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# Mobile Computing: Trend, Challenges, Trend Topics, Success Factors and Implementation Fields

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**ABSTRAK**

Tulisan ini bertujuan untuk mengeksplorasi perkembangan mobile computing dalam mengetahui trend, tantangan, trending topik, faktor keberhasilan, dan bidang apa saja yang berlaku pada mobile computing. Penelitian ini menggunakan metodologi *systematic literature review* (SLR) yang terdiri dari beberapa tahapan: strategi pencarian, kriteria literatur, ekstraksi dan pemantauan data, dan sintesis data. Hasil analisis mendeskripsikan temuan penelitian menunjukkan dari artikel yang ditinjau dapat menyimpulkan bahwa *Mobile Computing* diimplementasikan untuk mendukung dan memainkan peran penting dalam kegiatan masyarakat dan organisasi di semua disiplin ilmu. *Mobile computing* memiliki peranan sangat penting pada kemudahan penggunaan aplikasi pada perangkat. Hasil penelitian juga dapat menggambarkan evolusi mobile computing sehingga dapat dipelajari secara lebih mendalam.

**Kata Kunci:**

Mobile Computing, Trend, Tantangan, Faktor sukses Factors, Trend Topik, Bidang implementasi

***Keywords*** **:**

*Mobile Computing, Trend, Challenges, Success Factors, Trend Topics, Implementation Fields*

***ABSTRACT***

*This paper aims to explore the development of mobile computing in knowing trends, challenges, trending topics, success factors, and what fields apply to mobile computing. This study uses a systematic literature review (SLR) methodology consisting of several stages: search strategy, literature criteria, data extraction and monitoring, and data synthesis. The analysis results describing the research findings show that from the reviewed articles, it can be concluded that Mobile Computing is implemented to support and play an important role in community and organizational activities in all disciplines. Mobile computing has a very important role in the ease of use of device applications. The research results can also describe the evolution of mobile computing so that it can be studied in more depth.*

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## INTRODUCTION

Mobile computing is a technology that enables users to access information and services through mobile devices such as smartphones and tablets (Ba et al. 2013; Pejovic and Musolesi 2015; Wang, Chen, and Wang 2015). The history of mobile computing began in the 1970s, with a Xerox PARC researcher named Alan Key developing the idea in the form of a portable computer

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concept called the Dynabook (Laru, Naykki, and Jarvela 2015). Then, in the 1990s, laptops appeared with touch screens and handwriting recognition capabilities. Since then, the development of mobile computing has accelerated with the emergence of increasingly compact and sophisticated smartphones, tablets, and laptops.

Mobile Computing in the present is needed. Without a mobile device, someone will feel incomplete. Many applications that were previously made for computers will move to mobile. This supports one's daily activities, for example, moving around, communicating anywhere and anytime, and can be done in any form(Gaghana and Sutomo, 2023; Wiratama, Santoso and Clairence, 2023). Mobile Computing is growing and sophisticated with the existence of Artificial Intelligence (AI), cloud computing, Smart Devices, Augmented Reality, Virtual Reality, and others.

Implementation of the use of cloud computing in a mobile application is still rarely implemented. The mobile cloud includes cloud-based data, applications, and services that can be accessed via a network using mobile devices such as smartphones (Aliyu et al. 2018; Surbiryala and Rong 2019; Wang et al. 2015). The concept of Mobile Computing includes the history of its development, usage, and functions, as well as device and application development (Surbiryala and Rong 2019). Implementation of AI in mobile computing to create better image results. Smart device implementation can be in the form of controlling other devices with mobile. AR and VR implementations can see 3D objects on mobile screens so that they are more real.

This paper aims to explore the development of mobile computing in knowing trends, challenges, trending topics, success factors, and what areas apply to mobile computing. Thus, it is expected to contribute to readers for the development of mobile computing.

## RESEARCH METHOD

This study uses a literature review methodology based on previous research and literature that has related topics or fields. According to Kitchenham et al. 2009, a systematic literature review (SLR) was carried out in several stages: search strategies, literature criteria, data extraction and monitoring, and data synthesis. SLRs need to state research objectives in the form of research questions to explore studies relevant to the research topic (shown in Table 1). Research questions (RQ) are very important as a reference for establishing and determining research objectives.

**Table 1. Research Question**

| No | Research Question | Objectives |
|---|---|---|
| **RQ1** | Trends in Mobile Computing | Trends in Mobile Computing Discusses the latest trends in mobile computing |
| **RQ2** | Challenges computing | Challenges Describe the challenges that occur in the implementation and use of mobile computing. |
| **RQ3** | Topic Trends | Topic Trends Describes current topics related to mobile computing |
| **RQ4** | Implementation Success Factors | Implementation Success Factors Describe the success factors in implementing mobile computing. |
| **RQ5** | field Describes | field Describes fields that have used mobile computing |

The search strategy stage here determines that this research aims to understand and describe the field under study. This step involves finding and customizing the review with the appropriate title, abstract, or keywords. The search studies that are sought are related to trends, challenges, trending topics, success factors, and what fields apply them. The literature criteria stage, carried out in this study, contained research in the field of Mobile Computing in journals and articles taken in the last 10 years with various types of journals. Journals such as surveys, reviews, case studies, and SLRs. Journal sources taken and carefully come from various publishers such as, Springer, IEEE, elsevier and others. From the search results 74 articles have been taken and researched. Not only Mobile Computing, the articles taken and researched include Mobile Cloud Computing (MCC). After being researched, an overall analysis of references, trends, challenges, trending topics, success factors, and what fields apply them from the journals studied is carried out. The data extraction and monitoring stage is to obtain the appropriate information and document the appropriate articles. Documentation includes author, time of publication, type of article, and publisher.

