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A SURVEY ON AMBULANCE CONTROLLED TRAFFIC SYSTEM

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ABSTRACT

Traffic jam is one of the major issues nowadays. Due to lack of efficient and effective traffic signal control and management, so many ambulances are getting stuck in traffic jams and may lead to loss of lives. So clear the traffic on the lane in which the ambulance is coming by putting the corresponding lane to a green signal and make all other lanes to a red signal. The different methods for overcoming this problem is discussed in this paper. The latest traffic signal controlling techniques such as Embedded System, Wireless Technologies, Image Processing Based Intelligent Traffic Controller, Automatic Traffic management and Radio Frequency Identification (RFID) are described.

KEYWORDS: Traffic signal Control; Wireless Sensor Network; Radio Frequency Identification.

1. INTRODUCTION

A Wireless Sensor Network (WSN) is a wireless network which consists of a number of nodes which are scattered and each node is connected to a sensor which monitor its physical and environmental conditions. A Wireless Sensor Network has a gateway that provides wireless connectivity to the wired world and for the nodes. Wireless Sensor Network has applications in the areas like health care, remote monitoring, utilities, transportation etc. Wireless Sensor Network is also called as dust network, it is because of they are built by using sensor nodes of several hundred or thousands.

Components of a WSN Node

The Wireless Sensor Network node consists of 5 technical components. They include radio, battery, microcontroller, analog circuit, and sensor interface. The first component is a radio, radio means radio technology. The higher data rates and more frequent radio has higher power consumption. Usually, a battery life of three years is a requirement. Nowadays the Wireless Sensor Network uses ZigBee because of its low power consumption. Here Wi-Fi is an interesting technology used.

The second component of a WSN node is a battery. When selecting a battery one must focus on their size and weight. And also focus on the international standards for shipping and battery availability. While selecting a battery does not focus on their battery life. Usually used batteries are Carbon Zinc and alkaline batteries due to its wide availability and low cost. To increase the life of a battery the node periodically wakes up and transmit data through radio by powering it ON. After transmitting data it goes back to sleep mode by powering it OFF.

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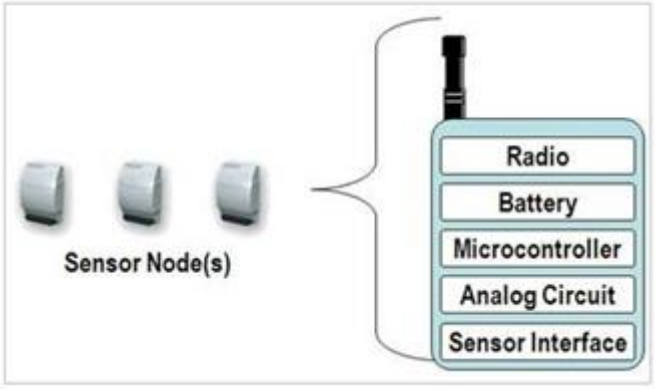

Fig. 1. WSN Sensor Node Components[2]

The third component is a microcontroller, which is actually a general purpose processor. It is optimized for the embedded applications and it must have a low power consumption. The last component is a sensor interface. The sensor interface consists of two subunits. They are; Sensors and ADC (Analog to Digital Converter). The analog signals produced by sensors are converted into digital signals by using an ADC. After converting into digital form these signals are then fed into a processing unit. The processing unit manages the procedures of a sensor node collaborate with other nodes to carry out the assigned task. Usually, the processing unit is associated with some kinds of a small storage unit.

2. RELATED WORK

Several techniques are there to control traffic light. Follow-ing are the few popular systems:

Embedded System

The embedded system consisting of IR sensors and AVR-32 microcontroller. The AVR-32 microcontroller is with programmable flash memory and is with an 8 channel ADC. AVR is a family of microcontrollers and is developed by Atmel in 1996. The AVR family is one of the earliest and first family which use on-chip flash memory for storage. The AVR stands for Alf and Vegards RISC processor. 8 channel ADC means it has 8 inputs. One typical example of ADC is a SAR ADC(12 bits).

IR (i.e. Infrared) sensor is programmed to identify emer-gency vehicle and microcontroller is designed in such a way that it gives a red signal to all other lane but one with the emergency vehicle.

