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An Efficient Electronic Payment Using Biometric Authentication

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Abstract— *Traditional identification techniques for electronic payments, such as the Personal Identification Number (PIN), are becoming outdated and unsafe, while mobile payments are becoming more popular and widely used. It presents a risk to issuers since there is no reliable consumer verification method available, and the lack of safe and reliable e-payment systems is one of the key issues restricting progress. As a result, efforts have been made to develop and maintain a unified payment system that is well-organized, efficient, dependable, and secure. This system avoids the need for physical cash while also still satisfying all payment and identification requirements, a safe and trustworthy method is required for the country's successful adoption of an e-payment system. This article focuses on the future of online payment and the security problems through using effective biometric authentication technologies to provide a trustworthy authentication method for an e-payment system.*

Index Terms— *Payment System, IoE, Mobile Payment, biometric, NFC, Smart Card.*

I. INTRODUCTION

Biometric is a science that analyzes and measures biological data. In our technological environment, security is extremely important [1].

An electronic payment system (EPS) is an arrangement of monetary trade among purchasers and merchants in the online medium that is enabled by a computerized budgetary tool (such as encoded credit card numbers, electronic checks or digital cash) supported by a bank, a mediator or by lawful tender [2].

Nowadays Individuals are paying money electronically over the web online. Moreover, this system is important for developing in the new world and making life simple and easy.

An electronic payment system can be defined as the exchange of products and services between two-person, this process would be online without cash by using an electronic card. These cards can be divided based on their use and the features they offer us.

The debit card is the most commonly used e-payment platform, integrating the Internet banking idea with the Automated Teller Machines (ATM) card [3]. Through the debit card, holders make a direct deposit from the bank for products. Debit cards give users the ability to save money at the points of sale in their bank accounts for eventual withdrawal. Ideally, there are two sorts of charge cards: online and offline charge cards [4].

The smart card is a microchip-equipped plastic card that can be pre-loaded with money and only used to allow instant purchases. A chip card is another name for a smart card [5]. Much as a chip card can be used to store currency, the business data of a person can be stored on smart cards. Usually, the smart card is approved with a PIN that the service provider gives the customer. These cards store information in an encoded structure to guarantee data security، they have a high preparation speed. Instances of shrewd cards incorporate VISA and Mondex money cards [5].

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A credit card is another part of the e-payment service in which the card given to the cardholder by a monetary entity is used to make purchases on the internet or occupy an electronic gadget without paper money being used [5]. The foremost famously utilized sort of e-payment is the credit card. In comparison with other EPS, it is not acceptable to use credit cards for small-value exchanges, i.e., exchanges of less than a dollar [3].

E-cash this approach was created as an alternative to the use of credit cards to make payments over the Internet [3]. It is a form of electronic payment arrangement in which a certain amount of cash is deposited on a consumer computer and made available for internet purchases. Electronic money is also known as digital currency because it operates with e-cash software that is installed on the client's computer or electronic system [5]. Electronic cash stands out because of its low cost, making it one of the most attractive payment choices for small businesses [4],[6].

Recently, detected an increase in the number of electronic cards, for example, statistics of the Central Bank of Iraq. Noticeable growth in the number of electronic cards, for different people from 6,377,305 to 11,749,408 cards between 2017 and 2021, increase in the number of POS from 2019 to 2021, nearly three times the previous years, from 2,226 to 7,540 points of sale. distinguish increase in the ATMs machines from 656 to 1,340 between 2017 to 2021 [7],[9]. Overall, these values mean the country's aim to use electronic payment systems and the vital need for these systems because of their features, which are explained in the following sections.

II. RELATED WORK

This section describes the related work about the electronic payment system that focused on the method that used the IoE technique for the future of payment.

In [10], the authors developed a payment system that uses SMS gateway and line API to reach the entire area where the public can employ this system to conduct any transaction, including payments, purchases, top-up balances, and balance transfer, however this method is not suitable for areas without network coverage.

In [11], the authors introduced the use of RFID in public transportation for authentication and offline intelligent payment. This authentication is done with a contactless smart card that serves as an e-ticket and an identity card. The system consists of a Raspberry Pi 3 Model B, MFRC522, and LCD Waveshare 3.5, but in this research, the author does not use modern methods of payment such as smartphones.