Next, extract the literature according to the RQ. The data synthesis stage functions to conclude and harmonize the review results systematically according to the RQ. These results export the findings based on the RQ so that they can be represented as definitive answers. The last part of the trip is to report all systematic reviews in a format that has been adapted to the place of distribution and readers.

## RESULTS AND DISCUSSION

This research contains research in the field of Mobile Computing in the form of journals and articles taken in the last 10 years. Sources of articles that were taken and carefully came from various reputable publishers, as shown in table 2.

**Table 2. Article Source**

| No | Reference | No | Reference |
|---|---|---|---|
| **1** | (Gikas & Grant, 2013) | **38** | (Orsini et al., 2021) |
| **2** | (Y. Wang et al., 2015) | **39** | (Akbar & Lewis, 2017) |
| **3** | (Musumba & Nyongesa, 2013) | **40** | (Y. Sun et al., 2020) |
| **4** | (Yang et al., 2013) | **41** | (Akbar & Lewis, 2017) |
| **5** | (X. Sun & Ansari, 2016) | **42** | (Orsini et al., 2021) |
| **6** | (Grant et al., 2015) | **43** | (Mao et al., 2022) |
| **7** | (Pejovic & Musolesi, 2015) | **44** | (L. Sun et al., 2020) |
| **8** | (Kwon et al., 2019) | **45** | (Ali et al., 2023) |
| **9** | (Ba et al., 2013) | **46** | (Manikanthan et al., 2020) |
| **10** | (Tong et al., 2016) | **47** | (Sannino et al., 2019) |
| **11** | (Mitra et al., 2015) | **48** | (Zhou et al., 2010) |
| **12** | (Nazir et al., 2019) | **49** | (Q. Wang & Deters, 2010) |
| **13** | (Chung et al., 2014) | **50** | (W. Zhang et al., 2017) |
| **14** | (Keith et al., 2015) | **51** | (Tiwary et al., 2018) |
| **15** | (Ma et al., 2018) | **52** | (Luo, 2007) |
| **16** | (B. Liao et al., 2020) | **53** | (Gu et al., 2018) |
| **17** | (Manikanthan, S.V Padmapriya et al., 2020) | **54** | (Suo et al., 2013) |
| **18** | (T. Liao, 2019) | **55** | (Abdo et al., 2015) |
| **19** | (Zeng et al., 2023) | **56** | (Sacramento et al., 2005) |
| **20** | (Yoo, 2023) | **57** | (Ragini et al., 2014) |
| **21** | (Liang et al., 2022) | **58** | (Mach & Becvar, 2017) |
| **22** | (Humphreys, 2023) | **59** | (Abahussain & Albalooshi, 2019) |
| **23** | (Yadav et al., 2015) | **60** | (Aliyu et al., 2018) |
| **24** | (H.-T. Chen & Li, 2017) | **61** | (Tong et al., 2016) |
| **25** | (Din & Fazal Fazla, 2021) | **62** | (Subramanya et al., 2017) |
| **26** | (Chang et al., 2021) | **63** | (Messaoudi et al., 2018) |
| **27** | (Radhi, 2022) | **64** | (X. Zhang et al., 2019) |
| **28** | (Eroğlu & Özkoç, 2020) | **65** | (Zhao et al., 2023) |
| **29** | (Yan et al., 2021) | **66** | (Qin et al., 2019) |
| **30** | (Alfailakawi & Al-Anzi, 2022) | **67** | (M.-H. Chen et al., 2016) |
| **31** | (Silverio-Fernández et al., 2018) | **68** | (de Freitas Martins et al., 2020) |
| **32** | (Buabbas et al., 2021) | **69** | (Erlangga et al., 2020) |
| **33** | (Lupton et al., 2021) | **70** | (Oteyo et al., 2021) |
| **34** | (T. Zhang et al., 2019) | **71** | (Rathor & Kumari, 2021) |
| **35** | (Hubert et al., 2019) | **72** | (Namani & Gonen, 2020) |
| **36** | (Mohan et al., 2020) | **73** | (Gutierrez et al., 2019) |
| **37** | (Pejovic & Musolesi, 2015) | **74** | (Moedjiono et al., 2018) |

**RQ1. Research Question Trend in Mobile Computing**

The trend that occurs in mobile computing is currently widely used to change the way students learn and interact in tertiary institutions by using learning applications that use mobile learning. The development of mobile learning helps students learn the material and increases class participation. This mobile also changes the social order by bringing together people in a medium currently referred to as social media, such as Facebook, Instagram, Twitter, and LinkedIn. People use this medium to communicate, share

information, and find relevant connections. Furthermore, there is also the trend of using QR codes on mobile devices. This provides convenience and efficiency in various aspects of daily life, including buying and selling transactions, data migration, and data transmission. Do not forget the use of sensors on mobile which allows users to get information about the surrounding environment directly. This mobile computing trend positively impacts access to resources and experiences, increasing student engagement, facilitating collaboration, and providing convenience in everyday life. Universities continue to adopt this technology to create a more dynamic and interactive learning environment.

