

Automation of Tollgate and Vehicle Tracking System

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Abstract: Automation of Toll Gate and Vehicle Tracking System is designed to automatically keep track of the vehicle's movement, record the time and the details like Owner's name, contact details, vehicle registration number, vehicle model etc. A computerized system automatically identifies an approaching vehicle and records the vehicle details. RFID-based automation of Toll gate and vehicle tracking system is designed to automatically process the toll gate system without any manual power. This system is very useful for automatic bomb detection, vehicle monitoring, time management and also for automation of payment system. In this paper, we propose an automatic system of toll gate for monitoring and controlling the entry of vehicle. This RFID-based system automatically records time and the details of vehicle's entry time, owner's name, mobile number and vehicle model etc. A passive RFID tag is used to have information about the vehicle registration number etc. And also read by RFID reader which is located at computerized system. An IR communication is proposed to count the number of vehicles which enters the toll gate. In this system, a computerized system automatically checks the details like vehicle owner's name, vehicle registration number and mobile number etc. If the vehicle belongs to the authorized person/group it automatically opens the Toll gate. A proximity sensor is used to detect the presence of weapons in the vehicle without any physical contact with the object. A pre-determined amount will be automatically deducted from vehicle owner's account and it will be shortly intimated to the user by short message service. This automation of Toll gate and vehicle tracking system is proposed to increase the traffic control in a very efficient and effective manner.

Keywords: GSM, IR sensor, Proximity sensors, RFID, Tollgate.

1. Introduction

Automation of Toll Gate and Vehicle tracking System is used to solve the problem raised by increase in the number of vehicles on- road and due to the task of traffic management at Toll Gate becomes more complex. It is hard to keep & maintain the details of the each vehicle, which is running on the road. Also in case of hit –and-run or carrying of illegal goods over inter-state cross border or road-robbery cases, the police may not trace the culprits very easily, as the vehicle details are not monitored continuously. This paper describes about the Automation of Toll Gate and Vehicle Tracking System using the Infrared (IR) Transmitter and Receiver, RFID module, Microcontroller, GSM module, Proximity Sensor, LCD Display and PC interface. In this system, Radio Frequency Identification (RFID) is evolving as a major technology enabler for identifying and tracking goods and assets around the world. It is intended to help the RTO, Police Department, Public Transport and Cargo Companies to track the vehicles. The system comprises of Toll Gate office having a personal computer connected with the IR receiver, RFID reader and the software to run the "Automation of Toll Gate and vehicle tracking" system. All this is possible by the use of automated toll gate system for which every vehicle must be fitted with a RFID Tag, hidden behind the number plate of the vehicle. The IR transmitter and receiver is used to count the number of vehicles entering the Toll Gate. RFID Tag with vehicle's detail is continuously sensed by the RFID reader. When a vehicle enters the zone of toll gate office, the IR transmitter and receiver fitted on either side of the road, sense and send the signal to the toll office control unit. This Microcontroller based control unit activates the number plate sensor, which in results receives the number of the entering vehicle [capturing the signal sent by vehicle's remote IR transmitter and receiver] and sends it to computer. The centralized database in the system is scanned and displays the details of

that vehicle with the current time and date. The details can be registration number, owner's name, vehicle type and user's mobile number etc. If the vehicle records show that its current status is clear, then the gate will be opened automatically. Otherwise, the gate will not open and the vehicle owner can be called for further enquiry. This system can be used at the regional Transport Office to watch the unregistered vehicles or trace the other state vehicles and also for public transports to keep the details of each vehicle's check-in and check-out times with number of round trips it makes in a day. This system is a step towards improving the tracking and monitoring vehicles.

2. Proposed System

The Block Diagram shown in Fig 1 consist of ATMEGA 162 microcontroller, LCD, RFID module, Gate model GSM Modem and various sensors such as IR and Proximity sensor.

