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Group members

London Met ID	Student Name
22067753	Apil Thapa
22067795	Prafulla Raj Subedi
22067819	Lipi Singh
22067811	Lijala Tuladhar
22067800	Sakchyam Thapa

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I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our module leader Mr. Sugat Man Shakya, and our dedicated class tutor, Mr. Ayush Pradhananga, for their invaluable support and guidance throughout the development of our IOT project on 'RFID Security Authorized Gate System.' Their encouragement and mentorship provided us with the opportunity to demonstrate our knowledge and passion for this subject.

We also express gratitude to our college for facilitating access to essential materials crucial for the successful completion of the project. The collaborative environment and resources provided by the institution significantly contributed to our learning experience. Additionally, our sincere thanks go to our respected teachers for their commitment, insightful inputs, and encouragement, which played a vital role in enhancing our understanding of IOT technologies through extensive research.

ABSTARCT

This is a prototype model of a ‘RFID-Secure Gate System’. The system is made from different hardware components such as Arduino uno, Ultrasonic sensor, RFID, Led, Buzzer, Breadboard, Jumper Wire and Servo Motor. Moreover, ultrasonic sensors strategically identify incoming vehicles, and upon validation through an RFID card, the reader identifies authorized individuals, triggering a LED and motor-powered gate opening. Additionally, ultrasonic sensors detect the Vehicle entering and based on rfid card servo motor will open gate for authorized entries, activating a buzzer and alerting the system. The prototype model, built on a breadboard with jumper wires and resistors, showcases the potential of RFID technology for access control and security applications.

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1. INTRODUCTION:

The Internet of Things (IoT) refers to the interconnected network of physical devices, vehicles, appliances, and other objects embedded with sensors, software, and network connectivity. These devices can collect and exchange data, creating a seamless web of communication and enabling real-time interactions. In the contemporary world, the integration of IoT has transformed various aspects of daily life and industries. From smart homes and wearable devices to industrial automation and healthcare applications, IoT has revolutionized how we interact with the environment and technology. The ability of devices to communicate and share data not only enhances efficiency but also opens up new possibilities for innovation and connectivity.

Internet of Things (IoT) is a new paradigm that has changed the traditional way of living into a high tech life style. Smart city, smart homes, pollution control, energy saving, smart transportation, smart industries are such transformations due to IoT. A lot of crucial research studies and investigations have been done in order to enhance the technology through IoT. (Zymbler, 09 December 2019).

The RFID Secure Gate System is the project which is created using Iot system. In today's world where security is the biggest concern, many unauthorized people are founded to be entered in a secured place. Like Schools, colleges, and universities, government places and many political seminars there is an unauthorized entry of people with their vehicles which can lead to different kind of unwanted activities. To avoid such problems and to allow only secured pass entry we have created this project which aids in proper authorized entry for authorized people, Access control and safety for people.

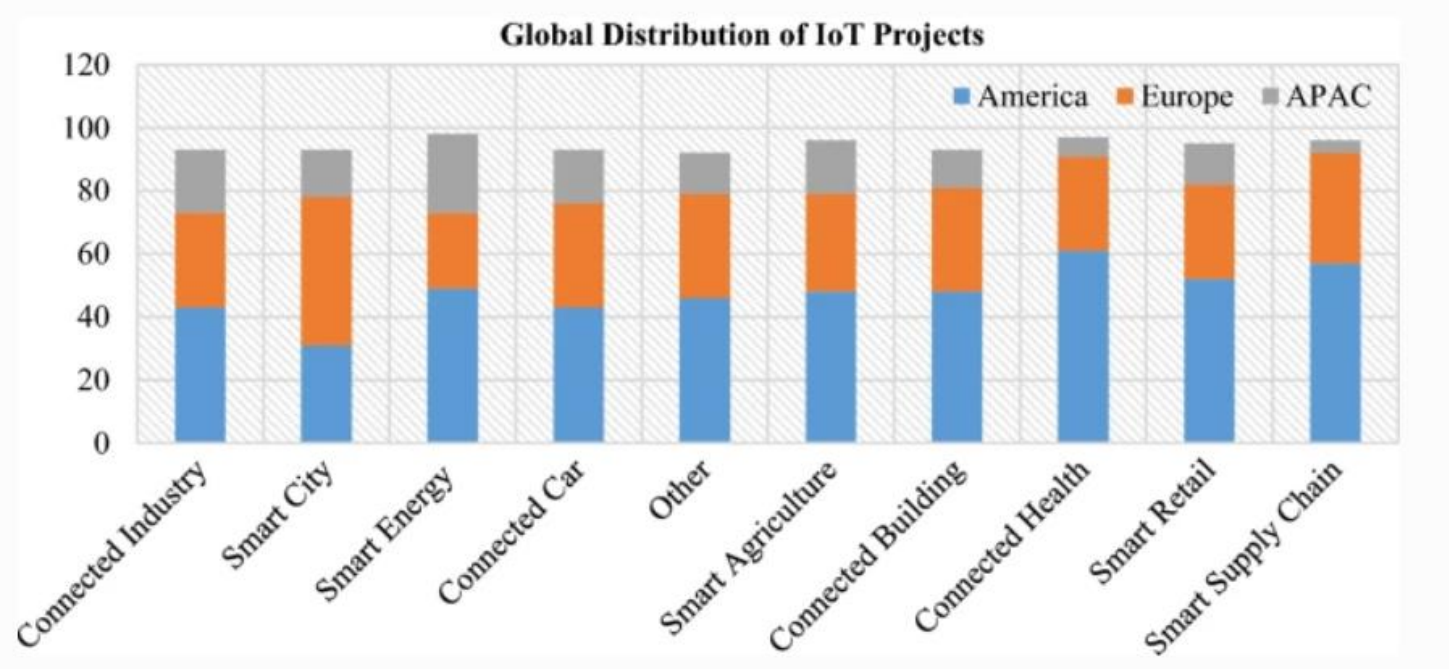

Figure 1 Global distribution of iot projects by different countries in various sectors

1.1 CURRENT SCENARIO:

An Automatic Gate opening system for vehicles with RFID and campus access control system RFID based were proposed in [5][6]. The systems grant access to authorized persons with valid tags and deny the unauthorized persons with invalid tags. (Peter Adole, 2016).

NEW DELHI: Indian Army has from Wednesday implemented the Radio Frequency Identification (RFID) tagging of its ammunition inventory in order to not improve the lot management but also make ammunition storage safer. (Anon., 09th February 2022 10:47 PM).

Some advantages of this project:

- Automated Control: Eliminates the need for additional personnel to manage gate access, reducing operational costs.
- Precision: Offers high accuracy in verifying and allowing entry to authorized individuals, minimizing errors.
- Cost-Effective: Represents a cost-efficient solution, avoiding the necessity for complex and expensive technologies.
- Enhanced Security: Improves overall security by ensuring only authenticated individuals with RFID tags can access the secured zone.

1.2 PROBLEM STATEMENT AND PROJECT AS A SOLUTION:

The current security measures face significant fault in ensuring a reliable means of permitting access to restricted areas, particularly in the context of vehicle entry. Conventional approaches such as manual identification or key-based access can result in human errors, potential misuse, and are frequently associated with time-consuming procedures. These limitations underscore the need for a more better and precise security solution that can offer enhanced accuracy, efficiency, and reliability in controlling access to restricted zones.

In response to the security concerns, our proposed solution involves the implementation of an RFID-based Security Gate System. This system uses Radio-Frequency Identification (RFID) technology to regulate access to restricted areas, specifically for vehicles. Authorized individuals are equipped with RFID cards, which serve as secure credentials to activate the gate, which is a better way in facilitating a secure and efficient entry process.

1.3 AIM AND OBJECTIVES:

1.3.1 AIM:

The main aim of our project is to create an RFID Security authorized Gate System to improve access control against unauthorized entries. It ensures that only authorized individuals with valid RFID card gain entry through the gate, contributing to the overall safety and integrity of the controlled environment.

1.3.2 OBJECTIVES:

- Gate Activation Mechanism:

  Implemented a gate activation mechanism that exclusively responds to valid RFID card presentations, preventing unauthorized individuals from gaining entry.

- Efficient Vehicle Entry:

  Optimize the efficiency of vehicle entry using advanced RFID technology, ensuring rapid card detection and swift gate activation response times.

- Integration with Security buzzer and LED:

  Integrated the gate system with buzzer and led systems to trigger alerts and for Visual indication in the system.

2. BACKGROUND:

2.1 SYSTEM OVERVIEW:

The RFID-based Security Gate System is a best solution designed to enhance security and control access. Using RFID technology, the system ensures that only authorized individuals can enter specific areas. The primary focus is on creating an automated gate-opening mechanism activated by authorized RFID cards, guaranteeing a secure and efficient entry process for vehicles with valid credentials.

The main goal of this project is to develop a fully functional RFID-based Security Gate System tailored for controlling vehicle access.

Key components include RFID card readers, a controller unit, and a motorized gate mechanism. When an authorized RFID card is read, the system triggers an automatic gate opening through the motorized mechanism, ensuring a swift and secure entry process.

In summary, The RFID-based Security Gate System is designed to improve security and access control. Using RFID technology, the system ensures that only authorized people can enter specific areas. The primary deliverable is an automated gate-opening mechanism triggered by the reading of authorized RFID cards. This ensures a secure and efficient entry process exclusively for vehicles with valid credentials.

2.2 DESIGN DIAGRAM

2.2.1 CIRCUIT DIAGRAM

A circuit diagram is a graphical representation of an electrical circuit. It is also known as an electrical diagram, wiring diagram, electronic schematic, and elementary diagram. (testbook, May 27, 2023)

The prototype diagram here is shown below. It demonstrated that RFID module is connected with arduino also servo motor and ultrasonic sensor are also connected with an arduino.

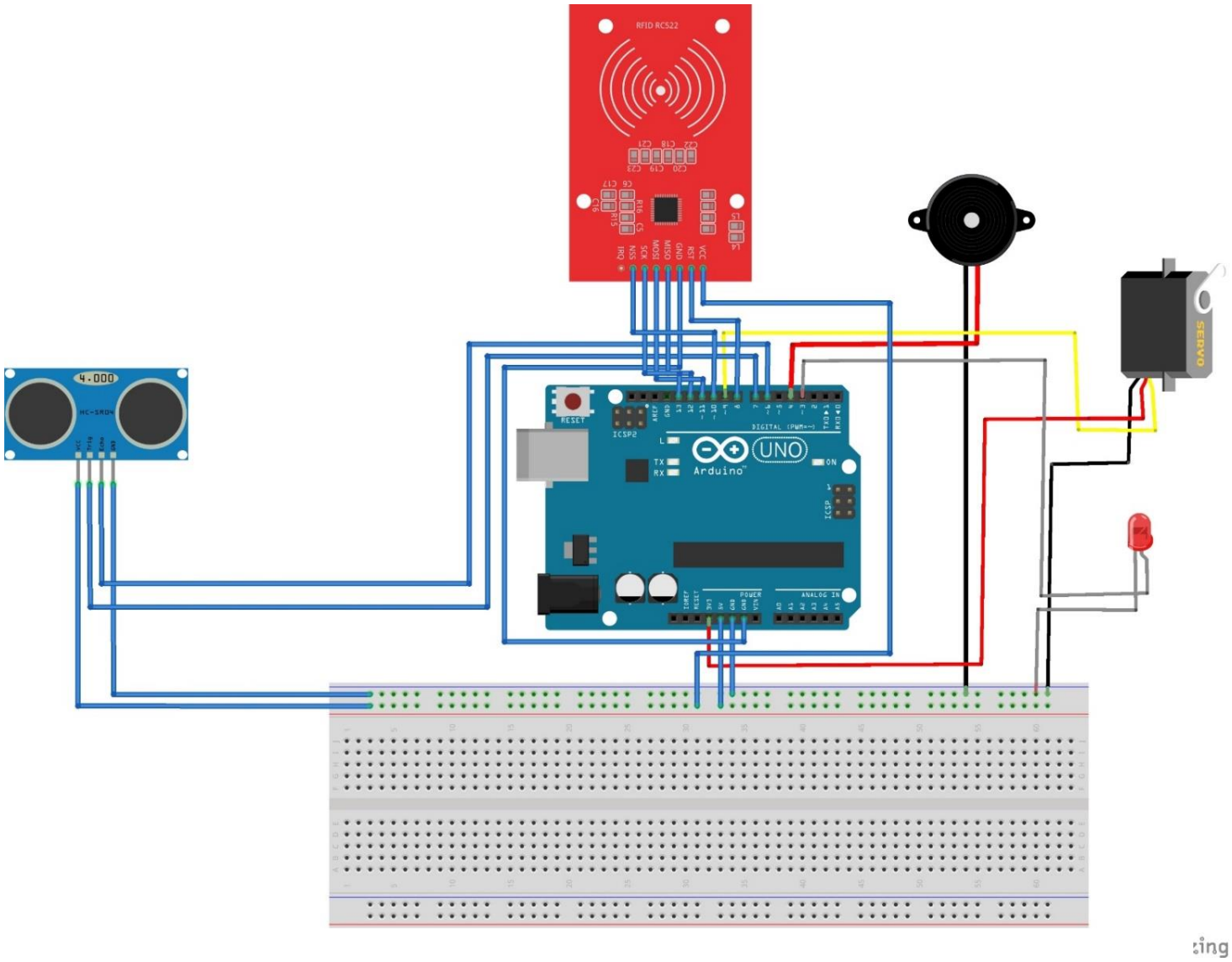

Figure 2 Circuit diagram for this system

2.2.2 SCHEMATIC DIAGRAM

This figure shown below represents the schematic Representation for this system.

