Energy efficient Laser based embedded system for blind turn traffic control

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Abstract: The usage of embedded system in the traffic control unit is not new. Many advanced intelligent systems are being used to reduce the human effort, and wasting time. As a result, road congestion and accident rate are being decreased. But in some critical spots like blind turn in the hill areas where the turn is too much sharp that it's impossible to identify the existence of coming vehicles and the result may be very dangerous which need to be improved more with advance traffic controlling system. In this paper, we are going to propose a laser based embedded system which can efficiently control the traffic in the blind turn areas through giving proper signals in any situation. A driver can easily identify both the types and numbers of the vehicles coming from the other side by getting signals from the signal terminal. The proposed system is flexible and cost effective so that it can play a vital role by being widely used in the near future.

Keywords: Arduino, Embedded traffic signal, Traffic control system, Laser based traffic system, Blind turn vehicles control.

1. INTRODUCTION

Blind turn is considered as a sharp turn mostly found in hill-side roads and highways. Hill areas are very popular for tourism and traffic is a must for transportation. But hill-side roads are very dangerous to drive without proper traffic control system. Those who have visited hill areas may discover that the roads specially the turns are very risky. The turns are too sharp that traffic/vehicles coming from the other side can't be pre-detected [21]. So, without proper traffic control system and signaling facilities, there may be a lot of chances of deadly accidents. Technologies are improving day by day to make the life more comfortable and secured. So, technologies are being used in traffic controlling system to reduce the traffic jam and accidental rate, which is able to save our two valuable properties- life and time [2]. A system, combining electronic hardware and software is known as embedded system which is able to perform a dedicated task.

Embedded systems are being used in traffic controlling system. Besides many developed countries, developing countries like ours are also using embedded devices to control the traffic more efficiently. Day by day the number of vehicles is growing up so that traffic control facilities must be enhanced to avoid the unexpected events [1]. In case of blind turn, the turn is too much bent that vehicle coming from one side can't identify the vehicles coming from the other side. So, there may be a huge possibility of collisions which can conclude a deadly result in the hill-side areas. So, traffic control system is very necessary in the blind turn areas to avoid the collisions.

This paper gives the approach for taking the blind turns in a safer manner. It starts with the work that has already been done in this direction followed by the design and the working of the proposed approach for the effective blind turn mechanism. At last the comparisons of different existing approaches along with their limitation have been expressed.

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2. RELATED WORK

In this part of the paper the work that has been done by researchers in the field of traffic and signals has been thoroughly investigated.

Nitish Kumar A et al. [1] proposed a system based on inter vehicular communication where both vehicle and blind spots. When a vehicle comes across the spot, the module attached with that spot send signal to the module attached with the vehicle. After receiving the signal, the vehicle would be able to avoid the collision. Mohit Dev Srivastava et al. [2] in their work the modern traffic signaling process is deeply discussed. The system is based on PLC technology which helps to make the traffic control system smart. The signaling processes are nicely designed to reduce the traffic jam and unexpected traffic collisions. Implementation of this system also could save our valuable time. Preeti et al. [3] develops a system based on infrared technology where a module with IR sensor can detect the coming vehicle and warn the passing car to avoid the collision. This system is based on M2M technology. The system is able to detect the coming vehicle so that any driver can get to know that any vehicles are coming or not from the opposite side. The accuracy of the system is very high even in the night, but the system is unable to identify the type and the number of coming vehicles. Dinesh Rotake et al. [4] provide an intelligent system means the system can perform the dedicated work by itself with a very efficient way. A system is proposed in this paper which can detect the vehicle movement and able to send signal to avoid the collision and reduce the traffic congestion. The system helps to reduce the waste of time. The system doesn't need to control manually.

