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FAST PAY

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A Project Report submitted to

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

In partial fulfillment of the requirements of the course of

BCE401L – INTERNET OF THINGS

in

B.Tech COMPUTER SCIENCE & ENGINEERING

BONAFIDE CERTIFICATE

It is certified that this project report entitled "**FastPay**" is a bonafide work of Soham Datta (22BCE1547), Pulaparthi Penchala Deepthi Sri (21BCE5464) & Reba (21BCE1569) who carried out the Project work under my supervision and guidance for BCSE401L – INTERNET OF THINGS.

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ACKNOWLEDGMENT

We wish to express our sincere thanks and deep sense of gratitude to our project guide, Dr. VELMATHI G, Professor Higher Academic Grade, School of Electronics Engineering, for her consistent encouragement and valuable guidance offered to us in a pleasant manner throughout the course of the project work.

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We thank our parents, family, and friends for bearing with us throughout the course of our project and for the opportunity they provided us in undergoing this course in such a prestigious institution.

ABSTRACT

In response to the persistent challenge of long queues and delays within university stores and marketplaces, this project proposes the implementation of an innovative payment system leveraging Radio Frequency Identification (RFID) technology. The system aims to enhance transaction efficiency and diminish waiting times by introducing RFID-enabled cards and scanners. Through the integration of RFID scanners and facial recognition technology, transactions become seamless and rapid, promoting a cashless environment while ensuring offline security. Moreover, the system includes a monthly top-up mechanism through V-TOP, further enhancing convenience and accessibility for both students and staff. By addressing the identified problem, this project offers a comprehensive solution to streamline transactions, ultimately fostering a more efficient and convenient university shopping experience.

Keywords: MFRC 522 (SPI), 16x2 LCD, ESP8266 NodeMCU Board, Facial Recognition, Transaction Efficiency, RFID Technology

INTRODUCTION

In today's fast-paced university environment, the efficiency of transactions within campus stores and marketplaces plays a crucial role in ensuring a smooth and convenient experience for students and staff alike. However, the prevalence of long queues and delays often impedes this efficiency, leading to frustration and wasted time. To address this challenge, this report proposes the implementation of a cutting-edge payment system utilizing Radio Frequency Identification (RFID) technology. By introducing RFID-enabled cards and scanners, coupled with facial recognition technology, the system aims to revolutionize the checkout process, making it faster, more secure, and hassle-free. This introduction sets the stage for exploring the methodology and benefits of this innovative solution, ultimately aiming to enhance the overall shopping experience within university premises.

OBJECTIVE

The primary objective of this report is to propose and outline the implementation of an RFID-based payment system within university stores and marketplaces. This system aims to address the challenge of long queues and delays by streamlining transactions and enhancing overall efficiency.

OUR GOALS

1. Introduce RFID technology: The report will elucidate the fundamentals of RFID technology and its potential application in university settings to improve transaction processes.

2. Enhance transaction efficiency: The report aims to demonstrate how the proposed RFID-based payment system can significantly reduce waiting times and expedite the checkout process within university stores and marketplaces.

3. Ensure security and convenience: The report will highlight the security features integrated into the RFID system, such as facial recognition and offline

capabilities, to ensure the safety of transactions while providing convenience to users.

4. Promote cashless transactions: One of the goals of the report is to advocate for the adoption of cashless transactions through the implementation of RFID-enabled cards, thereby aligning with modern payment trends and reducing reliance on physical currency.

5. Facilitate ease of use: The report will emphasize the user-friendly nature of the proposed system, including features such as monthly top-up mechanisms, to ensure accessibility and convenience for both students and staff.

APPLICATIONS

- Facilitating seamless transactions for purchases of goods and services within campus retail outlets.
- Streamlining payment processes during meal times, reducing waiting times, and ensuring efficient transactions in cafeterias and dining halls.
- Allowing quick borrowing and returning of books by scanning RFID-enabled student ID cards at library checkouts.

- Managing ticket sales and entry at campus events, ensuring smooth and secure transactions for attendees.
- Simplifying payment for laundry services in university dormitories through RFID-enabled cards.
- Making printing and copying services on campus more efficient, with easy access and payment using RFID technology.
- Utilizing RFID cards for parking access and payment in university parking lots, providing a convenient payment solution for drivers.
- Implementing the system in campus gyms, swimming pools, and other recreational facilities to manage memberships and streamline payment for access to amenities.