The embedded system is based on a microcontroller. The microcontroller used in the system is an 89V51RD2 which is MCS51 family based. The system contains an IR transmitter and an IR receiver. This IR transmitter and IR receivers are placed on the roadsides respectively. Here there is an amplifier which amplifies the current through IR LED. The IR sensor and IR transmitter are placed at a gap. When any obstacles like vehicles pass in between these two, the microcontroller understand and detects and using this data microcontroller increase the vehicle count.

This vehicle count is stored in the memory of a microcon-troller. Appropriate decisions such as traffic light delays are taken by the microcontroller based upon this vehicle count. There must be a certain distance between the IR system and traffic light. The micro controller also updates the traffic light delays. Here the IR sensor is placed ahead of traffic light so that the decision taken by the microcontroller can control traffic light and thereby avoid the congestion at the junction.

In this system, the microcontroller is connected to a com-puter by using a serial communication cable. By establishing this connection the traffic administrator sitting in front of the computer can command the microcontroller to send the recorded data. It also can update and erase the previously recorded data.

The embedded system has limitations such as here IR sensors are used and these IR sensors must be kept in a strong box or a safe place. The cost is high for this system.

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Wireless Technologies
In this technique, a wsn has the role of communication infrastructure. Here there is a central monitoring system and it collects all information and makes a response.

The emergency vehicle faces problems when there is heavy traffic in the 2 junctions. If the ambulance is used for an emergency purpose the driver will turn on the emergency light and siren. The sensors are placed certain distance before the traffic junction and these sensors detect the speed and sound waves of the siren. Using this information an appropriate time is calculated for the ambulance reaching the junction and the traffic is cleared for that time. By using an inter communication the two junctions communicate with each other and they pass the information of speed so that the junction 2 can clear the traffic in the corresponding lane, so that emergency vehicles can pass quickly [2].

overview of priority based traffic lights controller: *Here we are considering 3 inputs such as police, ambulance and fire brigade vehicles. If the vehicle is used for an emergency purpose the driver will turn on the emergency light and siren. The sensors are placed certain distance before the traffic junction and these sensors detect the speed and sound waves of the siren. If more than one emergency vehicle is approaching a junction in a different direction it may lead to collisions.*

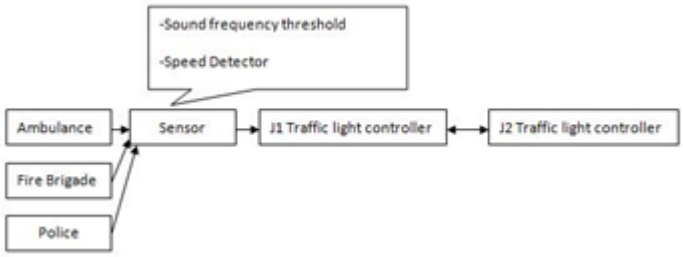

Fig. 2. Block diagram of the WSN system[2]

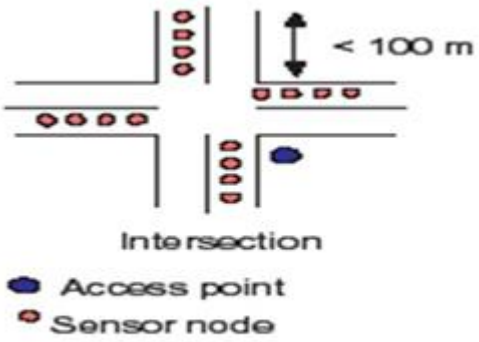

Fig. 3. Example Configuration of the system[2]

The system contains access nodes. The traffic administrator collects information from these nodes and updates the delay. An example configuration for the system is given in Fig.3 It has limitations such as WSN is still a research field. Unnecessary extra hardware is required for this method and also require a robust sensor.

Image Processing Based Intelligent Traffic Controller
In this technique, we use cameras which are placed appro-priate positions so that the clear view of traffic is obtained. The various steps of Image Processing Based Intelligent Traffic Controller system are described in Fig.4.

