

## Implementation of the internet of things on smart posters using near field communication technology in the tourism sector

Muhammad Luthfi Hamzah<sup>1</sup>, Astri Ayu Purwati<sup>2</sup>, Sutoyo<sup>3</sup>, Arif Marsal<sup>1</sup>, Sarbani<sup>4</sup>, Nazaruddin<sup>5</sup>

<sup>1</sup>Department of Information System, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Pekanbaru, Indonesia

<sup>2</sup>Department of Management, Faculty of Business, Institut Bisnis dan Teknologi Pelita Indonesia, Pekanbaru, Indonesia

<sup>3</sup>Department of Electrical Engineering, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Pekanbaru, Indonesia

<sup>4</sup>Department of Math, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Pekanbaru, Indonesia

<sup>5</sup>Department of Industrial Engineering, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Pekanbaru, Indonesia

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### ABSTRACT

Tourism promotion in Pekanbaru is one step in increasing the number of tourists visiting Pekanbaru City. Through tourism promotion, tourists will find out where the locations are in Pekanbaru and information related to these tourist objects. This research aims to design a tourism promotion system using near-field communication (NFC) smart posters using smartphones in the city of Pekanbaru and apply NFC technology to Android smartphones in the city of Pekanbaru. Promote tourism in the city of Pekanbaru. They were testing this application with the System Usability Score, which had a good score of 74.30. This study shows that the planning and modeling of the smart poster system using NFC technology makes it easier to identify important information for every tourism activity in Pekanbaru. The results of this study are the design and product of an intelligent poster using NFC on an Android smartphone that can help users achieve information so that it is more effective and efficient.

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### Corresponding Author:

Muhammad Luthfi Hamzah

Department of Information System, Faculty of Science and Technology

Universitas Islam Negeri Sultan Syarif Kasim Riau, Pekanbaru, Indonesia

Email: Muhammad.luthfi@uin-suska.ac.id

## 1. INTRODUCTION

In the era of the industrial revolution 4.0, all digital-based industries involving interactions between humans, machines, data, and everything are now known as the "internet of things" (IoT) and "cyber-physical systems" (CPS) [1]–[3]. The increased demand for precise, effective, and efficient technology and information systems to make it easier to carry out activities in the business, social, and educational sectors has fueled the rapid rise of information technology [4], [5]. As computer technology gets better, so does the way people work as a system. This has led to a big shift toward information systems based on computers and smartphones [6], [7].

The smart city refers to urban innovation and transformation that intends to use infrastructure, information and communication technology (ICT), knowledge resources, and social infrastructure to promote economic regeneration, social cohesion, improved municipal administration, and infrastructure management. Smart City is a technology that combines technical innovation, organizational innovation, and policy innovation to make it simpler for people to access information and move rapidly and flexibly [8]–[11].

Tourism promotion in Pekanbaru is one step in increasing the number of tourists visiting Pekanbaru City. Tourists will be aware of the locations in Pekanbaru, as well as information about these tourist attractions, thanks to tourism promotion. With this strategic location, Pekanbaru City also has a lot of tourism potential, which can be categorized into recreational tourism, nature tourism, cultural tourism, special interest tourism, religious tourism, historical tourism, and shopping tours. For this reason, it is necessary to take more severe handling actions to attract interest and increase tourist visits to Pekanbaru City. This study aims to design a tourism promotion system in Pekanbaru using an NFC smart poster and a smartphone, as well as to apply NFC technology to an Android smartphone in order to promote tourism in Pekanbaru.

NFC is one of the most critical advancements in wireless communication technology because it allows radio frequency identification (RFID) technology to be integrated into mobile devices. This technology is used in ubiquitous computing to obtain various information and services from multiple sources at any location. Creating tools that give all of the fundamental choices for deciding, storing, and retrieving this information and services is required to create an intelligent environment where we can acquire knowledge from items around us via NFC. Furthermore, these tools must interface with various devices and RFID tags using different standards set by the NFC Forum. This paper covers the tool and how it may be used in a university setting. Several varieties of smart posters, such as faculty smart posters, have been created with this goal in mind [12], [13].

