Day 2: Tuesday 24th October 2023 SESSION 2 @ Sepakat 5

13:15	Arrival of participants
13:20	Recital of Surah Al-Fatihah Welcoming remarks by Programme Chair
Keynote Moderator: Prof Somnuk	
13:30	Keynote Session 1 (Prof Ian Mclaughlin)
14:10	Keynote Session 2 (Prof Hamamoto)
14:50	JICA Opening Presentation
15:10	AUN-SEED Introduction
15:30	AFTERNOON BREAK
Session 2 – AIML/CNS ***Session Chair: Dr S H Shah Newaz***	
15:45	Usability Assessment of e-Wallet: User Acceptance Testing Among Students and Merchants - Missie Chundau; Hamimah Ujir; Irwandi Hipiny
16:05	Comparative Study on User Preference of Food Delivery Mobile Application in Malaysia - Johari Abdullah; Magdeline Changai
16:25	Bridging the Digital Gap: A Systematic Review on UI/UX Design Considerations for Elderly-Friendly Digital Wallets - Jonathan Sidi; Syahrul Nizam Junaini; Wang Chai; Nur Alfreeana Alfie; Remmy Gedat; Edwin Mit
16:45	State Management Against Two-Message Attacks in Hash-Based Post Quantum Signatures for Large IoT Sensor Networks Using Blockchain - Vincent Lew Kok Seng; Au Thien Wan; S H Shah Newaz
END OF DAY 2	

Day 2: Tuesday 24th October 2023 SESSION 1 @ Sepakat 4

Session 1 – CC/CNS ***Session Chair: Dr Ahmad Mohammad***	
15:45	Glasses-Free Autostereoscopic Viewing on Laptop Through Spatial Tracking - Muizz Kasim; Somnuk Phon-Amnuaisuk
16:05	Interactive Dance with Visual Background Recomposition Using BLE Beacons - Jiqing Wen; Pai Chet Ng; Ian McLoughlin
16:25	Exploring the Intersections Between the Metaverse and Web3 Emerging Technologies - Pengiran Shaiffadzillah Pengiran Omarali
16:45	uNGINXed: Detecting NGINX Misconfigurations - Kenneth Lee; How Chong Ong; George Neo; Alloysius Goh; Huaqun Guo
END OF DAY 2	

Day 3: Wednesday 25th October 2023 SESSION 4 @ Sepakat 5

8:00	Registration
8:30	JASTIP
8:40	AEJ Presenter
Session 4 – CNS ***Session Chair: Dr Sharul Haji Tajuddin***	
s8:50	The Weaponisation of the Internet -- Effect Models - Ian McLoughlin
9:10	The Internet of Things in the Rearing of Giant Freshwater Prawn: A Pilot Study - Musyaffa' Aziz; Wida Haji Suhaili; Ravi Kumar Patchmuthu; Shahriar Shams
9:30	5G-Wi-SUN for Building Management System - Filbert Hoo; Su-Lim Tan; Raymond Ching Bon Chan; Peter Waszecki; Sye Loong Keoh; Chee Kiat Seow; Minghui Li; Qi Cao; Chin-Sean Sum
9:50	Moisture Impact Analysis on NFC Tag Antennas - Najwa Mohd Faudzi; Azlan Aziz; Ahmad Rashidy Razali; Nurul Huda Abd Rahman; Asrulnizam Abd Manaf; Amirudin Ibrahim; Aiza Mahyuni Mozi
10:10	MORNING COFFEE/TEA BREAK

Day 3: Wednesday 25th October 2023 SESSION 6 @ Sepakat 5

Session 6 – AIML ***Session Chair: Dr Ibrahim Venkat***	
10:30	Acoustic-Based Classifier for Detecting Abnormal Events in a University Setting - Jethro P. Batislaong; John Christian R Leonin; Amorah K Utto; Danilo Dadula; Ryan G. Banal; Cristina P. Dadula
10:50	Computer Vision in Smart City Application: A Mapping Review - Aulia Akhrian Syahidi; Kiyoshi Kiyokawa; Fumio Okura
11:10	Classification of Subspecies of Honey Bees Using Computer Vision - Ashan Milinda Bandara Ratnayake; Hartini Haji Mohd Yasin; Abdul Naim; Emeroylariffion Abas
11:30	Adult Content Detection on Indonesian Tweets by Fine-Tuning Transformer-Based Models - Ahmad Fathan Hidayatullah; Rosyzie Apong; Daphne Teck Ching Lai; Atika Qazi
11:50	Educator-Oriented Authoring Tools to Develop Rich Educational Media: A Systematic Review - Azhan Ahmad; Ahmad Elaklouk; Deenina Salleh; Ibrahim Edris
12:10	LUNCH

