtualization
		Dynamic
		Specialization
		Mobile
	Design methods	whimsy
		association
		metaphor
		style
	Aesthetic features	Technicality
		Molding beauty
		Beauty in form

Source: Authors' elaboration.

Depression metaphors mediated the perceived complexity of video advertisement. Depression metaphors enhanced the persuasion of advertisements by establishing a strong connection to the viewer's personal experience. metaphors in video advertisements elicited a variety of emotional responses: [51]
1) Fear
2) Depression
3) Happiness

Story

Use animated charts to express five positive affects in data stories by involving practitioners of data stories in a need-finding study and offering Kineticharts, an animation design scheme for creating charts that express in Table 8 [46].

Animation

The impact of animation on the internet depends on several factors such as the type of animation used, the task at hand, and the complexity of the webpage. The effectiveness of animated advertisements may be impacted by the complexity of the webpage design. Different online tasks may lead to varied effects on online consumers, even with the use of the same animation features [47].

When presented in an animated format rather than a static one, the "Left Banner" attracted noticeably more visual attention. When combined, the in-game advertisements (IGAs) can draw in 3.49% of the users' visual attention. In certain

situations, the "Goal" scenes generate more visual attention from the advertisements than the "No-Goal" scenes [50].

From a climate perspective, the impact of modality on the perception of climate change news and the intention to seek information is dependent on the level of concern about climate change. Exposure to animated videos reinforced the positive effects of concern on people's perceptions of climate change news [48].

Table 8. Summarize the literature on animation and advertising

Refer ence	Journal	Methodol ogy	Finding	Sample size	Participants
43	Journal of Men's Studies	qualitative textual design	Examined framing of masculinity among Western Hemisphere Indigenous peoples. Highlighted stereotyping and omission in children's media regarding underrepresented groups	Five films 13 male characters	
42	Applied Mathematics and Nonlinear Sciences	quantitativ e analysis	The research paper focuses on optimizing advertising animation design with visual communication, enhancing system hardware, simplifying design steps, and ensuring effective three-dimensional advertising animation design, meeting practical research needs.	From 2021to 2022 164 film	
45	International Journal of Communicati on	content analysis	In order to create referents that can motivate females to design a more egalitarian paradigm for society, female characters in animated films serve as important role models.	10 successful animation films	
46	IEEE Transactions on Visualization and Computer Graphics	Interviews	Compared to the animations in Dataclips, kineticharts can accurately portray the five affects, improve the expressiveness of the story, and increase users' affective engagement with the stories without impairing data comprehension.	53 of the 60 Kineticharts	197 participants108 were female, 87 were male,
47	Journal of the Association for Information Systems	Eye Tracking	three animation features—motion, looming, and lagging—were tested for their effectiveness in grabbing online users' attention during various online tasks.	8 advertisements	45 subjects 25 were female and 20 were male. They were between 19 and 22 years old, with an average age of 20.42 years.
48	Journal of Broadcasting & Electronic Media	Experiment , survey	the modalities (animation, live action) did not directly influence people's information-seeking	AJ+ and The Verge (part of Vox Media).	413 US participants

			intention, and this is consistent across topics.		
49	Applied Network Science	Quantitative	The co-occurrence network of TV advertisements in Japan reveals cultural features through keywords like 'woman', 'man', 'animation', and 'logo', reflecting gender role inequalities and temporal changes.	five TV stations	
50	Brain sciences	Eye-Tracking	Chat section attracts more visual attention than streamer's face.	44 videos	47 male participants with a mean age of 23
51	Lingua	Interview	Depression metaphors elicited a range of emotions in viewers, moderated the perceived complexity of video advertising, and strengthened the persuasive of advertisements by forging a close link to the viewer's own experience.		

Source: Authors' elaboration.

4.2.3 Empirical studies on Culture

In the field of culture, most of the research is based on culture as the background, to explore the visual effect, especially the brand, is the most affected. Character behavior will also change differently with different cultures in Table 9.

The cultural differences between Chinese and Western users affect their appreciation of visuals. it remains to be seen to what extent differential effects on appreciation for visuals will lead to more comprehensive and practically relevant effects, such as users' overall appreciation for a manual, their intention to use the manual, the usability and User experience (UX)of the manual, product or brand image, and brand loyalty [52].

Consumers in three cultural contexts create their self-generated images with brands in accordance with their country-specific thinking style—analytic or holistic despite constraining effects of selfie technology [54]. Depending on cultural contexts, participants' capacity for facial emotion expression, and situational factors, creating datasets of images of facial expressions presents difficulties with regard to emotional features like phenotypic traits [53].

Individual behavioral decisions are more likely to be influenced by personal emotional inclinations than by the general cultural environment. People who blend their own culture with that of other nations become insensitive to the cultural forms that arise within their own nation [55].

Table 9. Summarize the literature on culture

Refer ence	Journal	Methodology	Finding	Sample size	Participants
52	Journal of Technical Writing and Communication	quasi-experimental	Chinese manuals emphasize visuals more than Western ones, reflecting cross-cultural differences in user instructions for household appliances. Visual selection varies between Chinese and Western user preferences.	15 pictures	Chinese and Western participants 158 university students
53	Psychological Research	experimental	Building face expression datasets presents challenges concerning emotional features, such as phenotypic traits, contingent on cultural contexts, participants' expressiveness of facial emotions, and situational settings	672,172 image	110 people (50 in Bogotá, Colombia and 60 in Aracaju, Brazil) 54 women and 56 men, aged 22(± 6) on average.
54	Journal of Current Issues & Research in Advertising	Quasi-experiment.	Studies on various cultural items have shown that customers of all cultures typically create brand selfies according to their thought processes.	Culture product	50 participants by Russian and U.S.
55	Behavioral sciences	grounded theory, Questionnaire	cross-cultural production saying that we should increase the in-depth understanding and experience of cultural connotations, look for the needs that exist in persons in the context of globalization, and start with the emotions of the audience.	Turning Red 220 short reviews and 661 movie reviews	

Source: Authors' elaboration

5. Conclusion

Cultural values are necessary in light of globalization and the increasing diversity of cultures in society to effectively engage consumers and improve advertising outcomes. This need motivates academics to produce conceptual models that explain possessing cultural value as well as to define the terms "animated advertising" and "cultural value." The review found the most recent animated advertising models and cultural frameworks that center on the aspects of consumer behavior. From a visual perspective, visual components are crucial in determining how customers perceive things and pay attention to them, as well as their willingness and attitude. Subsequent investigations ought to integrate animation and advertising with comprehensive discourse on culture, particularly concerning the correlation between cultural values and consumer conduct. Furthermore, to measure the relationship between culture and animated advertisement, both quantitative and qualitative methods should be used in order to produce more trustworthy results.

Acknowledgments

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Review of Modern Approaches to 3D Digitization of Tangible Cultural Heritage

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Abstract. This review highlights modern technologies' pose in cultural heritage, digitization and accessibility. It provides a comprehensive view of the issue from the perspective of the digitisation centre, at the Czech University and cooperates with organizations of different sizes. Technology and Innovation offer countless possibilities, but not all are suitable for working with cultural heritage. Several rules must be followed to avoid damaging it while respecting the ethics related to the heritage in question. In addition, it is important to consider copyright law and other regulations that vary from state to state. However, these aspects are not the main concern of this study.

Keywords: Digital humanities, digital heritage, 3D digitalization, Artificial Intelligence, AI, Virtual Reality, gamification

1. Introduction

Cultural heritage is a broad term that encompasses elements that are important to the identity and history of a place or community. It can include tangible objects such as historic buildings, artifacts, monuments, and works of art, as well as intangible elements such as traditions, rituals, language, music, and folklore [1]. The preservation of tangible and intangible cultural heritage is rightly one of the current global priorities. The advent of advanced technologies, such as 3D digitization, has opened up new possibilities to meet these goals. The process of 3D scanning of tangible cultural heritage can be fraught with challenges and an understanding of the nuances of different digitization methods, processes and techniques is essential to ensure optimal results [2].

3D digitization of cultural heritage has significant potential and is becoming an important component in the field of cultural heritage. In 2019, the 28 EU member states and Norway signed a Declaration of Cooperation that recognizes the importance of 3D digitization technologies for cultural heritage and their needs. Among other things, this declaration supports the creation of common standards, methodologies, and guidelines for comprehensive 3D documentation of cultural heritage in Europe [3, 4].

The acquisition of 3D models, usually through scanning and/or photogrammetry technologies, but also perhaps through 3D modeling, presents a variation of different challenges for interdisciplinary collaboration. It is no longer just one field of interest, but the preservation of cultural heritage teaches scientists and researchers from different disciplines to work together, be it information technology, humanities, or natural sciences. This and much more teach the disciplines to engage in common dialogues, creating new opportunities and scientific focuses [5].

This review study aims to highlight different approaches to the 3D digitization of tangible cultural heritage and to highlight the strengths and potential limitations of each method. By understanding these approaches, 3D digitization practitioners, as well as historians, museum professionals, or other researchers, can make better decisions about which 3D digitization strategy is best for their workplace. Creating 3D

models of cultural heritage allows for sharing this data with researchers around the world while preserving cultural heritage in case of destruction or damage. This study is based on the experience and knowledge of the digitization team from the Centre for Digital Historical Sciences under the Department of Historical Auxiliary Sciences and Archival Studies, based at the Philosophical Faculty, University of Hradec Kralove. It also used articles that were searched using scientific research databases such as Web of Science, Scopus, and the online web application Consensus.ai, an academic search engine using artificial intelligence. Finally, the AI tools DeepL and Grammarly were used to correct the English translation. The review describes some of the models, which can be viewed on the department's Sketchfab and directly on the website: https://sketchfab.com/KPVHA-FF-UHK/models.

2. Challenges and pitfalls of modern 3D technologies

One of the main concerns when 3D scanning historical monuments is undoubtedly the possibility of data loss or distortion. For example, even though 3D scanners offer high accuracy and resolution, they can still have problems capturing fine details or complex surface textures, especially in hard-to-reach areas, and shiny or transparent surfaces. In addition, the entire scanning process can be time, labor, cost, and knowledge intensive. To be brief, 3D laser scanning is divided into contact and non-contact, among others. As the name suggests, contact scanners scan an object through physical contact with the object and provide relative data. These scanners are not used on cultural heritage objects because they can damage the object. In contrast, non-contact devices and methods are suitable for digitizing cultural heritage. The choice of scanner always depends on the size and complexity of the object chosen for digitization. It can be said in advance that you cannot scan a coin and a building with one device. Factors that influence the choice of equipment include, for example, the availability of equipment, expertise, and the financial possibilities of acquiring the equipment [3].

If we are looking for an alternative to 3D scanning, we can mention digital photogrammetry, which is more accessible in several ways. It is a method of overlaying photographs that are processed in special software and from which a 3D model is created. For the best result, the photos should be taken with a DSLR, but it is also possible to create a 3D model from photos taken with a smartphone. [6] A potential acquisition cost may be the full license of the mentioned software. However, some software is available to some extent for free.
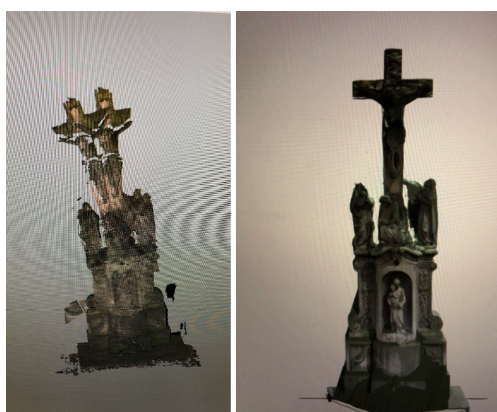

Fig. 1. *Left screenshot of the 3D model creation process. Although the scanner collected enough data, the moss-covered parts were too difficult to process. In the end, the cross on the finished monument (Calvary sculpture) had to be manually modeled and textured in Blender. Pictures are from the authors' archive.*

Photogrammetry can also provide accuracy comparable to 3D scanning, and it can also capture high-resolution color information and document hard-to-reach areas. In addition, the rise of unmanned aerial vehicles (UAVs) has revolutionized the field of photogrammetry and enabled the efficient digitization of large-scale heritage sites [7, 42].

Fig. 2. Left photo of a UAV overflight. The photograph was taken during the digitization process by members of the Center for Digital Historical Sciences. The drone flying over the column with the statue of the Virgin Mary was flown by student Daniel Beneš. On the right is a sample of part of the finished 3D model. Source: Pictures are from the authors' archive, [42].

One of the important parts of the digitization process is setting goals and determining what the outcome will be used for. If the 3D model is to be used for better display or increased legibility, alternative 3D digitizing techniques may be more appropriate, or we should rather write "pseudo-3D" or even "2.5D". This is the Reflectance Transformation Imaging (RTI) method, which captures the surface properties of an object, including texture, and reflectivity, and can be particularly effective for documenting small-scale artifacts or very complex details. Not least monuments that have, for example, almost illegible handwriting. This particular method displays the resulting "2.5D" model based on data consisting of information about the light source reflected from the surface of the digitized object, as well as information about space, angle, and position of the lights, color spectrum and time. The basic technique of RTI is the so-called polynomial texture mapping (PTM for short), which allows the visualization of relief surfaces under different angles of the light source. In the image capture process, information about camera position, highlights, and shadows is recorded, allowing special RTI software to enhance the surface features, and color attributes of the object for better-quality imaging. The light source information is mathematically synthesized and leads to the creation of a plastic surface. [8] The RTI method is suitable for small objects such as coins or seals. In both cases, this method can significantly help with the legibility of the object's relief. We cannot forget the most accessible technologies and those that have become part of our everyday lives. Nowadays, there are various applications available for all operating systems of mobile phones and tablets, which can make 3D digitization accessible to absolutely every owner of such a device. This enables fast and low-cost documentation of (not only) cultural heritage. [2, 9, 10]

Fig. 3. *Example of "Pseudo 3D" or in other words "2.5 D" output obtained using the RTI digitizing method. Pictures are from the authors' archive. The result of the RTI is not available online, but you can look at the 3D model, which we also created for 3D documentation reasons. It can be viewed on Sketchfab or at this link: https://skfb.ly/o9TMr*

3. Introduction to 3D digitization of cultural heritage

In exploring the challenges associated with the 3D digitization of tangible cultural heritage, it is essential to consider the environment. This can have a significant influence and impact on the quality of the resulting model. Digitization in an open space can be greatly affected by lighting conditions. A different result will be produced in direct light and another in diffused light. The weather itself can create directly undesirable conditions for digitization.[1] Similar factors can result in inconsistent data quality and ultimately affect the accuracy and reliability of the 3D models produced. [11] In addition, other factors can pose a significant challenge. The size and complex, complex appearance of the material objects themselves. A certain challenge for digitizers is such monuments whose condition is dilapidated or very fragile. In such cases, it is crucial to choose the right digitization method that will not affect the condition of the monument at any cost but will manage to produce the desired output. Some objects may be too delicate to allow full digitization. An example is an old clock where the clock movement was uncovered but the fragility and dark surface did not allow the smallest details to be penetrated. In similar cases, alternative techniques such as Multi-View Stereo (MVS) or computed tomography scanning can be used. These advanced methods can offer the ability to capture detailed data while minimizing physical contact with the object. [12]

Legal and ethical aspects also play an important role in the digitization of cultural heritage. The acquired 3D data can be misused for unauthorized copying and commercialization. This can raise concerns about the real ownership and integrity of cultural heritage. [13] The problems associated with 3D digitization of cultural heritage go beyond technical, legal, and ethical aspects such as protection of intellectual property and respect for cultural values. By delving into these multifaceted issues, cultural heritage professionals, historians, preservationists, and the like can develop nuanced strategies for 3D digitization that can incorporate not only technical accuracy but also the ethics of preserving cultural heritage. This process includes educating and training history, heritage, and heritage professionals in new technologies, copyright law, and ethical standards so that they can make informed decisions. Such a comprehensive approach is essential to ensure that the digitization of tangible heritage retains its intrinsic value and can contribute to the global preservation of cultural heritage. [13, 14, 15, 16, 17, 18] Adherence to ethical principles is key to ensuring that the digitization process respects the legal frameworks, sensitivities, and authentic preservation of historical artifacts. For example, when digitizing objects with cult or religious significance, care must be taken to respect these values and not to forget to consider the potential impacts of publicly sharing digital models not only in the local community but perhaps also abroad. Similarly, unauthorized commercial use of 3D data can lead to infringement of intellectual property rights. This can damage relationships between those institutions that manage cultural heritage and the wider public [16, 17, 18, 19].

4. Technical, legal, and ethical challenges in 3D digitization of cultural heritage

As a key tool for the preservation and dissemination of cultural heritage, 3D digitization technology offers the possibility of creating detailed, high-resolution digital representations of entire sites. This enables their documentation, study, and, among

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[1] This can then manifest itself, for example, in the photogrammetry method, and the digitized image needs a lot of editing and cleaning. In this respect it is best to digitise when it is under a cloud. Scanning/taking photos for photogrammetry in direct sunlight can lead to unwanted shadows. [42]

other things, virtual presentation to a wider audience. [20] Especially nowadays, when virtual reality goggles are becoming more and more popular and accessible to people, there are many opportunities to introduce the treasures of history to the professional and general public in an entertaining way using modern technologies and 3D digitization. Technologies such as the iPhone 15 PRO, which can record spatial video, and Apple Vision Pro, which allows these videos to be projected in virtual reality, are potential tools for bringing cultural heritage to life and making it accessible. [21] Of course, there are many similar technologies and it is not necessary to rely on Apple alone, but it serves as an interesting example.

Fig. 4. *An example of the process of rapid 3D documentation using an iPhone 13 PRO mobile phone (with LiDAR technology) and the Luma app. From left: a point cloud gradually forming a 3D model of Vatican Square. Next, a cloud of points gradually forms a 3D model of the Abbey Hall in the Broumov Monastery. This was not the creation of the final model. Pictures are from the authors' archive.*

In the case of outdoor digitization, environmental factors such as natural lighting conditions and weather fluctuations can significantly affect the accuracy and consistency of the 3D scanning or digital photogrammetry process. Other undesirable environmental elements may also affect the quality of the data thus obtained (for example, in aerial photogrammetry with UAVs it may be difficult to get to all locations relative to the surroundings, last but not least, the drone may make shadows or shadows may appear on the texture of objects), which may lead to inconsistencies in the resulting 3D models. In response to these issues, researchers are exploring innovative solutions to mitigate the impact of these environmental factors on 3D digitization. They are developing adaptive scanning techniques and using advanced software algorithms that can compensate for environmental variables, thereby improving the accuracy and consistency of the resulting 3D models. [22, 42]

Fig. 5. *On the left, a Louis XVI-style gilded metal table clock, digitized through the method of photogrammetry (by Beata Dvořáková, student project). On the right, St. Nicholas Church in Hradec Králové, Czech Republic, digitized by UAV (by Daniel Beneš, student project). Shadows are visible on both models. In the first case due to poor lighting. In the second case due to the bad time of day when the drone was flown over the building. Pictures are from the author's archive. The finished 3D models can be seen on Sketchfab or at this link: https://1url.cz/R1JFH*

The current development of modern technology is fast-paced. The Internet, computers, and especially artificial intelligence play a significant role in many industries. Developments are not shying away from the field of 3D digitization, which is also poised to make great strides. [24] One example is the mobile application Luma[2], whose creators, Luma Labs AI, are focusing on the development of multimodal artificial intelligence that aims to expand the possibilities of human imagination. Through Luma, it allows mobile phones to create either directly or through captured video a 3D model, or in basic terms a spatial video from which a 3D model can then be generated. [23] Although such a model is only created by the mobile phone, we believe that it is very good for basic data acquisition or presentation purposes.
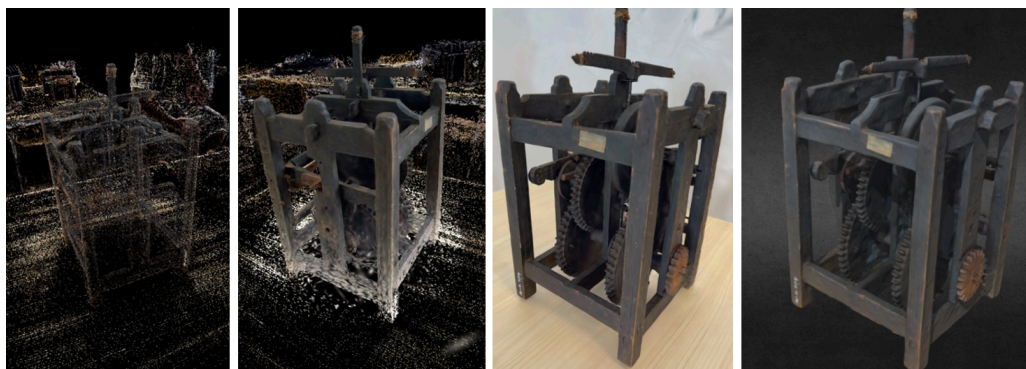
Fig. 6. *From left, the sequential creation of the model through the point cloud. The third from the left is a 3D model created through the spatial video method. On the right, is the finished 3D model of the clock, which can be viewed on our institution's Sketchfab at[3]. The photographs are from the author's archive. The finished 3D model can be seen on Sketchfab or at this link: https://1url.cz/x1JF2*

5. Virtual Reality and Artificial Intelligence in 3D Digitization of Cultural Heritage

The automation and efficiency of 3D digitization is another area where increased development efforts are underway. Automation and streamlining of processes can significantly reduce the time and resources required to create 3D models, making digitization available in other places where it would not be possible due to financial burden and excessive complexity. This can also increase the initiative for preservation, awareness, and promotion of cultural heritage over time [25]. Last but not least, we can also focus on virtual reality technologies, where a wide range of uses for digitized cultural heritage are opening up. Interactive presentations offer new possibilities for engaging audiences and providing immersive educational experiences. Through virtual reality, users can explore the cultural heritage and historical artifacts in a way that might not normally be possible in the physical world due to the fragility, rarity, or even non-existent ability to see the object [25, 26]. By using these technologies, memory institutions can create interactive experiences for people with different abilities and requirements. This can include audio descriptions, tactile models, and multi-sensory interpretations of digitized objects, which not only provide a great experience but can also promote a more inclusive experience for the user [26, 27].

