

Smart Traffic Monitoring

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Abstract: The main objective of the project is to detect the traffic rule violator on road by means of RFID reader, RFID scanner and RFID tag technology. Traffic control is a big problem in the metropolitan area. One of the major challenges in traffic control is to give way to emergency vehicles such as the ambulance or fire engines. Smart traffic monitoring includes priority control such as letting emergency vehicle to pass the traffic signal when the corresponding signal is red by making it to green. Features of this project include automatic sending of SMS to traffic officers and vehicle owners when a vehicle violates the signal. Electromechanical locking can be also being enabled to maximize control over vehicle. 'C' is used as the programming language for microcontroller. 'Compiler C' is used for this. By using this software, the C level diagrams are programmed to control the traffic light based on the flow chart.

In order to avoid traffic problems, Smart Traffic Analytical module is used and it provides Traffic Incident Detection, and real time Traffic Flow Metrics & statistical analysis. Smart Traffic Monitoring can integrate with third party traffic management and smart roadway systems and hosts a feature rich product scope itself. The system can be used for incident detection or for statistical metrics of a roadway, and control the misuse and theft. In future this module can also be used to track the vehicles that had been lost and also to track the unauthorized vehicles. The vehicles which are parked in the No parking zone can also be locked using this module rather than towing the vehicles which can cause damage.

Keywords: Traffic, RFID Technology, Signals, GSM module.

1. Introduction

India is the second most populous country in the world. Because of more population, the growth in the number of vehicles is increasing day by day. But the infrastructure growth is slow due to space and cost constraints. As a result, India is facing terrible road congestion problems. Also, Indian traffic is non-lane based and chaotic. The main issue related to the increase in traffic is accidents. The major reasons for this problem are increase in the number of vehicles, violation in the traffic rules, etc. Smart traffic management is a system where centrally-controlled traffic signals and sensors regulate the flow of traffic through the city in response to demand. It will also provide a perfect opportunity to install monitoring equipment to collect much more detailed traffic and journey data than we have now. In the recent times, the problems are common due to

traffic violence in city areas especially in metropolitan cities. This is a common scenario in main roads. It is extremely tough to control traffic violence in proper time. So, it is possible to use smart traffic violence control system to control the traffic. As there is no sound system which correctly detects all vehicles that jumps red light at traffic signals in India, traffic police force is used for the purpose but as a matter of fact they have not been much effective. Other than this, the problem is of corruption and bribery by traffic police which allows vehicle drivers to break law. In order to avoid traffic problems, Smart Traffic Monitoring module can be used and it provides Traffic Incident Detection, and real time Traffic Flow Metrics & statistical analysis. Smart Traffic Monitoring can integrate with third party traffic management and smart roadway systems and hosts a feature rich product scope itself. The system can be used for incident detection or for statistical metrics of a roadway, and control the misuse and theft. In this context, the basic challenge lies in usage of real time analytics on online traffic information and currently applying it to some basic traffic flow.

Traffic Control and Management System is important nowadays so as to have a safer and much reliable system. However, the existing system needs manual monitoring of traffic rule violation and proposed system includes tracing vehicles automatically without manual help. It is done with the help of active RFID tag and reader. RFID tag is also called as transponders receive a radio signal and in turn response to it by producing a radio signal. The project will include deploying RFID tags on the vehicle and RFID readers at the signal. The RFID reader will be responsible of detecting the vehicle violating traffic rules. The RFID tag will have a unique ID. Here the tag stores the information about vehicle license number, RFID reader reads the vehicle number and send to RTO unit with the help of GSM. If the vehicle crosses the red signal, then the message will be sent to the vehicle owner and RTO. Manual locking is provided to the RTO to lock the fuel flow of the vehicle when the traffic rules are violated. Once the penalty is paid, the vehicle will be unlocked manually. The proposed traffic control system will also use RFID technology to detect emergency vehicle and control the traffic lights accordingly. Due to this whole process there will be reduction in the workload of traffic police and also reduction in accidents.