Day 3: Wednesday 25th October 2023 SESSION 8 @ Sepakat 5

Session 8 – AIML ***Session Chair: Dr Sharul Haji Tajuddin***	
13:30	Personal Identity Information Detection Using Synthetic Dataset - Jie Lin Tan; Venkata Abhishek Nalam
13:50	Enhancing Indoor Smoking Detection Through Deep Learning in AI-Enabled Surveillance Systems - Donny Soh; Indriyati Atmosukarto; Michelle Choo; Arthur Loo; Selvakulasingam Thirunneepan; Toshiki Ishii; Junichi Hirayama; Shuyang Dou; Zhou Mo
14:10	*Keynote 3 Moderator* 3 (Prof Gyu Myoung Lee) *Moderator: Dr Ravi Kumar Patchmuthu*
14:30	
15:00	AFTERNOON BREAK

Day 3: Wednesday 25th October 2023 SESSION 10 @ Sepakat 5

Session 10 – AIML ***Session Chair: Dr Ravi Kumar Patchmuthu***	
15:30	Comprehensive Analysis of Feature Extraction Techniques and Runtime Performance Evaluation for Phishing Detection - Subrata Nath; Mohammad Manzurul Islam; Abdullahi Chowdhury; Maheen Islam; Taskeed Jabid; Mohammad Rifat Ahmmad Rashid
15:50	END OF ACIIS 2023

Day 3: Wednesday 25th October 2023 SESSION 3 @ Sepakat 4

8:00	Registration
Session 3 – CC and AIML ***Session Chair: Dr Nor Zainah Hj Siau***	
8:50	Emotions in Video Games: An Investigation of Game Mechanic Influences - Nurwathiqah Ali; Sharul Tajuddin; Arif Bramantoro
9:10	A Framework for Tele-Rehabilitation Gaming System - Ahmad Elaklouk; Ratna Zuarni Ramli; Ibrahim Edris; Nena Padilla-Valdez; Adel Al Jumaily
9:30	An Interactive Alumni Tracking Dashboard - Mubarak Sanusi Dange; NurSuraya Shazlin Sujairi; Syaheerah Lebai Lutfi; Azmien Ielia Mohd Kharunizan; Sharifah Darweena Syed Ahmad Amir Feisal
9:50	Design and Development of an Advanced Upper Limb Rehabilitation Robot for Post-Stroke Rehabilitation - Zunaidi Ibrahim; Khair Hamizan Surzana; Azlan Aziz; Maziri Morsidi; Shamil Rahman; Zeiti Malai Hamid
10:10	MORNING COFFEE/TEA BREAK

Day 3: Wednesday 25th October 2023 SESSION 5 @ Sepakat 4

Session 5 – AIML ***Session Chair: Dr Arif Bramantoro***	
10:30	Evaluating User Interface and User Experience in Mobile Applications Designed for the Elderly - Syazwan Rosman; Hjh Nor Zainah binti Hj Siau; Arif Bramantoro
10:50	Rain Gauge Network Optimization in Brunei-Muara District Using Historical Data - Wallace Chin
11:10	Analysis of Deep Learning Algorithms for Prawn Aquaculture in a Challenging Environment - Tiong Hoo Lim; Wafiq Zariful; Najeebah Az-Zahra Tashim Tashim; Aida M Basri; Hanif Fakhrurroja; Suriayati Chuprat; Seno Adi Putra, SSi MT; Pengcheng Liu
11:30	Lane Tracking for Autonomous Road Pavement Inspection with Unmanned Aerial Vehicles - Melody Mae O Maluya; Earl Ryan Aleluya; Joel G Opon; Carl John Salaan
11:50	Enhancing Continual Deep Open-Set Recognition with Perceptive Unknown Feature Search - Gusti Ahmad Fanshuri Alfarisy; Owais Ahmed Malik; Wee-Hong Ong
12:10	LUNCH

