BSc. (Hons.) in Engineering in Electronics and Telecommunications

BSc. (Hons.) in Engineering in Electronics and Power Systems

School of Engineering

Engineering Design Project (EEE-2403)

Automatic ATTENDENCE MARKING SYSTEM With Hand Sanitizer Dispenser

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School of Engineering

THESIS: ATTENDENCE MARKING SYSTEM

With Automatic Hand Sanitizer Dispenser

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DECLARATION

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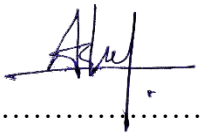

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"The above candidates have carried out research for the Bachelor of Science (Hons.) Degree dissertation under my supervision."

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Dr. Nicoloy Gurusingha

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ABBREVIATIONS AND ACRONYMS

IOT	- Internet of Things
RF	- Radio Frequency
GPIO	- General Purpose Input or Output
GSM	- Global System for Mobile communication
AC	- Alternating Current
DC	- Direct Current
EEPROM	- Electrical Erasable Programmable Read Only Memory
EM	- Electromagnetic
GND	- Ground
HF	- High Frequency
IC	- Identification card
ID	- Identification
I/O	- Input / Output
LED	- Light Emitting Diode
LF	- Low frequency
RF	- Radio Frequency
RFID	- Radio Frequency Identification
ROM	- Read Only Memory
UHF	- Ultra-High Frequency
USB	- Universal Serial Buss

CHAPTER 1

1.1 ABSTRACT

This report describes an engineering design project completed by SLTC Research University undergraduate students studying Electronics and Telecommunication Engineering and Electronics and Power Systems. The goal of the project is to design and manufacture an Attendance marking system with automatic hand sanitizer dispenser for students. This project was created from the ideas of our team members for the EEE2403-Engineering Design Project module.

While entering campuses, many problems are faced while marking attendance manually. It takes time for students to find and sign their name on the attendance sheet, students face additional difficulties by intentionally or unintentionally signing another student's name and attendance, losing the record, and especially violating the COVID-19 safety regulations.

Attendance is manually done and the record is maintained in files. Our main idea of the approach is to reduce manual work and to automate the attendance system The attendance system is basically an embedded one. Embedded stands for hardware controlled by software. Here, the software using a Microcontroller control all the hardware components. The microcontroller plays an essential role in the system. The system's main objective is to uniquely identify and make attendance for a person. This requires a unique product, which has the capability of distinguishing different persons. This is possible through the new emerging technology RFID (Radio Frequency Identification). The main parts of an RFID system are an RFID tag (with a unique ID number) and an RFID reader (for reading the RFID tag).

Therefore, An automatic contactless attendance marking system using RFID technology can be introduced as a solution to such situations. This avoids all the problems of manual attendance marking and can efficiently and accurately capture the attendance of students on a Google Sheet. Apart from this, it has an automatic hand sanitiser dispensing system, so it is possible to clean the hands of germs. It has been designed according to an engineering design to be convenient for students and other people, making it an effective and successful design.

This report provides a clear picture of the hardware and software used in the system. It also provides an overall view with a detailed discussion of the operation of the system. All established engineering specifications have been validated and satisfied in the final prototype. finally, our recommendations concerning improving the final design and suggested future work.

1.2 INTRODUCTION

IoT refers to a situation in which devices are given distinctive identifiers and the capability to automatically transmit data over a network without requiring human-to-computer interaction. The Internet of Things (IoT) is a situation in which devices are given distinctive identifiers and the capacity to automatically transmit data over a network without the need for human-to-computer interaction. RFID is fundamentally based on The Internet of Things (IoT), and RFID devices are wireless microchips that are used to tag objects for automatic identification.

Nowadays, there are many universities around our country and each of these universities consists of students up to 3 thousand. Handling a large number of students may be a problem specially to get attendance. Now, the process to get attendance in the majority of universities still used the manual process. The manual process means that when students are coming to the university entrance there is a book that will give them to mark their Student ID, name, arrival time and the signature on it.

Normally, the attendance book needs much time to be signed by all students, especially during a busy time with a lot of students. Students also forget to sign the attendance book and students face additional difficulties by intentionally or unintentionally signing another student's name and attendance. Additionally, as another result of this, students are ignoring COVID-19 safety recommendations.

A suitable solution to this problem is to create a system that records attendance and cleans hands. In this project, an RFID system is used to record student attendance and have an automatic hand sanitizer dispenser unit. This project will use a student ID card as an RFID tag and an RFID reader.

This method is more effective to prevent problems in the process of getting the attendance manually.

1.3 PROBLEM STATEMENT

After asking the SLTC university students a number of questions, we learned that administrators need to use paper to record students' attendance. We learned from this questionnaire that there were numerous issues with recording student attendance on paper. Some of these issues include cheating, the weight of the papers, time consuming, stressful and expensive over time. As a result, a student's personal identification must be linked to their identity. In our university society, it is crucial to ask questions about student identity, such as "Is this student who he claims to be? ", "Has this student got permission to come to university? ", etc.

People are becoming even more electronically connected as a result of the technology's rapid advancement, making it more important than ever to achieve higher accuracy automatic personal identification in our increasingly mobile and electronically connected university

society. Therefore, they are unable to meet the university's electrically connected information's security requirements. In order to ensure high security in sensitive areas like university systems, health care, telecommunication, government organizations, and even the financial sectors, electronic identifier security systems based on radio frequency (RF) are required.

On the other hand, Coronavirus Disease (COVID-19) has become a very common occurrence in situation. It assimilated into our daily lives. But, there are germs all over the places. Thus, we must abide by the safety regulations. To help stop the virus from spreading, keeping your hands clean is especially crucial. When we touch books for student attendance and other objects, germs can adhere to our hands and cause illness. One of the most crucial steps you can take to prevent getting sick and infecting those around you is to wash your hands with soap and water or hand sanitizer that contains at least 60% alcohol.

The dissertation topic "contactless attendance system based on RFID with an automatic hand sanitizer dispenser" was chosen due to all of these factors.

1.4 RESEARCH QUESTIONS

In order to complete this project, there are a number of questions about the software's design that must be addressed, such as "How does the entire system function?" "How do we couple a RFID Tag to a RFID Reader?" "How the data base is constructed and connected using Google Sheet?" etc.

Additionally, the following component-related questions require an answer in order for this project to be completed:

- What type of microcontroller should be used in this project?
- Which type of programming should be used in this project?
- How do we make the automatic hand sanitizer dispenser?
- What are the characteristics (that is, type, nominal value, power rating, and tolerance) of the required electrical component needed for this project?
- For example, resistors, transistors, interrupters, integrated circuits, and so on.
- What type of Radio Frequency Identification (RFID) Reader Module is needed for this project?
- How should the RFID reader module and the database be linked?
- How do we supply power to the microcontroller and automatic hand sanitizer dispenser unit?
- How we output our final design system for entrances, etc.

1.5 OBJECTIVE OF THE STUDY

The primary goal is to create an RFID system that record student attendance and includes a hand sanitizer dispenser.
We must create a way to that we can identifly the card data acquisition with the RFID system.
To do so, we create a lighting system that monitors everything that happens in the system.
A data log interface should be created to record student attendance.
The specific objectives of this study are divided into the following two parts.

1. Study of data exchange between RFID system and Google sheet.
    - Here, the data read by the RFID reader communicates with Google Sheets. Communicated data is displayed in Google Sheets.
2. Study of hand hygiene using an automatic hand sanitizer dispenser unit.
    - Here, the automatic hand sanitizer dispenser has the ability to sense hands under the sense area to dispense liquid sanitizer. It automatically dispenses the perfect amount of sanitizer for quick hand cleaning.

1.6 RESEARCH HYPOTHESIS

In order to complete this project, it is hypothesized that the research university currently uses a manual attendance marking system.

1.7 SIGNIFICANCE OF THE STUDY

The application of RFID developed and implemented in the study to student attendance marking can eliminate time wasted in manual attendance collection, cheating on the part of the students, bulkiness of the papers, stressful, cost full after a long period. As a result, more accurate automatic person identification can be achieved. In addition, using this system will simplify the attendance marking process. Additionally, RFID has a greater ability to receive and transmit data to a remote source. Thus, this results in less work generation, better student attendance management, and less administrative tasks.

1.8 PROJECT SCOPE, ORGANIZATIONAL LAYOUT AND OVERVIEW OF DISSERTATION

1.8.1 PROJECT SCOPE AND ORGANIZATIONAL LAYOUT

The main goal of this project is to develop a student attendance marking system using RFID technology.
There are two scopes that will be covered in this project.
To begin, an appropriate RFID tag and reader must be used for this application, and the GUI must be designed to integrate with RFID technology. (Here, we are using Google Sheet as the GUI)
Secondly, we will design the automatic hand sanitizer dispenser using an IR sensor module.

1.8.1.1 USE APPROPRIATE RFID TAG & READER FOR THIS APPLICATION

RFID readers and tags are widely available on the market. In addition to brand, RFID's own frequencies should be considered. The RFID reader must use the same frequencies as the student ID card used by the university, as this system will be used there. Here, the student card or tag used in this instance is a MIFAR 1K type with a 13.56 MHz frequency.

1.8.1.1 DESIGN AND IMPLEMENTATION OF A STUDENT ATTENDENCE SYSTEM USING RFID

RFID readers are used to identify student ID card data. RFID cards contain the relevant data for each student. After the RFID reader receives data from the RFID card, the data will be stored in the Google Sheet along with the student's information, the arrival time, and the date.

1.8.2 OVERVIEW OF DISSERTATION

This "Electronic Attendance System based on RFID with an Automatic Hand Sanitizer Dispenser unit" final thesis is a combination of 5 chapters that contains and elaborates specific topics such as the Introduction,
Literature Review, Hardware Design, Software Development, Result, Discussion, Conclusion and Further development that can be applied in this project.

Chapter 1 is basically an introduction of the project. Background and project goals are the main topics of discussion in this chapter. This chapter will also cover the overall project overview.

Chapter 2 part one will be focused on hardware design of the Student Attendance Using RFID System. There are several subtopics in this chapter. This project's hardware will be briefly discussed as a whole.

Chapter 3 These studies guide our component selection. We present the list of materials in this chapter as well as the test of the circuit following realization.

Chapter 4 discusses the project's conclusion and future direction. This chapter also covers the project's potential for commercialization as well as the overall costs associated with it.

CHAPTER 2

METHODOLOGY (SYSTEM STUDY, HARDWARE AND SOFTWARE DESIGN)

CONCEPTUAL FRAMEWORK

Student attendance using RFID systems has been specially developed for universities using RFID systems. An RFID module and an ESP8266 module are used for the system. To fully implement this system, both modules must be integrated. A separate circuit and an IR sensor module are used to design the Hand Sanitizer Dispenser System.

Here, student attendance using an RFID system and a hand sanitizer dispenser system have been created separately under two headings.

Each of these built-in modules has its own function and special features, which are discussed in detail in this chapter.

