International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 01 | January - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

Advance Payment System using Wireless RFID Technology

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Abstract - As the world is moving toward a digital era, cashless payments are quite in demand. Smart cards that need to be swiped are vulnerable to skimming attacks and data theft. Thus, there is a need to have a cashless transaction system that is fast as well as secure and allows hassle-free transactions. This Work propose a novel approach to develop an advanced cashless payment system based on RFID that can be deployed anywhere to enable faster smoother, and secure transactions. The users of the system will have to be pre-registered and all the user-related information will be saved in a MySQL database the system will be programmed using HTML, CSS, and PHP or any supporting back-end programming language. The RFID reader will interact with a microcontroller ESP32 WROOM and the Microcontroller will be connected with an application using a WIFI module built into the micro-controller.

Key Words: RFID Technology, Wireless Payment Systems, Secure Transactions.

1.INTRODUCTION

In this era, the uses of mobile applications are more advanced. Nowadays, the Smartphone is a multifunctional device in addition to making a call and sending messages and is recognized as an important tool in human daily lives. With the rise of new technology mechanisms such as RFID, NFC IOT, and Biometrics, the latest smartphones become more reliable than their predecessors. Same for the payment system a secure and convenient way of making a payment is the cashless transaction Cashless transactions are a way of making payments without the use of physical cash, a gateway to technological advancement in the field of world economy. Cashless payment is a behavioral change in people where people eliminate the usage of money as a medium of exchange for goods and services by allowing electronic transfer payments or non-electronic payments via cheques. Most of the research suggests that even though cashless payment systems are growing rapidly across the world, the hard currency remains resilient. By adopting an electronic payment system an economy leads to a cashless society.

Radio Frequency Identification (RFID) enables flexible, wireless, automatic identification of an object or person using radio waves. It transmits the identity as a unique serial number [1, 2]. Radio Frequency Identification Technology (RFID) has moved from obscurity into mainstream applications that help speed up the handling of manufactured goods and materials [3]. A few of the advantages of RFID described in [4] are highlighted below:

- The User can read and write data to RFID tags without direct contact and no line-of-sight problem.
- No maintenance costs RFID can work in different environments and can be used effectively for over 10 years.
- Fast read and write with the time taken for read/write being a few milliseconds.

Storing and maintaining a database will ensure that only authorized users can make a transaction. This will also solve the issue of multiple tags near the reader. In this work a handheld device has been designed and programmed as a smart card with an RFID reader using Micro-controller ESP32 WROOM. Recharging the smart card with money can be done through an authorized bank or at recharge points. In, a transaction system is developed that uses Tensilica Xtensa LX6 dual-core as the processor. [5] They have made use of an RFID reader which includes a contactless RFID tag. The reader will be connected to a PC via WIFI. [2] The advantages of the system are: Centralized data storage, adds to the safety. Eases the transactions. It can be installed in any scenario. Advance payment System using wireless RFID technology is invented to help the customer to make payment without involving any cash but using an RFID tag that contains electronic cash yet it can increase the smoothness while making payment.

2. OBJECTIVES

This work aims to identify an RFID technology which is been applied in an advanced Payment System. Here, the stated objectives as

1. To develop an advanced payment system using Wireless RFID Technology.
2. To apply RFID technology in authorizing the payment using an RFID card or Tag

This development model design the new web application by recognizing an RFID chip that has been embedded within the RFID card or tag and the credit data to maintain all transaction records. The transaction like Credit and debit of amount from the card and update the balance in the database. It is structured to the use of the RFID concept. Storing and maintaining a database will ensure that only the authorized user can make transactions. And all the processes will be completed with wireless content using wireless technology and RFID Reader.

3. LITERATURE REVIEW

Enhanced Payment Speed and Convenience Numerous studies have demonstrated how RFID technology has expedited the payment process. [4] An article revealed that contactless RFID payments enable users to complete transactions up to 10 times faster than traditional payment methods. The seamless tap-and-go functionality minimizes the time spent at checkout, making it a convenient choice for consumers. Improved Security RFID technology has also significantly improved payment security. [6] Research shows how RFID-equipped payment cards generate dynamic authentication codes for each transaction. This dynamic data authentication makes it extremely difficult for fraudsters to replicate or intercept payment information. Accessibility and Inclusion RFID payments have been hailed for their inclusivity. [8] A study highlighted that RFID technology has opened doors for those who previously faced challenges with traditional payment methods. It offers a simple and reliable solution for individuals with physical or cognitive impairments, thereby promoting financial inclusion.