Day 3: Wednesday 25th October 2023 SESSION 7 @ Sepakat 4

Session 7 – AIML ***Session Chair: Dr Au Thein Wan***	
13:30	Digital Twinning in Precision Agriculture: Fabrication of a Close-Range Photogrammetry and Microclimate IoT-Enabled Data Acquisition System - Dennis Ivan Chavez Baliguat; Francis Jann A Alagon; Earl Ryan Aleluya; Stephen Haim; Carl John Salaan
13:50	Universiti Sains Malaysia (USM) Talent Management Dashboard - Aisyahtul Mardhiah Mokhtar Alfakari; Syaheerah Lebai Lutfi
15:00	AFTERNOON BREAK

Day 3: Wednesday 25th October 2023 SESSION 9 @ Sepakat 4

Session 9 – AIML ***Session Chair: Serina Hj Mohd Ali***	
15:30	Integrated Prediction System for Optimizing Shrimp Production in Brunei Darussalam - Arif Bramantoro; Hjh Nor Zainah binti Hj Siau; Awangku Muhammad Zul Hafiz
15:50	Intelligent Modeling of Temperature Profile for Sustainable Food Waste Composting - Jia Chi Lai; Yi Lung Then; Siaw San Hwang
17:00	END OF ACIIS 2023

Bridging the Digital Gap: A Systematic Review on UI/UX Design Considerations for Elderly-friendly Digital Wallets

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***Abstract*—In an era defined by rapid technological innovation, inclusivity in digital design emerges as a critical yet often overlooked aspect. However, seniors and older citizens often grapple with complex interfaces and sophisticated technology, leading to their digital marginalization. This paper offers a detailed systematic literature review of research trends spanning 2018 - 2023. Sourcing from the renowned SCOPUS database, this review identified a limited 13 journal articles conforming to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. These scholarly publications were thoroughly examined and divided into five core themes encapsulating the focal points of this research: gerontechnology, user experience, user interface design, usability testing, and the advantages mobile apps can offer to the elderly. Further, this synthesized review, aiming to enhance the UI/UX design of digital wallets for seniors, could offer substantial insights to researchers and educators while highlighting potential directions for ensuing research.**

Keywords—older adults, digital wallet, user interface, user experience.

I. INTRODUCTION

This paper aims to review, categorize, and assess the research literature related to the advancement of digital wallets for the older adults. This systematic review examines the research patterns and identifies comparable topics, frameworks and research samples. Table 1 illustrates the research questions of this study.

TABLE I. RESEARCH QUESTIONS

RQ	Research question
1	What are the barriers to the adoption of gerontechnology among older adults?
2	What possible obstacles could prevent older adults from acquiring and using mobile apps?
3	What elements contribute to developing user-friendly mobile apps for older adults?
4	What are methods used to gather usability testing results?
5	What are the significant benefits of designing mobile apps for older adults?

In recent years, the use of digital wallets has become increasingly popular due to the prevalence of cashless payments in various industries, which has contributed to the rapid expansion of mobile technology. Designing user interfaces and user experience (UI/UX) for digital wallets to meet the requirements of older adults is a key area of study in Malaysia, as the population is aging rapidly. The term "older adult" refers to an individual who has reached 60 years of age and above, as reported by the Ministry of Statistics Malaysia (MyGov) [23]. The latest statistics from the Ministry of Statistics Malaysia have revealed that the percentage of Malaysians aged 15 to 64 (working age) in the population has risen from 69.6% in the year 2022 to 70.0% in the year 2023. At the same time, the percentage of the population aged 65 years or older has risen from 7.3% to 8.4%. This demographic shift highlights the importance of providing accessible and intuitive digital products and services to older adults, as research has demonstrated that such user interfaces are essential for improving their digital experience [16].

Chawla and Joshi [17] examined the variables that influence the uptake of mobile wallets among consumers in the United States, with a particular emphasis on the moderating influence of age, where trust and enabling conditions had a considerable positive impact on both personal and digital word of mouth, resulting in a significant positive impact on attitudes towards mobile wallet adoption. Nabila et al., [18] used a survey questionnaire to collect data from 400 respondents aged between 18 and 64 years old in Indonesia. The findings of the study corroborated those of the preceding study, which identified a variety of elements that affect the uptake of digital wallet and digital cash, including user experience, usability, trust, and social influence, as well as facilitating conditions. The data was then cross-referenced using statistical techniques. Furthermore, a study conducted by Ilieva et al. [20] identified a number of key features, including the perceived utility, usability, trustworthiness, and security concerns derived from customer sentiment analysis, which have a significant impact on the uptake of mobile payment technology by consumers. Ilieva et al. [20] examined the consumer perception of digital wallet services which are increasingly important in the rapidly evolving and rapidly changing world of digital payments.