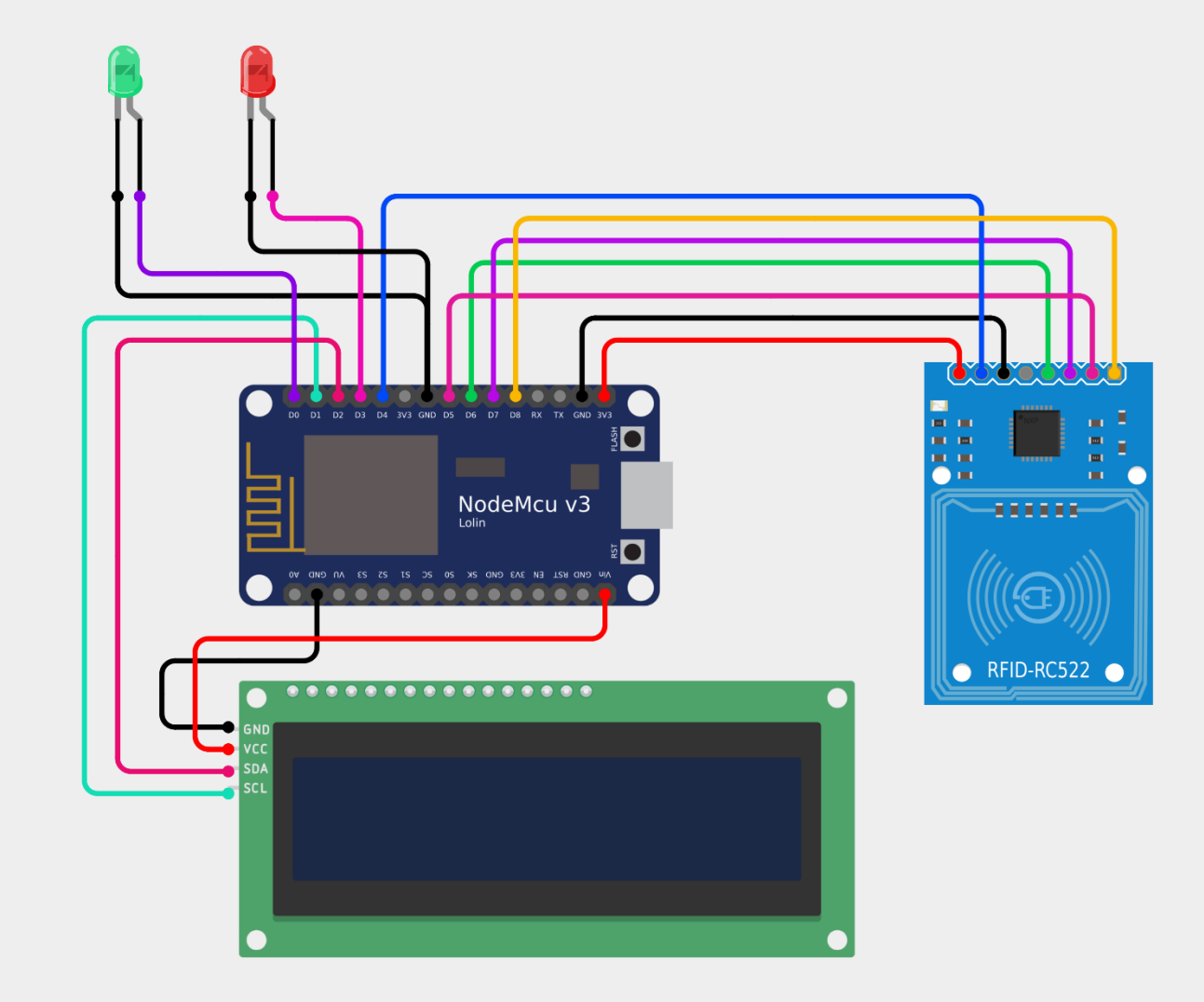
FEATURES

- Facilitates quick and effortless payments, reducing checkout times and enhancing convenience for users.
- Incorporates features such as facial recognition and offline capabilities to ensure the safety and integrity of transactions.
- Promotes cashless transactions, aligning with modern payment trends and reducing reliance on physical currency.

- Provides a simple and intuitive system, including features like monthly top-up mechanisms, to ensure accessibility and ease of use for students and staff alike.

IMPLEMENTATION

Connect the components as shown below in the schematic:



COMPONENTS

1. MFRC 522 RFID Scanner:

The MFRC 522 RFID Scanner is a popular RFID module that operates at 13.56 MHz frequency. It is capable of reading and writing RFID tags. The module communicates with microcontrollers through SPI protocol and can be easily interfaced with various platforms like Arduino, Raspberry Pi, etc. It consists of an antenna for communication and typically requires external power supply. The MFRC 522 module is commonly used in access control systems, attendance systems, and other projects requiring RFID technology.

2. ESP8266 NodeMCU:

The ESP8266 NodeMCU is a versatile development board based on the ESP8266 Wi-Fi module. It features a microcontroller unit (MCU) along with integrated Wi-Fi capabilities, making it ideal for IoT projects and prototyping. The NodeMCU board is compatible with the Arduino IDE, allowing for easy programming using the familiar Arduino language. It offers GPIO pins for connecting sensors, actuators, and other peripherals, as well as built-in USB-to-serial communication for programming and debugging.

3. LCD with I2C module (16x2):

The 16x2 LCD with I2C module is a liquid crystal display with a resolution of 16 characters per line and 2 lines. The I2C module simplifies the interfacing of the LCD with microcontrollers by reducing the number of pins required for communication. This module typically includes a small onboard chip that acts as an I2C expander, allowing the microcontroller to send data to

the LCD using I2C protocol. The 16x2 LCD is commonly used for displaying text and basic graphics in various electronic projects.