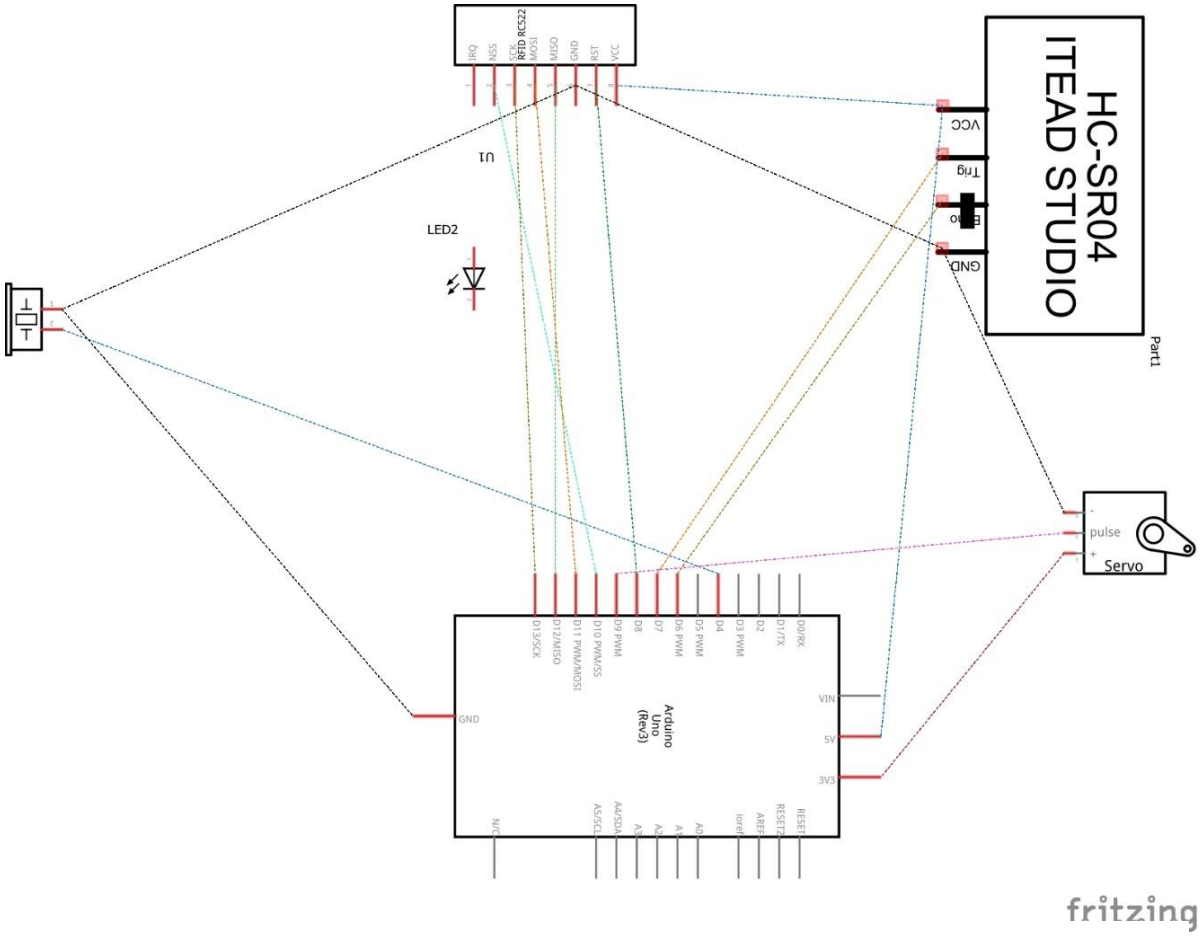

Figure 3 Schematic diagram for this system

Wires are connected accordingly.

RFID MODULE	ARDUINO UNO
SDA	10
SCK	13
MOSI	11
MISO	12
GND	GROUND
RST	8
3.3V	3.3V
BREADBOARD POSITIVE RAIL	5V
BREADBOARD NEGATIVE RAIL	GROUND
ULTRASONIC VCC	BREADBOARD +VE
TRIG PIN	7
ECHO	6
GND	BREADBOARD NEGATIVE SERIES
SERVO ORANGE WIRE	ARDUINO UNO 9
BROWN WIRE	BREADBOARD NEGATIVE
RED WIRE	BREADBOARD +VE

Table 1 Connected Cable Diagram

2.2.3 FLOW CHART:

A flowchart is simply a graphical representation of steps. It shows steps in sequential order and is widely used in presenting the flow of algorithms, workflow, or processes. Typically, a flowchart shows the steps as boxes of various kinds, and their order by connecting them with arrows. (Allawi, may 2020).

Initially, Vehicle enters into the sensor range then sensor detects vehicle then gate will close knowing vehicle has entered. Then the person inside vehicle scans the rfid card then rfid reader sends data to arduino which will check rfid of that person with rfid present in our database then if card is matched then only gate will open indicating

buzzer activated and led on for 1 seconds, after 7 seconds gate will gate closed automatically.

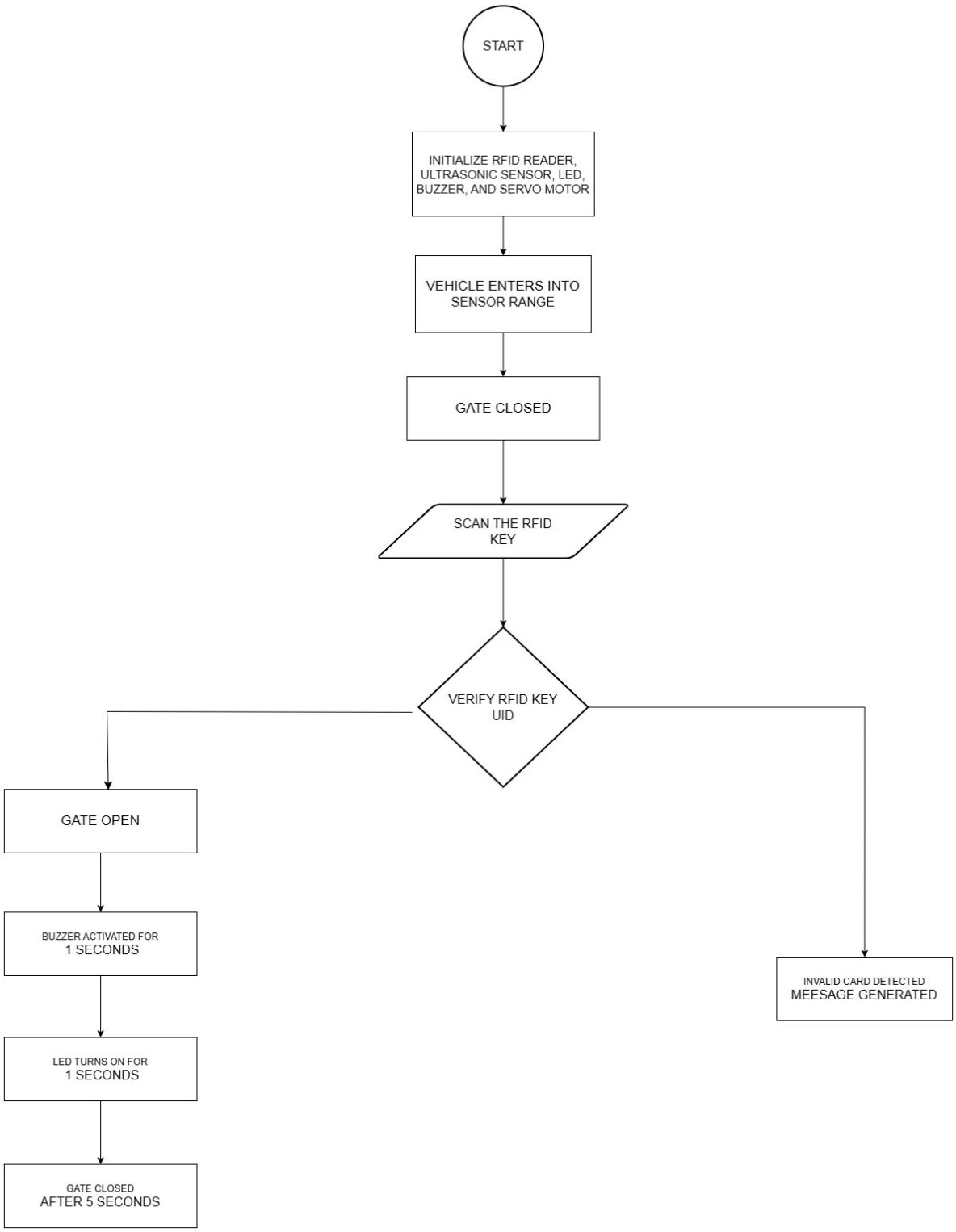

Figure 4 Flowchart Diagram

2.2.4 HARDWARE ARCHITECTURE:

A critical component of the broad field of computer architecture is the hardware architecture of a computer. The architecture of computer system involves the physical aspects like the Central Processing Unit (CPU), memory, input/output (I/O) devices, and address buses, control bus, which are integral to data transfer within the computer. (Diuzhakova, n.d.)