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[2] Currently available for iOS and Android operating systems. [23]

[3] For example, you can see the models that were created using the Luma app at this hyperlink. https://skfb.ly/oVuSK

It is also expected that platforms for collaboration and sharing of knowledge and the models themselves will continue to be developed (as long as this does not conflict with copyright law or the wishes/regulations of the institution). This may also play a key role in the future of 3D digitization due to the development of the field of artificial intelligence. Networks designed to share practices, resources, and the data itself can help to address many of the questions of practitioners in the field of 3D digitization and cultural heritage. There are already fairly well-known platforms for sharing and presenting 3D models in this area. One of them is undoubtedly Sketchfab.com or Dashboard.share3d.eu. There is also the idea of creating standardized procedures (where possible) and ethical guidelines for 3D digitization on a local or, in time, global scale. An accessible web as well as a mobile app can also help to present the data. [13, 14, 28] In the context of data presentation, mention should also be made of the development of interactive digital archives that can provide a dynamic platform for research and exploration of digitized cultural heritage. These archives or various web-based databases and presentations can contain comprehensive information as well as historical context, artifacts, and multimedia resources, allowing users to delve into the in-depth stories and meaning of each digitized object or work. Last but not least, they can have an AI model implemented that can help answer various questions and better understand the data. Other interactive features such as audio guides, interactive timelines, or virtual tours enhance the learning experience and encourage longer-term interest in the subject. [14, 28] Gamification can undoubtedly contribute to interest in history and cultural heritage and can be used to create interactive and educational experiences within 3D digitized spaces of historical objects. By integrating gamification elements such as rewards, challenges, or storytelling, educational platforms can meaningfully engage users and foster their curiosity and sense of exploration. Gamification methods can not only educate but also inspire a relationship with cultural and historical heritage, not least with digitized artefacts. [29]

In this respect, it is also worth highlighting the issue of the possible involvement of policymakers and advocacy for the development of clear and adaptable rules, which could facilitate the use of 3D digitization technologies where these possibilities are prevented through excessive bureaucracy. For example, possible collaboration with government bodies and cultural heritage organizations could influence the development of regulations protecting intellectual property rights, the protection of cultural heritage, and the potential ethical dissemination of 3D models. [13, 30]

To successfully address the environmental, technical, and ethical aspects of 3D digitization, it is essential to promote interdisciplinary collaboration, as outlined earlier. This includes the creation of partnerships between cultural heritage specialists, conservators, technologists, and legal experts. Through interdisciplinary collaborations, it is possible to integrate different perspectives and develop comprehensive approaches that take into account technological advances. [31, 32] This goes hand in hand with raising public awareness of the benefits and challenges of 3D digitization, which is essential to gaining the support and understanding of different stakeholders. Educational initiatives may include public lectures, exhibitions, seminars or workshops, and other activities highlighting the impact of 3D digitization on the preservation and accessibility of cultural heritage. Responsible handling of digitized cultural artefacts can also promote the highlighting of ethical considerations and the potential misuse of 3D data. [13, 33] It is also advisable to consider incorporating indigenous perspectives into the digitization process and working with local communities to ensure cultural sensitivity and respect for traditions. This undoubtedly involves consulting with representatives of indigenous groups when digitizing tangible cultural heritage located in similar areas. By incorporating their perspectives, 3D digitization initiatives can respond to cultural values and promote inclusive presentation of diverse heritage. [33, 34]

As already mentioned, the technological environment is constantly evolving. In this respect, the integration of machine learning and artificial intelligence represents a promising way to improve 3D digitization processes. Machine learning can be used to automate the identification and classification of cultural artifacts, which can streamline the digitization and data processing workflow. Similarly, the application of AI and similar techniques can contribute to the development of advanced reconstruction algorithms, which can lead to increased accuracy and fidelity of models. [35] In this regard, in addition to capturing geometric details, future developments in 3D digitization may also focus on more accurate preservation of material properties, textures, colors, and compositions, which may provide a more comprehensive representation of digitized objects [36] It is the preservation of material properties that is important for preservation efforts and accurate representation of the natural properties of cultural heritage. [37] Here too, however, an ethical framework needs to be considered. Integrating AI and machine learning into 3D digitization should require the development of ethical frameworks that take into account data privacy, potential algorithmic bias, and cultural sensitivity to ensure that the use of technology is consistent with ethical standards and respects the diverse cultural contexts of the objects being digitized [38, 39].

As indicated, technological developments are turbulent and it is therefore essential to establish long-term preservation strategies for 3D digital cultural heritage. However, it is also advisable to take into account intangible cultural heritage, such as sound recordings, videos, and over time spatial videos, or various interactive solutions that can capture information of different kinds [13]. Issues for long-term preservation strategies include the implementation of robust data management systems for 3D models, established and appropriate data formats, as well as metadata standards that ensure accessibility and clearer description and retrieval of digitized data. Collaboration between researchers, the private sector, archival institutions, or ICT experts can further enhance the sustainability of digital collections, opening the way for further research, education, and cross-cultural collaboration [40, 41].

6. Conclusion

The overview study Review of Modern Approaches to 3D Digitization of Tangible Cultural Heritage provided an analysis of different methods of 3D digitization of cultural heritage, highlighting the technological advances, challenges, and ethical aspects associated with this process. The use of advanced technologies, such as 3D scanning, digital photogrammetry, and RTI, offers a wide range of possibilities for the preservation of cultural heritage and can offer broader opportunities for the study of culture, history, architecture, and other disciplines. Each of these methods has specific advantages and limitations that should be considered when choosing the best digitization approach for a particular project.

The study highlighted the technical challenges associated with 3D digitization, such as capturing fine details, complex surface textures, and hard-to-reach areas. It mentioned the difficulty of the process in terms of time, labor, cost, and knowledge. She also pointed to photogrammetry, which due to its affordability and cost-effectiveness can be an accessible alternative for the general public, especially with the use of modern mobile devices, quality DSLRs, and specialized software.

Ethical and legal aspects also play an important, but sometimes neglected, role in the digitization process. Ensuring intellectual property protection and respect for cultural values is essential to maintain the integrity and authenticity of digitized objects. The study highlighted the need for education and training of professionals in technology, copyright law, and ethical standards to enable them to make informed decisions and effectively protect cultural heritage.

The introduction of new technologies such as artificial intelligence and machine learning is a promising avenue for future developments in 3D digitization. These technologies can significantly streamline workflows and improve the accuracy, and more importantly the veracity, of 3D models. However, it is essential to ensure that their use is also in line with ethical standards and respects cultural contexts. Recent developments in 3D technology have had far-reaching impacts in many sectors, from architecture and engineering to education and computer games. The manipulation of 3D data provides new opportunities and innovative possibilities compared to traditional multimedia.

Interdisciplinary collaboration and knowledge sharing are key to the successful digitisation and preservation of cultural heritage. Partnerships between heritage experts, technology experts, or legal specialists allow for the integration of different perspectives and the development of comprehensive approaches to digitization. Educational initiatives, public lectures, exhibitions, or workshops can raise awareness of the benefits and challenges of 3D digitization and gain the support of the general public.

In conclusion, it can be stated that the increasingly frequent and popular 3D digitization of cultural heritage offers a unique opportunity for the preservation and accessibility of tangible heritage. Through a combination of technological innovation, ethical approach, and interdisciplinary collaboration, cultural heritage can be effectively preserved and shared for future generations.

Acknowledgments

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A brief overview of existing neural network solutions and services for photographers

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Abstract. This article focuses on neural networks and artificial intelligence systems used to enhance images. It attempted to analyse the maximum range of existing systems that can be used for photography. The aim of the article was to find as many systems and services used to enhance photos, restore details, remove noise and improve image quality, in order to understand how neural networks are becoming useful to a wide range of professionals - photographers, photo editors, bloggers, marketers, designers, photo restorers and some other specialists. This finding of 146 neural networks and AI-based systems is summed up in a table compiled by the author. There is also an analysis of a number of neural network-based solutions that allow photographers to improve their images.
Key words. artificial intelligence systems, neural network, photographer, photography, enhance photo, improve image quality

1. Introduction

With the rapid development of the field of artificial intelligence (AI), it is not uncommon for publications and the press to suggest that AI will soon change many areas of life and creativity, including replacing humans in the fields of painting, art, photography, film, and so on. In parallel with the development of neural network systems that generate new images and images that have never existed before, the development of systems that use neural networks and AI to solve practical tasks to improve the quality of images has begun. For example, light adaptation or brightness correction is an important step in the improvement of the contrast and visual appeal of an image [1]. Due to the limitations of digital imaging equipment, it is usually difficult for photographers to obtain a complete and clear image of a scene in the case of dual and multiple targets. This is because most digital imaging systems have a limited depth of field control range, so they can only focus on one or a few objects in the far or near distance. This results in clear and blurred areas with clear boundaries, i.e. a multi-focus image. This type of image limits further image processing such as target recognition, image segmentation, target tracking and so on. [2]. As the author's main project is to take pictures in nature, rural areas are rich in cultural ecosystem services, which function as essential public goods, providing benefits for livelihoods and promoting the conservation of large landscapes. Geotagged social media photos capture detailed information on public use of natural areas, useful for stakeholders interested in promoting resilient socio-ecological systems [3,4].

While a camera as a sensor input provides detailed texture and semantic information, its performance is degraded by small objects at long range, occlusion, and poor lighting conditions, radar as a sensor input has the ability to provide reliable performance in all weather and lighting conditions, detect small objects at long range, and operate unhindered by occlusion problems. [5, 6, 7]. This framework

appropriately rethinks the generation of an image not as the creative effort of the artist in front of the canvas, but as a construction of data points compiled into lines of code that accurately reflect the inner workings of these neural networks and artificial intelligence [6].

Thus, there are a number of practical tasks [8, 9, 10] to improve the quality of images by using solutions and services based on neural networks. In other words, neural networks began to be used not only to assist people in creative fields, but also to compete with humans.

2. Typology of AI systems and neural networks used in photography and the imaging field

To systematise knowledge and facilitate finding the right neural network for a specific task, I have created a classification of neural networks and artificial intelligence. Shown in Fig. 1 typology of artificial intelligence systems and neural networks used in photography and image processing is based on a study of the work of some practitioners and scientists [11 - 18]. In addition, I have had a rethink of my previous publications in the light of the use of neural networks for image quality improvement [19, 20].
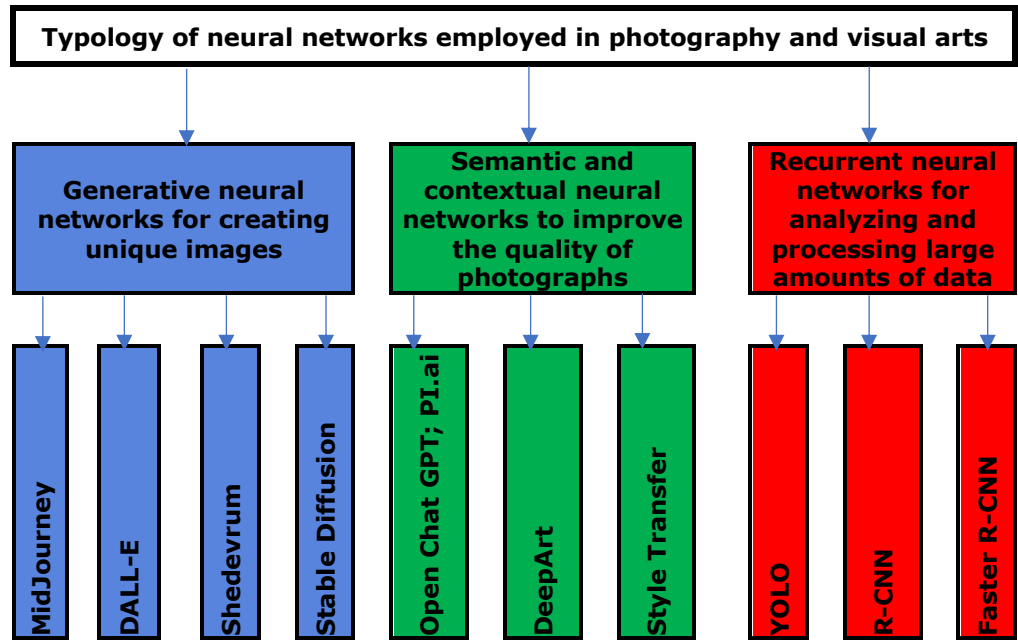
Fig. 1. Typology of neural networks employed in photography and visual arts.
Source: Author's drawing.

As shown on Fig.1, the systems that currently exist can be divided into three groups by the type of neural network.
- Generative neural networks for creating unique images;
- Semantic and contextual neural networks for improving the quality of photographs;
- Recurrent neural networks for analyzing and processing large amounts of data.

The following solutions can be classified as generative neural networks:

MidJourney: creating images based on text;
DALL-E: generating images and videos based on descriptions;
Shedevrum: generating images and videos based on descriptions;
Stable Diffusion: creating photorealistic images.

Examples of semantic and contextual neural networks include solutions such as:
ChatGPT and YandexGPT: generating descriptions and ideas for photographs;
DeepArt: creating works of art based on photographs;
Style Transfer: transferring the style of one image to another.

Recurrent neural networks:
YOLO: detecting objects in photographs;
R-CNN: object recognition and segmentation;
Faster R-CNN: object recognition and segmentation, improving the performance of R-CNN.

3. The relevance of using neural network solutions in the practice of a photographer

For me, as a photographer, the task of generating images and improving images has always existed. For solving these problems, one could use, for example, the same Photoshop, but with the advent of neural networks, new opportunities for solving these problems began to appear.

At some point in time, the question of a faster and easier solution to technical problems of improving image quality arose for me personally. Therefore, I tried to look as broadly as possible at the field of AI and answer the question for myself personally, to what extent I can use neural networks and AI to solve my urgent problems. At the same time, for me the task was practical, not theoretical. Therefore, the first thing that was decided to do was to familiarize myself with this field as broadly as possible and specifically in the applied aspect.

The number of neural network solutions and solutions using AI technologies and the latest trends in the development of AI systems in the field of visual content that I found in various sources and on the Internet allow me to look with optimism towards progress and perhaps even positively answer this question about the practical application of such systems in the work of a photographer in the foreseeable future.

Until recently, I looked at AI systems only as a new area of "entertainment". First of all, this was due to the fact that the first systems to appear were those generating new images based on text descriptions, as well as systems that allowed one to imitate the style of certain artists. In essence, the first systems were created that were supposed to directly compete with living authors, creators of visual objects - artists, photographers, illustrators, theater artists, architects, actors, and anyone who creates any visual content and visual objects. And what is important is that, in essence, AI begins to create almost any objects that can act as a replacement for works of art, photographs, sketches of clothing models, images of theater costumes, car designs or any other objects, architectural projects, etc.

Therefore, it was precisely generative solutions that rather repelled me as a photographer than attracted me with their functionality. I practically did not find any use for them in my work. However, at a certain stage, I even created accounts in the Shedevrum, ruDALL-E and some other systems to try to evaluate the capabilities of generative systems. Several experiments were conducted with such tasks as describing an idea for a photo shoot and obtaining a visual result to analyze the possibility of constructing a similar picture during the photographic process. The second task was an attempt to obtain an image based on the description of my own

photo in order to compare the result of the system's work and my work and evaluate the capabilities of the AI system.

It should be noted right away that the first task has not yet been fully solved. This is especially true for my area - I tried to use Shedevrum and ruDALL-E to create a picture in the style of my project "Dance and Nature". In this case, we can state that the system can create beautiful natural landscapes based on your wishes and your description. But they often do not always coincide with your own vision of the landscape and dance image (a specific movement or pose). Although, as a hint for the photographer, how exactly else to build a frame and for a broader view of the photographer's task, the generated images can be considered. But certainly not as a replacement (although in my case the task was never set like that). From my point of view, the obtained results in generating images have not yet given me the desired result, but they can still be useful and can help with the search and construction of an interesting final shot that you are going to take. So far, AI has not learned to create objects completely identical to the vision that is in your head and that you described in the system in order to get the desired result, moreover, close to a real photograph. At least in the Shedevrum system, all the images I received were far from the real natural landscapes that I have ever photographed, and when I wanted to get a similar or at least approximately similar landscape from the system. The approximate similarity in some cases was a little more, and in some others it was quite far from the described place. The results of the image of dancers are not subject to any assessment at all. The system has difficulty understanding what is wanted from it and cannot depict a dancer in the pose you needed.

For clarity, I provide several of my photographs and generative images. Certainly, you can see some similarity and resemblance in them. But a complete repetition and execution of the task is definitely not possible.

Fig. 2   Fig. 3   Fig.4

The images in Fig. 2, Fig. 3 and Fig. 4 respectively show:
Fig. 2 – an image generated by the ruDALL-E neural network (rudallee.ru).
Fig. 3 – an image generated by the Shedevrum neural network (shedevrum.ai).
Fig. 4 – this image shows a collage (a ballerina in an "arabesque" pose in Antelope Canyon, Utah, USA). The generation task for the Dall-E and Shedevrum systems was to obtain exactly this image.

What can be noted in the obtained results. As a plus - the landscape of the Antelope Canyon is conveyed quite accurately and beautifully, the composition for possible photographs is well built. Cons - the canyon landscape is far from natural and looks more like a stylized image than a real photograph. The biggest minus is the lack of sandstone structure on the canyon walls. Another big minus, in my opinion, is that the dancer is not in the pose that was specified in the description. Also, the minuses include the fact that the more or less acceptable images were obtained not the first time, but in the process of many generations, at least 10 in the case of each

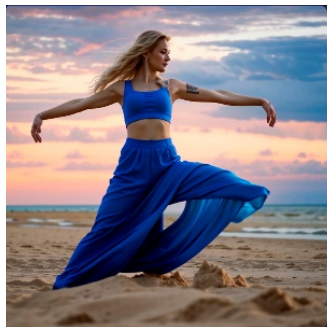network. In many cases, I did not like the dancer - her pose, the presence of extra limbs, her ugly face, etc.
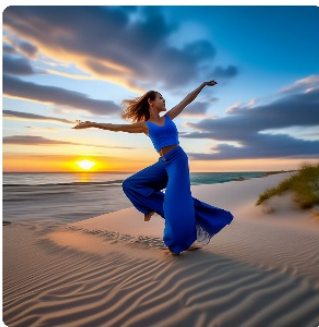

| Fig. 5 | Fig. 6 | Fig. 7 |

Fig. 5 – image generated by the ruDALL-E neural network (rudalle.ru/)
Fig. 6 – image generated by the Shedevrum neural network (shedevrum.ai)
Fig. 7 – this image shows a real photograph (a dancer in blue wide trousers and a blue top is dancing a modern dance on the sandy shore of the Curonian Spit). The generation task for the ruDALL-E and Shedevrum systems was to obtain exactly the same image, but with the addition of a sunset.