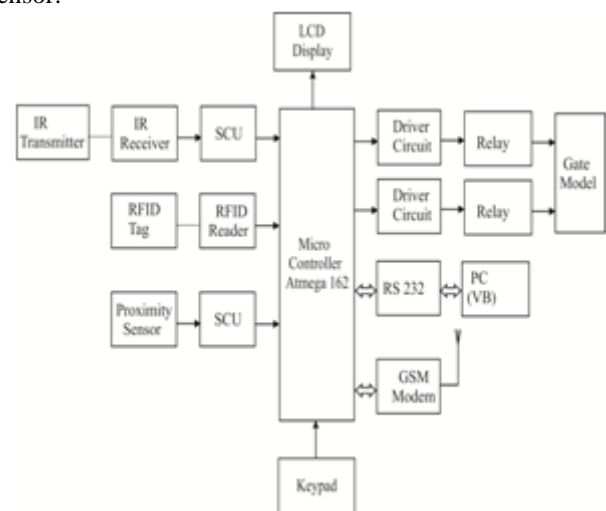


Figure 1: Block Diagram

A. RFID Module

Transponder

The Transponder or tag is fixed on to the baggage to be tracked in the airport. When this tag comes within the range of the reader or integrator, the tag is energized. Now, this tag transmits the data to the reader. This data is automatically sent to the micro-controller for further processing. The time at which the tag is sensed is sent to the micro-controller from the RTC (Real Time Clock). These details are displayed on LCD (Liquid Crystal Display). The same is sent to the EEPROM (Electrically Erasable and Programmable Read Only Memory), which is used as a backup. It can be stored, and retrieved.

Passive Tag and Reader

Passive tags are those energized by the reader itself, they contain no power source, typically have very long lifetimes (near indefinite) a drawback over active tags is the read range, typically 2cm (1in) to 1.5m (4.5 ft), a strong positive is individual tag cost. RFID Passive tag is composed of an integrated electronic chip and an antenna coil that includes basic modulation circuitry and non-volatile memory. In most cases the amount of data storage on a passive tag is fairly limited - capacity often being measured in bits as opposed to bytes. Most tags carry an unalterable unique electronic serial number, which makes RFID tags potentially very useful in applications where item tracking is needed or where security aspects are important.

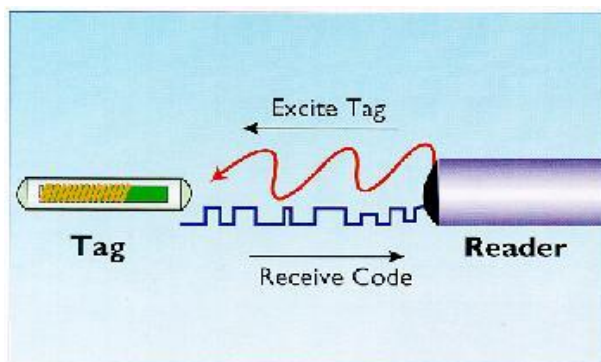


Figure 2: Interaction between tag and reader

The reader powers the tag (transponder), by emitting a radio frequency wave. The tag then responds by modulating the energizing field. This modulation can be decoded to yield the tags unique code, inherent in the tag. The resultant data can be passed to a computer for processing. Tags have various salient features apart from their physical size. Other available features are Read Only, Read Write, Anti-Collision.

B. Proximity Sensor

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

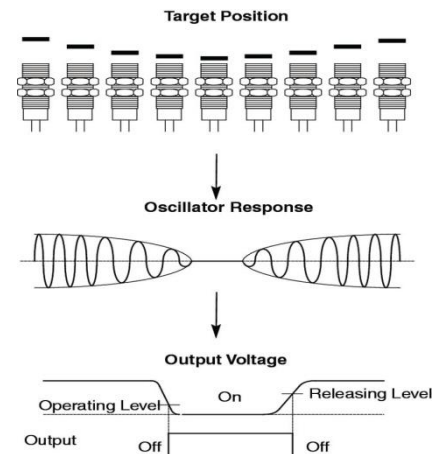


Figure 3: Response of Proximity Sensor

Inductive proximity sensors are designed to operate by generating an electromagnetic field and detecting the eddy current losses generated when ferrous and nonferrous metal target objects enter the field. The sensor consists of a coil on a ferrite core, an oscillator, a trigger-signal level detector and an output circuit. As a metal object advances into the field, eddy currents are induced in the target. The result is a loss of energy and smaller amplitude of oscillation. The detector circuit then recognizes a specific change in amplitude and generates a signal which will turn the solid-state output "ON" or "OFF". A metal target approaching an inductive proximity sensor (above) absorbs energy generated by the oscillator. When the target is in close range, the energy drain stops the oscillator and changes the output state.