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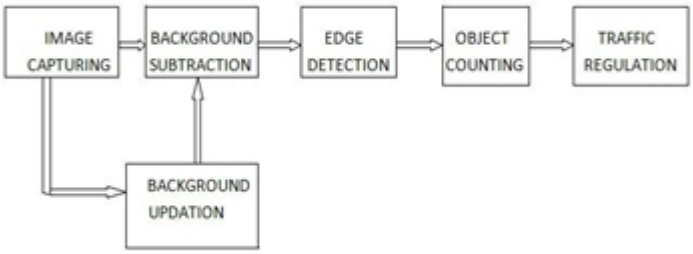

Fig. 4. steps of Image Processing Based Intelligent Traffic Controller system[5]

Image capturing: The first step is image capturing, that means the images are taken from a video. Here the images are captured for every 3 minutes. Image capturing is nothing but take the image of the traffic. If an emergency vehicle is detected then that lane has more priority

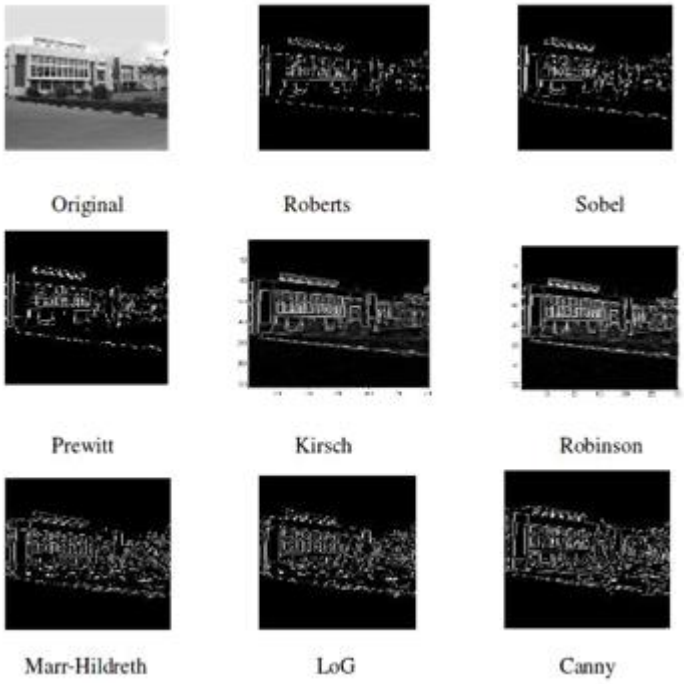

Fig. 5. Original Image with the result of various edge detection techniques [5]

Background Subtraction: The second step is back-ground subtraction. An adaptive background technique is used for background subtraction. An adaptive background technique means that the current image based on the result extracted from differencing the image with the previous extracted background. Adaptive background technique is the basic idea of this.

After background subtraction, we want to separate the fore-ground from the background. This separation of foreground is done by pixel by pixel comparison of the current frame with the background. If the value of a pixel is different from the corresponding value of pixels in the background, then that pixel is a part of the foreground.

Edge Detection: The separation of the foreground is done by pixel by pixel comparison and then need to specify their edges in the subtracted image. For this purpose, so many edge detecting algorithm is there. The Boolean edge detector is one of the simple edge detectors. In Boolean edge detector, it converts a window of pixels into a binary pattern and then applies a mask to determine the edges exist or not.

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A lot of edge detecting algorithms are there. Some of them are; Roberts Edge Detection, Sobel Edge Detection, Prewitt Edge Detection, Kirsch Edge detection, Robinson Edge detection, Marr-Hildreth Edge Detection, LoG edge detection, and Canny Edge Detection. It is shown in fig.5

After this based upon the edge detected images calculate the vehicle count and thereby regulating the traffic. But the main limitation is that the camera used here must be robust. And this system also fails if more than one ambulance appearing in different lane may lead to producing green light for all lane.

Automatic Traffic management
The automatic traffic management scheme completely avoids the interference of human. The working of a traffic signal in this scheme is fully automatic. Usually the traffic signal consists of three colour signals green, yellow and red that we see every day.

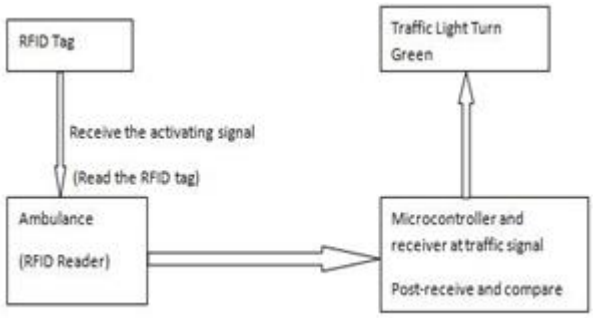

Fig. 6. System overview of RFID[7]

The basic idea of this scheme is very simple and is that assigning a particular time for each signal light to flash. The yellow light must be ON before the green light. The yellow light is an indicator for starting the vehicle and ready to go. Here the green signal is ON for 120 seconds for each lane. Before green light, the yellow light flashes for 20 second. All other times the red signal is ON and it arranges the vehicle in the junction by stopping them. There were a lot of limitations for this technique. This technique cannot have the ability to detect an emergency vehicle. It treats an ordinary car and an emergency vehicle such as an ambulance in the same way. Another serious problem is that if any driver breaks this signal, then it may lead to major accidents.

