CHAPTER 1

INTRODUCTION

1.1. Introduction

Today a car is an essential part of our life. In the 21st century, a car is waiting for changes because it must be not only a conveyance but an assistant on the road. However, 1214 road crashes occur every day in India [8]. More than half of all road traffic deaths occur among young adults ages 15-44 [7]. A large number of accidents occurred due to carelessness of drivers and traffic violations. One of the best measure to reduce accidents on the roads can be done with the development of systems that provide alert to the driver while moving. To solve this problem, we plan to develop an automated system that would allow to detect traffic signs along the way, in advance informing the driver about changes in driving conditions without detracting from driving. Thus the driver will not be distracted from driving when special vigilance is required. Also, including an effective and real-time ticketing system for violation of any traffic rules will save the efforts of traffic officials to monitor every route and also curb corruption among such officials.

The aim of this project is to develop a method for traffic signs detection for vehicles that reduces the number of accidents while driving and automatic generation of traffic violation fines.

1.2 Road Sign Problems

Road traffic constitutes a major part in the problems of society. As the road traffic is increasing day by day with increase in population, there is a need of following the traffic rules with proper discipline. Traffic rules consists of traffic sign boards and traffic signals which are meant to be followed by everyone on the road. However, there are lot of issues associated with it which includes the following:

1.2.1 Sign Boards

Traffic Signs are Silent Alarms which inform the driver about the oncoming situations around the route, warn or guide drivers and ensure proper functioning of road traffic. A driver takes the necessary action while driving based on the road sign encountered in his/her journey. Any person who wants to acquire a drivers license in India needs to be familiar with the road signs and symbols. Road signs are categorized into three

types: Mandatory signs, Cautionary signs and Informatory signs[10].

- Mandatory Signs

  These signs are used to ensure free movement of traffic and make the road users cognizant to certain laws and regulations, restrictions and prohibitions. Violation of these signs is an offence as per law.

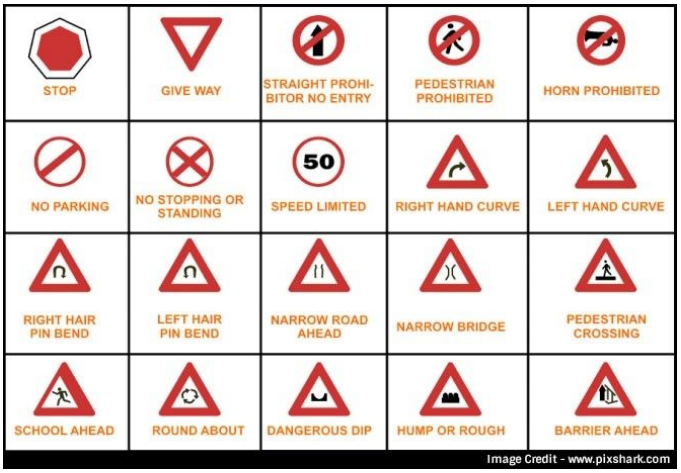

Figure 1. Mandatory signs[10]

- Cautionary Signs

  These signs make the road users conscious of hazardous conditions on the road beforehand. The drivers, accordingly, take necessary actions to handle the situation.

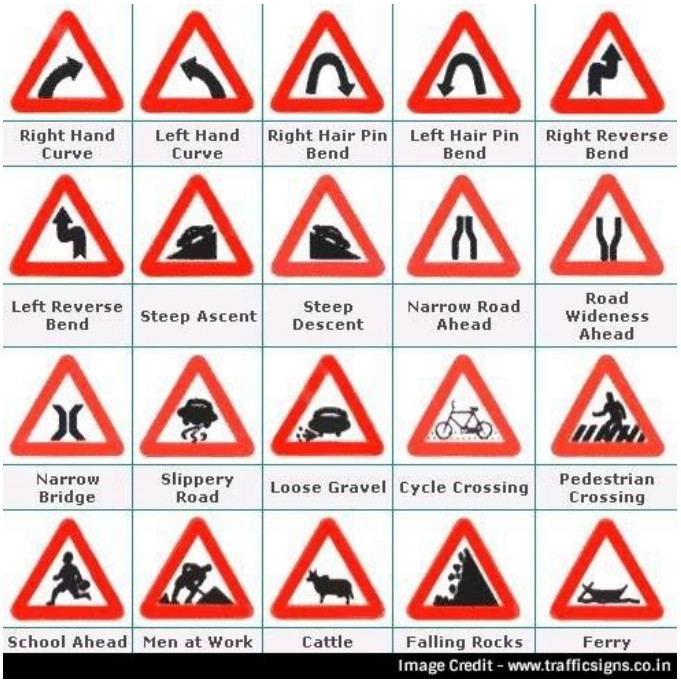

Figure 2. Cautionary signs[10]

- Informatory Signs

  These signs guide the road users about destinations, distance, alternative routes and prominent locations, food joints, public toilets, nearby hospitals, etc.

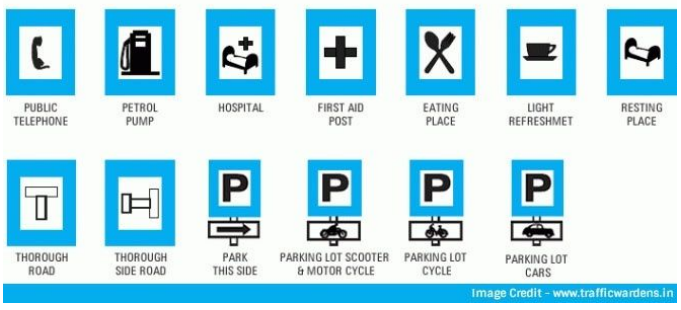

Figure 3. Informatory signs[10]

However, it has been observed that a less experienced driver often gets confused among these symbols and may interpret incorrect information leading to accidents and mishaps.

Few of the examples include "No Motor Vehicles Allowed" which people misinterpret considering it as a sign that means only cars and motor vehicles are

allowed on that road and "Give Way" sign which people misinterpret as sign to slow down or even to roll down one's windows to listen for oncoming traffic.