4. LEDs:

LEDs (Light Emitting Diodes) are semiconductor devices that emit light when current passes through them. In this context, having 2 LEDs implies two individual LED components that can be used for visual indicators or status notifications in a project. LEDs are often used in conjunction with microcontrollers to provide visual feedback, such as indicating power status, connectivity, or specific events. They are energy-efficient, come in various colors, and can be easily controlled using digital output pins from microcontrollers like the NodeMCU.

HARDWARE

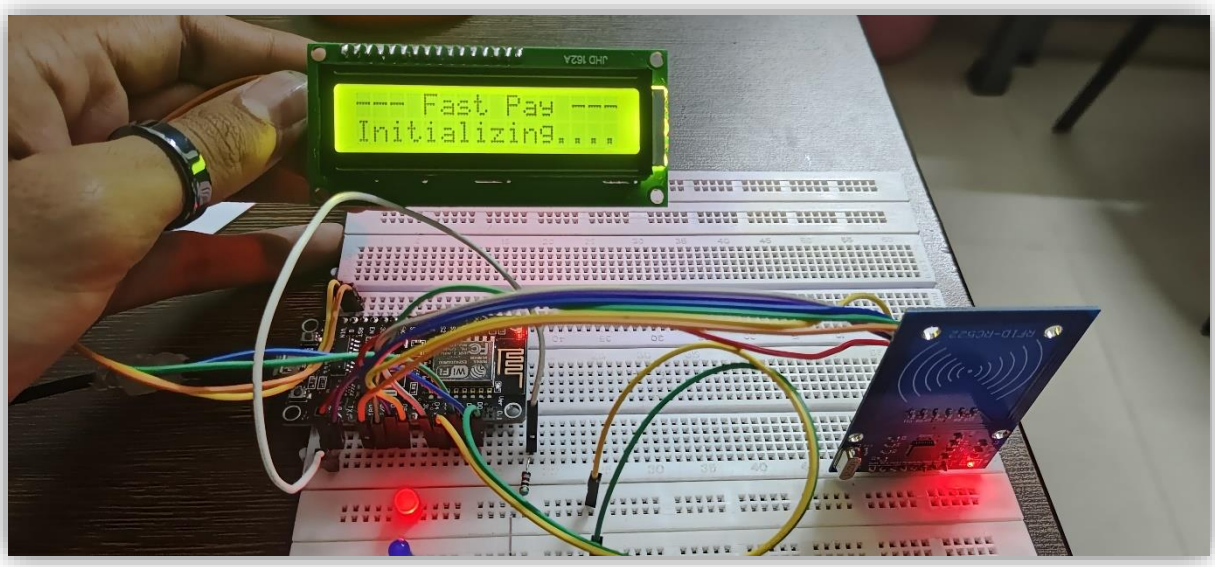


Figure 1: Connecting to Wi-Fi

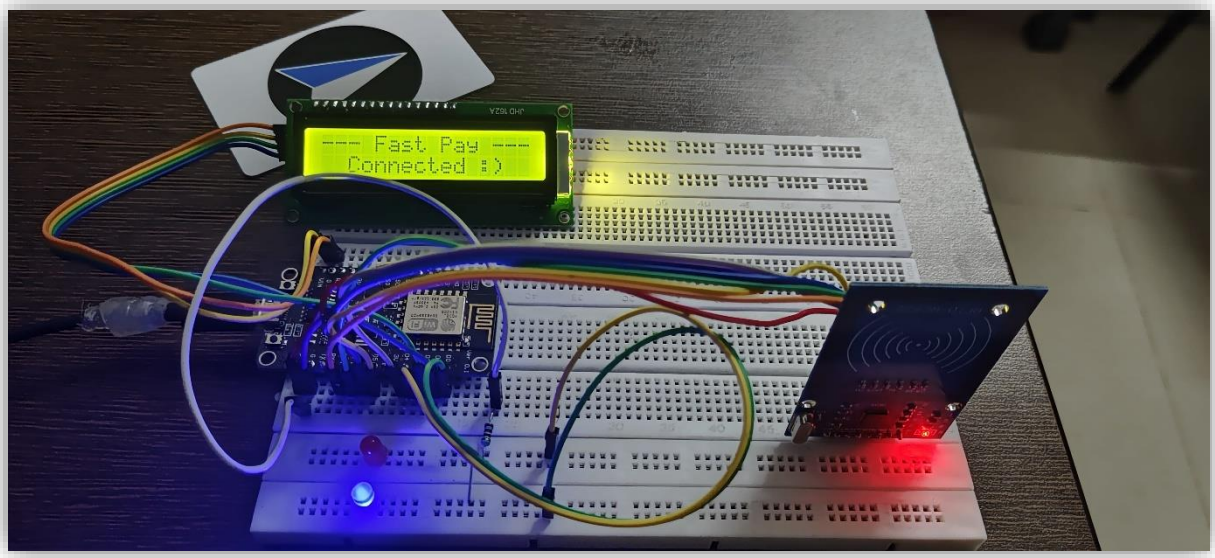


Figure 2: Wi-Fi connected successfully!

