RFID Based Attendance Monitoring System Using ESP8266 Wi-Fi Module and IoT Enabled Mobile Application

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Abstract

Monitoring attendance of people became a very important part of any organization. Earlier, we used paper- based systems to monitor attendance records, which is a very tedious task. Nowadays, many new techniques evolved to monitor attendance records, and RFID (Radio Frequency Identification) based systems are one of them. RFID uses radio waves to transmit data over a short distance. The proposed system uses RFID technology with a Wi-Fi-based microcontroller (ESP8266) to monitor the attendance records. The proposed system provides a way by which we can manage all the attendance related data via a single mobile application. The Firebase Real-time Database will store all the attendance related data. The app provides all the basic features to manage people's attendance like Managing employees, generating and sharing reports, managing departments, controlling multiple attendance management devices, etc.

Keywords— *ESP8266, RFID, Wi-Fi, Firebase, EEPROM, NodeMCU*

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I. INTRODUCTION

In this research paper we are going to discuss the Implementation of RFID Based Attendance Monitoring System Using ESP8266 Wi-Fi Module. And the User Interface for this system, will be developed using Flutter Application Software.

- **ESP8266**: The ESP8266 is an insignificant exertion Wi-Fi microchip, with a full TCP/IP stack and microcontroller limit, conveyed by Espressif Systems in Shanghai, China. This little module grants microcontrollers to interface with a Wi-Fi framework and make direct TCP/IP affiliations. he ESP8266 is set up to do either encouraging an application or offloading all Wi-Fi arranging limits from another application processor. This module has an astounding enough prepared getting ready and limit capacity that grants it to be composed with the sensors and other application unequivocal devices through its GPIOs with immaterial improvement ahead of time and unimportant stacking during runtime.

- **RFID**: It utilizes electromagnetic fields to naturally distinguish and follow labels appended to objects. A RFID label comprises of a modest radio transponder; a radio recipient and transmitter. It uses electromagnetic fields to consequently distinguish and follow labels connected to objects. A RFID label comprises of a small radio transponder; a radio recipient and transmitter. When activated by an electromagnetic cross examination beat from a close by RFID scanner gadget, the tag transmits advanced information, typically a recognizing stock number, back to the scanner. This number can be utilized to stock merchandise [1].

- **Firebase:** Firebase is a real-time database which is hosted on cloud. Data is stored in firebase as the JSON and is synchronized in the real-time to each connected user. Firebase provides the Native integration with different environments like Android and iOS SDKs.

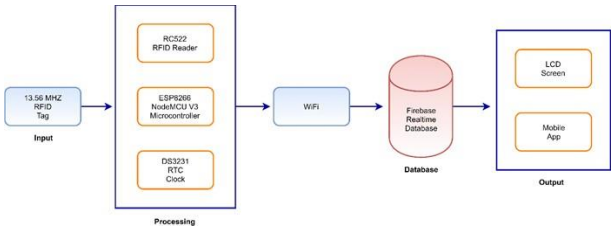

Fig.1. Block Diagram of Proposed System

II. PROPOSED SYSTEM

As per the previous studies, we observed some core points that the system was implemented through web based application. In that study the Arduino UNO R3 was used as microcontroller. The data was stored and managed through PHP and MySQL. And the transmission was achieved through wired media [2].

In our proposed work, we are implementing the technology in more advanced way. In this order, we are using ESP8266 Wi-Fi module as microcontroller. It is wi-fi enabled chip and it is less expensive to the previous work hardware setup. If we talk about the data storage and management, we are using the Firebase database which is real-time database. It is synchronized in real-time to each connected user. The data access and storage is more faster.

We have a comparison table below in which we compared some parameters with the previous work.

TABLE I. COMPARISON BETWEEN PREVIOUS AND PROPOSED WORK

Para meters	**Time Require d**	**Security**	**Bac kup**	**Regis trati on Time**	**User Inter acti on**	**Conn ectivi ty**	**Repo rts**	**Devic e Mana geme nt**
Trad ition al Syst em	Mo re tha n 5 min ute s	More vulner able	No	More than 8 minu tes	Pape r	No	Man ual	No
Previ ous Wor k	Les s tha n 2 min ute s	Authe nticate d person s only	No	1-2 Minu tes	Web - Base d	Ether net	Elect ronic	No
Prop osed Wor k	In sec ond s	Multip le Authe nticati ons and securit y protoc ols	On- De ma nd Dat aba se Bac kup	In Seco nds	Mob ile App- Base d	Wi-Fi	On- Dem and Repo rts with sorti ng funct ionali ty	Multi ple Devic e Mana geme nt Unde r Each User Acco unt

Wi-Fi Credentials. The Wi-Fi credentials saved in the EEPROM of ESP8266 Microcontroller.

III. METHODOLOGIES

We classified our tasks into two major parts i.e. Hardware configuration, in which we'll configure all the hardware components and Software Part, in which we'll develop the Mobile application to operate the complete system.