Figure 4. Confusing signs [11]

Another problem with road signs is their visibility to drivers. During night or any other weather conditions like fog, heavy rains,etc that can hinder visibility on road, road signs prove to be failure to inform the driver about the current situations on road and further lead to road disasters. Furthermore, such signs can be damaged or vandalised.

Figure 5. Vandalised road signs[12]

1.2.2 Traffic Violation Ticketing Of Offenders

Drivers in some cases try to avoid following the traffic signs and rules. In such situations, traffic officials are responsible for monitoring and regulating the traffic as well as keeping in check of such traffic offenders.

But the presence of such officials at every route of a city or a region is quite impossible thus avoiding violation ticket. Thus both the breaking of traffic laws and corruption increases in the region.

Figure 6. Offenders escape law due to corruption

Therefore, there needs to be a solution which can eliminate both the problems mentioned and allow smooth and efficient working of traffic laws and regulations on road.

1.3 Solution using IOT

Presently there are no systems present and accepted among consensus for traffic sign board detection and strapping fines on drivers for traffic violations. Most of the proposed systems highly rely on traffic sign boards constructed on routes which could be a problem as discussed before.

The system proposed by this paper makes use of IOT to handle both the problems of detection of sign boards and issuing of tickets to traffic offenders. Further, this can eliminate the dependency on Road signs for describing traffic situations on road. Our system makes use of RFID technology which consists of RFID tags and Reader to uniquely identify and detect different sign boards. Similarly they can be used to alert the drivers about the incoming traffic situation and book the offenders by processing the data from Rfid tags with help of any processing element like Arduino.

CHAPTER 2

LITERATURE REVIEW

2. Literature Review

A literature review is the effective evaluation of selected documents on a research topic. It is a form of an essential part of the research process and constitutes a research project in itself. In the context of a research paper and thesis, the literature review is a critical synthesis of previous research.

2.1 FPGA based traffic sign detection for Automotive camera systems by Fynn Schwiegelshohn and Lars Gierke

In this paper, we introduce a camera based image processing system for traffic sign detection for Full HD resolution. This system is able to detect speed limit traffic signs but additional traffic signs can be implemented using the same model. The hardware components consist of a Microblaze softcore from Xilinx and an extended IP core for HDMI-in and out signals. The system is implemented on a a Spartan-6-FPGA. For image acquisition, an off-the-shelf car camera is used. The developed system is able to reliably detect traffic signs on short distances on static images as well as on image streams.

Pros:

The complete system was designed and implemented on a Spartan-6-FPGA with the requirement to be able to process Full HD video streams. A great advantage of a FPGA compared to a general purpose processor is the focus and optimization on one task. This enables the reduction of memory accesses when converting an image from one color space to another since these conversion can be performed on the data stream. Additionally, FPGAs, especially the Spartan6 since it is approved for the automotive domain, provide a low cost solution for designing and implementing future ADAS which is very important in the automotive domain.

Cons:

The programming of FPGA requires knowledge of VHDL/Verilog programming languages as well as digital system fundamentals. The programming is not as simple as C programming used in processor based hardware. Moreover engineers need to learn use of simulation tools.

- The power consumption is more and programmers do not have any control on power optimization in FPGA. No such issues in ASIC.
- Once any particular FPGA is selected and used in the design, programmers need to make use of resources available on the FPGA IC. This will limit the design size and features. TO avoid such situation, appropriate FPGA need to be chosen at the beginning itself.
- FPGAs are better for prototyping and low quantity production. When the quantity of FPGAs to be manufactured increases, cost per product also increase.

2.2 Road sign detection and recognition System for real time embedded system by Siti Sarah, Mohd Sallah and Fawnizu Azmadi

Most of accidents are attributed to either reduced attention of drivers or that they simply choose to ignore the road signs. The weather condition like rain and sometimes heavy fog and dew, especially during early morning and late evening, also have been reported as being some of the causes of many accident cases. Therefore, the recognition of road signs will be a great help to reduce the number of traffic accidents and deaths. In this paper, we present a system for the detection and recognition of the road signs which consists of three phases:

1) Phase 1: Color Segmentation: The regions of the road sign colors are segmented from real images by using HSI (Hue, Saturation and Intensity) color thresholding technique for chromatic signs. In addition, achromatic color decomposition technique is used to segment white signs from images.

2) Phase 2: Shape Classification: The shapes of road signs are classified into four patterns by computing Extent value. Road signs are then classified into four categories: prohibitory, warning, informational and mandatory.

3) Phase 3: Symbol Recognition: The symbols of road signs are recognized by comparing shape measurement- Area and Perimeter ratios with the template values. The template values are based on standard images without noise.

Pros:

Most road signs can be correctly detected and recognized by the proposed method with the accuracy of 90.7% for the segmentation phase based on color extraction. On the other hand, the proposed method for classifying the shapes of road signs is extremely accurate with 98.3%. More samples need to be tested in order to get a better evaluation of the algorithm in achromatic color in the color segmentation phase by considering road signs in various situations and weather condition, i.e. cloudy, sunny and rainy. Even though this method has been designed using simple technique, but it has good performance that is proven by experimental results in term of less time processing and can be used in various weather condition, thus making it suitable for real time embedded applications.

Cons:

Although the traffic signs were designed for quick and simple understanding of human they are not so easy recognizable by a machine. Traffic signs are simple objects having simple shapes, colors and pictograms. Even from the point of recognition field they might seem easy to solve.However there are many problems which make hard to recognize traffic signs:

- Video source (video camera) recognition depends on quality of an image sensor(CMOS/CCD chips)and outputformat of an image. It can be used color or gray cameras with various resolutions, settings, compression rates etc.Issues can arise not only by settings of a camera but also if the camera is not correct fixed in a vehicle so vibration and blurring can be appeared on the video sequences. Another problem is causing by auto focus.We can therefore recommend auto focus mode switch off and focus set to infinity.
- Blurring and vibration by a moving vehicle, therefore the camera must be fixed properly.
- Weather conditions– Captured image is influenced by raining, snowing or occurrence of a fog. For example, traffic signs can be shrouded by snow or be poorly visible in a fog.
- Occlusion –any kind of objects that block face of traffic signs, for example by trees, vehicles, pedestrians, poles or any objects on the road. Another specific occlusion can becaused by shadow. Then traffic sign can change its meaning, e.g. shadow from power line on the priority road sign can be observed as the end of priority road.
- Faded color– color of traffic signs will be faded over time by the influence of the sun and condition weather.
- Damage–traffic signs can be damaged not only by sunshine, but also by vandalism or weather over time (strong breeze, storm, raining). They can be then dirty, scribbled over, tilted, rusty etc.