**Table 3. Trends in Mobile Computing**

| No | Trend in Mobile computing | Reference Articles |
|---|---|---|
| **1** | Adoption of mobile learning technology | (Alfailakawi & Al-Anzi, 2022; Grant Et Al., 2015; Kwon Et Al., 2019; Sengupta Et Al., 2013) |
| **2** | The development of augmented reality (AR) and virtual reality (VR) technology | (Liang Et Al., 2022; T. Liao, 2019; Yoo, 2023; Zeng Et Al., 2023; Zienarski & Such-Pyrgiel, 2019) |
| **3** | Increased use of social media | (H.-T. Chen & Li, 2017; Humphreys, 2023; Yadav Et Al., 2015) |
| **4** | QR code introduction | (Chang et al., 2021; Din & Fazal Fazla, 2021; Eroğlu & Özkoç, 2020; B. Liao et al., 2020; Radhi, 2022; Yan et al., 2021) |
| **5** | Smart Devices with sensor | (Alfailakawi & Al-Anzi, 2022; Buabbas et al., 2021; B. Liao et al., 2020; Silverio-Fernández et al., 2018; X. Sun & Ansari, 2016; T. Zhang et al., 2019) |

**RQ2. Research Question Challenges in Implementing Mobile Computing**

Mobile computing is currently widely applied in all aspects of human life and organizations. Mobile computing still has many limitations that must be resolved. This limitation can be in the form of device access that is used to communicate with one another. Weak, disconnected, and lost connections still constrain this access. With access like this, it can impact user desires in using online services in applications. All of this access depends on the internet network connectivity available in an area. This internet network will also be influenced by network infrastructure so that it can reach better and wider later. Mobile computing also experiences problems with the security and privacy of user data. This problem occurs when devices or users who use the service must take care of one another. This obstacle occurs in the use of devices in various public areas that are not sterile so that users can maintain or avoid access to data exposure. Mobile computing access also depends on network latency and available bandwidth. In network latency, delays in response to interactions in online applications or services can occur for quite a long time. This can occur in the substance of applications developed by developers who do not optimize applications or on devices unsuitable for use. There is a failure to send data in the bandwidth because the transfer speed decreases and even the connection is lost because the application is too large to consume resources.

The development of mobile applications that are increasingly complex in terms of functions results in limited resources (CPU, memory, and battery life). This limits the application's ability to run its complex features and functions with optimal performance. As a result, it experiences decreased performance, response delays, and loading. Which is slow and crashes Device development uses context-aware computing that is inconsistent with functionality Where the application retrieves and utilizes user context data such as the user's location, time, device, and other users around, as well as user activity Inappropriate use or misuse of data context can raise security and privacy issues. The most risky challenge is the scalability of mobile computing devices. Computing and network infrastructure must handle the workload of these complex applications. This causes the infrastructure to increase processing capacity and resource availability.

Addressing this challenge requires upgrading network infrastructure, considering app availability across multiple regions, educating users about privacy and security, proper data protection, increasing network capacity, and developing infrastructure that can handle complex application workloads. Efforts

continue to be made to overcome these obstacles so that mobile computing technology can provide maximum benefits in education and everyday life.

**Table 4. Challenges in Implementing Mobile Computing**

| No | Challenge | Reference Articles |
|---|---|---|
| **1** | Device access limitations | (Gikas & Grant, 2013; Grant Et Al., 2015; Kwon Et Al., 2019; Mohan Et Al., 2020; Y. Wang Et Al., 2015) |
| **2** | Data security and privacy | (Chang Et Al., 2021; Gikas & Grant, 2013; Kwon Et Al., 2019; B. Liao Et Al., 2020; Musumba & Nyongesa, 2013; Nazir Et Al., 2019; Pejovic & Musolesi, 2015; Y. Wang Et Al., 2015) |
| **3** | Network bandwidth and latency limitations | (Akbar & Lewis, 2017; Orsini et al., 2021; Y. Sun et al., 2020; Yao et al., 2008) |
| **4** | The more complex the application, the lower the application performance | (Yang et al., 2013) |
| **5** | Context-Aware Computing | (Mitra et al., 2015; Musumba & Nyongesa, 2013; Pejovic & Musolesi, 2015) |
| **6** | Scalability | (Mitra et al., 2015; X. Sun & Ansari, 2016) |
| **7** | Hardware limitations | (Mitra et al., 2015) |

**RQ3. Research Question Topic Trends in Mobile Computing**

Challenges The implementation of mobile computing technology currently has many popular topics, including Artificial Intelligence (AI) in security devices, which has successfully reduced security vulnerabilities in companies. Machine learning techniques such as sensor-based behavioral recognition, smartphone vulnerability scanning, and language understanding have proven effective. Topics in Anonymous Discussions are increasingly common, especially in the pandemic era. Many people do this because they feel braver about expressing opinions without being known by others. So, the development of mobile devices that support anonymous use is very important for developers to pay attention to. The Internet of Things (IoT) allows mobile devices to connect to IoT networks and access data from IoT devices. Sensor technology in mobile devices is developing rapidly, and universities have developed special mobile applications to increase user engagement. The success of mobile computing services is highly dependent on user experience.