2.1 STUDY OF SYSTEM COMPONENTS

2.1.1 INTRODUCTION

thorough understanding of the components that will be used is required when designing electronic circuits (or diagrams). Concerning this project, to reach the stated goal and objectives which is to build an electronic attendance system based on Radio Frequency Identification (RFID) with an automatic hand sanitizer dispenser unit, we must first study some key components.

2.1.2 LIST OF COMPONENTS

The following named components comprised this project:

2.1.2.1 RESISTORS.

Figure 1 Resistor

A resistor is a two-terminal electronic component that prevents electric current from flowing through it in a circuit, ultimately causing a voltage drop across it as determined by the expression V=IR from Ohm's law.

Electrical networks and electronic circuits both contain resistors as component parts. They are the electronic devices that are used the most. In addition to resistance wire (wires made of high resistivity alloy, like nickel), resistors can also be made from a variety of compounds and films. Both hybrid and printed circuits, as well as integrated circuits, can incorporate resistors. In order to prevent overheating when dissipating power (that is, I^2R).

2.1.2.2 LIGHT EMITTING DIODE (LED)

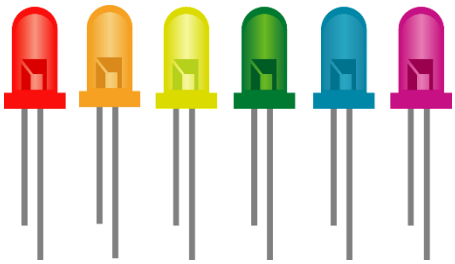


Figure 2 : Light Emitting Diode (LED)

A semiconductor device called a light-emitting diode (LED) produces light when current passes through it. The semiconductor's electrons and electron holes combine once more to produce photons, which are energy particles. The energy needed for electrons to cross the semiconductor's band gap determines the color of the light (corresponding to the energy of the photons.

2.1.2.3 RFID Tags

Figure 3 : RFID Tag

The tag, also known as the transponder, holds the data that is transmitted to the reader when the tag is interrogated by the reader. The most common tags today consist of an Integrated Circuit with memory, essentially a microprocessor chip. Other tags are chipless and lack an integrated circuit on board. Although they can help to achieve more accuracy and better detection range, at potentially lower cost than their Integrated Circuit-based counterparts, chip less tags work best in applications where a simpler range of functions is all that is required. Integrated circuit-based tags will be referred to as tags from this point forward. When necessary, we will make explicit reference to tags without chips.

2.1.2.4 RFID Cards

Figure 4 :RFID Cards

RFID cards are used in applications where it's important to track or identify personnel or where access control is necessary. Cards today use a variety of RFID frequency bands, such as 125 kHz low frequency proximity, 13.56 MHz high frequency smart cards, and 860-960 MHz ultra-high frequency (UHF).

RFID cards are a common shorthand for proximity cards, smart cards, and other types of cards. The type of RFID frequency band that is employed depends on the application, taking into account the requirements for security level, read range, and data transfer speed.

- 125 kHz (LF) - Employee badges and door and gate access control frequently use the common proximity card format.
- 13.56 MHz (HF) - For physical and logical access control, credit cards and employee badges are formatted with higher security.
- 860-960 MHz (UHF) - For identification, access control, and transactional purposes, UHF cards have a read range of up to 50 feet.

For this project we use 13.56 MHz RFID card as they are very suitable.

2.1.2.5 RFID Reader

Figure 5 : RFID Reader

An RFID reader is used in this RFID-based attendance system to gather data from RFID cards and tags. It uses radio waves to transmit data from the RFID tag to the RFID card reader for each individual item. The RFID reader only scans the RFID tags that are within 3 to 300 feet, not all RFID tags. Multiple items can be quickly scanned, and the specific objects can be quickly identified thanks to RFID technology.

2.1.2.6 MICROCONTROLLER

Figure 6 : ESP8266 Microcontroller

The minimum components of a microcontroller include a microprocessor, program memory, data memory, and input/output devices. Microcontrollers are single-chip microcomputers. A microcontroller is distinguished by its integration and lower electric consumption (which is a milliwatt when ON and a nanowatt when OFF).

2.1.2.7 IR Sensor Module

Figure 7 : IR Sensor Module

The most fundamental and widely used sensor in electronics is the infrared (IR) sensor or IR sensor module. It is utilized in wireless technology for remote-control features and obstacle detection. IR sensors typically comprise an infrared (IR) LED and a photodiode; collectively, these components are referred to as an "IR pair." A special-purpose LED called an IR LED can emit infrared light with wavelengths between 700 nm and 1 mm. We cannot see these kinds of rays with our eyes. The infrared rays are instead detected by a photodiode or IR receiver LED. The output voltage and resistance vary in direct proportion to the intensity of the IR light when it strikes the photodiode.

2.1.2.8 DC ELECTRIC WATER PUMP MOTOR

Figure 8 : 5v DC Water Pump

A DC water pump is a low voltage electric pump. They are energy-efficient and quiet. They are employed in numerous fields, such as the automotive, domestic, and water well industries. There are many different DC water pumps on the market, including the DC Fountain Pump VP30, a five-volt mini water pump ideal for a solar fountain. For aquariums, tabletop crafts, and even fish tanks, you can also find DC Submersible Pumps VP30A and VP40A.

2.1.2.9 TIP32C Transistor

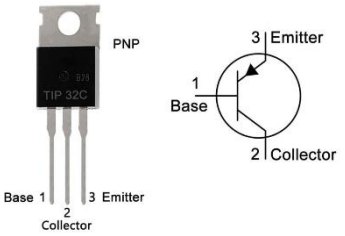


Figure 9 : TIP32C Power Transistor

Another essential transistor for your electronics lab is TIP32C. It is a power transistor with a low cost that can be used in a variety of general switching and amplification applications. The maximum load this transistor can handle is 3A, and the maximum peak current it can handle is 5A; the peak current is the maximum amount of current this transistor can handle intermittently rather than continuously. The maximum load voltage limit is 100V. Additionally, it can act as an amplifier thanks to the 40W maximum collector dissipation, which also makes this transistor perfect for use in separate amplifier stages for driving speakers as well as audio amplifier stages. A connection is also made between the transistor's collector and the metal can tab or the heatsink connection tab.

2.1.2.10 IC – Integrated Circuits

An electronic component assembly that is manufactured as a single unit and is known as an integrated circuit (IC), also known as a microelectronic circuit, microchip, or chip, contains miniature active devices (e.g. g. , diodes and transistors) and inactive gadgets (e. g. On a thin semiconductor substrate (typically silicon), components (such as resistors, capacitors, and capacitors) and their interconnections are assembled. Thus, the resulting circuit is a tiny monolithic "chip," which may only be a few square millimeters or a few square centimeters in size. Smaller than a human hair, the individual circuit parts are typically.

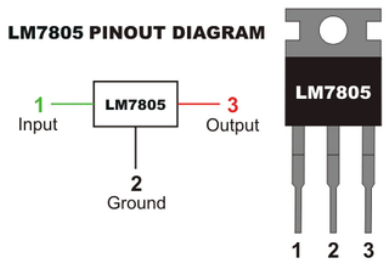


Figure 10 : LM7805 IC

Electronic circuits frequently use voltage regulators. For a variable input voltage, they provide a constant output voltage. The 7805 IC is a well-known regulator in our situation and is used in the majority of projects. The letters "78" and "05" in the name "7805" denote two different meanings: "78" denotes a positive voltage regulator, and "05" denotes an output voltage of 5V. Consequently, the output voltage of our 7805 will be 5V.

This IC's output current has a maximum of 1 point 5A. However, the IC loses a lot of heat, so heat sinks are advised for projects that use more current.

2.1.2.11 Buzzer

Figure 11 : Buzzer

The buzzer is a sounding tool that can transform audio signals into sound signals. DC voltage is typically used to power it. As a sound device, it is frequently used in alarms, computers, printers, and other electronic products. The two main types are piezoelectric and electromagnetic buzzers, which are denoted in the circuit by the letter's "H" or "HA.". The buzzer can produce a wide range of sounds, including music, sirens, buzzers, alarms, and electric bells, depending on its designs and intended uses.

2.1.2.12 Breadboard Power Supply Module

Figure 12 : Breadboard Power Supply Module

A Breadboard Power Supply Module accepts an input through a barrel jack from a battery, a 12V adapter or any other source, and provides to our circuit a 5V or 3.3V tension, depending on our needs. We're going to soon introduce Arduino into our circuits, and all our Arduino circuits will work with those voltage levels.

2.1.2.13 Push Button

Figure 13 : Push Button

A machine or appliance's push buttons can be thought of as basic power control switches. These typically have metal or thermoplastic switches with easy access for the user in mind. Electric circuits are designed so that electricity can move continuously through a number of wires and parts. However, circuits that operate only when necessary are more useful than those that are always complete.

2.1.2.14 DC 12V 2A Power Adapter

Figure 14 : DC 12V 2A Power Adapter

This 12V/2A power adapter is a power supply manufactured specifically for electronics. These are switch-mode power supplies, which means the output is regulated to 12 volts and the capable output current is much higher (2000 mA).

Specification:

- Voltage Input: AC 100-240V
- Frequency Response: 50/60 Hz
- Voltage Output: DC 12V
- Electric Current: Max. 2A

2.2 HARDWARE DESIGN

2.2.1 BLOCK DIAGRAM FOR THE SYSTEM

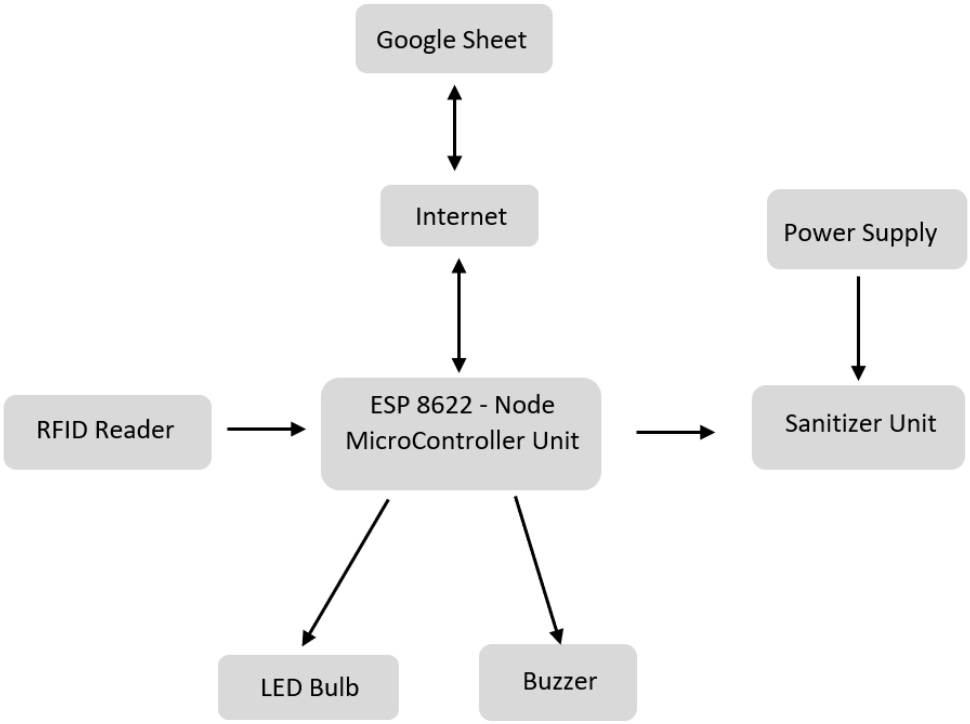


Figure 15 : Block diagram for the system

2.2.2 COMPONENTS DIMENSIONING FOR THE SYSTEM

2.2.2.1 COMPONENTS DIMENSIONING OF THE POWER SUPPLY UNIT

2.2.2.1.1 BREADBOAD POWER SUPPLY

In the RFID-based attendance system, the breadboard power supply module is used to power the ESP8266 module. Basically, with the help of a Micro USB cable, the breadboard is connected through the USB output of the power supply module to the Micro USB input port of the ESP8266 module. Here, the breadboard power supply module only supplies power to the ESP8266 module. The water pump of the automatic hand sanitizer dispenser requires more power, so another power supply is provided to power it.