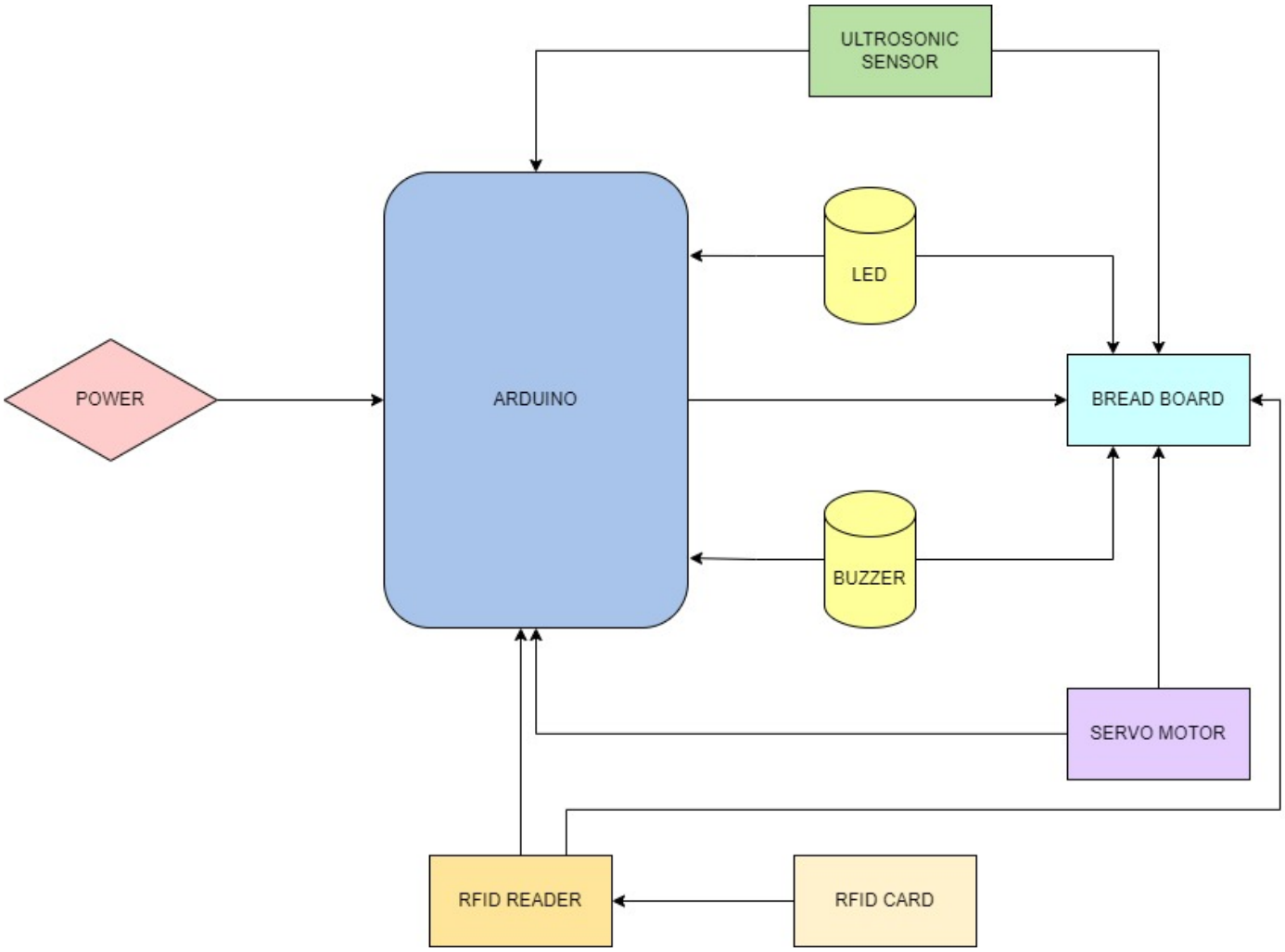

Figure 5 Block diagram of the project

The above diagram shows the hardware architecture for the project which used arduino uno, Breadboard, Ultrasonic sensor with rfid reader and servo motor.

2.2.5 SYSTEMATIC DIAGRAM:

The Figure below shows systematic diagram from whole system.

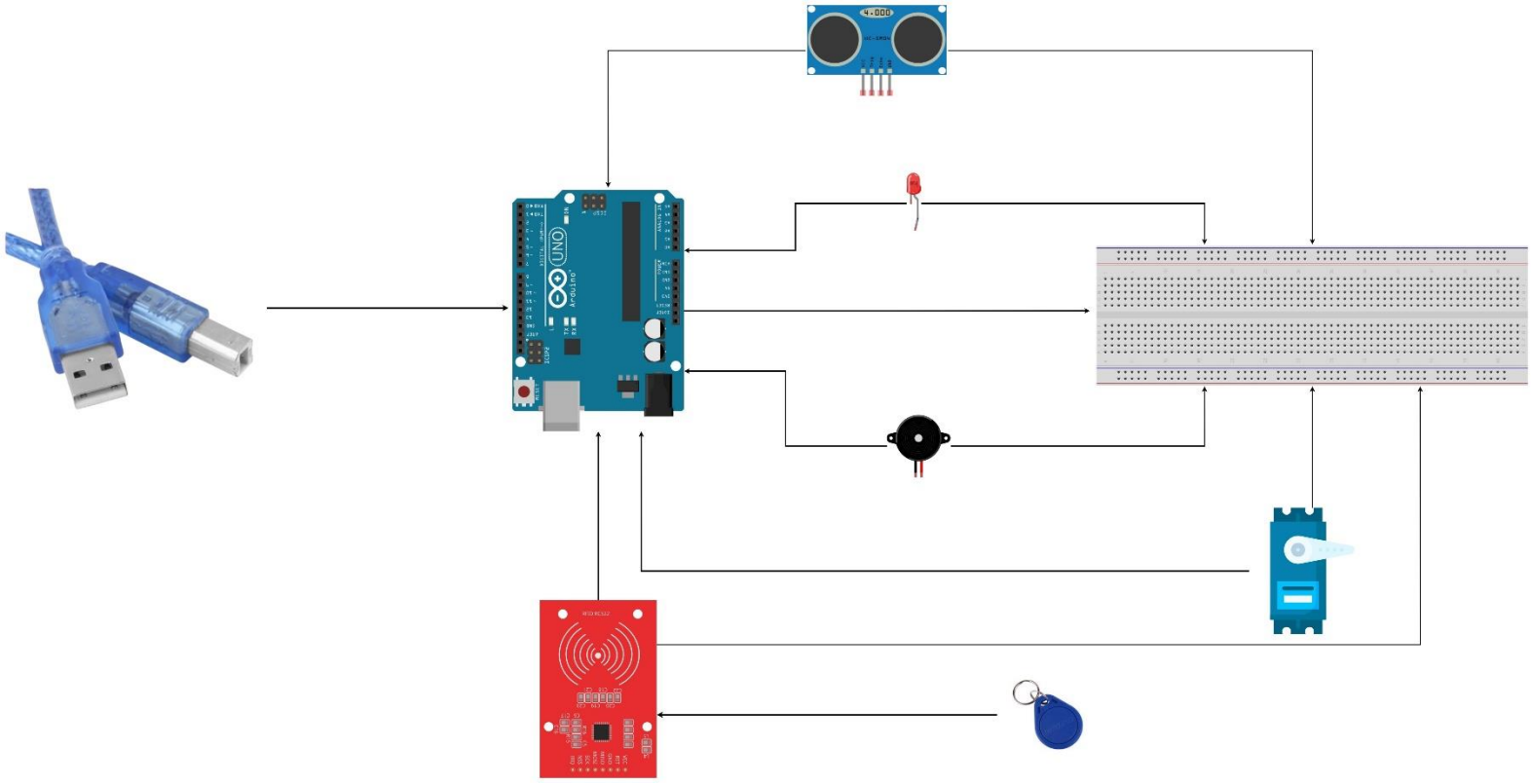

Figure 6 systematic diagram for my system

2.3 REQUIREMENT ANALYSIS:

2.3.1 HARDWARE REQUIREMENTS:

- **Arduino Uno:**

  Arduino is an open source microcontroller which can be easily programmed, erased and reprogrammed at any instant of time. Introduced in 2005 the Arduino platform was designed to provide an inexpensive and easy way for hobbyists, students and professionals to create devices that interact with their environment using sensors and actuators. (Louis, 2016).

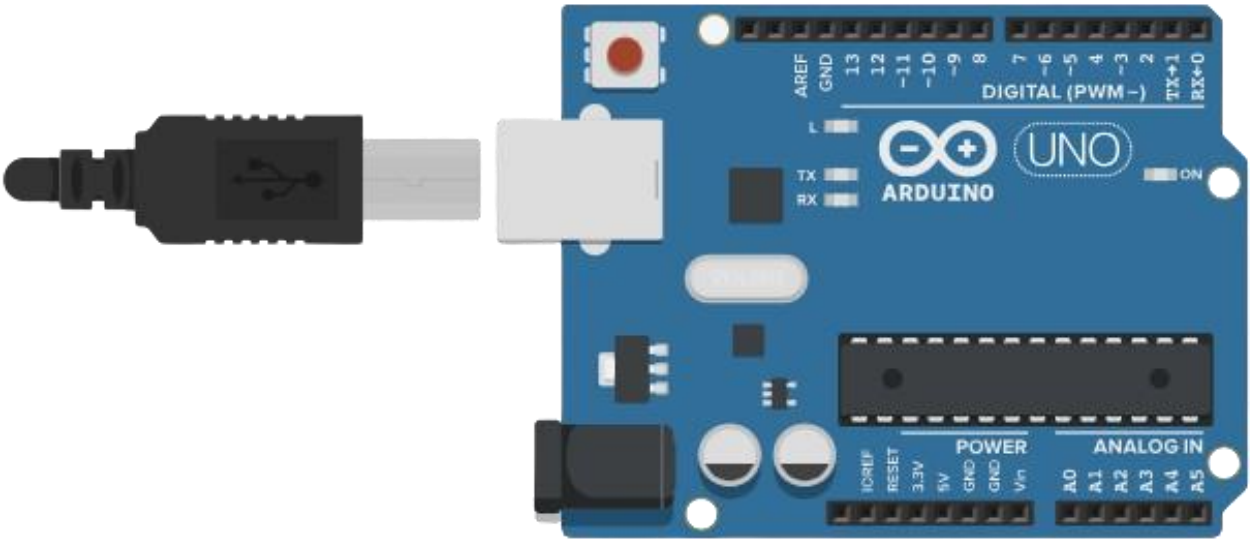

Figure 7 Arduino uno

❖ RFID:

RFID is a generic term for technologies that use radio waves to automatically identify people or objects from several inches to hundreds of feet. This is an Automatic identification technology by which any object can be identified automatically. Barcode, Magnetic Strip, IC card, Optic Character Recognition (OCR), Voice Recognition. (Chechi, Sep 2012)

Figure 8 RFID Reader and Tags

❖ Ultrasonic sensor:

Ultrasonic sensors work by transmitting a pulse of sound, much like sonar detectors, outside the range of human hearing. This pulse travels away from the range finder in a conical shape at the speed of sound (340 m/s). The sound reflects off an object and back to the range finder. (Ng, April 2020)

Classification of ultrasonic sensor:

Type	Classification
Based on energy conversion	Active sensor
Based on nature of output signal	Analogue sensor
Level Sensors	Continuous level measurement

Figure 9 Ultrasonic Sensor

❖ Servo Motor:

A servo motor is a revolving actuator or engine that considers an exact control as far as precise position, speeding up and speed, abilities that a customary engine doesn't have. It utilizes a normal engine and sets it with a sensor for position input. (Mezher, 2021)

Classification of Servo motor:

Type	Classification
Based on output movement	Angular actuator
Based on source of energy	Electrical actuator

Figure 10 Servo Motor

❖ LED:

Light emitting diodes, commonly called LEDs, are real unsung heroes in the electronics world. They do many different jobs in all kinds of devices. They form numbers on digital clocks, transmit information from remote controls, light up watches and tell you when your appliances are turned on. (Tom Harris, feb 11, 2021).

Figure 11 Led

❖ Breadboard:

A Breadboard is simply a board for prototyping or building circuits on. It allows you to place components and connections on the board to make circuits without soldering. *(circuitbread, Feb 14, 2019)*.