Shilpa S. Chavan et al. [5] develops an intelligent traffic control system is proposed which is more efficient than an ordinary traffic control system. The system is able to give a signal to the vehicle to go for the shortest path. The proposed model is very helpful for time is saved and fuel saving. GSM module is used to send the signal to the vehicle to get the current traffic condition of a road by traffic congestion which can be reduced. Jasmin Maria Jose et al. [6] provide a dynamic traffic control technique in which they have discussed where the control of the signal light depends on the density of the vehicles of a respective lane. The image processing technology has been used where a camera is attached with the traffic signal; that camera captures images of the vehicles and sends it to the controller; the controller processes the data according to the logic and sends the signals with respect to the density of the vehicles. Mohammed M. Elkhatib et al. [7], works talk about the cost effective image processing-based system has been discussed which is able to control the traffic with an efficient way, the advantage of the model is less waiting time. This can also help to reduce the accident rate. The system is based on image processing algorithms and different hardware like microcontroller and camera were used in system.

XuFei Sun [8] proposed an embedded system which can be used to control the traffic with fewer efforts. The application of artificial intelligence can be found in the system. The man-machine term is also discussed which makes the interface more easy to manage the system. ARM9 IC is used as the microcontroller which is considered as the heart of the system. The embedded technology with the artificial intelligence makes the system more efficient to reduce the traffic jam. Dhruv A et al. [9] discuss many kinds of technologies related to traffic control system has been discussed. Different traffic issues and its solution also highlighted in the paper. Image processing, fuzzy logic and respective hardware are thoroughly described. The importance of image processing technique in traffic control has been mentioned significantly. S.Solomy Hema Preethi et al. [10] discuss the advance traffic control techniques helps to reduce the unexpected traffic congestion, which helps to reduce our time, resources and even life. The clearance of Ambulance is a big concern in traffic control system. In the paper, RF-ID based anti-theft techniques and reduce of traffic jam techniques are also noted. Sony Francis et al. [11] pointed out that Raspberry Pi is considered a microcomputer having some graphics properties. Raspberry pi is used to develop advanced technical projects. In the paper, a traffic control system based on raspberry pi is proposed. Embedding cameras with raspberry pi can make an intelligent system which may help to detect the current traffic condition and update information to reduce the traffic jam.

Dheeraj Dang et al. [12] in their work, priority-based traffic controlling system has been proposed where traffic can be controlled with respect to depending on the priority of the vehicles. Emergency services like Ambulance or fire services have the most priority to move fast on the road. So, the clearance of the emergency vehicle plays an important role to control the traffic system. An embedded device which is able to detect the priority of the vehicle helps to clear the road for

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that particular vehicle. Ganiyu R. A. et al. [13] stressed that the heart of embedded system is microcontroller. Sensors, actuators, microcontrollers, converters and memory forms the embedded system. Embedded systems are being used to develop human life. In this paper, Embedded system is used for the safety of the vehicles and pedestrians. The advance embedded system can be used to develop an advanced traffic control system where time can be saved and safety would be provided.