2.2.2.1.2 COMPONENTS DIMENSIONING OF THE HAND SANITIZER DISPENSER UNITE.

For the water pump circuit that controls the automatic hand sanitizer dispenser unit, we used IR sensor module, TIP 32 PNP transistor, LM 7805 IC, 1k resistor, 330ohm resistor, push button and green LED bulb. Each of these components is connected as shown in Figure 3.19. After the IR sensor module detects the hands, the green LED bulb will light up and the water pump will turn on for clean the hands by sanitizer.

LM 7805 voltage regulator IC is used to provide 5V input voltage to circuit. Here the input voltage in LM 7805 is provided using a 9v battery.

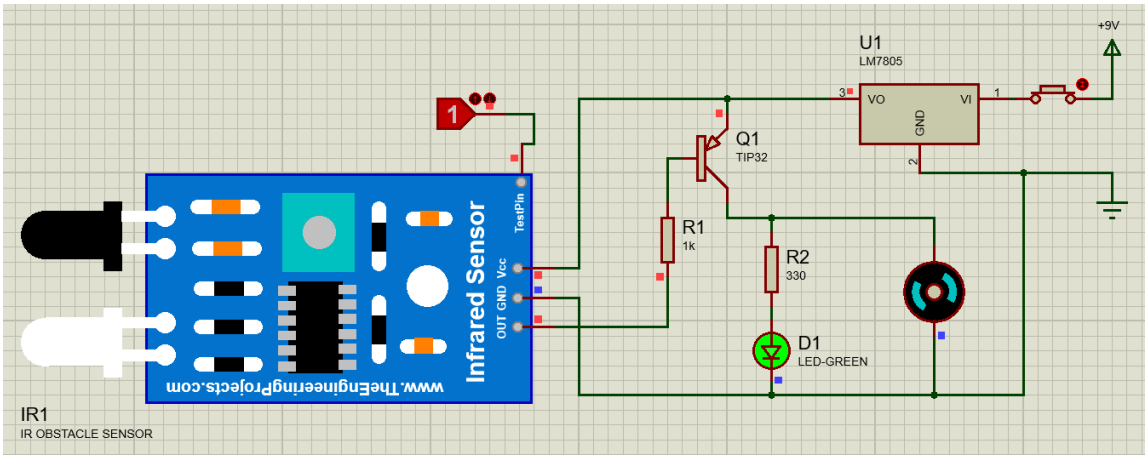


Figure 16 : The Hand Sanitizer Dispenser Circuit Diagram

2.2.2.3 COMPONENTS DIMENSIONING OF THE ATTENDENCE MARKING UNITE

2.2.2.3.1 NodeMCU – ESP8266 Wi-Fi module

A microcontroller board called NodeMCU is based on the ESP8266 32-bit. It has one analog input, 16 digital input/output pins (of which 16 can be used as PWM outputs), a USB port, reset button and flash button. A USB to Serial Converter is built into each NodeMCU and it has the best compatibility and is based on the CP2102 chipset. Simply attach it to a computer using a USB cable; it comes with everything needed to support the microcontroller. The ESP8266 can also be powered directly from the VIN pin if you have a regulated 5V voltage source, or it can be powered through the on-board Micro-USB connector.

Microcontroller - ESP8266
Operating Voltage - 3.3V
Input Voltage - 4.5V - 10V
Current consumption - 15µ to 400mA
Current consumption Deep sleep- 0.5µA
Digital I/O Pins - 16
Digital I/O pins with PWM - 16
Analog Input pins - 1
SPI - 2
12C - 1
UART - 2
DC current per I/O pin - 12mA
Flash Memory - 4MB
SRAM - 6KB
EEPROM - 512 Bytes
Clock speed - 80MHz
USB connection – Micro-USB

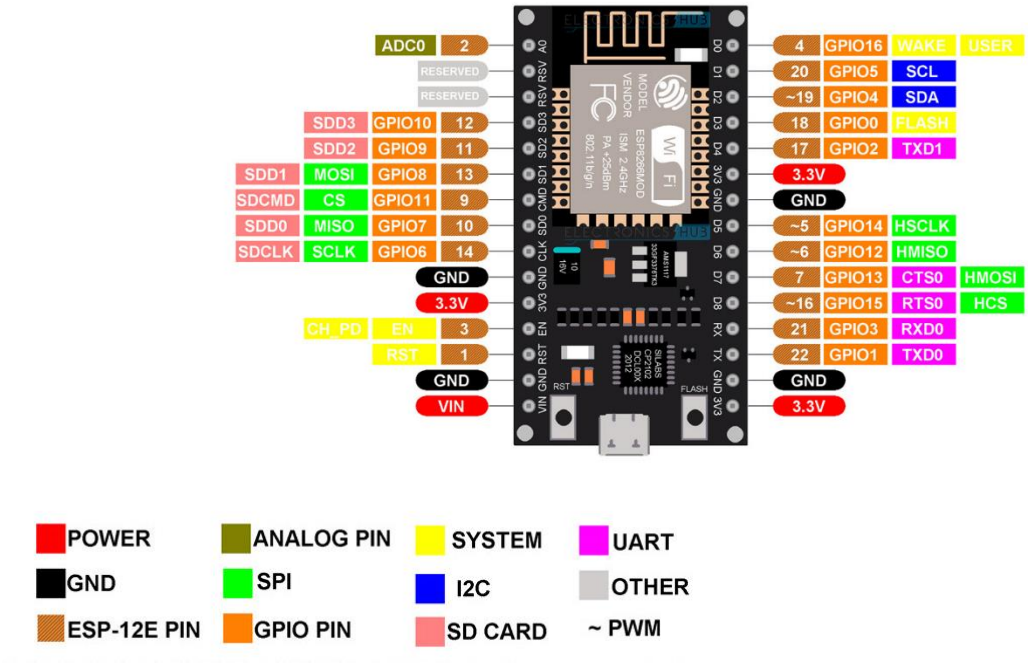


Figure 17 : NodeMCU - ESP8266 ESP8266 WIFI Module

Power Pins - A total of four power pins are present. VIN pin and three 3.3V pins.
The NodeMCU/ESP8266 and its accessories can be directly powered by VIN. The onboard regulator on the NodeMCU module regulates power delivered on VIN; you can also supply 5V regulated to the VIN pin. The onboard voltage regulator's output, represented by the 3.3V pins, can be used to power extraneous parts.
Ground Pins - GND are the ground pins of NodeMCU/ESP8266
Connecting I2C sensors and accessories requires **I2C pins**. It supports I2C Master and I2C Slave. I2C interface functionality can be implemented programmatically, and the maximum clock frequency is 100 kHz. It is important to remember that the I2C clock frequency must be faster than the slave device's slowest clock frequency.
GPIO Pins - The NodeMCU/ESP8266 has 17 GPIO pins that can be programmatically assigned to various tasks, including I2C, I2S, UART, PWM, IR Remote Control, LED Light, and Button. Each GPIO with a digital capability can be set to high impedance, internal pull-up, or internal pull-down. It can also be configured as an input and set to edge-trigger or level-trigger to produce CPU interrupts.
ADC Channel - The NodeMCU has a 10-bit precision SAR ADC built in. ADC can be used to implement the two operations. Both the input voltage to the TOUT pin and the power supply voltage of the VDD3P3 pin are tested. However, they cannot be put into action simultaneously.
UART Pins - NodeMCU/ESP8266 has 2 UART interfaces (UART0 and UART1) that offer asynchronous communication (RS232 and RS485) and can communicate at up to 4.5 Mbps. Communication is possible using UART0 (TXD0, RXD0, RST0, and CTS0 pins). UART1 (TXD1 pin), on the other hand, only has a data transmit signal, so it is typically used for printing logs.

SPI Pins - NodeMCU/ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:
4 timing modes of the SPI format transfer
Up to 80 MHz and the divided clocks of 80 MHz
Up to 64-Byte FIFO
SDIO Pins - Secure Digital Input/Output Interface (SDIO) pins are available on the NodeMCU/ESP8266 and are used to directly interface SD cards. Both 4-bit 50 MHz SDIO v2.0 and 4-bit 25 MHz SDIO v1.1 are supported.
PWM Pins - The board has four PWM (Pulse Width Modulation) channels. Digital motors and LEDs can be driven using the PWM output, which can be implemented programmatically. The PWM frequency range can be set to anything between 100 Hz and 1 kHz, or 1000 s and 10000 s.
Control Pins - The NodeMCU/ESP8266 is managed by control pins. Chip Enable pin (EN), Reset pin (RST), and Wake pin are some of these pins.
When the **EN pin** is pulled HIGH, the ESP8266 processor is activated. The chip uses very little power when it is pulled LOW.
ESP8266 chip reset is accomplished using the **RST pin**.
Wake pins are used to rouse a chip from a deep sleep.

The NodeMCU has several facilities for communicating with a computer, another NodeMCU, or other microcontrollers. The board channels this serial communication over USB and appears as a virtual com port to software on the computer. NodeMCU is essentially firmware built on the Lua scripting language. For writing Lua scripts for NodeMCU, ESPlorer IDE is recommended, so we must become familiar with both the ESPlorer IDE and the Lua scripting language. However, there is a different approach that uses the well-known IDE known as Arduino IDE to program NodeMCU. It is simpler for Arduino developers than learning a new language and IDE for NodeMCU.
Using the Arduino IDE (Integrated Development Environment), users can choose from a number of development environments with NodeMCU. The NodeMCU/ESP8266 community increased IDE options by creating an Arduino add-on.
To upload code to the ESP8266 and use the serial console, any data-capable micro USB cable must be connected to the ESP8266 IOT board and the other end to your computer's USB port. Then we need to download and install the NodeMCUv1.0 driver that comes with the CP2102 serial chip. Then, we can install the Arduino IDE and ESP8266 board packages. After all this effort we can finally write the code and upload it to NodeMCU.