Adiani et al. [19] found that mobile wallets are based on different generational perspectives and external influences in the use of e-wallets, with a primary emphasis on building trust and loyalty. Felberbaum et al. [28], found that elderly

mobile health app users may experience distress due to the advanced features and menus of the applications, as well as the interface designs that do not take into account the needs of the elderly. Low adoption rates may be attributed to the fact that over 43% of individuals aged 70 and over discontinue their use of mobile health technology after a mere 14 days. Additionally, non-tech-savvy elderly individuals may find the features and menus of the app unnecessarily complex or difficult to navigate. Lichtenberg et al. [22] examine the numerous uses of mobile wallets and the relationship between personal finance and premature memory decline. The study, which was conducted by the Rush Alzheimer's Disease Center at the University Medical Center of Chicago (UMC) and the Gerontology Institute of Wayne State University (WSU), focused on the development of a new measurement approach to assess the impact of early memory loss on long-term wealth and personal finance in elderly individuals with and without pre-existing memory loss. A recent study, conducted by the WALLET Study, revealed that elderly individuals with early cognitive impairment are more likely to be financially vulnerable to exploitation and fraud. Specifically, participants with early cognitive impairment were found to have lower levels of financial literacy, demonstrate poor financial judgment, and be at risk of being financially exploited or defrauded.

The WALLET Study further demonstrated that enhanced financial decision-making abilities are linked to specific cognitive abilities, including executive function and cognitive processing speed. The WALLET Study suggests that cognitive impairment may have a significant impact on an individual's ability to effectively manage their finances. A study conducted by Sweeney et al. [27] found that elderly individuals may experience difficulties in utilizing technology, potential privacy and personal information risks, and harm from applications with inadequate quality control when using mobile applications. The study found that the majority of elderly individuals are concerned about their privacy, however, they may be willing to share their information if they are informed of the purpose of data collection and the advantages they will receive.

This paper is structured as follows: Section 2 outlines the review strategy; Section 3 outlines the review findings; Section 4 outlines the analysis; Section 5 outlines the study trends; Section 6 concludes the paper with additional research.

II. Review Methodology

In accordance with the PRISMA guidelines, a systematic literature review was conducted to provide a comprehensive overview of the existing literature on the development of digital wallets for elderly individuals. To address the study queries, the content of 13 selected publications will be analyzed. However, the selected articles met the following inclusion criteria:

- This text is intended to be published in peer-reviewed academic journals (in order to ensure the quality of the refereeing).
- The main topic of discussion focused on the development and user interface of mobile applications for older adults.
- It was published in the period from 2018 to 2023 (to facilitate the analysis of publication trends).
- Indexed to the Scopus database for the purpose of quality indexing and citation.
- This text has been produced and published in the English language.

In order to accurately determine the articles to be included in the document categories, the following exclusion standards were established: books; book reviews; brief surveys; brief communications; conference proceedings; correspondences; discussions; editorials; erratum; magazines; newsletters; publisher's notes; and product reviews. Subsequently, the selected articles were read and analyzed. Fig. 1 shows the PRISMA flow diagram [24].

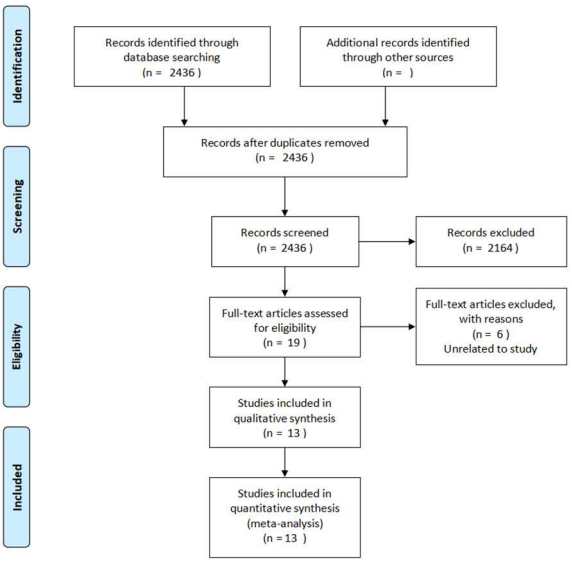

Fig. 1. PRISMA Flow Diagram [24]

A short thematic review was conducted to identify the themes related to the study's research models and trends. All 13 articles were reviewed to collect pertinent data relevant to our study objectives and were then classified into five broad categories.

