A

PROJECT REPORT

ON

"RFID Based Attendance System"

SUBMITTED TO

DKTE's Textile and Engineering Institute

BY

NAME	PRN
Atharv Mahadeo Jamkhindikar	21UET044
Rajbhushan Kamalakar Kadam	21UET046
Rushikesh Sanjay Kamate	21UET052

UNDER THE GUIDENCE OF

Dr. Mrs. A.R. Patil

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

D.K.T.E. SOCIETY'S TEXTILE AND ENGINEERING INSTITUTE, ICHALKARANJI

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D.K.T.E. SOCIETY's

TEXTILE AND ENGINEERING INSTITUTE,

ICHALKARANJI

DEPARTMENT OF ELECTRONICS AND

TELECOMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the project entitled

"RFID Based Attendance System"

Is a bonafide work of the following students

NAME	PRN
Atharv Mahadeo Jamkhindikar	**21UET044**
Rajbhushan Kamalakar Kadam	**21UET046**
Rushikesh Sanjay Kamate	**21UET052**

Guide

Dr. Mrs. A.R. Patil

HOD

Dr. Mr. S.A. PATIL

Director

Dr. Mrs. L.S. Admuthe

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Date: -

Place: - Ichalkaranji

ABSTRACT

Most educational institutions' administrators are concerned about student irregular attendance. Truancies can affect student overall academic performance. The conventional method of taking attendance by calling names or signing on paper is very time consuming and insecure, hence inefficient. Radio Frequency Identification (RFID) based attendance system is one of the solutions to address this problem. This system can be used to take attendance for student in school, college, and university. It also can be used to take attendance for workers in working places. Its ability to uniquely identify each person based on their RFID tag type of ID card make the process of taking the attendance easier, faster and secure as compared to conventional method. Students or workers only need to place their ID card on the reader and their attendance will be taken immediately. With real time clock capability of the system, attendance taken will be more accurate since the time for the attendance taken will be recorded. The system can be connected to the computer through Universal Serial Bus (USB) port and store the attendance taken inside database.

This project presents the design and implementation of an RFID-based attendance system using the Raspberry Pi Pico microcontroller. The system aims to automate the process of recording attendance in various settings such as educational institutions, workplaces, or events. RFID technology is utilized to uniquely identify individuals through RFID tags/cards.

The Raspberry Pi Pico serves as the central processing unit, interfacing with RFID reader modules to scan and capture tag information. The system employs Python programming language for software development, providing flexibility and ease of integration with the Raspberry Pi Pico platform. Additionally, we monitor the attendance on the shell. (Here we assumed that shell is like a database

management system which is integrated to store attendance records securely. The system offers real-time monitoring and reporting functionalities, facilitating efficient attendance management and analysis.)

This project demonstrates a cost-effective and scalable solution for streamlining attendance tracking processes in diverse environments.

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CHAPTER 1 – INTRODUCTION

1.1 Motivation

In today's fast-paced world, traditional methods of attendance tracking are often inefficient, prone to errors, and time-consuming. Whether in educational institutions, corporate settings, or event management, manual attendance management can lead to significant administrative overheads and potential inaccuracies. The motivation behind developing an RFID-based attendance system using the Raspberry Pi Pico stems from the need to address these challenges and streamline the attendance recording process.

1. **Automation**: Manual attendance tracking processes are often tedious and prone to errors. By implementing an RFID-based system, you automate the attendance recording process, saving time and reducing the likelihood of errors associated with manual entry.

2. **Efficiency**: Traditional methods of attendance taking, such as paper-based systems or manual entry into electronic spreadsheets, can be time-consuming and inefficient, especially in large organizations or events. The RFID system streamlines this process, allowing for quick and accurate data capture without the need for manual intervention.

3. **Real-time Monitoring**: The system offers real-time monitoring capabilities, allowing administrators to track attendance as it happens. This enables proactive intervention in case of any discrepancies or issues with attendance.

4. **Cost-effectiveness**: Raspberry Pi Pico, being a low-cost microcontroller, makes this project an affordable solution for institutions or organizations with budget constraints. The RFID tags/cards are also relatively inexpensive, making the overall system cost-effective.

These are some of the factors that inspired us to work on this project. The RFID-based attendance system developed using the Raspberry Pi Pico embodies the spirit of innovation and efficiency. It represents a step towards modernizing traditional attendance management practices, fostering a more streamlined and effective approach in various domains.

