Turkish Journal of Physiotherapy and Rehabilitation**; 32(2)**
ISSN 2651-4451 | **e-ISSN** 2651-446X

MQTT Based Multipurpose Management System Using ESP8266 and RFID

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ABSTRACT

The authors propose a new event management system made with the help of a simple ESP8266 paired to an RFID which also includes setting up of AP on NODEMCU , which is an open source platform based on ESP8266 and let data transfer through the Wi-Fi protocol. The aim is to interface RFID with the NODEMCU ESP8266. The novelty added by this proposal is to use NODEMCU for connecting with the database using an AP which can be configured to connect to any APS protocol used for sending the unique identity number (UID) of the scanned RFID tag to the MQTT database. The advantage that is gained by doing this is, we can make the system multipurpose based and can also create multiple modes such as Registration mode or Check in mode according to the needs of the user. In registration mode a new RFID tag can be scanned and its UID is sent to the backend which will return a randomly generated unique password for that UID which is displayed by the LCD, which can be later on used by the user to compute the registration process online. In check-in mode if the scanned RFID tag has already been registered for this particular event then "ACCESS GRANTED" will be displayed on the LCD and access is given otherwise "ACCESS DENIED" will be displayed and the access is denied. The LCD display will also show the mode that it is presently operating in . In addition to this we can also store a lot of information, which will remain confidential, of the attendee in an event which can be useful in case of emergencies or other purposes.

Key words: MQTT, NODEMCU ESP8266, RFID, LCD display, APS protocol

I. INTRODUCTION

The COVID-19 pandemic is impacting us in many ways. This has literally put our world to a standstill. However, to prevent the community, spread,the need for social distancing is absolutely necessary and important. In this project, we are trying to solve the problem of social distancing which will make a favourable condition for the community spread of the pandemic. Referring to the highly successful Kerala Model for Covid19, social distancing & amp, containment was one of the major factors that helped to flatten the curve.

We are better equipped to address the continued pandemic and the need of the hour is developing sustainable low-cost solutions that can provide safe, preventive, and effective ways to protect people in workplaces, Shopping malls,Hospitals etc. The MQTT and RFID technologies are one way to reduce exposure surfaces that may have viruses or bacteria and does not require human interaction.

MQTT based Multipurpose management system can be one step solution for taking attendance at various organizations ,giving authorization , having entry /exit information record etc. without human interaction .The system can be modified as per the requirements of the user and has two modes which can serve multiple purposes for the end user. A vast amount of data of all the users can be stored in the system which makes it ideal for the purpose it is designed to serve that too at a very low cost. It is a great alternative to the traditional way of gathering data which involves human interaction and there can be no scope of errors in the data collected .it also saves a lot of time for the users who use traditional methods for data gathering which otherwise is as simple as pointing a tag in the direction of RFID just for a few seconds.

II. IMPLEMENTATION

2.1 Components

- NodeMCU ESP8266
- RFID RC522
- Adafruit RGB Backlight LCD - 16x2
- DFRobot I2C 16x2 Arduino LCD
- Buzzer
- LED (generic)
- Connecting Wires

2.2 Hardware Description

2.2.1 RFID RC522

The RC522 is a 13.56MHz RFID module that is based on the MFRC522 controller from NXP semiconductors. The module supports I2C, SPI and UART and is shipped with an RFID card and a key fob. It is commonly used in attendance systems and other person/object identification applications.

Fig:1: RFID-RC522

2.2.2 NODEMCU ESP8266

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having TensilicaXtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

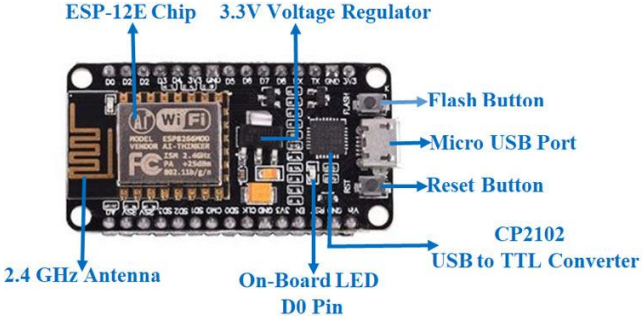

Fig:2: MCU ESP8266 development board

2.2.3 Adafruit RGB Backlight LCD - 16x2

These LCDs work just like the normal character type, but the backlight has three LEDS (red/green/blue) so you can generate any color you'd like. Very handy when you want to have some ambient information conveyed.

2.2.4 DFRobot I2C 16x2 Arduino LCD Display Module:

This is a 16x2 LCD display screen with I2C interface. It is able to display 16x2 characters on 2 lines, white characters on blue background. This I2C 16x2 Arduino LCD Screen is using an I2C communication interface.

2.2.5 LED:

A light-emitting diode (LED) is a semi conducter source that emits light when current flows through it.