Thus we have seen Literature Review which is a synthesis of available research and critical evaluation. In each of the two cases, there is a heavy dependency on traffic sign boards constructed across routes by the systems. Our proposed system for traffic sign board detection not only eliminates this dependency on sign boards but also ensures real time alerts on current situations on road via voice updates to drivers.

CHAPTER 3
REQUIREMENT ANALYSIS

3. Requirement Analysis

After the extensive analysis of the problems in the system, we are familiar with the requirement that the current system needs. The system requirements are categorized into the functional and non-functional requirements. These requirements are listed below:

3.1. Functional Requirement

Functional requirement are the functions or features that must be included in any system to satisfy the business needs and must be acceptable to the users. Based on this, the functional requirements that the system must require are as follows:

- Reliability.

  Current systems employ image processing to capture the signs and provide appropriate output to the driver. However in case of weather conditions like heavy rain, fog, etc, such systems can prove to be insufficient. Also such systems become useless if the sign boards are damaged or occluded by other stationary or moving objects like SUV, Truck, etc. RFID tags are built to endure natural and incandescent light, vibration, shock, rain, dust, oil and other harsh conditions. They are normally passive in that to function, they do not require batteries and can operate 24/7 without risk of power loss.

- Safety.

  Most systems make use of visual devices to alert the drivers of any incoming traffic sign or symbol. However this in turn can prove fatal as the driver needs to monitor the visual device and in doing so might lose focus on his/her driving. Our system along with any visual device, uses a speaker in order to alert any incoming traffic sign or symbol. Thus user can respond to both voice

and visual alerts rather than just the latter thus eliminating the danger of any accidents.

- Time and Money saving.

  Its every drivers worst nightmare to be caught breaking any traffic rule and receiving heavy penalty for it. In most cases the driver has to either visit the traffic control office in order to pay the fine or bribe the traffic official with a heavy amount to get out of the situation. Our project focuses on automatically apply penalties for any traffic violation by drivers by debiting the appropriate amount from system which maintains a balance refilled by drivers time to time. This in turn saves valuable time of user, eliminates corruption and also reduces the pressure on traffic officials to monitor each and every street or road for any traffic violators.

- Simplicity.

  There are multiple traffic signs or symbols which confuse drivers thereby leading to accidents and road mishaps. Our system with the help of processing modules like Arduino and speakers, can alert our drivers and simplify the instructions in simple words thus helping them take right actions while driving..

3.2. Non-Functional Requirement

Non-functional requirement is a description of features, characteristics and attribute of the system as well as any constraints that may limit the boundaries of the proposed system. The non-functional requirements are essentially based on the performance, information, economy, control and security efficiency and services. Based on these the non-functional requirements are as follows:

- Multilingual

  Multilingual systems are the ones that can communicate with the user with more than one language. Our current system uses simple English commands to alert the drivers. This feature can be updated to support

more than one languages based on the geographical location and users preferences.

- Efficiency.

  Efficiency of any system is the ability to gain inputs, process them in time and prepare outputs in less time with accurate precision. Our current system can work on some basic signs and symbols. Further it can perform grouping of such symbols based on mandatory, cautionary and informatory signs. More signs and symbols can be updated further into the system.

- Authentication.

  Each and every driver would be accounted for his/her own traffic fines and violations. Also they must be able to keep check on the types of violations they incurred. Thus each driver will have a username and a password associated with his/her account where after login will be able to view his/her record of all violations.

CHAPTER 4
DESIGN & IMPLEMENTATION

4.1 Design

Our proposed system is demonstrated by using two different modules: A lane and a RC Car with our prototype system which will be activated by a RFID Card tag to add amount in the system and start the car. The lane is embedded with 13.56 MHz RFID Card Tags which would represent our traffic signs on the lane. The RC car module is mounted with several devices as follows:

1. Zigbee S2C module
2. L298 Motor Control Driver Board
3. Arduino Board Atmega 2560
4. LCD Keyboard Uno Shield VM37
5. RC522-13.56 MHz Smart Card Reader
6. 12V DC Geared Motors- 1000 rpm
7. 5V Amplifier