1.2 Problem Statement

Manual attendance tracking systems are prone to inefficiencies, inaccuracies, and time-consuming processes, leading to administrative burdens and potential data inconsistencies. The existing methods often involve manual data entry, which is susceptible to errors and can result in discrepancies in attendance records. Additionally, traditional systems lack real-time monitoring capabilities, making it challenging for administrators to promptly address attendance-related issues.

To address these challenges, the project aims to develop an RFID-based attendance system using the Raspberry Pi Pico microcontroller. The system seeks to automate the process of recording attendance by leveraging RFID technology for individual identification. By integrating RFID reader modules with the Raspberry Pi Pico, the system will enable seamless scanning and capture of RFID tag information, eliminating the need for manual data entry and reducing the risk of errors.

1. **Automation of Attendance Recording**: The system will automate the process of recording attendance by scanning RFID tags/cards issued to individuals. This eliminates the need for manual data entry, saving time and reducing the risk of human errors.

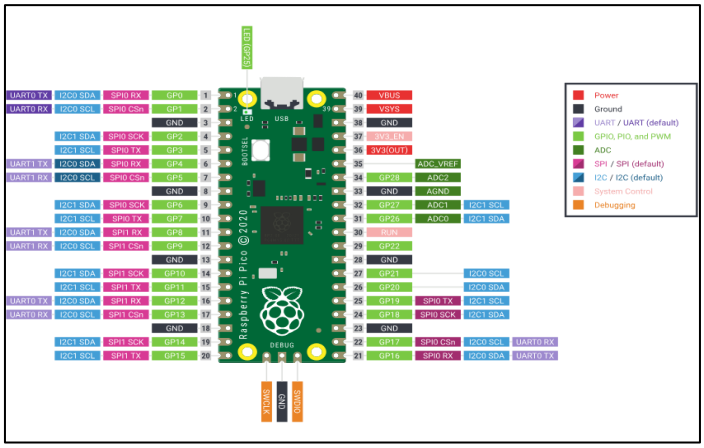
2. **Real-time Monitoring and Reporting**: The system will provide real-time monitoring capabilities, allowing administrators to track attendance status instantly. Additionally, the system will generate comprehensive attendance reports, enabling administrators to analyze attendance patterns and trends efficiently.

3. **User-Friendly Interface**: The system will feature a user-friendly interface for easy operation and configuration. Administrators will have access to intuitive controls for managing attendance records and generating reports.

4. **Scalability and Flexibility**: The system will be designed to be scalable and adaptable to various settings, including educational institutions, workplaces, and events. It will accommodate different RFID tag/card formats and support the expansion of the system as needed.

1.3 Literature review

➢ Raspberry Pi Pico



The Raspberry Pi Pico is a microcontroller board developed by the Raspberry Pi Foundation, released in January 2021. It marks the foundation's first venture into microcontrollers, aiming to provide a low-cost, high-performance platform for hobbyists, educators, and professionals to explore and develop embedded projects.

1. **RP2040 Microcontroller:** The Pico is powered by the RP2040 microcontroller, designed by Raspberry Pi themselves. It features a dual-core ARM Cortex-M0+ processor running at up to 133MHz, 264KB of RAM, and a rich set of I/O peripherals.

2. **Flexible I/O:** The board features 26 multi-function GPIO pins, which can be configured for a variety of purposes including digital input/output, PWM output, SPI, I2C, UART, and more.

3. **USB Connectivity:** It includes a micro-USB port for power and data transfer, allowing it to be easily programmed and powered from a computer.

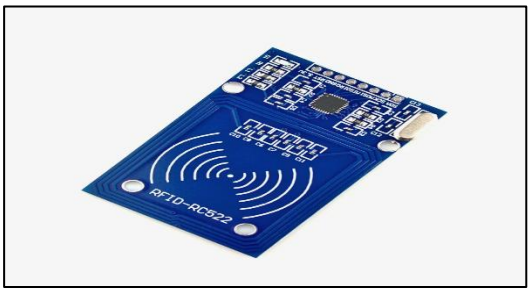
4. **Programmability**: The Pico supports programming in C and MicroPython, making it accessible to both seasoned developers and beginners. It can be programmed using various development environments including the official Raspberry Pi Pico C/C++ SDK and the Thonny Python IDE.