This project will reduce the traffic problems and minimize the traffic rules violation on road. It makes fine collection easy. It maintains the transparency between people and government authority due to which there will be reduction in corruption.

2. Problem Formulation

- In the recent times traffic controlling has been a bigger issue as the number of traffic rules violations has increased such as traffic signal jumping, over speeding and vehicle parking in “No parking” zone.
- Accidents may happen due to these traffic rules violations.
- Corruption and bribery by traffic police.
- Emergency vehicles such as ambulance and fire engines may get blocked at traffic signals.

3. Objectives

- To propose a smart traffic management system and to manage all traffic situations more accurately.
- To avoid vehicles from signal jumping and hence to reduce accidents.
- To prevent corruption between the police and the citizens.
- To give priority to the emergency vehicles to pass through the traffic signal.

4. Proposed Methodology and Implementation

A. Hardware Description

Hardware components used

- Arduino Mega 2560
- RFID Tag and RFID reader
- RF module
- IR module
- GSM module
- ESP8266
- 9V Battery

B. Traffic junction unit

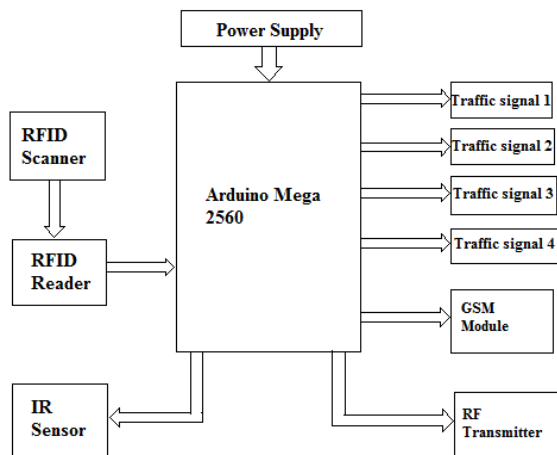


Fig. 1. Block diagram of traffic junction unit

The traffic unit consists of an Arduino Mega 2560, Traffic signal lights, GSM Module, RF Transmitter, IR sensor and RFID reader. Arduino Mega acts as a microcontroller. The traffic lights are connected to the microcontroller. RFID reader and IR sensor are placed at each traffic signal lane. Road markings should be done so that the RFID reader could detect the vehicle which violates the traffic signal correctly. GSM module is used to send the message to the RTO and the particular vehicle owner about the rule violation. RF transmitter sends the signal to the RF receiver of the corresponding vehicle.

C. Vehicle unit

The vehicle unit consists of RF receiver, buzzer and locking system. The RF receiver receives the signal sent from the RF transmitter and makes the buzzer to activate. The signal will also be sent to the vehicle locking system to lock the vehicle.

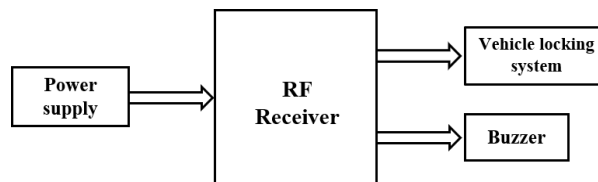


Fig. 2. Block diagram of vehicle unit

D. Vehicle locking system

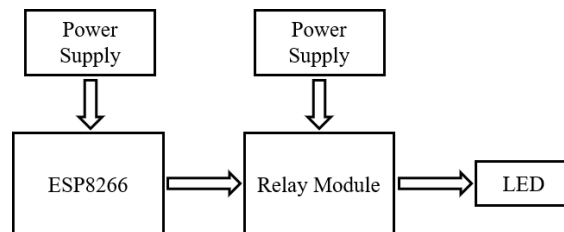


Fig. 3. Block diagram of the Vehicle Locking System

The vehicle locking system in this prototype consists of an ESP8266, Relay module and LED. The locking system of the vehicle is controlled by the RTO unit. ESP8633 is programmed to lock the vehicle whenever the signal is received from the RTO unit. The LED lamps are used to represent whether the vehicle is locked or not. Once the penalty is paid by the vehicle owner the RTO unit could unlock the vehicle.