III. Results and Analysis

A. Summary of findings

On the SCOPUS database, a search was done. As a result, 2,436 articles were found using the Title-Abstract-Keywords search: "UI/UX" OR "User Experience" OR "User Interface" AND "Older" OR "Senior" OR "Elderly" AND "People" OR "Adult*" OR "Citizen*". Second filtering through the search queries by adding Title-Abstract-Keywords search: "Mobile application*" or "Mobile app*" or "Mobile device*" or "Mobile platform*" which results in 272 journal articles found. The titles and abstracts of the publications were manually reviewed. The publications were then further scrutinized to determine their applicability in addressing the research topics. Only 13 of the 272 articles that were found satisfied the requirements for the inclusion criteria. Finally, we carefully examine the papers to collect the pertinent information that will assist our research topics.

B. Data extraction

From the articles we included, we obtained the following relevant information: Types of User Interface/User Experience elements to be used in the development of mobile applications, key contributors (UI/UX design implementation, development, usability), methods to assess

the usability of mobile applications for older adults, advantages, challenges, and research approaches to UI/UX design in mobile application development for older adults.

The country with the most articles produced was Malaysia (n = 4). China released two articles next, followed by Saudi Arabia with three articles. The remaining nations, the United States, Australia, France, Italy, Netherlands, Pakistan and the United Kingdom, each released just one article. The five themes of gerontechnology (perceived usefulness, perceived ease of use, attitudes, social support, health status, financial resources, accessibility), user experience (physical limitations, lack of interest or motivation, lack of familiarity with the technology), and user interface design (simple and clear layout, appropriate font size and style, a consistent color scheme) are represented by the color-related patterns and trends in studies on UI/UX design for older adults (2018-2023).

C. Gerontechnology

RQ1: What factors influence the adoption and use of technology among older adults?

Three of the thirteen articles focus specifically on the issues associated with the adoption of elderly individuals. Ilyas et al. [11] found that older adults are likely to use technology if they believe it will help them reach their objectives or solve their problems. Maiden et al. [8] demonstrated in a study that adopters of a new technology are likely to be more likely to use it if they perceive it to be user-friendly and are willing to learn to use it. It has been suggested by Zhu et al. [12] that the attitudes of older adults towards technology can have an impact on their uptake and utilization of the technology. It has been suggested that negative attitudes towards technology can lead to a decrease in self-assurance in the use of the technology. The results of a study cited from Szklanny et al. [10] suggest that elderly individuals may be more likely to adopt and use technology if they are accompanied by family members, friends, or carers.Abdullah and Hamid [9] proposed that older adults with chronic health issues may be more inclined to adopt and utilize technology that assists in the management of their health conditions. However, according to Quintana et al. [7] older adults may be influenced by their income level as they may not be able to afford the costs associated with the adoption of technology, including a computer or smartphone.

Macis et al. [6] further explored the possibility that technology tailored to the requirements of older adults, such as larger font sizes or simplified user interfaces, could be more user-friendly and thus more adoptable.

D. User Experience

RQ2: What possible obstacles could prevent older adults from acquiring and using mobile apps?

7 articles specifically discussed the first obstacles that explained the physical limitations of older adults when using mobile apps. A study by Szklanny et al. [10] stated older adults with physical limitations, such as poor eyesight or motor impairments, may find it challenging to use mobile apps that require precise movements or small buttons, and the statement was supported by four articles. According to a research by Ahmad et al. [11], cognitive and visual impairments can make it challenging for older persons to focus on gadgets for extended periods of time and can lower their capacity to concentrate and process information. A study by Abdullah and Hamid [9] stated that many older adults suffer from vision impairment, which can make it challenging to read small text or navigate complex interfaces. Maiden et al. [8] studied that older adults with visual impairments, hearing impairments, mobility issues, or dexterity problems may be led to potential barriers to technology. As people age, they may experience changes in their memory, attention, and processing speed, which can make it more difficult for them to learn new information or navigate complex interfaces - Zhu et al. [12]. Ilyas et al. [11] found that the cognitive ability of elderly individuals may be affected by a variety of diseases, including dementia due to brain shrinkage, motor impairment, blurred vision, or a lack of attention. This can make it more difficult for them to read, comprehend, and process information. As a result, text-based interfaces may not be attractive to older people.