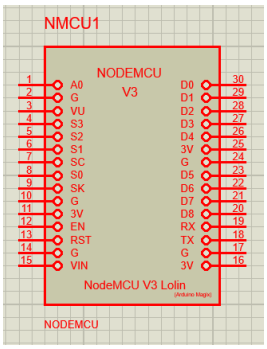


Figure 18 : Proteus NodeMCU

2.2.2.3.2 RFID-RC522 READER MODULE

Based on the RFID-RC522 Module, this board. It is very easy and only requires a serial connection to use the board with microcontrollers to read data from a card. The board has a 3V voltage regulator, allowing it to be powered by a 9–15V DC adapter. A different interfacing board's header wires (3V and GND) can also be used to power this module.

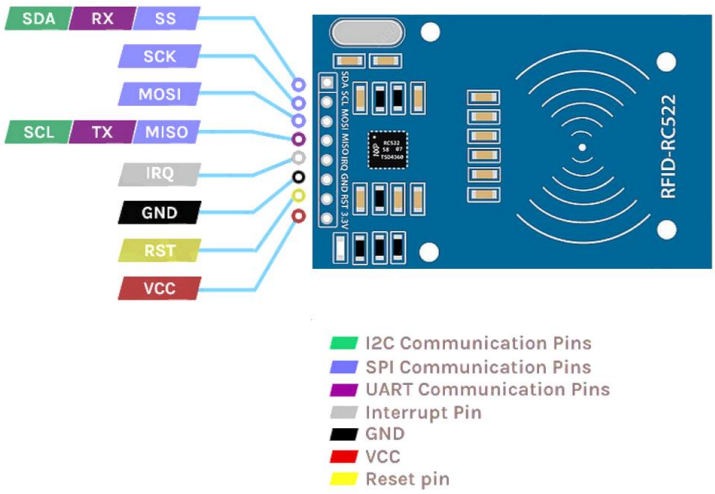


Figure 19 : RFID-RC522 Reader Module

SDA - SCL I2C Communication pins. DATA and CLOCK.
SS SCK MOSI MISO SPI - communication pins. Slave Select, Clock, MOSI, and MISO.
RX TX - UART Communication pins.
IRQ - Interrupt signal from the module to indicate RFID tag detection.
GND - Ground pin that needs to be connected to the GND pin on the Arduino.
RST - Reset pin for the module
VCC - Supply pin for the module. The supply voltage can be anywhere from 2.5V to 3.3V and must be connected to the 3.3V pin on the NodeMCU.

Features:

Operating frequency	: 13.56MHz
Supply Voltage	: 3.3V
Current	: 13-26mA
Power down mode consumption	: 10uA (min)
Read Range	: 5cm
Communication	: SPI, I2C protocol, UART
Read Range	: Approx 3cm with supplied card and fob
Max Data Transfer Rate	: 10Mbit / s
Dimensions	: 60mm × 39mm

2.2.3 WORKING PRINCIPLE AND CIRCUIT DIAGRAM

2.2.3.1 WORKING PRINCIPLE

2.2.3.1.1 The process of reading the data from the RFID card or tag and storing it in the database.

The RFID-based attendance system with the automatic hand sanitizer dispenser unit has a very simple operating concept. Radio frequency waves form the basis of its operation. A microcontroller and an RFID reader make up the system. An electromagnetic field is created when voltage is applied to the coil that makes up the RFID reader. Current is created when this electromagnetic field makes contact with the RFID tag or card. The RFID reader receives data from the RFID tag or card via this stream. The RFID system with the RFID sensor detects the RFID tag when it is brought close to it and sends a signal to the RFID reader.

The microcontroller and the RFID reader are connected, and the RFID reader retrieves the student's data and transfers it to the microcontroller.

The microcontroller connects to script.google.com via Wi-Fi. Here, the Google script is linked to the Google Sheet using the Google script Web App Deployment ID. Using the received data and the Google script ID, the microcontroller creates a URL and sends the data from the RFID tag or card to the Google sheet.

To verify each these steps of the system, three red, blue, and green LED bulbs and a buzzer are turned on. The red LED bulb flashes for a long time to indicate system errors, and the bulb turns on and off to indicate that the RFID card or tag is ready to be read. When the data on the RFID card or tag has been successfully read, the blue LED bulb will begin to blink and a buzzer will sound. Also, the green LED bulb will blink to show that the Internet has been successfully connected and the students' data has been successfully stored in the database.

After confirming the presence of students, when their hands are placed near the IR sensor module, signals are emitted considering the distance between the hand and the module. With a current corresponding to that signal, the motor turns on and pumps the sanitizer as needed to clean hands. In addition, a push button has been added to the unit to turn off or on the automatic hand sanitizer dispenser unit when needed.

2.2.3.1.2 The process of storing student data in the RFID card or tag

The gathering of student data is a prerequisite for the process of storing student information on an RFID card or tag. Therefore, data such as the student's name, ID number, phone number, and home address should be gathered. This can be done by collecting data from the university's current student database or a Google form.

After collecting the student's data, software and hardware are used to program the RFID card or tag. The hardware for that is the NodeMCU (ESP8266) connected to the RFID Reader module, and the software is the Arduino IDE application.

Once the NodeMCU (ESP8266) is connected to the computer via USB, the Arduino IDE program is used to write and upload code. The serial monitor option of the Arduino IDE application is used to program an RFID card or tag after the code has been uploaded to the

NodeMCU (ESP8266). After that, correctly activated and loaded with student information RFID card or tag is ready for use.

The information stored on the RFID card or tag can then be accessed when it is close to an RFID reader. It is crucial to remember that when using RFID technology, student data security and privacy are significant factors to consider. Appropriate security measures must be in place to protect student data and guarantee that only authorized individuals can access it.

```
**Card Detected**
Card UID: CA 59 E8 81
PICC type: MIFARE 1KB
---------------------------------------
Enter Student ID, ending with #

Data saved on block4: 21ug0512
---------------------------------------
Enter First Name, ending with #

Data saved on block5:
Manilka
---------------------------------------
Enter Last Name, ending with #

Data saved on block6:
Gunawardhana
---------------------------------------
Enter Phone Number, ending with #

Data saved on block8:
0776338161
---------------------------------------
Enter Address, ending With #

Data saved on block9:
Matale
```

Figure 20 : Data storage of students using Arduino IDE Serial Monitor

2.2.3.2 CIRCUIT DIAGRAM

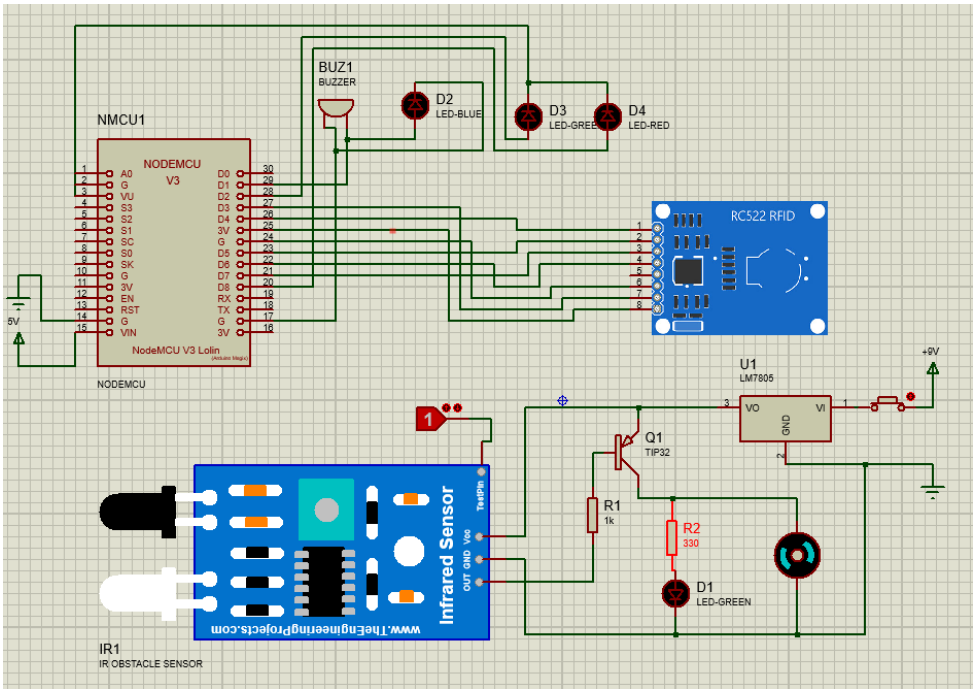


Figure 21 : Proteus circuit diagram of automatic student attendant marking system with an automatic sanitizer dispenser unit

As noted in the above figure, it shows both circuit of the attendance marking system circuit unit and the automatic hand sanitizer dispenser circuit unit.

The pins of the ESP8266 module and the pins of the RFID reader module are connected as follows in the attendance marking system.

- The RFID reader module **SDA/RX/SS pin** is connected to the **GPIO2 pin** of the ESP8266 module.
- The RFID reader module **SCK pin** is connected to the **GPIO14 pin** of the ESP8266 module.
- The RFID reader module **MIOSI pin** is connected to the **GPIO13 pin** of the ESP8266 module.
- The RFID reader module **MISO pin** is connected to the **GPIO12 pin** of the ESP8266 module.
- The RFID reader module **GND pin** is connected to the right side up **GND pin** of the ESP8266 module.
- The RFID reader module **RST pin** is connected to the **GPIO0 pin** of the ESP8266 module.
- The RFID reader module **VCC pin** is connected to the right side up **3V3 pin** of the ESP8266 module.

The pins of the ESP8266 module and the pins of the Buzzer are connected as follows in the attendance marking system.

- The **buzzer's positive pin** is connected to **GPIO 5** of the ESP8266 module.
- The **buzzer negative pin** is connected to **the right-side down GND pin** of the ESP8266 module.

The pins of the ESP8266 module and the pins of LED bulbs are connected as follows in the attendance marking system:

- The **positive pin of the blue LED** is connected to **GPIO5** on the ESP8266 module.
- The **negative pin of the blue LED** is connected to **the right-side-down GND** pin of the ESP8266 module.