What can be noted in the results obtained. As a plus - the landscape is quite beautifully rendered, which can be considered as the Curonian Spit, the composition for possible photographs is well built. Cons - the landscape of the sandy shore is far from natural and looks more like a stylized image than a real photograph. The biggest minus is the lack of small details and structure of the sand of the coastline. A big minus was that in an attempt to obtain the desired image, at least 10 generations were made in each system. In many cases, I did not like the dancer - her pose, the presence of extra limbs, an ugly face, etc.

| Fig. 8 | Fig. 9 | Fig. 10 |

The images in Fig. 8, Fig. 9 and Fig. 10 respectively show:
Fig. 8 – an image generated by the Shedevrum neural network (shedevrum.ai)
Fig. 9 – the original photograph, which was described in the request to the Shedevrum neural network. The photograph shows Balanced rock, which was taken

in Arches National Park (Utah, USA). The task of generating for the Shedevrum system was to obtain exactly the same image, but with the addition of snow after a snowfall.

Fig. 10 – a photograph that was taken in Zion National Park (Utah, USA). The photo shows the double rock Temple of Sinawava. And which, apparently, served as a prototype for generating Shedevrum.

What can be noted in the obtained result (Fig. 8). As a plus - a beautiful rock and snow landscape. Cons - the result in a very distant approximation can be considered as the Balancing Rock. The image is far from natural and looks more like a stylized image than a real photo. The biggest minus is the lack of small details and structure on the rocks and snow. Everything is very slick, although in the description the style of the image was defined as superrealism, with high resolution and great detail. A big minus was also the fact that in an attempt to get the desired image, quite a lot of generations were made in the system. Many images were rejected.

Further, two more examples showing the capabilities of the Shedevrum generative network.

Fig. 11

Fig.12

The images in Fig. 101 and Fig. 12 respectively show:

Fig. 11 – image generated by the Shedevrum neural network (shedevrum.ai)

Fig. 12 – the original photograph, which was described in the request to the Shedevrum neural network. The photograph shows a view from a high river bank and an approaching thunderstorm front.

The resulting generated image (Fig. 11) turned out beautiful both in composition and color rendering, but it again falls short of a realistic image; rather, it is a kind of stylization.

Fig. 13

Fig. 14

The images in Fig. 13 and Fig. 14 respectively show:

Fig. 13 – an image generated by the Shedevrum neural network (shedevrum.ai)

Fig. 14 – the original photograph, which was described in the request to the Shedevrum neural network. The photograph shows an arch similar to a dragon's eye.

The situation is similar in this case. The resulting generated image (Fig. 13) turned out beautiful both in composition and in color rendering, but it again falls short of a realistic image; rather, it is a kind of stylization.

In photography, there are a number of technical tasks that a photographer has to solve from time to time, and which take up a lot of time.

Such tasks could include the following: - scaling and enlarging an image without losing quality (for example, to print a poster on large banners or to enlarge small fragments of photographs to standard sizes); - removing blurriness from an image and increasing the sharpness of an image (it happens that an interesting frame is taken with inaccurate focusing, this is especially common when moving, dynamic objects are being shot, for example, when you are shooting dancers and the camera's autofocus system sometimes works inaccurately and a valuable frame is blurry, or when you need to change the depth of field of a frame); - removing unnecessary objects and details from the image (for example, in theatrical photographs it is often necessary to remove adjacent figures of people or interfering objects in order to emphasize the main actor) or, on the contrary, adding missing space to the frame (sometimes the frame is cropped incorrectly, for example, the dancer is too close to one edge of the picture and too far from the other (in this case, you can add the missing part of the stage space from the right side); - also often requiring work with color (changing the color palette) and light in the photograph (aligning highlights); - the task of removing noise; - retouching photographs; - improving the image; - selecting the best photographs and a number of other tasks.

All these tasks are solved with varying degrees of success by traditional systems. For example, many tasks can be solved using a traditional photo editor or other applications. However, this takes a lot of time. And when you have a lot of shots that need some kind of work, the time spent on these processes becomes a critical factor. So, my preliminary conclusion about generative networks is the following: the results of generation can be used only for some purposes, but I think it is premature to say that they can replace a photographer right now. At the moment, one would not expect that photographers will cease to be needed at all tomorrow.

4. Systematisation of neural networks and AI-based systems for photography

In addition to generative neural networks, systems appeared that allow you to repeatedly enlarge photos, draw missing or lost details, improve image quality, eliminate various types of defocus and blur, increase the sharpness and clarity of the image, remove unnecessary image details and draw missing fragments, colorize black and white images, then these capabilities served as an impulse for a more detailed study of the direction of using neural networks and systems with AI. It is for this reason that I conducted a search and preliminary review of existing solutions and services that is shown in Table 1.

Table 1. Neural networks and AI-based systems

#	Name	Functionality	Website link
1.	aftershoot	Photo selection for the photographer. In beta testing - automatic processing of photos in the photographer's style.	https://aftershoot.com/
2.	AI Image Enlarger	Using AI to upscale small or pixelated images. Image Enhancement.	https://imglarger.com/ru
3.	AI Image Sharpener byMedia.io	Sharpening the image for more detailed visualization. Image Enhancement.	https://imgsharpen.media.io/app/
4.	AI Image Upscaler	Using AI to upscale small or pixelated images. Image Enhancement.	https://www.upscale.media/ru
5.	AI Pet Photos	Pet Portrait Tool. Image Enhancement.	https://aipetphotos.com/
6.	AILab Tools	Image Processing Toolkit. Image Enhancement. Avatar.	https://www.ailabtools.com/
7.	Artbreeder	Generate images in large quantities and sort them into folders.	https://www.artbreeder.com/
8.	Artificial Studio	A platform with a collection of AI tools for managing images, audio and video. Image Enhancement. Video Manipulation.Music. Interior Design.	https://www.artificialstudio.ai/tools
9.	B^ EDIT	AI Image Generation and Editing. Generative Art. Image Enhancement.	https://bedit.kakaobrain.com/
10.	beautiful.ai	Creating presentations from pictures with descriptions.	https://www.beautiful.ai/
11.	BestBanner	Image Compression and Optimization Tool. Image Enhancement. Productivity.	https://bestbanner.jina.ai/
12.	bigjpg		https://bigjpg.com/
13.	BigJPG	Improves image quality.Image Enlargement Tool up to 16x. Image Enhancement.	https://bigjpg.com/
14.	Breeze	Professional Product Photography Tool. Image Enhancement.	https://breeze.ai/
15.	CAMIRA	A suite of AI-powered apps to help photographers and videographers. Image enhancement. Marketing. Planners.	https://www.camira.ai/
16.	Cartoonify	Turn a photo into a cartoon with a neural network	https://experiments.withgoogle.com/cartoonify
17.	Claid.ai	Image creation, lighting and color correction tool. Image enhancement. Generative art.	https://claid.ai/
18.	ClipDrop	Image scaling, background removal, removing unnecessary elements from images Image enhancement,	https://clipdrop.co/
19.	Cloudinary	API for AI Software Development. Image Enhancement. Social Media. Video Editing. Development.	https://cloudinary.com/
20.	Cognify Studio	Design app that lets you turn photos into designs. Image enhancement.	https://cognifystudio.com/
21.	CogVideo	Draw video on request in gif format.	https://github.com/THUDM/CogVideo
22.	Color.io	A tool for automating color correction and image editing. Image enhancement. Video work. 3D.	https://www.color.io/match
23.	Colorize	Colorizes b&w photos and videos.	https://colorize.cc/
24.	Craiyon	Create AI Art with free AI image generator, generates 9 images in one click	https://www.craiyon.com/
25.	CREATOSAURUS	Graphic Design Editor Generative AI Toolkit Social Media Management Social Inbox & Analytics	https://www.creatosaurus.io/
26.	Cutout Pro	Removing background from image. Image enhancement.	https://www.cutout.pro/
27.	DALL·E 2	An AI system that can create realistic images and works of art based on natural language descriptions.	https://openai.com/dall-e-2/
28.	Deep Agency	Virtual Photo Studio Platform. Image Enhancement. Interior Design.	https://www.deepagency.com/
29.	Deep Dream Generator	Creating realistic images in specified styles, scaling images.	https://deepdreamgenerator.com/
30.	Deep Image	Enhancing photos with advanced editing features. Image Enhancement.	https://deep-image.ai/
31.	DeepAI	Generator of images, videos, music, texts	https://deepai.org/
32.	DeepFillv2	Architecture for automatically removing unwanted objects from photographs.	https://github.com/JiahuiYu/generative_inpainting
33.	Dezgo	Generate high-resolution images from a text description. Powered by Stable Diffusion XL Lightning AI. Image to image conversion based on description, image processing, and background removal.	https://dezgo.com/
34.	Dopepics	Advanced Image Editing. Image Enhancement.	https://dopepics.io/

35. Draw3D	Tool for turning sketches into photorealistic images. Image Enhancement.	https://draw3d.online/
36. Dream by wombo	Surreal designs, turns photos into cartoons	https://www.wombo.art/
37. Dream by wombo	Generate images by prompt	https://dream.ai/create
38. Dreamlife	Camera app to make home design easier. Image enhancement. Interior design.	https://apps.apple.com/us/app/im-ai-interior-design-more/id6444075319
39. Enhanced AirBrush Studio	Headshot Platform. Image Enhancement.	https://airbrush.com/aigc/headshots/home
40. Face26	A tool for enhancing and correcting photos. Image enhancement.	https://face26.com/
41. FaceSwapper	Online tool for replacing faces in photos and videos. Image enhancement. Video editing.	https://faceswapper.ai/ru
42. FILTERPIXEL	Selection of photographs for the photographer.	https://filterpixel.com/
43. FotoFix	Enhancing and Restoring Photos. Image Enhancement.	https://fotofix.app/
44. fotor	Photo editor with great possibilities of image enhancement and transformation using AI tools.	https://www.fotor.com/
45. fotor	Transform photo into Artworks, tylizes a photograph to look like famous portraits or paintings	http://goart.fotor.com/
46. Free Profile Picture Maker	Professional Profile Picture Tool. Image Enhancement.	https://pfpmaker.com/
47. Fusionbrain	Creating images and videos from text descriptions, outpainting, inpainting, style presets.	https://fusionbrain.ai/
48. Gigapixel AI Upscaler	Using AI to upscale small or pixelated images. Image Enhancement. Learn.	https://www.topazlabs.com/gigapixel
49. GliaStudio	Built-in video editor, automatic voice generator, and the ability to create video from text.	https://www.gliacloud.com/
50. Green Screen AI	Change the background of any image. Image enhancement.	https://greenscreenai.com/
51. Hama	Tool to remove objects or people from photos. Image enhancement	https://www.hama.app/
52. Headshot Generator AI	Headshot Tool. Image Enhancement.	https://www.headshotgenerator.io/
53. HeyPhoto	Online face editing tool to change facial features, add makeup and hairstyle. Image enhancement.	https://hey-photo.com/
54. HitPaw	Tools for working with photos and videos. Remove watermarks, add subtitles, improve quality, and compress video and dozens of other services on one site.	https://online.hitpaw.com/
55. Hotpot	Generate pictures by description.	https://hotpot.ai/art-generator
56. Img Upscaler	AI Image Upscaler. Image enhancement	https://imgupscaler.com/ru
57. IMGCreator.ai	Create text images that help you think and create. Generative Art. Image Enhancement.	https://imgcreator.zmo.ai/
58. Imglarger	Improves image quality.	https://imglarger.com/
59. InPixio	Image enhancement and editing tool. Image enhancement.	https://www.inpixio.com/
60. Kandinsky	Creates images based on description.	https://www.sberbank.com/promo/kandinsky/
61. Lama Cleaner	Removing unwanted objects from images or replacing something in an image. Image enhancement. Generative art.	https://neuro-seti.ru/lama-cleaner/
62. LeiaPix	Upload an image and turn it into a 3D animation. Image enhancement. Video generation. 3D Animation.	https:// leiapix.com/
63. Lensa by Prosma AI	Lensa is an all-in-one image editing app based on AI. Image Enhancement.	https://prisma-ai.com/lensa
64. Let's Enhance	Improves image quality.	https://letsenhance.io/
65. Lexica	Create a picture from a description	https://lexica.art/
66. logoai	Draws logos, branding.	https://www.logoai.com/
67. Looka	Draws logos, branding.	https://looka.com/
68. Lumen5	A site for creating video content. A tool for creating videos from text content.	https://lumen5.com/
69. mage	Creating images from text descriptions.	https://mage.space/
70. Magic Eraser	Removing Unwanted Elements from Images. Image Enhancement.	https://magicstudio.com/ru/magiceraser/
71. Magic Studio	A set of tools for creating product photos and profile images. Image enhancement	https://magicstudio.com/ru/
72. magickimg	Image editing, enhancement and optimization platform. Image enhancement. Learning.	https://magickimg.com/ru/
73. Mems	Image Enhancement.	https://memsapp.ai/

74.	Metademolab	Brings sketches and children's drawings to life.	https://sketch.metademolab.com/
75.	Midjourney	Neural network for generation images from natural language descriptions and synthesizing images with variations or modifications of existing photographs.	https://www.midjourney.com/home/
76.	Midjourney Prompt helper	Midjourney Hint Generator and promt helper.	https://midjourney-prompt-helper.netlify.app/
77.	Modyfi	Image Editing Tool. Image Enhancement.	https://www.modyfi.com/
78.	MyHeritage	Animates photos.	https://www.myheritage.com/deep-nostalgia
79.	NARRATIVE SELECT	Selection of photographs for the photographer.	https://narrative.so/select/
80.	Nero Image Upscaler	Increase image size and resolution while maintaining quality. Image Enhancement. Real Estate.	https://ai.nero.com/image-upscaler
81.	Neural Love	A set of tools for artificial intelligence, images, videos and text. Generative art. Image enhancement. Video manipulation.	https://neural.love/
82.	NightCafe Creator	Image generation. Create, share and print artworks with AI Art Generator.	https://creator.nightcafe.studio/
83.	Object Remover	Photo object removal tool. Image enhancement. Learning. Recognition.	https://objectremover.com/
84.	Objectremover	Quickly remove unwanted objects from images. Image enhancement.	https://objectremover.com/ru/image-cleaner
85.	OPTYX 2	Selection of photographs for the photographer.	https://optyx.app/
86.	Ostagram	Combines the styles of different paintings into one.	https://www.ostagram.me/
87.	Palette	Using AI to Colorize Black and White Photos. Image Enhancement. Learn.	https://palette.fm/
88.	Phosus	AI-powered image enhancement tools. Image enhancement.	https://phosus.com/
89.	Photo AI	A tool for photographers to create custom photo shoots, train their own models, copy photos. Image enhancement. Training.	https://photoai.com/
90.	Photo Editor AI	Photo editor with artificial intelligence to remove objects and people from images. Image enhancement. Real estate. Interior design. Logo.	https://photoeditor.ai/
91.	PhotoAI	Tool for creating customized photos for social networks. Image enhancement.	https://www.photoai.me/
92.	PhotoFix	Removing People or Objects from Photos. Image Enhancement.	https://photofix.io/
93.	Photoleap	Photo Editing App for iOS. Image Enhancement. Video Editing.	https://www.photoleapapp.com/
94.	PhotoRoom	Photo editing platform with powerful tools. Image enhancement. Generative art.	https://www.photoroom.com/
95.	Phygital+	A set of tools for creating AR graphics and image enhancement. Generative art. Image enhancement. 3D.	https://phygital.plus/
96.	Pic Craft AI	Product Photography Tool. Image Enhancement.	https://www.piccraftai.com/
97.	Pics Enhancer	Easily improve image quality and resolution. Image Enhancement.	https://picsenhancer.com/
98.	Picsart	AI tools for creating, editing, drawing and publishing photo and video content. Image enhancement. Video editing.	https://picsart.com/
99.	Pictory	Creates a picture based on audio, text and source video.	https://pictory.ai/
100	Pictura	Improves photos and increases image resolution. Image Enhancement.	https://picturaapp.com/
101	PicTush	Image Enhancement: Resolution and Color Enhancement. Image Editing. Image Enhancement.	https://pictush.com/
102	PicWonderful	Online photo editing tool. Image enhancement.	https://www.picwonderful.com/
103	Pixalto	Enhancing and editing images for professional-grade photography. Image Enhancement.	https://pixalto.app/
104	Pixelcut	Virtual photo studio app for creating product photos. Image enhancement.	https://www.pixelcut.ai/
105	Pixlr	Photo creation, editing and design tool. Image enhancement.	https://pixlr.com/ru/
106	Poemportraits by EsDevlin	Overlays text on a portrait.	https://artsexperiments.with google.com/poemportraits
107	POSTPRO WAND	Selection of photographs for the photographer.	https://www.postpro.ai/
108	PromptBase	Help in composing text queries.	https://promptbase.com/
109	PromtFolder	Midjourney Hint Generator	https://promptfolder.com/midjourney-prompt-helper/
110	ProPhotos	A tool to turn ordinary photos into professional portraits. Image Enhancement. Education.	https://prophotos.ai/

111	QQ World AI Painter	Turns photos into anime.	https://h5.tu.qq.com/web/ai-2d/cartoon/index
112	Remini	Photo Enhancement App. Image Enhancement.	https://remini.ai/
113	remove.bg	Removes background from photo.	https://www.remove.bg/
114	Rentoor	Improves old, blurry images. Image Enhancement.	https://rentoor.vercel.app/
115	RETOUCHER	Removes background from photo.	
116	Ripl	An application that help create beautiful and dynamic scenarios Reels.	https://www.ripl.com/
117	ruDALL-E	Generates images from text description.	https://rudalle.ru/
118	runway	Creates video based on different frames, video editing and editor, animation and 3D models. The application is based on Stable Diffusion.	https://runwayml.com/
119	Shedevrum	Generation of images, videos and texts based on description.	https://shedevrum.ai/
120	Smart upscaler	Improves image quality.	https://icons8.ru/upscaler
121	Spyne	Increasing image resolution without losing quality, reducing blur.	https://www.spyne.ai/tools/image-deblurrer
122	Stable Diffusion	Neural network used to generate detailed images conditioned on text descriptions, though it can also be applied to other tasks such as inpainting, outpainting, and generating image-to-image translations guided by a text prompt.	https://stablediffusionweb.com/
123	starryai	Art and NFT generator	https://www.starryai.com/
124	Stillgram	Travel camera app to remove background crowds from photos. Image enhancement. Video editing. Travel.	https://stillgram.io/
125	Storia Textify	A tool for adding or replacing text in AI-generated images. Image Enhancement.	https://lab.storia.ai/
126	Submagic	An application that automatically converts speech into text animation.	https://t.me/c/1823033671/1043
127	SupaRes	Image Enhancement Platform.	https://supares.com/
128	Synthesia	Creates videos, has a large library. Allows editing videos, has a built-in editor.	https://www.synthesia.io/?via=sachin-prajapati
129	Synths Video	Platform designed for YouTubers, but the prices are steep. There is one standard subscription of $800 per month. It does wonders, of course, but it's up to its client	https://synths.video/
130	TheDream.ai	Social media profile picture maker. Image enhancement. Avatar. Education. Fashion. Movies.	https://thedream.ai/
131	thispersondoesnotexist	Generates a portrait of a non-existent person.	https://thispersondoesnotexist.com/
132	Tome	Presentations' creating using describing of pictures	https://beta.tome.app/
133	UpscalePics	Enhancing and enlarging images while maintaining quality. Image enhancement.	https://upscalepics.com/
134	Upscayl	An open source image scaler for MacOS, Linux and Windows. Image Enhancement.	https://www.upscayl.org/
135	VANCEAI	Improves image quality.	https://vanceai.com/
136	VanceAI Image Upscaler	Enlarge images up to 800% with improved resolution. Image Enhancementю Learn.	https://vanceai.com/image-enlarger/
137	Vectorizer	Tool for converting raster images to vector graphics. Image enhancement.	https://www.vectorizer.io/
138	Vectorizer.AI	Tool to convert JPEG and PNG raster images to SVG vectors for printing, cutting, embroidery and more. Image Enhancement. Image Scanning. Pdf.	https://vectorizer.ai/
139	Vidyo ai	Makes tik toks, reels and short videos for youtube from videos.	https://vidyo.ai/
140	Viesus	Enhanced and upscaled photos for business with API. Image Enhancement.	https://neuro-seti.ru/viesus/
141	Virtual Face	LinkedIn Profile Image Creator Tool. Image Enhancement.	https://virtualface.app/
142	Vmake by AirBrush	Image and Video Editing Platform. Image Enhancement. Video Editing.	https://vmake.ai/
143	waifu2x	Improves image quality.	https://www.waifu2x.net/index.ru.html
144	Watermark Remover	Removing watermarks from image. Image enhancement.	https://www.watermarkremover.io/ru
145	Wisecut	Correct errors in videos. Remove unnecessary pauses in videos and add subtitles and music as desired.	https://www.wisecut.video/
146	Wondershare Filmora	A video editor that offers a variety of tools for creating professional scripts.	https://filmora.wondershare.com.ru/

Source: Author's compilation.