[4] Security and Privacy Concerns Discussion of the security challenges and privacy issues associated with RFID payments. Examination of encryption and authentication methods used to address security risks. Consideration of the protection of user data and personal information. Challenges and Future Directions Highlighting the obstacles to the widespread adoption of RFID in payment systems. [7] Discussion on emerging trends, innovations, and the potential for combining RFID with blockchain and NFC technologies for secure and seamless payments.

Fraud Prevention and Security Measures Detail the security measures and fraud prevention mechanisms incorporated into RFID payment systems. Highlight the role of tokenization, biometrics, and other technologies in safeguarding transactions.[2]

Cost Savings and Efficiency investigate the cost savings achieved by businesses and organizations through the implementation of RFID payment systems. Discuss how RFID technology enhances operational efficiency and reduces overhead costs. Integration with Mobile Devices Explore the integration of RFID technology with mobile devices, such as smartphones and wearables, to facilitate contactless payments. Examine the role of mobile apps and digital wallets in enabling RFID-based transactions. [10] User Adoption and Acceptance Analyze user adoption rates and the acceptance of RFID-based payment methods in different regions. Discuss the factors that influence consumer trust and willingness to use RFID-enabled payment systems. [10]

[8] Contactless Payment in Pandemic Response Explore the role of contactless payments and RFID technology during the COVID-19 pandemic. [8] Analyze how these technologies facilitated safer and more hygienic payment options. Financial Technology (fintech) Integration Examine the integration of RFID payments into the broader financial technology (fintech) ecosystem. [9] Discuss how fintech start-ups and established financial institutions are leveraging RFID technology. Analyze the impact of RFID payments on traditional banking services and brick-and-mortar branches. Discuss how financial institutions are adapting to the shift towards digital payments. [3] Highlight RFID payment solutions in various industries beyond retail and transportation, such as healthcare and hospitality. Analyze the specific benefits and challenges in these sectors.

4. METHODOLOGY

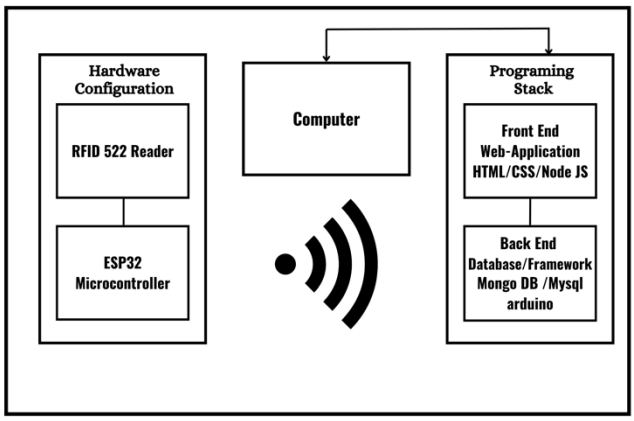

Fig -1: Methodology for Advance payment system

As shown in Fig 1, the methodology implemented there are 2 main segments of project first segment is the hardware configuration and the second segment is the Programming Stack. In the first segment configuration of all the required hardware components like RFID reader, ESP32 Microcontroller, piezo Buzzer, and 1Kohm resistor all the components are connected to the PCB board all the Components are controlled by the Micro-controller and the Microcontroller is connected with PC using inbuild WIFI modal and the Data and instruction are transfer over WIFI.

In the second segment, there are two main parts first part is the Front End of the web application. The web application will be developed using programming languages like HTML and CSS or Bootstrap Framework and for logical implementation, use of PHP and Node Js. In second part is a back end in which the database and the Hardware framework implementation. The database use of Mongo DB and MySQL. For Hardware Framework Arduino University Framework used.

This involves selecting RFID tags operating at a suitable frequency, integrating them with wireless RFID readers, and establishing communication protocols. Simultaneously, a robust software framework is developed, encompassing backend servers, payment gateways, and secure databases. The hardware and software components are intricately interwoven to create an efficient Advance Payment System using Wireless RFID Technology. Rigorous testing, validation, and user feedback are crucial stages, ensuring seamless integration and functionality. The methodology employs an iterative process, refining both the hardware and software aspects to achieve an optimized and secure RFID-based payment system. The Projects employs a two-fold approach, beginning with the design of the hardware configuration.