**Table 5. Topic Trend in Mobile Computing**

| No | Topics Trend | Reference Articles |
|---|---|---|
| **1** | Artificial Intelligence (AI) | (Ali Et Al., 2023; Manikanthan, S.V Padmapriya Et Al., 2020; Manikanthan Et Al., 2020; Sannino Et Al., 2019; L. Sun Et Al., 2020) |
| **2** | Internet Of Things | (B. Liao et al., 2020; Nazir et al., 2019; Orsini et al., 2021; Radhi, 2022; Silverio-Fernández et al., 2018; Y. Wang et al., 2015) |
| **3.** | Quality of Experience | (Chung et al., 2014; Mitra et al., 2015; Musumba & Nyongesa, 2013; Zeng et al., 2023) |

**RQ4. Research Question Factors for Successful Implementation in Mobile Computing**

The successful implementation of mobile computing depends on several important factors. First, mobile devices must be easy to use for users to access them easily. Second, good management is needed to optimize device use and prevent misuse. Third, regular evaluations help identify the strengths and weaknesses of mobile programs. Fourth, data processing speed affects the speed of access to the required information. Fifth, system scalability is the key to dealing with data and user growth. Sixth, adequate data protection is essential in the mobile computing environment. Lastly, good architecture and technology support the development of complex mobile applications. These factors are interrelated and must be considered to implement mobile computing successfully.

**Table 6. Implementation Success Factors in Mobile Computing**

| No | Factor | Reference Articles |
|---|---|---|
| 1 | Availability of Adequate Infrastructure and Technology | (Gikas & Grant, 2013; Kwon Et Al., 2019; X. Sun & Ansari, 2016; Yang Et Al., 2013) |
| 2 | Good Management and Control | (Gikas & Grant, 2013; Radhi, 2022) |
| 3 | Measurement and Evaluation | (Gikas & Grant, 2013; Kwon Et Al., 2019; Mitra Et Al., 2015; Yao Et Al., 2008) |
| 4 | The ability to process data quickly and efficiently. | (Keith et al., 2015; Kwon et al., 2019; Manikanthan et al., 2020; Y. Wang et al., 2015) |
| 5 | Scalability | (Gu et al., 2018; Luo, 2007; Tiwary et al., 2018; Q. Wang & Deters, 2010; W. Zhang et al., 2017; Zhou et al., 2010) |
| 6 | Data security and privacy | (Abdo Et Al., 2015; Ragini Et Al., 2014; Sacramento Et Al., 2005; Suo Et Al., 2013) |
| 7 | Development of better architecture and technology | (Abahussain & Albalooshi, 2019; Aliyu et al., 2018; Mach & Becvar, 2017; Subramanya et al., 2017; Tong et al., 2016; Y. Wang et al., 2015) |

**RQ5. Research Question Fields in Mobile Computing**

Mobile computing has become an important part of many aspects of life, including education, business, the gaming industry, government administration, and healthcare. This facilitates student information capture, buying and selling processes, game development, government data processing, remote healthcare, and use on farms to speed up the grow-to-sale process. Mobile computing provides benefits in increasing access to information, efficiency, and innovation in everyday life. Mobile computing has penetrated various fields and has positively impacted access to information, increased efficiency, and provided innovative solutions in everyday life.

**Table 7. Fields in Mobile Computing**

| No | Fields | Reference Articles |
|---|---|---|
| 1 | Education | (Gikas & Grant, 2013; Grant Et Al., 2015; Kwon Et Al., 2019; Y. Wang Et Al., 2015; Yang Et Al., 2013) |
| 2 | Business | (Chang et al., 2021; Din & Fazal Fazla, 2021; Eroğlu & Özkoç, 2020; Y. Wang et al., 2015; Yadav et al., 2015; Yan et al., 2021) |
| 3 | Game | (M.-H. Chen et al., 2016; de Freitas Martins et al., 2020; Messaoudi et al., 2018; Qin et al., 2019; X. Zhang et al., 2019; Zhao et al., 2023) |
| 4 | Government | (Yang et al., 2013) |
| 5 | Health | (Chung et al., 2014; Ma et al., 2018; Nazir et al., 2019; Radhi, 2022; L. Sun et al., 2020) |
| 6 | Agriculture | (Erlangga et al., 2020; Gutierrez et al., 2019; Moedjiono et al., 2018; Namani & Gonen, 2020; Oteyo et al., 2021; Rathor & Kumari, 2021) |

## CONCLUSION

The results of this study explore mobile computing from trends, challenges, trending topics, success factors, and what fields apply it. Mobile computing has a significant role and impact in various fields, including health, education, business, agriculture, and society. In health, mobile computing enables remote services, monitoring of health conditions, and more accurate diagnoses. In education, mobile computing provides unlimited learning resources, flexibility, and online collaboration. In business, mobile computing increases operational efficiency, facilitates remote work, and opens up new opportunities in e-commerce and marketing. Within society, mobile computing enables global connections, social participation, and rapid response to disasters. In the agricultural sector, efficiency is carried out in all processes, from planting to sales. Despite the benefits, data security challenges and access gaps still need to be addressed. The results of this study are expected to be able to thoroughly describe the development of mobile computing so that it can be studied in more detail and depth.

