Intelligent Traffic Control for Smart Cities

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Abstract:*Traffic congestion can be looked upon as a disorder in the road network that happens when the expected number of vehicles plying on the road increases to an extent that it becomes a nuisance to the commuters itself. Congestions are characterized by slower vehicle speeds, longer journey times, and extensive vehicular queuing.Traffic congestion generally leads to heavy traffic jams making the drivers frustrated which may cause them to engage in road rage. Thescenariocan further worsen for the easy passage of emergency vehicles such as an ambulance or a fire brigade. An ideal solution to the above mentioned problems would be to automate the traffic signals based on the density of traffic so that unnecessary waste of time and fuel resources can be evaded. The emergency vehicles should be made to be equipped with radio frequency identification tags for its easy exit at crowded junctions. Real time traffic information is made available to the commuters so that they can decide the quickest travel path to their destination. Also a feature such that the travellers can get information about the several utilities in a particular region is added. The increase is the number of vehicles also increases the air pollution through the vehicle exhaust. Hence vehicle emission testing needs to be a priority. The vehicle thefts could be controlled with the use of the Smart Android phones.*
Keywords*: automatic signaling, density based signaling, emergency vehicles, vehicle emission, stolen vehicles*

I. Introduction

The primary focus of every developed nation is to have a powerful transportation infrastructure system with well-organized traffic governance on roads. Negligence and traffic bottleneck consequences lead to elongated waiting times, loss of non-renewable resources and economic losses. Provision needs to be made for the smooth passage of emergency vehicles like ambulance, a convoy or fire brigades. Another issue of concern with the ever increasing rise in the vehicles is the increase of air pollution leading to various health hazards. The solution lies in mending traffic flow and taking care of the current transportation system byintroducing mechanization and smart control methods fortransport infrastructure and vehicles.

The primary aim to study transportation is to enhance convenient flow of individuals and merchandises. As the resources ofthe current infrastructures are limited; the need for intelligent control of traffic becomes the need of the hour. The focal objective of the transportation system should be to improve and boost the transportation flow of people and goods with minimum overheads. Tracking of the stolen vehicles is another concern which could be handled by passing the message to the owner when unauthorized person tries to unlock a vehicle. Likewise the monitoring of the atmospheric air during high traffic time is also a difficult scenario. Provisions should be made for travellers to get information about the various utilities of a particular area.

The domain used to develop this project is Industrial Internet of Things (IIoT) which is a fragment of Internet of Things (IoT). IoT is an evolving industry trying to bridge the difference between human and machine communication.

II. Related Work

Findler et. al., [1] express that the road junctions connected by traffic light-based expert systems need a set of rules that can be boosted by investing how frequently each instructions work and the success it has. The system could even be designed to learn new traffic rules.

Tejashri Gadekar et. al.,[2] have recommended an effective system for Traffic Control for Congestion, Ambulance passage and Stolen Vehicle Detection. It uses the conceptsof traffic regulator and proposes ways for making way for emergency vehicles.

Y. N. Udoakah et. al.,[3] says traffic cramming chiefly on the road junctions is a tussle for the road users daily. The present traffic lights are set on a fixed logic of assigning equal "STOP" and "GO" times to all the lanes irrespective of the number of vehicles on each lane. A microcontroller interfaced with infrared sensors could be made to develop an improved traffic control system for a particular troubled lane or intersection.

Shabnam Sayyed et. al.,[4] say thattraffic lights are source of indicating device for road junctions. Present-day Traffic Light Controllers are positioned on various microcontrollers. As the number of people commutingis on a regular increase, transport facilities provided by current infrastructures are becoming limited, proper managing of traffic becomes essential.

Prof.R.U.Yawle et. al.,[5]have shown concerns about the swift increase in the vehicles on the road. At present, the traffic light controllers have restrictions because it uses apredetermined hardware that does not provide the comfort for alterations. The fixed time intervals of the traffic lights lead to more waiting time. By deploying sensors with embedded technology, the timings of the stop and go signal lights can be decided based on the traffic on the roads.

III. Proposed Model

The use of sensors for automatic signaling system helps in managing traffic lights which can also help in managing density based signaling system.Appropriate measures are taken for facilitating easy passage for emergency vehicles such as ambulance, fire brigade etc. By proper deployment of smoke purifying sensors in the congested junctions polluted air could be purify to a certain extent. The cameras in traffic junctions could be mounted so as to get the dynamic picture of the present traffic conditions. With the use of GSM technology real time information and details of basic amities can be given to travellers.A detector is designed for the monitoring of the emission from the vehicles on the spot. Finally, stolen vehicles could be easily detected byusing RF transmission and receiving method.

