CONTROLLING OF TRAFFIC SIGNALS AND VEHICLES AT ROAD JUNCTION USING ZIGBEE

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Abstract- Traffic congestion is the biggest problem faced by densely populated countries like India, China, etc. Our project focuses on three areas- Traffic density control, making path to emergency vehicles (like ambulance, patrol vehicles, etc.) and making the vehicles to stop at stop line. ZigBee based traffic control will be provided for traffic signals and vehicles. ZigBee are used to provide dynamic traffic control and thus increasing the duration of the Green light of the lane in which traffic density is high. Hence the traffic density is regulated. Thus the ZigBee communicates with the microcontroller in each vehicle crossing the lane while it was in red signal. The emergency vehicles have more priority in signal changes to creating path in that particular lane.

Keywords- ATmega8, RF (radio frequency), ZigBee.

I. INTRODUCTION

Traffic congestion occurs due to the ignorance of the traffic rules at road junction. Traffic congestion may also occur due to over period of red signal i.e. traffic signal is not depending on vehicle density in the lanes. Therefore we optimize the signal based on the action of the sensors. Ever since the major problem faced by us is displaying the time in LED which make us intense to raise the acceleration of vehicles.

One of the major problems faced by the emergency vehicles is due to heavy traffic. As we all know that ambulances are the most important medical means of transporting any country as they carry patients to the nearby hospitals. But due to heavy traffic, one can often see the ambulances stuck in traffic for long durations thus causing danger to patient’s life. So our project aim is to solve this problem caused by ambulances.

When an ambulance arrives to any junction, the traffic light of corresponding lane changes to green and all the other signals turns to red. Thus paving traffic-less way to the ambulance and helping it to reach the hospital as soon as possible. The RF transmitter ranges up to 50 meters and the detection of the emergency vehicles could possibly done before entering the road junction. This is possible by the use of RF transmitters and receivers [6]. Secondly, we control the traffic density on roads by using ZigBee. Since ZigBee is a transceiver, it can be used for the communication between vehicles and the controlling unit. Each vehicle transmits its own individual number to the receiver placed at 30m distance from stop line. In return to this, the transmitter from the lane side transmits the data about traffic signal and timings. Based on the signal, the vehicle responds to these. The data about the vehicles can be stored for the later use. This helps in reducing the unnecessary timing of the green signal. Each vehicle has transmitter and receiver which decodes the data about vehicles and transmit to the ZigBee receiver. It receives data like signal or timing to change the signal. When data about vehicle is received, it can be taken as a count of an individual vehicle. Traffic signal time is changed according to the number of count on vehicles. This makes a smooth passing of vehicles without any disturbance.

II. BLOCK DIAGRAM DESCRIPTION

The microcontroller manages both the traffic signal control and the vehicle density on the road. ZigBee module collects data from each vehicle and transfers the data to the microcontroller.

![Block Diagram](image-url)
It stores the data of each vehicle as number, this helps in calculating density on the road side. The response from the microcontroller to the vehicle i.e. signals timing and status of signal. ZigBee module acts as transceiver.

The vehicle decoder decodes the individual number and transmits the data to the receiver. The RF transmitter helps to detect the emergency vehicles and it acts as the relevant protocol.

III. CONCEPTS USED

A. ZigBee
ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. Though it is low power consumption limit transmission distance about 10–100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.)

ZigBee has a defined rate of 250 Kbit/s, best suited for intermittent data transmissions from a sensor or input device. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi [2]. ZigBee is a low-cost, low-power; wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications. ZigBee devices have low latency, which further reduces average current.

ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flash memories. No external Antenna required. Maximum range of 10-30 Meters as Line of Sight.

B. ZigBee Protocols
The Protocols build on recent algorithmic research to automatically construct a low speed ad-hoc network of nodes. In most large network instances, the network will be a cluster of clusters. It can also form a mesh or a single cluster.

The current ZigBee protocols support beacon and non-beacon networks. In non-beacon enabled networks, an un-slotted CSMA/CA channel access mechanism is used. In this type of network, ZigBee routers typically have their receiver continuously active, networks in which some devices receive continuously, while other only transmit when an external stimulus is detected. In beacon enable networks, the special network nodes called ZigBee routers transmit periodic beacons to confirm their presence to other network nodes. Researchers have developed many new protocols specifically designed for WSNs, where energy awareness is an essential consideration; focus has been given to the routing protocols. Since they might differ from traditional networks (depending on the application and network architecture).Nodes may sleep between beacons, thus lowering their duty cycle and extending their battery life. Beacon intervals depend on data rate; they may range from 15.36ms to 251.6582s at 250 Kbps. In general, the ZigBee protocols minimizes the time the radio is on, so as to reduce power use. In beaconing networks, nodes only need to be active while a beacon is being transmitted. In non beacon enabled networks, power consumption is decidedly asymmetrical. Some devices are always active, while others spend most of their time sleeping.