5. Practice of using ChaiNNer neural network, some examples and descriptions

ChaiNNer Neural Network is a node-based graphical user interface for image processing designed to simplify, intuitively understand and customize a chain of image processing tasks including scaling with neural networks.

Features currently available in ChaiNNer:

- Image editing;
- Image enhancement;
- Image conversion.

Supports multiple platforms - Windows, macOS, Linux;

The system has an intuitive node-based GUI for customizing image processing workflow. This allows you to control the processing sequence and perform complex tasks by connecting multiple nodes.

The following figures show examples of photo scaling tasks.

Enlarges a screenshot of 1080*1080 pixels by 4 times and produces an image of a standard size, sufficient for high-quality publication in a magazine. The enlarged image is 4320*4320 pixels in size. Time spent on photo processing was 41 min 22 sec (Fig. 15).
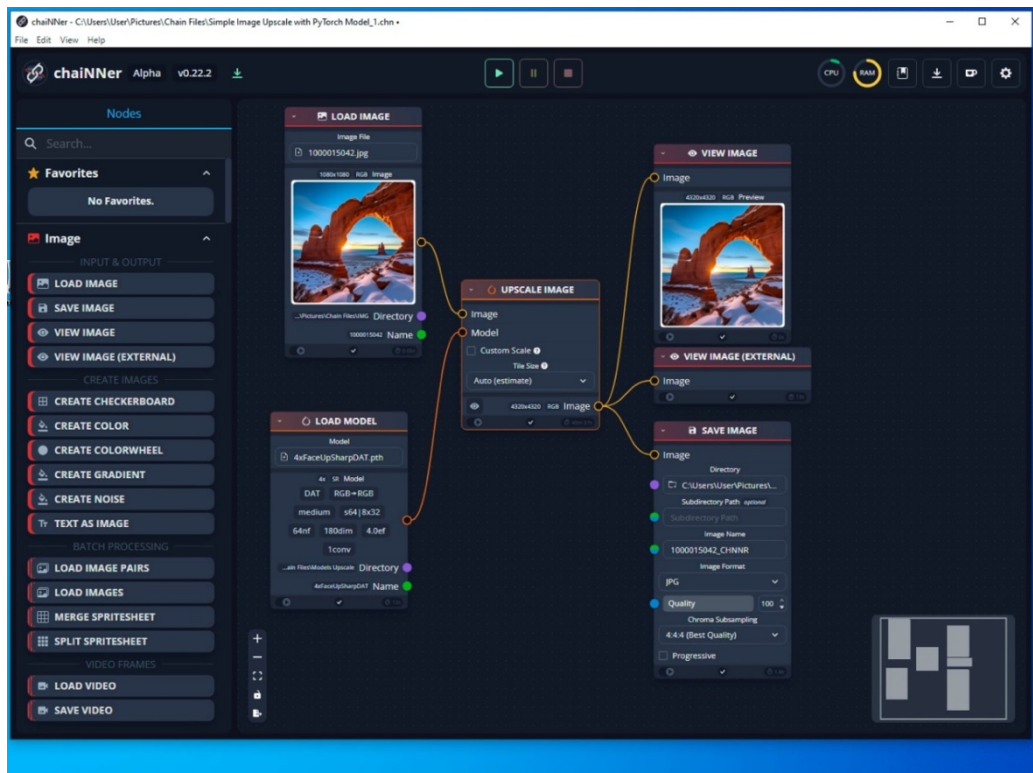
Fig. 15. Photo scaling tasks – Enlarges a screenshot.
Source: author's compilation.

Processing another image of 1080*1080 pixel and enlarging it 4 times. Obtaining an image of a standard size, sufficient for high-quality publication in a magazine. The enlarged image is 4320*4320 pixels in size. Time spent on photo processing 43 min 22 sec., Fig. 16.
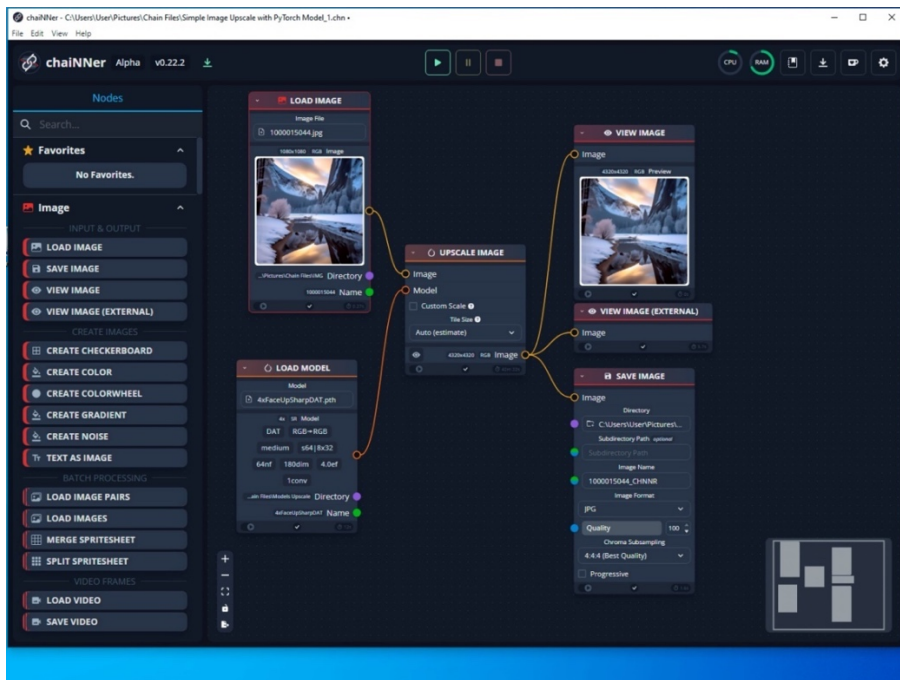
Fig. 26. Enlarging photo in 4 times.
Source: author's compilation.

Enlarged image in the updated version of the ChaiNNer system.
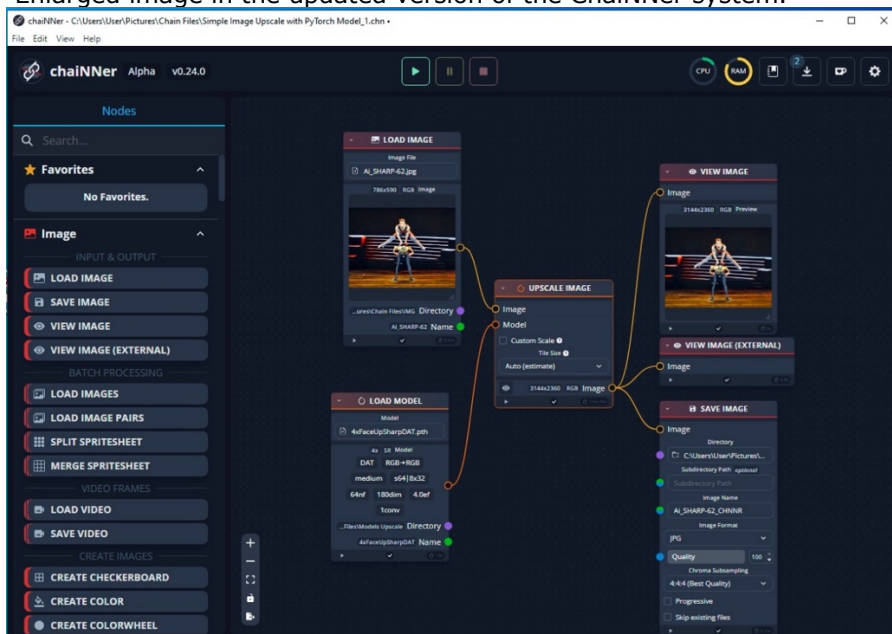
Fig. 37. Enlarging photo in 4 times in the updated version.
Source: author's compilation.

On Fig. 17 shown an image measuring 786*590 pixels was also enlarged 4 times. Obtaining an image of a standard size, sufficient for high-quality publication in a magazine. The enlarged image is 3144*2360 pixels in size. Time spent on photo

processing 16 min 40 sec. The new version has improved some algorithms and processes and has clearly reduced processing time.

It should be noted that the ChaiNNer system is in constant development, often optimized and improved.

6. Practice of using Media.io and Stable Diffusion neural networks

To reach image enhancement and sharpening for more detailed visualization we can use AI Image Sharpener by Media.io (https://imgsharpen.media.io/app/). The result of Media.io implementation is shown on Fig. 18 and Fig. 19.
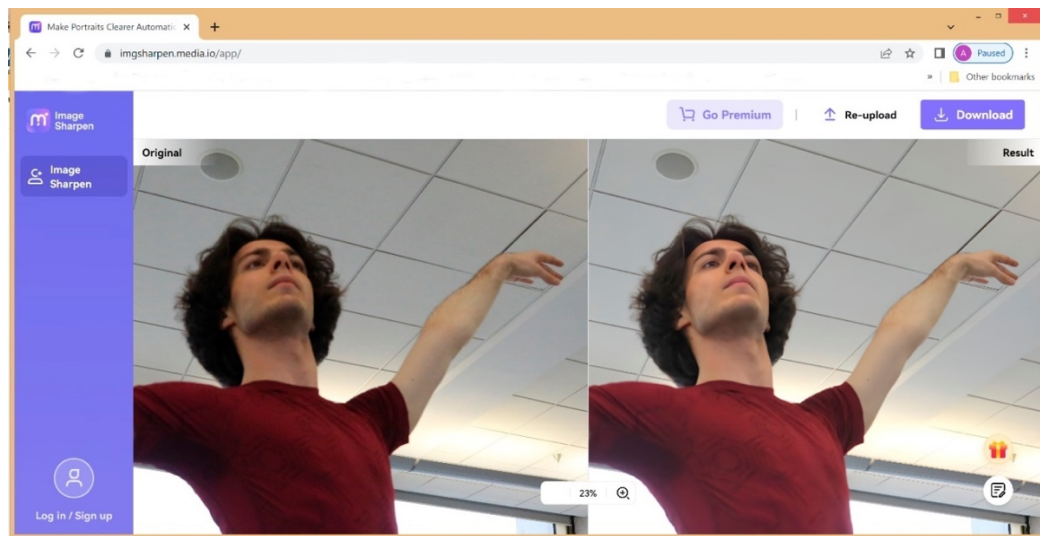
Fig. 48.

On Fig. 18 (to the right) the face really began to look sharper and clearer after using AI Image Sharpener. The image became clearer and brighter.
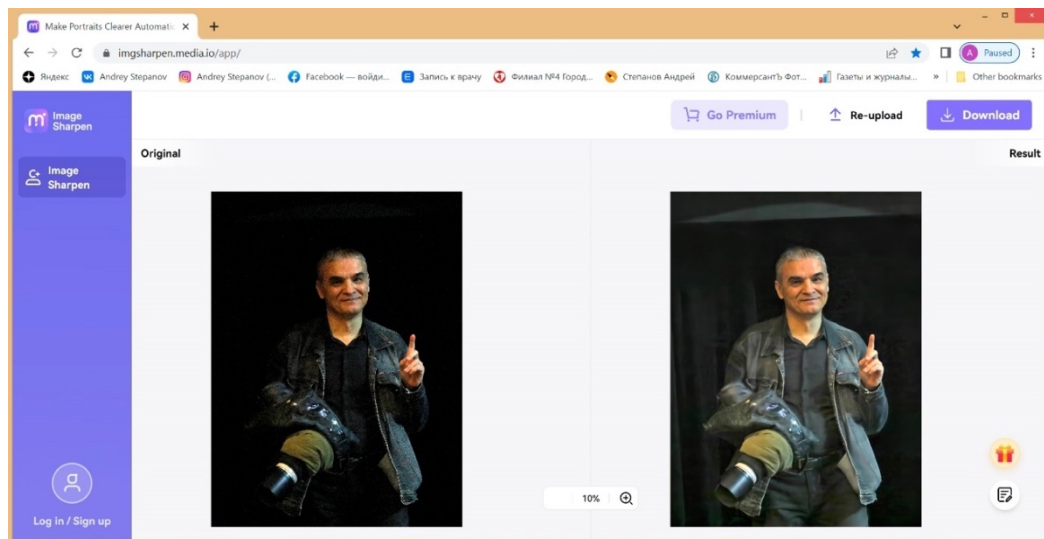
Fig. 59.

Fig. 19 (to the right) presents that the face began to look sharper and clearer after using AI Image Sharpener. The image became clearer and brighter. However, this photo shows some disadvantages: The denim jacket material has lost its structure.

Stable Diffusion is a neural network from Stability.ai that uses a diffusion model to generate images based on a text query. The model consists of several components:

Text encoder - takes text as input and converts it into a set of numbers that describe each word.

Image generator - includes the UNet neural network and planning algorithm, creates information about the image.

Decoder - draws a picture based on the information received.

Stable Diffusion can perform the following functions:

Generate images based on text description.

Draw in the styles of different artists.

Replace objects in images and complete the background.

Finish sketches.

Create visual projects, including stop-motion animation and videos.

Generate objects and locations for video games.

For example, I provide several of my photographs and generative images that I can generate at the Stable Diffusing Online System (Fig. 20,21,22). Certainly, you can see some similarity and resemblance in them. But a complete repetition and execution of the task is definitely not possible.

| Fig. 20 | Fig. 21 | Fig. 22 |

Fig. 20, 21 and 22 – all three images generated by the Stable Diffusion neural network. The task for generation – ballerina in an "arabesque" pose in Antelope Canyon, Utah), see above the Fig. 4.

What can be noted in the obtained results. The results was the approximately the same as for Shedevrum and ruDALL-E systems. As a plus - the landscape of the Antelope Canyon is conveyed quite accurately and beautifully, the composition for possible photographs is well built. Cons - the canyon landscape is far from natural and looks more like a stylized image than a real photograph. The biggest minus is the lack of sandstone structure on the canyon walls. Another big minus, in my opinion, is that the dancer is not in the pose that was specified in the description (Only in the last generation the result matched the request as closely as possible, Fig. 22). Also, the minuses include the fact that the more or less acceptable images were obtained not the first time, but in the process of many generations, at least 10 in the case of each network. In many cases, I did not like the dancer - her pose, the presence of extra limbs, her ugly face, etc (Fig. 20 and Fig. 21).

7. Conclusions

Based on a small part of the applications studied, we can make an intermediate conclusion that the role of neural network solutions in modern photography is rapidly increasing.

As a result of this study summarized 146 neural networks and AI-based systems for photographers (Table 1). Unfortunately, the commercial nature of many systems does not allow for a full analysis of all systems without payment, and this is the main limitation of this work.

Neural networks are beginning to play an important and prominent role in modern photography. They are used to enhance photographs, restore details, remove noise, and improve image quality. Neural networks are becoming useful for a large number of specialties - photographers, photo editors, bloggers, marketers, designers, restorers of old photographs and some other specialists. The provisional conclusion with regard to neural networks is as follows: the results of the neural networks' generation can only be used for certain purposes, but it is too early to say that they can already replace a photographer. At this point in time, there is no reason to believe that tomorrow there will be any need for photographers at all.

Future research will focus on improving the use of neural networks to enhance the quality of photographs taken in nature.

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Integration of Ukrainian refugees in Belgium thanks to learning French

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Abstract. This paper considers the integration of Ukrainian refugees in Belgium – French Language assistance in the province of Walloon Brabant in Belgium. The learning of the local language is essential to enable them to orientate themselves, communicate and integrate into French-speaking society. Learning of French plays an essential role in the integration of these refugees in Belgium. It facilitates social interactions, access to employment and understanding of local culture. Initiatives such as the Reception and Schooling Scheme for Newly Arriving and Assimilated Students, the French Language of Education support system, the Local Integration Initiative as well as the applications and sites: Wallangues, "Bonjour Belgique", First Aid Communication Tool, Alpha French Foreign Language Portal were developed to help Ukrainian refugees learn French, thus promoting their integration into French-speaking Belgian society. Also, several systems and structures studied to teach French quickly and effectively to Ukrainian refugees who arrive in Belgium. As a result of the study, it was found that the level and speed of progression in learning depend on the initial notions of French previously received, the personal motivation and the commitment of Ukrainian learners.
Keywords: French Language assistance, Ukrainian refugees, Belgium offers, Integration into French-speaking society.

1. Introduction

Conflict between Russia and Ukraine has generated a migration crisis in Europe without precedent since the Second World War. Among those fleeing the country, a high proportion of children and young people had to leave their homes. Many of them experienced trying and traumatic situations before leaving their country, as well as throughout their migratory journey. When they arrive in the host country, they may encounter various difficulties related to adapting to their new environment. These experiences can cause mental health disorders such as post-traumatic stress, anxiety, sleep disorders and depression [1].

Following the start of the armed conflict and given the massive influx to Europe of displaced people from Ukraine, the Council of the European Union started the temporary protection mechanism on March 4, 2022. This emergency mechanism offers immediate collective protection to displaced persons who thus benefit from harmonized rights throughout the European Union (stay rights, access to the labor market, access to housing, social and medical assistance). This temporary protection lasts up to 3 years depending on the evolution of the conflict [https://dofi.ibz.be/fr/news/accueil-en-belgique-des-personnes-en-provenance-dukraine-bilan-apres-un-de-conflit].

Now Belgium offers three routes to protection for people fleeing Ukraine, including eligible stateless people: refugee status, subsidiary protection, and temporary protection. In line with the decision of the Council of the EU, Belgium has extended its temporary protection scheme until 4 March 2025 [https://www.statelessness.eu/sites/default/files/2024-05/ENS_Belgium_Ukraine_Country_briefing_update_February_2024.pdf].

The integration of Ukrainian refugees in Belgium consists of the main three elements (see Fig.1):

Right to Work: According to Belgian law, Ukrainian refugees have the right to work, and they do not need a work permit.

Right to Housing: Refugees are entitled to housing assistance in Belgium. This assistance may include temporary emergency housing, subsidized rental housing, or other forms of support.

Language Assistance: The Belgian government provides language courses and other forms of language assistance to refugees, to help them integrate into Belgian society.
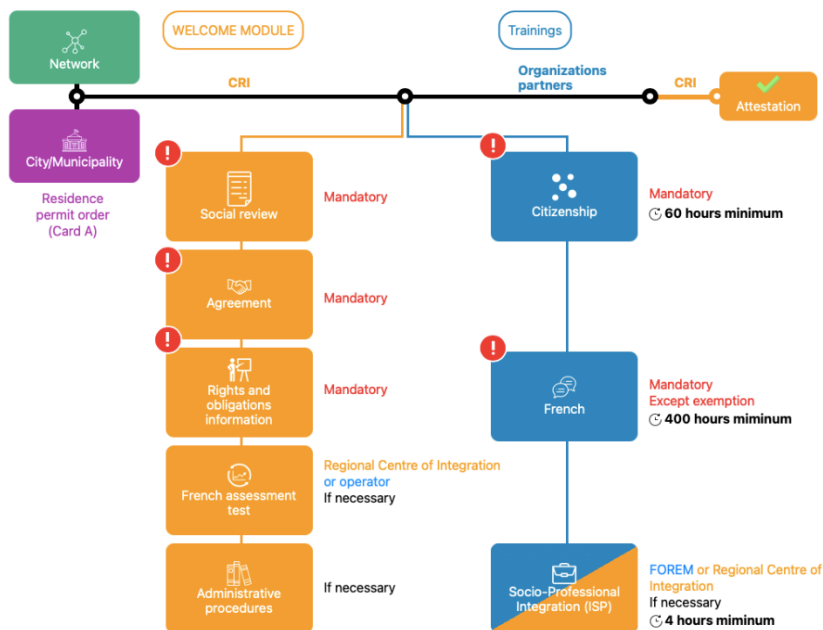
Fig. 6. Integration program in Wallon district in Belgium.
Source: https://parcoursintegration.be/en/

This paper considers one element of the integration of Ukrainian refugees in Belgium – French Language assistance in the province of Walloon Brabant in Belgium. The learning of the local language is essential to enable them to orientate themselves, communicate and integrate into French-speaking society.

