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RFID BASED AUTOMATIC TOLL TAX COLLECTION SYSTEM

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Abstract: RFID technology is increasingly being used in a variety of fields, including toll election systems. In an automated toll tax collection system, an RFID reader detects an RFID tag attached to the vehicle as it passes through the toll booth. The RFID sensor read the user's data. The user can enter the amount needed to pay the toll fee. When the fee is paid, the servo motor opens the gate, allowing vehicles to pass through. An infrared sensor detects unauthorised vehicles or tailgaters and activates an alarm or trigger that locks the gate. If a vehicle passes through the tollgate, a second tollgate approaches from the front and prevents any vehicle from proceeding. With the help of this technology, toll fees may be collected reliably and efficiently. When the process is automated, there is no need to manually pay at toll payment locations, which can greatly alleviate traffic congestion.

Keywords **– Arduino, IR Sensor, Tollgate, Vehicles.**

I.INTRODUCTION

RFID (Radio Frequency Identification) technology is increasingly being used in a variety of fields, including toll collection systems. In this project, we propose an automated toll tax collection system that includes an RFID reader as well as other components such as an Arduino, LCD display, servo motor, key pad, IR sensor, and RFID sensor. The system detects an RFID tag attached to a vehicle passing through a toll booth. The RFID sensor reads the information stored on the tag, which is then transmitted to the Arduino for processing. The Arduino compares the information received with the database to determine the toll fee that will be charged. Once the toll fee is determined, the LCD display displays the fee, and the driver can then enter the required amount using the key pad. Once the correct amount is entered, the servo motor opens the gate, allowing the vehicle to pass through. An infrared sensor is also include in the system to detect any unauthorised vehicles or tailgaters. An alarm is triggered if an unauthorised vehicle is detected, and the gate remains closed. If a vehicle passes through the

tollgate, a second tollgate approaches from the front and prevents any vehicle from passing through. the Overall, this system provides a reliable and efficient method of collecting toll tax while also ensuring the security of the toll booth. It eliminates the need for manual toll collection, reducing traffic congestion and ensuring that toll fees are collected accurately.

II. SYSTEM SPECIFICATION

1.1 HARDWARE REQUIREMENTS

. Arduino Uno

. Servo Motor

. LCD Display

. RFID Tag

. IR Sensor

• ARDUINO UNO

Arduino Uno is a flexible, easy-to-use programmable opensource microcontroller board that can be integrated inro a variety of electronic projects. Arduino consist of both a programmable physical circuit board and a piece of software or IDE running on your computer. Arduino IDE used machine code to write and transfer to the Arduino physical board.

Other Arduino Boards: Arduino Nano, Arduino Pro Mini, Arduino Mega, Arduino Due, Arduino Leonardo.

Overview: Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 Analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. How to use Arduino Board: The 14 digital input/output pins can be used as input or output pins by using pinMode(), digitalRead() and digitalWrite() functions in Arduino programming. Each pin operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default.

• SERVO MOTOR

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It is used in applications such as robotics, CNC machinery and automated manufacturing. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. we will be discussing only about the DC servo motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc. Most of the hobby Servo motors operates from 4.8V to 6.5V, the higher the voltage higher the torque we can achieve, but most commonly they are operated at +5V. Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure you project can live with the half circle if no, you can prefer for a 0° to 360°motor or modify the motor to make a full circle. The gears in the motors are

easily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear. Next comes the most important parameter, which is the torque at which the motor operates. Again there are many choices here but the commonly available one is the 2.5kg/cm torque which comes with the Towerpro SG90 Motor. This 2.5kg/cm torque means that the motor can pull a weight of 2.5kg when it is suspended at a distance of 1cm. So if you suspend the load at 0.5cm then the motor can pull a load of 5kg similarly if you suspend the load at 2cm then can pull only 1.25. Based on the load which you use in the project you can select the motor with proper torque. The below picture will illustrate the same.

• LCD DISPLAY

An electronic device that is used to display data and the message is known as LCD 16*2. As the name suggests, it includes 16 columns & 2rows so it can display 32 characters (16*2=32). In an LCD television, the pixels are switched on or off electronically using liquid crystals to rotate polarized light. LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. LCDs (Liquid Crystal Displays) are used in embedded system applications for displaying various parameters and status of the system.LCD 16x2 is a 16-pin device that has 2 rows that can accommodate 16 characters each.