2.3 Block Diagram

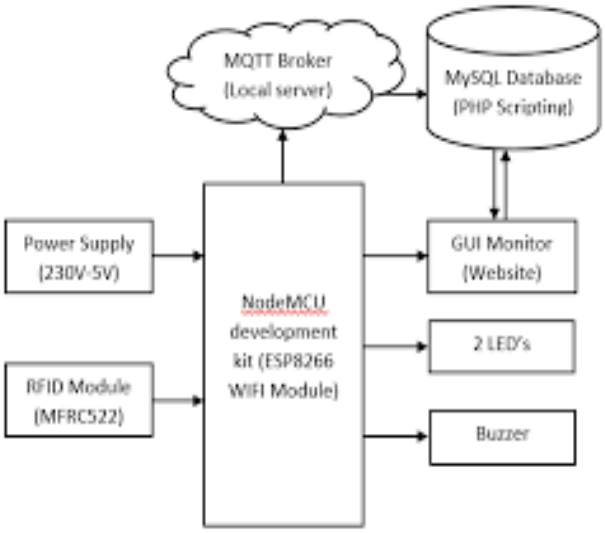

Fig.3:Block Diagram

III. WORKING PROCEDURE

There are Four Modules in this project. They are:

- ► Configuring the MQTT details
- ► Configuring the AP
- ► Defining and structuring the modes: 1. Registration mode 2. Check-in mode
- ► Integration and testing of RFID tag

3.1.1 Module 1: Configuring the MQTT details:

- First we have to register a new account in CloudMQTT.com. Then we have to create a new Instance and we can opt for a free plan. Once the instance is created , make a note of the details such as the Server/Hostname, Username, Password and Port No etc. for your instance.
- Then we have to install an MQTT application on our mobile phone and create a new connection using our CloudMQTT credentials which we got in the first step.
- In the Subscribe section of our mobile MQTT application, we have to add a value to subscribe by pressing on the '+' icon at the top-right corner of the application and enter our details. We have to name the field name and topic name of our choice. Leave the unit field empty.
- Go to Publish tab and create a few(=2 according to the program) text fields by clicking on the + icon on the top-right corner of the window in your mobile application.

3.1.2 Module 2: Configuring the AP:

- Connect to the AP set up by the nodeMCU and configure it according to our needs.
- Click on the configure WiFi.
- Select an AP which supports our system or enter the SSID and password. After the NodeMCU is connected to the internet it will wait for configuration , attempt to connect to our MQTT connection and wait for an RFID TAG to be scanned.

3.1.3 Module 3: Defining and structuring the modes:

- Registration mode: In registration mode, a new RFID tag can be scanned. Once the RFID tag gets scanned, a UID(Unique identification) number is sent to the backend of the system which will return a randomly generated unique password for that UID, which will be displayed by the LCD screen. These credentials can be later on used by the user to complete the registration process online.
- Check-in mode: In Check-in mode, if the scanned RFID tag has already been registered for a particular event earlier then that tag will have access to the event and "ACCESS GRANTED" will be printed on the LCD display, otherwise "ACCESS DENIED" will be printed.
- Current mode of the device can be known by checking the LCD display where the mode is mentioned.
- The default mode is REGISTRATION. In order to switch between the two modes, we can use a push button on the controller.

3.1.4 Module 4: Integration and testing of RFID tag:

- Upon scanning a valid RFID tag we can see it's UID displayed on the MQTT app subscribe section. We can generate a random password through publish section of app and the password will be displayed on the LCD screen.

- In order to change the mode, press the push button and scan a valid card. We can send '1' through MQTT app manually to display "Access Granted" as well as '0' to display "ACCESS DENIED".

IV. RESULTS AND DISCUSSION

Fig.4:LCD screen

Once the system is set up, initially in the Registration mode the default status of the LCD screen will be the same as the picture shown above.

Once the registration process has been initiated, details entered and is approved by the admin the LED screen will flash the one time code as the picture shown below.

Fig.4: GN54jk8p

In Check-in mode the initial setup on the screen will be similar to that of the registration mode but it will be highlighted as Check-in mode instead of registration mode.

If the RFID tag has already been registered and details of the user is already stored in the system, then the output of the screen would be as the picture shown below.

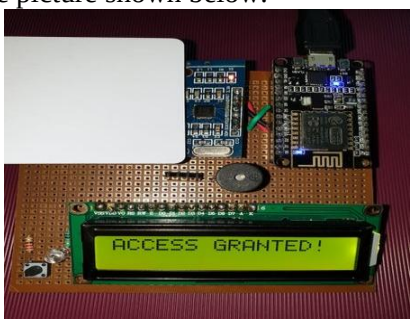

Fig.4: Access Granted

If the RFID tag has not been registered with the system or the details of the user did not match with the details in the system then access is denied and the LCD screen will flash as the picture below:

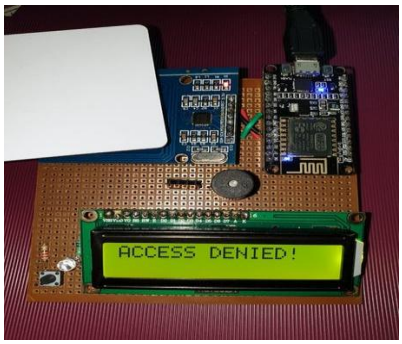

Fig.4: Access DENIED

V. CONCLUSIONS

In the proposed project we are designing and developing an MQTT based event management system which works with an RFID tag and has multiple modes. It will be integrated to a database for efficient use of data of the users and its maintenance. Highly flexible, efficient, and safe system to use especially in times such as Covid pandemic where it is mandatory to maintain social distancing.

The proposed system overcomes the problems faced by the existing systems and is highly reliable. It also offers a lot of information at the disposal of the owner or the organizer for further analysis which can help companies to get information of the people for their sales and marketing purposes which can benefit the customers as well as companies and has a win – win situation.

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