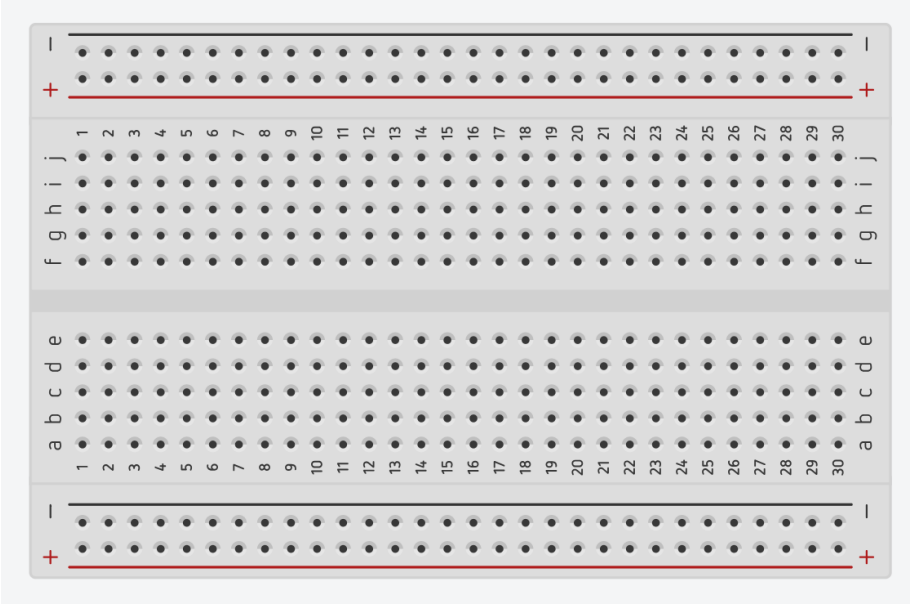

Figure 12 BreadBoard

2.3.2 SOFTWARE REQUIREMENTS:

- **Arduino IDE:**

  The integrated development environment (IDE) known as Arduino is used to create, assemble, and upload code to microcontroller boards made by Arduino. It is a software platform that offers an easy-to-use interface for Arduino board programming and interaction.

- **MS-Word:**

  One popular word processing program created by Microsoft is called Word. It is intended for document creation, editing, formatting, and sharing and is a component of the Microsoft Office suite.

- **Fritzing:**

  Fritzing is an open-source hardware initiative that serves as a creative platform, enabling accessibility to electronics for individuals of all skill levels. It encompasses a software tool, a community website, and associated services inspired by the principles of Processing and Arduino. (fritzing, n.d.)

3. DEVELOPMENT:

3.1 PLANNING AND DESIGN:

In the beginning, our team, including Apil Thapa, Lipi Singh, Lijala Tuladhar, Prafulla Raj Subedi, and Sakchyam Thapa, had a meeting to brainstorm and explore different project ideas. We focused on finding ideas that were affordable and useful in the real world. We took some days for selecting project ideas because to start the project we need to have clear sight of vision of that project how it will looks like after completing. After some days of research, we landed on the concept of an RFID-based security gate system.

The planning phase incorporates the strategic integration of RFID technology. We chose this technology because it seemed promising for improving security and having practical applications. The idea of creating an RFID-based Security Gate System came up, especially to enhance access control. In today's world security is major concern for all people around. We have planned to create security gate systemy. this overall system with decision was a result of our discussions and research, aiming to develop a project that is both budget-friendly and applicable in real-world scenarios.

3.2 SYSTEM DEVELOPMENT:

Phase 1: The system Development process is done same as we have done in creating circuit diagram in fritzing.Initially, we connected the breadboard and Arduino Uno by linking the ground and a 5 volt pin from the Arduino to the negative and positive terminals of the breadboard.

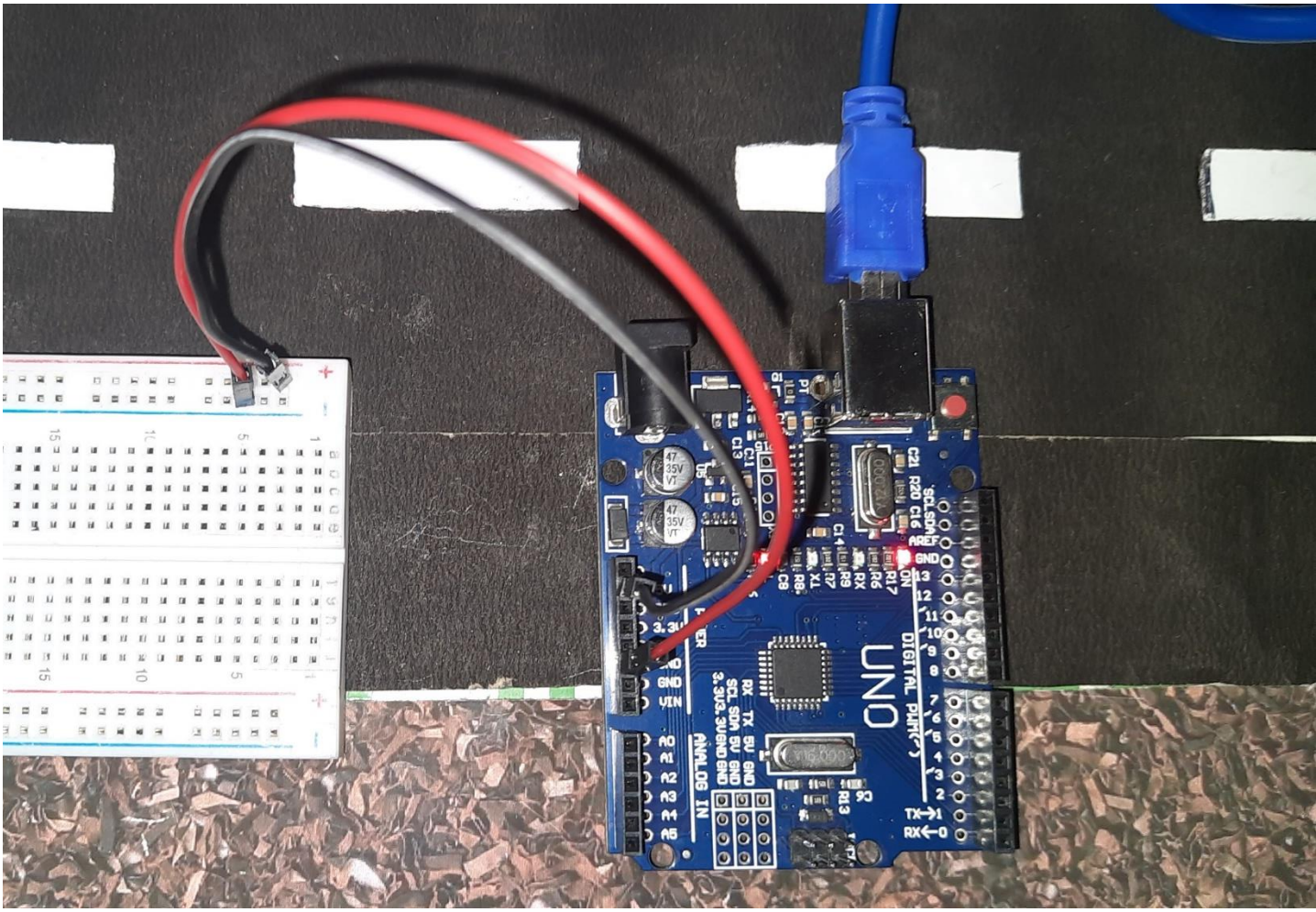

Figure 13 Connection of Arduino 5v pin and GND to Breadboard positive and Negative terminals

Phase 2: In this phase, connection for ultrasonic sensor is made.

- **VCC**: Connected to the 5V output on the Arduino.
- **TRIG (Trigger)**: Connected to Arduino pin 7.
- **ECHO**: Connected to Arduino pin 6.
- **GND**: Connected to the ground (GND) on the Arduino.

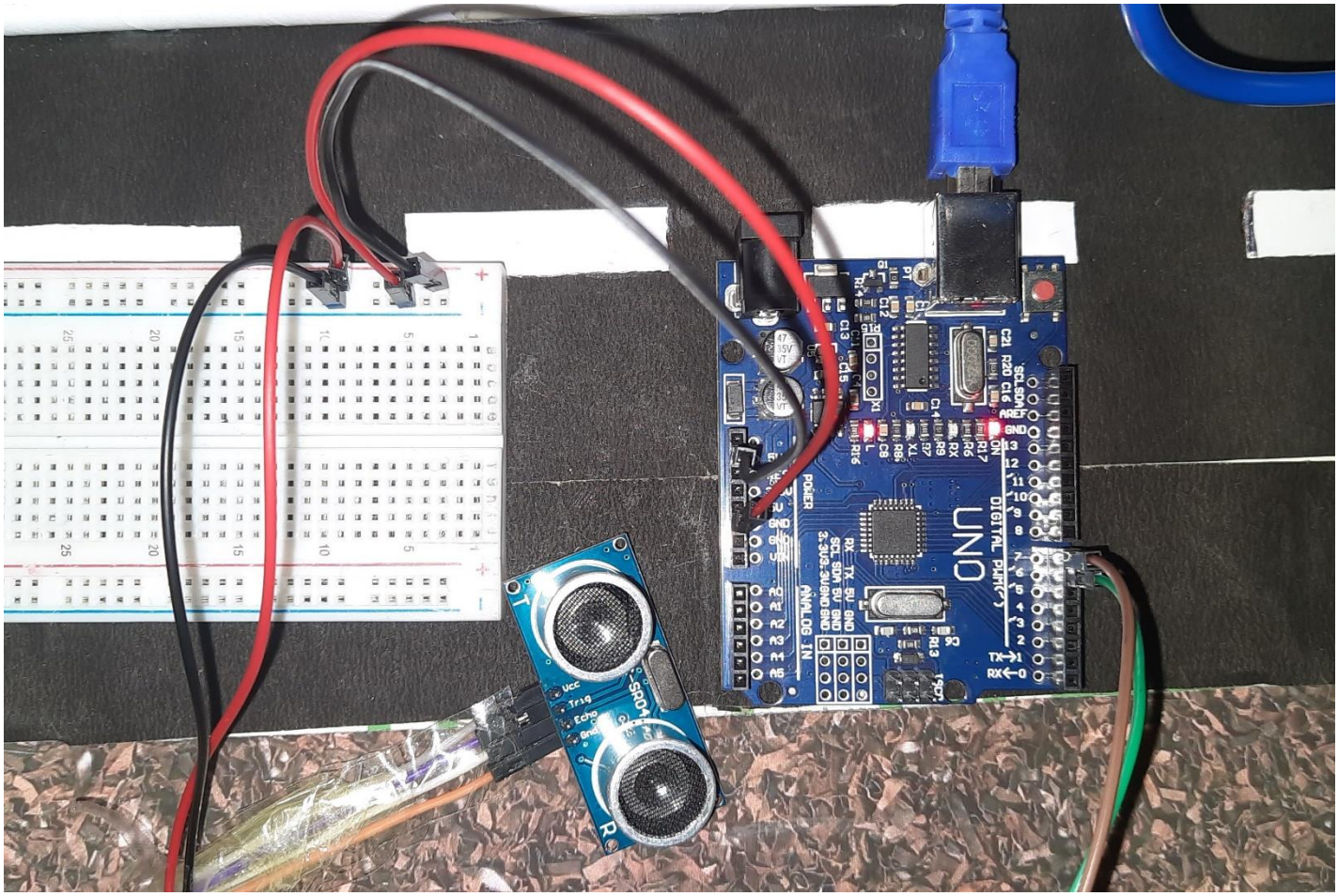

Figure 14 Connecting Ultrasonic sensor with arduino and breadboard

Phase 3: In this phase connection for RFID module is made.

- **SDA (Data Line):** Connected to Arduino pin 10.
- **SCK (Clock Line):** Connected to Arduino pin 13.
- **MOSI (Master Out Slave In):** Connected to Arduino pin 11.
- **MISO (Master In Slave Out):** Connected to Arduino pin 12.
- **GND (Ground):** Connected to the ground (GND) on the Arduino.
- **RST (Reset):** Connected to Arduino pin 8.
- **3.3V (Power):** Connected to the 3.3V output on the Arduino.