Smart posters are an exciting new application for NFC and QR-Code capable mobile devices; however, no security mechanism is currently in place. Secure Smart Poster for Android Using NFC (SPAN) is a three-part smart poster system that includes an administrator web interface for managing posters, backend servers for storing and serving data, and Android apps for end users. S-SPAN enforces smart poster data integrity and the authentication and authorization of administrators and end-users, thereby ensuring that only authorized users can access the content. This project may be used for college projects. This is a relatively secure method of distributing homework to students [14], [15]. Smart tourism is a new phrase used to describe how tourist locations, their industries, and their visitors are becoming increasingly reliant on developing types of ICT that allow enormous volumes of data to be translated into value offerings. However, it is not defined as a notion that impedes its theoretical growth. This paper describes smart tourism, examines current smart tourism trends, and then sets out the technical and business basics. A brief review of the benefits and downsides of smart tourism follows. This report also emphasizes the critical importance of research in creating and managing smart tourism. NFC, particularly NFC tags and smart posters, can aid in destination service quality, branding, and marketing for tourist professionals [16]–[19].

Data-intensive computing (Big Data), open-source, large-scale distributed systems, IoT, physical computing, cybersocial networking, service orientation, and cloud computing are crucial concepts for realizing the Smart City vision [20], [21]. Real-world smart cities are supported by a mix of paradigms that use a mix of architectures (centralized, decentralized, or a combination of both) and infrastructures like middleware and IoT platforms to support the creation of smart city applications and information systems [22], [23].

Cities are about their citizens, the people who live in them and interact with them. Fortunately, thanks to the continued development of sensing and communication technologies, interactions between people and the virtual and physical worlds can be digitized, recorded, and aggregated, opening up new opportunities for monitoring urban activity on an unprecedented scale [24]. Data is essential to developing smart cities in the current era of big data. They look at how far Chinese cities have come, what problems they face, and what opportunities there are for the future [25], [26].

The smart city is a place full of cameras, sensors, big data analytics, control centers, and the like. Smart cities are closely related to the IoT. The IoT has been hailed as a promising technology that can address a wide range of societal issues [27], [28]. Many firms, according to Cisco, are experiencing IoT, which is a network link between actual items and virtual worlds. Individuals, society, and the corporate sector now have new chances to access large amounts of data and build new applications and services, resulting in a cleaner environment and a wiser society. This technology enables users to track, regulate, and affect their energy consumption and create renewable energy on their own (for example, by using solar panels). Choosing when and how to charge your electric car is one way to maximize renewable energy usage while lowering costs. Consumers may use smartphones or tablets to get information on the system's renewable energy supply and how much power it costs [29], [30].

In the Industrial Revolution paradigm framework, studies in the literature demonstrate that the application of the fourth industrial revolution will lead to new risks and possibilities in the tourism industry, particularly in transportation, marketing, visitor expectations, and types of services [31], [32]. Big data analytics, cloud systems, the IoT, and simulations have the potential to transform tourist service delivery and marketing. Customer demands will be easier to understand and satisfy due to product digitalization, big data, and cloud computing. Intelligent buildings and cybersecurity applications will have a significant impact on the physical environment of the hospitality industry. Excursions to locations and facilities in a virtual

environment, bookings, hotel selection, and food and beverages may be arranged in advance using the Industry 4.0 application. Intelligent robots might provide greetings, transfers, waiter service, payments, marketing, on-site guidance, and food and drink orders. Producers and consumers can also share innovation and diverse experiences based on high technology employment in this scenario [33], [34].

Furthermore, with the implementation of Industry 4.0, such a technique will undoubtedly result in a multi-faceted transformation for visitors and managers seeking a unique experience in the industry's future. Finally, it appears that throughout the fourth industrial revolution, tourism will continue to promote peace, stability, and the restoration of socio-cultural links between nations. As a result, new trends in the tourist business will result in new revolutionary processes [35], [36].

The majority of smartphones today include several sensors that may improve and build new user experiences. This is true for integrated cameras capable of scanning visual codes such as Quick Response (QR) Codes, as well as other sensing technologies such as RFID and associated NFC. QR codes and RFID tags have become more popular in the last decade. They were initially employed to track items in the industry, but they have now helped build several novel concepts that combine the real and virtual worlds. RFID and Data Capture is a technology for storing and retrieving data from an identification chip that employs radio waves. RFID tags are the name for these chips. RFID is currently widely utilized in industry for security, access control, transportation, and supply chain management, among other uses. A reader/writer, an RFID tag, and a software program for data processing are the three essential components of an RFID system [37], [38]. A radio frequency unit, a baseband processor, and an NFC controller with an antenna are required components of an NFC-enabled mobile device. It also has a secure smartcard chip called a specific element that may be used for emulation mode tags, which allow mobile devices to function as smart cards [39], [40].

## **2. RESEARCH METHOD**

This research methodology includes a framework that includes identifying the scope, determining objectives, studying literature, analyzing problems, designing models with UML, designing library management systems with NFC, system testing, implementation, evaluation, and product launching. The framework for this research method describes how an Android-based NFC smart poster was used to promote tourism in Pekanbaru as a step toward making it a smart city.