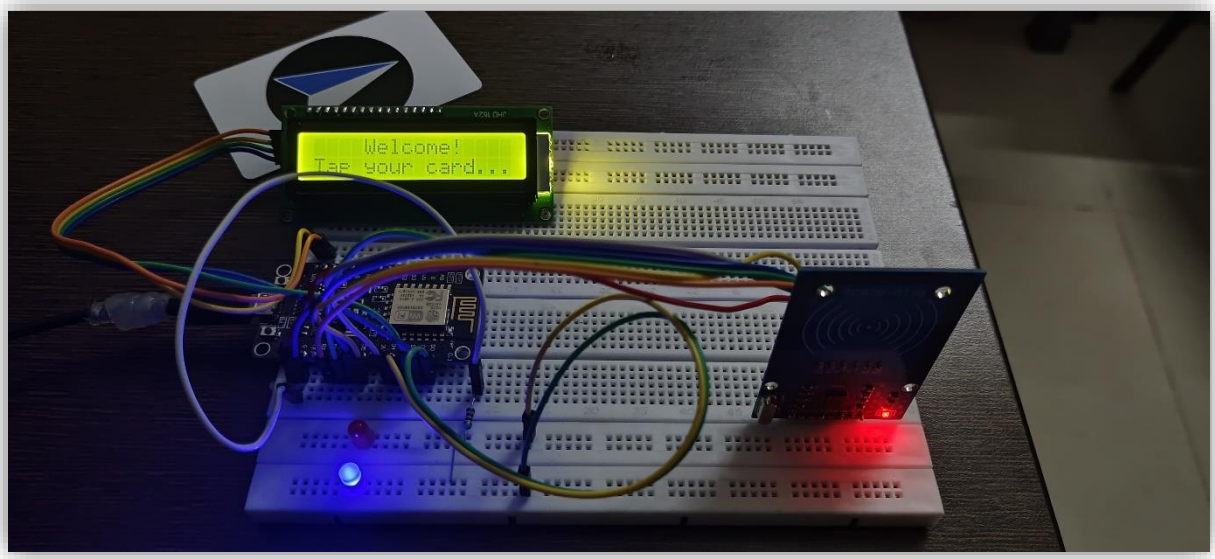


Figure 3: Waiting for RFID Card Tap

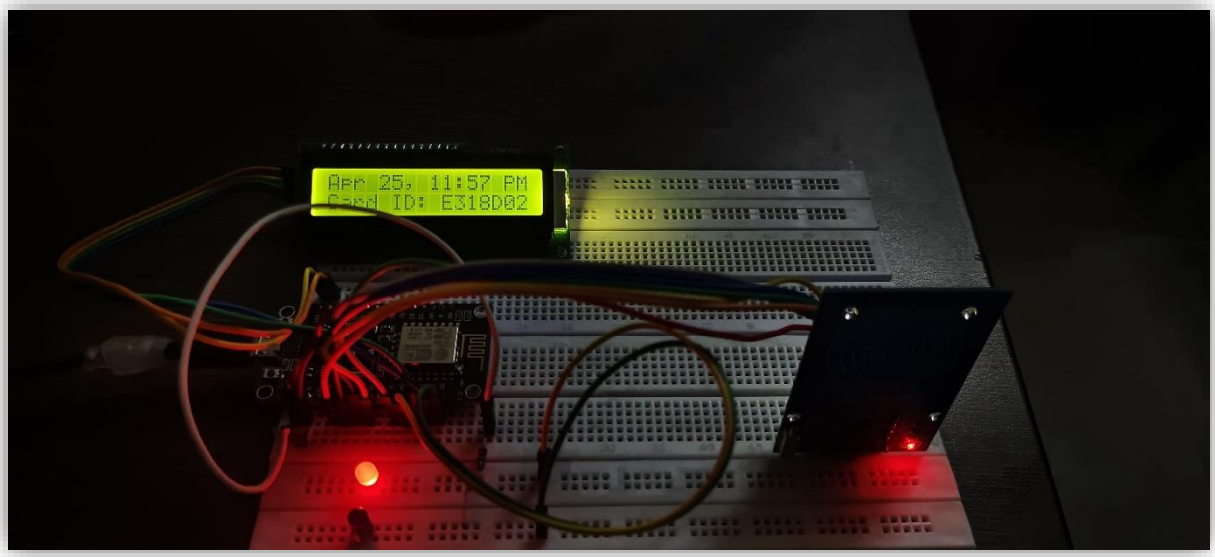


Figure 4: Card read successfully!