2. The representation of the population of Ukrainian refugees on the territory of Belgium

We are interested in actions undertaken by Wallonia, one of the three regions of Belgium, concerning the offers of learning of French to Ukrainians.

Currently, 4.2 million people from Ukraine benefit from the temporary protection mechanism initiated by the Council of the European Union since March 4, 2022.

The number of temporary protection certificates issued in Belgium since March 10, 2022 concerns 77,636 people. Nearly 59,000 beneficiaries of temporary protection were registered in the national register in December 2023. Currently, 19% of them are in Wallonia (which represents around 11,272 people).

Regional authorities, with the support of local authorities, mobilized their resources and actively collaborated to ensure the distribution of the reception of refugees on Belgian territory.

The distribution of refugees in the large Walloon cities compared to the rest of the country indicates in first position, the province of Liège with 6%, then the province of Hainaut 5%, the province of Walloon Brabant 3%, the province of Luxembourg 2% and finally 3% for the province of Namur [9].

3. Role of educational establishments in learning of French

Schools play a fundamental role in meeting the needs of refugee learners and supporting their learning and social and emotional well-being. Here are some profiles of Ukrainian learners who can benefit from this support:

a. Children Witnesses to Violence:

- Many Ukrainian children have witnessed violence and destruction in Ukraine. They may have lost loved ones and suffered other trauma before and during their migratory journey. Their social and emotional well-being is essential for their adjustment both in education and in wider society.

b. Young people separated from their families:

- Some young Ukrainians were separated from their families during their flight. They may feel grief, anger and guilt. Their integration into schools and society will depend on the psychosocial support they receive.

c. Adaptation Difficulties:

- Upon arrival in the host country, Ukrainian learners may encounter difficulties related to adapting to their new environment. Acts of discrimination or family changes can affect their social and emotional well-being.

d. Mental Health Disorders:

- Some Ukrainian refugee learners may experience post-traumatic stress disorder, anxiety, sleep problems or depression. Their long-term care will depend on the support they receive in their host country [1].

It is essential that schools and communities provide a supportive environment to support these learners and facilitate their integration. Their social and emotional well-being is an essential component of the process of integration into their new life [1].

Faced with this situation, public authorities at all levels had to develop a specific reception program with all federal, regional and local stakeholders to meet the main needs and best welcome Ukrainian refugees.

4. Training offered to Ukrainian refugees to learn French

How to teach French quickly and effectively to Ukrainian refugees who arrive in Belgium?

In Wallonia, several systems and structures are in place for the teaching of French as a foreign language:

A. Reception and Schooling Scheme for Newly Arriving and Assimilated Students.

B. French Language of Education support system.

C. Training and Resources.

Let us consider each of these.

A. Reception and Schooling Scheme for Newly Arriving and Assimilated Students :

o This system is an educational structure within educational establishments. It aims to welcome, educate and integrate newly arrived and assimilated students into mainstream education, from the third year of nursery education.

o During this intermediate stage of schooling, students benefit from intensive French teaching as well as courses relating to humanities, mathematics, science and philosophy and citizenship.

o If the organization of this educational structure is not possible in the establishment due to an insufficient number of beneficiaries, support for students is provided in the form of an another educational structure: French Language of Education support system.

B. French Language of Education support system:

o The French Language of Education support system consists of granting teaching periods to a school. It aims to strengthen knowledge and mastery of the school language as well as school culture.

o It is aimed at students, including new arrivals and assimilated to new arrivals, from the third year of nursery education to the fourth year of primary education, who have obtained a grade of C in the proficiency test of the language of instructions.

C. Training and Resources:

Lack of mastery of the language often represents a hindrance in administrative procedures, hence the need to offer several possibilities for learning of French.

a. By following the integration course, which includes training in the French language. The integration course in Wallonia is a program set up to welcome and support new foreign residents in the region. The integration process is compulsory for new arrivals domiciled in French-speaking Wallonia, aged 18 to 65, of foreign nationality, legally resident for less than 3 years and having a residence permit of more than 3 months. There are key stages of the integration journey:

- Ordering a residence permit (more than 3 months): The process begins on the date the residence permit is ordered.

- Welcome module: A first step which allows you to familiarize yourself with Belgian society.

- Trainings:

* Certificate of rights and duties is issued at the end of the training on rights and duties in Belgium.

* Citizenship course: 60 hours minimum. The objective of the integration course is to welcome and support new foreign residents of Wallonia, to help them acquire basic knowledge about the functioning of society and social relations in Belgium, and to facilitate their integration on the territory.

* French courses: 400 hours minimum (except exemptions).

* Socio-professional integration: 4 hours minimum. This program makes it possible to implement professional projects and training adapted to the needs of foreign workers.

* Evaluations: At 3 months, 6 months and 12 months to take stock of the progress of the personal and professional project.

b. By following courses given by educational establishments (social promotion education which is an educational system in Belgium which offers secondary or higher level training to adults), training operators (Walloon Institute of Alternance Training and independents and Small and Medium Enterprises which offer training for professions in a multitude of professional sectors) or associations. Concretely, the project proposes to organize intensive French Foreign Languages courses intended for adults. First, over a short period: 11 weeks from March 2022 to the end of the 2021/2022 school year and then over the entire 2022/2023 and 2023/2024 school year. These training courses are organized in around thirty establishments in Brussels

and the Walloon region. Registrations are possible thanks to the residence permit granted to Ukrainian refugees.

The School of Social Promotion of the Wallonia-Brussels Federation issues recognized certificates of success for each module of the French as a foreign language course. [6]

c. By taking free French courses accessible online according to common distance technologies [7; 8; 9] or via an application from the PC, smartphone or tablet. For example, the free Wallangues site which has an interface in Ukrainian. It aims to improve the language skills of Walloon citizens and prepare them for employment and mobility.

d. By following French e-learning courses via the "Bonjour Belgique" mobile application developed by the NGO "Bibliothèques Sans Frontières de Belgique" in collaboration with the King Baudouin Foundation. Until recently, there was no free and practical solution for learning French from Ukrainian and the Cyrillic alphabet. This specific practice considers in one of previous work [10]. Also, this is where "Bonjour Belgique" comes in. It offers an innovative method to quickly acquire French language skills, while providing cultural and practical resources to better understand Belgium. One of the characteristics of "Bonjour Belgique" is: fast and fun learning: this application offers podcasts, exercises and pre-recorded sentences to improve vocabulary, grammar and pronunciation in French. The themes are varied: this application covers 50 essential topics of daily life, such as housing, employment, healthcare and travel. For each theme, "Bonjour Belgique" offers information and cultural resources to better understand Belgium. This application received the 2023 European Language Label for its added value in learning French and its usefulness for refugees and migrants recently arrived in Belgium [3].

e. By using the FACT (First Aid Communication Tool) application to learn professional vocabulary in the maintenance professions, agriculture, horticulture and industry to be effective at work. In addition to sectoral vocabulary, there is current vocabulary and an opportunity to check your knowledge [4].

f. By consulting the Alpha French Foreign Language Portal (Portail Alpha Fle) which is intended for integration and guidance professionals. It allows you to search for training offers as part of learning of French [5].

g. Via the Local Integration Initiative which is a program set up by Wallonia to facilitate the integration of migrants and refugees. The objective of the Local Integration Initiative is to offer
- French language training to help acquire language skills.
- citizenship training so that foreigners learn the social, cultural codes and institutions of the host country.
- social support to facilitate integration into society.
- specialized legal support in foreigners' rights to help migrants understand their rights and obligations. [6].

Thus, by giving these adult refugees the opportunity to become familiar with the French language, the Walloon region contributes to helping their social and individual development.

5. The objectives of learning of French

Learning of French is essential for communication, understanding and integration [11, 12]. The main objectives are to enable adult refugees to:
• Become familiar with the perception and pronunciation of the French language
• Distinguish the graphic elements of the French language
• Reproduce short and simple messages heard
• Become familiar with the essential social and cultural aspects of the country.
The work is done on four skills:

- Listening comprehension:

It is about distinguishing the different sounds of the language, capturing and recognizing the meaning of short and simple messages, in usual communication situations linked to one's experience and projects.

- Reading comprehension:

The learner finds his way in the graphic space, learns to recognize shapes, colors, acronyms, logos linked to everyday life. He can recognize the meaning of common words linked to the daily environment. He is also able to identify the nature and function of the main writings of daily life.

Learning to understand oral and written messages is a key objective.

The learner must develop the ability to grasp the meaning of texts, interpret information and react appropriately. This equally promotes mastery of written language and preparation for reading. [20].

- Oral expression:

The aim is to reproduce the sounds heard as correctly as possible and to reproduce short messages in question/answer situations, linked to simple speech acts. To master oral communication, the learner must gradually move from collusive language to understandable verbalizations that allow them to communicate effectively in society. Oral proficiency is an essential prerequisite for reading and preventing future difficulties. To achieve this, teachers offer communication situations based on shared experiences, promoting the use of syntactic structures and a diverse vocabulary. [20]

- Written expression:

The learner manages to master the layout of letters in order to reproduce words and to use graphic space correctly, as well as to reproduce a written string while respecting conventional signs. [13]

-Progress towards overall mastery of the language:

Language learning is not limited to oral communication and understanding. It also includes the observation and analysis of language as a manipulable object.

This step is crucial for an effective entry into reading and mastering the French language as a whole.

In short, learning of French plays a crucial role in academic success, professional and social integration, and must be encouraged from an early age and from the first day on Belgian territory.

6. The organization of French courses for foreigners

By organizing these French as a Foreign language courses intensively in the French-speaking regions of the country, the government seeks to offer asylum seekers, driven from their homes by the conflict, a rapid possibility of integration and autonomy.

The aim of the training is such that after the first training module, people forced to stay for a longer or shorter time on Belgian territory can then, if they feel the need or simply desire it, turn to other training courses to learn the trade.

By initiating the French learning project, the Walloon region is helping to build a society that is ever more democratic and united.

French as a foreign language courses are organized by public authorities: the provinces, the municipalities and the French Community Commission of the Brussels-Capital region. Placed under the authority of elected representatives and accountable to citizens, they are guarantors of the values of democracy, pluralism and solidarity.

These French as a foreign language courses are open to all and are taught through teaching that is essentially inspired by the principles of secularism: their neutral character guarantees respect for everyone's personal convictions. Educational approaches focus on adapting practices and resources to the needs of learners, taking

into account their learning pace and their social and cultural diversity: they tend towards real equality of opportunity thanks to the appropriation of knowledge [14].

Under the terms of a decree published in the Official Journal dated May 8, Ukrainian refugees can benefit from up to 400 hours of French lessons, as part of temporary protection [15]. In Belgium, this means that Ukrainian refugees have the opportunity to take French courses to facilitate their integration and learning the language. These courses are essential to promote their adaptation and active participation in Belgian society.

Thus, Level A1 learners can follow 100 or 200 hours of lessons.

Level A includes two sub-levels: A0 (absolute beginner): learners have no prior knowledge of French and A1 (basic user): learners have basic skills for simple situations.

Level A2 learners are entitled to 100 hours of lessons. These are elementary users or false beginners, their skills are more developed for common interactions.

And Level B1 and B2 learners can also take 100 hours of lessons. The Level B1 learner is an independent user of the French language: he or she has the ability to communicate independently in various contexts.

The Level B2 learner masters everyday French, French for more complex conversations.

Before starting classes, Ukrainian refugees must take an assessment of their written and oral skills in French to determine their level.

7. Progress in learning French

Ukrainians' progress in French as a foreign language may vary depending on several factors, such as their starting level, their commitment to learning and the available resources. Here are some elements that can influence their progress:

1. Starting Level:

- Ukrainian learners start at different levels depending on their initial language skills. Some may already have some basic French, while others may be total beginners and start from scratch. It depends on their previous exposure to the language, their motivation and their engagement in learning. The important thing is to provide support adapted to each learner, in order to help them progress and achieve linguistic objectives.

2. Motivation and Commitment:

- Personal motivation and commitment to learning are essential to progress in French as a foreign language. Learners who are motivated, consistent in their practice and who actively seek to improve their language skills tend to progress more quickly. Teachers advise them to determine from the start of learning what they want to achieve by learning French: whether for professional, personal or academic reasons, having specific goals will help you stay motivated.

3. Learning Environment:

- The environment in which Ukrainian learners study French may also play a role. Formal courses, exchanges with native speakers, the use of online resources and daily practice are all factors that can promote their progress.

Alternative learning groups are also organized for foreign learners, particularly Ukrainians. They are invited to join and participate in conversation groups, language workshops or language clubs. Exchanging with other learners allows them to practice and stay motivated.

4. Educational Support:

- French as a foreign language courses taught by qualified and experienced teachers are essential to guide learners in their progress. Teaching methods, interactive activities and constructive feedback contribute to their linguistic development. Learning of French can be difficult, but the main thing is to remain

persistent, not to get discouraged and accept mistakes as learning opportunities by continuing to practice.

5. Regular Practice:

- Regular practice is crucial to improve your language skills. Ukrainian learners should practice listening comprehension, reading, written expression and oral communication to strengthen their mastery of French.

It is also important to dedicate time every day to learning French through reading, discussions with native speakers, and discovering of French culture.

In short, progress in French as a foreign language depends on a combination of individual factors, personal efforts and available resources.

Learning outcomes vary depending on the initial level, personal motivation and engagement of Ukrainian learners.

Some may progress quickly and reach a sufficient level of communication to integrate into Belgian society, while others may require more time and practice.

8. Learning of French in practice

As said above, currently, around 11,272 people benefiting from temporary protection are present in Wallonia, a French-speaking region of Belgium. This represents 19% of the total Ukrainian refugees in Belgium. The distribution of refugees in the large Walloon cities is as follows: Province of Liège: 6%, Province of Hainaut: 5%, Province of Walloon Brabant: 3%, Province of Luxembourg: 2%, Province of Namur: 3%.

Currently, around 1,250 people benefiting from temporary protection are present in the province of Luxembourg in Belgium. This represents 11.5% of the total Ukrainian refugees in Wallonia[10]. The province of Luxembourg has therefore welcomed a significant number of Ukrainian nationals who benefit from rights harmonized throughout the European Union, in particular rights of residence, access to the job, access to housing and social assistance and medical, as well as learning one of the country's three languages, in this case, it is French.

However, it is important to note that the success percentage of French learners cannot be directly calculated from these figures, because they do not only represent people who have completed their language training. Some may still be learning or have specific needs that are not captured in these statistics.

8.1 Levels of progression in learning of French

This study is based on a sample of 41 people who took French courses from April 2022 to the present. On the scale of French courses organized and financed by Local Integration Initiative, this represents the following figures (Table 1):

Table 2. Progression of Ukrainian learners in learning of French

	Those who have progressed to Level B1	Those who have not progressed much, Level A2 maximum	Those who have left the country
Number of people	10	26	5
Percentage	24.4 %	63.4 %	12.2 %

This data shows that the largest percentage of learners have the tendency to stagnate in learning of French.

Learning French can be a challenge for Ukrainians newly arrived in Belgium. Here are some possible causes of stagnation in their learning:

a. Cultural and Linguistic Shock:

- Switching from one language to another, especially when the two languages are very different, can be difficult. Ukrainians may encounter difficulties related to French pronunciation, grammar and vocabulary.
- Culture shock can also play a role. Adapting to a new culture, new habits and an unfamiliar environment can be unsettling.

In Belgium, several programs and initiatives aim to help migrants, including Ukrainians, to overcome cultural and linguistic shock. These include language courses and the integration course, of course, but also individual support when volunteers and professionals help to understand the local culture, navigate the administrative system and adapt to their new environment.

Ukrainians are also invited to cultural workshops that explain Belgian culture, customs, gastronomy and history to promote mutual understanding and conviviality between communities.

Intercultural exchanges are at the center of meetings between Belgians and migrants, which allows Ukrainians to share their own culture and learn more about Belgium.

It is essential that Ukrainians newly arrived in Belgium benefit from these resources to facilitate their adaptation and integration in their new host country.

b. Trauma of the conflict experienced:
- Many Ukrainians have fled their country due to the conflict. The trauma of violence, loss of loved ones and destruction can affect their psychological well-being and their ability to focus on learning of French. The psychological after-effects can make it difficult to concentrate, memorize and communicate. It is therefore important to adapt teaching methods to take these factors into account and support learners affected by these traumas to take into consideration the individual experiences of learners in order to promote successful integration into French-speaking society and culture [21].

c. Social isolation:
- Some Ukrainian refugees live alone in Belgium, far from their family and friends. Social isolation can make learning more difficult because they have fewer opportunities to practice the language with native speakers or other learners. Additionally, isolation can lead to stress and anxiety, which can affect concentration and memorization when learning a new language. As a result, without social interaction, motivation to learn can decrease and make it difficult to adapt to Belgian culture and social norms. Interactions with other people can build motivation and engagement [22].

To overcome these challenges, it is important that Ukrainians actively seek opportunities to interact with other people, join language groups, participate in cultural activities and engage in Belgian social life.

d. Learning Conditions: Learning conditions, quality of teachers and available resources may vary.
- French lessons can be demanding, especially for teenagers and young adults who also have to adapt to a new school system. Adapting to a new school system in Belgium can be a challenge, but there are ways to make this transition easier. You must find out about the Belgian education system and understand the teaching levels, subjects, exams and rules specific to each region (Wallonia, Flander, Brussels) as well as familiarize yourself with your rights as a foreign student, with financial aid, scholarships and support services. It is essential to establish contacts with teachers, classmates and parents, which is possible through school life and extracurricular activities.

Staying open-minded allows you to discover new teaching methods, different customs and traditions.

e. Motivation and Objectives:

- Personal motivation plays a key role in learning a language. Some Ukrainians may lack motivation if they do not immediately see the benefits of mastering French because interactions with locals, access to employment and participation in community life are limited or non-existent.

- Having clear goals, such as pursuing higher education (B1 level is required) or finding a job (minimum A2 level is required), can help maintain motivation.

Thus, the motivation of Ukrainians in learning French is varied, but it generally aims to promote their integration and success in Belgium.

In short, learning of French by Ukrainians is a complex process that depends on many individual and contextual factors. It is important to provide appropriate support and create a favorable environment to facilitate their linguistic and cultural integration [17].

8.2 Motivation depends on gender

Learning of French may vary between Ukrainian men and women (Table 2), but it is essential to note that these differences are not strictly gender-related.

Table 3. Differentiation between Ukrainian men and women based on motivation to learn French

	Men	Women
Number of people	15	26
Percentage	36.6 %	63.4 %

Here are some general observations:

1. Motivation and Objectives:

- Personal motivation plays a key role in learning of French. Some individuals, whether men or women, may be more motivated than others to learn French based on their personal goals (e.g., pursuing education, finding a job, etc.).

2. Prior Experiences:

- Previous experiences with other languages can influence learning French. For example, if a Ukrainian man or woman already has Russian skills, this may make learning French easier due to some linguistic similarities.

3. Social and Cultural Environment:

- Ukrainian men and women may have different social networks, which may affect their exposure to French. For example, if a Ukrainian woman has more opportunities to practice French in her social circle, she can progress more quickly.

4. Attitudes and Perceptions:

- Attitudes towards learning of French may vary. Some people may view learning as an exciting challenge, while others may view it as difficult or daunting.

In short, there is no intrinsic difference between Ukrainian men and women in learning of French. Each individual is unique and their learning experience depends on various personal and contextual factors [18].

9. Conclusion

Since the start of the conflict between Ukraine and Russia, the Belgian authorities have worked together to best welcome Ukrainian people who have fled their country. The Council of the European Union has activated the temporary protection mechanism, offering immediate collective protection to people displaced from Ukraine in Europe. Currently, more than 4.2 million people benefit from this mechanism in Europe, including 77,636 in Belgium [23].