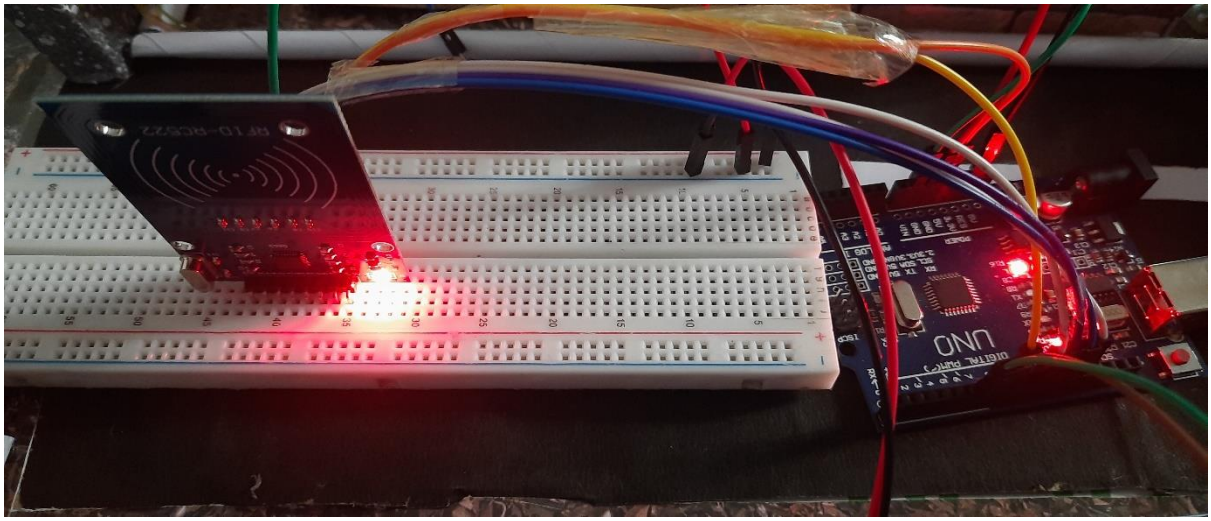

Figure 15 Connecting RFID with Arduino (front view)

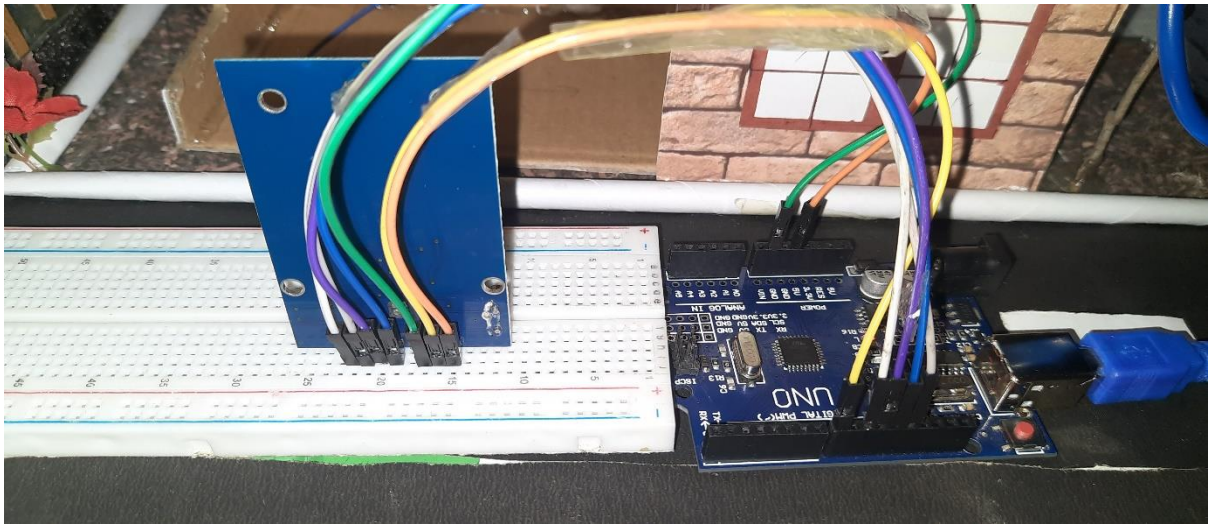

Figure 16 Connecting RFID with Arduino (back view)

Phase 4: In this phase connection for Servo Motor is made.

- **Orange (Control Line):** Connected to Arduino pin 9.
- **Brown (Ground):** Connected to the ground (GND) on the Arduino.
- **Red (Power):** Connected to the Bread Board Positive side for power.

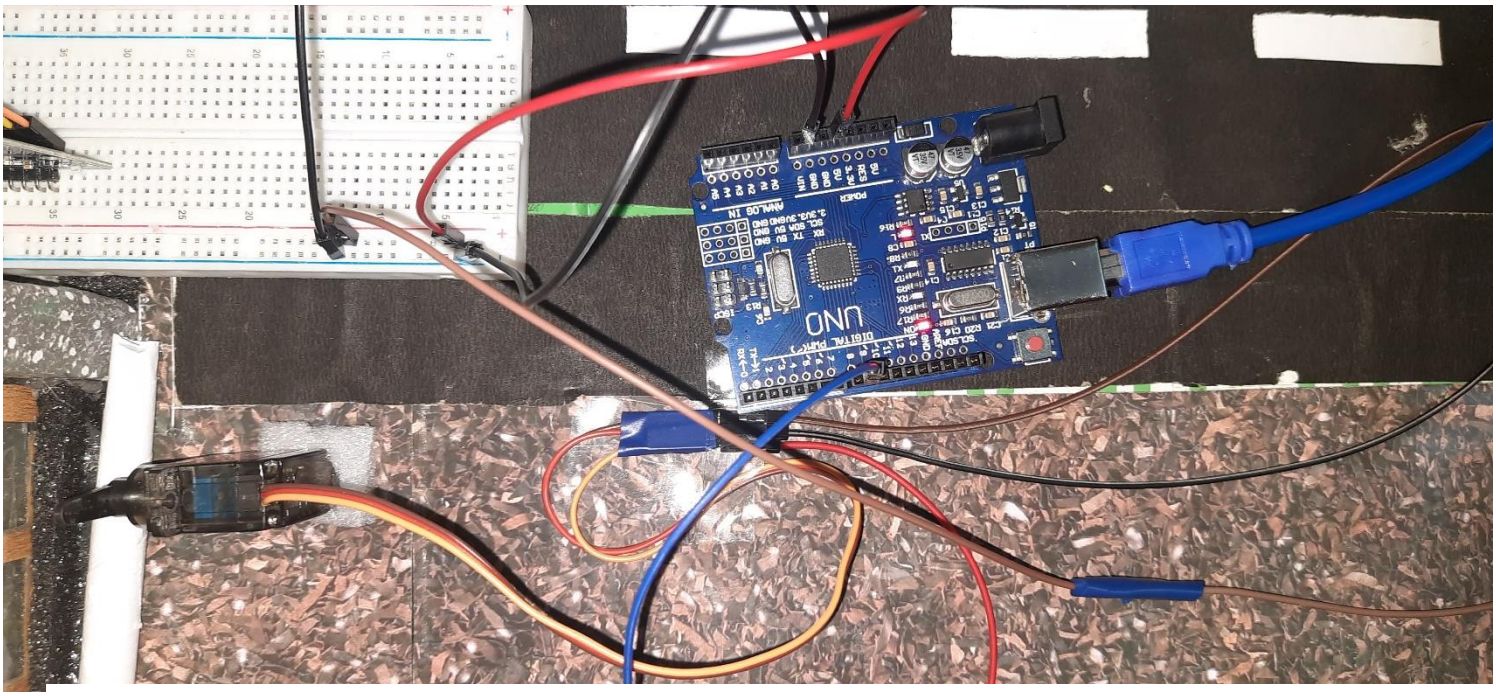

Figure 17 Connecting Servo motor with Arduino and Bread board

Phase 5: At last this is our final circuit connection made after connecting all those Components.

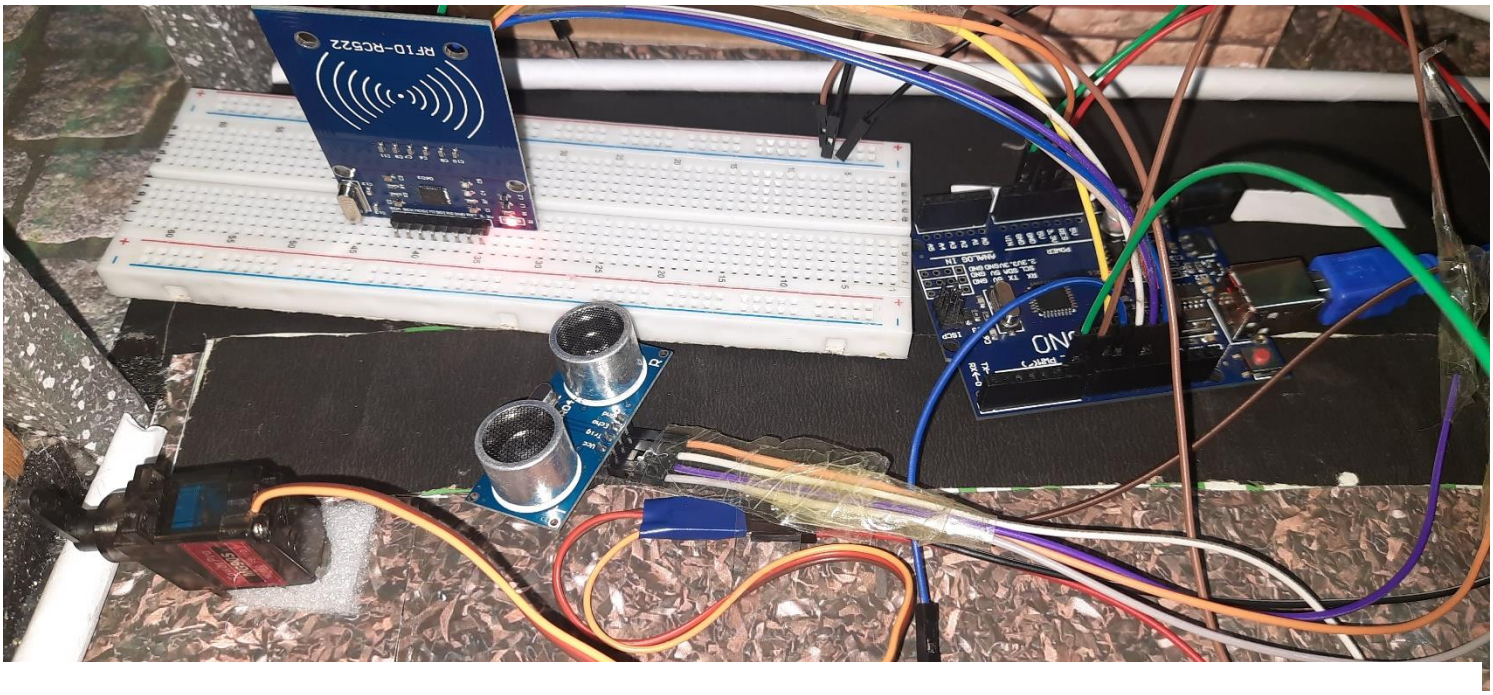

Figure 18 Final connection made after connecting all components

4. RESULTS AND FINDINGS:

4.1 RESULTS OF THIS SYSTEM

Our RFID Security Gate System seamlessly integrates IoT components, automating vehicle detection and access verification through RFID cards. This technology raise security in diverse environments, from residential areas to commercial establishments. Initially, we have successfully integerated whole iot system through all iot components.

The final system eliminates manual errors, ensuring real-time access control and efficient gate operations. The system is adaptable for parking lots, restricted zones, and events, with potential integration into existing security systems for heightened security measures.

4.2 FINDINGS:

This segment includes a variety of test cases designed to illustrate the expected outcomes of the results.

4.2.1: Test 1

TEST NO	**1**
OBJECTIVE	To demonstrate the successful execution of the code.
ACTION	Code was written, verified, and then uploaded onto the Arduino Uno using the Arduino IDE application.
EXPECTED RESULT	The code should undergo a successful verification, compilation, and uploading process onto the Arduino without encountering any errors.
ACTUAL RESULT	The Code was compiled and uploaded successfully.
CONCLUSION	Test was Successful.