In [12], the authors presented a simple payment system based on OneM2M and an IoT gateway through the system. Users may simply order menus from a shop using a smart device by using the IoT Gateway, the store manager may simply check the shop's menu and order status, this system is restricted to a traditional method of use in the online store.

In [2], the authors discuss security Issues of the electronic payment systems For customers and retailers, each payment method has pros and cons. The analysis of security levels concerning fraud vulnerability is highlighted, and they evaluate how this relationship reduces or improves user confidence.

In [13], the authors developed a secure payment system in the vending machine employing radio frequency identification technology has been developed to enhance the traditional cash-based payment system which has a lot of issues and threats.

In recent research, protection methods were used on electronic payment operations, and this is needed at present to develop electronic payment systems and secure them from any possible hacking process.

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III. THE PROPOSED SYSTEM CONSTRUCTION

The proposed electronic payment system contains different sides and components. As a result, it is subdivided into items to make reading easier.

A. System Structure

The system design is made up of a variety of hardware and software that are all connected to ensure that the system runs correctly, these devices are connected with the network as represented in *Fig. 1*.

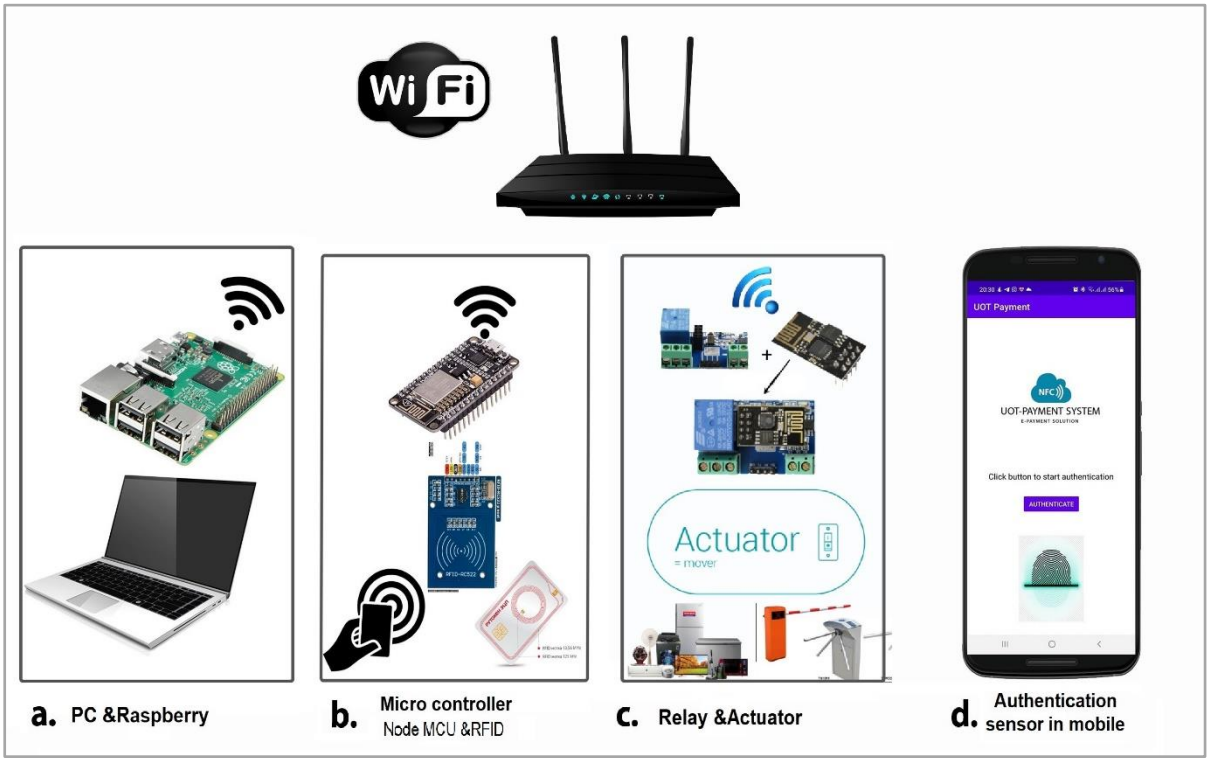

FIG. 1. MAJOR COMPONENTS OF PROPOSED SYSTEM STRUCTURE.