5. **Low Cost:** One of its most attractive features is its affordability, making it an excellent choice for both individual projects and educational purposes.

6. **Expansion Options:** While the Pico itself is a relatively simple board, it can be expanded using add-on boards (known as "hats" in the Raspberry Pi ecosystem) to add additional functionality or interfaces.

The Raspberry Pi Pico offers a compelling combination of performance, flexibility, and affordability, making it an excellent choice for a wide range of embedded projects.

➢ RFID Sensor



RFID (Radio-Frequency Identification) sensors are devices that use radio waves to wirelessly identify and track objects or individuals equipped with RFID tags or cards. These sensors consist of two main components: an RFID reader or interrogator and an RFID tag.

1. **RFID Reader/Interrogator**: The RFID reader is the component responsible for emitting radio waves and receiving signals from RFID tags within its vicinity. It typically consists of an antenna, radio frequency (RF) module, and data processing unit. The reader emits radio waves at a specific frequency and power level, which energizes RFID tags within range. When an RFID tag detects the reader's signal, it responds by transmitting its unique identification code or data back to the reader. RFID readers can be fixed or handheld and come in various form factors to suit different applications.

2. **RFID Tag**: The RFID tag, also known as a transponder or label, is attached to or embedded in the object or individual being tracked. It contains a microchip (integrated circuit) and an antenna for communication with RFID readers. When energized by the radio waves emitted by the RFID reader, the microchip in the tag modulates the radio signal to transmit data back to the reader. RFID tags can be passive, active, or semi-passive, depending on their power source and communication capabilities.

➢ OLED Display

An OLED (Organic Light-Emitting Diode) display is a type of display technology that uses organic compounds to emit light when an electric current is applied. OLED displays are known for their vibrant colors, high contrast ratios, and thin form factors, making them popular choices for various electronic devices.

Characteristics and features of OLED displays:

1. **Organic Materials:** OLED displays utilize organic compounds that emit light when an electric current passes through them. These organic materials are sandwiched between two conductive layers, typically made of glass or plastic substrates.

2. **Self-Illuminating Pixels:** Unlike traditional LCD displays, which require a backlight to illuminate the pixels, each pixel in an OLED display emits its own light. This self-emissive property allows for deeper blacks, higher contrast ratios, and improved energy efficiency.

3. **Flexible and Thin:** OLED displays can be made on flexible substrates, allowing for curved or foldable form factors. Additionally, OLED panels are inherently thin and lightweight, making them suitable for applications where space and weight constraints are important.

4. **Fast Response Time:** OLED displays have fast response times, resulting in smoother motion and reduced motion blur, making them ideal for applications such as gaming and video playback.

5. **Wide Viewing Angles:** OLED displays typically offer wide viewing angles, ensuring consistent image quality even when viewed from different angles.

6. **Color Accuracy and Vividness:** OLED technology enables accurate color reproduction and vibrant, saturated colors, enhancing the visual experience for users.

OLED displays represent a versatile and innovative display technology that continues to drive advancements in visual quality, form factor, and user experience across a wide range of applications.

CHAPTER 2- SYSTEM DESIGN

2.1 System Overview

The RFID-based attendance system developed using Raspberry Pi Pico and OLED display combines RFID technology with a compact microcontroller platform to automate attendance tracking efficiently. The system comprises several key components working together seamlessly to capture attendance data, process it, and display relevant information:

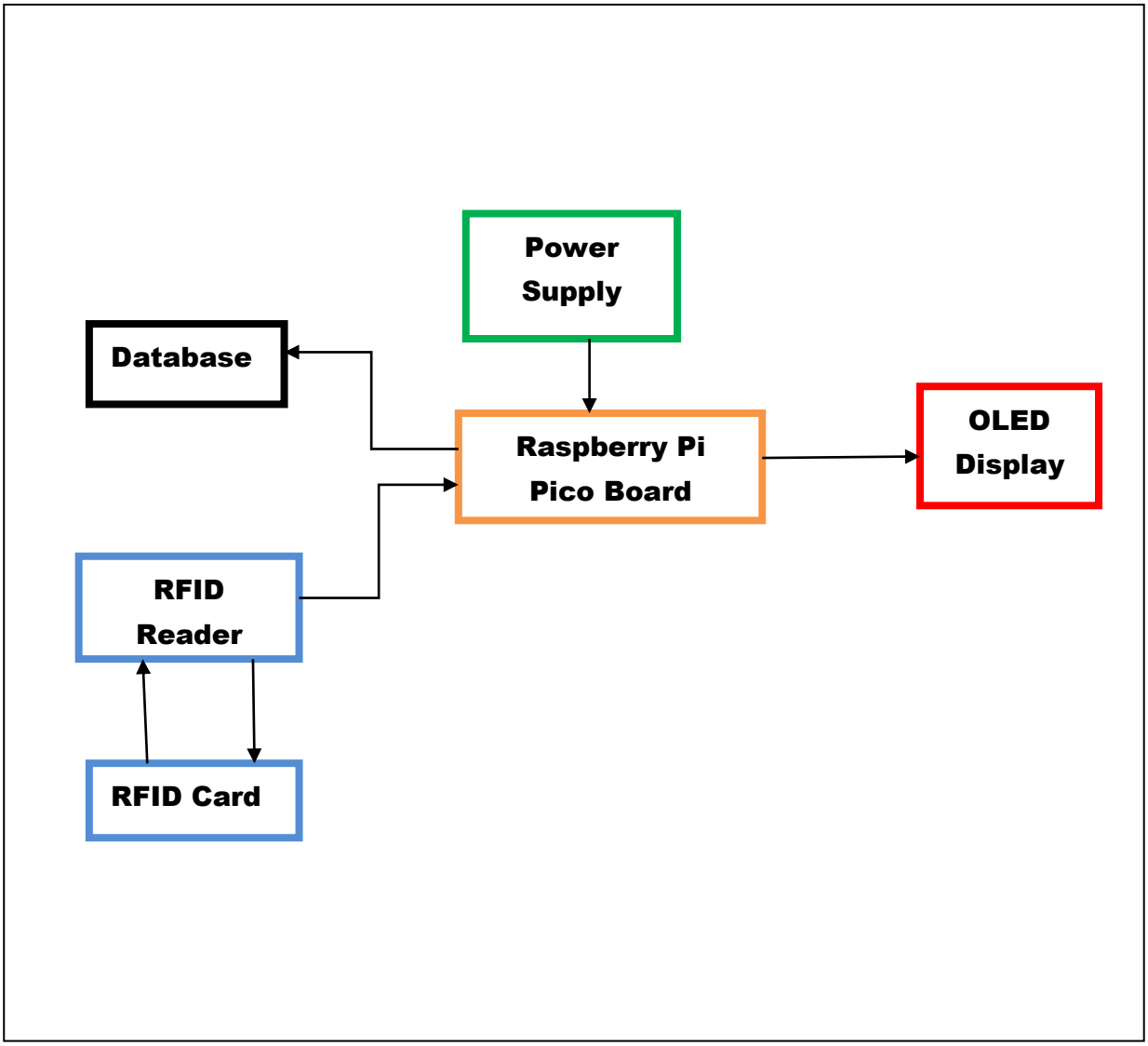
1. **Raspberry Pi Pico Microcontroller**: The Raspberry Pi Pico serves as the central processing unit of the system. It is responsible for interfacing with RFID reader modules, capturing tag information, processing attendance data, and controlling the OLED display. The Pico's GPIO pins are utilized to communicate with peripherals and sensors, enabling real-time interaction and data processing.

2. **RFID Reader Module**: The RFID reader module is connected to the Raspberry Pi Pico via GPIO pins. It emits radio waves to energize RFID tags/cards within its range and captures the unique identification codes transmitted by the tags. The RFID reader module acts as the primary means of identifying individuals for attendance tracking purposes.

3. **RFID Tags/Cards**: RFID tags or cards are issued to individuals and contain unique identification codes that are transmitted when energized by the RFID reader module. Each individual's RFID tag/card serves as their unique identifier in the attendance system.