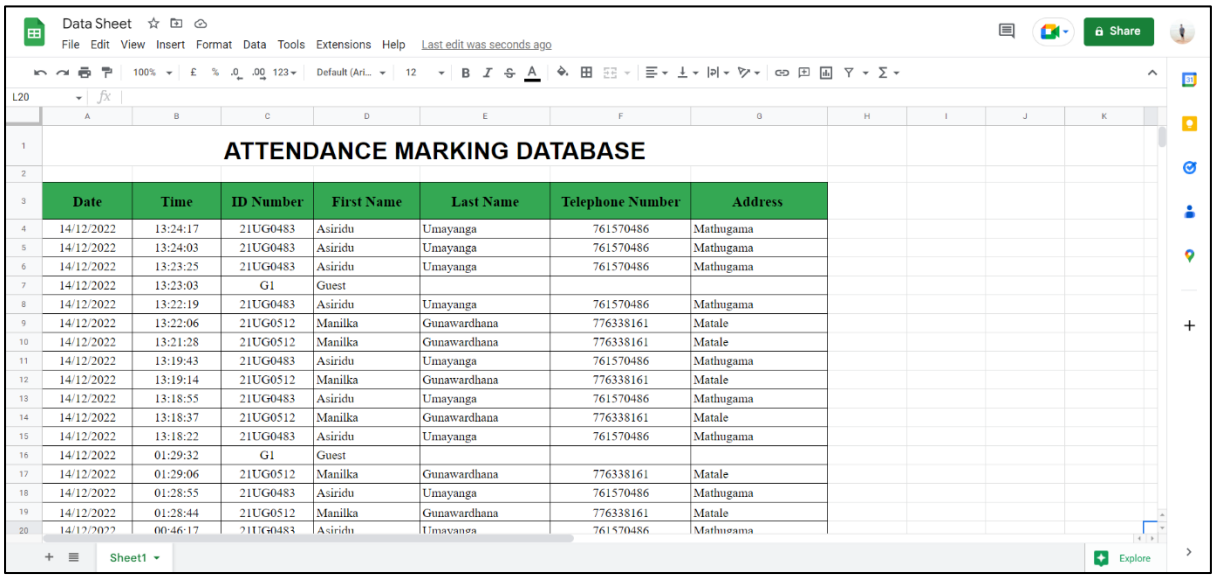
- The **positive pin of the green LED** is connected to **GPIO4** on the ESP8266 module.
- The **negative pin of the green LED** is connected to **the left-side up GND pin** of the ESP8266 module.

- The **positive pin of the red LED** is connected to the ESP8266 module's **GPIO15** pin.
- The **negative pin of the red LED** is connected to **the left-side up GND** pin of the ESP8266 module.

2.3 GOOGLE SHEET DATABASE DESIGN

In this section, consider about Google Sheets and Google Script.

2.3.1 GOOGLE SHEET



Date	Time	ID Number	First Name	Last Name	Telephone Number	Address
14/12/2022	13:24:17	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	13:24:03	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	13:23:25	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	13:23:03	G1	Guest			
14/12/2022	13:22:19	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	13:22:06	21UG0512	Manilka	Gunawardhana	776338161	Matale
14/12/2022	13:21:28	21UG0512	Manilka	Gunawardhana	776338161	Matale
14/12/2022	13:19:43	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	13:19:14	21UG0512	Manilka	Gunawardhana	776338161	Matale
14/12/2022	13:18:55	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	13:18:37	21UG0512	Manilka	Gunawardhana	776338161	Matale
14/12/2022	13:18:22	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	01:29:32	G1	Guest			
14/12/2022	01:29:06	21UG0512	Manilka	Gunawardhana	776338161	Matale
14/12/2022	01:28:55	21UG0483	Asiridu	Umayanga	761570486	Mathugama
14/12/2022	01:28:44	21UG0512	Manilka	Gunawardhana	776338161	Matale
14/12/2022	00:46:17	21UG0483	Asiridu	Umayanga	761570486	Mathugama

Figure 22: Student Attendance Google Sheets Interface

As part of the Google Workspace office productivity suite, Google Sheets is a spreadsheet program. Organizing your data into rows and columns, it can be used as a database and allows you to create, edit and collaborate on spreadsheets. The availability and ease of use of Google Sheets from any device with an Internet connection is a major advantage of using it as a database. With this, you can manipulate and analyze your data with the help of various built-in functions and formatting options.

You can create a brand new spreadsheet and enter your data into rows and columns to use Google Sheets as a database. A variety of formatting and data manipulation tools can be used to process and examine your data. For example, you can calculate your data using functions such as SUM, AVERAGE, and MAX, or you can summarize and process your data in various ways using filters and pivot tables.

For this reason, the Google Sheets spreadsheet program has been used to create a database for the RFID-based attendance system. Accordingly, the database is created as shown in the image.

2.3.2 GOOGLE SCRIPT

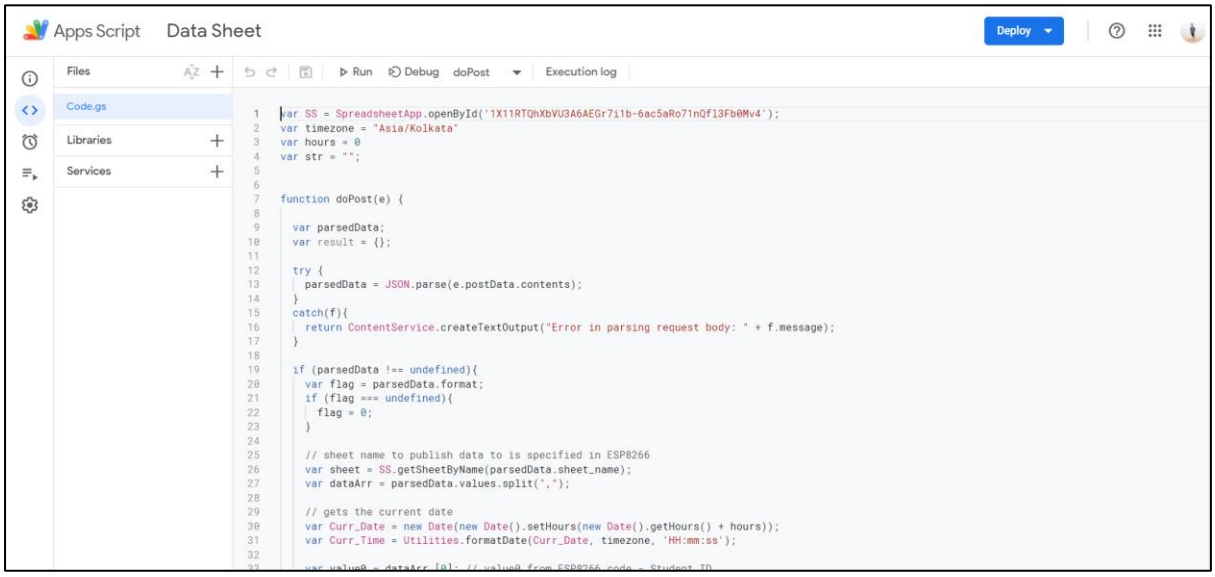


Figure 23: Google Script Editor Interface

Google Script is a scripting language developed by Google for use on the Google Workspace platform. It provides simple ways to automate tasks across Google products and third-party services and is based on JavaScript. By automating emails, creating personalized forms and reports, and integrating with other APIs, you can create solutions tailored to your needs using Google Scripts. In addition to writing and publishing Google Docs and developing web applications, Google Script can be used to write custom functions for Google Sheets. To get started with Google Script, use Google's online script editor, which enables you to write and run your code directly in your web browser. To manage your scripts and code remotely, you can connect to the Google Script API using a native code editor.

Google Sheets can be linked to Google Scripts, which allows you to automate tasks and add custom functionality to spreadsheets. For example, Google Script can be used to retrieve data from external sources, such as a website or an API, and automatically update Google Sheets with the new data. You can use Google Scripts to trigger events and perform actions based on certain conditions. such as sending an email when a cell in the spreadsheet meets a certain threshold.

2.3.3 Integration of Google Sheets and Google Script.

To use Google Scripts with your Google Sheets database, you'll need to create a new script by going to the Tools menu and selecting "Script editor." This will open a new tab where you can write and test your script. You can then use the various functions and classes provided by the Google Sheets API to interact with and act on your data.

In this way, we have connected our Attendance Marking Google Data Sheet to Google Script and given the Web App Deployment ID in Google Script to NodeMCU. When the NodeMCU connects to script.google.com via Wi-Fi, using the received data and the Google script ID, the microcontroller creates a URL and sends the data from the RFID tag or card to the Google sheet.

CHAPTER 3

PRESENTATION AND DISCUSSIONS OF RESULT INTRODUCTION

We discussed a theoretical study relating to an RFID-based electronic attendance system with an automatic hand sanitizer dispenser unit in the previous chapter. These studies guide our component selection. We present the list of materials in this chapter as well as the test of the circuit following realization.

3.1 REALIZATION TEST OF THE CIRCUIT

Circuit testing of an RFID-based attendance marking system with an automatic hand sanitizer unit was performed as follows:

First, gather all the necessary components for the circuit, including the RFID reader, RFID tags, microcontroller, hand sanitizer dispenser components, and any other required components. Make sure that all the components of the circuit are properly connected and that there are no loose connections.

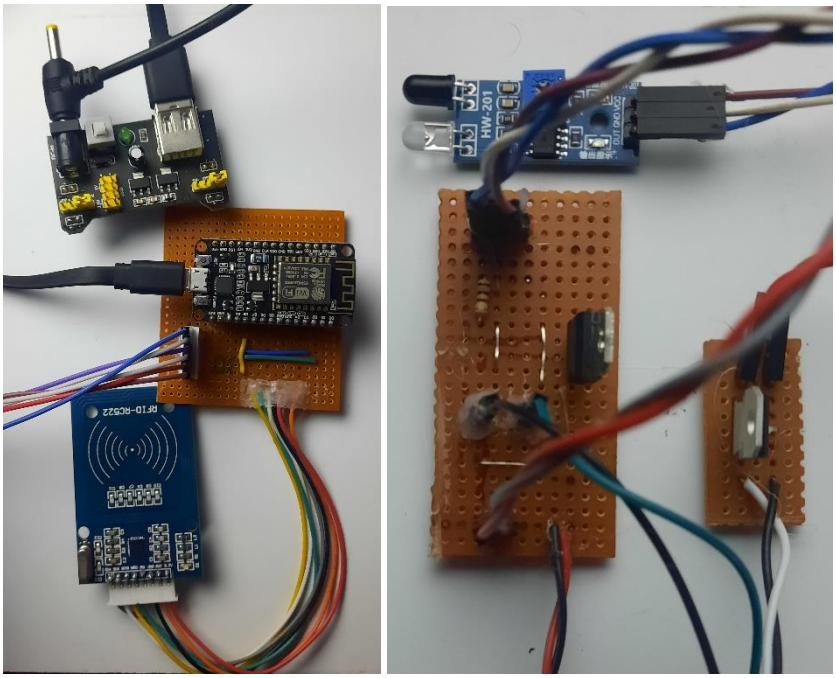
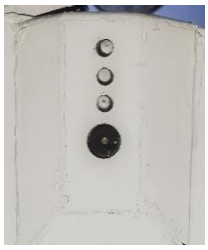


Figure 24 : Circuit of automatic student attendant marking system with an automatic sanitizer dispenser unit



After that, turn on the circuit and use the LED blinks to determine if the NodeMCU is online or not. By bringing an RFID tag or card to the RFID reader, you can scan it. LED bulbs were checked for the reader's ability to recognise the tag, send it to the database, store it, and detect errors in the system.