The system consists of four parts:

a. The first part is a local server (Raspberry) and web server (cloud): - this part contains the database, the host of the website can manage the system through it, all main process happens there, and storage all recorded log of purchase for customers.
b. The second part is a microcontroller (NodeMCU) and Card Reader with an RFID tag as shown in *Fig. 2* the clients can use their unique id found in the card to check in with the database. Therefore, these devices help us to verify the identity of the customers with vendors.

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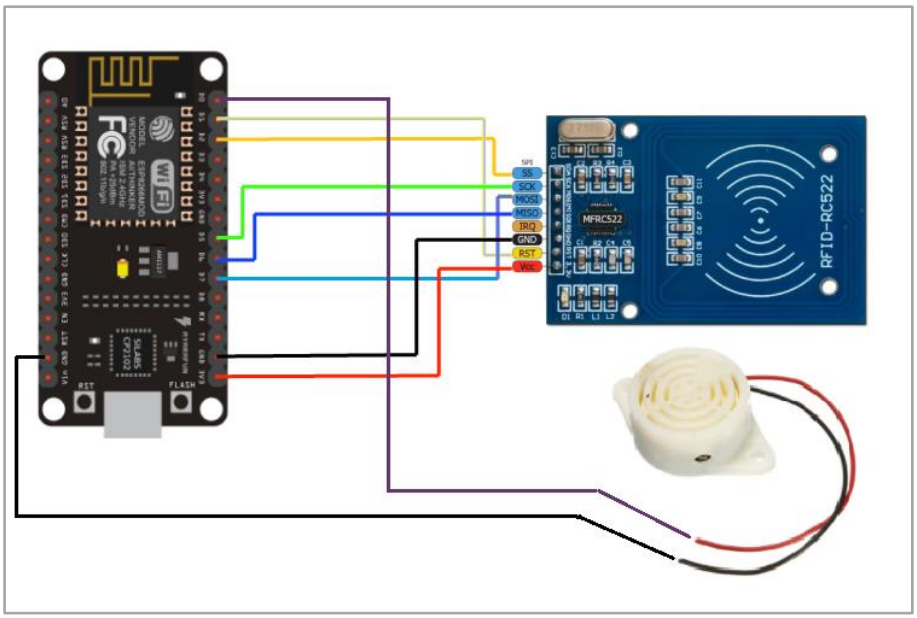

FIG. 2. NODEMCU CONNECTED WITH RFID READER AND BUZZER.

c. The third part consists of Wi-Fi relay and any electric devices: - developed the system to enable service like the open gate of the park, reserve a hall, sports club (GYM), Hotel booking and bus fare, etc. These services may require the operation of an electrical device by using a relay that can control it.

d. The fourth part is the security part consisting of the application and authentication sensor (fingerprint, face recognition) that exists in the smartphone as shown below in *Fig. 3*.

