IoT based Smart Traffic Signal: Time Stealer

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Abstract:

The increased numbers of private vehicles on the roads has added much to the traffic congestions and wait time at the intersections. To make cities smart and smart cities smarter by reducing this problem, the number of systems has been and is being developed, as it also causes the wastage of time, fuel and also increases air and noise pollution. In this paper, we present a system 'Time Stealer' which will check the density of the traffic on the sides of the road and will give green light time accordingly keeping in view that all sides get their turn. This system will reduce the wait time that vehicles do even when there is no traffic on the green side and will also avoid signal jumping which is very common in our country and also a cause of the number of accident.

1. INTRODUCTION

Today people around the globe are connected by the internet. They can communicate via video call, audio call and also share data using the internet, it was for people, now the Internet of Things (IoT) is a similar development. IoT is connecting physical objects making them communicate, share their experience i.e., what they sense in their environment using sensors. We give physical objects the ability of sensing, measuring and then communicating the data sensed or measured over a network so that it may be further processed to perform certain tasks. IoT has hardware like the sensor to sense, Data which is gained by sensing and is shared on the network over which it is connected to others or software which processes the data get meaning out of it. It is making our life easy. IoT is making things smart and above all, it is cost-effective. Internet of Things has made life easy, better and enjoyable in every aspect. Its application in our daily life. Fields like medical and many other IoT have increased the rate of precision and accuracy. IoT's application has been and still is making cities smart by managing local departments' information systems, schools, libraries, transportation systems, hospitals, power plants, water supply networks, waste

management, law enforcement, and other community services. It makes monitoring systems of these department senses using objects and acts according to the data received. Cities are growing faster because of the availability of better facilities and resources to spend a better life. This has attracted more population in the cities, with more people and vehicles on the road have increased the number of traffic jams on the roads. Daily new and better gadgets are introduced in the market to make cities smart and do daily simple tasks easily and efficiently. All these also include the systems developed to make traffic signal smart. The number of attempts has been made and the number of devices and systems has been developed. Here in this paper, we present a system called Smart Traffic Signal: Time Stealer. In today's world, everyone is busy nobody got time to stop. Every day we wait at a traffic signal for the green light of our side of the road, even if there is no traffic on the side of the road with green light, and if someone tries to run that signal that vehicle gets the ticket and could also become the cause of the accident. In a country like Pakistan, jumping signal is very common which is very dangerous; to avoid this new system is presented in this paper. Time stealer as the name suggests it steals the time from the signal of the road with no traffic and

will turn it to read and will turn green the side of the road with traffic. It will detect the density of traffic on each side of the road and using the data gained will steal the time with no or low traffic and will control the signal accordingly.

2. LITERATURE REVIEW:

Internet of Things was in development even though the term was introduced later. Kevin Ashton an entrepreneur first introduced the term "Internet of Things". He first used the term internet of things in a presentation he made in 1999. He was one of the founders of the Auto-ID Center at MIT, he along with his team discovered how to link objects with RFID tags. Today IoT is working in medical, transportation, telecommunication, manufacturing, retail and utilities [1]. This is not the limit. Kevin Ashton in "That 'Internet of Things' thing" from the RFID journal says that RFID makes computers identify and understand the world without any human help but it is not limited to that. He further says that from ten years now we must not narrow ourselves to just identification by RFID by ignoring what technology can do. We must not shrink our vision, IoT has the potential to change the world [2]. So it is happening we have automated things that not only reduce human effort but also work with more accuracy and precision. IoT is not just making us as individuals smart but it is making whole cities smart by helping them managing transportation, power and water supplies, it is working in law enforcement, hospitals agriculture, etc. The purpose of making cities smart is to make the services efficient for the residents using urban informatics and technology. Using IoT officials will get to know about the city more closely how it is evolving what things and procedures must be changed or enhanced to give a better quality life to the residents. Data gathered from the sensors integrated with real-time monitoring systems, after processing and analysis can help to get to know about the flaws and incompetence moreover it will help to resolve the issues identified. An Example of smart cities is Barcelona city of Spain, in 2014 Barcelona's Parc Del Park was seen to have gardener with tablets to control system of watering plant and other things. The city moved 178 points of irrigation to internet controlled system. Their data is recorded through the software to analyze so that the system could be made more efficient [3]. Traffic in cities is one of the biggest