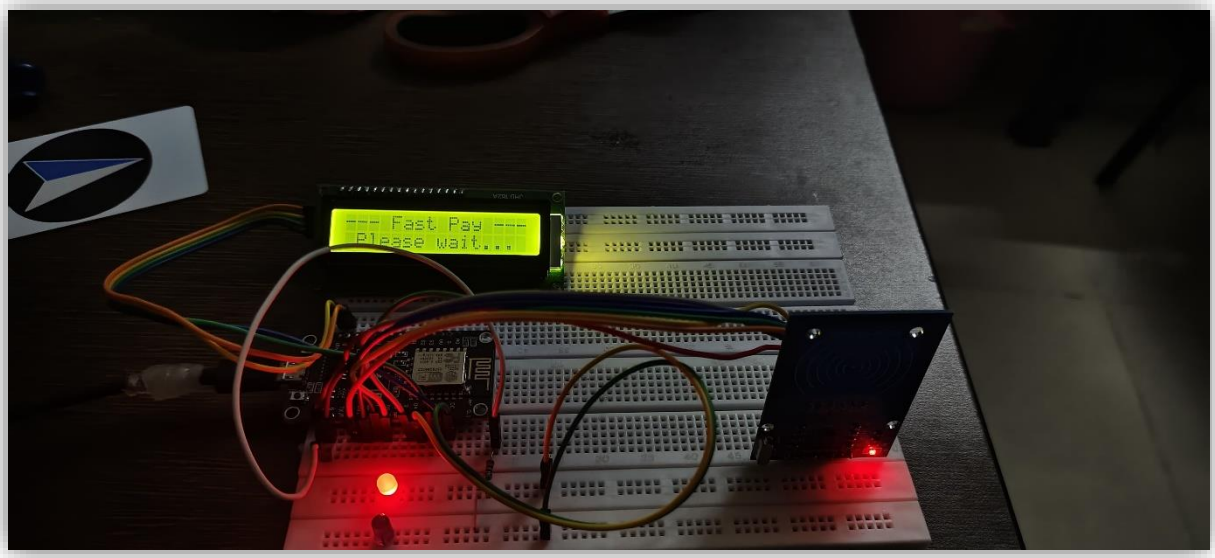


Figure 5: Transaction in progress...