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## REFERENCE

Abahussain, O., & Albalooshi, F. (2019). People and Mobile Computing: Architecture and Concerns. *2019 8th International Conference on Modeling Simulation and Applied Optimization (ICMSAO)*, 1–3. https://doi.org/10.1109/ICMSAO.2019.8880411

Abdo, J. B., Demerjian, J., Chaouchi, H., Atechian, T., & Bassil, C. (2015). Privacy using mobile cloud computing. *2015 Fifth International Conference on Digital Information and Communication Technology and Its Applications (DICTAP)*, 178–182. https://doi.org/10.1109/DICTAP.2015.7113194

Akbar, A., & Lewis, P. R. (2017). Towards the optimization of power and bandwidth consumption in mobile-cloud hybrid applications. *2017 Second International Conference on Fog and Mobile Edge Computing (FMEC)*, 213–218. https://doi.org/10.1109/FMEC.2017.7946433

Alfailakawi, A., & Al-Anzi, A. A. (2022). The Reality of Using Smart Device Applications in Learning Applications by University Students at the College of Basic Education in Kuwait. *Global Journal of Educational Studies*, *8*(2), 102. https://doi.org/10.5296/gjes.v8i2.20562

Ali, O., Abdelbaki, W., Shrestha, A., Elbasi, E., Alryalat, M. A. A., & Dwivedi, Y. K. (2023). A systematic literature review of artificial intelligence in the healthcare sector: Benefits, challenges, methodologies, and functionalities. *Journal of Innovation & Knowledge*, *8*(1), 100333. https://doi.org/10.1016/j.jik.2023.100333

Aliyu, A., Abdullah, A. H., Kaiwartya, O., Tayyab, M., & Joda, U. M. (2018). Mobile Cloud Computing: Layered Architecture. *2018 Seventh ICT International Student Project Conference (ICT-ISPC)*, 1–6. https://doi.org/10.1109/ICT-ISPC.2018.8523997

Ba, H., Heinzelman, W., Janssen, C.-A., & Shi, J. (2013). Mobile computing - A green computing resource. *2013 IEEE Wireless Communications and Networking Conference (WCNC)*, 4451–4456. https://doi.org/10.1109/WCNC.2013.6555295

Buabbas, A. J., Hasan, H., & Buabbas, M. A. (2021). The associations between smart device use and psychological distress among secondary and high school students in Kuwait. *PLOS ONE*, *16*(6), e0251479. https://doi.org/10.1371/journal.pone.0251479

Chang, V., Chen, W., Xu, Q. A., & Xiong, C. (2021). Towards the Customers' Intention to Use QR Codes in Mobile Payments. *Journal of Global Information Management*, *29*(6), 1–21. https://doi.org/10.4018/JGIM.20211101.oa37

Chen, H.-T., & Li, X. (2017). The contribution of mobile social media to social capital and psychological well-being: Examining the role of communicative use, friending and self-disclosure. *Computers in Human Behavior*, *75*, 958–965. https://doi.org/10.1016/j.chb.2017.06.011

Chen, M.-H., Dong, M., & Liang, B. (2016). Multi-user Mobile Cloud Offloading Game with Computing Access Point. *2016 5th IEEE International Conference on Cloud Networking (Cloudnet)*, 64–69. https://doi.org/10.1109/CloudNet.2016.52

Chung, K.-Y., Yoo, J., & Kim, K. J. (2014). Recent trends on mobile computing and future networks. *Personal and Ubiquitous Computing*, *18*(3), 489–491. https://doi.org/10.1007/s00779-013-0682-y

de Freitas Martins, G., de Freitas, R., & Gadelha, B. (2020). A mobile game based on participatory sensing with real-time client-server architecture for large entertainment events. *2020 XLVI*

*Latin American Computing Conference (CLEI)*, 332–339. https://doi.org/10.1109/CLEI52000.2020.00045

Din, M. M., & Fazal Fazla, A. (2021). Integration of Web-Based and Mobile Application with QR Code implementation for the library management system. *Journal of Physics: Conference Series*, *1860*(1), 012018. https://doi.org/10.1088/1742-6596/1860/1/012018

Erlangga, Wihardi, Y., & Nugraha, E. (2020). Development Mobile Learning For Vegetable Farming In Indonesia Based On Mobile Cloud Computing. *2020 6th International Conference on Science in Information Technology (ICSITech)*, 6–10. https://doi.org/10.1109/ICSITech49800.2020.9392074

Eroğlu, E., & Özkoç, E. E. (2020). A Mobile QR Code Application for an Article: QR-ticle. *Computer and Information Science*, *13*(3), 82. https://doi.org/10.5539/cis.v13n3p82

Gaghana, K.G. and Sutomo, R. (2023) 'Development of a Mobile-Based Commodity Exchange Information Application Prototype for Indonesian Companies', G-Tech: Jurnal Teknologi Terapan, 7(3), pp. 1037–1050. Available at: https://doi.org/10.33379/gtech.v7i3.2694.

Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. *The Internet and Higher Education*, *19*, 18–26. https://doi.org/10.1016/j.iheduc.2013.06.002

Grant, M. M., Tamim, S., Brown, D. B., Sweeney, J. P., Ferguson, F. K., & Jones, L. B. (2015). Teaching and Learning with Mobile Computing Devices: Case Study in K-12 Classrooms. *TechTrends*, *59*(4), 32–45. https://doi.org/10.1007/s11528-015-0869-3

Gu, R., Zhang, X., Yu, L., & Zhang, J. (2018). Enhancing Security and Scalability in Software Defined LTE Core Networks. *2018 17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/ 12th IEEE International Conference On Big Data Science And Engineering (TrustCom/BigDataSE)*, 837–842. https://doi.org/10.1109/TrustCom/BigDataSE.2018.00120

Gutierrez, S., Martinez, I., Varona, J., Cardona, M., & Espinosa, R. (2019). Smart Mobile LoRa Agriculture System based on Internet of Things. *2019 IEEE 39th Central America and Panama Convention (CONCAPAN XXXIX)*, 1–6. https://doi.org/10.1109/CONCAPANXXXIX47272.2019.8977109

Hubert, M., Blut, M., Brock, C., Zhang, R. W., Koch, V., & Riedl, R. (2019). The influence of acceptance and adoption drivers on smart home usage. *European Journal of Marketing*, *53*(6), 1073–1098. https://doi.org/10.1108/EJM-12-2016-0794

Humphreys, L. (2023). Mobile social media: The challenges and opportunities continue. *Mobile Media & Communication*, *11*(1), 74–79. https://doi.org/10.1177/20501579221132209

Keith, M. J., Babb, J. S., Lowry, P. B., Furner, C. P., & Abdullat, A. (2015). The role of mobile-computing self-efficacy in consumer information disclosure. *Information Systems Journal*, *25*(6), 637–667. https://doi.org/10.1111/isj.12082

Kitchenham, B., Brereton, O. P., Budgen, D., Turner, M., Bailey, J., & Linkman, S. (2009). Systematic literature reviews in software engineering – A systematic literature review. *Information and Software Technology*, *51*(1), 7–15. https://doi.org/10.1016/j.infsof.2008.09.009

Kwon, K., Ottenbreit-Leftwich, A. T., Sari, A. R., Khlaif, Z., Zhu, M., Nadir, H., & Gok, F. (2019). Teachers' Self-efficacy Matters: Exploring the Integration of Mobile Computing Device in Middle Schools. *TechTrends*, *63*(6), 682–692. https://doi.org/10.1007/s11528-019-00402-5

Liang, C., Song, Y., & Wang, B. (2022). The Influence of Social Function of Mobile Game Augmented Reality and Virtual Reality Environment on Mobile Phone Users' Addiction.

*Wireless Communications and Mobile Computing*, *2022*, 1–8. https://doi.org/10.1155/2022/2903124

Liao, B., Ali, Y., Nazir, S., He, L., & Khan, H. U. (2020). Security Analysis of IoT Devices by Using Mobile Computing: A Systematic Literature Review. *IEEE Access*, *8*, 120331–120350. https://doi.org/10.1109/ACCESS.2020.3006358

Liao, T. (2019). Future directions for mobile augmented reality research: Understanding relationships between augmented reality users, nonusers, content, devices, and industry. *Mobile Media & Communication*, *7*(1), 131–149. https://doi.org/10.1177/2050157918792438

Luo, X. (2007). PACE: Augmenting Personal Mobile Devices with Scalable Computing. *Seventh IEEE International Symposium on Cluster Computing and the Grid (CCGrid '07)*, 875–880. https://doi.org/10.1109/CCGRID.2007.81

Lupton, D., Pink, S., & Horst, H. (2021). Living in, with and beyond the 'smart home': Introduction to the special issue. *Convergence: The International Journal of Research into New Media Technologies*, *27*(5), 1147–1154. https://doi.org/10.1177/13548565211052736

Ma, X., Wang, Z., Zhou, S., Wen, H., & Zhang, Y. (2018). Intelligent Healthcare Systems Assisted by Data Analytics and Mobile Computing. *2018 14th International Wireless Communications & Mobile Computing Conference (IWCMC)*, 1317–1322. https://doi.org/10.1109/IWCMC.2018.8450377

Mach, P., & Becvar, Z. (2017). Mobile Edge Computing: A Survey on Architecture and Computation Offloading. *IEEE Communications Surveys & Tutorials*, *19*(3), 1628–1656. https://doi.org/10.1109/COMST.2017.2682318

Manikanthan, S.V Padmapriya, T., Hussain, A., & Thamizharasi, E. (2020). Artificial Intelligence Techniques for Enhancing Smartphone Application Development on Mobile Computing. *International Association of Online Engineering*. https://www.learntechlib.org/p/218298/

Manikanthan, S. ., Padmapriya, T., Hussain, A., & Thamizharasi, E. (2020). Artificial Intelligence Techniques for Enhancing Smartphone Application Development on Mobile Computing. *International Journal of Interactive Mobile Technologies (IJIM)*, *14*(17), 4. https://doi.org/10.3991/ijim.v14i17.16569

Mao, Y., Pranolo, A., Hernandez, L., Wibawa, A. P., & Nuryana, Z. (2022). Artificial intelligence in mobile communication: A Survey. *IOP Conference Series: Materials Science and Engineering*, *1212*(1), 012046. https://doi.org/10.1088/1757-899X/1212/1/012046

Messaoudi, F., Ksentini, A., & Bertin, P. (2018). Toward a Mobile Gaming Based-Computation Offloading. *2018 IEEE International Conference on Communications (ICC)*, 1–7. https://doi.org/10.1109/ICC.2018.8422518

Mitra, K., Zaslavsky, A., & Ahlund, C. (2015). Context-Aware QoE Modelling, Measurement, and Prediction in Mobile Computing Systems. *IEEE Transactions on Mobile Computing*, *14*(5), 920–936. https://doi.org/10.1109/TMC.2013.155