Table 2 Testing 1

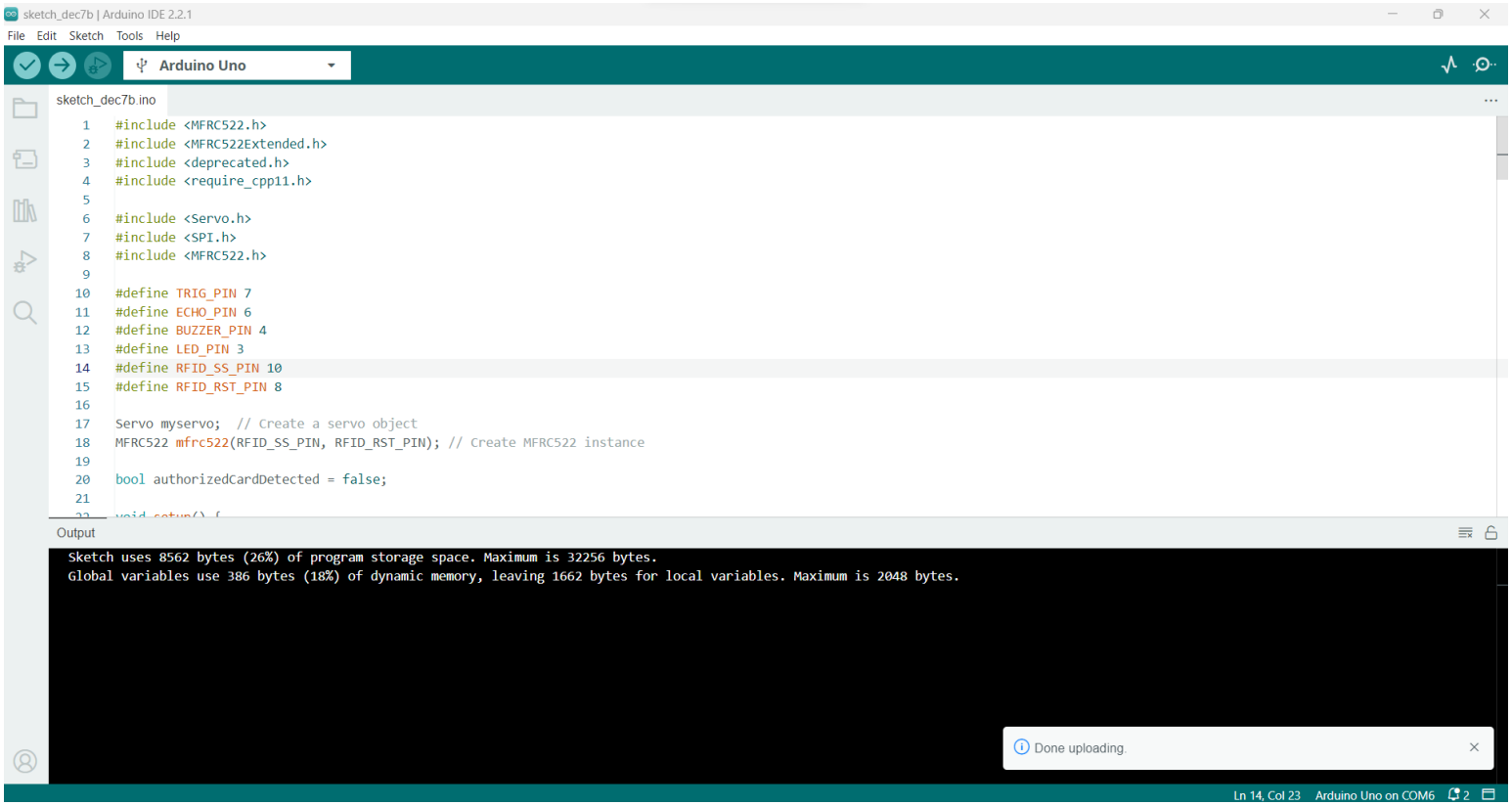

Figure 19 uploading code successfully in arduino ide

4.2.2: Test 2:

TEST NO	**2**
OBJECTIVE	To Confirm the automatic lowering of the barrier when a vehicle is detected by an ultrasonic sensor.
ACTION	A vehicle is brought into the range of the sensor, and it is verified whether the barrier lowers or not.
EXPECTED RESULT	The system should detect the vehicle's presence and respond by initiating the gate-closing mechanism.
ACTUAL RESULT	The Gate was closed successfully when sensor detects vehicle.
CONCLUSION	Test was Successful.

Table 3 Testing 2

Figure 20 Door closed when sensor detects vehicle

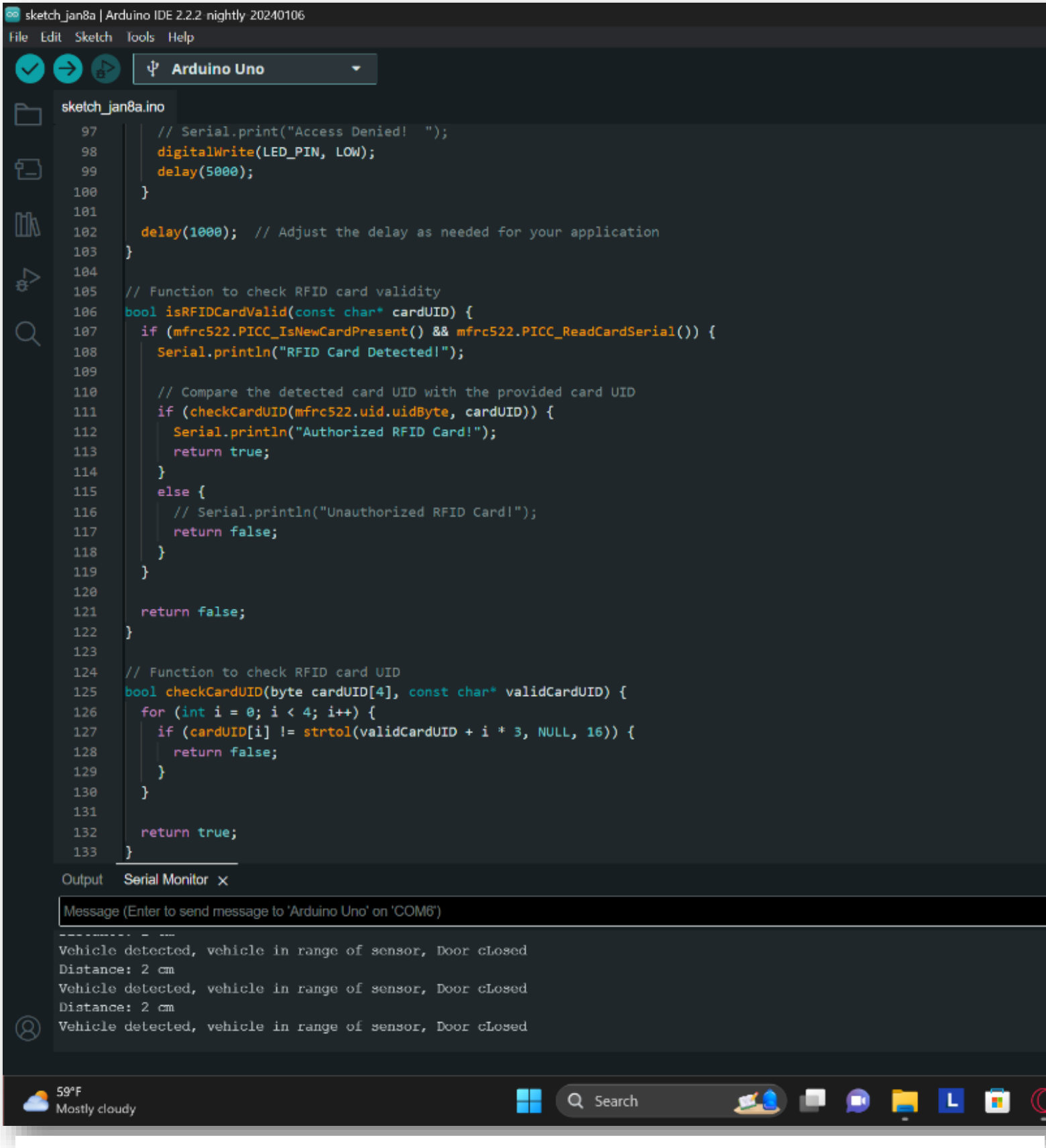

Figure 21: Displaying sensor detected and door closed message in serial monitor

4.2.3: Test 3:

TEST NO	**3**
OBJECTIVE	To Scan an RFID card with invalid credentials to the reader.
ACTION	A RFID card with invalid credentials is brought near RFID Reader.
EXPECTED RESULT	The system should accurately identify the unauthorized RFID card, leading to the denial of access.
ACTUAL RESULT	Unauthorized card message is printed in serial monitor also no any action is there in the system.
CONCLUSION	Test was Successful.