Figure 25 : LEDs Panel with Buzzer

Then, test the automatic hand sanitizer unit by placing your hand under the dispenser. The unit has been tested to see if it delivers the right amount of sanitizer to your hands.

Next, the attendance marking system was tested by swiping an RFID tag or card and verifying that attendance was recorded correctly. Here, by accessing the attendance records in the Google Sheet, the time, day, and student data were checked for accuracy.

	A	B	C	D	E	F	G
1	ATTENDANCE MARKING DATABASE						
2							
3	**Date**	**Time**	**ID Number**	**First Name**	**Last Name**	**Telephone Number**	**Address**
4	14/12/2022	13:24:17	21UG0483	Asiridu	Umayanga	761570486	Mathugama
5	14/12/2022	13:24:03	21UG0483	Asiridu	Umayanga	761570486	Mathugama
6	14/12/2022	13:23:25	21UG0483	Asiridu	Umayanga	761570486	Mathugama
7	14/12/2022	13:23:03	G1	Guest			

If all of these steps work as expected, the circuit is working correctly. All circuits are debugged by identifying and resolving all problems and errors encountered during the testing process.

3.3 CIRCUIT BOARD DESIGN

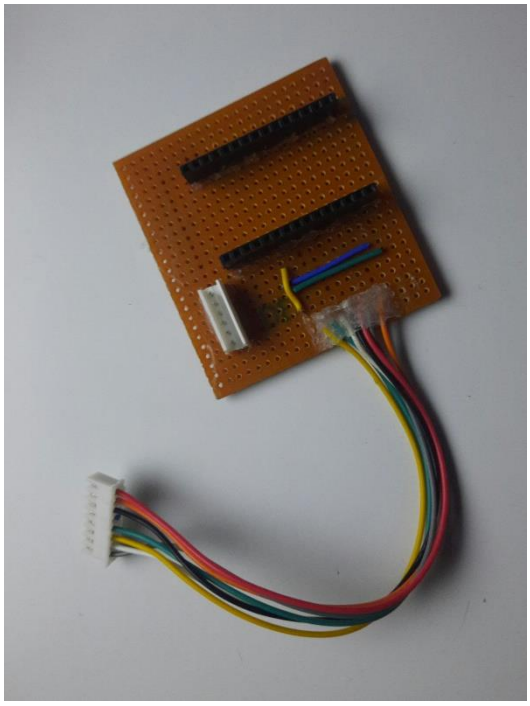


Figure 27 : NodeMCU connector circuit

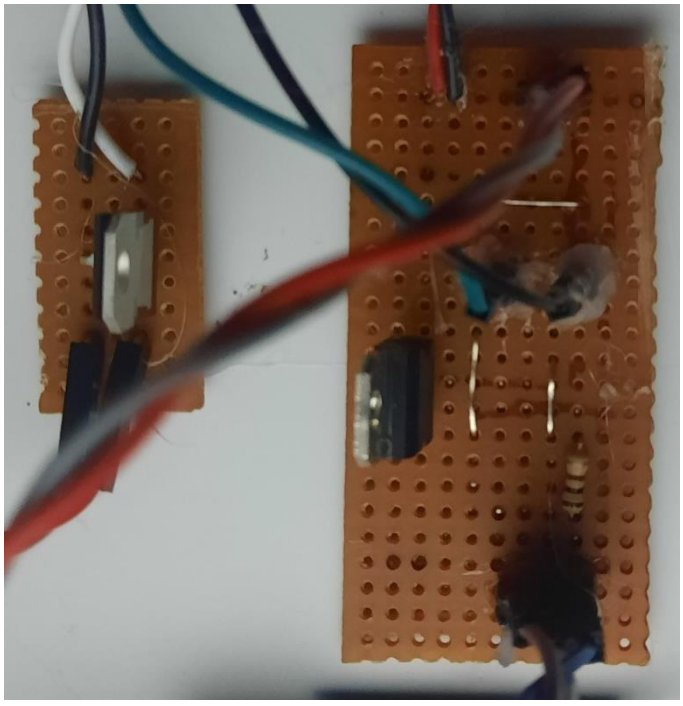


Figure 26 : Automatic sanitizer dispenser and DC 9V to 5V converter circuits

3.4 CABLE MANAGEMENT

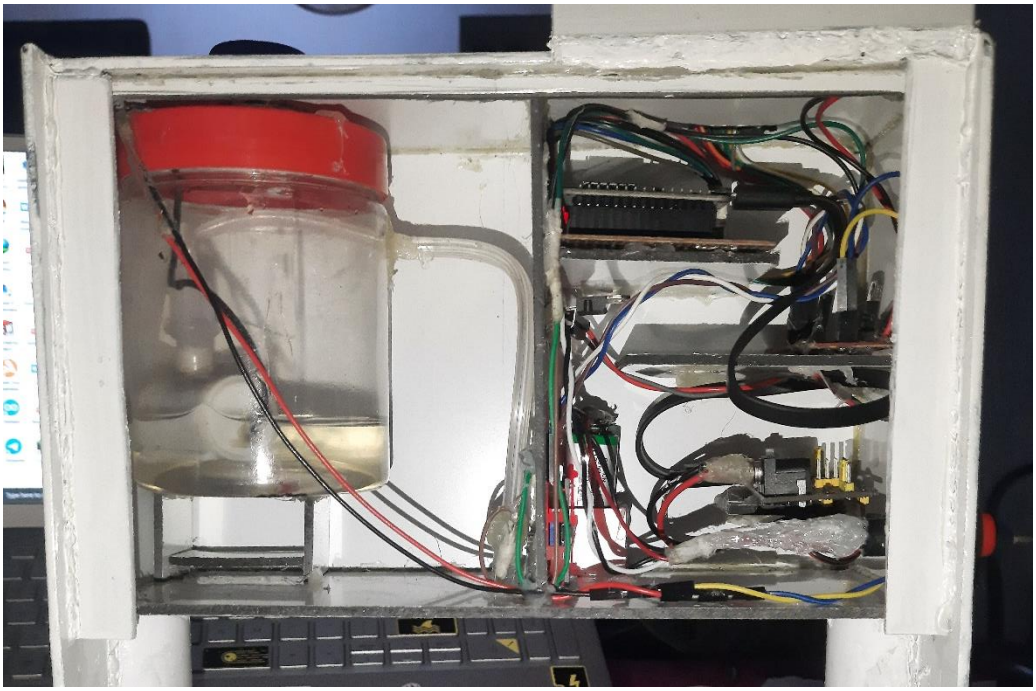


Figure 28 : Inside View of the Device

3.5 FINAL DESIGN AND PROTOTYPE DEVICE

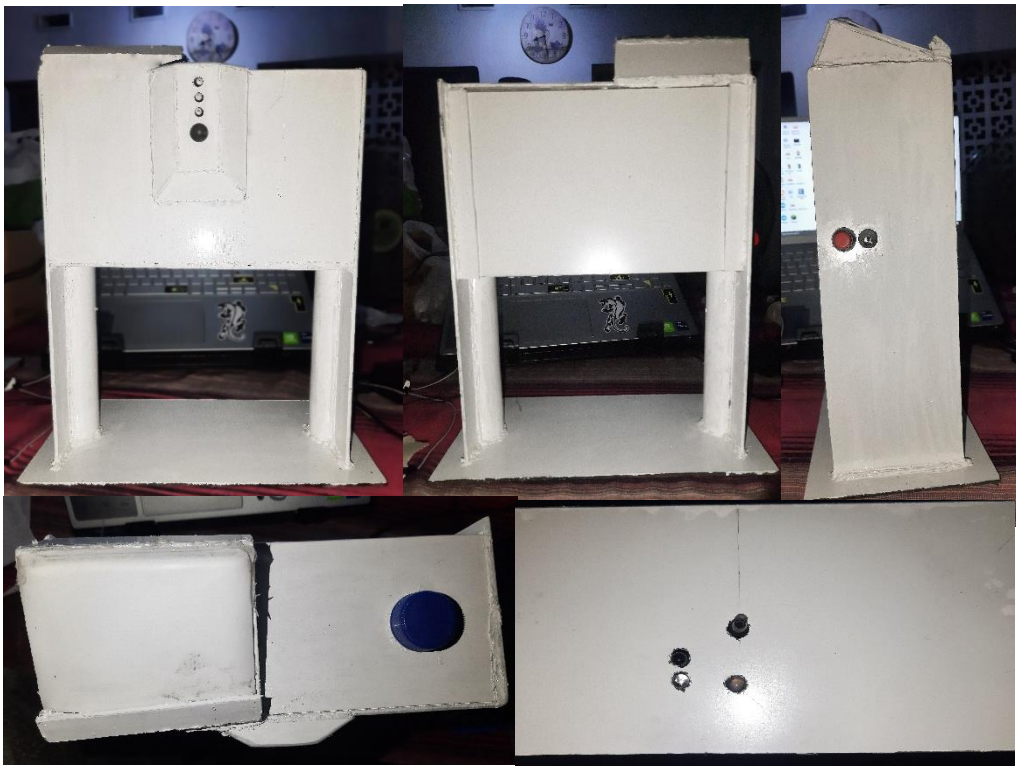


Figure 29 : Front, sides and back view of the device

3.2 LIST OF COMPONENTS

Table 1 : List of components

Component Name	Quantities
RFID RC522 Module	1
RFID Card	5
RFID tag	1
NodeMCU (ESP8266)	1
MB102 Breadboard Power Supply Module 3.3V/5V	1
IR Senser Module	1
1KΩ Resistor	2
LED Bulb	4
DC Submersible Water Pump	1
TIP32C Transistor	1
LM7805 IC	1
Buzzer	1
Toggle Switch Push On/Off	1
Dot Board	2
9V Battery	1
9V Battery Clip connector	1
Aluminum composite board	1
Glue gun sticks	6
Circuit wires	-
40 Pin Female Header	1
Lead	-
DC 12V 2A Power Adapter	1
JST XH Wire Connector and Socket 8 pin	1

CHAPTER 4

VALIDATION, RECOMMENDATIONS AND CONCLUSION

4.1 VALIDATION PLAN AND RESULTS

This section describes the validation tests that will be performed on the prototype of the automatic attendance marking system with a hand sanitizer dispenser to ensure that it satisfies the engineering requirements. Each specification that can be tested will have a description of the validation test.

Safety:

It is important to ensure the safety of an automatic attendance marking system with a hand sanitizer dispenser to avoid possible accidents or injuries while using the system. There are several key security issues to consider when designing and implementing such a system:

- Electrical Safety: The system is designed and installed in accordance with applicable electrical codes and standards to prevent electrical accidents or injuries.
- Physical Safety: The system is designed and installed to minimize the risk of physical injuries such as falls or collisions.
- Chemical Safety: If the hand sanitizer dispenser uses chemicals, such as alcohol, ensure safe handling and use of chemicals to avoid accidents or injuries.
- Data Security: The system is designed and implemented in such a way that sensitive data such as attendance records are protected from unauthorized access or breach.