The lack of interest and motivation among older adults was thoroughly discussed in 5 out of 13 articles. Szklanny et al. [10] stated that some older adults may not see the value of using mobile apps or may not be motivated to learn how to use them. Moreover, Maiden et al. [8] stated that older adults are more likely to adopt and use computer technologies if they have a personal interest in them, rather than if they possess specific social or technology-related skills. In a study by Zhu et al. [12], older adults may be more cautious about sharing personal information online or using mobile apps that require access to sensitive data, leading to a lack of interest in technology. Tabak et al. [4] indicated older adults may be easily demotivated by intense gameplay and have a low threshold for upsetting and stressful material. This suggests older adults might be less likely to use mobile apps with frantic or difficult gameplay. A study by Abdullah and Hamid [9] stated that negative perceptions about smartphones can be a barrier to adoption and use among senior citizens which can cause them to feel uneasy about using mobile apps.

The third obstacle is a lack of familiarity with mobile devices, which was explained in 5 articles where older adults with little knowledge of technology may have difficulty using them, especially in the initial phase of touchscreen operations, as studied by Szklanny et al. [10] and another study supported these findings by Macis et al. [6] where the study stated that limited experience with technology prevents older adults from using new devices or software. A study by Ahmad et al. [11] indicated that many older adults did not grow up using computers or smartphones, and may find it difficult to learn how to use new apps or navigate complex interfaces. It may be difficult for older adults who are not familiar with modern technologies to purchase and use mobile apps, as quoted by Quintana et al. [7]. Additionally, according to Wong et al. [5], older persons find using smartphones to be challenging and need additional technical support and/or training so they can stop depending on their children or other family members. Aljedaani and Alnanih [3] focused more on the proposed user model for the elderly, which includes all design implications for physical and cognitive change, but did not particularly highlight the obstacles that would prevent older people from using and buying mobile apps. A number of potential barriers were briefly explored by Salman et al. [1], including a lack of digital literacy, the price of technology, and worries about security and privacy. These might also make it difficult for older folks to find and use mobile apps.

E. User Interface Design

RQ3: What elements contribute to developing user-friendly mobile apps for older adults?

This review identified three main heuristic elements. The first element is simplicity, where the interface design should be easy to navigate for older adults, with clear instructions and minimal distractions during the interaction. In a study conducted by Wong et al. [5], it was concluded that developers and designers should design mobile applications with a straightforward and user-friendly interface that is user-friendly, even for those with limited technical expertise. It should also be supported by Abdullah and Hamid [9], where it should include large, clear fonts, simple icons, and straightforward navigation menus. In addition, Fang et al. [26] suggests that the interface design should be easy to navigate and understand, with large buttons and clear labels, and should provide clear and simple instructions during users interaction. Ahmad et al. [11] indicated older adults may have difficulty navigating complex interfaces, so it is important to keep the design simple and intuitive.

Choosing the right text size and style when creating mobile apps for older persons is the second element as studied by Zhu et al. [12] emphasizes that text should be large enough to read easily, with high contrast between text and background. Maiden et al. [8] recommended that font size should be at least 16 points or larger to ensure readability for older adults, as some experience age-related changes in vision, such as presbyopia, which can make it difficult to read small text. However, Ilyas et al. [11] argued there is no specific font size suitable for older adults, and suggested minimizing the use of text and relying on visual cues such as icons, images, and videos to make the interface more accessible for older adults.

Macis et al. [6] indicated that providing feedback to users about their actions or progress can help them feel more in control and engaged with the system. According to Szklanny et al. [10], mobile apps should provide clear feedback to users, like visual or auditory cues, to help them understand what actions they are taking. Aljedaani and Alnanih [3] stated that when designing user-friendly mobile apps for older adults, it is important to provide clear error messages or notifications to help users when something has gone wrong and how to correct it.

F. Usability Testing

RQ4: What are methods used to gather usability testing results?