IV. Methodology

The hardware required for the implementation of the project is listed below.
- Microcontroller - P89V51RD2 –Phillips
- IR sensors
- LCD Display
- Red & Green amp
- Radio Frequency transmitter and receiver
- Global System for Mobile Communication (GSM) modem
- MQ 2 Smoke detecting sensors
- Relay
- Buzzer

The software required for the implementation is listed below
- Embedded – C
- Keil Complier
- Flash magic
- Android HDK
- Java
- Eclipse

The project is designed in such a way that main focus is on providing an intelligent, convenient and cost effective method to control and manage the traffic in congested junction of various cities.
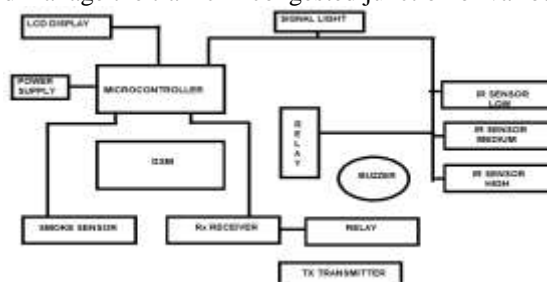

Fig 1 Block diagram of system architecture

There Infrared sensors arecalculatedlypositioned for gauging the density of the traffic and the necessary instructions are given through the microcontroller. The outputs of the microcontrollers are the inputs for the devises which can control the speed of the vehicles. The system checks on the vehicles lined up at a traffic junction to change the traffic signal from STOP signal to GO signal automatically so that there is no traffic congestion. One of the primary aims of this project is to allow theeasy passage of emergency vehicles by permitting them to bypass heavy traffic by using the RFTxRx method and reach their destinations on time by safeguarding the vehicle. Every emergency vehicle is assigned with a unique identity tag that distinguishes and

prioritises its exit from the rest of the vehicles on the road. On receiving the information of emergency vehicles from the radio frequency signal, the sensors estimates the distance of emergency vehicles and delivers quick access for easy exit to the emergency vehicle on that particular road segment immediately.
A brief on the modules developed are:

1. **AUTOMATIC SIGNALLING SYSTEM**
Each heavy traffic junctions unnecessarily make thepublics to wait as the traffic light remains red for the stipulated amount of time, even if there is not much vehicles on the road. This is owing to manual operation of the traffic signals. On the on-set of the green signal in a particular lane, it remains in the same condition even when all the vehicles have crossed or when no more traffic is found on that lane. The problem could be resolved by changing a system which detects traffic flow on each road and sets the timings of signals accordingly.

2. **DENSITY BASED SIGNALLING SYSTEM**
With each passing day as the quantity of vehicles on the road is increasing, heavy traffic congestion has become a common scenario almost all major cities. This happens regularly at the central junctions most frequently in the mornings, before office peak hour rush and in the evening, after office hours when getting back from work. The answer to this situation is to program by imposing delays at different junctions depending on the density of traffic. The interval at junctions that have high volumes of traffic should be set to lower waiting periods than the junctions that has low traffic. This is done by placing anIR sensor at regular distances for every road such that these sensors sense the traffic density on that specific road. As the IR sensors are connected to the microcontroller,based on the information it provides, the controller detects the densely populated traffic and controls the traffic system.

3. **EASY PASSAGE OF EMERGENCY VEHICLES**
Frequently, through the traffic jam, the emergency vehicles, such as ambulance, fire brigade and police patrol vehicles are trapped particularly at the traffic light junctions. This is because the vehicles need to wait till the traffic light turns to green. The main purpose of using emergency vehicles such as an ambulance or fire brigade is to quickly reach to the persons who have had an accident or are seriously ill and have to speedily relocate them to hospitals, the solution lies in fitting traffic lights with Radio frequency transmitter and receiver to detect such emergency vehicles.

4. **AIR POLLUTION MONITORING SYSTEM**
As the number of vehicles keep increasing on the road by every passing year, the threat for air keeps increasing. It has been proved time and again that the main reason for the air pollution is the release of carbon monoxide which is released from the exhaust of vehicles.Air pollution leads to health hazards, causing a threat to life of more people.
MQ 2 sensor which detects the presence of polluted air at heavy traffic conjuction regions are deployed. The presence of the polluted air is displayed on the LCD screen as "Smoke detected". The sensor is connected to an exhaust fan, it starts to rotate to purify the polluted air.

5. **VEHICLE EMISSION TESTING**
Emissions tests are done to check the levels of toxic gases produced by vehicles on the road. Proper conditioning of the vehicles is important for the reduction of the release of exhaust gases from the vehicles. There exhaust may contain toxic gases like CO, hydrocarbons, particulates matter or sulphur dioxides. Since these gases are the main causes for global warming, periodic checks on the exhaust must be done regularly.
On the spot emission testing device has been designed so that the emission testing can be done anywhere. If the exhaust gases are more than the expected value, the buzzer beeps indicating that the vehicle has failed the emission test and needs a proper servicing.