C. Radio Frequency
RF transmitter is placed in all emergency vehicles. It will be turned on with siren sound. RF receiver is placed at road ends. When RF receiver receives signal it intimates system to make a way for emergency vehicle. The RM-433 is a radio frequency receiving device that operates at 433 MHz it is designed to receive signals that are transmitted by RTI universal system controllers. The RM-433 contains a microprocessor that monitors all received signals so that RF noise and data from non-RTI transmitters is filtered out.

When valid RTI data is detected, the RM-433 passes the signal through its output driver which allows the data to travel long distances over wire. The output driver is compatible with industry standard infrared
repeating systems, and can be wired together with those systems or with additional RM-433 units. This allows RTI control systems to be controlled from almost any location with either IR or RF transmitters.

CC2500 RF Module is a transceiver module which provides easy to use RF communication at 2.4 GHz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source. This module is a direct line in replacement for your serial communication it requires no extra hardware and no extra coding to It works in Half Duplex mode i.e. it provides communication in both directions, but only one direction at one time [3]. No complex wireless connection software or intimate knowledge of RF is required to connect our serial devices. Designed to be as easy to use as cables.

IV. SYSTEM OPERATION

ATmega8 (L) has three ports namely B, C and D. The memory size is 8kb on chip and EEPROM size is 512 bytes. It consumes less amount of power and multiple uses for operation. It is easy to access and control. It has both the transmitter and receiver ports. The voltage supply to the micro controller is given by DC source using voltage regulator [3]. At each road there will be RF receiver and ZigBee module; this will be placed at distance of 30meters from stop line. Each vehicle is provided with ZigBee trans-receiver.

Vehicles are already encoded with their vehicle number which they transmit it. Receiver on the road receives it and adds it to the memory. Density of traffic is calculated based on number of vehicle’s signal received. Transmitter on road transmits the data about the traffic signal. Vehicles react according to the signal. Vehicle stops the engine when signal is red or timing less than required to pass the junction. Vehicles are made to stop before stop line. According to the density of the vehicles the “on time” of green signal is varied.

During emergency vehicle passing, transmitter of emergency vehicle transmits the RF signal. This makes clear that the vehicle needs emergency way to pass the junction. Microcontroller makes ongoing signal into red and which gives a path to emergency vehicle by making all the vehicles to cross the junction. The system is at low power state for few seconds after crossing a signal because there may be interface which will cause problem in finding density of vehicles [4].

V. ABS SYSTEM

The Anti-lock braking system is concerned as an automobile safety system that allows the wheels on a motor vehicle to maintain tractive contact with the road surface according to driver inputs [1]. It prevents the wheels of the vehicles from ceasing rotation and avoids uncontrolled skidding. This prevention occurs at a much faster rate and with better control than a driver could manage. Generally it offers improved vehicle control and it decreases stopping on dry or slippery surfaces.
In our idea, we designed the ABS system along with the microcontroller inside each vehicle. When the lane was in red signal, the ZigBee receives the decoded data from each vehicle and activates the microcontroller action towards ABS system in each vehicle.

The ABS system consists of a central electronic control unit (ECU), speed sensors and brake hydraulics to complete its operation.

The ECU constantly monitors the rotational speed of each wheel and detects them significantly. If ECU detects the rotational speed of the wheels at faster rate, the brake hydraulic pressure to the wheel is increased.

Hence the braking force is reapplied, slowing down the wheel speed. In modern electronic stability control system has two additional sensors- it has steering wheel and gyroscopic sensors.

The gyroscopic sensors are used for detecting the orientation of the wheel, based on the principle of preserving angular momentum. The action will end up in decreasing the speed of the vehicle and stop behind the stop line.

VI. FUTURE SCOPE:

- Store the data of vehicles which will be helpful in search of theft vehicles.
- As vehicle can decode speed of vehicles, it can be useful for traffic patrol to detect high speed vehicles at the junction of the road.

CONCLUSION

This paper presents the ZigBee adaptive traffic signal controller of an isolated intersection of our approaches. The controller can adjust the signal timing in response to observed changes. In different traffic states (traffic parameters, such as the number of vehicles waiting in queue) the urgency degree for green time will differ in different phases. The urgency degree is used to describe the different user demands. And the controller decides the signal response with respect to the density of the area. While using smart ambulance system, traffic jam can be controlled and the accidents can be avoided. This new system can be used in main cities such as Chennai, New Delhi, etc for controlling the traffic system and it will be useful for traffic patrol to control it.

REFERENCE

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