Signs with Smart Connectivity for Better Road Safety

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INTRODUCTION:

Fast transportation systems and rapid transit systems are nerves of economic developments for any nation. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control system for national development. The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming such a problem. One way to improve traffic flow and Safety of the current transportation system is to apply automation and Intelligent control methods. As the Number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important issue in the future . Traffic congestion may result due to heavy traffic at a junction. To avoid congestion there are so many traffic management techniques available. But no technique is perfect by itself as the real time situations are generally continuously changing and the system has to adapt itself to change in the continuously changing circumstances. We have made an attempt to provide some traffic management strategy which is self-changing in nature, so as to fit into continuously changing real time traffic scenarios. In this system time is assigned to traffic light of particular lane according to the traffic density on the road with priority given to ambulance. Also we can indicate signal break in a particular lane. If there is an obstacle LCD is used to display the message of obstacle detection to avoid inconvenience. The current traffic control systems (TCS) within the metro cities of India are inefficient due to randomness within the traffic density pattern throughout the day. The traffic light timers have a hard and fast period to modify traffic between different directions. Due to this, the

vehicles need to wait an extended time albeit the traffic density is extremely less. If the traffic light timer (TST) is often programmed to be manipulated with the continuously varying traffic density, the matter of traffic jam can be often reduced to a significantly lower level. Bilal Ghazal about Smart traffic signal Control System, states that the planning of an intelligent control system is a lively research topic. Researchers round the world are inventing newer approaches and innovative systems to unravel this stressful problem. Models supported by mathematical equations are used to estimate the car waiting time at a junction, the number of cars and therefore the extension of the waiting cars along the lane, the optimal timing slots for green, yellow, and red lights that best fit the real situation and therefore the efficient combination of routing. The mutual dependencies between nearby intersections cause a sophisticated formulation with cumbersome parameters. These parameters are accidental, hazardous, dependent, and therefore the worse point is that the variance of those parameters with time. Thus, finding a dynamic, consistent, and convenient solution is quite impossible. Researchers from different disciplines are collaborating to explore feasible solutions that reduce traffic jams. Therefore, various methodologies are constantly proposed within the literature and lots of techniques are implemented taking advantage of the technological advances of microcomputers, recent manufactured devices and sensors, innovative algorithms modelling, the maximum amount as possible, the complication of traffic lights. The IR sensors are used in numerous traffic systems. The IR transmitter and therefore the IR receiver are mounted on either side of a road. When an automobile passes on the road between the IR sensors, the system is activated and therefore the car count is incremented. The collected information about the traffic density of the various roads of a junction is analysed to switch dynamically the delays of green light at the lane having the most traffic volume. The entire system might be controlled by PIC microcontroller or maybe by PLC.

Camera detection:

Intelligent Transport System (ITS) use cases like ALPR, traffic monitoring, and parking lot management rely on cameras to perform people & vehicle counting, facial recognition, demography analysis, etc. Explore the key camera features of an ITS application and how to choose the right camera. Increased traffic congestion, overcrowding and rise in fatal accidents in cities demand a coordinated traffic management system. Today, an Intelligent Transport System (ITS) has become a necessity more than a luxury in urban planning, and has already been utilized in various cities across the world. In these, reliable vision systems play a significant role in smart traffic management by helping in accurately acquiring data on vehicles and pedestrians. Many ITS applications like Automatic License Plate Recognition (ALPR), traffic monitoring, parking lot management, people counting in traffic signals etc. require cameras that can read numbers and texts and perform facial recognition & demography analysis. In this article we explore the key benefits of using cameras in an ITS, and more importantly how to choose the right camera for your ITS or smart traffic management solution.

Advantages:

Vision based smart traffic systems enabled with ALPR and speed control provide real-time analysis that helps in efficient traffic violation control.

Integrating a camera into Smart Traffic Systems increases the extent of use cases the system can potentially cover. This will also lead to an overall increase in the performance price ratio of the system with integration of cameras offering better performance for a lower incremental cost.

Cameras with HDR capabilities in traffic monitoring systems enable round the clock surveillance under challenging lighting conditions.