5. ARCHITECTURE BLOCK DIAGRAM

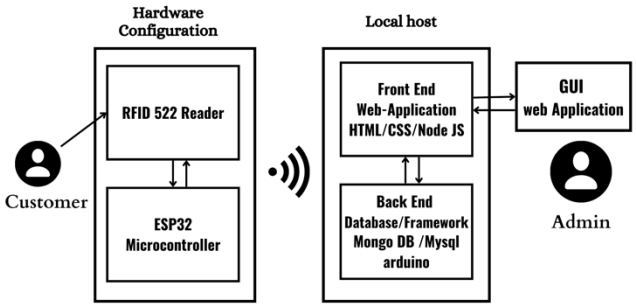

Fig -2: Architecture Diagram

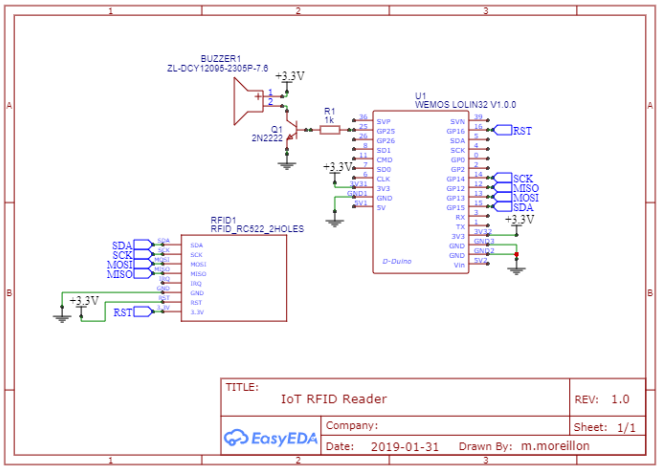

Fig -3: Circuit Diagram

In Figure 2, the complete workings and how each transaction takes place is shown. First the customer will tap their RFID card on the RFID reader. The RFID reader is connected to the microcontroller. Then the micro-controller will get data from the RFID card or tag and it will send the data to the local host which is connected using WIFI and will check the data if the user is already registered then it will show the user profile to the admin or it will display a message that user not found. The RFID reader will be used to read and write data on the RFID card or tag.

When the RFID card is tapped, it only reads the unique card ID, which serves as the primary key to identifying each user. The remaining data is stored in the localhost database for security purposes and to speed up transactions. The database contains all the details, including name, phone number, address, transaction history, and balance. The administrator has the right to create a new user, add the balance to the card, or debit the balance on the card. The Figure 3 shows all the connections of the hardware components used like an RFID reader, microcontroller, Buzzer, transistor, resistor, and all components are connected in the circuit. The SSD1306 OLED display will display the amount that needs to be paid to the shop and will be connected to all the components in the series using the customized print circuit board. In order to confirm that the payment was successful, there is a small buzzer that makes a small sound after the payment is completed. The micro-controller will control all the components and the data and instructions will pass through it. At the core of the circuit is the RFID module, consisting of an RFID reader and an antenna. The RFID reader emits radio waves to activate RFID tags in proximity and captures the unique identification data from the tags. The antenna plays a crucial role in facilitating wireless communication. Connected to the RFID module is a microcontroller, such as Arduino or Raspberry Pi, serving as the brain of the system. The microcontroller processes the RFID data, manages user accounts, and controls the flow of information between different components. The circuit includes a display unit, which could be an LCD or LED screen, providing real-time feedback to users. It displays transaction details, balances, and prompts for user actions.

6. CONCLUSION

The incorporation of wireless RFID technology into advanced payment systems represents a monumental shift towards a more efficient, secure, and interconnected financial landscape. The elimination of physical contact through contactless RFID payments not only streamlines the payment process but also contributes to a hygienic and socially responsible payment environment, aligning with the evolving needs of a modern society. Moreover, the robust security features embedded in RFID technology bolster the resilience of payment systems against fraudulent activities. The encryption and authentication protocols employed in RFID transactions ensure the integrity and confidentiality of financial data, instilling confidence in users and stakeholders alike. Furthermore, the real-time data transmission capabilities of RFID enhance transaction visibility, providing both consumers and businesses with instantaneous updates on their financial activities.

7. FUTURE SCOPE

With the growth of quantum computing, the development of post-quantum encryption methods will become increasingly critical. Mobile Wallet Integration with mobile wallets and digital payment apps will be a key area of development. RFID technology will be integrated into mobile devices, allowing users to make payments by simply tapping their smartphones or wearables, further reducing the reliance on physical cards. Blockchain Integration the integration of RFID with blockchain technology holds potential for transparent, secure, and immutable transaction records. Blockchain can enhance payment system security, reduce fraud, and streamline reconciliation processes. Research in this area will likely expand. Biometric Authentication Biometrics, such as fingerprint or facial recognition, will play a more significant role in authentication. Users will be able to confirm transactions with biometric data, adding an extra layer of security and convenience.

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