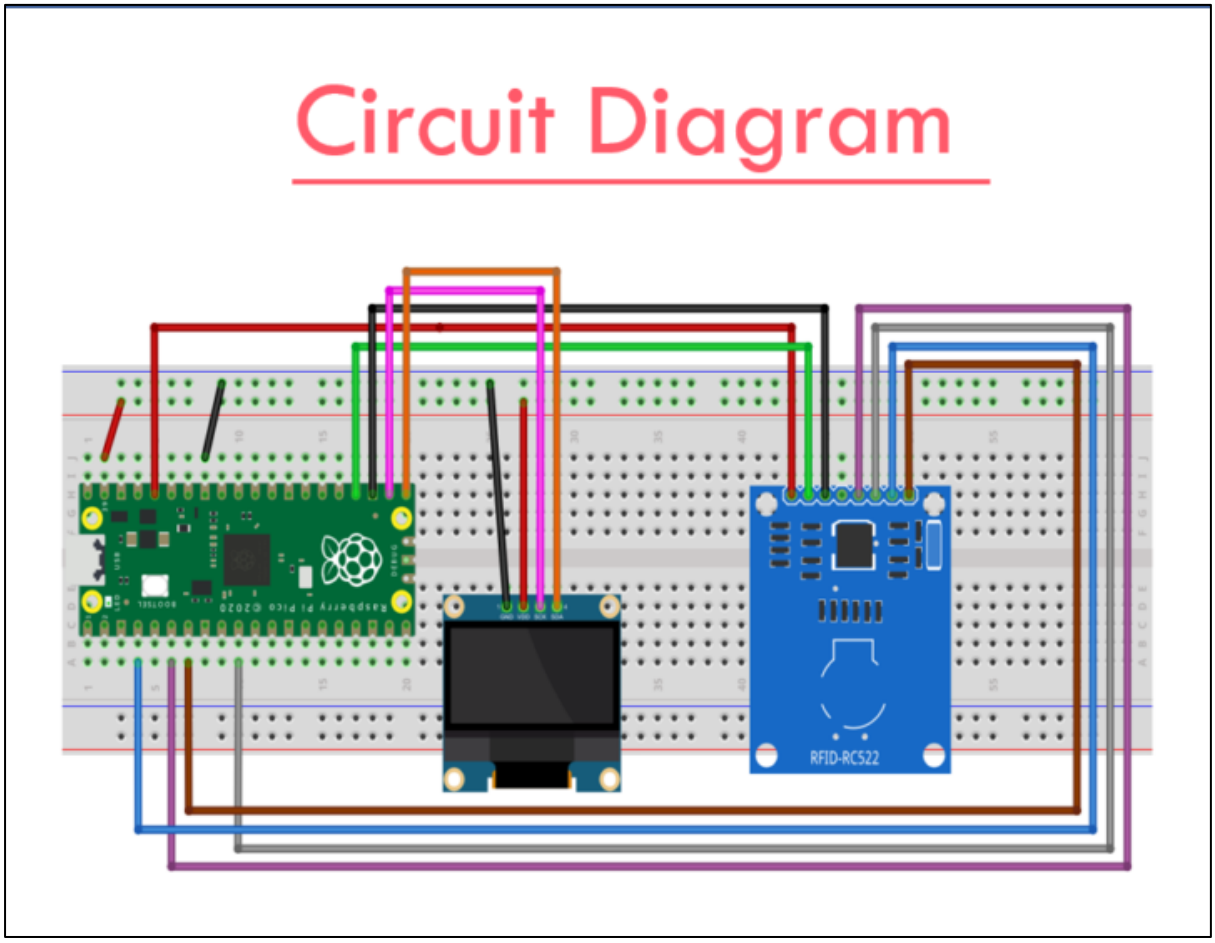
4. **OLED Display**: The OLED display is connected to the Raspberry Pi Pico and serves as the user interface for the attendance system. It provides visual feedback by displaying relevant information such as attendance status, scanned tag IDs, and system messages. The OLED display enhances user interaction and facilitates real-time monitoring of attendance data.

2.2 System Block Diagram



Block diagram for RFID Based Attendance System Project

2.3 System Circuit Diagram



Circuit diagram for RFID Based Attendance System Project

2.4 Methodology

1. System Design and Requirements Gathering:

Define the functional requirements of the attendance system, including features such as RFID tag detection, attendance recording, real-time monitoring, and reporting. Determine the hardware components required, including Raspberry Pi Pico microcontroller, RFID reader module, OLED display, and necessary peripherals. Establish the communication protocols between the RFID reader, Raspberry Pi Pico, and OLED display to ensure seamless integration.

2. Hardware Setup:

Connect the RFID reader module to the Raspberry Pi Pico microcontroller using appropriate interfaces (e.g., UART, SPI, I2C). Wire the OLED display to the Raspberry Pi Pico, ensuring proper electrical connections and compatibility with the chosen display interface (e.g., SPI, I2C). Configure the GPIO pins on the Raspberry Pi Pico for interfacing with the RFID reader module and OLED display.