Moedjiono, S., Saepudin, & Kusdaryono, A. (2018). Application Development Based On Mobile Learning Framework On Rice And Vegetable Agriculture. *2018 Third International Conference on Informatics and Computing (ICIC)*, 1–6. https://doi.org/10.1109/IAC.2018.8780414

Mohan, D., Bashingwa, J. J. H., Tiffin, N., Dhar, D., Mulder, N., George, A., & LeFevre, A. E. (2020). Does having a mobile phone matter? Linking phone access among women to health in India: An exploratory analysis of the National Family Health Survey. *PLOS ONE*, *15*(7), e0236078. https://doi.org/10.1371/journal.pone.0236078

Musumba, G. W., & Nyongesa, H. O. (2013). Context awareness in mobile computing: A review. *International Journal of Machine Learning and Applications*, *2*(1). https://doi.org/10.4102/ijmla.v2i1.5

Namani, S., & Gonen, B. (2020). Smart Agriculture Based on IoT and Cloud Computing. *2020 3rd International Conference on Information and Computer Technologies (ICICT)*, 553–556. https://doi.org/10.1109/ICICT50521.2020.00094

Nazir, S., Ali, Y., Ullah, N., & García-Magariño, I. (2019). Internet of Things for Healthcare Using Effects of Mobile Computing: A Systematic Literature Review. *Wireless Communications and Mobile Computing*, *2019*, 1–20. https://doi.org/10.1155/2019/5931315

Orsini, G., Posdorfer, W., & Lamersdorf, W. (2021). Saving bandwidth and energy of mobile and IoT devices with link predictions. *Journal of Ambient Intelligence and Humanized Computing*, *12*(8), 8229–8240. https://doi.org/10.1007/s12652-020-02557-z

Oteyo, I. N., Pupo, A. L. S., Zaman, J., Kimani, S., De Meuter, W., & Boix, E. G. (2021). Building Smart Agriculture Applications Using Low-Code Tools: The Case for DisCoPar. *2021 IEEE AFRICON*, 1–6. https://doi.org/10.1109/AFRICON51333.2021.9570936

Pejovic, V., & Musolesi, M. (2015). Anticipatory Mobile Computing: A Survey of the State of the Art and Research Challenges. *ACM Computing Surveys*, *47*(3), 1–29. https://doi.org/10.1145/2693843

Qin, A., Cai, C., Wang, Q., Ni, Y., & Zhu, H. (2019). Game Theoretical Multi-user Computation Offloading for Mobile-Edge Cloud Computing. *2019 IEEE Conference on Multimedia Information Processing and Retrieval (MIPR)*, 328–332. https://doi.org/10.1109/MIPR.2019.00065

Radhi, A. A. (2022). Use QR Code and IoT Mobile Devices to Prevent the Spread of an Epidemic (COVID-19). *International Journal of Interactive Mobile Technologies (IJIM)*, *16*(12), 127–136. https://doi.org/10.3991/ijim.v16i12.32125

Ragini, Mehrotra, P., & Venkatesan, S. (2014). An efficient model for privacy and security in Mobile Cloud Computing. *2014 International Conference on Recent Trends in Information Technology*, 1–6. https://doi.org/10.1109/ICRTIT.2014.6996177

Rathor, S., & Kumari, S. (2021). Smart Agriculture System Using IoT and Cloud Computing. *2021 5th International Conference on Information Systems and Computer Networks (ISCON)*, 1–4. https://doi.org/10.1109/ISCON52037.2021.9702345

Sacramento, V., Endler, M., & Nascimento, F. N. (2005). A Privacy Service for Context-aware Mobile Computing. *First International Conference on Security and Privacy for Emerging Areas in Communications Networks (SECURECOMM'05)*, 182–193. https://doi.org/10.1109/SECURECOMM.2005.8

Sannino, G., Bouguila, N., De Pietro, G., & Celesti, A. (2019). Artificial Intelligence for Mobile Health Data Analysis and Processing. *Mobile Information Systems*, *2019*, 1–2. https://doi.org/10.1155/2019/2673463

Sengupta, P., Kinnebrew, J. S., Basu, S., Biswas, G., & Clark, D. (2013). Integrating computational thinking with K-12 science education using agent-based computation: A theoretical framework. *Education and Information Technologies*, *18*(2), 351–380. https://doi.org/10.1007/s10639-012-9240-x

Silverio-Fernández, M., Renukappa, S., & Suresh, S. (2018). What is a smart device? - a conceptualisation within the paradigm of the internet of things. *Visualization in Engineering*, *6*(1), 3. https://doi.org/10.1186/s40327-018-0063-8

Subramanya, T., Goratti, L., Khan, S. N., Kafetzakis, E., Giannoulakis, I., & Riggio, R. (2017). A practical architecture for mobile edge computing. *2017 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN)*, 1–4. https://doi.org/10.1109/NFV-SDN.2017.8169855

Sun, L., Jiang, X., Ren, H., & Guo, Y. (2020). Edge-Cloud Computing and Artificial Intelligence

in Internet of Medical Things: Architecture, Technology and Application. *IEEE Access*, *8*, 101079–101092. https://doi.org/10.1109/ACCESS.2020.2997831

Sun, X., & Ansari, N. (2016). EdgeIoT: Mobile Edge Computing for the Internet of Things. *IEEE Communications Magazine*, *54*(12), 22–29. https://doi.org/10.1109/MCOM.2016.1600492CM