W. Wen et al. [14] develop a system is a system where there is no human interaction or the interaction of human is very less. Auto nation system reduces the human effort. This paper proposes an advance system which is able to reduce the traffic in very efficient way where there are very lesser human activities. This type of automation system reduces human effort and saves our valuable time. The application of automatic system in traffic control section is highly significant. Sivak et al. [15] found that autonomous vehicles may decrease the rate of accidents by increasing the accuracy. This paper discussed thoroughly on the security and safety. Road safety is a big concern on which researchers are working. In the current technology, self-driving vehicles are able to identify the big vehicles, but most of the vehicle can't notify the presence of bicycle or pedestrians which may cause an accident. Security is a big concern as the vehicle is driverless, so there may be chances of vulnerabilities. Sometimes, self-driving car may not be accurate as an experienced driver. Cai Bai-gen et al. [16] discuss different types of algorithms are discussed which have been used in the traffic control system. The system is able to control the traffic through observing the speed of the vehicles. Sensors are used to sense the data and sends it to the microcontroller. Microcontroller receives the data from sensors and processes the data with the help of the predefined algorithms. W. Wen et al. [17] pointed out the numbers of vehicle are increasing day by day. In a result, traffic congestion is also increasing which has become a great challenge to control. Time waits and emergency services are being interrupted because of road congestion. The authors propose a system which is able to reduce the road congestion in a very simple and effective way. Sayali Ambekar et al. [18] provides a traffic control system using embedded technologies which is briefly discussed. TLC is not enough flexible to control the situation of huge traffic. The duration of red light is getting more and extra fuels are being wasted. So, an embedded system is proposed where some sensors, microcontrollers and some advance algorithms are used to control the traffic smartly. Milos N. Mladenovi et al. [19] execute a case study on the importance of social justice in the transformation of traffic control technology. The autonomous technology will be permitted soon with the convergence of communication technology. For social justice, new traffic control technologies have been implemented. This also focuses on the efficient traffic control designs. The limitations of traffic control are also been explained thoroughly. Nikita Shinde et al. [20] propose a system which is considered as a smart signal system which is more advance than previously used one and is able to control the traffic in an automatic way. As a result the road congestion as well as the human effort can be reduced through using the system. Efficient traffic control system also can save our valuable time. Mohd Sani Mohamad Hashim et al. [21] inferred that blind turn is considered as a sharp turn mostly found in hill side road. The turn is too sharp that the vehicle coming from the other side can not be detected which results in dangerous collisions. So, advance traffic control system is necessary to avoid the deadly collisions. Generally, passenger-vehicles depend on the rear view of the vehicle to identify if there is any car behind or not. Sometime in some blind spot, we can see the use of the same concept where a mirror is placed in the spot to identify the other side vehicles. But it's a matter of fact that in the night or foggy weather, the mirror doesn't efficiently work. In this paper a technic which is considered as grid-based to control the blind spot traffic. Bogdan Mihai [22] pointed that arduino is a very popular development board mostly used to make initial electronic projects. Different types of Arduino board are available in market like Arduino Uno, mega, nano, lily-pad etc. Arduino Uno is the most popular board having AT Mega 328 microcontroller. Arduino is able to support the real time application. In this paper, the author proposes an Arduino based traffic light signal which is considered as a smart traffic control system. The main advantage of using Arduino board is the cheap cost and flexibility. The program inside the Arduino can be updated/changed easily by inserting the new command. The microcontroller attached with the Arduino is responsible to process the data.

3. SYSTEM DESIGN

Micro-controller is considered to be the heart of embedded system. To give logic to the micro controller, compiled .hex file has to be generated and inserted to the micro controller. Only Micro controller is not defined as an embedded system, there are sensors, actuators, converters and memory which make the whole system embedded. Sensors sense the input

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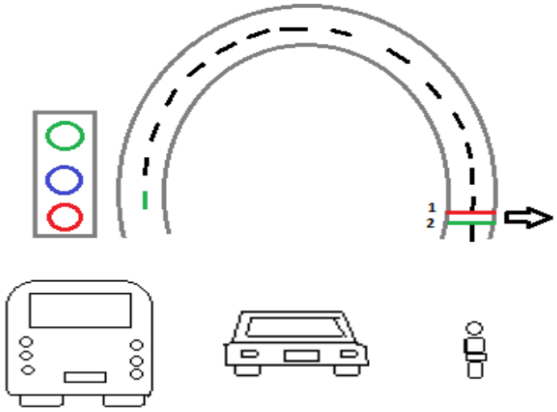
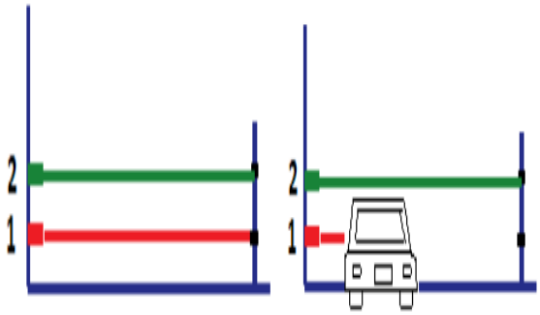
signal from the environment and send the data to the micro controller. The micro controller processes the data received by sensor according to the logic and sends the output signals to the actuators [16]. Actuators are considered as output devices which receive the processed data from the micro controller and form mechanical movements as output.

