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EXPLORATORY PROJECT REPORT

AIM: Automated Toll Collection System using RFID & Arduino.

Submitted by:-

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CERTIFICATE

This is to certify that this project report "Automated Toll Collection System using RFID & Arduino" is submitted by Om verma, Titiksha Dharania, Rishav kumar and the project was carried out under the supervision of Professor, Amit Kumar Singh. We approve this project for submission of the Exploratory Project, IIT(BHU) Varanasi.

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ACKNOWLEDGEMENT

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ABSTRACT

Automatic Toll Tax systems have really helped a lot in reducing the heavy congestion caused in the metropolitan cities of today. It is one of the easiest methods used to organize the heavy flow of traffic. When the car moves through the toll gate on any road, it is indicated on the RFID reader that it has crossed the clearing. The need for manual toll based systems is completely reduced in these methods and the tolling system works through RFID. The system thus installed is quite expedient reducing the time and cost of travelers since the tag can be deciphered from a distance

INTRODUCTION

We have all passed a toll collection booth of some or the other kind at some point of time. Our project aims to understand the working of a toll collection system. We have developed a system that detects a vehicle on its arrival, scans the RFID card available on the device and subtracts the payment required to pass the toll from the user's available balance. In case of insufficient account balance, we provide a method to recharge their account. We then try again and since the account has sufficient the gate to the toll opens.

LITERATURE SURVEY

Existing system:

Manual toll collection is the most widely used collection method in India. It requires a toll collector or attendant. Based on the vehicle classification, cash toll is received by the collector. The collector, who also dispenses change, accepts and sells scrip, tickets, coupons, making an entry of the vehicle in the system and issuing receipts to the user.

Disadvantages:

Due to physical collection of toll by an attendant it is very time consuming. The chances of escaping taxes are there. It also leads to queuing of vehicles at the toll.

Proposed Solution:

The proposed solution is an RFID-based toll system that would automate the toll collection process and eliminate the need for manual operations at toll booths. This system would use RFID tags installed on vehicles to collect tolls and track vehicle movement, helping to prevent theft and monitor speeding vehicles.

METHODOLOGY

The components used are:

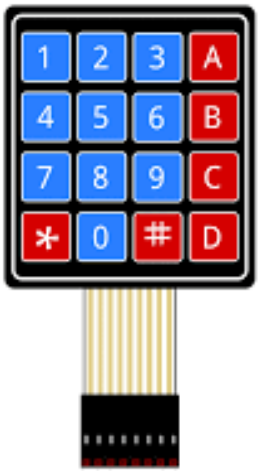
1. Arduino UNO:

Arduino UNO is a microcontroller board. It has 14 digital input and output pins, 6 analog inputs and a USB connector. We can simply connect it to a computer with a USB cable to get started. It is the most used board of the Arduino family. It is the easiest board to get started with electronics and coding.

2. RFID reader:

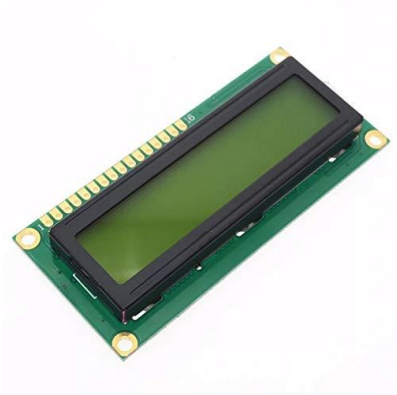
Every RFID system consists of three components: a scanning antenna, a transceiver and a transponder. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. It uses radio waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data. The transponder is in the RFID tag itself.

3. 4x4 keypad module:



In case of insufficient balance, the keypad module can be used to allow the user to enter the amount they need to recharge their account with.

4. LCD display:



We have used a 12x2 LCD display to display the balance of the user's account balance before and after the transaction. In case of insufficient balance, the display shows the message "insufficient balance" and shows the balance after recharging.

5. IR sensors:

IR sensors are motion sensors. They are used to detect the motion of an incoming or outgoing vehicle. We have used one sensor at the first toll gate which closes the barrier as it detects a vehicle. Another sensor is placed just before the barrier which opens the barrier after the user has paid the toll price.