3. Software Development:

Develop firmware for the Raspberry Pi Pico microcontroller using a suitable programming language (e.g., MicroPython, C/C++). Implement code to initialize and configure the RFID reader module for detecting RFID tags/cards and reading tag information. Write code to process RFID tag data, validate attendance entries, and record attendance information in a database or file system. Integrate code to control the OLED display, including functions for displaying attendance status, real-time monitoring, and system notifications.

4. User Interface Design:

Design a user-friendly interface for the OLED display to provide visual feedback and interaction with the attendance system. Develop menu structures, navigation controls, and information displays to facilitate user interaction and system configuration. Implement features for displaying attendance status, real-time updates, error messages, and system prompts on the OLED display.

5. Testing and Validation:

Conduct thorough testing of the RFID-based attendance system to ensure proper functionality and reliability. Validate the system's ability to detect RFID tags/cards accurately, record attendance entries correctly, and display relevant information on the OLED display. Perform integration testing to verify the seamless interaction between hardware components (RFID reader, Raspberry Pi Pico, OLED display) and software modules (firmware, database, user interface). Address any issues or bugs identified during testing and refine the system as necessary to meet performance requirements and user expectations.

6. Deployment and Maintenance:

Deploy the RFID-based attendance system in the target environment (e.g., educational institution, workplace) following thorough testing and validation. Provide user training and documentation to facilitate adoption and usage of the system by administrators and end-users. Establish procedures for system maintenance, including regular backups, software updates, and troubleshooting guidelines. Monitor system performance and gather feedback from users to identify areas for improvement and future enhancements.

2.5 Hardware Design technique

1. Modular Design:

Raspberry Pi Pico board, RFID RC522 Module, 0.96″ OLED display module, Jumper wires etc.

2.GPIO Expansion:

OLED Module	Raspberry Pi Pico
SCL	GP27
SDA	GP26
VCC	5v
GND	GND

RC522 Module	Raspberry Pi Pico
SS	GP5
SCK	GP2
MOSI	GP7
MISO	GP4
IRQ	NC
GND	GND
RST	GP18
VCC	3.3v

3. Power Management:

Supply for RFID Module & for OLED display is 3.3V.

4. Sensor Selection:

The sensor used is RC522 RFID module

5. Communication Protocols:

Communication protocols for connecting external devices to the Raspberry Pi is SPI & I2C communication.

By applying these hardware design techniques, you can create a robust and reliable Attendance monnitoring system using Raspberry Pi.

2.6 Software Design Technique

The micro-python code needed for operating the project is divided into 4 codes:

- **The SSD1306 library code**: required for OLED display
- **The OLED library code**: required for configuring the OLED display
- **The RC522 library code**: required for RFID RC522 module

  And
- **The main code** that runs and checks the authentication

CHAPTER 3 – SYSTEM IMPLEMENTATION

3.1 Operation

Create a Attendance monitoring system using a RC522 RFID module, a Raspberry Pi Pico, OLED display, you can follow these steps:

- **Components Needed:**
  - Raspberry Pi Pico
  - RC522 RFID with card
  - 0.96″ I2C OLED Display
  - Micro - USB cable
  - Connecting wires
  - Breadboard
  -

- **Steps:**

1. **Set Up Raspberry Pi Pico:** Connect your Raspberry Pi Pico to your computer. Install MicroPython on the Raspberry Pi Pico. Set up Thonny or any other MicroPython editor for programming.

2. **Connect RC522 RFID Module:** Connect the RC522 RFID Module to the Raspberry Pi Pico according to GPIO pin expansions. Power the RC522 RFID module according to its specifications**.**

3. **Connect OLED display:** Connect OLED display to the Raspberry Pi Pico. We need this display for showing the output of RFID card reader.

4. **Write MicroPython Code:** Write MicroPython code to control the RFID based on the commands received from the RFID module. Initialize I2C communication to communicate with the RFID RC522 module.

5. **Test:** Transfer the MicroPython script to the Raspberry Pi Pico. Test the system by sending commands via miro-USB cable from computer.