Necessary components:

1. Arduino Uno x1
2. Laser Module x5
3. Led (Red, Blue & green)
4. Connecting jumper wires and bread board
5. 10 K-ohms register x5
6. LDR x5

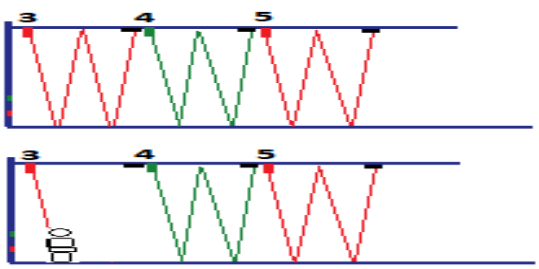
Arduino Uno is very popular as development board and open source platform used in developing initial electronic projects having ATmega 328 microcontroller, 6 analog pins and 14 digital i/o pins. Three colors of LEDs are used in different signal purpose. LDRs are light responsive. All the laser modules emit the intense beams of monochromatic coherent light on each of the LDR sensor. If any of the LDR gets interrupted to receive the light, it will send the signal to microcontroller and LEDs will glow according to the logic[4]. So, when any vehicle crosses the laser line, instantly the LED signal will be generated.

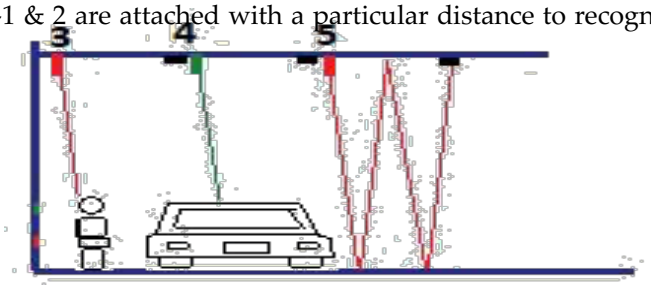




Heavy weight Four wheelers | Lite weight Four wheelers | Lite weight Two wheelers

In part 1, there are two laser(1,2) which helps to indicate the size/type of vehicle weather the vehicle are heavy or lite. When a vehicle come across the laser, the laser line will be interrupted from the LDR. Laser-2 is attached at higher position than laser 1. If only laser-1 is interrupted, the vehicle must be lite. If both of the lasers (laser-1 & laser-2) are obstructed by vehicle, then the vehicle should be heavy. Laser-1 & 2 are attached with a particular distance to recognize the vehicle type.





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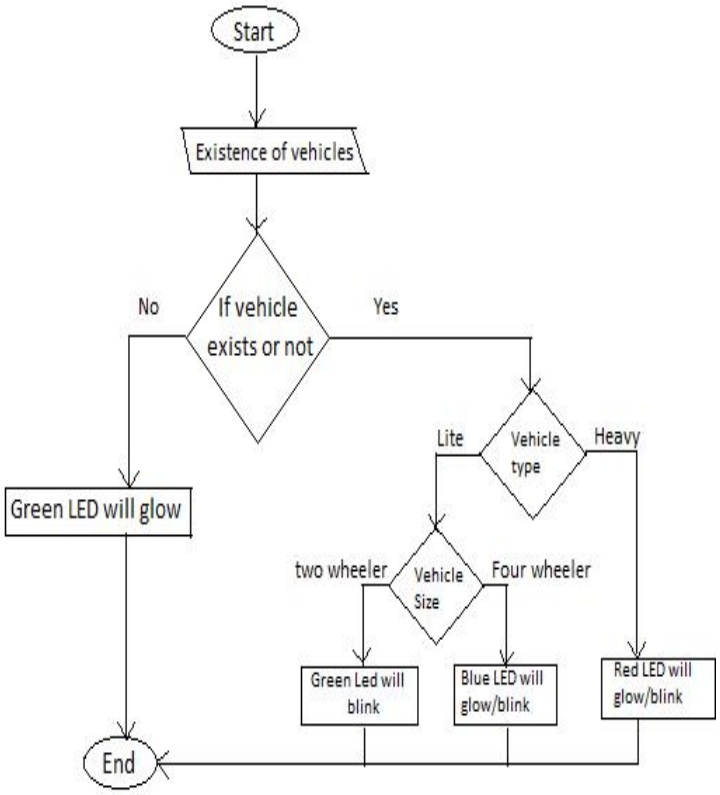
In Part 2, Laser-3, 4 & 5 are used to identify the number of vehicles in the same lane of the road. The identification procedure is discussed in the Working functionalities. If we combine Part 1 and Part 2, we can easily find or identify both the type and number of the coming vehicle from the opposite side.