Table 4 Testing 3

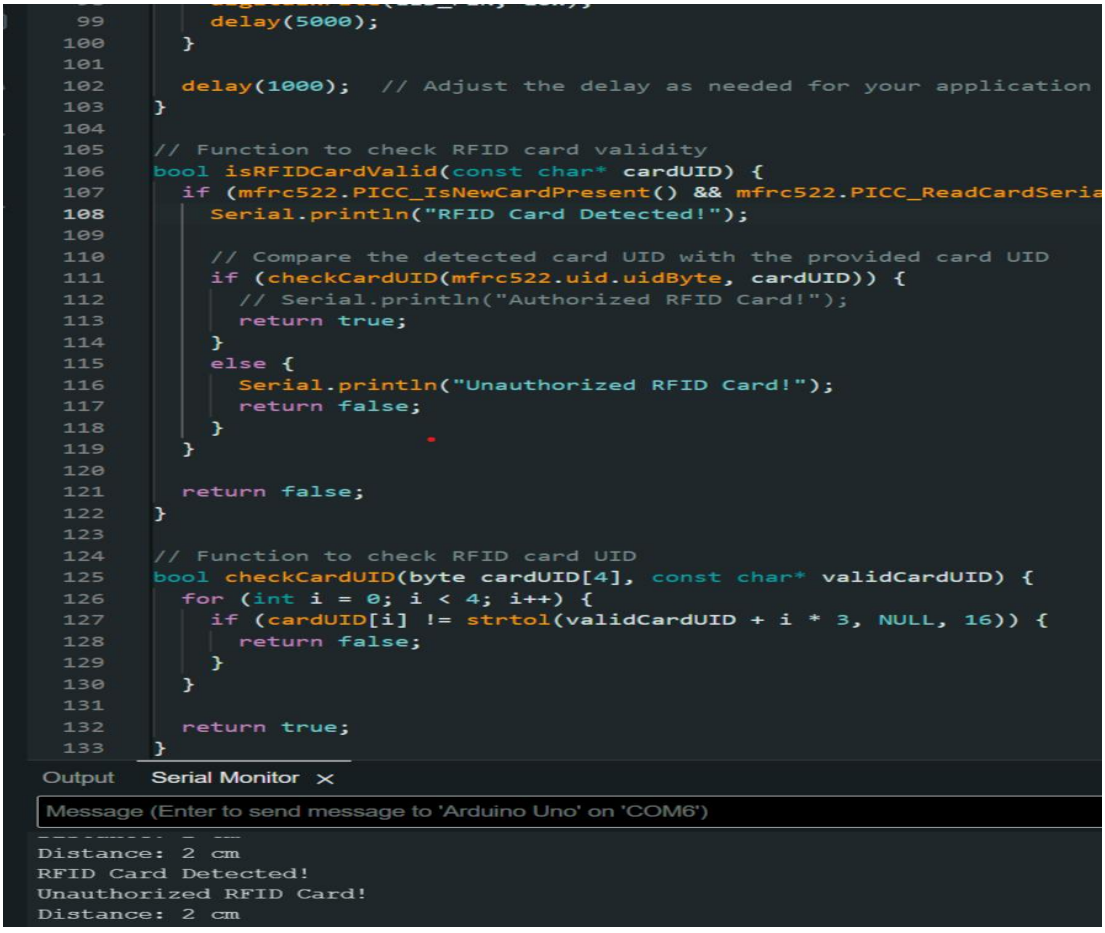

Figure 22: Displaying message unauthorized card in serial monitor

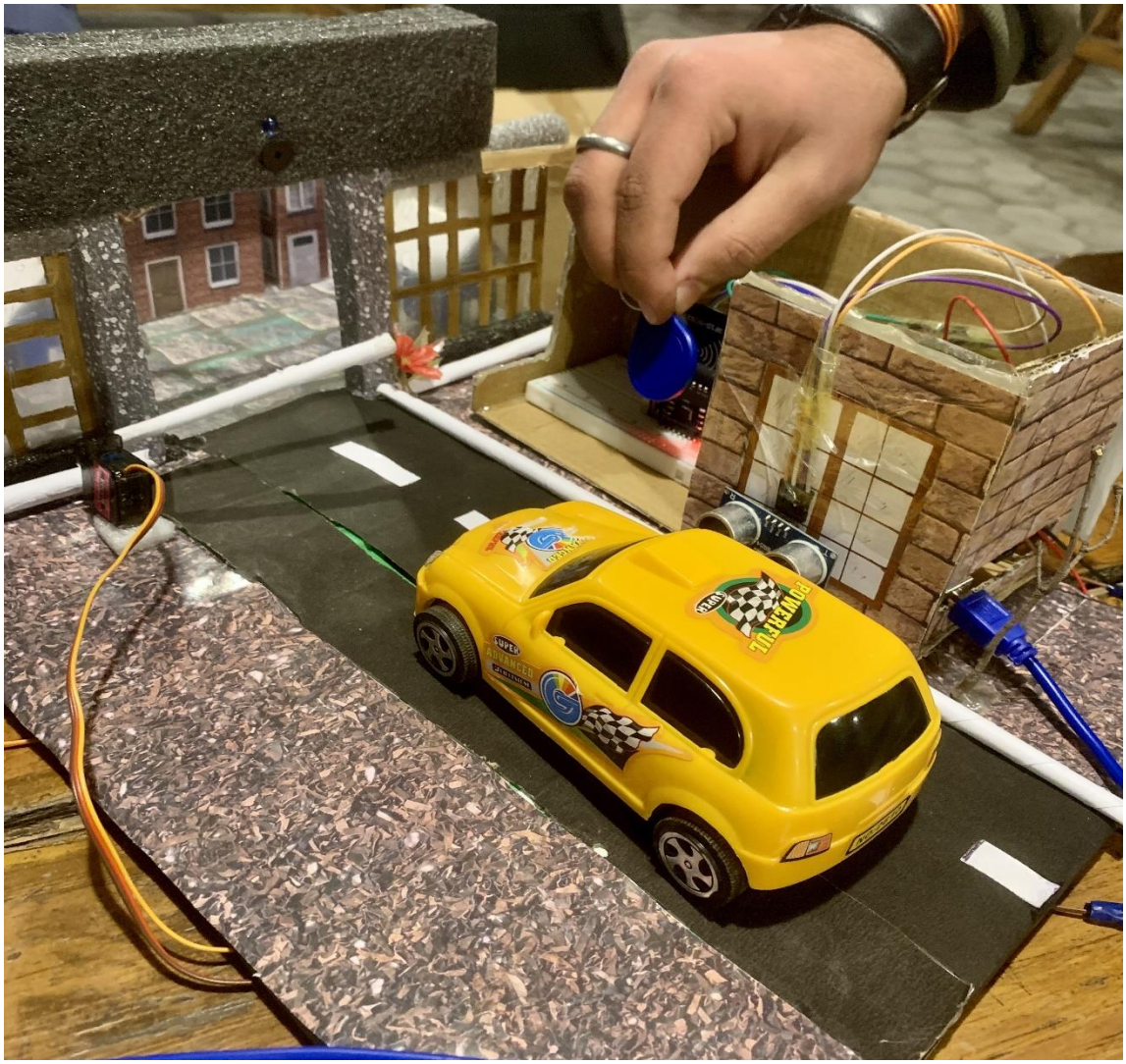

Figure 23 Scanning invalid rfid card into rfid reader

4.2.4: Test 4:

TEST NO	**4**
OBJECTIVE	To Scan an RFID card with valid credentials to the reader.
ACTION	A RFID card with valid credentials is brought near RFID Reader.
EXPECTED RESULT	The system should detect the authorized RFID card, triggering the gate to open swiftly.
ACTUAL RESULT	Gate was opened when authorized rfid card is scanned also authorized card message is displayed.
CONCLUSION	Test was Successful.

Table 5 Testing 4

Figure 24 Valid rfid card is scanned into rfid reader which makes gate to opened

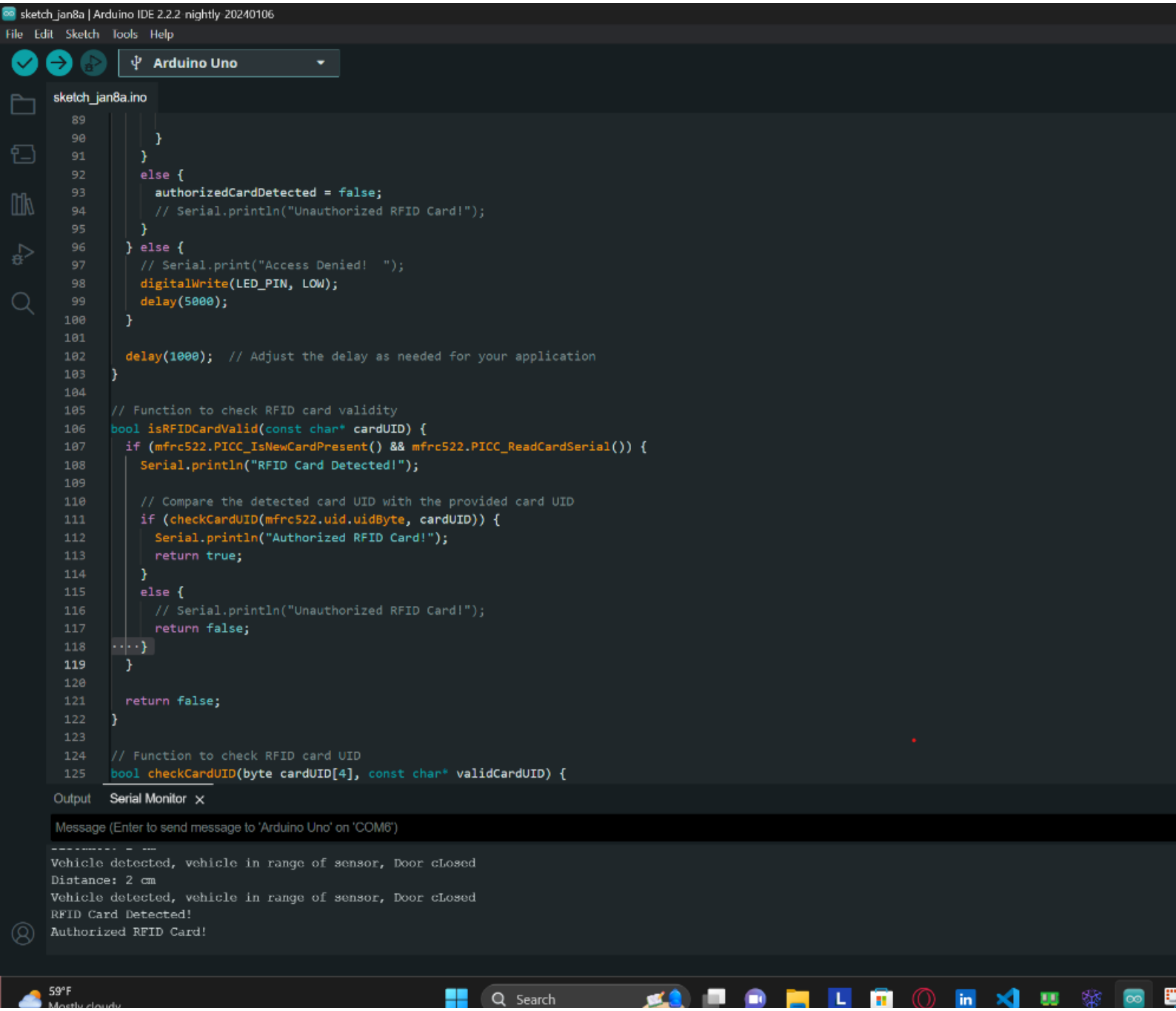

Figure 25 Displaying authorized rfid detected message in serial monitor

4.2.5 Test 5:

TEST NO	**5**
OBJECTIVE	Activation of Led and buzzer after valid rfid card detected.
ACTION	Led and buzzer was activated.
EXPECTED RESULT	The system should activate the buzzer to provide audible feedback, along with illuminating the LED for visual confirmation.
ACTUAL RESULT	Buzzer and Led was activated after valid rfid card scanned in reader.
CONCLUSION	Test was Successful.

Table 6 Testing 5

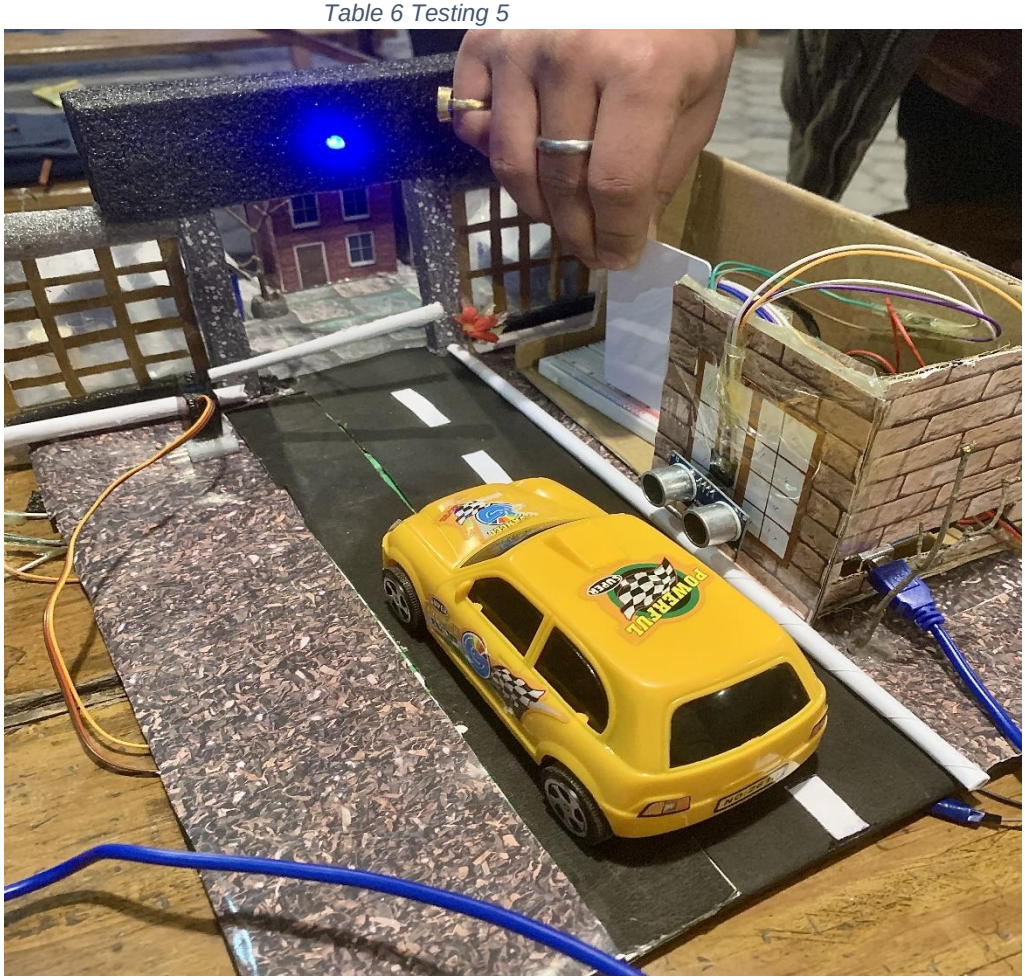

Figure 26 Led and buzzer ativated

4.2.6 Test 6:

TEST NO	**6**
OBJECTIVE	Lowering gate after vehicle pass.
ACTION	Gate was lowered automatically when vehicle pass away from main gate.
EXPECTED RESULT	The servo should lowered down automatically after 5 seconds.
ACTUAL RESULT	Gate was lowered successfully after 5 seconds when vehicle passed from main Gate.
CONCLUSION	Test was Successful.