A. Hardware Part

1) Step 1 (Connect to Wi-Fi)

We are using ESP8266 NodeMCU V3 Microcontroller in our project, which is Wi-Fi-enabled. When we start the device, it starts the Station mode and tries to connect to a previously saved Access Point. If Wi-Fi connection gets failed (or no previous Wi-Fi configurations

saved), it starts the Access Point mode, which enables us to configure new

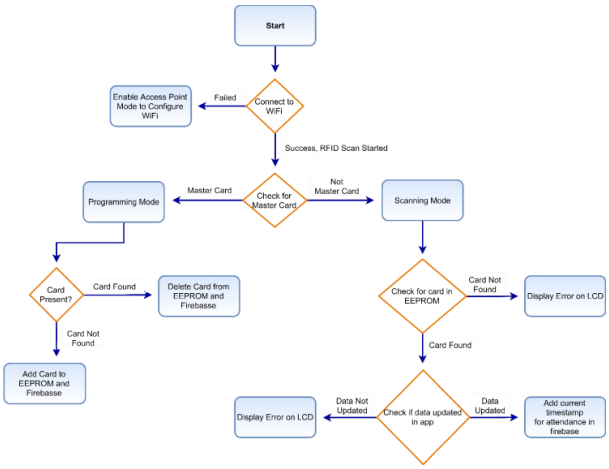

Fig.2. Flow Chart of Hardware Processing

We are using the Wi-Fi Manager Library from Tapzu to provides users with an easy way to configure new Wi-Fi credentials. The two-step process is as follows –

- Once the device goes into Wi-Fi Access Point mode, the user will see a new Wi-Fi access point named WDF Wi-Fi in his / her mobile or laptop device. The user must connect to the WDF Wi-Fi (No password required) to proceed further.

- After connecting to the WDF Wi-Fi, the user will have to open the IP Address shown in the LCD screen, which is usually http://192.168.4.1. It will open a web page that will let us configure new Wi-Fi credentials for our device.

2) Step 2 (Scan RFID Tags)

After configuring the Wi-Fi, the user can now scan RFID cards in the device. We are using the RC522 RFID module, which supports 13.56 MHZ RFID tags. There are two types of RFID tags we are going to use in our device. There is a Master RFID tag that will enable us to add or delete a student's / employee's RFID tags. Apart from the Master RFID tag, we will use all other RFID tags for Attendance purposes.

a) ***Master Tag:*** Once the Master tag gets scanned, the device will go into the Programming Mode. Programming mode allows us to configure a new tag into our device, and also allows us to remove previously saved tag from our device. The EEPROM and the Firebase Database will store the master card's unique ID. Now there are two cases possible.

- **RFID Tag Already Exists –** If RFID Tag already exists in the device, the system will delete the tag from the EEPROM of the device, once the tag gets deleted from the EEPROM, the device will connect to the Firebase Database, and it will delete RFID tag information from Firebase Database also.

- **New RFID Tag –** If the device can't find the new RFID tag in the device's EEPROM, it will add the unique ID of the RFID tag into the EEPROM, and after that, it will add an entry of new RFID tag into the Firebase Database.

To go back to the normal scanning mode, the user must scan the Master Card again. Once the master card gets scanned in the programming mode, it will go back to the scanning mode.

the Dashboard screen.

b) ***Student / Employee RFID Tag:*** When a student or employee scans his RFID tag, the device first will look into the EEPROM for the tag entry. If the RFID tag's unique ID is not available in the device's EEPROM, the device will show an error message on its LCD screen.

If the RFID tag exists in the EEPROM, it will connect to the Firebase Database, and it will first check if the employee's / student's basic information (like name, mobile number, and department) updated in the Mobile App or not. If it finds that the information is not up to date in the app, it will show an error message on the LCD screen that the RFID tag's information not yet updated in the app. The user must add the relevant information of the user to mark the attendance.

If the device finds that the employee's / student's data updated in the app already, it will add an entry for the Attendance in the Firebase Database. We are using the DS3231 RTC Clock module to get the current timestamp for the attendance entry. Once the tag gets scanned, it will save the current timestamp into the Firebase database, and the user will see a welcome message on the LCD screen.

B. Software (Mobile Application) Part

We are using Flutter (A Cross-Platform, single code-base mobile app development SDK by Google), which allows us to develop hybrid mobile apps (which will work on Android, as well as iOS devices). Once the user opens the app, it will prompt the user authentication screen, which will let the user Log in or Register to his / her account. The Firebase Authentication systems manage the Authentication Details. The app will provide all the basic functionality to

manage the user's account. After the successful authentication, the user will see a Welcome Screen.