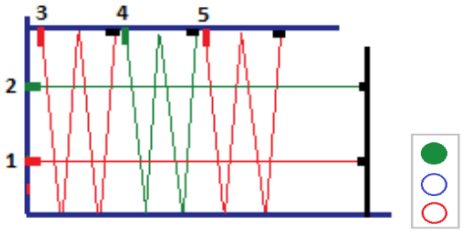
4. PROPOSED METHODOLOGY

The working of the proposed approach for the effective blind turn is represented below in the form of flow-chart.

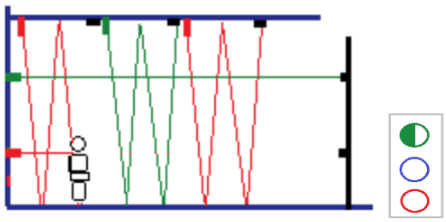


The whole working process is expressed with three LEDs with different color (R,G,B).

1. If no lasers are interrupted, then green light will glow. That means there is no vehicle coming from the lane.



2. If laser-1 is interrupted along with any one laser among laser-3,4,5 is also interrupted, then the green LED will start to blink. That means the vehicle must be lite weight and small in size like a bike.



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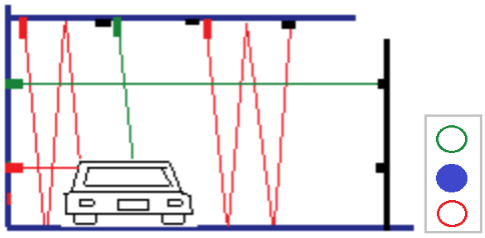
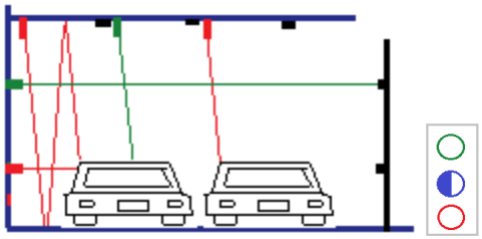
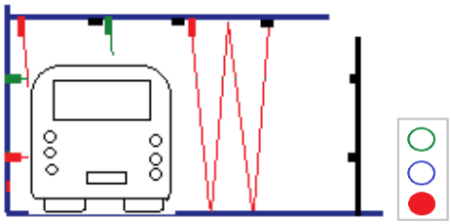
3. If laser-1 is interrupted along with any two of the lasers from 3,4,5 are also interrupted, then the blue LED will glow. It indicates, the vehicle is lite weight four wheelers like car and single in number.



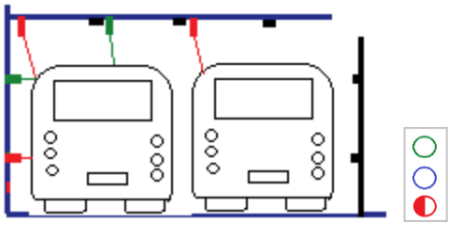
4. If laser-1,3,4,5 are interrupted, the vehicle must be lite weight and two or more vehicles are in the same lane. The blinking of blue LED will indicate it.