Table 7 Testing 6

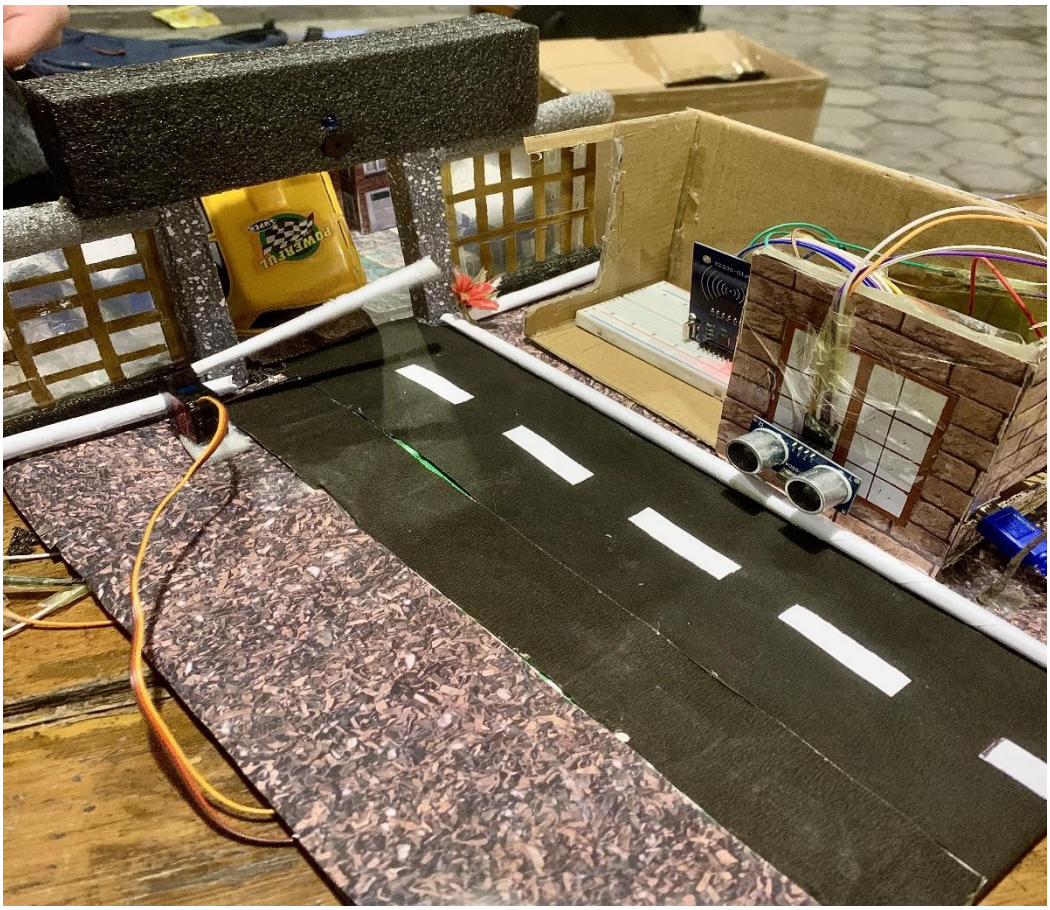

Figure 27 Gate lowered after 5 seconds when vehicle pass away from main gate

5. FUTURE WORK:

- Integration with IoT Devices

  Enhance connectivity with IoT devices for smarter applications.

- Biometric User Authentication

  Implement facial recognition or fingerprint scanning for precise user identification.

- Real-time Data Analytics:

  Continuously analyze generated data for instant insights into access patterns and system performance.

- Advanced Visual Identification:

  Integrate cameras for enhanced visual identification, crucial in scenarios like supermarkets.

- Integration with POS Systems:

  Seamless integration with Point of Sale (POS) systems for a more efficient billing process.

- Automated Alerting Mechanism:

  Develop an automated alert system for swift responses to security breaches or unpaid bills.

6. CONCLUSION:

In conclusion, the implementation of the RFID-based Security Gate System represents a significant leap towards enhancing security measures and access control. By utilizing RFID technology, the system ensures that only authorized individuals with valid credentials gain entry, offering an efficient process for vehicles. The project's aim and objectives revolve around creating a secure gate activation mechanism, optimizing vehicle entry efficiency, and integrating additional features like security buzzer and LED for enhanced functionality.

The successful execution of the project has not only addressed the current challenges associated with traditional security measures but has also laid the foundation for future developments. The system's advantages, including automated control, precision, cost-effectiveness, and enhanced security, make it a promising solution for various applications.looking ahead, potential future works include integrating the RFID Security Gate System with IoT devices for smarter applications, incorporating biometric user authentication for additional security layers, implementing real-time data analytics for informed decision-making, and enhancing visual identification capabilities through advanced technologies like cameras. The integration with POS systems aims to streamline billing processes, while the automated alerting mechanism ensures a swift response to potential security breaches.

In essence, the RFID Security Gate System not only addresses current security needs but also sets the stage for ongoing innovations and improvements in the realm of access control and security technologies. Its adaptability and potential for integration with emerging technologies position it as a versatile solution with room for continual enhancement and expansion.our attempt into implementing a gate security system using sensors, LEDs, and Arduino Uno has been a transformative journey into the world of Internet of Things (IoT). While the developed system has enhanced security and streamlined access control, it has also exposed us to the challenges associated with real-world implementations, such as optimizing sensitivity and addressing environmental factors affecting sensor accuracy.

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8. APPENDIX:

8.1 RESOURCE COLLECTION:

In order to successfully complete our RFID-based Security Gate System project, several critical components were required. These included:

- Arduino Uno
- Servo motor for gate movement
- Ultrasonic sensor for distance measurement
- RFID reader along with corresponding tags for user identification
- Buzzer for audible feedback, an LED for visual indicators
- Breadboard for circuit connections
- Jumper wires to link the various components.

Sakchyam and Prafulla took on the responsibility of acquiring additional components from external sources. They visited the IoT shop Himalaya in Baneswor, where they bought the RFID reader and corresponding tags for user identification, and jumper wires to facilitate seamless connections within the circuit.

To obtain these components, we collaborated with the Islington College resource department, securing the Arduino Uno, servo motor, buzzer, LED, ultrasonic sensor and breadboard. These foundational elements were essential for building the core structure of our security gate system.

This selection and arrangement of components ensured that we had all the necessary materials to initiate the development of our RFID-based Security Gate System, combining resources from both our institutional support and external vendors.

8.2 INDIVIDUAL CONTRIBUTION PLAN:

Student Name	Role	Contribution
➢ Apil Thapa	➢ Gate Control Logic	➢ Designed and implemented effective gate control logic for the RFIDbased security system.
	➢ Prototype Development	➢ Functionalities into the prototype for practical testing.
	➢ Code Logic and Documentation Assistance	➢ Implemented robust code logic for the system, ensuring efficiency and reliability.
➢ Lipi singh	➢ Presentation Support	➢ Provided crucial support in preparing anddelivering project presentations.
	➢ Documentation Review	➢ Collaborated with the team to refine and enhance the quality of written project materials

	➢ Presentation Design	➢ Contributed to the design aspect of presentations
➢ Lijala Tuladha	➢ Debugging	➢ Ensured the system's reliability through rigorous testing and effective debugging.
	➢ LED and Buzzer Integration.	➢ Integrated LED visual indicators and a buzzer for enhanced user feedback.
	➢ Comprehensive Documentation	➢ Created detailed and comprehensive documentation
➢ Sakchyam Thapa	➢ Authorization Logic	➢ Implemented secure authorization logic for the RFID-based security system.
	➢ Sensor Setup and Integration.	➢ Integrated sensors with gate control, facilitating a cohesive and responsive security system.
	➢ Sensor Setup and Integration.	➢ Validate the functionality and reliability of the security system

➢ Prafulla Raj subedi	➢ Integration	➢ Implemented the motor mechanism for gate operation, ensuring smooth and reliable functionality.
	➢ Project Overview	➢ Provided a concise and informative overview of the entire project, summarizing key components and goals
	➢ Code Logic for sensor	➢ Integrated sensor code, enhancing the system's responsiveness to environmental inputs

Table 8 Individual Task

8.3 CODE:

```
#include <MFRC522.h>
#include <MFRC522Extended.h>
#include <deprecated.h>
#include <require_cpp11.h>

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

#define TRIG_PIN 7
#define ECHO_PIN 6
#define BUZZER_PIN 4
#define LED_PIN 3
#define RFID_SS_PIN 10
#define RFID_RST_PIN 8

Servo myservo;  // Create a servo object
MFRC522 mfrc522(RFID_SS_PIN, RFID_RST_PIN); // Create MFRC522 instance

bool vehicleAuthorized = false;   // New state variable to track RFID card
authorization

void setup() {
  Serial.begin(9600);
  pinMode(TRIG_PIN, OUTPUT);
```

```
  pinMode(ECHO_PIN, INPUT);
  pinMode(LED_PIN, OUTPUT);
  pinMode(BUZZER_PIN, OUTPUT);

  myservo.attach(9);  // Attach the servo to pin 9

  // Initialize RFID reader
  SPI.begin();
  mfrc522.PCD_Init();
}

void loop() {
  myservo.write(90);

  // Trigger ultrasonic sensor
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  // Measure the echo pulse duration
  long duration = pulseIn(ECHO_PIN, HIGH);

  // Calculate distance in centimeters
  long distance = (duration * 0.0343) / 2;
```

```
// Print the distance to the Serial Monitor
Serial.print("Distance: ");
Serial.print(distance);
Serial.println(" cm");

// Move the servo based on distance
if (distance < 10) {
  myservo.write(180);

  // Check for an authorized RFID card only if the vehicle is newly detected
  if (!vehicleAuthorized && isRFIDCardValid("A3 63 D3 A7")) {
    // Code to execute when the RFID card is authorized
    vehicleAuthorized = true;

    digitalWrite(LED_PIN, HIGH);
    tone(BUZZER_PIN, 2000, 1000);

    // Delay for 1 second
    delay(1000);

    // Turn off LED and buzzer
    digitalWrite(LED_PIN, LOW);
    noTone(BUZZER_PIN);
    myservo.write(90);
    delay(7000);
```

```
      myservo.write(180);
      delay(3000);
      myservo.write(90);
    }
  } else {
    // Reset the state variable when the vehicle is not detected
    vehicleAuthorized = false;
    Serial.print("Access Denied!  ");
    digitalWrite(LED_PIN, LOW);
    delay(5000);
  }

  delay(1000);  // Adjust the delay as needed for your application
}

// Function to check RFID card validity
bool isRFIDCardValid(const char* cardUID) {
  if (mfrc522.PICC_IsNewCardPresent() && mfrc522.PICC_ReadCardSerial()) {
    Serial.println("RFID Card Detected!");

    // Compare the detected card UID with the provided card UID
    if (checkCardUID(mfrc522.uid.uidByte, cardUID)) {
      Serial.println("Authorized RFID Card!");
      return true;
    }
    else {
```

```
      // Serial.println("Unauthorized RFID Card!");
      return false;
    }
  }

  return false;
}

// Function to check RFID card UID
bool checkCardUID(byte cardUID[4], const char* validCardUID) {
  for (int i = 0; i < 4; i++) {
    if (cardUID[i] != strtol(validCardUID + i * 3, NULL, 16)) {
      return false;
    }
  }

  return true;
}
```