problems, how to control it efficiently? How to avoid traffic congestions? How to make intelligent traffic signals? It does not just waste time, it is the cause of pollution, stress and fuel wastage. Several solutions for mentioned problems have been presented and these solutions have helped us make cities smarter here is an example of IoT is making the city smart in transportation also. Taking Barcelona as an example again there is the number of traffic and signal systems that have been developed for smart traffic lights as buses run on the routes to optimize the green lights. More to that whenever there is an emergency in the city the route of the emergency vehicle is entered in the traffic light so they may turn green for that emergency vehicle [3]. Many systems have been presented using IoT to reduce traffic problem, as it is one of the big problems and also cause the number of health problems. Intelligent Traffic Information System Based on Integration of Internet of Things and Agent Technology have been presented in which information about the traffic on the roads like density on the certain road closed routes etc. is sensed and communicated to the drivers and more to that it is an intelligent system which not only guides drivers about the traffic condition on the roads but also predicts the future traffic flow. To achieve this architecture proposed is an integration of the internet of things with agent technology, agent technology handles effective communication and interfaces among a large number of heterogeneous highly distributed, and decentralized devices within the IoT. It covers the roads, tunnels, bridges and traffic signals using Infrared, RFID, Global Positioning System, laser scanner sensors [4]. IoT-RFID Testbed for Supporting Traffic Light Control another system to make traffic signals efficient and intelligent. For this system, the problem is much similar to ours that empty lanes are given green light, but this system collects the data and communicates it with police in charge of the signal and neighboring signals to control the flow accordingly. Here they have used RFID to detect average speed, average wait time and queue size which is used further as the input for the neural network to determine the percentage green light time and duration of its cycle for best throughput. This system calculates the congestions density by the speed of the vehicles. More to that it can also trace information of the vehicles which can help against crime. The system employs UHF Passive RFID technology

to collect vehicle information [5]. Another system has been presented to detect congestion on the intersections and optimize the working of traffic lights so that the traffic keeps moving and there may not be congestion. In this system, they have used an ultrasonic sensor to detect the density of the traffic. According to the system, the sound producer is installed on one side of the road and receiver of the other side on the footpath so that they may not give the wrong information. The ultrasonic sensor can work in case of heavy rainfall and if there is water on the road. Data of the sensor is received and fed to a microcontroller, data is processed and traffic lights are controlled accordingly. Besides this, this system has a GSM module which in case of any issue in the system or traffic light sends the message to the operating authority of the traffic light system to take appropriate action [6]. Intelligent Traffic Signal Control System Using Embedded System developed by Dinesh Rotake and Prof. Swapnili Karmore, they have developed a system which detects the traffic density at the signals and makes traffic lights to turn green intelligently, they have also worked on the detection of the emergency vehicles and operate lights accordingly using microcontroller. For emergency vehicle detection and giving the way, they have considered two scenarios when there are other vehicles in front of an emergency vehicle and when there is just emergency vehicle at the signal they have made the system work accordingly intelligently. This system addresses the problem of congestion at signals, fixed signal times even when there is a lot of traffic or no traffic at all and emergency vehicles stuck in traffic at signals. "The ITSC system consists of high-performance, low power AVR_32 microcontroller with 32kbytes of in-system programmable flash memory and in-built 8-channel, 10-bit ADC which is required to process the IR input from the sensor network." It detects the traffic volume using a genetic algorithm and emergency vehicles using the IR sensor [7].