High resolution of sensor size

The Department of Transportation in Tennessee has deployed ITS systems in highways and tunnels to monitor traffic and ease congestion. One of the challenges faced by the transport department was covering the wide FOV (Field of View) or area at highway intersections. This means that the

systems need a camera with high resolution that gives an image output that can be zoomed in to view the necessary details of a scene. Sensor size also determines the ability of a camera to cover a wide field of view. A large sensor has large pixel size which allows to capture more photons due to its large pixel well. Higher the number of photons, more will be the light absorbed, and hence better will be the details captured. Consider two 4K cameras, one with a 1/2.8-inch sensor and another with a 1/2-inch sensor. Though the resolution supported by both the cameras is the same, 1/2.8-inch sensor measures only ~6.4 mm diagonally which results in a pixel size of 1.45 µm x1.45 µm. Whereas the 1/2-inch sensor measures ~9.5 mm diagonally which results in a larger pixel size of 2.1 µm x 2.1 µm. A large pixel size also facilities a short exposure time which helps to capture images with less noise. This shorter exposure time also allows to reduce motion blur in the output image caused due to fast motion of the target objects.

Inductive loop detection

Inductive loop detection works on the principle that one or more turns of insulated wire are placed in a shallow cutout in the roadway, a lead in wire runs from roadside pull box to the controller and to the electronic unit located in the controller cabinet. When a vehicle passes over the loop or stops, the induction of the wire is changed. Due to change in induction, there is change in the frequency. This change in the frequency causes the electronic unit to send a signal to the controller; indicating presence of the vehicle. Inductive loop detection is useful in knowing the vehicle presence, passage, occupancy and even the number of vehicles passing through a particular area. But there are few problems with this system. These include poor reliability due to improper connections made in the pull boxes and due to application of sealant over the cutout of the road. If this system is implemented in poor pavement or where digging of the roads is frequent then the problem of reliability is aggravate.

Video analysis

consists of a smart camera placed which consists of sensors, a processing unit and a communication unit . The traffic is continuously monitored using a smart camera. The video captured is then compressed so as to reduce the transmission bandwidth. The video analysis abstracts scene description from the raw video data. This description is then used to compute traffic statistics. This statistic includes frequency of the vehicles, average speed of the vehicles as well as the lane occupancy .The problems associated with video analysis are – (a) the overall cost of the system is quite high (b) the system gets affected in case of heavy fog or rains (c) night time surveillance requires proper street lighting idea analysis.

Infrared sensors

Infrared sensors are used to detect energy emitted from vehicles, road surfaces and other objects. The energy captured by these infrared sensors is focused onto an infrared sensitive material using an optical system which then converts the energy into the electric signals. These signals are mounted overhead to view the traffic. Infrared sensors are used for signal control, detection of pedestrians in crosswalks and transmission of traffic information . The basic disadvantages of infrared sensors are that the operation of the system may be affected due to fog; also installation and maintenance of the system is tedious. The design of intelligent traffic control system is an active research topic. Researchers around the world are inventing newer approaches and innovative systems to solve this stressful problem. Models based on mathematical equations are applied to estimate the car waiting time at a junction, the number of cars in the waiting queue, the extension of the waiting cars along the lane, the optimal timing slots for green, yellow, and red lights that best fit the real and veritable situation and the efficient combination of routing. In fact, the mutual dependencies between nearby intersections lead to a complicated formulation with cumbersome parameters. These parameters are accidental, hazardous, dependent, and the worse point is the variance of these parameters with time. Thus, finding a dynamic, consistent, and convenient solution is impossible. Researchers from different disciplines