E. Implementation and Working

An embedded system is a computer system a combination of a computer processor, computer memory, and input/output peripheral devices that has a dedicated function within a larger mechanical or electrical system.

The block diagrams give a brief implementation and construction of the project. It requires small investment as we know the traffic signal lights has already implied with embedded timer for smooth flow of traffic light signal. The RFID scanner and indicator lamps are connected to microcontroller. The microcontroller controls every signal which is coming from the scanners through software and display required action through indicator lamps. The RFID

reader, RF transmitter and the IR sensor are installed at every traffic signal lane. The RFID reader is activated only when the corresponding traffic signal is red. The RFID passive tags will be attached to each and every vehicle including the emergency vehicles. The RFID scanner will be placed behind at some distance which will detect only the emergency vehicles. Whenever the emergency vehicle is detected, the corresponding traffic signal will be turned to green giving priority to the emergency vehicle to pass through the signal without any traffic jam. When the normal vehicle jumps the traffic signal, the RFID reader detects the vehicle and reads the RFID tag in the vehicle which will consist of the vehicle details such as vehicle license number. The vehicle details are then sent to the RTO unit and vehicle unit using the RF transmitter. The vehicle unit consists of a RF receiver, buzzer and locking system. When the signal is sent from transmitter, the RF receiver receives the signal and sends the same to the buzzer in the vehicle which will give an alarm to the vehicle user about the traffic rule violation. This project also includes of automatic sending of SMS to RTO unit when a vehicle violates signal and enabling him to inform same to the vehicle owner. A signal will also be sent to the RTO unit which will allow them to lock the traffic rule violated vehicle manually. Once the penalty is paid, the vehicle could be unlocked manually.

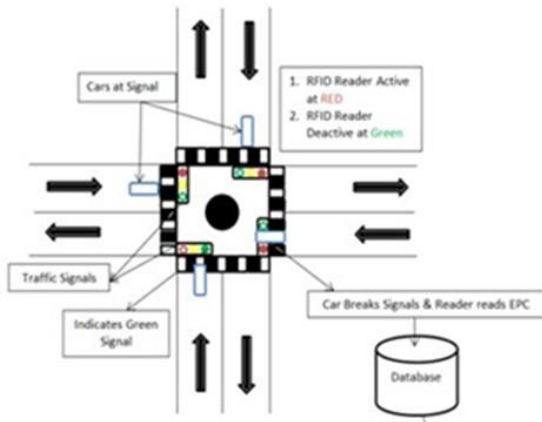


Fig. 4. Implementation

F. Flow chart

The figure 5 shows the flowchart of the system.

- Start the process.
- The RFID reader detects the vehicle.
- If it is an emergency vehicle, the IR sensor scans the vehicle and turns the particular traffic signal to green.
- If it is a normal vehicle, the IR sensor scans the vehicle and check if that traffic signal is red.
- If the signal is green then there is no traffic rule violation.
- If the signal is red, the vehicle has violated the traffic rule and the rule violation SMS is sent to the vehicle owner.
- The locking system of the corresponding vehicle locks the vehicle.