In another paper [9] a framework was introduced for traffic signal violation detection where a microcontroller and ultrasonic sensor are used. These sensors are placed in those areas of the road which are declared prohibited for vehicles when signals are turned off. If any vehicle passes through this area during those time of period when signals are turned off then sensors immediately detect the motion and pass

a message to the microcontroller which passes a message to a camera which is already attached with it, that camera capture the image of this vehicle and save for record.

3. DESIGN AND ANALYSIS

Traffic is one of the biggest problems in today's world, every day some new technology is introduced in the market. Getting private cars is one of the priorities of the people which cause an increase in the number of vehicles on the roads and also causing congestions at intersections especially. The number of the system have presented using different techniques to avoid traffic congestions by making intelligent traffic lights and predicting the traffic flow providing drivers with the information about traffic conditions on the roads and also about closed roads, tunnels, bridges, and diversions so drivers may plan their routes accordingly to avoid wait time and congestions. The system is making traffic signals intelligent by detecting the concentration on the road and giving them appropriate time so there may be no congestion. They have made use of IoT technology which is cheap easy to handle. The use of different suitable sensors has made according to their useful aspects and conditions. Some systems also have a GSM module to inform the authority in case of a system failure or any case which is against the odds, so that authority may check the system and control the traffic manually till the system resume its working.

3.1. ARCHITECTURE

For our proposed system we first detect the density of the traffic at the road on each side. Different techniques have been used to detect the density of the traffic at signals on roads; IR sensors are good at this.

Figure 1: IR Sensor [8]

As IR sensors have a transmitter and receiver placed on sides of the road, constantly transmitting and receiving if interrupted for a little longer than usual means there is traffic on the road waiting for the green light. A microcontroller will receive the output from the sensor and send the signal to the traffic light accordingly. Three sensors on each side of the road will be placed to detect the traffic until a certain distance. There are three-point first one near 20-30m from the signal, second further 20-30m from the first point and third 20-30m from the second point.

Figure 2: The microcontroller receives information by IR sensors

Normally signals for each of the roads turn green for 30-45 seconds. If the sensor detects traffic till the first point then it will turn green on its turn for 15 seconds and go to red when the point clears out, and pass the turn to the other side of the road. If the traffic is till the second, 30 seconds to the green light on the side of the road will be given it will be considered normal. For the third point, the traffic on the side of the road will be assigned 45 seconds to the green light. This will not only reduce the wait at the traffic signal but also reduce the chances of congestion.

Figure 3: Traffic control by Microcontroller

3.2. WORKING METHODOLOGY

Figure 4: Working Model of smart traffic signal

Figure 4 shows the model of a smart traffic signal in which three IR sensors will detect the traffic at three different points according to which the density of the traffic will be calculated. The output of the sensors and the traffic signal status i.e. which side is green which will be next will be fed to a microcontroller which accordingly will control the traffic signal. If the traffic is still the first point, the time of the green light will be reduced. If it is still the second or third point, 30 or 45 will be given respect and it will cycle. All sides will get their turns accordingly system will not steal turns.

4. LIMITATIONS

IR sensors can work properly at a certain distance, it might not work properly if the distance is disturbed and signals may not work properly. Sunlight may affect the detection so for that we have to place it at such point that sunlight may not cause any problem and signal output may not be trouble the drivers. This system is to reduce wait time at signals and reduces the chances of congestion at intersections. This system might not be helpful if traffic is diverted from other routes and traffic on the signal in this case traffic may even cross the third point of detection, during that situation signals will work normally, fixed time on each side.

5. CONCLUSION

The system presented have application on road especially like the roads of Pakistan where it can help in making people not jump traffic signals which is one of the causes of the accidents. It is a solution for the number of problems like time wastage at signals, pollutions (air and sound) fuel wastage, etc., it will not eliminate these problems but will reduce to some extent. The system has limitations but can be improved with further study and guidance.

Future works on the same system may include detection of emergency vehicles so they may not have to wait on the signals, also to add GSM module that if the system crashes in charge of the traffic area may be informed or authorities so proper steps may be taken to bring the system to normal working condition.

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