If no device is present into the user's account, the user will see an Add New Device screen. The user must enter the serial number of the device and other basic information of the device. Each device will have a unique serial number. Once the user presses the Add Device button in the app, the app will communicate to the firebase database and check if the serial number is valid or not. If the device's serial number already registered to another user or if the serial number is not valid, it shows an error message on the screen. Once the device gets added successfully, the app will show

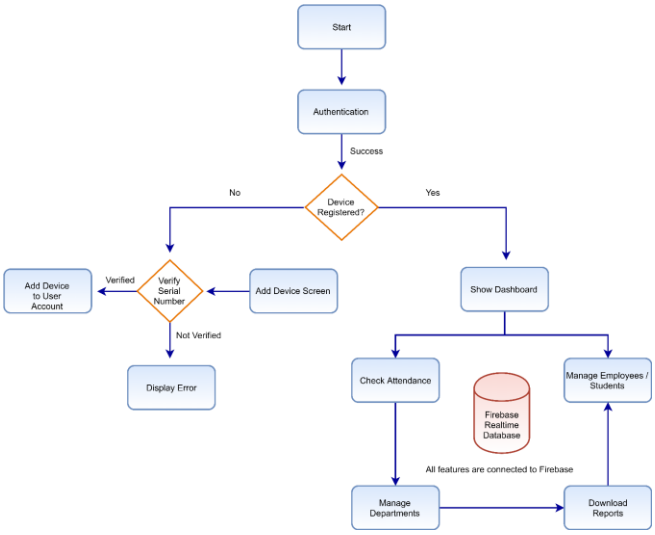

Fig. 3 – Flow Chart of Application Process

We can also manage multiple devices from a single account. We have an option to switch between multiple devices registered into a user's account.

Now there are four basic functionality of mobile app which is as follows –

1) Attendance Details : On this page, the user can see attendance details of all the employees/students. The user can sort students/employees by their respective departments. The user can also see attendance details of a particular date. Once the user clicks on the particular employee/student's name, the user will see a calendar of the current month, which will show marking if the student or employee is present or not. The user can see the time of entry also on the calendar page. The user also has the option to manually mark absent or present of a particular employee/student. The app fetches all the attendance data of an employee/student from the Firebase Database.

2) Download Reports: On this page, we can download reports of all the employees/students. There are three options to download the reports which are as follows –

- Download All Reports
- Download by Department
- Download by Employee / Student

We can download the reports as per our choice. We will get all the reports in PDF format. There is also an option to share the reports in WhatsApp, Email, or any other supported sharing platform.

3) Manage Employees / Students: On this page, we can update basic information like Name, Department, and mobile numbers of all the employees. Once a new RFID Tag gets added into the device, we have to update the basic information from this page. We cannot remove an employee/student from this page, as it is managed by Master Card only.

4) Manage Departments: We can add or remove departments from this page. We can also modify the name of the current department. If any information related to the department gets updated from this page, it will reflect in all the employees or students associated with this department.

IV. RESULT AND CONCLUSION

The proposed system provides better user interaction facilities, and it is Wi-Fi-enabled, which makes it a portable system. The mobile application provides Multiple Device Management facilities so that we can use multiple devices in a single user account. The application provides facilities to generate reports with advanced sorting and filtering options. The app also allows its users to share reports directly from the application screen. We can also manage Employees/Students' basic details from the application. Security and Database backup is the most important thing in any software. Google's Firebase manages the credential information and security of the user's data. We can also take an on-demand backup of the database.

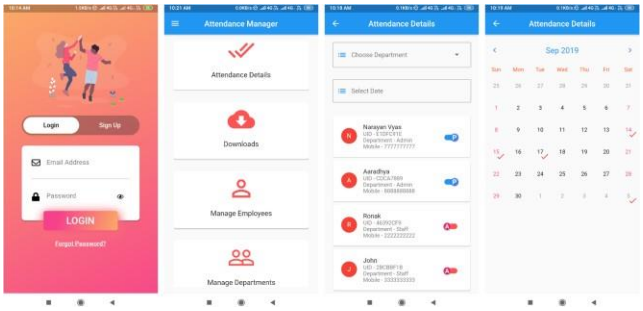

Fig. 4- Application User Interfaces

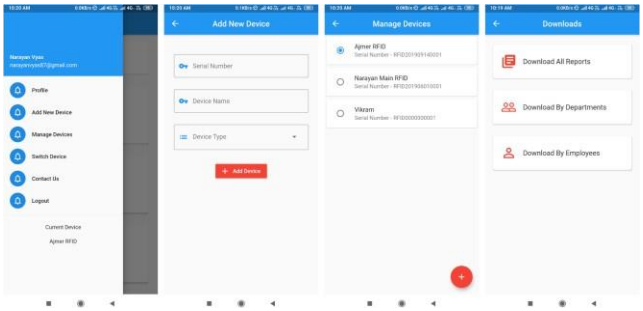

Fig. 5- Application User Interfaces

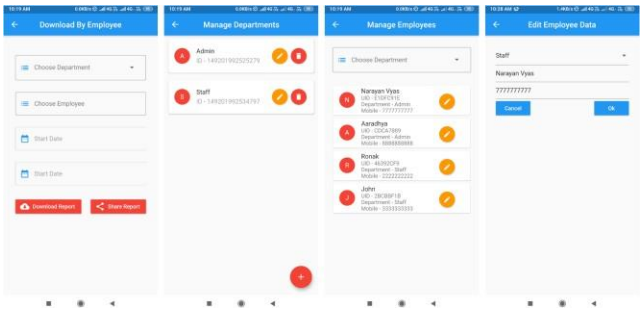

Fig. 6- Application User Interfaces

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