### **2.1. Scope identification**

At this stage, the authors identify the scope of the research, which aims to maintain the consistency of this research so that it is more focused and the expected goals of the research are achieved. In identifying this scope, the author sets the boundaries of the problem to be solved. In this case, it is in the form of UML modeling to design the Pekanbaru tourism promotion system towards a smart city using an Android-based NFC smart poster.

### **2.2. Setting goals and studying literature**

After limiting the scope and formulation of the problem in the topic under study, the next step is to determine the framework of the objectives of the research being carried out. The purpose of this research is to determine how to design a UML model for the design of the Pekanbaru tourism promotion system towards a smart city using an Android-based NFC smart poster. The next step is to study the literature so that it can be selected to determine which literature will be used in this study. Journal articles about library management, smartphones, Android, NFC, and other reading materials that help with research are used as literature sources.

### **2.3. Problem analysis**

Problem analysis is carried out to understand the problems that have been found in field research. By analyzing the problem, it is hoped that the problem can be properly understood to determine the steps for solving it. The problem in question is how to design and build an application for tourism promotion in Pekanbaru toward a smart city using an Android-based NFC smart poster.

### **2.4. Data collection and model design**

After analyzing the problem, the next step is to collect the data needed to design the Pekanbaru tourism promotion system towards a smart city using an Android-based NFC smart poster. After obtaining the analysis of the problem, it was carried out. The next step is to put the problem into the form of a UML model. Later, an Android-based NFC smart poster will be used to build a tourism promotion app for Pekanbaru's move toward becoming a smart city. This will be done with the help of the UML model.

## 2.5. System planning

The results of the model's design will then be implemented into the design of the Pekanbaru tourism promotion system aimed at creating a smart city using an Android-based NFC smart poster. In this case, the system in question is an Android-based learning application. This design will later be made in accordance with NFC technology on Android using the Java programming language with the help of Android Studio software so that this application can run smoothly on Android-based smartphones.

## 2.6. System test, implementation, evaluation and product launch

The designed system is then tested to see how well it meets expectations using the System Usability Score Test. The system that was built was implemented in the promotion of tourism in Pekanbaru towards a smart city using an Android-based NFC smart poster. Following implementation, the program is evaluated to determine its shortcomings as well as its effectiveness, efficiency, and practicability. The product will launch after being evaluated so that there are no shortages and it can be used continuously.

## 3. RESULTS AND DISCUSSION

### 3.1. System analysis and need analysis

Analysis is the breakdown of a large-scale information system into its constituent parts. In order to propose adjustments, it is necessary to identify and assess problems, possibilities, and obstacles. The goal of the needs analysis is to determine what is required for the system that is constructed and to understand the supporting needs of the system design.

#### 3.1. Functional needs analysis

Functional requirements are the types of requirements that describe the processes that the system will perform. Information that must exist and be made by the system is also part of the functional requirements. This includes the following:

- a) This system will display a main menu page with several menus, namely: add data menu, update/edit data menu, view inventory data, delete data.
- b) When the user selects a menu, the application will display a new page containing a list of information based on the chosen menu.
- c) This system can display information according to the selected menu.
- d) There is an additional data menu by attaching an Android smartphone equipped with NFC technology to the NFC tag on the poster, then entering the computer data into the NFC tag and the database.
- e) In the view data menu by attaching the android smartphone to the NFC tag it automatically reads the contents of the tag.

#### 3.2. Non-functional needs analysis

Non-functional needs are those that have behavioral aspects that belong to the system., including hardware requirements, software requirements (software) and human resource requirements.

- a) Analysis of hardware requirements  
Hardware requirements analysis aims to find out exactly what hardware is needed. The hardware needed for the creation and implementation of applications are:
  - i) Hardware requirements for manufacture:
    - AMD Dual Core A9-9420 3.6 GHz
    - RAM DDR4 4 GB
    - 1TB ATA hard drive
    - Samsung Monitor 21"
    - Keyboard and Mouse
  - ii) Hardware requirements for implementation:
    - Xiaomi MI 8 Mobile with Android OS
    - Processor Octa-core Max 2.8 GHz
    - 6GB RAM
    - NFC tag (Ntag 216)
- b) Analysis of software requirements (software)  
Software is a device that functions to carry out work on data processing systems to support the operation of computer systems that can be obtained free of charge because the supporting applications are open source. The software needed for the creation and implementation of applications are:
  - i) Software requirements for manufacturing:
    - Windows 10 OS

- Eclipse/Android Studio
- Android SDK
- Android Development Tools (ADT)
- Java Development Kit (JDK)
- ii) Software requirements for application:
  - Android 9 (Pie)

### 3.3. System design and global system design

This stage is in the process of designing a better system and can run in accordance with the various aspects of the problems and needs described previously. The system design on a smart poster using NFC technology is designed using a tool in the form of unified modeling language (UML) to make it easier to transfer the designed concept into program form, where the design is described in the following diagrams.