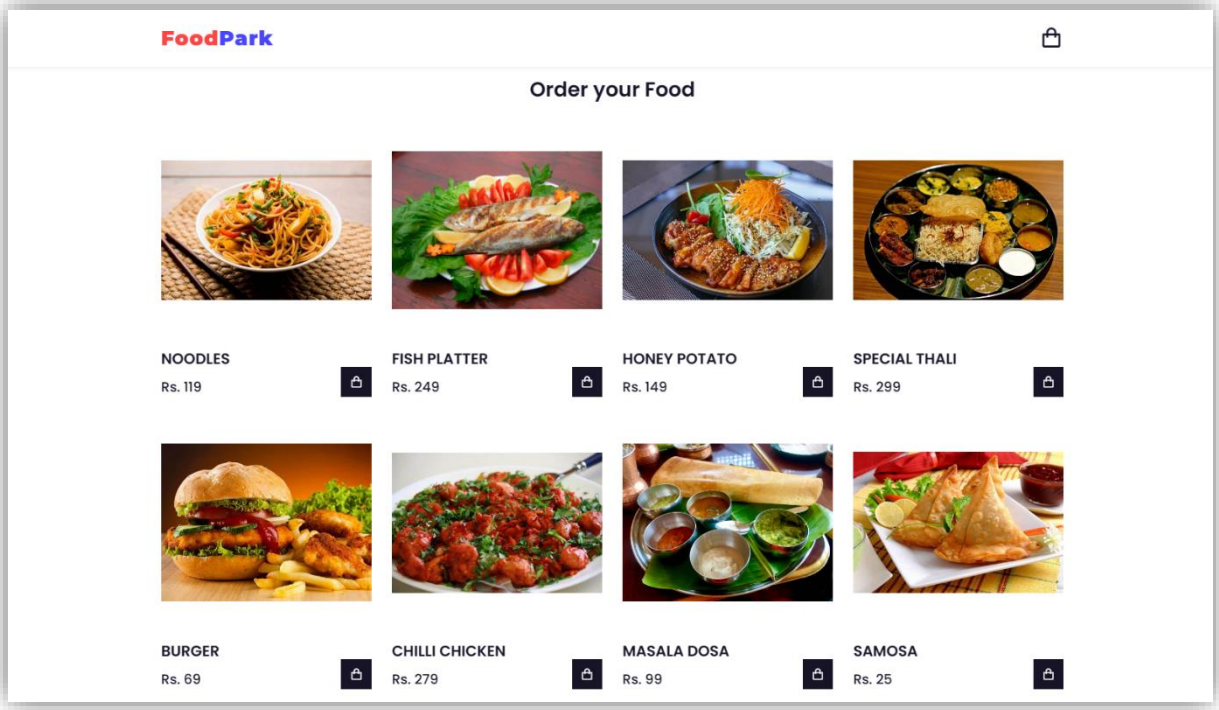


Figure 6: Online Web Portal

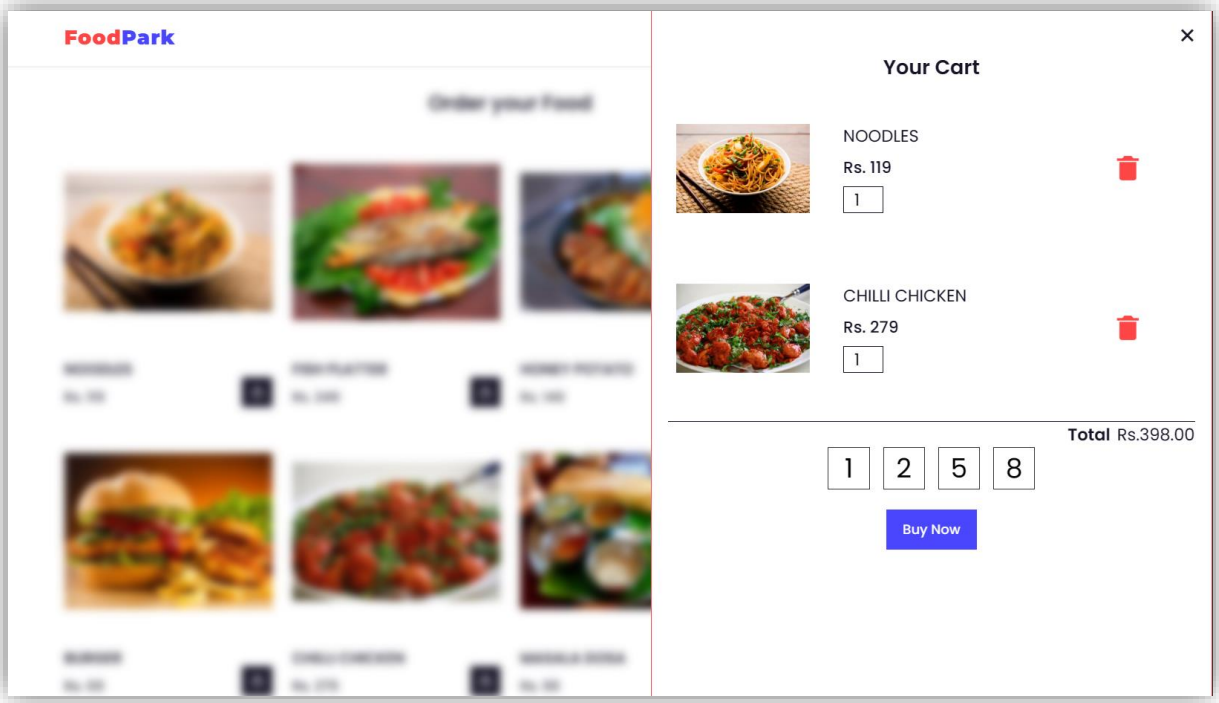


Figure 7: Enter Pin and place order

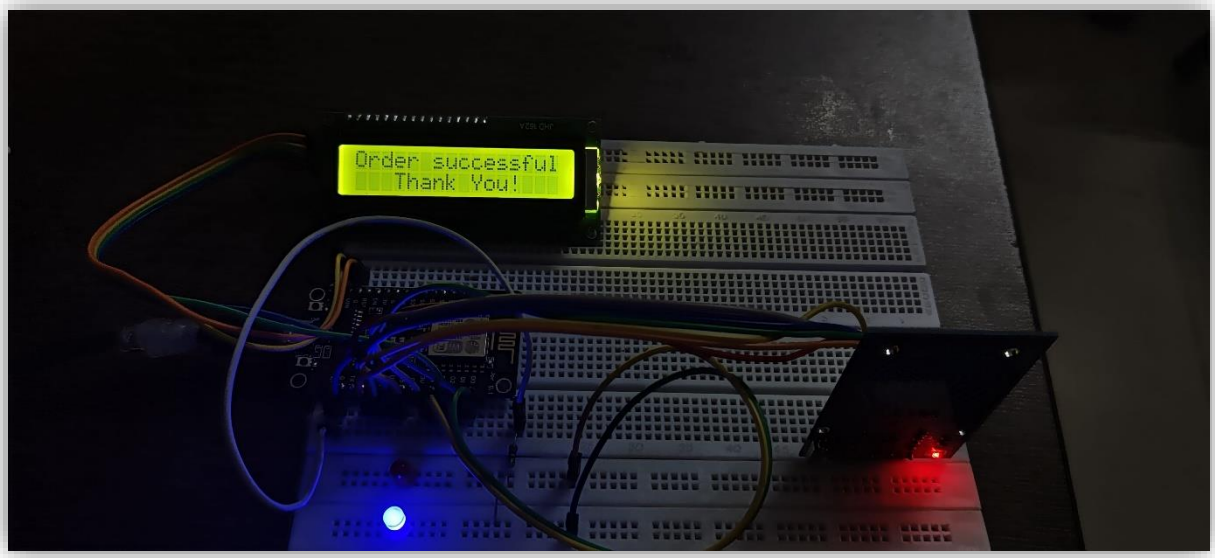


Figure 8: Order is successful

SOFTWARE AND CODE

FastPay.ino

```
#include <SPI.h>
#include <Wire.h>
#include <WiFiUdp.h>
#include <TimeLib.h>
#include <MFRC522.h>
#include <NTPClient.h>
#include <ESP8266WiFi.h>
#include <LiquidCrystal_I2C.h>
#include <Firebase_ESP_Client.h>

#include "addons/RTDBHelper.h"
#include "addons/TokenHelper.h"

#define LED1 0     // D3
#define LED2 16    // D0
#define SS_PIN 15  // D8
#define RST_PIN 2  // D4

// Array to store the month names
const char* months[] = {
  "Jan", "Feb", "Mar",
  "Apr", "May", "Jun",
  "Jul", "Aug", "Sep",
  "Oct", "Nov", "Dec",
};

#define WIFI_SSID ""
#define WIFI_PASSWORD ""

#define API_KEY "AIzaSyB3mjowGqzmLtCL6Vs9ZH14skVIhLdgQPw"
#define DATABASE_URL "https://fast-pay-iot-default-rtdb.firebaseio.com/"

FirebaseData fbdo;
FirebaseAuth auth;
FirebaseConfig config;

WiFiUDP ntpUDP;
bool signupOK = false;
int totalPrice, totalItems;
unsigned long sendDataPrevMillis = 0;

MFRC522 mfrc522(SS_PIN, RST_PIN);
LiquidCrystal_I2C lcd(0x27, 16, 2);
NTPClient timeClient(ntpUDP, "pool.ntp.org", 19800); // UTC +5:30 Offest

void displayLCD(String text, int row, bool clear);
```

FastPay.ino

```
void setup() {
  Serial.begin(31250);

  lcd.init();       // Initialize the LCD
  lcd.backlight();  // Turn on the backlight
  lcd.clear();      // Clear the LCD screen

  displayLCD("--- Fast Pay ---", 0, true);
  displayLCD("Initializing....", 1, false);

  Serial.println();

  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("Connecting to Wi-Fi...");
  while (WiFi.status() != WL_CONNECTED) {
    Serial.print(".");
    delay(300);
  }
  Serial.println();
  Serial.print("Connected with IP: ");
  Serial.println(WiFi.localIP());
  Serial.println();

  timeClient.begin();
  timeClient.update();

  config.api_key = API_KEY;
  config.database_url = DATABASE_URL;
  if (Firebase.signUp(&config, &auth, "", "")) {
    Serial.println("SignUp Okay!");
    signupOK = true;
  } else {
    Serial.printf("%s\n", config.signer.signupError.message.c_str());
  }

  config.token_status_callback = tokenStatusCallback;  //see addons/TokenHelper.h

  Firebase.begin(&config, &auth);
  Firebase.reconnectWiFi(true);

  pinMode(LED1, OUTPUT);
  pinMode(LED2, OUTPUT);

  digitalWrite(LED1, LOW);   // Turn Red LED OFF
  digitalWrite(LED2, HIGH);  // Turn Blue LED ON

  SPI.begin();
  mfrc522.PCD_Init();

  displayLCD("  Connected :)  ", 1, false);
  delay(1500);
}
```

FastPay.ino

```
String card_num;
bool cardTapped = false;
String currentUser = "None";

void loop() {

  timeClient.update();

  if (currentUser == "None") {