6. Servo motor:

A servo motor is used to maneuver the toll gate. It is joined with the Sensors to open and close the barrier as required. It controls the movement of the barrier with the IR sensors.

7. Potentiometer:

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. We have used it to provide a resistance to the LCD display.

RFID

What is RFID (radio frequency identification)?

RFID (radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.

How does RFID work?

Every RFID system consists of three components: a scanning antenna, a transceiver and a transponder. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. There are two types of RFID readers -- fixed readers and mobile readers. The RFID reader is a network-connected device that can be portable or permanently attached. It uses radio waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.

The transponder is in the RFID tag itself. The read range for RFID tags varies based on factors including the type of tag, type of reader, RFID frequency and interference in the surrounding environment or from other RFID tags and readers. Tags that have a stronger power source also have a longer read range.

What are RFID tags and smart labels?

RFID tags are made up of an integrated circuit (IC), an antenna and a substrate. The part of an RFID tag that encodes identifying information is called the RFID inlay.

There are two main types of RFID tags:

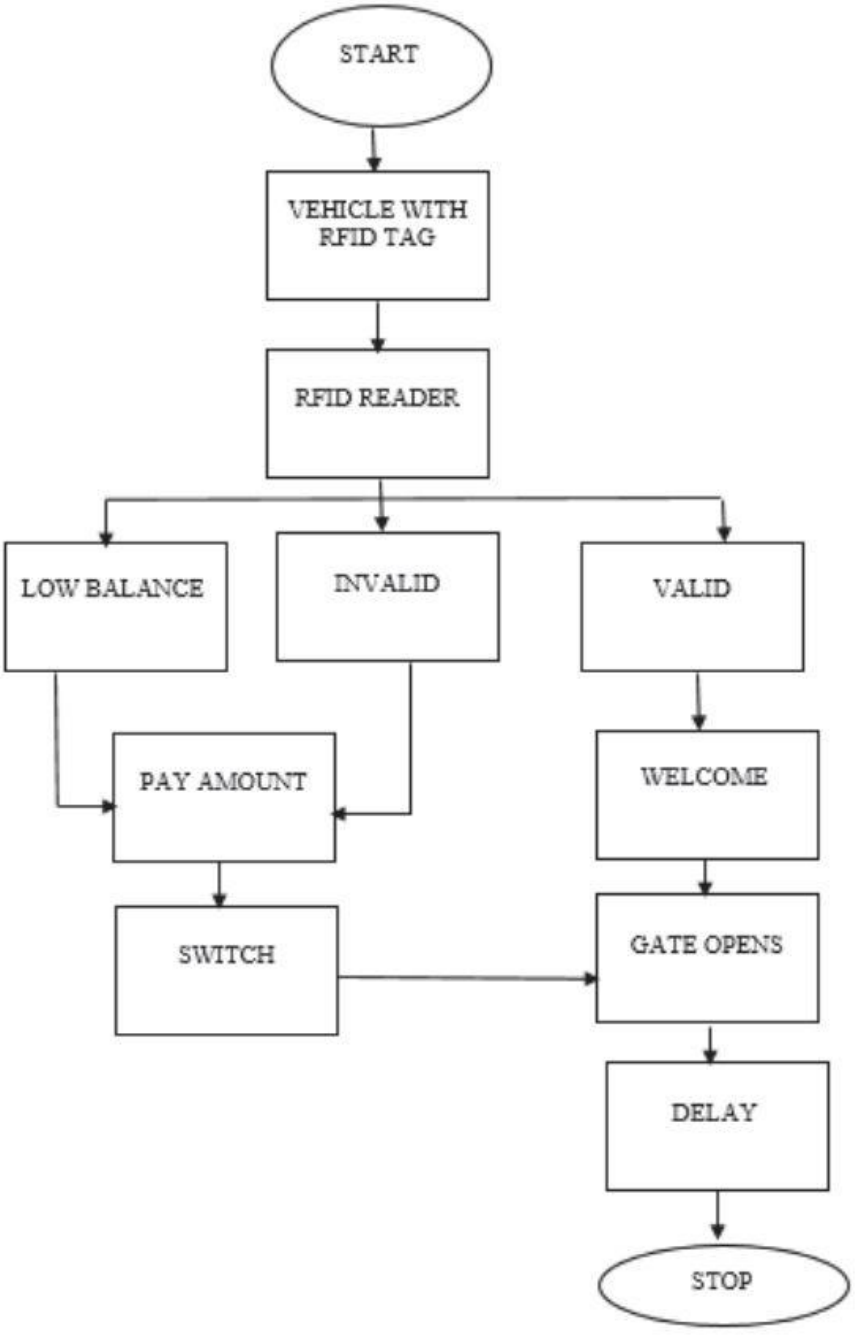
1. Active RFID. An active RFID tag has its own power source, often a battery.
2. Passive RFID. A passive RFID tag receives its power from the reading antenna, whose electromagnetic wave induces a current in the RFID tag's antenna.