• RFID TAG

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. An RFID tag consists of a tiny radio transponder, a radio receiver and transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. This number can be used to inventory goods. There are two types. Passive tags are powered by energy from the RFID reader's interrogating radio waves. Active tags are powered by a battery and thus can be read at a greater range from the RFID reader; up to hundreds of meters. Unlike a barcode, the tag doesn't need to be within the line of sight of the reader, so it may be embedded

in the tracked object. RFID is one method of automatic identification and data capture (AIDC). EM-18 Pin Configuration EM-18 is a nine pin device. Among nine pins, 2 pins are not connected, so we basically have to consider seven terminals.

• **RFID READER**

The RFID reader is one kind of wireless module used for transferring the data to identify and track tags which are connected to objects. The RFID tag mainly includes the stored information. Some of the RFID tags are run by electromagnetic induction from magnetic fields formed nearby the reader. RFID reader comprises an RF module that works as a transmitter as well as a receiver of RF (radio frequency) signals. The TX of the RF module is inbuilt with an oscillator to make the carrier frequency. A modulator to intrude commands upon this carrier signal and an amplifier to raise the signal sample to wake the tag. The RX (receiver) of the RFID module contains a demodulator to remove the returned information and also grips an amplifier for supporting the signal of processing. A microprocessor is used for forming the control unit, which uses an operating system, a memory of the module filter and also stores the data.

III SYSTEM STUDY AND ANALYSIS

3.1 EXISTING SYSTEM

There are two methods of collecting tax presently used . They are First is the traditional manual method where one person collects money and issues a receipt. The other one is the Smart Card method where the person needs to show the smart card to the system installed at the toll tax department to open the Gate. The other one is The RFID readers mounted at toll booth will read the prepaid tags fixed on vehicles windshield and automatically respective amount will be deducted. The vehicle ignoring the traffic signal will be detected by the RFID readers fixed at signal crossing and will be notified to the traffic police. This can be done efficiently and great accuracy.

3.1.1 DRAWBACKS

. Both the above mentioned method for collective tax is time consuming method.

. Chances of escaping the payment of tax are there.

. It leads to queuing up of following vehicles.

. If Some vehicles breaks through the tollgate, no one will stop the vehicle.

3.2 PROPOSED SYSTEM

This project gives the simplified procedure to passengers to pay toll at toll booths by making them automated. The system includes IR sensor to detect any authorized vehicles and alarm or trigger is activated to lock the gate.

• **Automatic Toll Collection:** The RFID Readers mounted at toll booth will read the prepaid RFID tags fixed on vehicles' windshield and automatically respective amount will be deducted. If the tag is removed from the windshield then cameras fixed at two sites at toll plaza take snaps of the front and back number plate. Since every vehicle registration ID is linked to users account, toll can be deducted from the account bank directly.

• **Vehicle Theft Detection:** When vehicle is stolen the owner registers complaint on the website with its registration ID and unique RFID tag number. Now when stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth.

3.2.1FEATURES

INCREASED SAFETY: This system provide the variants of safety like dozing , escaping , accident and so many more. It can be able to detect the unauthorized vehicle in the tollgate.

TIME CONSUMING: This system helps in the vehicle tracking with the less time because If any vehicle damaged or breaks the toll the system used to stop the vehicle with the help of second barrier without the help of CCTV or surveillance camara.

4.CONCLUSION

In conclusion, the RFID reader-based automated toll tax collection system using Arduino is an efficient and reliable method of collecting toll tax. The system eliminates the

need for manual toll collection booths, reducing traffic congestion and ensuring accurate toll fees collection. The use of RFID technology and other components such as an LCD display, servo motor, key pad, IR sensor, and RFID sensor provides a secure and effective means of processing toll payments. The system is also able to detect unauthorized vehicles or tailgaters, ensuring the security of the toll booth. If any vehicles breaks through the tollgate, a second tollgate approaches. This project demonstrates the potential of automated toll tax collection systems in improving transportation infrastructure and making toll collection more efficient and convenient. Overall, the system offers a practical solution for toll collection that can be implemented in various locations, contributing to improved traffic flow and generating revenue for the maintenance and development of transportation infrastructure.

4.1 FUTURE SCOPE OF THE PROJECT

• **Automatic Vehicle Identification:** The automatic vehicle identification (AVI) component of this system refers to the technologies that determine the identification or ownership of the vehicle so that the toll will be charged to the corresponding customer.

• **Automatic Vehicle Classification:** Vehicle type and class may have differentiated toll amount. The vehicle type may include light vehicles like the passenger car or heavy vehicles like recreational vehicles. A vehicle's class can be determined by the physical attributes of the vehicle, the number of occupants in the vehicle, the number of axles in the vehicles and the purpose for which the vehicle is being used at the time of classification

• **Video Enforcement System:** When used for electronic toll collection, the video enforcement system (VES) captures images of the license plates of vehicles that pass through an electronic tollbooth without a valid electronic tag.

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