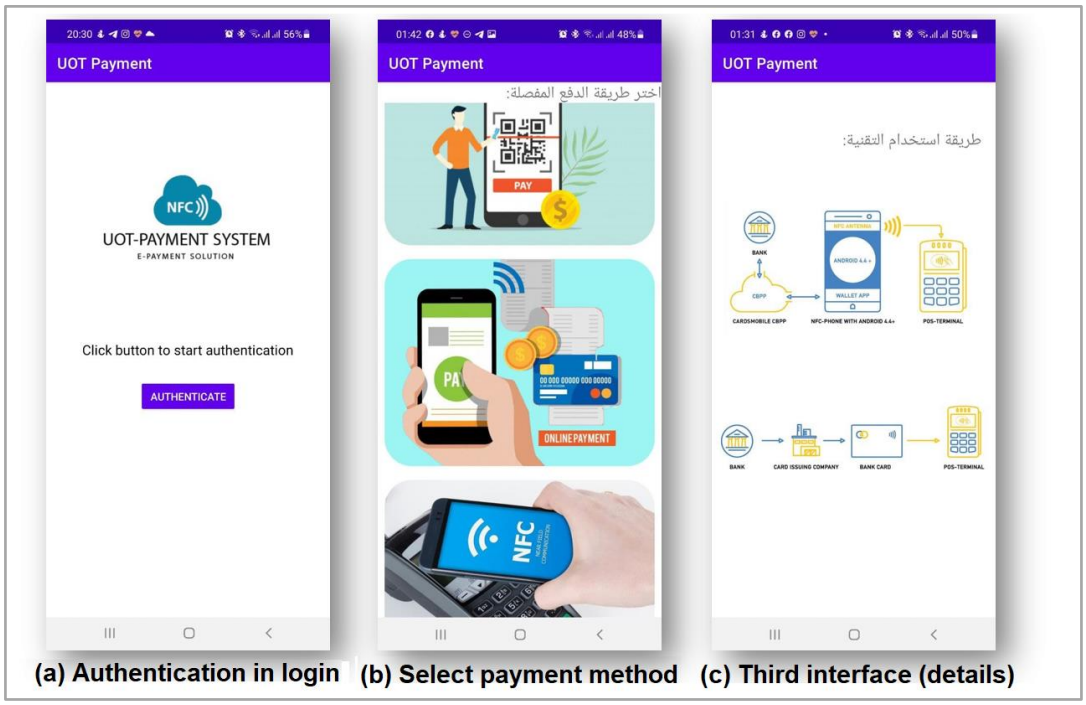

FIG. 3. SMARTPHONE APP WITH LOGIN VIA FINGERPRINT AUTHENTICATION.

programmed a phone application using the Kotlin language and using libraries for fingerprint programming to make the payment process more secure via the smartphone.

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B. The proposed System Architecture

The graphical user interface introduced explains the proposed payment system and divides into two main scenarios.

1- The proposed System For customer

A block diagram includes purchase and the steps are as following: at first, when decided to get some service such as car parking, reservation in a gym, and reserve a meeting room, etc., or this service would be online, for example, buy products (program, antivirus, charge phone balance, etc.)

These items are possibly more than one item, can be put purchasing in the cart, and paid for it as a collection after verification by biometric authentication fingerprint in the smartphone.

The customer uses a smart card (NFC) and verification by phone, gets the notification in Email or SMS containing the success of bought with the amount of balance, and during this process, the client can check if an error occured

This system can apply locally or public as a cloud with other systems connected to the main server with a database, for example, locally in a smart supermarket or online store. The public can be applied in an institution with other departments that work in the cloud. Can be illustrated in *Fig. 4*.