3.2 Application Details

1. **Educational Institutions:**

Improve attendance tracking in schools, colleges, and universities by automating the process of recording student attendance. Streamline classroom management and reduce administrative overhead by eliminating manual attendance-taking tasks. Enhance student engagement and accountability by providing real-time feedback on attendance status through the OLED display. Facilitate accurate reporting and analysis of attendance data, enabling educators to identify attendance trends and address potential issues promptly. Support hybrid or remote learning environments by offering flexible attendance tracking solutions that can adapt to changing educational needs.

2. **Corporate Environments:**

Simplify employee attendance management in workplaces, offices, and corporate events by implementing a reliable RFID-based system. Increase efficiency and productivity by minimizing the time and effort required for manual attendance recording and verification. Enhance security and access control by integrating RFID technology with existing employee identification systems. Provide management with insights into attendance patterns and workforce attendance trends for better resource allocation and planning. Improve compliance with regulatory requirements and audit standards by maintaining accurate and accessible attendance records.

3. **Event Management:**

Streamline attendee registration and check-in processes at conferences, seminars, and trade shows with a RFID-based attendance system. Expedite entry procedures and reduce queues by enabling fast and efficient scanning of RFID tags/cards upon arrival. Enhance the overall event experience for participants by providing a seamless and user-friendly attendance tracking solution. Enable event organizers to monitor attendance in real-time and adjust event logistics accordingly to optimize attendee engagement. Facilitate post-event analysis and reporting by capturing attendance data and generating attendance reports for stakeholders and sponsors.

4. **Healthcare Facilities:**

Improve patient care and streamline workflow efficiency in hospitals, clinics, and medical facilities with RFID-enabled attendance management. Automate staff attendance tracking to ensure adequate staffing levels and optimize resource allocation based on patient demand. Enhance patient safety and security by integrating RFID technology with access control systems for restricted areas. Enable healthcare administrators to monitor staff presence in critical areas such as operating rooms, emergency departments, and patient wards. Comply with regulatory requirements and accreditation standards by maintaining accurate records of staff attendance and activity.

3.3 Result and Discussion

After developing the RFID-based attendance system using Raspberry Pi Pico along with an OLED display, the results demonstrate a successful implementation of an efficient and automated attendance tracking solution.

The system effectively utilizes RFID technology to detect and capture RFID tag information, allowing for seamless identification of individuals without manual data entry. With the integration of the OLED display, users can conveniently view attendance status, real-time updates, and system notifications in a user-friendly interface.

During testing and validation, the system demonstrated accurate detection of RFID tags/cards, reliable recording of attendance entries, and responsive display of relevant information on the OLED screen. The real-time monitoring capabilities provided by the system empower administrators to track attendance status instantly and address any attendance-related issues promptly.

the RFID-based attendance system developed using Raspberry Pi Pico and OLED display delivers on its objectives of streamlining attendance management processes, improving administrative efficiency, and enhancing the user experience.

CHAPTER 4 – CONCLUSION & FUTURE SCOPE

In conclusion, the development of the RFID-based attendance system using Raspberry Pi Pico, along with an OLED display, represents a significant achievement in automating attendance management processes. By leveraging RFID technology and integrating it with the Raspberry Pi Pico microcontroller and OLED display, the project has successfully addressed the challenges associated with manual attendance tracking systems. The system offers several benefits, including accuracy, efficiency, real-time monitoring, and user-friendly operation, making it a valuable tool for educational institutions, workplaces, and event management settings.

- **Future Scope**

1. **Enhanced Data Analytics**: Incorporate advanced data analytics capabilities to analyze attendance patterns, trends, and insights. This could involve integrating machine learning algorithms to predict attendance behavior or identify anomalies.

2. **Mobile Application Integration**: Develop a companion mobile application that allows users to access attendance records, receive notifications, and perform administrative tasks remotely. This would enhance accessibility and convenience for users.

3. **Biometric Authentication**: Integrate biometric authentication technologies, such as fingerprint or facial recognition, to enhance security and ensure accurate identification of individuals.

4. **Expandable Hardware Support**: Explore the possibility of supporting additional hardware peripherals, such as proximity sensors, cameras, or barcode scanners, to enhance the capabilities and versatility of the system.

5. **Scalability and Deployment Flexibility**: Design the system architecture to be scalable and easily deployable across different environments, including small-scale deployments in classrooms to large-scale implementations in corporate campuses or event venues.

CHAPTER 5 - REFERENCES

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