The mixed methods research was the most popular method, combining quantitative and qualitative research methods to gather the results. Maiden et al. [8] conducted a semi-structured interview with 10 care professionals affiliated with the residential home in order to collect qualitative data. The quantitative data was collected through a mobile software platform that allowed care professionals to record daily care notes for residents with dementia. 15 old persons (13 women and 2 men), ranging in age from 50 to 74, with an average age of 56, are highlighted in Aljedaani and Alnanih [3] where they participate in face-to-face testing using a prototype, as the examiner observes their behavior and collects feedback from them. An empty table with various properties was included in the paper log-in form that the examiner filled out to record the observational data for each task, such as the amount of time and mistakes made.

Salman et al. [1] used two types of methods to gather both qualitative and quantitative methods, which are user-based methods. It involves observing seven active participants while using or commenting on the system interface. The methods include think-aloud protocols, observation, surveys, and interviews. The second method is the expert-based method, which involves experts inspecting the UI and predicting problems users would encounter while interacting with the interface through heuristic evaluation and cognitive walkthroughs. Quintana et al. [7] conducted a study in which ten informal carers, as well as ten fragile elderly individuals, verbally reported on cognitive confusion while providing open-ended comments on the testing process, the application, and the qualitative data scenarios. The collection of quantitative data, such as task completion and time-on-task analysis, was actively engaged by participants. The inclusion criteria for Macis et al.'s [6] sample group included being over 65, being capable of living independently, having a basic understanding of how to communicate verbally, and participating in Social Services Department activities in an Italian town. To collect qualitative data, they observed and spoke with the individuals in interviews. Both versions of their monitoring system were evaluated for usability and user perception using the System Usability Metrics (SUS) and Post-Study System Usability Questionnaire (PPSUQ).

Ahmad et al. [11] involved around 10 to 15 participants in the research, where they were asked to keep a diary of their experience using the mobile applications and verbalize their thoughts and actions as they interacted with the applications. A post-interview question was prepared for each participant after the 3E Diary's interpretation was finished in order to clarify the information gleaned from the diary and learn more about their experiences using the application. Users' perceptions of the usability and their emotional reactions to the program, which may include elements like attractiveness, stimulation, and efficiency, were assessed using the SUS and User Experience Questionnaire (UEQ). In a study conducted by Szklanny et al. [10] 6 individuals with aphasia aged between 30 and 66 years old (5 female and 1 male) completed a usability test. The participants were observed while using the mobile applications and interviewed after completing the tasks, inquiring about their experiences and concerns. Participants were recorded as video to record their interactions with the mobile applications for review. The participants were also asked to fill in questionnaires regarding the SUS and Likert scales, with a psychologist providing a simplified version of the SUS after participants had used the apps. In a study by Wong et al. [5], 30 individuals were separated into two groups, with P1 standing for Participant 1 and P2 for Participant 2. The duration of each session for users to interact with the tasks was between 45 and 120 minutes, depending on the participant's proficiency and familiarity with the smartphone user interface. The study conducted interviews with a sample of participants over a number of sessions. The survey gauged the expectation of an affordability gap on the smartphone user interface based on Likert scale results.

Two articles, however, favor gathering either qualitative or quantitative data. Only qualitative studies—those with 20 participants aged 65 to 75—in which interviews were conducted to assess participants' reactions to a mobile coaching game intended to promote daily physical activity—were included in the collection by Tabak et al. [4]. All interviews were audio recorded and transcribed. In order to

ensure a diverse sample for quantitative analysis and a dependent measure, Ilyas et al. [11] used random sampling to choose respondents from a variety of age groups and literacy levels. The research measures users' ease of access while using a UI-based application through a survey or questionnaire. In-depth interviews with the target users were also undertaken in the study by Fang et al. [26] in order to sort out their methodologies and integrate them with the Kano Model, a quantitative tool for assessing customer satisfaction with product characteristics.

G. Benefits of mobile apps for older adults

RQ5: What are the significant benefits of designing mobile apps for older adults?