C. RS232

In telecommunications, RS-232 is a standard for serial binary data interconnection between a DTE (Data terminal equipment) and a DCE (Data Circuit-terminating Equipment). In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA 232 voltage levels from a single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver converts TTL/CMOS input levels into EIA-232 levels. In this circuit the microcontroller transmitter pin is connected in the MAX232 T2IN pin which converts input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to reviver pin of 9 pin D type serial connector which is directly connected to PC. In PC the transmitting data is given to R2IN of MAX232 through transmitting pin of 9 pin D type connector which converts the RS232 level to 5v TTL/CMOS level. The R2OUT pin is connected to receiver pin of the microcontroller. Likewise the data is transmitted and received between the microcontroller and PC or other device vice versa.

D. DC GEARED MOTOR

The DC motor works over a fair range of voltage. The higher the input voltage more is the RPM (rotations per minute) of the motor. For example, if the motor works in the range of 6-12V, it will have the least RPM at 6V and maximum at 12 V. In terms of voltage, we can put the equation as:

$$\text{RPM} = K1 * V, \text{ where,}$$

$K1$ = induced voltage constant
 V = voltage applied

The working of the gears is very interesting to know. It can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more RPM than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio. When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it. In any DC motor, RPM and torque are inversely proportional. Hence the gear having more torque will provide a lesser RPM and converse. In a geared DC motor, the concept of pulse width modulation is applied.

E. Subscriber Identity Module (SIM)

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM card. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them; this practice is known as SIM locking. The total symbol rate for GSM at 1 bit per symbol in GMSK produces 270.833 K symbols/second. The gross transmission rate of the time slot is 22.8 Kbps. GSM is a digital system with an over-the-air bit rate of 270 kbps. The uplink frequency range specified for GSM is 933 - 960 MHz (basic 900 MHz band only). The downlink frequency band 890 - 915 MHz (basic 900 MHz band only).

3. Results & Analysis

Our proposed model is scalable and efficient. We demonstrated the usefulness of this model in processing tracking and tracing queries. Extensive experimental results showed the viability, efficiency, and scalability of our proposed techniques.

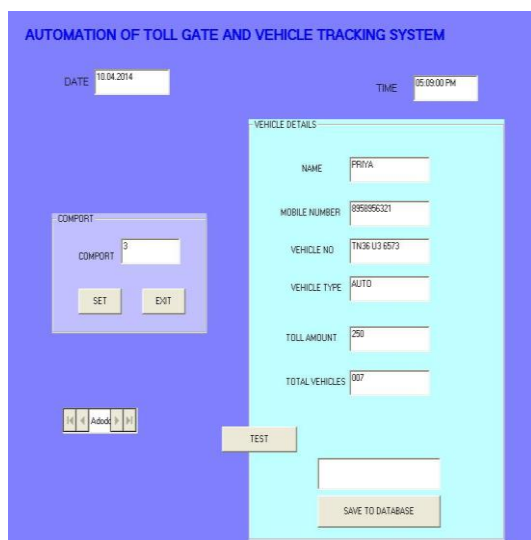


Figure 4: Output Window

A computerized system automatically identifies an approaching vehicle and records the vehicle number and time. If the vehicle belongs to the authorized person/group, it automatically the toll gate and a predetermined amount is automatically deducted from the user's account. Here, a proximity sensor is used to detect the explosive metals in the vehicles. If the system detects the bomb inside the vehicle then the toll gate will not be opened. That particular unauthorized person who carried the illegal goods will be called for enquiry by concern authority. Also there are many benefits by Automation of Toll Gate and Vehicle Tracking System. The average service time with E- pass is 10 seconds compared to 30 seconds for manual collection. This translates to reduced traffic congestion at toll gates, lower fuel consumption, less air pollution, and therefore less economic losses.



Figure 5: Snap shot of the project

4. Conclusion

The progress in science & technology is a non-stop process. The proposed system based on Atmel microcontroller is found to be more compact, user friendly and less complex, which can readily be used in order to perform several tedious and repetitive tasks. Though it is designed keeping in mind about the need for industry, it can extended for other purposes such as commercial & research applications. Due to the probability of high technology (Atmel microcontroller) used in this system performs various applications like Traffic Management Process, Vehicle Movement Tracking, Bomb Detection and Stolen Vehicle Detection could be implemented. The feature makes this system as a base for future systems. This can be extended to handle more number of vehicles, as the number of registered users may increase. Sophisticated setup can be built where in two or more vehicles can enter a toll gate at a time and still the system recognizes the valid users and differentiates the vehicles which are entering the toll gate. The ID of the vehicle can be made more sophisticated to increase the security and reducing the risk of tampering.

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