    displayLCD("    Welcome!    ", 0, true);
    displayLCD("Tap your card...", 1, false);

    if (!cardTapped) {

      while (!(mfrc522.PICC_IsNewCardPresent() && mfrc522.PICC_ReadCardSerial())) {
        // Wait until a new card is detected
      }
      cardTapped = true;
      currentUser = getCardNumber();

      Serial.println("Card ID: " + currentUser);
      Serial.println(getDate());

      displayLCD(getDate(), 0, true);
      displayLCD("Card ID: " + currentUser, 1, false);

      toggleLED("red");
      toggleLED("blue");

      Firebase.RTDB.setString(&fbdo, "currentUser", currentUser);
    }
  } else {

    if (Firebase.ready() && signupOK && (millis() - sendDataPrevMillis > 2000 ||
sendDataPrevMillis == 0)) {
      sendDataPrevMillis = millis();

      Firebase.RTDB.getString(&fbdo, "currentUser", &currentUser);

      if (currentUser == "None") {
        toggleLED("red");
        toggleLED("blue");
        cardTapped = false;
        displayLCD("Order successful", 0, true);
        displayLCD("   Thank You!   ", 1, false);
        delay(2000);

      } else {
        displayLCD("--- Fast Pay ---", 0, true);
        displayLCD(" Please wait... ", 1, false);
      }
    }
  }
}
```

FastPay.ino

```
String getCardNumber() {
  String UID = "";
  for (byte i = 0; i < mfrc522.uid.size; i++) {
    UID += String(mfrc522.uid.uidByte[i] < 0x10 ? "0" : "");
    UID += String(mfrc522.uid.uidByte[i], HEX);
  }
  UID.toUpperCase();
  return UID;
}

void toggleLED(String color) {
  if (color == "red") {
    digitalWrite(LED1, !digitalRead(LED1));  // Toggle LED1
  } else if (color == "blue") {
    digitalWrite(LED2, !digitalRead(LED2));  // Toggle LED2
  } else {
    Serial.println("Invalid color parameter. Please specify 'red' or 'blue'");
  }
}

void displayLCD(String text, int row = 0, bool clear = true) {
  if (clear) {
    lcd.clear();
  }
  if (row == 0) {
    lcd.setCursor(0, 0);  // Set cursor to the first row
  } else if (row == 1) {
    lcd.setCursor(0, 1);  // Set cursor to the second row
  } else {
    Serial.println("Invalid row parameter. Please specify 0 or 1.");
    return;
  }
  lcd.print(text);  // Print the text to the LCD
}

String getDate() {
  time_t epochTime = timeClient.getEpochTime();
  struct tm *timeinfo;
  timeinfo = gmtime ((time_t *)&epochTime);

  int currentMonth = timeinfo->tm_mon + 1;
  int currentDay = timeinfo->tm_mday;
  int currentHour = timeinfo->tm_hour;
  int currentMinute = timeinfo->tm_min;
  bool isAM = currentHour < 12;

  char formattedTimestamp[20];
  sprintf(formattedTimestamp, "%s %02d, %02d:%02d %s", months[currentMonth - 1],
currentDay, currentHour % 12 == 0 ? 12 : currentHour % 12, currentMinute, isAM ?
"AM" : "PM");

  return String(formattedTimestamp);
}
```