Radio Frequency Identification (RFID)
Radio Frequency Identification is simply called it as RFID. The RFID avoids the problems associated with traffic signal control a certain level. It will be the most suitable solution for problems associated with image processing. The RFID technique deals with the different junction and different lanes.

Radio Frequency Identification(RFID) Sensors: The problem of traffic signal controlling can be solved at a certain level using RFID. Here the ambulance is equipped with an RFID reader and an RFID tag. Radio frequency identification technique uses the radio waves to control the traffic signal. The RFID can be applied in various areas such as commerce, medical science, Electronic toll collection system, security, access control etc.
The three main components of RFID are; RF Reader, RFID tag and Database. Mainly two types of tagsare used in RFID. They are; active tags and passive tags. The main difference between an active tag and passive tag is that in active tag an internal power source is present. But there is no internal power source in passive tags. The passive tags are activated by the RFID reader. The reader sends electromagnetic waves and when this wave reaches the tag it leads to a generation of a small amount of current in the tag's antenna. As a result of this current generation, the antenna transmits the information stored in it.

There are three parts of an RFID tag: a semiconductor chip, antenna, and an encapsulation. The passive tag has a very long life and is of less cost compared to an active tag. The active tag contains an internal power source such as a battery so its life time is small and its range and cost are more. The RFID based traffic signal

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controlling faces some issues such as the driver must know the start point and end point of the travel. If the route of ambulance changes due to some issues then the RFID may not work.

3. COMPARISON

The latest traffic signal controlling techniques such as Embedded System, Wireless Technologies, Image Processing Based Intelligent Traffic Controller, Automatic Traffic management and Radio Frequency Identification (RFID) are described above. Each traffic signal controlling techniques are different from one another and each method has its own advantages and disadvantages.

The first technique is an Embedded system and it can be applied to a large number of areas. In this technique, an IR sensor is used and it uses infrared light. The IR sensor receives infrared light and this light is non radiated for both living thing and non-living objects. The embedded system has limitations such as here IR sensors are used and these IR sensors must be kept in a strong box or a safe place. The cost is high for this system.

The second technique is a wireless system which use wireless sensor network and it detects the speed and sound waves at a particular threshold so that the ambulance arrival time at junctions can be calculated and control the traffic at that time. It has limitations such as WSN is still a research field. Unnecessary extra hardware is required for this method and also require a robust sensor. Another major issue is that the data exchange in between Sensor is not reliable. Here the IR sensor detects the sound of the siren but there is a chance that this sound is easily influenced by noise.

The third method is Image Processing Based Intelligent Traffic Controller and it does not waste the time by putting a green signal to empty roads. This is the main feature of image processing based traffic signal control. Here the camera takes images and detect the vehicles and count them by going through certain steps. So it does not make a green signal for empty roads. But the main limitation is that the camera used here must be robust. And this system also fails if more than one ambulance appearing in different lane may lead to producing green light for all lane.

The fourth technique is Automatic Traffic management and it does not contain any human interference. This is the main advantage of this technique and it also has many limitations due to this. This technique cannot have the ability to detect an emergency vehicle. It treats the ordinary car and an emergency vehicle such as an ambulance in the same way. Another serious problem is that if any driver breaks this signal, then it may lead to major accidents.

The last technique discussed above is Radio Frequency Identification (RFID). The RFID based traffic signal control-ling faces some issues such as the driver must know the start point and end point of the travel. If the route of ambulance changes due to some issues then the RFID may not work.

4. CONCLUSION

In this paper survey on the latest traffic signal controlling techniques such as Embedded System, Wireless Technologies, Image Processing Based Intelligent Traffic Controller, Auto-matic Traffic management and Radio Frequency Identification (RFID) are done. Each technique is unique and has its own advantages and disadvantages. By comparing these four tech-nique much better one is the Radio Frequency Identification (RFID). By using this technique we can control the heavy traffic at the junction at a certain limit. The RFID helps to reduce the waiting time at the traffic signal. So RFID helps to control the traffic signal by putting a green signal for the lane in which the ambulance is coming and its working is simple compared to others. So RFID is the most suitable technique for traffic signal control.

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