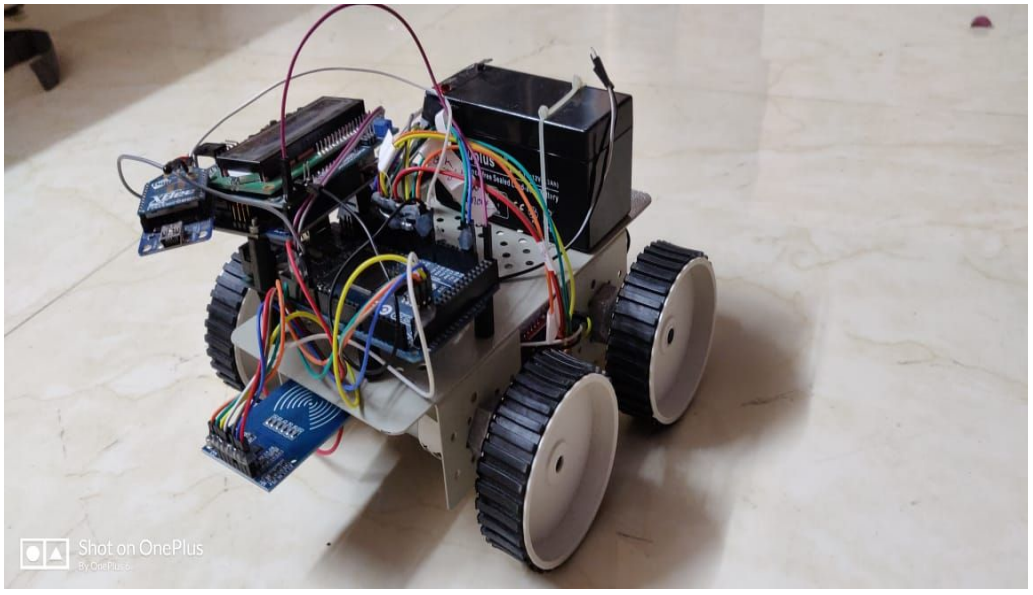

Figure 7. Prototype

Figure 8. RFID tags

Two Zigbee devices are used denoted by “Coordinator” and a “Router”. The Coordinator is connected to the laptop which will give directional instructions to the RC car while the Router receives these commands from coordinator and streams this data to Arduino which will further control the RC car. The commands are given via XCTU-a free multi-platform application installed on the laptop to instruct our car and control its speed. The 5V Amplifier and a speaker module will generate the voice alert while the LCD display mounted and integrated with Arduino Uno will generate visual data and notify the driver about the fines processed by the system for each violation detected.

In the current implementation of the prototype, two traffic signs are selected from each of the three categories of Road signs, i.e. Mandatory signs:“Speed limit”, Cautionary signs: “Work in Progress” and Informatory signs: “Hospital Ahead”. For Cautionary and Informatory signs, only alerts are provided whereas for Mandatory signs, both alerts as well as fines are added.

4.2 Implementation

There are two main objectives of the system: provide voice alerts to the driver about the traffic laws and situations and issue fines to the driver on violation of traffic rules. Initially the system will allow the car to start only after the Driver scans his

Activation RFID Card to the RFID Reader of the system. This will add the balance amount in the system which will be used to process the fines incurred in future.

The overall working of the whole system is as shown in figure 9. There will be two phases through which the system will pass through: the Warning Phase and the Final Phase. In the Warning Phase , the system will scan for any nearby Warning RFID tags which are assigned as any traffic sign or symbol.

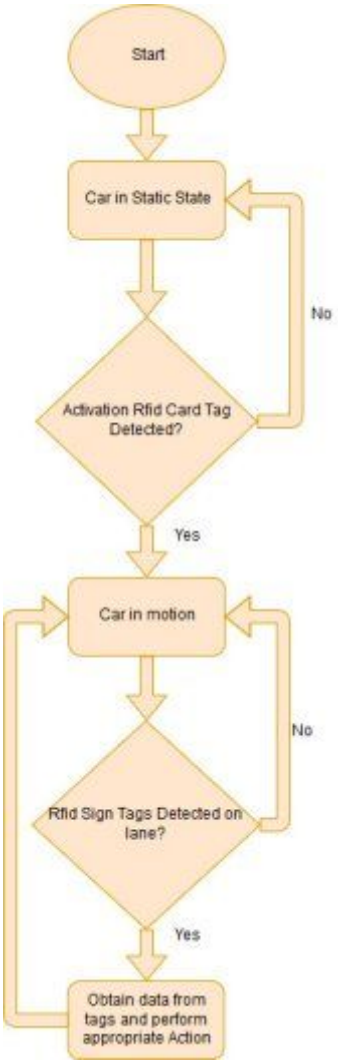

Figure 9. Overall flow

According to the flowchart shown in figure 10 , as soon as a Warning RFID tag is detected on the lane, the Reader will identify the RFID tag data and send it to the Arduino for processing. Based on the data obtained by the Reader and Arduino, a voice alert is played from the speaker notifying the driver about the traffic rule or law to be followed on the route.The Warning Phase will continue until an End RFID tag is detected by the Reader meaning that the bound of traffic law has ended on that lane.

The Final phase is the one responsible for monitoring any traffic violations on road.The figure 11 flowchart describes the flow of the Final Phase on road by the system. After a Warning tag is detected, if the driver does not change his/her course of action commanded by the system via voice alert, the Final Phase will record the violation.A final RFID Tag on lane when detected by the Reader will notify the system that the driver has violated the law and thus a fine is implemented and notified to the user via LCD display by the system. The appropriate fine amount will be deducted from the balance amount in the system.

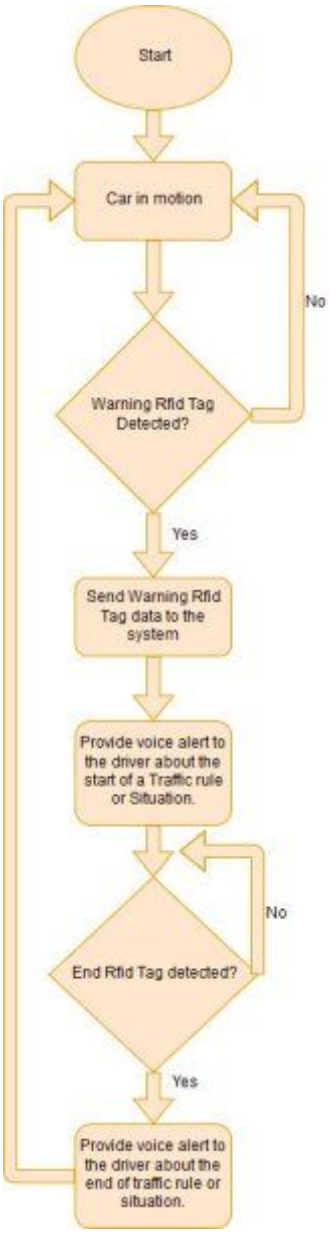

Figure 10. Warning phase

Figure 11. Final phase

CHAPTER 5
TECHNOLOGIES USED

5.1 RFID TAGS

A Radio Frequency Identification Tag (RFID tag) is an electronic tag that exchanges data with a RFID reader through radio waves. Most RFID tags are made up of at least two main parts. The first is an an antenna, which receives radio frequency (RF) waves. The second is an integrated circuit (IC), which is used for processing and storing data, as well as modulating and demodulating the radio waves received/sent by the antenna. A RFID tag is also known as a RFID chip.