There are also semi-passive RFID tags, meaning a battery runs the circuitry while communication is powered by the RFID reader.

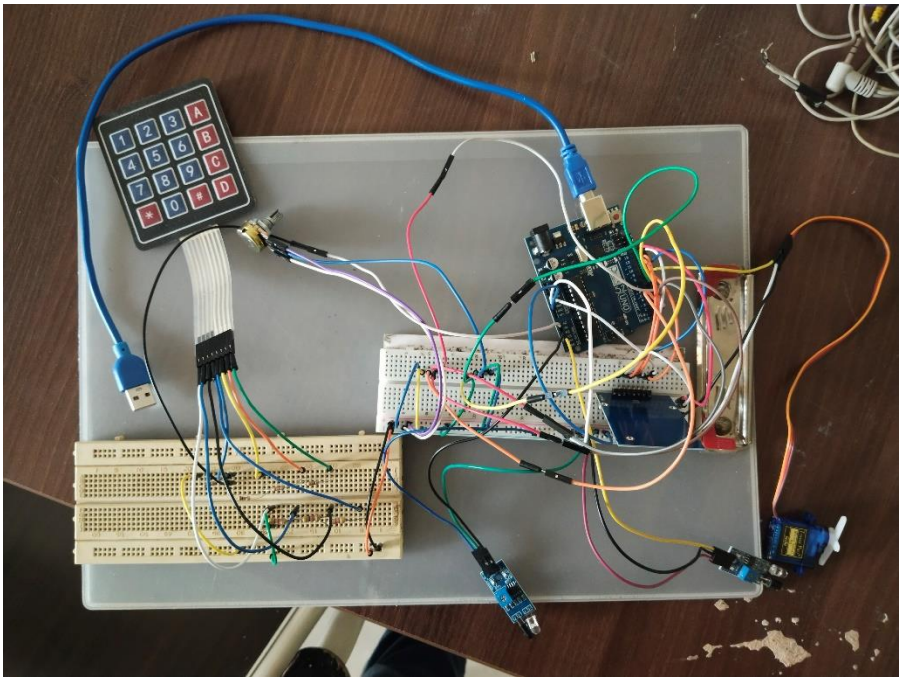
The read range for RFID tags varies based on factors including type of tag, type of reader, RFID frequency, and interference in the surrounding environment or from other RFID tags and readers. Active RFID tags have a longer read range than passive RFID tags due to the stronger power source.