are collaborating to explore feasible solutions that reduce traffic congestion. Therefore, various methodologies are constantly proposed in the literature and many techniques are implemented profiting from the technological advances of microcomputers, recent manufactured devices and sensors, and innovative algorithms modelling, as much as possible, the complication of traffic lights. The IR sensors are employed in numerous traffic systems .The IR transmitter and the IR receiver are mounted on either sides of a road. When an automobile passes on the road between the IR sensors, the system is activated and the car counter is incremented. The collected information about the traffic density of the different roads of a junction is analysed in order to modify dynamically the delays of green light at the lane having the significant traffic volume. The whole system could be controlled by PIC microcontroller [1-2, 4-5] or even by PLC. To inform the traffic system about the arrival of the emergency vehicles toward the junction, they are supported by RF emitters [10-12] that send warning signals to RF transceivers disposed at every traffic light intersection. The triggering sequences of the traffic lights are modified correspondingly in order to provide a special route to the emergency vehicles. Other researchers [13] use the Global Positioning System (GPS) to communicate with the traffic light controllers and send permission signals. The ambulance was equipped with both RF to communicate with traffic light controller and the GSM module to report to hospital doctors about the patient status and to receive messages concerning the kind of therapy or first aid recovery that should be done to the injured patient.

Smart sign

The smart road signs use several forms of radar as well as a range of weather and traffic sensors to collect information and a built-in algorithm to process data as well as Bluetooth to communicate with one another. A team of leading researchers have developed ‘intelligent’ road signs which can warn drivers about hazardous road conditions ahead. A specialised Doppler radar will be built-in to the traffic signs and transmit pulses of radio waves directed at vehicles and other moving objects on the road and

measure the difference between the transmitted impulse and an echo in order to measure their velocity. The signs also use a unique built-in radar system combined with wireless technologies and sensors, to collect information on weather conditions, traffic and hazards on the road to warn drivers in real-time. The innovation includes a 'Doppler radar' based on the Doppler effect discovered by Austrian physicist Christian Doppler in the 19th century. The Doppler Effect, which refers to the change in wave frequency during the relative motion between a wave source and its observer helps to explain why an ambulance siren sounds higher pitched when approaching us and lower pitched after it has passed us. The specialised Doppler radar will be built-in to the traffic signs and transmit pulses of radio waves directed at vehicles and other moving objects on the road and measure the difference between the transmitted impulse and an echo in order to measure their velocity. It is already used in police speed guns and along some roads to take speed readings and tell drivers to slow down if they are exceeding the limit, but the smart signs will also use it to measure rain drops hitting the road's surface. The use of Doppler radar will be complemented by the use of acoustic vector sensors (AVS), technology more commonly used underwater, which works by reading the motion and pressure changes of reflected sound waves. It would be used in the road signs to calculate traffic on a section of the motorway by showing the direction in which a sound wave is travelling and how many other sources of sound are nearby. The information will be used to alert drivers to any congestion in front of them. AVS can also be used to analyse sound signals to provide a better picture of road conditions in both wet and dry weather. Another innovative aspect of the system is the way in which road signs would communicate with each other and with motorists over a special form of Bluetooth Wifi system called vehicle to everything (V2X) technology designed for fast moving objects and compatible with Bluetooth enabled cars and smartphones. The smart road signs were due to be rolled out earlier this year, but were delayed by the pandemic. When introduced, it is hoped they will help to prevent major road collisions. The system is being

pioneered as part of a national Polish project called INZNAK, financed by the Polish National Centre for Research and Development, Poland's Public agency for scientific innovation.

Intelligent speed adaptation

ISA is a system which informs, warns and discourages the driver to exceed the statutory local speed limit. The in-vehicle speed limit is set automatically as a function of the speed limits indicated on the road. GPS allied to digital speed limit maps allows ISA technology to continuously update the vehicle speed limit to the road speed limit. Informative or advisory ISA gives the driver a feedback through a visual or audio signal. A Speed Alert System is an informative version of ISA; it is able to inform the driver of current speed limits and speeding. Supportive or warning ISA increases the upward pressure on the accelerator pedal. It is possible to override the supportive system by pressing the accelerator harder. Intervening or mandatory ISA prevents any speeding, for example, by reducing fuel injection or by requiring a "kick-down" by the driver if he or she wishes to exceed the limit.