6. **DETECTION OF STOLEN VEHICLES**
Usually when the vehicle is parked, we don't use any technology to track its location. Only when the vehicle has been stolen, we lodge a police complaint. The solution to avoid such unwanted situations is to install a radio frequency transmitter into the vehicles during their manufacturing phase. When the vehicle is trying to be forcefully started, the RF generates an alert in the form of a message that is sent to the registered number. The alert message is sent to the owner and the co-owner. So, by doing so the owner could be alerted about the vehicle theft taking place.
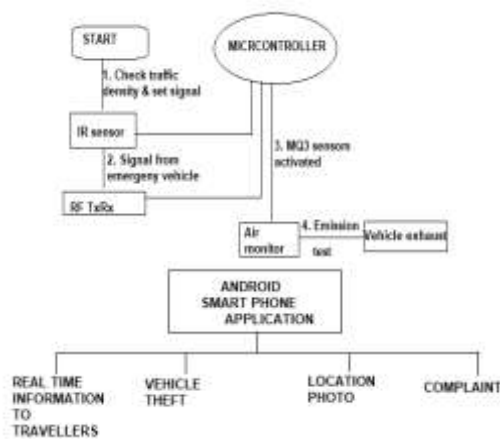
Fig 2 Context analysis

V.   Results And Discussion

The figure below shows the actual hardware setup before the actual execution of the model. The hardware starts working when the adapter is connected to 12V and 2Amps.
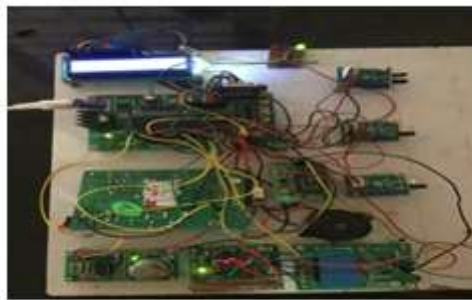

Fig 3 Hardware setup

The figure below shows the scenario when there is a heavy traffic in a particular junction. This is indicated in the LCD display where the counter runs for 60s as the IR sensors have detected high traffic.

Fig 4 Density based traffic

The emergency vehicle sends a radio frequency receiver if the traffic is at stop in the direction of travel. This signal is interpreted as an EMERGENCY and immediately the moving traffic in the opposite direction is stopped and green light is turned on in the direction of travel for the emergency vehicle to pass easily.
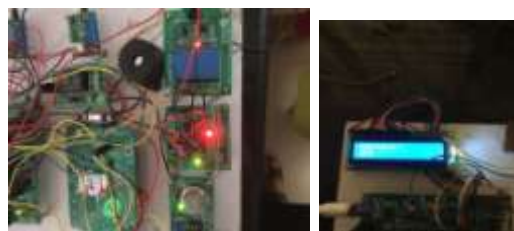

Fig 5 Emergency signal

Emissions tests are done to check the levels of toxic gases produced by vehicles on the road. Proper conditioning of the vehicles is important for the reduction of the release of exhaust gases from the vehicles.
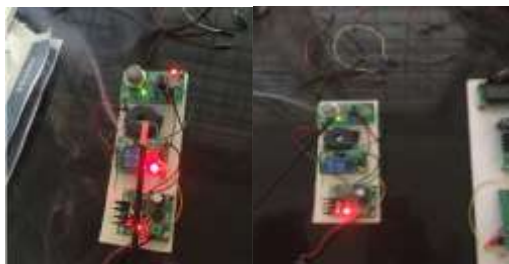

Fig 6 Emission testing

As the number of vehicles keep increasing on the road by every passing year, the threat for air keeps increasing. It has been proved time and again that the main reason for the air pollution is the release of carbon monoxide which is released from the exhaust of vehicles.

Fig 7 Detection of air pollution

VI.   Conclusion

Intelligent Traffic control for Smart cities system has been productively planned and verified by incorporating most of the primary features of the hardware components that have been used in developing the project. By incorporating IR sensors into the traffic light signalwhich is controlled by a microcontroller the possibilities of traffic jams, could be handled appropriately. The amount of vehicles passing, during a defined time slot decides the density range of traffic and on the basis of vehicle count, the microcontroller can be designed which decides the traffic light delays for next interval of time.

By using this project in future we can know traffic density in the city and so that remedies can be made according to that. All the vehicles which are in the design and production phase could be fitted with the RFTxRx sensors to control vehicle thefts. In an ambulance, the data of the patient being transported can be sent to the hospitals via GSM technology. Provision could be made for people to get actual visuals of the traffic at any junctions. Thus, it can provide early and fast treatment of the patients.

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