Sun, Y., Chen, Z., Tao, M., & Liu, H. (2020). Bandwidth Gain From Mobile Edge Computing and Caching in Wireless Multicast Systems. *IEEE Transactions on Wireless Communications*, *19*(6), 3992–4007. https://doi.org/10.1109/TWC.2020.2979147

Suo, H., Liu, Z., Wan, J., & Zhou, K. (2013). Security and privacy in mobile cloud computing. *2013 9th International Wireless Communications and Mobile Computing Conference (IWCMC)*, 655–659. https://doi.org/10.1109/IWCMC.2013.6583635

Tiwary, M., Sharma, S., Mishra, P., El-Sayed, H., Prasad, M., & Puthal, D. (2018). Building Scalable Mobile Edge Computing by Enhancing Quality of Services. *2018 International Conference on Innovations in Information Technology (IIT)*, 141–146. https://doi.org/10.1109/INNOVATIONS.2018.8605955

Tong, L., Li, Y., & Gao, W. (2016). A hierarchical edge cloud architecture for mobile computing. *IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications*, 1–9. https://doi.org/10.1109/INFOCOM.2016.7524340

Wang, Q., & Deters, R. (2010). Mobile devices, scalability digital ecologies. *4th IEEE International Conference on Digital Ecosystems and Technologies*, 124–129. https://doi.org/10.1109/DEST.2010.5610658

Wang, Y., Chen, I.-R., & Wang, D.-C. (2015). A Survey of Mobile Cloud Computing Applications: Perspectives and Challenges. *Wireless Personal Communications*, *80*(4), 1607–1623. https://doi.org/10.1007/s11277-014-2102-7

Wiratama, J., Santoso, H. and Clairence (2023) 'Developing a Class Scheduling Mobile Application for Private Campus in Tangerang with the Extreme Programming (XP) Model', G-Tech: Jurnal Teknologi Terapan, 7(2), pp. 484–493. Available at: https://doi.org/10.33379/gtech.v7i2.2288.

Yadav, M., Joshi, Y., & Rahman, Z. (2015). Mobile Social Media: The New Hybrid Element of Digital Marketing Communications. *Procedia - Social and Behavioral Sciences*, *189*, 335–343. https://doi.org/10.1016/j.sbspro.2015.03.229

Yan, L.-Y., Tan, G. W.-H., Loh, X.-M., Hew, J.-J., & Ooi, K.-B. (2021). QR code and mobile payment: The disruptive forces in retail. *Journal of Retailing and Consumer Services*, *58*, 102300. https://doi.org/10.1016/j.jretconser.2020.102300

Yang, L., Cao, J., Yuan, Y., Li, T., Han, A., & Chan, A. (2013). A framework for partitioning and execution of data stream applications in mobile cloud computing. *ACM SIGMETRICS Performance Evaluation Review*, *40*(4), 23–32. https://doi.org/10.1145/2479942.2479946

Yao, J., Kanhere, S. S., & Hassan, M. (2008). An empirical study of bandwidth predictability in mobile computing. *Proceedings of the Third ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization*, 11–18. https://doi.org/10.1145/1410077.1410081

Yoo, J. (2023). The effects of augmented reality on consumer responses in mobile shopping: The moderating role of task complexity. *Heliyon*, *9*(3), e13775. https://doi.org/10.1016/j.heliyon.2023.e13775

Zeng, J.-Y., Xing, Y., & Jin, C.-H. (2023). The Impact of VR/AR-Based Consumers' Brand Experience on Consumer–Brand Relationships. *Sustainability*, *15*(9), 7278. https://doi.org/10.3390/su15097278

Zhang, T., Zhao, S., Cheng, B., Ren, B., & Chen, J. (2019). Research, implementation, and improvement of MPTCP on mobile smart devices. *International Journal of Computers and Applications*, *41*(6), 407–417. https://doi.org/10.1080/1206212X.2018.1455020

Zhang, W., Wen, Y., Zhang, Y. J., Liu, F., & Fan, R. (2017). Mobile cloud computing with voltage scaling and data compression. *2017 IEEE 18th International Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, 1–5. https://doi.org/10.1109/SPAWC.2017.8227788

Zhang, X., Chen, H., Zhao, Y., Ma, Z., Xu, Y., Huang, H., Yin, H., & Wu, D. O. (2019). Improving Cloud Gaming Experience through Mobile Edge Computing. *IEEE Wireless Communications*, *26*(4), 178–183. https://doi.org/10.1109/MWC.2019.1800440

Zhao, T., Zhou, S., Sun, Y., & Niu, Z. (2023). A Predictive Frame Transmission Scheme for Cloud Gaming in Mobile Edge Cloudlet Systems. *IEEE Transactions on Mobile Computing*, *22*(7), 3774–3789. https://doi.org/10.1109/TMC.2022.3149056

Zhou, W., Tan, J., Xie, Y., & Xu, Q. (2010). A Scalable Multi-Service Collaboration Mobile Computing Middleware System Architecture. *2010 2nd International Workshop on Database Technology and Applications*, 1–4. https://doi.org/10.1109/DBTA.2010.5659110

Zienarski, P., & Such-Pyrgiel, M. (2019). Dijital Dönüşüm Çağında Sürdürülebilir Turizmin Gelişimi. *OPUS Uluslararası Toplum Araştırmaları Dergisi*, *10*(17). https://doi.org/10.26466/opus.530216