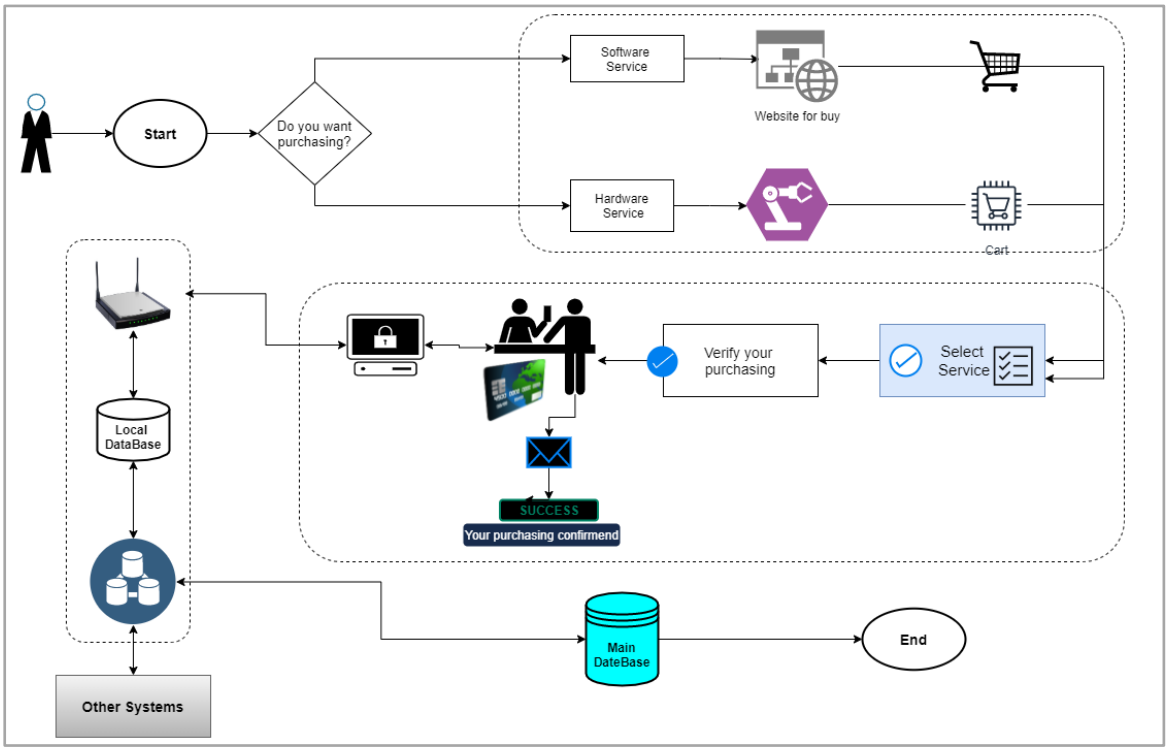

FIG. 4. SYSTEM SCENARIO FOR THE CUSTOMER.

2-The proposed System For Admin

The second system scenario describes the admin panel of the payment system, this dashboard-established user access it by secure login page only for authorized admin and prevents any intruder from accessing. The manager can edit with relevant information about his market or institution, enabling him to check all purchasing happen and provide statistical information per day, per week, per month, and yearly.

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This statistical information enables the manager to make new decisions good for his business and increase productivity. The proposed system for admin can be illustrated in *Fig. 5*.

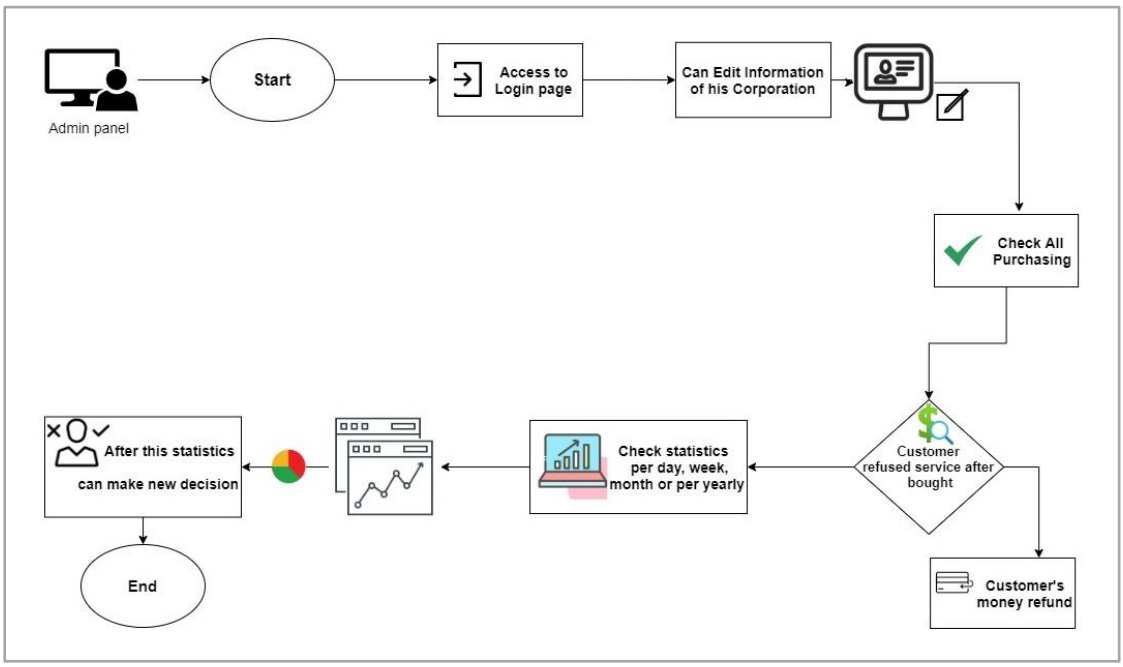

FIG. 5. SYSTEM SCENARIO FOR ADMIN.