The National Crisis Center worked with all partners to facilitate the registration, reception and support of Ukrainian people.

Learning of French plays an essential role in the integration of these refugees in Belgium. It facilitates social interactions, access to employment and understanding of local culture. Initiatives such as the Reception and Schooling Scheme for Newly Arriving and Assimilated Students, the French Language of Education support system, the Local Integration Initiative as well as the applications and sites: Wallangues, "Bonjour Belgique", First Aid Communication Tool, Alpha French Foreign Language Portal were developed to help Ukrainian refugees learn French, thus promoting their integration into French-speaking Belgian society.

It is noted that the level and speed of progression in learning depend on the initial notions of French previously received, the personal motivation and the commitment of Ukrainian learners.

Some of them progress quite well and are quickly able to reach a sufficient level of communication to integrate into Belgian society, find work, and continue their studies. Others need more time to learn French well enough. They lack motivation, because they do not see the immediate benefit of integrating into Belgian society, and language practice because they feel socially isolated and lost in the new life in the new host country.

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The Market of True Matters:
A Novel Approach for Taking Stock of Personal Values

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Abstract. The field of personal visualization has seen significant advancements, driven by increased personal data and interest in self-improvement. While traditional personal visualization tools focus on behavior tracking, this paper explores an innovative approach to visualizing personal values aligned with users' professional mental models. We present the development of a tool that uses the stock market metaphor to represent individual values, leveraging the business backgrounds of the co-authors. Data collected over a year tracked four values: wisdom, security, curiosity, and love. These values were visualized as stocks, reflecting their daily fluctuations and overall trends. Our work demonstrates that aligning personal visualization tools with a familiar metaphor enhances user engagement and personal development, suggesting new directions for personal visualization research and for one's approach to life.
Keywords: Personal Visualization, Personal Values, Visualization Tool, Dynamic Values Tracking

1. Introduction

The field of personal visualization (PV) has experienced remarkable growth in recent years, driven by the proliferation of personal data and a rising interest in self-tracking and self-improvement. PV empowers users to engage with their own data, promoting self-reflection and providing valuable insights into various aspects of their lives [1, 2]. While most PV applications primarily focus on tracking (and possibly, changing) behaviors, there is a burgeoning interest in extending PV to represent individual values. Furthermore, aligning PV tools with users' preferences—whether in terms of personality, cognitive styles, or professional mental models—can significantly enhance the intuitiveness and impact of these visualizations.

In this paper, we present a project wherein we developed a tool to capture and represent personal values in alignment with an individual's professional mental model. Specifically, we utilized the stock market as a metaphor, consistent with the business backgrounds of the co-authors. This metaphor offered a familiar and dynamic framework for visualizing personal values. We term this endeavor the "Market of True Matters", acknowledging the profound connection between personal values and professional life.

The remainder of this paper is structured as follows: first, we review relevant literature on PV, with a focus on the distinctions between behavioral and value-based visualization and the importance of customization according to a user's professional mental model. Next, we detail the development of our tool designed to capture data about personal values, showcasing the visualizations created to represent these values similarly to tracking stock progression. We then discuss lessons learned from this endeavor. Finally, we offer concluding thoughts, acknowledge limitations in our work, and suggest ideas for future research.

2. Literature Review

Personal visualization is a type of visualization where users interact with their own data to self-reflect and draw insights about themselves [1]. The field of PV is rapidly evolving, with much research focused on designing tools that enable individuals to gain awareness, explore, and learn from data related to their personal contexts. Huang and colleagues [2] highlight PV's potential to empower individuals by providing insights into various aspects of their lives, such as fitness [3], energy consumption [4], sleep patterns [5], and dietary intake [6], among other areas.

Most PV applications focus on tracking behaviors, providing significant utility in promoting self-awareness and possibly changing behaviors and habits [7]. This focus on behavior tracking has been instrumental in areas such as health and wellness, where users can monitor their progress and make informed decisions about their lifestyles. For instance, health apps have gained popularity for their ability to track physical activity, diet, and other health metrics, providing users with personalized feedback that can motivate positive changes [3].

However, PV can be expanded beyond behaviors to include the representation of individual values, an area that has not yet been thoroughly explored. This gap presents a unique opportunity to develop tools that visualize something much more intrinsic, i.e., personal values, thereby enriching the PV landscape and providing individuals with a deeper understanding of their personal motivations and priorities. Visualizing personal values can help individuals reflect on how their core beliefs and priorities may affect their life choices, potentially leading to more fulfilling lives [8].

Previous literature has established that users' perceptions and preferences regarding different PVs vary strongly, rendering a one-size-fits-all approach unsuitable. For example, Schneider and colleagues found that personalizing visualizations to align with users' preferences and traits resulted in higher satisfaction and more effective data interpretation [8]. Another example can be found in the work conducted by Healey and Enns [9], who suggest that cognitive load can be significantly reduced when visualizations are designed in a way that aligns with the user's natural way of processing information. Such an alignment not only improves comprehension, but also enhances the overall user experience by making interactions with the data more intuitive and less cognitively demanding.

Building on this foundation, it is crucial to also consider individuals' mental frameworks, shaped by their professional training and education, as these may significantly impact their preferences for PV types. For instance, a marketer might find infographics most relatable, while an architect may prefer blueprints. Aligning a PV with one's mental framework allows individuals to more quickly and accurately understand what a given visualization represents. As Lee and colleagues argue, "*it does not matter what visualizations are used and what the underlying stories are if the visualizations do not make sense to the users and audience*" [10]. Aligning a PV with an individual's mental framework reduces the need for constructing and questioning a frame, two major cognitive tasks required when people make sense of unfamiliar information visualizations [10].

These insights underscore the importance of tailoring PV tools to the cognitive and professional contexts of users, ensuring that the visualizations are intuitive and meaningful to them. Our work seeks to extend the current research by focusing on the representation of personal values through PV, utilizing a metaphor that resonates strongly with individuals from the business world: the stock market. The stock market metaphor offers a familiar and intuitive framework for business professionals to understand and engage with their personal values. This innovative approach leverages the dynamic and fluctuating nature of stock markets to mirror the evolving importance of individual values. By using a metaphor that business professionals are already familiar with, the visualization of personal values can become more accessible and engaging for this demographic.

Ultimately, by bridging the gap between behavioral PV and value-based PV, and by aligning the type of PV to the individual's professional mental model (in this case,

the stock market), we extend the PV literature into novel areas. This approach not only broadens the application of PV but also enhances its relevance and impact by making it more personalized and contextually appropriate for diverse user groups. As the field continues to evolve, incorporating these nuanced understandings will be crucial for developing more effective and meaningful PV tools.

3. Data and Methodology

The initial step of our approach involved gathering data on individual personal values over time. The first author, a business student in her final year of higher education, undertook this data collection daily throughout the entire year of 2022. That year held particular significance for her, given that she was at a pivotal juncture, about to complete her education and embark on a new chapter of her life. She referred to that time as *"the hardest, weirdest, most humbling-beautiful-remarkable year of my life".* Right from the beginning of the project, she identified and selected four core values that were of paramount importance to her: wisdom, security, curiosity, and love. Each of these values was chosen because they individually represented a distinct dimension of her identity and collectively had the potential to weave a unique, data-based narrative about what she deemed most important at that stage in her life. Each of these four values was symbolized by a stock, labeled with a unique four-letter identifier. These values (stocks) are explained in the following sections.

Wisdom (WSDM)

Defined as the pursuit of growth, wisdom is associated with the acquisition of knowledge, perspective, and experience. The value is represented by the color green, symbolizing vigor, depth, and health.

A day with a high WSDM rating likely includes reflecting, learning, reading, encountering a new frame of reference, reevaluation of a problem, an insightful conversation, and thought-provoking observations. A day with a low WSDM rating likely includes isolation, close-mindedness, stubbornness, egotism, and foolish pride.

Questions that guided the daily evaluation of WSDM include: What was the biggest takeaway from today? What did that interaction teach me? Did my perspective change? Did a song/quote/conversation impact me? Why? Will I act differently because of that experience? What questions really made me think?

Security (SCTY)

Defined as the pursuit of trust, security is associated with the presence of faith, equilibrium, and confidence. The value is represented by the color blue, symbolizing rest, peace, and balance.

A day with a high SCTY rating likely includes feeling clarity in a difficult situation, confidence in decisions, hope in the future, low emotional volatility, witnessing a "God wink," and steadfast comfort despite change. A day with a low SCTY rating likely includes dramatization of conflict, self-pity, wallowing, unbelief, and frustration.

Questions that guided the daily evaluation of SCTY include: Did I let someone or something derail my mind? Why did that impact me so much? Do I feel confident in this decision? Is someone or something making me uneasy? In a difficult situation, am I calm or am I reeling?

Curiosity (CSTY)

Defined as the pursuit of wonder, curiosity is associated with the prioritization of creativity, contemplation, and exploration. The value is represented by the color coral, symbolizing vibrancy, freedom, and passion.

A day with a high CSTY rating likely includes asking questions, openness, observing the world with genuine interest, creating (art/writing), exposure to

something new, thinking or talking about an idea, and being inspired. A day with a low CSTY rating likely includes unfair judgments, assuming, self-absorption, fear of failure, and a clouded mind.

Questions that guided the daily evaluation of CSTY include: How can I approach this differently? What did I do for the right side of my brain? How much time did I spend wishing vs. doing? How much time did I spend assuming vs. asking? Why did that bother/excite/affect me? Did I explore anything today?

Love (LOVE)

Defined as the pursuit of gratitude, love is associated with a reverence for kindness, generosity, and significance. The value is represented by the color lavender, symbolizing devotion, dignity, and beauty.

A day with a high LOVE rating likely includes grace given and grace received, patience, time in community and communion, laughter, redemption, expression of thanks, loyalty, and reminders of love. A day with a low LOVE rating likely includes selfishness, self-pity, self-absorption, pessimism, and a defeatist attitude.

Questions that guided the daily evaluation of LOVE include: What am I grateful for? How did I give and receive grace? What filled me up? Why? Is my life honoring the good I've been given? Did I choose hope or despair? How did I serve myself and others today?

Data Collection

To have both mobile and desktop access, the collected data was stored on a Google Sheets file. Each value was tracked on an independent worksheet within the workbook. There were five fields to fill per day: Date, Rating, Converted Rating, Aggregate Rating, and Notes. "Rating" and "Notes" required manual input. "Date," "Converted Rating," and "Aggregate Rating" were automatically populated using in-cell formulas. Over 1,400 data points were collected.

Given the aim of representing data using a stock market metaphor, each value was visualized as a stock, fluctuating over time in either a positive or negative direction. To represent these fluctuations, each primary rating ("Rating", which ranged from 1 to 5) was converted into a secondary rating ("Converted Rating", which ranged from -2 to 2). As to "Aggregate Rating," this was a moving sum of converted values that conveys how progress can be represented by the sum of positive actions over time. An example of data collected over a few days for the WSDM stock (i.e., value) is shown in Table 1[4].

Table 1. Sample of Collected Data for WSDM

Date	Rating	Converted Rating	Aggregate Rating	Notes
01/01/2022	4	1	1	Ain't nothing a crunchy pickle can't fix. Good friends teach you a lot about love.
01/02/2022	3	0	1	The best way to do it, is to do it. Be patient - the smartest fish take a while to bite.
01/03/2022	2	-1	0	Learned that my car (I've had since 2015) has windshield spray.
01/04/2022	3	0	0	"If you're in love, fall." Join the dance!!!
01/05/2022	5	2	2	You are responsible for your own happiness. Paperback books reign supreme.

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[4] All tables/figures are from the first authors' original work.

4. Results

Once data was collected, it was then represented according to a stock market metaphor, with each value representing a particular stock. In the "Magsdaq" (the first author's nickname plus the caboose of Nasdaq), each stock is represented with the following metrics: its rating, closing value, weekly change, 52-week range, market cap, fair value, beta, and market change per quarter. Table 2 provides the list of these terms, along with their definitions in the context of this research.

Table 2. Terms and Definitions

Rating Key	1—Trough 2—Below Average 3—Average 4—Above Average 5—Peak
Closing Value	The closing aggregate rating for a value at the end of 2022. EXAMPLE: (Bolded) **100.00** +10.00 (+1.0%)
Week Δ	The number change and percent change in aggregate rating for a value over the last week of 2022. EXAMPLE: (Bolded) 100.00 **+10.00 (+1.0%)**
52-Week Range	A value's lowest and highest recorded aggregate rating in 2022.
Market Cap	The total worth of all documented actions and experiences associated with a value. There is "NO CAP" for each value because no numeric can adequately express this limitless sum.
Fair Value	The grade of quality relative to data collection for a value, with 5 being best.
Beta	A measure of the volatility of a value compared to the market. Values with betas higher than 1.0 are more volatile than the overall market, values with betas lower than 1.0 are less volatile than the overall market, and values with betas equal to 1.0 match the volatility of the overall market.
Qx Δ	The number change and percent change in aggregate rating over the course of a quarter for a value. NOTE: Q1: January, February, March. Q2: April, May, June. Q3: July, August, September. Q4: October, November, December

Each stock is represented in Fig. 1 to 4.

Fig. 1 shows the Wisdom (WSDM) stock. It was steady throughout 2022. As a non-volatile value, it has a beta of 1.00.98.9% of WSDM's days were "healthy," receiving a rating of 3 or higher. 213 days were rated as average. In the 10,974 words recorded to detail WSDM ratings, there were 300+ lessons and 59 quotes.
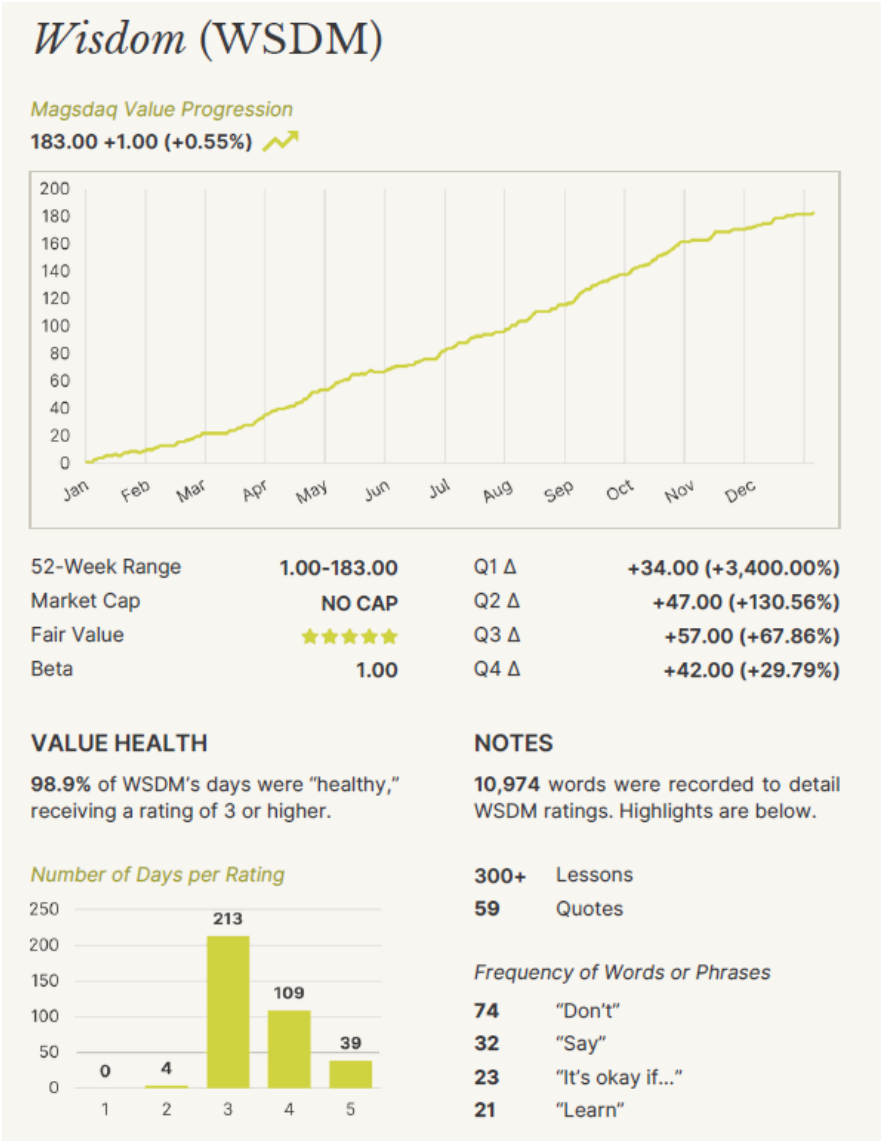

Fig.1 The WSDM stock

Fig. 2 shows the Security (SCTY) stock, which was variable throughout 2022. As a volatile value, it has a beta of 1.20. 90.1% of SCTY's days were "healthy," receiving a rating of 3 or higher. 257 days were rated as average. In the 2,286 words recorded to detail SCTY ratings, there were 195 mentions of the word "steady" and 93 mentions of the word "feeling."

Security (SCTY)

Magsdaq Value Progression
56.00 +0 (+0%)

52-Week Range	-10.00-56.00	Q1 Δ	-10.00 (-1,000.00%)
Market Cap	NO CAP	Q2 Δ	+29.00 (+414.29%)
Fair Value	★★★★★	Q3 Δ	+14.00 (+60.87%)
Beta	1.20	Q4 Δ	+17.00 (+43.59%)

VALUE HEALTH

90.1% of SCTY's days were "healthy," receiving a rating of 3 or higher.

NOTES

7,286 words were recorded to detail SCTY ratings. Highlights are below.