Effectiveness of ISA

The EU-funded and SRA co-ordinated project PROSPER looked into ways that advanced assisted driving technology and technology relating to speed limitation devices can improve safety, and also at the barriers for the implementation of ISA. The PROSPER project calculated crash reductions for six countries. Reductions in fatalities between 19-28%, depending on the country, were predicted in a market-driven scenario. Even higher reductions were predicted for a regulated scenario - between 26-50%. Benefits are generally larger on urban roads and are also larger if more intervening forms of ISA are applied . Trials with ISA have been carried out in ten European countries: Austria, Belgium, Denmark, Finland, France, Hungary, The Netherlands, Spain and Sweden . An earlier study in the Netherlands showed that ISA could reduce the number of hospital admissions by 15% and the number of deaths by 21% Research has shown

that ISA is a physical measures to reduce road speed are complementary rather than competing methods.

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System requirements

ARDUINO MEGA 2560

The Arduino Mega 2560, an ATmega2560 based microcontroller. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs, a 16 MHz quartz oscillator, a USB connection, a power jack, a reset button, and an ICSP header. It has got everything needed to support the microcontroller. Simply connect it to a computer using a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega 2560 board is often programmed with the Arduino Software (IDE).The ATmega2560 has got 256 KB of flash memory for code storage, 8 KB of SRAM and 4 KB of EEPROM. Each of the 54 digital pins on the Mega can be used as an input or output, using the functions: pinMode(), digitalWrite(), and digitalRead(). They operate at 5 volts.

LCD display

The LCD is a parallel port and its display regulation is done by controlling several interface pins directly. A register select (RS) pin that controls where within the LCDs memory youre writing data to. A Read/Write (R/W) pin that selects the mode of operation, an Enable pin that permits writing to the registers. 8 data pins (D0-D7). The states of these pins (high or low) are the bits that youre writing to a register once you write, or the values youre reading once you read. Theres also a display contrast pin (Vo), power supply pins (+5V and Gnd) and LED Backlight (Bklt+ and Bklt-) pins that you simply can use to power the LCD, control the display contrast, and switch on and off the LED backlight, respectively.

GSM module

The SIM900A is a complete Dual-band GSM/GPRS solution, which may be embedded within the customer applications. It delivers GSM/GPRS 900/1800MHz performance, as per industrial standards, for voice, SMS, data, and fax during a small form factor and with low power consumption.

SIM900A can be used in most space requirements in user applications, especially for slender and compact demand of design.

Traffic light bundle

Traffic light module consists of red, yellow, and green LEDs, each of which has an individual control pin to which the digital high and low signals will be provided, and a common ground. It usually operates at 5V.

IR sensor module

The IR sensor module consists of IR Transmitter and Receiver, an opamp, a variable resistor (Trimmer pot), and an output LED. The IR LED (transmitter) emits light. The IR receiver, a photodiode, conducts when light falls on it. Photo- diode is a semiconductor which has a P-N junction, operated in reverse bias, which means that it starts conducting the current in reverse direction when light falls on it, proportional to the amount of light. This property makes it useful for IR detection.

Existing system

All the traffic signals use LCD lights to show the traffic signals and static boards to show the speed limit, this board does not get changed and remains constant.

Proposed system

Smart connected sign boards will be used instead of static boards.

It will display the speed limitations.

Instead of static boards displaying the speed limit, smart boards will display.

It updates automatically and displays the speed limit accordingly to the climatic condition.

Based on the weather changes the speed limit will increase or decrease.

Diversions will also be displayed on the smart boards.

What's new from the old in our project

Our project overcomes many issues at present the people are facing while driving, if a board is there with speed limit 40 it remains same till the end, but at raining time the car should go slow, and the driver should be indicated by signs, that's the reason of doing this project.

Conclusion

Smart Traffic Management Systems are technology solutions that municipalities can integrate into their traffic cabinets and intersections today for fast, cost-effective improvements in safety and traffic flow on their city streets. The future of the transport industry looks pretty optimistic with digital traffic solutions. Therefore, we advise you to take advantage of the already apparent technological and organizational breakthroughs. Relevant Software specializes in solving business problems using software solutions, including IoT for transportation projects. So if you want to hire IoT developers to create a custom-made IoT app or improve an existing one, contact us right now. In addition to experience and technology, we will provide comprehensive information on emerging trends to keep your IoT solution relevant in the long term.