IV. RESULTS AND DISCUSSION

A prototype has been implemented in the electronic payment process system by using a microcomputer board in addition to the hardware and software specifications listed below:

- Hardware specified: Microcomputer board (Raspberry Pi3), microcontroller NODEMCU ESP 8266, RFID Reader with RFID Card, relay, and router to connect it.
- The software specified: Php, MySQL, Apache Server, XAMP, and IFTTT server.

The database consists of multiple tables and connects between them through PHP code and relationship by using a unique id, and there is a table for each client consisting of various columns id, name, email, gender, and balance as shown in *Fig. 6*, Relationships between tables illustrator in *Fig. 7*.

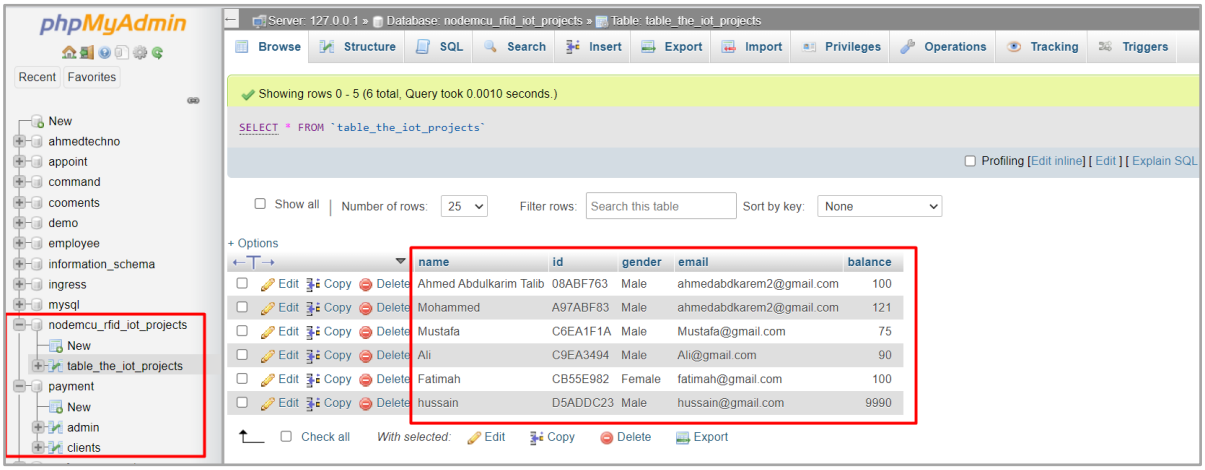

FIG. 6. DATABASE FOR CLIENTS.

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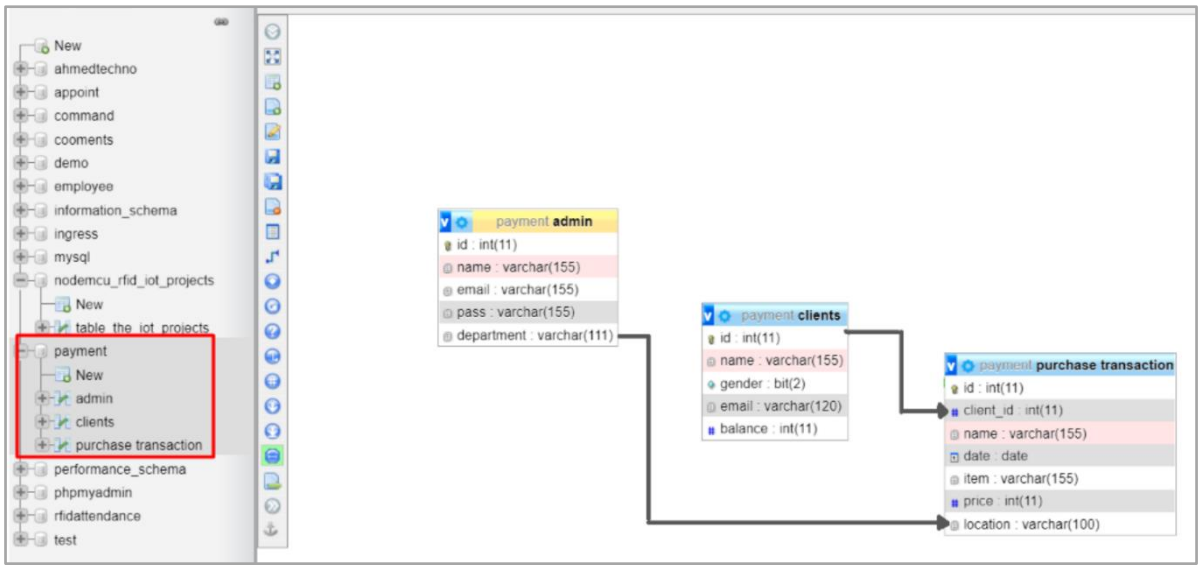

FIG. 7. RELATIONSHIPS BETWEEN TABLES.