Longevity:

The longevity of an automated attendance marking system with a hand sanitizer dispenser refers to the length of time the system is expected to function correctly and effectively. There are several main factors that affect the longevity of such a system:

- Quality of components: Using high-quality components designed to withstand any conditions helps extend the life of the system.
- Regular maintenance: Regular maintenance on the system, i.e., cleaning and replacement of damaged parts, helps extend its life.
- Operating Conditions: The operating conditions the system is used in can affect its lifespan. For example, a system used in a harsh or extreme environment may have a shorter lifespan than one used in a more favourable environment.
- System Design: The overall design of the system can also affect its longevity. Systems designed with strong and durable components and built to withstand the stress of use are more likely to have a long life.

Privacy:

The privacy of an automatic attendance marking system with a hand sanitizer dispenser will depend on how the system is designed and implemented. Here are a few factors to consider:

- Data collection: The system may collect data on the individuals who use it, such as their names, identification numbers, and the times they use the hand sanitizer dispenser. It's important to consider how this data will be used and stored and

whether individuals will be notified about the data collection and given the option to opt out.

- Data security: The system should be designed to protect the data it collects from unauthorized access or tampering. This may include measures such as encryption, secure servers, and access controls.
- Data sharing: It's important to consider who will have access to the data collected by the system and for what purposes it will be shared. Will the data be shared with third parties, and if so, under what circumstances?
- Data retention: The system should have a clear policy on how long data will be retained and under what circumstances it will be deleted.

Durability:

The durability of an automatic attendance marking system with a hand sanitizer dispenser will depend on a number of factors, including the materials and design of the system, the environment in which it is used, and the frequency and intensity of use. Here are a few things to consider:

- Materials: The system should be made of high-quality, durable materials that can withstand regular use and the rigors of the environment in which it will be used.
- Design: The system should be designed to be sturdy and able to withstand regular use without breaking or malfunctioning.
- Environment: The system should be able to withstand the conditions of the environment in which it will be used. This may include factors such as temperature, humidity, and exposure to dirt and dust.
- Frequency and intensity of use: The system should be able to withstand the frequency and intensity of use it is expected to receive. If it is expected to be used by a large number of people on a regular basis, it should be able to handle the wear and tear that comes with that level of use.

Comfort ability:

The comfort ability of an automatic attendance marking system with a hand sanitizer dispenser will depend on the design and functionality of the system. Here are a few factors to consider:

- Ergonomics: The system should be designed with ergonomics in mind, so that it is comfortable for users to interact with. This may include factors such as the placement and height of the hand sanitizer dispenser, the size and shape of the dispenser nozzle, and the ease of use of any touch screens or buttons.
- User experience: The system should be easy for users to interact with and should provide a smooth, seamless experience. This may include factors such as the speed and accuracy of the attendance marking system and the effectiveness of the hand sanitizer dispenser.
- Accessibility: The system should be accessible to all users, including those with disabilities. This may include features such as adjustable height, braille labeling, and audio prompts.

4.2 DESIGN CRITIQUES AND RECOMMENDATIONS

Every good engineering design innovation has flaws, and these design flaws can be further improved in the future to increase the reliability and efficiency of the project. Let's consider some suggestions for these improvements:

1. An IP camera is expected to be added to the system to monitor student actions such as cheating by scanning an ID card of other students.

2. Also, GSM technology is expected to enter the system to send messages to the students to confirm their attendance or absence.
Here, it can be easily done by adding GSM module to the system.

3. By incorporating all circuits into one module, final designs can be designed to be lightweight and compact.

4. When creating the database, it can be linked to the University's Learning Management System (LMS).
Thus, it is very easy to get other data of students when required and calculate whether 80% complete or not while calculating final attendance records of students.

5. MLX90614 non-contact temperature sensor module
By adding to the system, the student's temperature can be taken while reading the RIFID card or tag. It is more protective against Covid-19.

6. As a temporary solution for the convenience of students whose names are not mentioned in the database, guest cards have been introduced. We hope to introduce a method to get the data of the students who have obtained these guest cards immediately.

We hope to expand the use of this new attendance marking system beyond students to university staff and other employees.

4.3 MARKETING OF THE PRODUCT

We are looking to implement this design from SLTC Research University, and we can also sell it as a product. There are various tactics and strategies for marketing a product. Basically, who are most interested in buying the product? should be considered. Here, more attention should be given to educational institutions. In addition, the convenience of use the system, improved hygiene and safety should be highlighted as benefits to customers. Also, RFID technology can be confusing to some people, so we can introduce a user manual to explain how it works and its benefits. In addition, a video or other visual material may be created that demonstrates the use of the product. Social media platforms like LinkedIn, Twitter, and Facebook can be used for product promotion in addition to television channels, reaching a larger audience by disseminating information about the product there. Connecting with potential customers is

made possible by taking part in trade shows and conferences to introduce and display our design. It can be a great opportunity to expand the reach of our brand and attract new customers by partnering with businesses or organizations. In order to get people to try the product, we intend to offer special offers or discounts.

CONCLUSION

In the end, the goal of creating an RFID-based automatic attendance marking system with a hand sanitizer dispenser unit was successful. Compared to the conventional manual attendance method, this project has offered a convenient method of attendance marking in terms of performance and efficiency. Data is better organized thanks to databases. In addition to being user-friendly, the system allows for data manipulation and retrieval through the interface, making it a universal attendance system. Therefore, this could be applied at SLTC Research University or any other academic institution.

REFERENCES

RFID-based-attendance-system
ESP8266 Pinout, Datasheet, Features & Applications
RFID RC522 Reader Module Datasheet
Breadboard power supply module datasheet
IR infrared obstacle avoidance sensor module
TIP32C Transistor
LM7805 IC

APPENDICES

4.4 BILL OF MATERIALS

Table 2 : Bill of Materials

Component Name	Quantities	Price For Each Components	Price (LKR) RS
RFID RC522 Module	1	750.00	750.00
RFID Card	5	90.00	450.00
RFID tag	1	100.00	100.00
NodeMCU (ESP8266)	1	1450.00	1450.00
MB102 Breadboard Power Supply Module 3.3V/5V	1	290.00	290.00
IR Senser Module	1	280.00	280.00
1KΩ Resistor	2	10.00	20.00
LED Bulb	4	15.00	60.00
DC Submersible Water Pump	1	490.00	490.00
TIP32C Transistor	1	40.00	40.00
LM7805 IC	1	55.00	55.00
Buzzer	1	50.00	50.00
Toggle Switch Push On/Off	1	45.00	45.00
Dot Board	2	120.00	240.00
9V Battery	1	250.00	250.00
9V Battery Clip connector	1	50.00	50.00
Aluminum composite board	1	500.00	500.00
Glue gun sticks	6	75.00	450.00
Circuit wires	-	600.00	600.00
40 Pin Female Header	1	40.00	40.00
Lead	-	500.00	500.00
DC 12V 2A Power Adapter	1	1250.00	1250.00
JST XH Wire Connector and Socket 8 pin	1	75.00	75.00
Total Cost			**Rs: 8035.00**