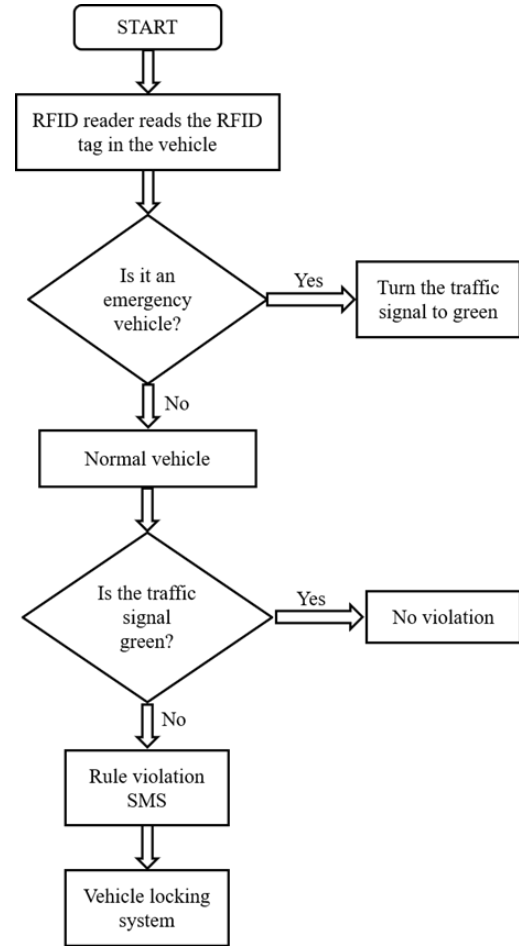


Fig. 5. Flowchart of the system

G. Software Description

The Arduino Integrated Development Environment (IDE) is a cross platform application used for Windows, IOS, Linux that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores and other vendor development boards. The source code for the IDE is released under the GNU General Public License. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards. The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area,

a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

5. Results and Discussion



Fig. 6. System design of the traffic unit

The traffic unit comprises of both traffic junction unit and the RTO unit.

The Fig. 6 shows the hardware design of the traffic unit. It consists of Arduino mega 2560, RFID reader, GSM module, RF transmitter and LEDs. The Green and Red LEDs are running alternatively. If the signal is Green, the vehicle will pass the stop lines freely without any alert. But if the signal is Red, an alarm is generated in the vehicle. Using GSM module, an alert message will also be sent to the RTO unit and the vehicle owner informing about the rule violation.

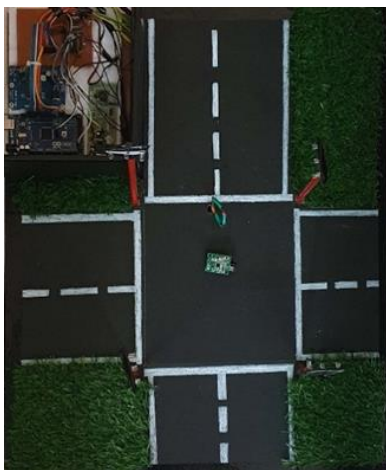


Fig. 7. Traffic junction setup

The fig. 7 shows the traffic junction setup of the model. The RFID technology is implemented only for one traffic lane. The RFID scanner and the IR sensor is placed just in front of the stop line to detect the vehicles which violates the traffic signal.

The fig. 8 shows the Hardware design of the vehicle. It consists of a RF receiver to receive the signal about the traffic signal violated vehicle from the RF transmitter in the traffic unit. An Alarm is fixed in the vehicle, which generates an alarm whenever the vehicle violates the traffic signal. The locking system is installed for a vehicle which will lock the vehicle

whenever the signal is received by the RF receiver.