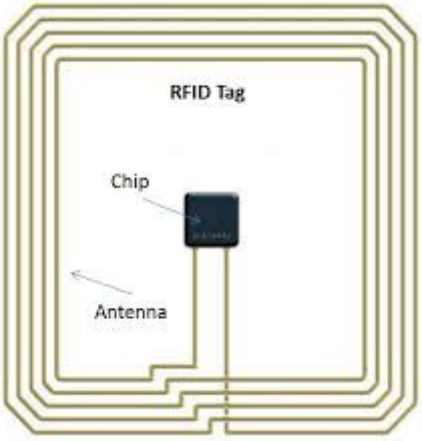

Figure 12. RFID chip

Although RFID tags have similar applications to barcodes, they are far more advanced. For instance, reading information from a RFID tag does not require line-of-sight and can be performed over a distance of a few meters. This also means that a single tag can serve multiple readers at a time, compared to only one for a bar code tag. In the context of RFID technology, the term “tag” also includes labels and cards. The kind of tag depends on the body or object to which the tag is attached. RFID systems can operate in either Ultra High Frequency (UHF), High Frequency (HF) or Low Frequency (LF). Thus, tags also can vary in terms of the frequencies on which they operate. These tags can be attached to almost any object. Although the usual target objects are apparel, baggages, containers, construction materials, laundry and bottles, they also may be attached to animals, humans and vehicles. Some RFID tags are designed for rugged, outdoor-based applications.

These are built to endure natural and incandescent light, vibration, shock, rain, dust, oil and other harsh conditions. They are normally passive in that to function, they do not require batteries and can operate 24/7 without risk of power loss. Such heavy-duty tags are usually attached to trucks, cargo containers and light rail cars for cargo tracking, fleet management, vehicle tracking, vehicle identification and supply container tracking, among others.

5.2 RFID READER

A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader. RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, in order to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items. RFID tags have not replaced bar codes because of their cost and the need to individually identify every item.

Figure 13. RFID reader

RFID technology may be used in a variety of applications including:

- Passports
- Smart cards
- Airplane luggage
- Toll booth passes
- Home appliances
- Merchandise tags
- Animal and pet tags
- Automobile key-and-lock
- Monitoring heart patients
- Pallet tracking for inventory
- Telephone and computer networks
- Operation of spacecraft and satellites

5.3 ARDUINO ATMEGA 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560(datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs),16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button[16]. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable orpower it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

Figure 14. Arduino Atmega 2560

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

5.4 XBEE S2C MODULE

XBee S2C is a RF module designed for wireless communication or data exchange and it works on ZigBee mesh communication protocols that sit on top of IEEE 802.15.4 PHY[13]. The module provides wireless connectivity to end-point devices in any ZigBee mesh networks including devices from other vendors. Please note that XBee is a module designed by ‘DiGi’ and ZigBee is the name of the protocol followed by XBee modules for establishing wireless communication. With a few of these modules the user can set up their own ZigBee network up-and-running in a matter of minutes.The XBee RF Module is compatible with other units that use ZigBee technology. These include other XBee modules, Connect PortS gateways, XBee and XBee-PRO Adapters, XBee Sensors and other products that are designated with “ZB” product name.

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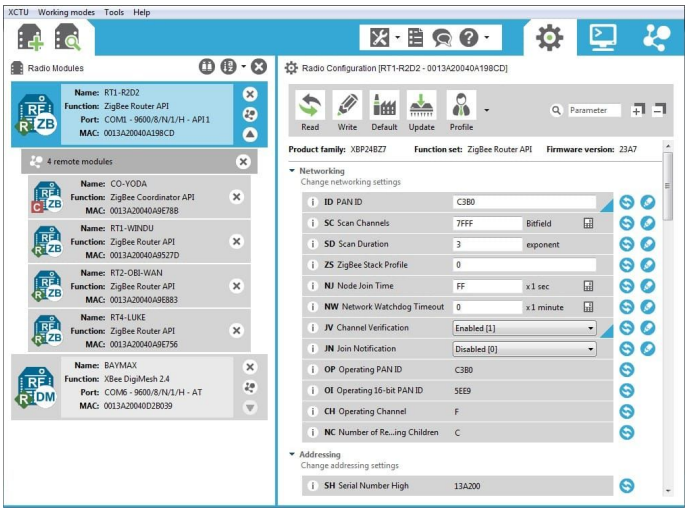

Figure 15. XBee S2C module[14]

Figure 16. XCTU Application[15]

XCTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple-to-use graphical interface. It includes new tools that make it easy to set-up, configure and test XBee® RF modules. XCTU includes all of the tools a developer needs to quickly get up and running with XBee. Unique features like graphical network view, which graphically represents the XBee network along with the signal strength of each connection, and the XBee API frame builder, which intuitively helps to build and interpret API frames for XBees being used in API mode, combine to make development on the XBee platform easier than ever.

CHAPTER 6
TESTING

6. Testing

Software testing is an activity to check whether the actual results match the expected results and to ensure that the software system is defect free. It involves execution of a software component or system component to evaluate one or more properties of interest.

6.1. Unit Testing

Unit testing is carried out for testing modules constructed from the system design. Each part is compiled using inputs for specific modules. Every modules are assembled into a larger unit during the unit testing process. Testing has been performed on each phase of project design and coding. The testing of module interface is carried out to ensure the proper flow of information into and out of the program unit while testing. The temporarily generated output data is ensured that maintains its integrity throughout the algorithm's execution by examining the local data structure. Finally, all error-handling paths are also tested.

6.2. Integration Testing

We usually perform system testing to find errors resulting from unanticipated interaction between the subsystem and system components. Software must be tested to detect and rectify all possible errors once the source code is generated before delivering it to the customers. For finding errors, series of test cases must be developed which ultimately uncover all the possibly existing errors. Different software techniques can be used for this process. These techniques provide systematic guidance for designing test that exercise the internal logic of the software components and exercise the input and output domains of a program to uncover errors in program function, behavior and performance. We test the software using two methods:

White Box Testing: Internal program logic is exercised using this test case design techniques. The tester chooses inputs to exercise paths through the code and determines the appropriate outputs.