Four major benefits can be obtained from designing mobile apps for older adults: (i) better health; (ii) increased social connections; (iii) enhanced cognitive function; (iv) increased independence. A study by Tabak et al. [23] stated that mobile apps designed for older adults promote physical activity and healthy habits, and Ilyas et al. [8] improved health outcomes for them by providing access to health information, tracking tools, and reminders for medication or appointments. Two studies ([8][1]) found that mobile apps can help combat loneliness and isolation by providing opportunities for social networking and connecting with friends and family. Szklanny et al. [10] indicated that the research helps older adults communicate more effectively with others, especially those who have difficulty speaking due to conditions such as aphasia. Zhu et al. [12] has shown that mobile apps can provide cognitive stimulation through games, puzzles, and other activities that challenge the brain. Abdullah and Hamid [9] stated that mobile apps are more accessible and user-friendly by addressing the specific needs and limitations of older adults, such as vision impairment and motor difficulties. It has been demonstrated by Aljedaani and Alnanih [3] that the development of mobile user interfaces using grounded theory and spatial retrieval therapy can assist Alzheimer's patients in recalling specific pieces of pertinent information.

Last but not least, Wong et al. [5] indicated that mobile apps that are easy to use and navigate can help older adults maintain their independence by allowing them to perform tasks such as banking, shopping, and scheduling appointments on their own, and Macis et al. [6] stated that mobile apps helped older adults manage their health and daily activities independently, which can improve their quality of life and reduce their dependence on caregivers. Study by Fang et al. [26] finds that by using mobile apps, older adults can manage their medications independently, which is able to improve their sense of autonomy and control over their health.

IV. Discussions and Limitations

A. Discussions

This review aids in comprehending a methodical and thorough examination of the past six years of research on developing digital wallets for senior citizens. It also offers an updated analysis that identifies the technological and educational requirements for future in-depth research. Five themes, which are constrained by the parameters of this assessment, were identified: gerontechnology, user experience, user interface design, usability testing, and the advantages of mobile apps for senior citizens. The integration of digital wallets into the fabric of society can thus contribute to the nation's transition towards a non-cash economy [25]. The use of digital wallets is on the rise, with various providers providing a wide range of services. Nevertheless, it is important to note that the user experience of such digital wallets is not necessarily the most suitable for elderly adults in the Kota Samarahan area of Sarawak. This study will provide practical suggestions for improving the UI/UX of digital wallets in Kota Samarahan, Sarawak, to make them more accessible and user-friendly for older adults. This review also found that the growing importance of digital payments, with the increasing number of older adults using digital devices, and improving the usability and accessibility of digital wallets for older adults, could have significant positive impacts on their financial inclusion, independence, and quality of life. We now have a clearer picture of the typical approaches and research techniques used by the studies included in this evaluation.

Nevertheless, we need to conduct more research to answer several questions about why the digital wallet is preferable to complete online transactions in the business industry. Why is the digital wallet more popular among the younger generation than the older generation? Other than that, researchers may also systematically review the negative side effects of cashless payment adoption in online transactions, as well as their user experience with the digital wallet [9] regarding privacy and security matters when using the app to handle the business virtually [13].

B. Limitations

The keywords that were utilized to restrict this study. The analysis was limited to Scopus-published articles. Other databases, including Web of Science, Google Scholar, or Dimensions, may have research articles on the educational applications of AR. Second, only journal articles published from 2018 until 2022 were included. Our review method greatly determined and limited our results. Therefore, if any of the following are changed: the review process (identification, screening, eligibility), the conceptual approach, the selection criteria (inclusion or exclusion), or the research objectives, our findings may be different from those of other reviews.

Citation analysis, reference counting, and expert article rating may all be components of a more thorough and systematic review methodology. You could also take into account the article's effect analysis based on recognized indexing databases. Our comprehensive study of the literature can be expanded into bibliometric and meta-analyses.

V. Conclusion and Future Works

The key finding of this comprehensive study of the literature is that there is a positive trend in the UI/UX design of digital wallets for older persons. A list of the difficulties associated with our study questions has also been provided. Thus, gerontechnology, user experience, user interface design, usability testing, and the advantages of mobile apps for older persons are the five subjects of research attention. Furthermore, the research subject is a narrowly concentrated area of study that aims to address usability issues encountered by older adults when using digital wallets. This systematic review closes the knowledge gap on the usability issue among

older adults and trends in current mainstream digital wallet apps. Additionally, this synthesized review on developing digital wallets for senior citizens may be of use to academics and researchers by offering new directions for future study.

In order to direct future and larger study on a systematic review of UI/UX design of digital wallets for older persons, the following research questions are proposed:

- What challenges with user interface and experience (UI/UX) do older persons have when using augmented reality (AR)?
- What developments in the fourth industrial revolution could be connected to augmented reality and digital wallets?
- What aspects of employing AR in the creation of digital wallets are older folks most satisfied with?

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