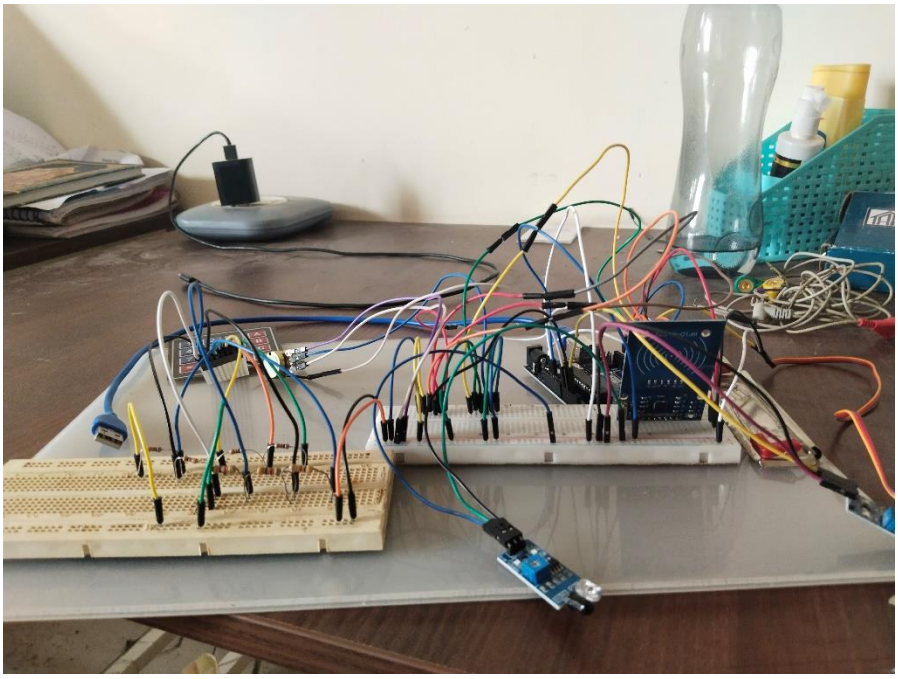
WORK FLOW

The first step is to design the steps for the system's operation. The flowchart below shows the process being followed when a vehicle enters the toll.The first step is to design the steps for the system's operation. The flowchart below shows the process being followed when a vehicle enters the toll.



Next we draw the circuit diagram:





The next part is to write the code:

We have used Arduino ide1.8.19 version for the coding part of the project.
Example:

sketch_may01a | Arduino 1.8.19

File Edit Sketch Tools Help

sketch_may01a

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

#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

Servo servo;
int servoPos = 0;

#define sensorPin1 A2
#define sensorPin2 A3
#define buzzerPin 3

int senVal1 = 0;
int senVal2 = 0;

#define RST_PIN 8
#define SS_PIN 10

int card1Balance = 4000;
int card2Balance = 200;

#define num 7
```

sketch_may01a | Arduino 1.8.19

File Edit Sketch Tools Help

sketch_may01a

```
OnewireKeypad <Print, 16 > KP2(Serial, KEYS, 4, 4, A0, 4700, 1000, ExtremePrec );

void setup () {

  lcd.begin();
  lcd.backlight();
  Serial.begin(9600);

  servo.attach(9);

  servo.write(30);

  pinMode(sensorPin1, INPUT);
  pinMode(sensorPin2, INPUT);
  pinMode(buzzerPin, OUTPUT);

  KP2.SetKeypadVoltage(5.0);

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

  lcd.setCursor(0, 0);
  lcd.print(" Automatic Toll");
  lcd.setCursor(0, 1);
  lcd.print("Colection System");
```

Working:

- After uploading the code to the Arduino Board, we can start testing the project. Initially, it will display the Welcome Message.

- Now when the Vehicle crosses the first IR Sensor, it will display a Vehicle Detected message. Then the system will ask you to scan the RFID Card so that you can go ahead.

- Now you can scan the RFID Card for your Vehicle. The system will deduct 500 from the balance on your RFID Card. The LCD will display Bill Successfully paid message.

- The amount of balance remaining in your RFID Card will be shown by the LCD Display at the same time.

- Now your bill is paid. So, you can go ahead now. The LCD will display a Safe journey Message and this is how the Automated Toll Collection System using RFID & Arduino works.

- You can repeat the same process again with another RFID. Consider the RFID has only a 200 balance and the amount that needs to be paid is 500. In this case, if you scan the card, the LCD Display will show Insufficient Balance.

- Therefore you need to recharge the RFID Card and load some balance. To do that press the ‘A’ Button on Keypad. The System will now go into recharging mode.

- Now you can enter the amount you need to load into your RFID Card. For example, after entering 2000 from the Keypad, you can press ‘D’ to confirm. Now your card will have a 2000 balance added to the previous balance.

- Thus this is how the entire system works and you can use this system to repeat the process again and again.

RESULTS

An automated toll collection system using RFID tag and arduino was built to try and solve the disadvantages of the current toll collection system. This automated system reduces the amount of traffic at polls by making the system of collecting tolls faster and far more efficient than manual collection.

REFERENCE

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- ResearchGate | Find and share research
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