CODE OF ATTENDENCE MARKING MAIN SYSTEM

```
#include <Arduino.h>
#include <ESP8266WiFi.h>
#include <SPI.h>
#include <MFRC522.h>
#include <HTTPSRedirect.h>
#include<Wire.h>

const char *GScriptId =
"AKfycbzyy3wgcWUgU_GIqNc2dwKn_BPiTFAf12vXYhIDDvwTNfc4N_0dL_sl6x4qFHJ-
i2MukQ";
const int led1 = D2;
const int led2 = D8;
const char* ssid     = "Manilka";
const char* password = "Manilka@99";

String payload_base =  "{\"command\": \"insert_row\", \"sheet_name\": \"Sheet1\",
\"values\": ";
String payload = "";

const char* host       = "script.google.com";
const int   httpsPort   = 443;
const char* fingerprint = "";
String url = String("/macros/s/") + GScriptId + "/exec";
HTTPSRedirect* client = nullptr;

// Declare variables that will be published to Google Sheets
String student_id;

int blocks[] = {4,5,6,8,9};
#define total_blocks  (sizeof(blocks) / sizeof(blocks[0]))

#define RST_PIN  0  //D3
#define SS_PIN   2  //D4
#define BUZZER   5  //D1

MFRC522 mfrc522(SS_PIN, RST_PIN);
MFRC522::MIFARE_Key key;
MFRC522::StatusCode status;

//----------------------------
/* keep watch out for Sector Trailer Blocks */
```

```
int blockNum = 2;

/* Create another array to read data from Block */
/* Legthn of buffer should be 2 Bytes more than the size of Block (16 Bytes) */
byte bufferLen = 18;
byte readBlockData[18];
//-------------------------------------------------------------

/* Main Setup Function */
void setup() {

  Serial.begin(9600);
  delay(10);
  Serial.println('\n');

  SPI.begin();

  // Connect to WiFi
  WiFi.begin(ssid, password);
  Serial.print("Connecting to ");
  Serial.print(ssid); Serial.println(" ...");

  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.print(".");
  }
  Serial.println('\n');
  Serial.println("Connection established!");
  Serial.print("IP address:\t");
  Serial.println(WiFi.localIP());
  Serial.println();


  pinMode(BUZZER, OUTPUT);
  SPI.begin();

  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);

  // Here HTTPSRedirect class to create a new TLS connection
  client = new HTTPSRedirect(httpsPort);
  client->setInsecure();
  client->setPrintResponseBody(true);
  client->setContentTypeHeader("application/json");
```

```
 Serial.print("Connecting to ");
 Serial.println(host);


 // Try to connect for a maximum of 5 times
 bool flag = false;
 for(int i=0; i<5; i++){
  int retval = client->connect(host, httpsPort);

  if (retval == 1){
   flag = true;
   String msg = "Connected. OK";
   Serial.println(msg);
   delay(2000);
   digitalWrite(led1, HIGH);
   delay(1000);
   digitalWrite(led1, LOW);
   break;
  }

  else
   Serial.println("Connection failed. Retrying...");
   digitalWrite(led2, HIGH);
   delay(1000);
   digitalWrite(led2, LOW);
 }
 //----------------------------------------------------------
 if (!flag){

  Serial.print("Could not connect to server: ");
  Serial.println(host);
  delay(5000);
  digitalWrite(led2, HIGH);
  delay(2000);
  digitalWrite(led2, LOW);
  return;

 }

 delete client;    // delete HTTPSRedirect object
 client = nullptr; // delete HTTPSRedirect object

}
```

```
/* Main loop Function */

void loop() {

  static bool flag = false;
  if (!flag){
    client = new HTTPSRedirect(httpsPort);
    client->setInsecure();
    flag = true;
    client->setPrintResponseBody(true);
    client->setContentTypeHeader("application/json");
  }
  if (client != nullptr){
    if (!client->connected())
      {client->connect(host, httpsPort);}
  }
  else{Serial.println("Error creating client object!");}
      digitalWrite(led2, HIGH);
      delay(750);
      digitalWrite(led2, LOW);

  Serial.println("Scan your Tag");


  /* Initialize MFRC522 Module */
  mfrc522.PCD_Init();
  /* Look for new cards */
  /* Reset the loop if no new card is present on RC522 Reader */
  if ( ! mfrc522.PICC_IsNewCardPresent()) {return;}
  /* Select one of the cards */
  if ( ! mfrc522.PICC_ReadCardSerial()) {return;}
  /* Read data from the same block */
  Serial.println();
  Serial.println(F("Reading last data from RFID..."));
  //-------------------------------------------------------------
  String values = "", data;


  /*Payload - method*/

  for (byte i = 0; i < total_blocks; i++) {
    ReadDataFromBlock(blocks[i], readBlockData);
    //*****************************************************
```

```
  if(i == 0){
    data = String((char*)readBlockData);
    data.trim();
    student_id = data;
    values = "\"" + data + ",";
  }
  //*************************************************
  else if(i == total_blocks-1){
    data = String((char*)readBlockData);
    data.trim();
    values += data + "\"}";
  }
  //*************************************************
  else{
    data = String((char*)readBlockData);
    data.trim();
    values += data + ",";
  }
}
//------------------------------
payload = payload_base + values;

/*Buzzer sound for RFID Read*/
digitalWrite(BUZZER, HIGH);
delay(200);
digitalWrite(BUZZER, LOW);
delay(200);
digitalWrite(BUZZER, HIGH);
delay(200);
digitalWrite(BUZZER, LOW);
delay(3000);


// Publish data to Google Sheets
Serial.println("Publishing data...");
Serial.println(payload);
if(client->POST(url, host, payload)){
  // do stuff here if publish was successful
  Serial.println("Student ID: "+student_id);
  Serial.println("Present");
  digitalWrite(led1, HIGH);
  delay(1000);
  digitalWrite(led1, LOW);
}
```

```
  else{
    // do stuff here if publish was not successful
    Serial.println("Error while connecting");
    Serial.println("Failed.");
    Serial.println("Try Again");
    //-------------------------------
    digitalWrite(led2, HIGH);
    delay(3000);
    digitalWrite(led2, LOW);
  }

  // Delay to required before publishing again
  delay(1000);
}


/* ReadDataFromBlock() function */

void ReadDataFromBlock(int blockNum, byte readBlockData[])
{

  /* Prepare the ksy for authentication - All keys are set to FFFFFFFFFFFFh at chip delivery
from the factory */
  for (byte i = 0; i < 6; i++) {
    key.keyByte[i] = 0xFF;
  }

  /* Authenticating the desired data block for Read access using Key A */
  status = mfrc522.PCD_Authenticate(MFRC522::PICC_CMD_MF_AUTH_KEY_A,
blockNum, &key, &(mfrc522.uid));

  //-----------------------------------------------
  if (status != MFRC522::STATUS_OK){
     Serial.print("Authentication failed for Read: ");
     Serial.println(mfrc522.GetStatusCodeName(status));
     return;
  }

  else {
    Serial.println("Authentication success");
  }

  /* Reading data from the Block */
```

```
  status = mfrc522.MIFARE_Read(blockNum, readBlockData, &bufferLen);
  if (status != MFRC522::STATUS_OK) {
    Serial.print("Reading failed: ");
    Serial.println(mfrc522.GetStatusCodeName(status));
    digitalWrite(led2, HIGH);
    delay(2000);
    digitalWrite(led2, LOW);
    return;
  }

  else {
    readBlockData[16] = ' ';
    readBlockData[17] = ' ';
    Serial.println("Block was read successfully");
  }
}
```

CODE TO STORE DATA INTO STUDENT ID CARDS OR TAGS

```
#include <SPI.h>
#include <MFRC522.h>

//GPIO 0 --> D3
//GPIO 2 --> D4
const uint8_t RST_PIN = D3;
const uint8_t SS_PIN = D4;

MFRC522 mfrc522(SS_PIN, RST_PIN);
MFRC522::MIFARE_Key key;

/* Be aware of Sector Trailer Blocks */
int blockNum = 4;
/* Create array to read data from Block */
/* Length of buffer should be 4 Bytes
more than the size of Block (16 Bytes) */
byte bufferLen = 18;
byte readBlockData[18];

MFRC522::StatusCode status;
```

```
void setup()
{
  Serial.begin(9600);

  SPI.begin();
  //Initialize MFRC522 Module
  mfrc522.PCD_Init();
  Serial.println("Scan a MIFARE 1K Tag to write data...");

}



/* Main loop() function */
void loop()
{
  /* Prepare the ksy for authentication */
  /* All keys are set to FFFFFFFFFFFFh at chip delivery from the factory */
  for (byte i = 0; i < 6; i++){
    key.keyByte[i] = 0xFF;
  }

  /* Look for new cards */
  /* Reset the loop if no new card is present on RC522 Reader */
  if ( ! mfrc522.PICC_IsNewCardPresent()){return;}

  /* Select one of the cards */
  if ( ! mfrc522.PICC_ReadCardSerial()) {return;}

  Serial.print("\n");
  Serial.println("**Card Detected**");


  /* Print UID of the Card */
  Serial.print(F("Card UID:"));
  for (byte i = 0; i < mfrc522.uid.size; i++){
    Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
    Serial.print(mfrc522.uid.uidByte[i], HEX);
  }
  Serial.print("\n");

  /* Print type of card (for example, MIFARE 1K) */
```

```
Serial.print(F("PICC type: "));
MFRC522::PICC_Type piccType = mfrc522.PICC_GetType(mfrc522.uid.sak);
Serial.println(mfrc522.PICC_GetTypeName(piccType));

byte buffer[18];
byte len;

Serial.setTimeout(20000L);

Serial.println(F("---------------------------------------"));
Serial.println(F("Enter Student ID, ending with #"));
len = Serial.readBytesUntil('#', (char *) buffer, 16);
//add empty spaces to the remaining bytes of buffer
for (byte i = len; i < 16; i++) buffer[i] = ' ';
blockNum = 4;
WriteDataToBlock(blockNum, buffer);
ReadDataFromBlock(blockNum, readBlockData);
dumpSerial(blockNum, readBlockData);

Serial.println(F("---------------------------------------"));
Serial.println(F("Enter First Name, ending with #"));
len = Serial.readBytesUntil('#', (char *) buffer, 16);
for (byte i = len; i < 16; i++) buffer[i] = ' ';
blockNum = 5;
WriteDataToBlock(blockNum, buffer);
ReadDataFromBlock(blockNum, readBlockData);
dumpSerial(blockNum, readBlockData);

Serial.println(F("---------------------------------------"));
Serial.println(F("Enter Last Name, ending with #"));
len = Serial.readBytesUntil('#', (char *) buffer, 16);
for (byte i = len; i < 16; i++) buffer[i] = ' ';
blockNum = 6;
WriteDataToBlock(blockNum, buffer);
ReadDataFromBlock(blockNum, readBlockData);
dumpSerial(blockNum, readBlockData);

Serial.println(F("---------------------------------------"));
Serial.println(F("Enter Phone Number, ending with #"));
len = Serial.readBytesUntil('#', (char *) buffer, 16);
for (byte i = len; i < 16; i++) buffer[i] = ' ';
blockNum = 8;
WriteDataToBlock(blockNum, buffer);
ReadDataFromBlock(blockNum, readBlockData);
```

```
  dumpSerial(blockNum, readBlockData);

  Serial.println(F("---------------------------------------"));
  Serial.println(F("Enter Address, ending with #"));
  len = Serial.readBytesUntil('#', (char *) buffer, 16);
  for (byte i = len; i < 16; i++) buffer[i] = ' ';
  blockNum = 9;
  WriteDataToBlock(blockNum, buffer);
  ReadDataFromBlock(blockNum, readBlockData);
  dumpSerial(blockNum, readBlockData);
}


/* Main Writ() function */
void WriteDataToBlock(int blockNum, byte blockData[])
{
   //Serial.print("Writing data on block ");
   //Serial.println(blockNum);

  /* Authenticating the desired data block for write access using Key A */
  status = mfrc522.PCD_Authenticate(MFRC522::PICC_CMD_MF_AUTH_KEY_A,
blockNum, &key, &(mfrc522.uid));
  if (status != MFRC522::STATUS_OK){
    Serial.print("Authentication failed for Write: ");
    Serial.println(mfrc522.GetStatusCodeName(status));
    return;
  }

  else {
    //Serial.print("Authentication OK - ");
  }

  /* Write data to the block */
  status = mfrc522.MIFARE_Write(blockNum, blockData, 16);
  if (status != MFRC522::STATUS_OK) {
    Serial.print("Writing to Block failed: ");
    Serial.println(mfrc522.GetStatusCodeName(status));
    return;
  }
  else {
    //Serial.println("Write OK");
  }

}
```

```
/* ReadDataFromBlock() function */

void ReadDataFromBlock(int blockNum, byte readBlockData[])
{
   //Serial.print("Reading data from block ");
   //Serial.println(blockNum);
  //-------------------------------------------------------------------------

  /* Prepare the ksy for authentication */
  /* All keys are set to FFFFFFFFFFFFh at chip delivery from the factory */
  for (byte i = 0; i < 6; i++) {
    key.keyByte[i] = 0xFF;
  }

  /* Authenticating the desired data block for Read access using Key A */
  status = mfrc522.PCD_Authenticate(MFRC522::PICC_CMD_MF_AUTH_KEY_A,
blockNum, &key, &(mfrc522.uid));

  if (status != MFRC522::STATUS_OK){
   Serial.print("Authentication failed for Read: ");
   Serial.println(mfrc522.GetStatusCodeName(status));
   return;
  }
  else {
    //Serial.print("Authentication OK - ");
  }

  /* Reading data from the Block */
  status = mfrc522.MIFARE_Read(blockNum, readBlockData, &bufferLen);
  if (status != MFRC522::STATUS_OK){
    Serial.print("Reading failed: ");
    Serial.println(mfrc522.GetStatusCodeName(status));
    return;
  }
  else {
    //readBlockData[16] = ' ';
    //readBlockData[17] = ' ';
    //Serial.println("Read OK");
  }

}
```

```
/* dumpSerial() function*/

void dumpSerial(int blockNum, byte blockData[])
{
  Serial.print("\n");
  Serial.print("Data saved on block");
  Serial.print(blockNum);
  Serial.print(": ");
  for (int j=0 ; j<16 ; j++){
    Serial.write(readBlockData[j]);
  }
  Serial.print("\n");

  //Empty readBlockData array
  for( int i = 0; i < sizeof(readBlockData);  ++i )
   readBlockData[i] = (char)0; //empty space
}
```