Black Box Testing: Black Box Testing is a software testing method in which the internal structure/design/implementation of the item being tested is not known to the tester. Software requirements are exercised using this test case design techniques. These tests can be functional or non-functional. Both techniques help in finding maximum number of errors with minimal effort and time.

6.3 Test Cases

The test cases for the proposed system are furnished as follows.The following table describes the test cases along with their expected outputs, actual results and discussions regarding the implementation details of the test case.

Sr. no.	Test Case	Expected Output	Results	Discussion
1	Balance RFID card detection	Added balance displayed on LCD display	Passed	A balance amount is added on the system as soon as a balance RFID card is detected.
2	Start on Balance card detection	The prototype car starts only after the balance card is detected	Passed	The car will not move unless the driver loads the balance into the system
3	Hospital Ahead sign detection	A voice alert on “Hospital ahead” sign is played	Passed	As soon as the car moves on Hospital ahead card, the driver is alerted about the sign.
4	Work in Progress sign detection	A voice alert on “Work in Progress” sign is played	Passed	As soon as the car moves on “Work in Progress”

				card, the driver is alerted about the sign.
5	Warning Speed limit sign detection	A voice alert on “Warning Speed limit” sign is played	Passed	As soon as the car moves on “Warning Speed limit” card, the driver is alerted about the sign.
6	Final Speed limit sign detection under limited speed	No Balance deduction is done	Passed	Since the car is following the traffic rule, the violation ticketing is not triggered
7	Final Speed limit sign detection under high speed	Balance deduction is done	Passed	Since the car violated the traffic law, an appropriate fine is deducted from the system
8	End Speed limit sign detection	A visual alert on “End Speed limit” sign is displayed	Passed	As soon as the car moves on “End Speed limit” card, the driver is alerted about the sign.

7. CONCLUSION

A new method of encoding traffic signs and symbols using RFID tags for traffic sign detection has been presented. This system can be used to save many lives from road accidents due to the inexperience of understanding traffic signs boards. The project is mainly focused on majority of the society especially the night travelers and it also helps traffic police to reduce the traffic issues. This new method provides maximum efficiency and is user friendly. At present in India, more than 150,000 people are killed each year in traffic accidents[9]. By our project we expected that we can able to reduce it up by more than 50%.

PUBLICATIONS

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Traffic Sign Board Detection With Voice Alert System Along Automatic Traffic Violation Ticketing

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Abstract—**Violation of traffic rules and unremitting cases of accidents on road is a major issue nowadays. Due to lack of traffic rule awareness among inexperienced drivers, cases of road mishaps continue to occur even when proper road signs and instructions are constructed around travel routes. Furthermore, people continue to break traffic rules by avoiding traffic-control officials without any problem since the officials cannot monitor each and every place in a city. Also, to monitor such culprit's vehicle manually is very difficult. Therefore, there needs to be a system that alerts the driver about any traffic sign or warning and simultaneously generate traffic violation ticket in case of breakage of mandatory rule. Hence, we proposed a monitoring system that will detect the road signs in real-time and alert our driver. In case the driver violates the rules even after alert, the system will issue a fine to the driver and deduct the amount from the balance maintained. This will cut down the efforts any driver has to face to pay the fine and also bring down corruption among traffic officials.**

Keywords-Radio Frequency Identification(RFID), Field Programmable Gate Array(FPGA), Remote Controlled(RC), Internet Of Things(IOT).

I. INTRODUCTION

Today a car is an essential part of our life. In the 21st century, a car is waiting for changes because it must be not only a conveyance but an assistant on the road. However, 1214 road crashes occur every day in India [8]. More than half of all road traffic deaths occur among young adults ages 15-44 [7]. A large number of accidents occurred due to carelessness of drivers and traffic violations. One of the best measure to reduce accidents on the roads can be done with the development of systems that provide alert to the driver while moving. To solve this problem, we plan to develop an automated system that would allow to detect traffic signs along the way, in advance informing the driver about changes in driving conditions without detracting from driving. Thus the driver will not be distracted from driving when special vigilance is required. Also, including an effective and real-time ticketing system for violation of any traffic rules will save the efforts of traffic officials to monitor every route and also curb corruption among such officials.

The aim of this project is to develop a method for traffic signs detection for vehicles that reduces the number of accidents while driving and automatic generation of traffic violation fines.

II. ROAD SIGN PROBLEMS

Road traffic constitutes a major part in the problems of society. As the road traffic is increasing day by day with increase in population, there is a need of following the traffic rules with proper discipline. Traffic rules consists of traffic sign boards and traffic signals which are meant to be followed by everyone on the road. However, there are lot of issues associated with it which includes the following:

A. Sign Boards

Traffic Signs are Silent Alarms which inform the driver about the oncoming situations around the route, warn or guide drivers and ensure proper functioning of road traffic. A driver takes

the necessary action while driving based on the road sign encountered in his/her journey. Any person who wants to acquire a drivers license in India needs to be familiar with the road signs and symbols. Road signs are categorized into three types: Mandatory signs, Cautionary signs and Informatory signs[10].

- Mandatory signs

These signs are used to ensure free movement of traffic and make the road users cognizant to certain laws and regulations, restrictions and prohibitions. Violation of these signs is an offence as per law.

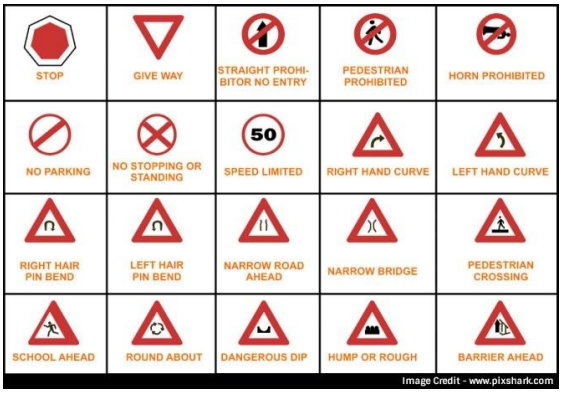

Figure 1: Mandatory Signs[10]

- Cautionary signs

These signs make the road users conscious of hazardous conditions on the road beforehand. The drivers, accordingly, take necessary actions to handle the situation.