Number of Days per Rating

Rating	1	2	3	4	5
Days	10	24	257	48	26

Frequency of Words or Phrases

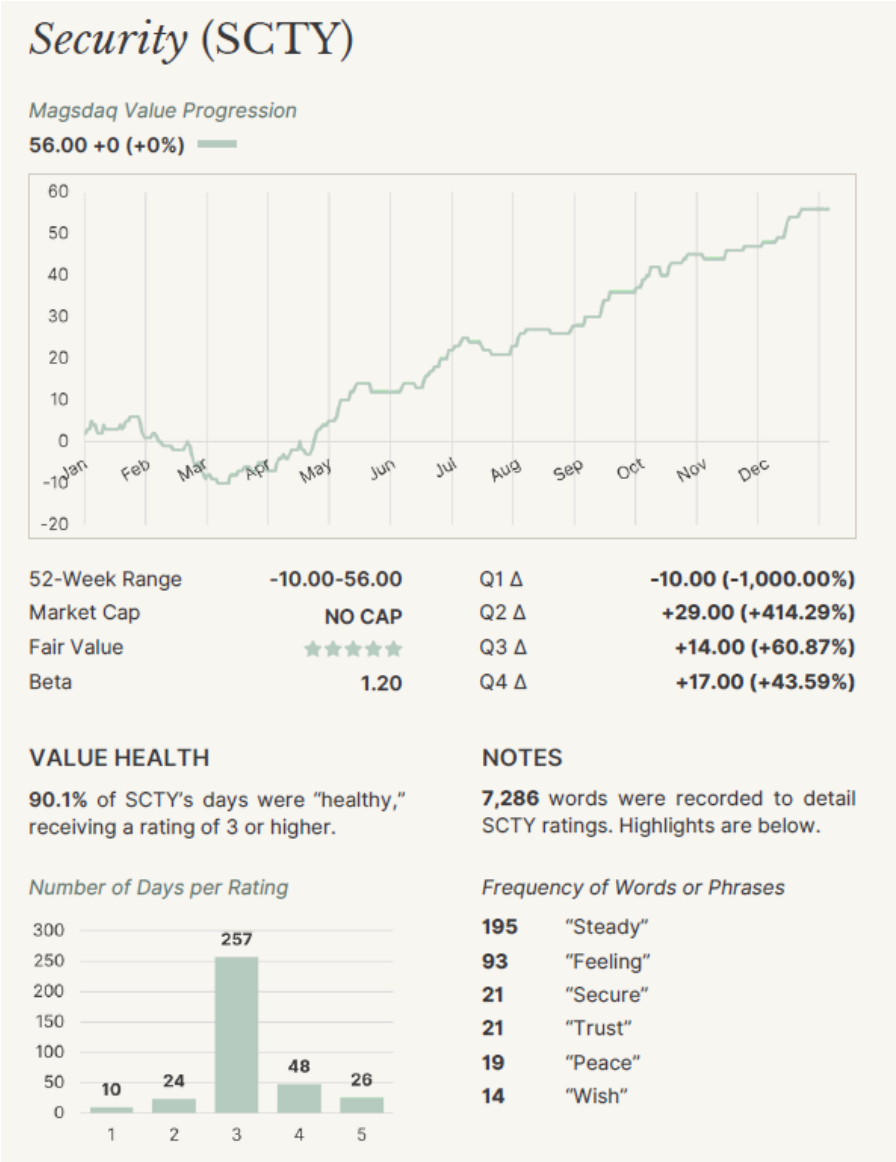| 195	"Steady"
93	"Feeling"
21	"Secure"
21	"Trust"
19	"Peace"
14	"Wish"

Fig.2 The SCTY stock

As to the Curiosity (CSTY) stock, represented in Fig. 3 below, it was variable throughout 2022. As a very volatile value, it has a beta of 1.30.83.0% of CSTY's days were "healthy," receiving a rating of 3 or higher. 214 days were rated as average. In the 7,826 words recorded to detail CSTY ratings, there were 228 questions and 100+ mentions of the word "how."
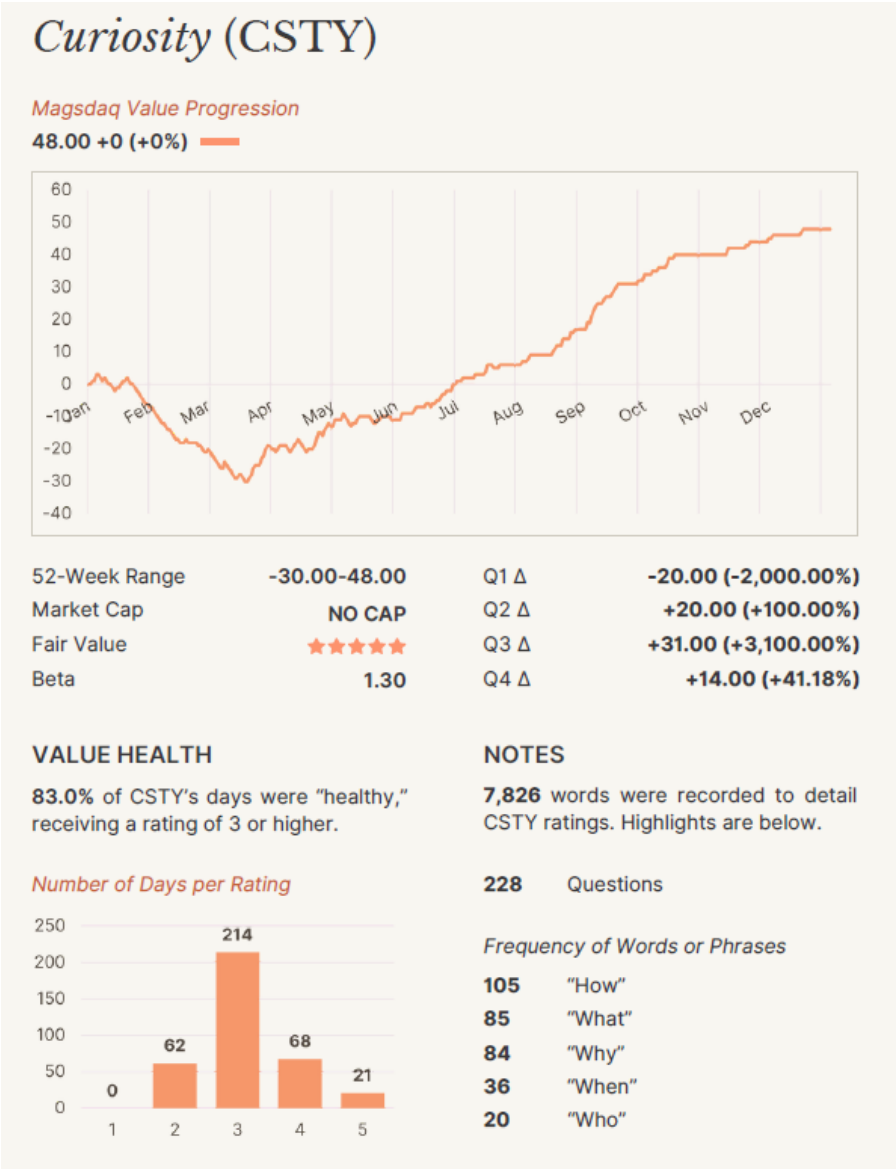

Fig.3 The CSTY stock

Lastly, the Love (LOVE) stock is shown in Figure 4. LOVE was very steady throughout 2022. As a value less volatile than the overall market, it has a beta of 0.90. 100% of LOVE's days were "healthy," receiving a rating of 3 or higher. An unparalleled 72 days received the peak rating of 5. In the 10,803words recorded to detail LOVE ratings, there were 86 mentions of the word "grateful" and 66 mentions of the word "friend".
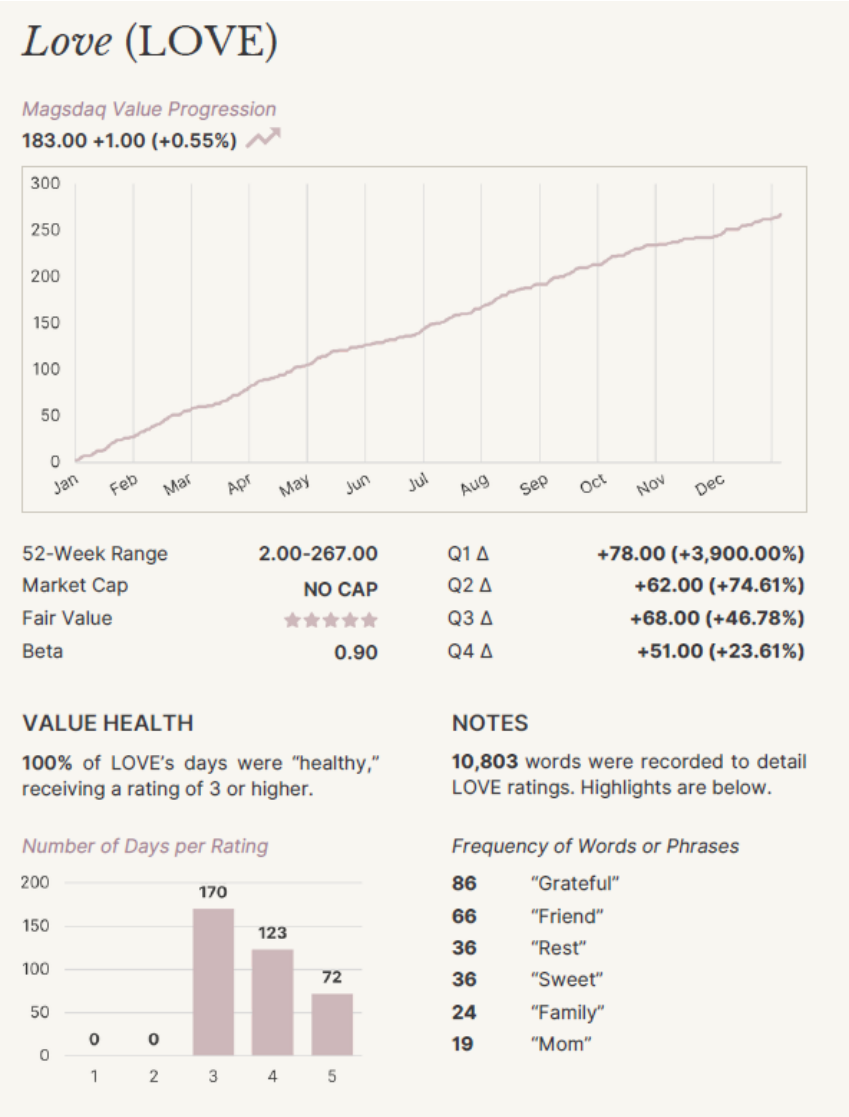

Love (LOVE)

Magsdaq Value Progression
183.00 +1.00 (+0.55%)

52-Week Range	2.00-267.00	Q1 Δ	+78.00 (+3,900.00%)
Market Cap	NO CAP	Q2 Δ	+62.00 (+74.61%)
Fair Value	★★★★★	Q3 Δ	+68.00 (+46.78%)
Beta	0.90	Q4 Δ	+51.00 (+23.61%)

VALUE HEALTH

100% of LOVE's days were "healthy," receiving a rating of 3 or higher.

Number of Days per Rating

Rating	1	2	3	4	5
Days	0	0	170	123	72

NOTES

10,803 words were recorded to detail LOVE ratings. Highlights are below.

Frequency of Words or Phrases

86	"Grateful"
66	"Friend"
36	"Rest"
36	"Sweet"
24	"Family"
19	"Mom"

Fig.4 The LOVE stock

5. Lessons Learned

A new perspective can be transformative. In the movie "Dead Poets Society", the inimitable Robin Williams plays an unorthodox English teacher named Mr. Keating. In one scene, he leaps upon his classroom desk, gazes out at his students, and

proclaims, *"I stand upon my desk to remind myself…that we must constantly look at things in a different way."* This project was a version of Mr. Keating's desk—a tool to see personal values anew. Daily actions came to be understood as small investments towards truer values. Shareholders were viewed as those individuals with large roles in one's life, and whether they were supportive in the peaks and valleys of a yearly quest. Writing "quarterly reports" meant reflecting on the previous three months and all that life holds. The main takeaway from the first author's endeavor at quantifying her personal values and reflecting on her PV was that although it did not change her most important values, it did positively transform how she saw them, how deeply she knew them, and the vocabulary with which she explored them.

Another lesson learned is encapsulated in the idea that investment in oneself is worth it. In the words of Warren Buffet, *"There's one investment that supersedes all others: Invest in yourself. Nobody can take away what you've got in yourself, and everybody has unused potential"* [11]. No amount of time or energy spent by the first author to discover and develop who she is ever felt wasted, especially not the time and energy spent on The Market of True Matters. When she tended to her values, she felt stronger, kinder, and more self-aware. Even when she neglected a value—effectively bet against herself—she learned to "buy the dip" and turn it around with confident investment in the form of action.

6. Conclusion

The goal of this paper was to convey the impact of the daily evaluation and metaphorical presentation of personal values as they relate to one's life. Through primary data collection and a distinct methodology—quantifying the degree to which one's daily life and experiences aligned with their personal values with a daily "score" on a scale of 1-5—the data from each tracked value (wisdom, security, curiosity, and love) was visualized as a stock (WSDM, SCTY, CSTY, and LOVE) and analyzed accordingly.

A multifaceted identity is like a diversified portfolio. In The Market of True Matters, the first author spread her identity across values towards the same ends of investors spreading capital across companies: to reduce risk and boost stability. In effect, her identity was never dependent on a single value's "performance." With the stock market metaphor in play, love (LOVE) and wisdom (WSDM) trended like a blue-chip stock: low-risk, reliable, and rewarding over time, whereas security (SCTY) and curiosity (CSTY) trended like a penny stock: high risk, volatile, but (potentially) immediately rewarding. All contributed something unique to her identity without dominating it completely. For example, even when curiosity (CSTY) or security (SCTY) were in a downward trend, love (LOVE) and wisdom (WSDM) stayed consistent. This healthy dynamic helped her feel balanced throughout the year.

Our research contributes to the PV literature by highlighting the impact of value-based PV, a relatively neglected area. We argue that shifting the focus beyond behaviors to include personal values offers a more holistic understanding of how values influence one's cognitive frameworks and guide the formation of intentions and choices. This value-based approach allows us to better capture the underlying motivations driving behavior, resulting in more comprehensive and effective PV strategies. Additionally, we emphasize aligning PV with individual preferences, specifically focusing on the professional mental models shaped by one's training and education. In our study, we tailored a visualization to resonate with the individual's business knowledge and training. This approach not only broadens the application of PV but also enhances its relevance and impact by making it more personalized and contextually appropriate for diverse user groups. As the field evolves, incorporating these nuanced understandings will be essential for developing more effective and meaningful PV tools.

In addition, our research offers valuable insights for practice by demonstrating how managers can leverage these findings to enhance their self-awareness and understanding of the people around them. Managers may benefit from these results by observing how personal values, like stocks, are subject to fluctuation relative to events, mood, and uncontrollable factors. This understanding allows managers to gain deeper insights into their own behaviors and motivations, as well as those of their colleagues and team members. By recognizing the dynamic nature of personal values, managers can cultivate a more empathetic and adaptive approach to leadership, ultimately fostering a more cohesive and supportive work environment.

Our work, like any other research endeavor, has some limitations, four of which are highlighted here. First, we acknowledge that data does not—and cannot—tell the whole story. With we elected to use a five-number scale for the rating of values, the spectrum of capturable experience was minimized. Even if the scale had been larger, it is important to note that the magnitude of detail in a day dwarfs what a single number can hold. There is something beautiful that such a limitation reminds us: that life is too rich to be reduced to data. Data is meant to illuminate, not encapsulate.

A second limitation revolves around the data collection, which one could argue was subjective. Indeed, the first author was at once both the researcher and research subject. Moreover, to underscore the imperfect, human side of data, she did not follow a regimented data collection schedule. That is, although data was collected every day of the year 2022, on some days, she spent 15 minutes adding value ratings and their respective notes before bed, while on others, she took notes throughout the day and added ratings when she had time the following morning. The motivation behind this decision was our certainty that the daily work would devolve into a thoughtless chore if a rigid plan was required.

Third, "performance" can be misleading. This project suggests that values are only valid when assessed meticulously and only important when "performing" well. The reality could not be further from the truth. Beyond this research, recording 365 days of data is not normal or necessary to legitimize one's values. Living a values-based life is not like completing a checklist, marking off a value once it has been honored. The opportunity to champion every personal value to the nth degree does not present itself every day.

Fourth, the market comparison is not perfect. This project was not a high-fidelity representation of the stock market. The stock market was a metaphor. In a financial market, investment is capital. Nasdaq, established 1971, is for stocks. Shareholders are backers who care about returns. A dividend is the distributed profit that comes with company success. To buy the dip is to purchase an asset in decline, confident there is profit in the rebound. Market data is pulled from financial exchanges and visualized in progressive price charts in five-minute intervals. The purpose? Accuracy, not exploration. In this metaphorical market, investment is action. Magsdaq, established in 2022, is for values. Shareholders are people who care about the first author. A dividend is the figurative fruit of intentional investment in values. To buy the dip is to refocus attention on a value that had been neglected. Market data is pulled from a Google Sheets file and visualized in progressive aggregate rate charts in one-day intervals. The purpose? Exploration, not accuracy.

Future research could substantiate our work through an expansion of the survey pool—e.g. more than one individual could track the performance of their respective personal values for a certain amount of time and note the impact of daily tracking on their personal life through the illuminating nature of a metaphorical PV that makes sense to them (such as that of the stock market for business professionals). Additionally, we encourage others to further explore our investigation into value-based PV by automating the transformation of collected data into suitable visualizations. These visualizations could be inspired by stock market metaphors or other formats that resonate with the target users.

Acknowledgments

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Highlighting the Role of Internal Government Audits in Enhancing e-Budgeting Practices in Bengkulu City

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Abstract. This study highlights the role of internal government audits in enhancing e-budgeting practices in the Bengkulu City Government. Using a qualitative approach with a case study design, data were collected through semi-structured interviews, participatory observation, and document analysis. The findings indicate that the digitalization of internal audits using the Data Collection System (DCS) enhances transparency and accountability in regional financial management. However, challenges include the quality of uploaded data, limited skilled human resources, adequate technological infrastructure, and resistance to change from employees accustomed to manual systems. Recommendations include continuous training enhancement and effective change management strategies to optimize e-budgeting implementation. Further research in other regions is recommended to share best practices and improve public financial management.

Keywords: Audit, Accountability, e-Budgeting, Regional Financial Management, Transparency.

1. Introduction

Internal government audit, known as APIP has the potential to transform the organizational environment of the audited entity through the implemented audit practices. By making information auditable, internal audit organizations can shape processes and routines within the audited organization. Although this potential may cause side effects that weaken the performance of the audited organization, it can also increase awareness and promote desired practices [1], [2], [3]. In the context of e-budgeting-based budget planning, internal audits can play a crucial role in implementing public financial management reforms. Digitalization of internal audits requires the application of computer-assisted audit tools to collect and analyze large volumes of data [4], [5]. Internal audit organizations have developed a Data Collection System (DCS) that compels local governments to upload data from their financial management information systems for auditing. The use of this system expands the scope of auditable information, changing how information is organized and reported by the audited organizations [6].

In Indonesia, the implementation of e-budgeting is regulated by various regulations from the national to the local level. The highest regulation governing regional financial management is Law No. 17 of 2003 concerning State Finance [7] and Law No. 23 of 2014 concerning Regional Government [8]. Additionally, Minister of Home Affairs Regulation No. 90 of 2019 concerning Classification, Codification, and Nomenclature of Regional Development and Financial Planning serves as a technical guideline for local governments in preparing e-budgeting [9]. The Bengkulu City Government refers to local regulations and mayoral policies that support the implementation of e-budgeting. BPKP Regulation No. 8 of 2021 concerning Capability

Assessment of Government Internal Supervisory Apparatus at Ministries/Agencies/Regional Governments is also relevant [10].

Despite the regulations supporting e-budgeting implementation, there remains a gap between policy and practical implementation. Identified gaps include limited human resources with the technical skills to manage e-budgeting, inadequate technological infrastructure to support an effective e-budgeting system, resistance from local government employees to transition from manual to digital systems, and often insufficient quality of data uploaded into the e-budgeting system, complicating the audit process. This study introduces several novel aspects that distinguish it from previous research. Most prior studies have focused on central government or other large local governments, whereas this study specifically examines the influence of APIP audits in the Bengkulu City Government. The research integrates regulatory analysis, technological infrastructure, and financial management practices within the context of e-budgeting and APIP audits. A combination of qualitative (interviews, observations) and quantitative (data analysis) approaches provides a more comprehensive view of the impact of internal government audit.

2. Literature Review

Implementation of e-Budgeting in the Public Sector

The implementation of e-budgeting in the public sector has become a primary focus in efforts to enhance transparency and accountability in government financial management. E-budgeting, as part of public financial management reform, allows governments to manage budgets more efficiently and effectively through an integrated electronic system [11], [12]. In Indonesia, regulations related to e-budgeting include Law No. 17 of 2003 on State Finance [7] and Law No. 23 of 2014 on Regional Government, which provide a legal framework for transparent and accountable financial management [8]. Additionally, Minister of Home Affairs Regulation No. 90 of 2019 on Classification, Codification, and Nomenclature of Regional Development and Financial Planning serves as a technical guideline for local governments in preparing e-budgeting [9]. The implementation of e-budgeting has also proven to improve efficiency and reduce opportunities for corruption through process automation and data transparency [13], [14]. According to Alawattage et al. [15] and Putu S. et al. [16], e-budgeting can enhance public participation and community oversight of budget use, which in turn can improve the quality of public services.

The Role of Internal Government Audit

Internal government audit plays a crucial role in ensuring compliance with financial regulations and procedures. Internal Government Supervisory Apparatus is responsible for auditing financial management within the government, including the implementation of e-budgeting. The digitalization of the audit process, such as the use of the Data Collection System (DCS), enables APIP to collect and analyze data more efficiently. According to Lempert [17], Medina [18], and Quam [19], effective audit practices can shape the organizational environment of the audited entity, increase awareness, and promote the adoption of desired practices. Internal Government Supervisory Apparatus also plays a role in identifying risks and providing recommendations for improvements in government financial management. The Financial and Development Supervisory Agency (BPKP), as the supervisory agency for internal government audit in Indonesia, has developed various audit guidelines and standards to ensure quality and accountability in internal government audits. Furthermore, research by Mihret & Yismaw [20] and ShewameneHailemariam [20]

indicates that the effectiveness of internal audits can improve the quality of financial reports and public trust in the government.

Gaps in the Implementation of e-Budgeting

Despite the regulations and systems in place, several gaps persist in the practical implementation of e-budgeting. Key challenges faced by local governments include the limited availability of skilled human resources, adequate technological infrastructure, and resistance to change [9]. Additionally, the quality of uploaded data is often inadequate, complicating the audit and analysis processes conducted by internal government audit. Research by Dunleavy et al. [21] reveals that digital transformation in the public sector frequently encounters significant challenges related to organizational culture change and resistance from employees accustomed to manual systems. Janssen & Estevez [22] also emphasize the importance of training and capacity building to ensure the successful implementation of e-budgeting. Furthermore, Andersen [23]notes that inadequate technological infrastructure can hinder the digitalization process and the adoption of new systems in the public sector.