#### Use case diagrams

Use cases describe how someone will use or utilize a system or application that describes the processes carried out by the user on the system or application. The function of the use case diagram is: Useful to show the process of activities in sequence in the system, Able to describe business processes, even displaying the sequence of activities in a process and as a bridge between the software developer and the consumer to describe a system. Here is Figure 1 about the use case diagram of the system design on Smart Poster using NFC technology:

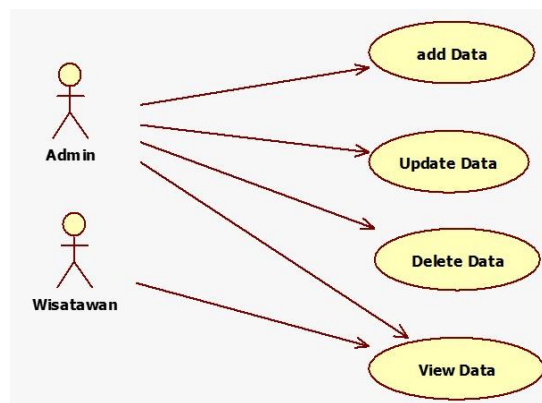


Figure 1. Use case diagram

### 3.4. System implementation and testing

After the system is analyzed and designed, the system is ready to be implemented or implemented. The implementation stage is where the user uses the system created. Before it can be used properly by users, the system must go through a testing phase first to ensure that no fatal problems arise when users use the system. If the software system has passed the testing phase, then the software system is ready for use.

### 3.5. System implementation

System testing aims to see whether the designed system is by what is expected, after testing, the quality of a system will be seen. The following is a system page display that has been designed, starting from the splash screen, home page, writing data into the tag page and reading data from the tag on the android application. The following smart poster has been made in Figure 2 and and in Figure 3 is showing the menus for entering data into the NFC tag.

Figure 3 shows that the user will fill the tourism information form into the NFC tag and database, then the user will attach his android smartphone to the NFC tag. The following is the display of writing data into the NFC tag, as shown in Figure 4. After the software is made the next step is testing. System testing is carried out to see how far the results are similar to the output of this system. First, writing data to the NFC tag is carried out, then reading the data from the NFC tag. The output displays the information obtained according to the data entered into the tag.