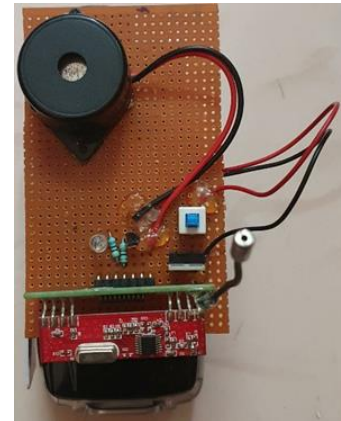


Fig. 8. Vehicle unit

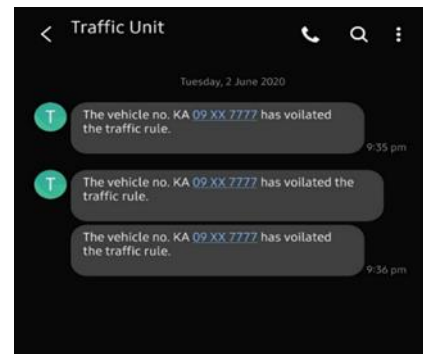


Fig. 9. Alert message

The fig. 9 shows the rule violation alert message which will be sent to the RTO unit and the vehicle owner when the traffic signal is violated.

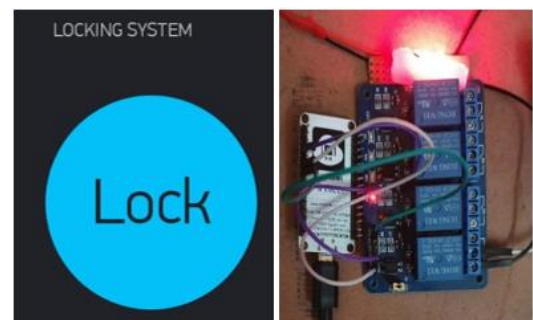


Fig. 10. Vehicle locking

When the message is sent, the RTO unit is capable to lock the vehicle. In this prototype an external application call “Blynk” is used for locking and unlocking of the vehicle. The vehicle status is represented by LED lamps. When the LED is on the vehicle is locked. The RTO unit could lock the particular vehicle which violates the traffic rule as shown in the fig. 10.

Once the penalty is paid by the vehicle owner, the vehicle could be unlocked manually by the RTO unit as shown in the fig. 11.

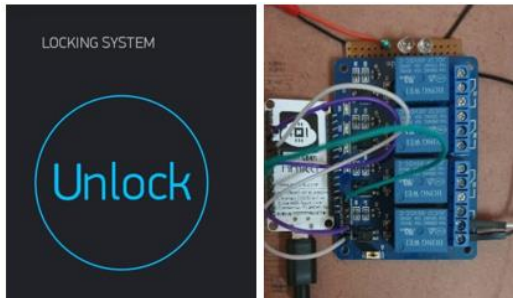


Fig. 11. Vehicle unlocking



Fig. 12. Overall proposed system

The Fig 12 shows the overall proposed system. It consists of two sections; traffic unit and a vehicle unit. When the signal is red, the RFID scanner fixed in the stop line reads the RFID tag at the vehicle and then generates an alarm in the vehicle.

6. Conclusion

A new RFID-based architecture for traffic monitoring and violation detection is presented. The proposed architecture was

compared to the existing technologies and the challenges were discussed. The accuracy of the RFID is more than cameras. So, the proposed system also improves the performance of traffic light violation detection system. This system is cost effective. This system will also reduce accidents which often happen at the traffic signal intersections because other vehicles have to huddle to give way to the Emergency services. The proposed system is new and many improvements can be done on the system to decrease the costs and ease the use.

7. Future Scope

From the hardware point of view, it can be complemented with many existing and novel technologies. On the other hand, from the software point of view, other traffic violation detection algorithms can replace the current algorithms. These algorithms may improve the proposed algorithms or monitor the other traffic violations not covered in this model.

Possible additions to the proposed system are:

- Implementing more traffic violation algorithms.
- Improving proposed basic algorithms with faster algorithms.
- Using Wireless Sensor Networks with the proposed architecture.
- Implementing adaptive algorithms capable of changing parameters with the instantaneous traffic density.
- Adding other applications to the system such as automated locking and unlocking system, etc.

Since the proposed system tries to read all vehicles travelling in the road, another equally important potential application is finding the location of a vehicle. This feature can be used for finding stolen vehicles. Using a RFID scanner gun, the vehicle parked in 'no parking' zone can also be locked.

References

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