The results from this system can be obtained using an (If This Then That) IFTTT server which is a web cloud service that helps us to connect devices of IoE by using APIs (application programming interfaces) to provide functions for integration between different software [14].

In this work, a webhook API will be triggered from NodeMCU esp8266 by RFID Reader when the user makes this action and buy the service as a result of receiving a notification to inform the customer success request [10].

The two methods for this operation are webhooks with email; the customer received an email from the payment system. Webhooks with SMS, the customer received an SMS from the payment system as shown in *Fig. 8*.

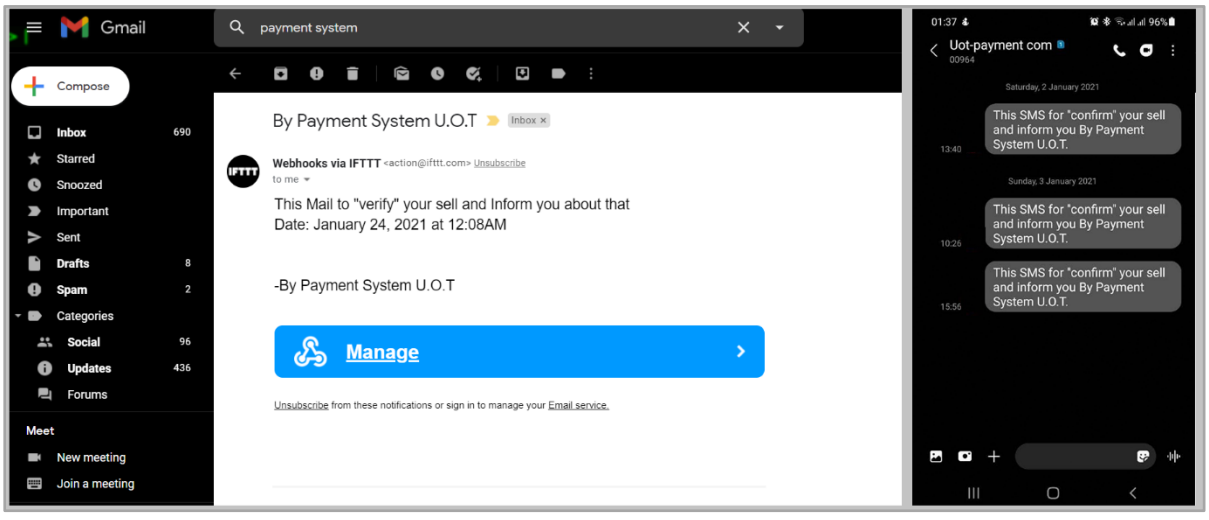

FIG. 8. THE EMAIL AND SMS OF SUCCESS PAYMENT.

This system enables the user to arrange his financial budget and distribute his expenditures in a manner commensurate with his monthly income by analyzing the database according to the type of customer consumption, as illustrated in the chart in *Fig. 9*.

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FIG. 9. THE CHART OF THE CLIENT'S FINANCIAL BUDGET.

V. CONCLUSIONS

Today, payment systems take up large space for electronic commercial transactions in our life, and this system provides flexibility by converting any regular system that requires an accountant to an electronic system without an accountant. Thus, this gives financial liquidity to the country by using the customer's card without using cash, running this money into other projects that benefit society.

This system provides detailed statistics for all purchases and helps us make a financial decision to organize our financial budget, ease of management without the need for additional employees, and organize the work without mistakes, and at a small cost by using IOE techniques

Finally, in the time of coronavirus disease, electronic payment systems have become an important way to avoid potential infection through money, which has greatly affected shopping behaviors around the world, electronic commerce has become more critical than ever.

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