5. If both 1 & 2 lasers are interrupted along with the interruption of any two laser among (3,4,5), the red LED will glow. It indicates a single heavy weight vehicle bus or truck

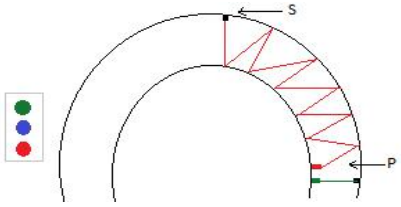


6. If all 5 lasers are interrupted, the red LED will start to blink. It indicates more than one heavy weight vehicle passing through the same lane together on the road.



Duration of glowing/blinking LED:

The laser 1 is covered with a wide range through reflection. Laser 1 must be interrupted if any type of vehicle passes. So, LED will be continuously glowing/blinking until the interruption of laser 1 is over!



For example, when a vehicle come across 'P', the laser 1 will be interrupted (must). According to the signal processing, the respective LED will glow/blink. When the vehicle cross 'S', the interruption of laser-1 will be over and according to the logic, the respective LED will be off.

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5. COMPARISION WITH EXSISTING METHODS

The proposed approach given in the paper is able to take care the limitations that are encountered while going through the literature work in the Section2 of the paper. The same has been discussed in the Table 1 below.

Table 1. Comparison of various existing techniques

Reference No.	PROPOSED TECHNIQUE	FINDINGS FACTS	LIMITATION
[1].	Vehicle to vehicle (v2v) and Vehicle to Infrastructure (v2I) technology	Proposes a model design of microscopic traffic simulation for self-driving vehicles with a protocol which is used for exchanging info	The paper doesn't describe about the present interruption and the proposed solutions
[3].	The role of Machine to machine technology (M2M) in the term of Internet of Things is nicely described	The concern, acceptancy, and willingness to by intelligent systems are investigated.	M2M technology can be interrupted because of the lack of proper internet connection
[5].	Designing model, Automated tools and functions	shows the role and responsibilities of human in the development of traffic control	The term "safety" is not discussed properly
[7].	This paper thoroughly describes the different technologies under the traffic control system. Intelligent Decision-making system by using image processing technologies, machine leaning and Collision detection technologies are clearly explained	The whole work compares the previous and current technologies and predicts the future demands and adoption of advance technologies	Proposed different technologies but doesn't mention of the progress of traffic control system
[14].	Authors proposed some innovative models of traffic control system and the whole functionalities were divided into several parts	Adoption of advance technology and innovative ideas can change the future of the present traffic system.	The security issue is overlooked
[16].	A robust embedded system for information exchange	The safety plays a big role in the autonomous vehicle	The solution is proposed but the method is not discussed
[20].	An advance system using software hardware and some algorithms/logic	The system is very helpful to utilize the	Doesn't show the detailed progress of traffic signal

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	that is able to control the traffic signal	time more efficiently	system

6. CONCLUSION

Traffic problem is a big problem in our daily life. The proper traffic control system is a must to control the traffic not only to save our time but also to save our life. In the deadly areas like highway/blind turn, lacking of proper traffic signal can have a chance of deadly accidents. The proposed device helps the drivers to identify the types and numbers of vehicles coming from the other/opposite side so that drivers can understand that he should go for a turn or not. As traffic problem is one of the major problems in our daily life, many researchers are researching and working on this to find a suitable solution of the problem. In some blind spots, we can see the usage of mirrors which helps to show the other side vehicles. But in the night or foggy weather, it doesn't work efficiently. Some developers have made an intelligent, advance module attached with both the spot and vehicles. But the true fact is that the most of the vehicle in our country are not smart/advance enough yet. In this paper I have proposed a solution where a system will be attached to the blind spot which is able to detect the number and types of the vehicle coming from the other side in any situation like rainy day, foggy weather or even in the night. The components used in the system are cheap/cost effective and available in the market. The whole system requires only 5v direct supply. We believe the system is going to play an important role to reduce the collision rate in the blind turn spot.

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