Impact of internal government audit on the Implementation of e-Budgeting

Internal government audit has a significant impact on the implementation of e-budgeting in local governments. The use of the DCS system by internal government audit, for example, can reduce the autonomy of local governments in budgeting according to their local needs. Research indicates that the data structure imposed by APIP's data collection system can limit flexibility in budget planning [24]. However, the digitalization of audits also offers benefits such as enhanced transparency and accountability, which can encourage better financial management practices in local governments. Studies by Alawneh et al. [25] and Sachan et al. [26] demonstrate that digitalizing audits can improve the efficiency and effectiveness of audits using information technology. Digitalization also enables early detection of discrepancies and deviations in government financial management, thus preventing fraud [27]. Additionally, Veerankutty & Ali [28] highlight the importance of technological support and clear regulations to ensure the successful implementation of digital audits in the public sector.

3. Data and Methodology

This study employs a qualitative approach with a case study design to explore the influence of internal government audit on the implementation of e-budgeting in the Bengkulu City Government. Data were collected through semi-structured interviews, participatory observation, and document analysis [29], [30] from municipal employees involved in e-budgeting, internal auditors, and officials responsible for the implementation of e-budgeting. This approach allows for an in-depth understanding of the processes, challenges, and impacts of e-budgeting implementation in its original context (Fig.1). Data analysis was conducted using a thematic approach, following the steps of transcription, codification, theme grouping, and interpretation. To ensure credibility and validity, the study applied data triangulation, member checking, and an audit trail. Using purposive sampling, respondents were selected based on the relevance of their information and experience related to the research topic, ensuring that the data obtained were accurate and comprehensive.
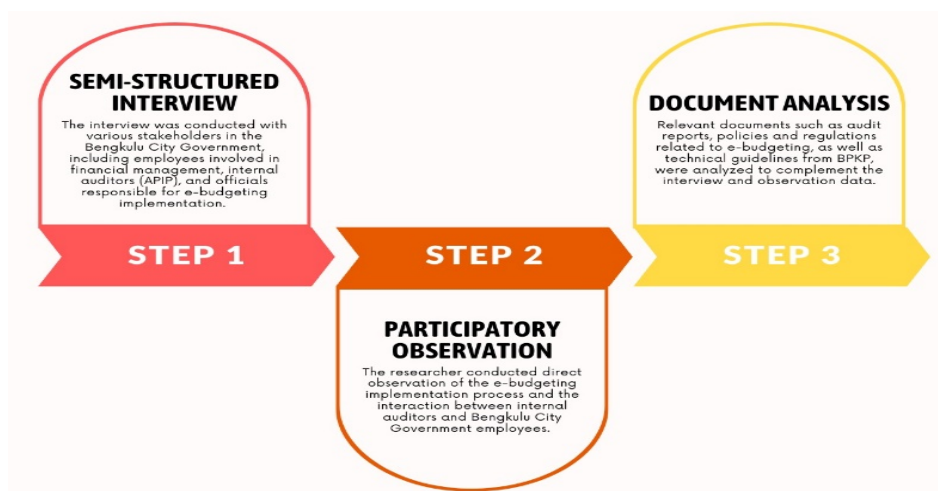
Fig. 1. Research Design.

This study involved interviews with various stakeholders, including financial management staff, Internal Government Supervisory Apparatus, and officials responsible for the implementation of e-budgeting in Bengkulu City. A total of 9 interviews were conducted to gain diverse perspectives on the implementation and challenges of e-budgeting. The interview questions focused on the experiences, challenges, and views of the respondents regarding internal government audit and e-budgeting, aiming to gather in-depth insights on how audits affect the e-budgeting process and public financial management overall. The interview transcripts were then thematically coded to identify patterns and key themes, such as data quality issues, technological infrastructure challenges, resistance to change, and the impact of audits on financial transparency.

4. Results

Characteristics of Informants

In this study, informants were selected through purposive sampling to ensure they have relevant knowledge and experience related to the research topic. Below are the characteristics of each group of informants involved in the study (Table 1).

Table 1. Characteristics of Informants

No.	Informant Category	Position	Background	Main Duties
1	Bengkulu City Government Employee	Budget Planning Staff	5 years of experience in local government budget management	Responsible for inputting e-budgeting data and budget reporting
2	Bengkulu City Government Employee	Head of Financial Planning Section	8 years of experience in public finance	Overseeing the implementation of e-budgeting and ensuring regulatory compliance
3	Bengkulu City Government Employee	Financial Analyst	6 years of experience in financial analysis and budget reporting	Analyzing budget data and preparing financial reports for internal audits
4	Internal Auditor (APIP)	Senior Auditor, Bengkulu City	10 years of experience in APIP internal audits	Conducting financial and performance audits on

No.	Informant Category	Position	Background	Main Duties
		Government Inspectorate		budget usage in Bengkulu City Government
5	Internal Auditor (APIP)	Junior Auditor, Bengkulu City Government Inspectorate	Bachelor's degree in accounting and 3 years of experience in APIP internal audits	Assisting in the audit process and verifying budget data
6	Internal Auditor (APIP)	BPKP	Certified Internal Auditor	Supervising all internal audit activities and providing improvement recommendations
7	Official related to e-budgeting policy	Head of OPD	Over 15 years of experience in public financial management	Formulating regional financial policies and ensuring the effective implementation of e-budgeting
8	Official related to e-budgeting policy	Financial Administration Officer (PPK-OPD)	Extensive experience in public administration and financial management	Coordinating the implementation of e-budgeting policies with various departments
9	Official related to e-budgeting policy	Head of Bappelitbangda Division	10 years of experience in government technology	Developing and maintaining the e-budgeting system, ensuring data integrity and security

Documents analyzed include audit reports, regulatory documents, technical guidelines from BPKP, and internal government financial records. Key documents analyzed are the annual APIP audit reports of Bengkulu City and relevant national and local regulations. The purpose of document analysis is to provide context and reinforce findings from interviews and observations, as well as to understand the framework and guidelines governing e-budgeting and internal government audit.

Table 2. Document Description Table for e-Budgeting and APIP Implementation

No.	Document	Description	Relevance to e-Budgeting and APIP Implementation
1	Law No. 17 of 2003 on State Finance	Regulates overall state financial management, including principles of transparency and accountability in public financial management.	Provides a legal framework for e-budgeting implementation and the role of internal audits in ensuring compliance with financial regulations.
2	Law No. 23 of 2014 on Regional Government	Regulates the authority and responsibility of local governments in managing regional finances, including oversight by APIP.	Emphasizes the role of local governments in e-budgeting implementation and the importance of internal audits to ensure accountability.
3	Minister of Home Affairs Regulation No. 90 of 2019 on Classification, Codification, and Nomenclature of Regional Development and Financial Planning	Establishes standards and technical guidelines for regional financial planning and management, including the use of e-budgeting systems.	Provides technical guidance for local governments in implementing e-budgeting according to established standards.

No.	Document	Description	Relevance to e-Budgeting and APIP Implementation
4	BPKP Regulation No. 4 of 2020 on Guidelines for Internal Audit Implementation	Sets guidelines for conducting internal audits in the public sector, including the use of information technology in the audit process.	Emphasizes the importance of using information technology in internal audits to enhance audit efficiency and effectiveness.
5	2023 Annual APIP Report of Bengkulu City Government	An annual report prepared by APIP of Bengkulu City Government, covering audit results, findings, and improvement recommendations.	Provides empirical information on the implementation of internal audits and e-budgeting in Bengkulu City Government.
6	Implementation Guidebook for e-Budgeting from the Ministry of Finance	An official guidebook prepared by the Ministry of Finance to assist local governments in implementing e-budgeting.	Provides practical and technical guidance for e-budgeting implementation in local governments, including steps to follow.

Observations

Observations were conducted at the Bengkulu City Government office to understand the practical implementation of e-budgeting and its interaction with APIP audits. These observations focused on actual processes, challenges faced, and staff responses to audit requirements. The researcher detailed the use of the e-budgeting system, interactions between auditors and staff, and workflow adjustments to meet audit requirements. The e-budgeting system is integrated into the daily operations of the financial management staff, allowing for real-time data entry and budget tracking. However, challenges such as data quality, limited technological infrastructure, and resistance to change were observed, highlighting the need for continuous training and technological upgrades. While some staff showed resistance to the new system, many adapted and saw the benefits of increased transparency and efficiency. The interaction between auditors and staff was cooperative, with auditors providing guidance on compliance and best practices, leading to better alignment with regulatory standards. Additionally, adjustments were made in workflows to incorporate audit feedback, enhancing the overall effectiveness of financial management practices.

This detailed observation provides a comprehensive understanding of the practical challenges and successes in implementing e-budgeting and internal government audit in Bengkulu City Government.

1. Transparency and Accountability

During the observation, it was evident that the e-budgeting system allows employees in the Bengkulu City Government to access financial data in real-time. Employees can easily view expenditures and available budgets. This system also facilitates the internal audit process, enabling auditors to verify data more quickly and accurately. The implementation of e-budgeting in the Bengkulu City Government aligns with the principles of transparency and accountability as emphasized in Law No. 17 of 2003 on State Finance [7]. This transparency is also supported by the 2023 Annual APIP Report of Bengkulu City Government, which notes improvements in regional financial management. However, observations indicate that while the system has increased transparency, challenges remain in ensuring all uploaded data is accurate and complete.

2. Data Quality

Observations revealed that employees in the Bengkulu City Government still face difficulties in uploading accurate and complete data. Many data entries uploaded to

the e-budgeting system still require validation and correction by internal auditors. There is a lack of understanding among employees about the importance of good data quality. The quality of data uploaded to the e-budgeting system remains a significant challenge. This aligns with findings in the 2023 Annual APIP Report of Bengkulu City Government and Minister of Home Affairs Regulation No. 90 of 2019 on Classification, Codification, and Nomenclature of Regional Development [9] and Financial Planning, which emphasize the importance of data standards. Training and capacity development for employees are crucial to ensure that uploaded data meets established standards.

The Role of Internal Government Audit

Internal government audit plays a crucial role in ensuring compliance with financial regulations and procedures within the government, including the implementation of e-budgeting. The digitalization of audits, such as using a Data Collection System (DCS), allows APIP to collect and analyze data more efficiently. Literature review indicates that effective audit practices can influence the organizational environment of the audited entity, increase awareness, and promote the adoption of desired practices [20]. Interviews with internal auditors revealed that the implementation of e-budgeting has facilitated access to and transparency of financial data in real-time. However, challenges related to the quality of uploaded data remain a major concern, primarily due to employees' lack of understanding of the need for accurate and complete data. As expressed by informant 5:

"As internal auditors, we have a significant responsibility to ensure that all financial procedures in the Bengkulu City Government comply with applicable regulations. The implementation of e-budgeting has made our work easier because financial data can be accessed in real-time and is more transparent. However, there are specific challenges in ensuring that all data uploaded to the system is truly accurate and complete. We often encounter cases where the uploaded data does not conform to the prescribed format, complicating the audit process."

Additionally, interview results highlighted the benefits of audit digitalization. An auditor (Informant 4) stated:

"With audit digitalization through the DCS system, we can collect and analyze financial data more quickly and efficiently. However, the quality of uploaded data often becomes an issue. Many employees do not fully understand the importance of accurate and complete data. We need to continually conduct socialization and training so that all employees understand the standards that must be met." (Informant 4)

Moreover, another auditor shared their experience regarding the implementation of e-budgeting and audit digitalization. An auditor (Informant 6) noted:

"The implementation of e-budgeting and audit digitalization has brought many positive changes to our work. We can be more proactive in identifying issues and providing improvement recommendations. However, the main challenge we face is resistance to change from some employees who are still comfortable with the manual system. We must work hard to overcome this resistance and ensure all employees can adapt to the new system." (Informant 6)

These insights highlight the dual nature of the impact of e-budgeting and digital audits, showing both the improvements in transparency and efficiency and the ongoing challenges in data quality and employee adaptation.

This aligns with findings from [31], which indicate that resistance to change is a primary challenge in the implementation of new systems in the public sector.

Document analysis, such as the Minister of Home Affairs Regulation No. 90 of 2019 on Classification, Codification, and Nomenclature of Regional Development and Financial Planning [9] and the 2023 Annual APIP Report of Bengkulu City Government, supports these findings by emphasizing the importance of data standards and increased transparency in regional financial management. This regulation provides technical guidance for local governments in implementing e-budgeting according to established standards, while the annual report notes that although e-budgeting has enhanced transparency, the quality of uploaded data still needs improvement.

Observations conducted at the Bengkulu City Government confirm that the e-budgeting system enables employees to access financial data in real-time and facilitates the internal audit process. However, challenges persist in ensuring that all uploaded data is accurate and complete. Observations also indicate that some employees still face difficulties in uploading accurate and complete data, requiring validation and correction by internal auditors. Research by Meiryani et al. [32] and Muda et al. [33] also demonstrates that digitalization in government financial management can improve efficiency and transparency, but data quality remains an issue to be addressed.

Overall, the role of internal government audit (APIP) in the implementation of e-budgeting is highly significant. Despite challenges related to data quality and resistance to change, audit digitalization offers substantial benefits in enhancing transparency and accountability.

Gaps in the Implementation of e-Budgeting

Despite the regulations and systems in place, there are several gaps in the practical implementation of e-budgeting. Key challenges faced by local governments include the limited availability of skilled human resources, adequate technological infrastructure, and resistance to change [32], [34]. Additionally, the quality of uploaded data is often inadequate, complicating the audit and analysis processes conducted by Internal Government Supervisory Apparatus [20].
Interviews with Bengkulu City Government employees revealed that they face significant challenges in transitioning from a manual system to e-budgeting. One employee stated,

> *"The transition from a manual system to e-budgeting is not easy. We face many challenges, especially in terms of staff training and providing adequate technological infrastructure. Many employees feel burdened by this change and do not fully understand how to use the new system." (Informant 3)*

This aligns with findings by Siti-Nabiha & Scapens [31] , which show that resistance to change is a primary challenge in implementing new systems in the public sector. Another employee added that the limited availability of skilled human resources is also a major obstacle,

> *"One of the main difficulties in implementing e-budgeting is the limited availability of skilled human resources. Not all employees have the background or skills needed to operate the e-budgeting system effectively. We need to continue training and capacity building so that all employees can adapt to this new system." (Informant 2)*

Research by Ahmi & Kent [35] indicates that adequate training is crucial for the successful implementation of information technology systems in the public sector. Further interviews revealed issues with technological infrastructure. One employee mentioned,

> *"Besides the limited human resources, inadequate technological infrastructure is also a major obstacle. We often experience system and network disruptions that hinder the data uploading process. This*

significantly affects the smooth implementation of e-budgeting and reduces our work efficiency." (Informant 1)

Research by Di Giulio & Vecchi [36] and Fridgen et al. [37] indicates that strong technological infrastructure is vital to support digitalization in the public sector. Document analysis, such as Law No. 23 of 2014 on Regional Government and Minister of Home Affairs Regulation No. 90 of 2019 on Classification, Codification, and Nomenclature of Regional Development and Financial Planning, shows that local governments have the authority and responsibility to manage regional finances with principles of transparency and accountability. However, these documents also emphasize the need to enhance human resource capacity and provide adequate technological infrastructure to support e-budgeting implementation [8], [9].

Observations at the Bengkulu City Government confirm that inadequate technological infrastructure often hinders the data uploading process. Additionally, many employees feel burdened by the system change and do not fully understand how to use the e-budgeting system effectively. Meiryani et al. [32] also indicate that digitalization in government financial management can improve efficiency and transparency, but data quality remains an issue to be addressed.

Overall, while e-budgeting has significant potential to enhance transparency and accountability in regional financial management, there are still substantial gaps in its implementation that need to be addressed. These include improving human resource capacity and providing adequate technological infrastructure [20], [31].

Impact of Internal Government Audit on the Implementation of e-Budgeting

Internal government audit has a significant impact on the implementation of e-budgeting in local governments. The use of the Data Collection System (DCS) by APIP (Internal Government Supervisory Apparatus), for example, can reduce the autonomy of local governments in budgeting according to their local needs. Research indicates that the data structure imposed by APIP's data collection system can limit flexibility in budget planning [24], [38]. However, audit digitalization also offers benefits such as enhanced transparency and accountability, which can encourage better financial management practices in local governments [20].

Interviews with policymakers indicate that they find internal government audit using the DCS system help improve transparency and accountability in financial management. However, some officials also feel that the format and data structure imposed by APIP are too rigid, reducing flexibility in budget planning.

"With APIP audits using the DCS system, we must follow the set data standards and formats. This sometimes limits our flexibility in budgeting according to local needs. However, on the other hand, this system also helps increase transparency and accountability in financial management." (Informant 8)

Research by DeLone & McLean [39], [40]also found that dependence on rigid data formats can hinder operational flexibility in the public sector. Another official (Informant 9) added,

"APIP audits with digitalization indeed bring many benefits, especially in terms of increased transparency. However, we often feel that the format and data structure set by APIP are too rigid, reducing our flexibility in budgeting. We hope for more room for adjustments according to local needs." (Informant 9)

This aligns with research by Siti-Nabiha & Scapens [31], which shows that resistance to change and rigidity in systems can be obstacles in the implementation of new systems. Another official stated, "The implementation of internal government audit with the DCS system indeed increases accountability, but we face challenges in aligning the uploaded data with the set formats. Nonetheless, we see many benefits

from this system, especially in terms of budget monitoring and oversight. We strive to continuously improve the quality of uploaded data to meet the set standards." (Informant 7). Research by Fotoh & Lorentzon [41] and Otia & Bracci [42] supports these findings, stating that improving data quality is crucial for the successful implementation of e-budgeting systems.

Document analysis, such as Law No. 17 of 2003 on State Finance [7] and BPKP Regulation No. 4 of 2020 on Guidelines for Internal Audit Implementation, emphasizes the importance of transparency and accountability in public financial management. These documents also highlight the need for the use of information technology in internal audits to improve audit efficiency and effectiveness. Observations in Bengkulu City Government show that the implementation of APIP audits with the DCS system indeed increases accountability and transparency in financial management. However, officials still face challenges in aligning the uploaded data with the set formats and maintaining flexibility in budgeting according to local needs. Diansari et al. [43] and Meiryani et al. [32] found that digitalization in financial management can improve efficiency and transparency, but flexibility and data alignment remain issues that need to be addressed.

Overall, while APIP audits with digitalization bring many benefits in terms of increased transparency and accountability, there are challenges related to flexibility and data alignment. Efforts to improve data quality and adjust audit standards to be more flexible may be necessary to optimize the implementation of e-budgeting at the local level [20], [31].

5. Conclusion

This study highlights the crucial role of APIP in ensuring compliance with financial regulations and procedures through the implementation of e-budgeting in the Bengkulu City Government. The digitalization of internal audits using the Data Collection System (DCS) has enhanced transparency and accountability, despite challenges such as data quality, limited skilled human resources, adequate technological infrastructure, and resistance from employees who are more comfortable with manual systems. The limitations of this study include a narrow focus on one region, a short research period, and a relatively small number of informants. To improve the effectiveness of e-budgeting implementation, clearer policies and regulations, as well as employee training and capacity development, are needed.

The implications of this study emphasize the need for strengthened and clarified regulations and guidelines that support audit digitalization and e-budgeting across all local governments. Central and local governments must collaborate to reinforce regulations, provide clear guidelines, and conduct effective oversight. Investment in technological infrastructure and human resource capacity development is crucial, including ongoing training and capacity-building programs. Additionally, effective change management strategies must be implemented to overcome resistance to the new system. Further research in other regions is recommended to obtain a more comprehensive view, and sharing experiences and best practices among regions can help enhance transparency, accountability, and the effectiveness of public financial management.

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Aims and Objectives

Published online by Institute of Cited Scientists (ICS), Cyprus, two times a year since 2020, Journal of Digital Art & Humanities (JDAH) is an international peer-reviewed journal which aims at the latest ideas, innovations, trends, experiences and concerns in the field of the arts & humanities. Our journal bridges the humanities, artistic, and scientific disciplines. It is a nexus for information exchange among academia and industry addressing theory, criticism, and practice.

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