RESULT

- The system successfully reads RFID tags and sends the data to a Firebase database.
- LEDs provide visual feedback on system status.
- The LCD displays messages to the user, enhancing the user experience.

CONCLUSION

The project effectively demonstrates the integration of RFID technology with IoT capabilities using the ESP8266 NodeMCU. It showcases real-time data communication with a cloud database and provides a user-friendly interface through an LCD display. The system can be further enhanced by implementing additional features such as user authentication, transaction logging, and error handling. Overall, it serves as a solid foundation for building access control systems, attendance systems, and other IoT applications leveraging RFID technology.

FUTURE WORK

Future work for enhancing the RFID-based IoT system involves several key areas:

Introducing user authentication mechanisms, like biometric verification or two-factor authentication, can bolster system security by ensuring only authorized access.

Implementing robust error handling and recovery mechanisms will enable the system to gracefully handle potential failures, such as network disruptions or database errors, ensuring uninterrupted operation.

Designing the system architecture with scalability in mind allows for seamless integration of additional features and support for a larger user base or increased device connectivity.

Conducting performance analysis and optimizing critical components can lead to efficiency gains, reducing response times and resource consumption, thus improving overall system performance.

Refining the user interface design and interaction elements, such as incorporating interactive menus and visual feedback cues, can enhance usability and user satisfaction, leading to a more intuitive and user-friendly system.

By focusing on these areas for future work, the RFID-based IoT system can be strengthened in terms of security, reliability, scalability, performance, and user experience, ensuring its suitability for various applications.

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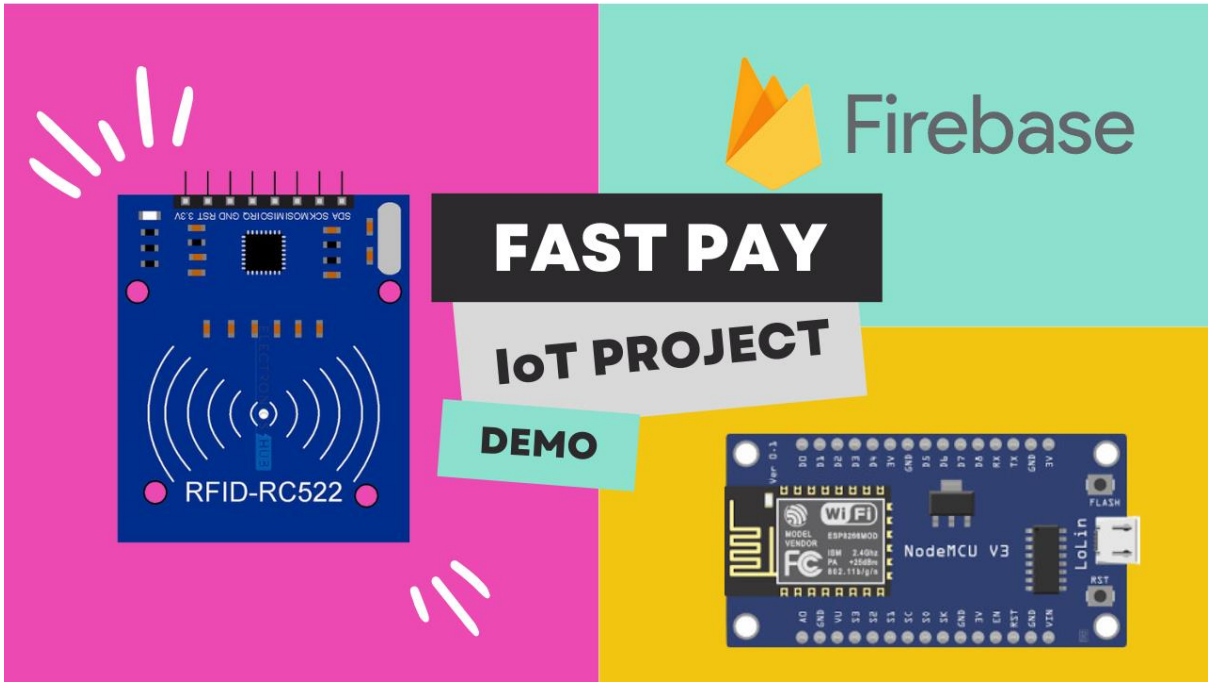
VIDEO DEMONSTRATION



Demo Link: https://www.youtube.com/watch?v=hwB9niK3oFY