Figure 2. NFC smart poster

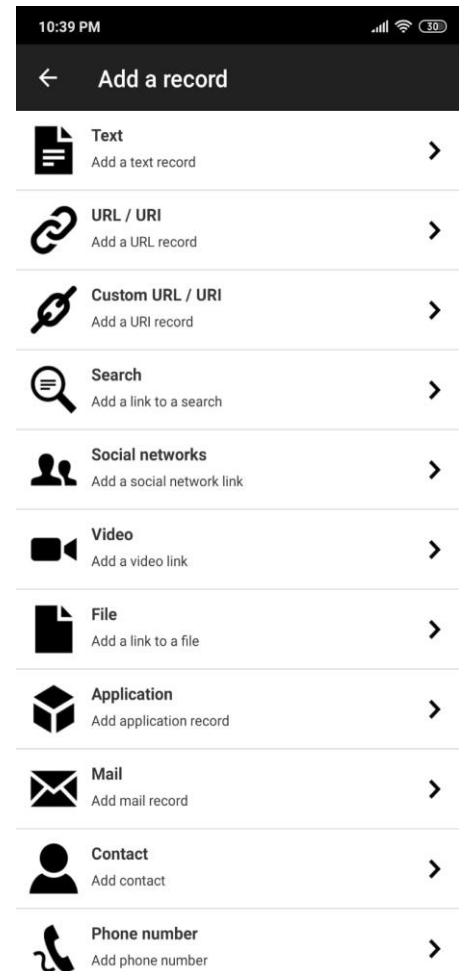


Figure 3. Write data to NFC tag

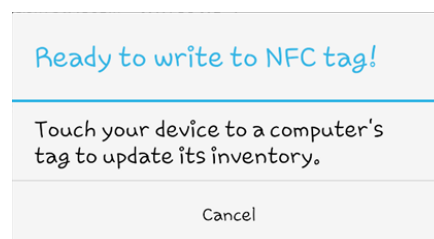


Figure 4. Add Data to NFC Tag

### 3.6. SUS calculation

The SUS score is calculated using 36 respondents; for odd-numbered questions, the weight of the answers obtained is reduced by one, and for even-numbered questions, the weight of the answers produced is reduced by five. To get the overall SUS score, the value of the first and second processes is multiplied by 2.5. So, in this study, the SUS score was 74.30. The adjective rating is an aspect in determining the rating on the application, and for calculating the SUS score that has been obtained, which is 74.30, it is included in the "good" category. The grade scale is an aspect in determining the quality level of the application; with a SUS score of 74.30, it is included in the grade C category. Acceptability Ranges play a role in determining the level of acceptance of the application; an SUS score of 74.30 places the application in the acceptable marginal category, indicating that it is already well accepted.

#### 4. CONCLUSION

Planning and modeling systems on smart posters that make use of NFC technology make it simpler for every tourist in Pekanbaru to identify information that is crucial to their experience. The Near Field Communication (NFC) mechanism included on Android smartphones has the potential to simplify the process of obtaining information and make users more productive and efficient. The use of NFC technology in the Smart Poster system, which was used in the modeling and design of the aforementioned system, can then be developed and applied to other units in other districts in Riau. This will allow for the realization of an overall and perfect enterprise architecture, as well as the need for further socialization to all stakeholders, which will ensure that the system runs according to expectations and goals.

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## BIOGRAPHIES OF AUTHORS






**Muhammad Luthfi Hamzah**    is a lecturer at the Information Systems Department, Faculty of Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia. He received the B.IT in Software Engineering from Universiti Utara Malaysia (2008–2011), the M.Kom in Computer Science from Universitas Putra Indonesia YPTK Padang (2015–2016), and the Dr. in Technical and Vocational Education at the Engineering Faculty of Universitas Negeri Padang (2017–2021). His research interests include management information systems, software engineering, UI/UX, AR, VR, blended learning, the internet of things, and artificial intelligence. He can be contacted by email at muhammad.luthfi@uin-suska.ac.id.






**Astri Ayu Purwati**    is a lecturer at the Management Department, Faculty of Business, Institut Bisnis dan Teknologi Pelita Indonesia, Indonesia. She graduated with a Bachelor of Science (B.Sc.) in Biotechnology Management from Universiti Kebangsaan Malaysia (2008–2011), a Master of Science (M.Sc.) in Quality and Productivity Improvement from Universiti Kebangsaan Malaysia (2011–2013), and a Doctor of Philosophy (Ph.D.) in Management Science from Sekolah Tinggi Ilmu Ekonomi Indonesia Surabaya (2014–present) (2018–2021). Her areas of interest in study include quality management, human resources, marketing, strategy, and information management for management. She can be contacted by email at: astri.ayu@lecturer.pelitaIndonesia.ac.id.








**Sutoyo**    is a lecturer at Electrical Engineering Department, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia. He received the ST in Electrical Engineering from Universitas Islam Negeri Sultan Syarif Kasim Riau, M.T in Electrical Engineering from Institut Teknologi Sepuluh Nopember. His research interest include Ionosphere, Radio HF Channel, Signal Quality, Communication Propagation Model. He can be contacted at email: [sutoyo@uin-suska.ac.id](mailto:sutoyo@uin-suska.ac.id).






**Arif Marsal**    is a lecturer at Information System Department, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia. He received the LC from Al Azhar University, M.A in Universiti Kebangsaan Malaysia. His research interest include Fiqh, Study Quran, Hadits, Morals, Information System in Islam. He can be contacted at email: [arif.marsal@uin-suska.ac.id](mailto:arif.marsal@uin-suska.ac.id).



**Sarbaini**    is a lecturer at Math Department, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia. He received the S.Si in Math from FMIPA Universitas Riau (2015), M.Si in Math from Institut Teknologi Bandung (2019). His research interest include graph theory and its applications. He can be contacted at email: [sarbaini@uin-suska.ac.id](mailto:sarbaini@uin-suska.ac.id).



**Nazaruddin**    is a lecturer at Industrial Engineering Department, Faculty Science and Technology, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia. He Received ST degree in industrial Engineering from Sekolah Tinggi Manajemen Industri 2015 and the MT degree From Universitas Trisakti 2019. His research interest include Total Quality Manajement, Risk manajement, Production System. He can be contacted at email: [nazar.sutan@uin-suska.ac.id](mailto:nazar.sutan@uin-suska.ac.id).