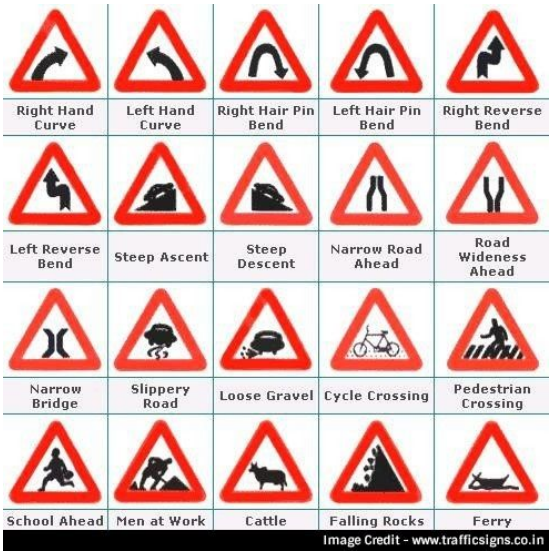

Figure 2: Cautionary Signs[10]

- Informatory signs

These signs guide the road users about destinations, distance, alternative routes and prominent locations, food joints, public toilets, nearby hospitals, etc.

However, it has been observed that a less experienced driver often gets confused among these symbols and may interpret incorrect information leading to accidents and mishaps.

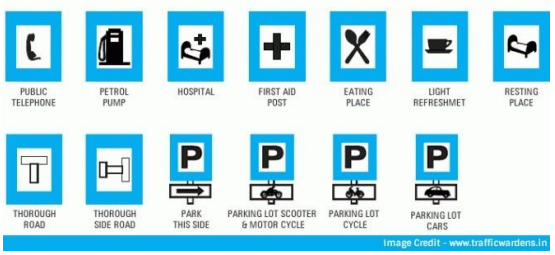

Figure 3: Informatory Signs[10]

Few of the examples include "No Motor Vehicles Allowed" which people misinterpret considering it as a sign that means only cars and motor vehicles are allowed on that road and "Give Way" sign which people misinterpret as sign to slow down or even to roll down one's windows to listen for oncoming traffic.

Figure 4: Some Confusing Signs[11]

Another problem with road signs is their visibility to drivers. During night or any other weather conditions like fog, heavy rains,etc that can hinder visibility on road, road signs prove to be failure to inform the driver about the current situations on road and further lead to road disasters. Furthermore, such signs can be damaged or vandalised.

B. Traffic Violation Ticketing of Offenders

Drivers in some cases try to avoid following the traffic signs and rules. In such situations, traffic officials are responsible for monitoring and regulating the traffic as well as keeping in check of such traffic offenders.

But the presence of such officials at every route of a city or a region is quite impossible. thus avoiding violation ticket. Thus both the breaking of traffic laws and corruption increases in the region.

Thus, there needs to be a solution which can eliminate both the problems mentioned and allow smooth and efficient working of traffic laws and regulations on road.

Figure 5: A Vandalised Sign Board[12]

III. Literature Survey

There were various technologies proposed by people for achieving the goal of sign detection and thus helping the driver to understand and interpret the road sign effectively.

A. FPGA based traffic sign detection: This methodology employed an off-the-shelf Full HD resolution camera system which would detect a road sign, analyse them and generate appropriate results for the driver.[3] This system supported and processed Full HD video streams using Microblaze softcore from ilinx and an extended Ip core for HDMI- in and out signals. However there were some problems associated with it which included:
    a. Power consumption is more in FPGA which is hard to optimize.
    b. Appropriate FPGA IC is needed to be chosen due to limited design size and features.
    c. FPGA are only better for prototyping and low quantity productions.

B. Real time recognition of road signs using embedded systems: This technique also employs use of image processing over traffic signs and symbols in which the image processing flows through three different phases: Colour Segmentation, Shape Classification and Symbol Recognition[4]. The proposed method puts up an accuracy of 90.7% for the segmentation phase based on color extraction and classification of the shapes of road signs is extremely accurate with 98.3%.Even though this method has been designed using simple technique, it had a good performance that is proven by experimental results in term of less time processing and can be used in various weather condition, thus making it suitable for real time embedded applications. However even this method was vulnerable to some issues like:
    a. Weather conditions like rains, fog, etc can affect the image capture.
    b. Blurring and vibration from the moving vehicle can affect the quality of image obtained.
    c. Interpretation of traffic signs and symbols can be difficult in case of vandalised or damaged sign board due to weather or human intervention.

In each of the two cases, there is a heavy dependency on traffic sign boards constructed across routes by the systems. Our proposed system for traffic sign board detection not only eliminates this dependency on sign boards but also ensures real time alerts on current situations on road via voice updates to drivers.

IV. Solution using IOT

Presently there are no systems present and accepted among consensus for traffic sign board detection and strapping fines on drivers for traffic violations. Most of the proposed systems highly rely on traffic sign boards constructed on routes which could be a problem as discussed before.

The system proposed by this paper makes use of IOT to handle both the problems of detection of sign boards and issuing of tickets to traffic offenders. Further, this can eliminate the dependency on Road signs for describing traffic situations on road. Our system makes use of RFID technology which consists of RFID tags and Reader to uniquely identify and detect

different sign boards. Similarly they can be used to alert the drivers about the incoming traffic situation and book the offenders by processing the data from Rfid tags with help of Arduino.

V. Design

Our proposed system is demonstrated by using two different modules: A lane and a RC Car with our prototype system which will be activated by a RFID Card tag to add amount in the system and start the car. The lane is embedded with 13.56 MHz RFID Card Tags which would represent our traffic signs on the lane. The RC car module is mounted with several devices as follows:

- Zigbee S2C module
- L298 Motor Control Driver Board
- Arduino Board Atmega 2560
- LCD Keyboard Uno Shield VM37
- RC522-13.56 MHz Smart Card Reader
- 12V DC Geared Motors- 1000 rpm
- 5V Amplifier

Two Zigbee devices are used denoted by “Coordinator” and a “Router”. The Coordinator is connected to the laptop which will give directional instructions to the RC car while the Router receives these commands from coordinator and streams this data to Arduino which will further control the RC car. The commands are given via XCTU-a free multi-platform application installed on the laptop to instruct our car and control its speed. The 5V Amplifier and a speaker module will generate the voice alert while the LCD display mounted and integrated with Arduino Uno will generate visual data and notify the driver about the fines processed by the system for each violation detected.

In the current implementation of the prototype, two traffic signs are selected from each of the three categories of Road signs, i.e. Mandatory signs: “Stop“ and “Speed limit”, Cautionary signs: “School Ahead” and “Men At Work” and Informatory signs: “Petrol Pump” and “Hospital”. For Cautionary and Informatory signs, only alerts are provided whereas for Mandatory signs, both alerts as well as fines are added.

VI. Implementation

There are two main objectives of the system: provide voice alerts to the driver about the traffic laws and situations and issue fines to the driver on violation of traffic rules. Initially the system will allow the car to start only after the Driver scans his Activation RFID Card to the RFID Reader of the system. This will add the balance amount in the system which will be used to process the fines incurred in future.

The overall working of the whole system is as shown in figure 1. There will be two phases through which the system will pass through: the Warning Phase and the Final Phase. In the Warning Phase , the system will scan for any nearby Warning RFID tags which are assigned as any traffic sign or symbol.

According to the flowchart shown in figure 2 , as soon as a Warning RFID tag is detected on the lane, the Reader will identify the RFID tag data and send it to the Arduino for processing. Based on the data obtained by the Reader and Arduino, a voice alert is played from the speaker notifying the driver about the traffic rule or law to be followed on the route.The Warning Phase will continue until an End RFID tag is detected by the Reader meaning that the bound of traffic law has ended on that lane.

The Final phase is the one responsible for monitoring any traffic violations on road.The figure 3 flowchart describes the flow of the Final Phase on road by the system. After a Warning tag is detected, if the driver does not change his/her course of action commanded by the system via voice alert, the Final Phase will record the violation.A final RFID Tag on lane when detected by the Reader will notify the system that the driver has violated the law and thus a fine is implemented and notified to the user via LCD display by the system. The appropriate fine amount will be deducted from the balance amount in the system.

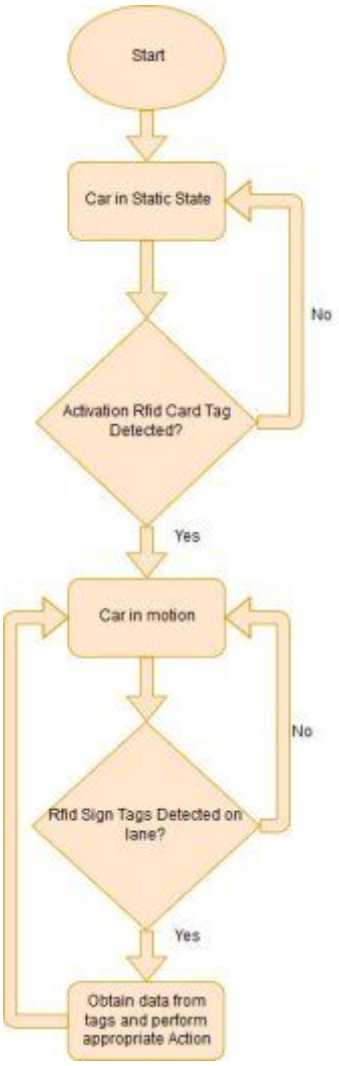

Figure 1: Overall Flow of System

VII. Future Scope

The proposed system is designed for satisfying the primary objective of traffic sign detection and automatic ticketing. However, the system can be upgraded to allow more features as per the requirements of the user in future. Some of them are as follows:

- Multilingual support: Multilingual systems are the ones that can communicate with the user with more than one language. Our current system uses simple English commands to alert the drivers. This feature can be updated to support more than one languages based on the geographical location and users preferences.
- Visual Aid: Currently our system is capable of providing voice alerts to the driver based on the traffic sign or situation detected on the road. In future, a visual display providing information for the same can be added thereby increasing the performance of the system.

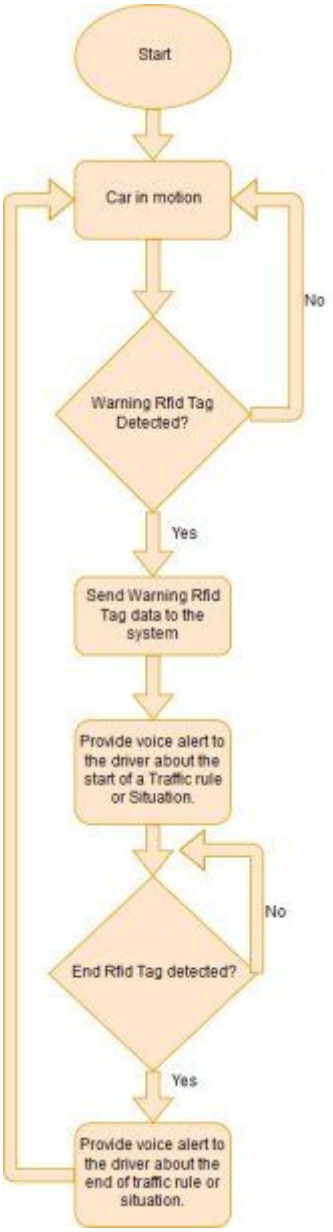

Figure 2: Warning Phase

Figure 3: Final Phase

- Authentication and Android support: Each and every driver must be accounted for his/her own traffic fines and violations. Also they must be able to keep check on the types of violations they incurred. Thus an android app can be built where each driver with a username and a password associated with his/her account will be able to view his/her record of all violations and current balance after paying the fines.

VIII. Conclusion

A new method of encoding traffic signs and symbols using RFID tags for traffic sign detection has been presented. This system can be used to save many lives from road accidents due to the inexperience of understanding traffic signs boards. The project is mainly focused on majority of the society especially the night travelers and it also helps traffic police to reduce the traffic issues. This new method provides maximum efficiency and is user friendly. At present in India, more than 150,000 people are killed each year in traffic accidents[9]. By our project we expected that we can able to reduce it up by more than 50%.

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