Traffic Congestion Detection for Highways Using Wireless Sensors

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Abstract

The deficiencies in the road network are 8causing huge economic losses because of slow transportation. These deficiencies also contribute to a high rate of road accidents. The most common problems that we can find in roads nowadays are huge; there are fearsome traffic congestions, which make lost a lot of time, money, health and environmental quality every day.This project will concentrate on the detection of traffic congestion on highways. So it is important to detect the vehicle count properly. This project may use magnetic sensor for detection of vehicle passing on the node of road. It's another objective to develop a protocol between sensor nodes for communication wrf traffic congestion. This paper presents an embedded wireless sensor network(WSN) prototype system for detection of traffic congestion. Each WSN node consists of a microcontroller and transceiver module.

Keywords Congestion, protocol, sensor, transceiver, wsn

I. INTRODUCTION

Traveling is part of our daily lives. Everyone has to be on the road, may it be on going to work, going to school, or going to the grocery store to buy any material. Every time we travel, we have to spend important time and energy on the road.

India has one of the largest road networks in the world (around 4 million km at present).National Highways (NHs) are the main arterial roads connecting ports, state capitals, industrial and tourist centers, and neighboring countries. NHs constitute less than 10 percent of the total road network, but carry nearly 60 percent of the total road

traffic A measurement system is needed to gauge the impact of travel-related problems on "quality of life" since it is insubstantial. An approximate measurement system for transportation is also recommended for the problem of overcrowding in trains and traffic congestion on roads. This system calculates the overall impact of congestion and transportation on quality of life. Number of steps have been taken by the Ministry to spread road safety culture in the country. These include road safety training, education and driving instructions, traffic regulations, measures to deal with traffic offences and improvement of both active and passive vehicle safety.

1.1: Problem Statement
The focus problem statement comes under highway management system .Highway management system includes
- Traffic congestion control
- Safety management on highways
- Toll management
- Highway maintenance

Traffic congestion is always there due to accidents, road repairing etc which leads to time wastage.

In India population is increasing .This leads to increase in use of vehicles. So it is important to Manage the vehicles properly .This project will concentrate on the detection of traffic congestion on highways. So it is important to detect the vehicle count properly. In most vehicle detection methods in the literature, only the detection of vehicles in frames of the given video is emphasized. However, further analysis is needed in order to obtain the useful information for traffic management such as real time traffic density and number of vehicle types passing these roads. There are various methods to detect the vehicles such as inductive loop, video monitoring system etc . This project will use magnetic sensor or peizo sensor for detection of the vehicles.

We use the Xbee modules based on IEEE 802.15.4 standards to build low power, low maintenance WSN. Low power, small size, low cost and long battery are the Reasons of using Xbee.we use Arduino board with ATmega328 for easy interfacing with Xbee module and for easy programming of microcontroller

2. PROBLEM FORMULATION
Traffic congestion detection system consists of a client computer which a user interface to the system, a coordinator as a data collector, and several end devices which provide sensor readings over XBee communication links.

The Traffic Monitoring system includes: peizo sensor/magnetic sensor, Arduino microcontroller, Xbee and a PC based map. The magnetic sensor, will detect the presence of a vehicles on a given point on the road. The data would be registered to the Arduino microcontroller. It will send to Xbee(1) module. The Arduino(1) will start to count up. Another two sensors will be positioned a certain distance from the first sensor will detect the same vehicle detected by the first sensor. Upon detection,

the Arduino will send data to Xbees (2&3). The no of counts of each sensor node(Xbee, sensor and microcontroller) will be compared.If no of count is same for each node then there is no traffic congestion but if no is varying then there is traffic congestion condition .Traffic congestion are displayed using user interface(via ethernate) or display.

Microcontroller
A microcontroller is simply a computer on a chip. Microcontrollers are entirely self-contained computers built on a single piece of silicon. They incorporate all of the functions of a traditional computer in a single silicon chip.
Microcontrollers include a processing unit, program (permanent) memory, data (temporary) memory, a clock/oscillator circuit, a timer/counter circuit, general purpose I/O ports, and specialized peripheral features. Specialized peripheral features are interrupt inputs, low power and sleep modes, A/D converters, analog comparators, capture/compare modules, high current outputs, pulse-width modulation (PWM) outputs, serial/I2C transceivers, and LCD drivers.

**Programming the Arduino Microcontroller**
The microcontroller understands only machine code. Binary numbers stored in the microcontroller's memory make it do arithmetic operations, Boolean logic operations, move data between memory and registers, and control which instructions get executed, in which order.

C programming
C is an(procedural) systems implementation language. It was designed to be compiled using a relatively straightforward compiler, to provide low-level access to memory, to provide language constructs that map efficiently to machine instructions, and to require minimal run-time support. C was therefore useful for many applications that had formerly be formerly been coded in assembly language. Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant and portably written C program can be compiled for a very wide variety of computer platforms and operating systems with few changes to its source code. The language has become available on a very wide range of platforms, from embedded system.

Sensor Placement and Design
Sensors distance should be longer than the engine of a vehicle because it is the part that the sensor will recognize. The group designed the distance of the sensors to be 2 meters apart
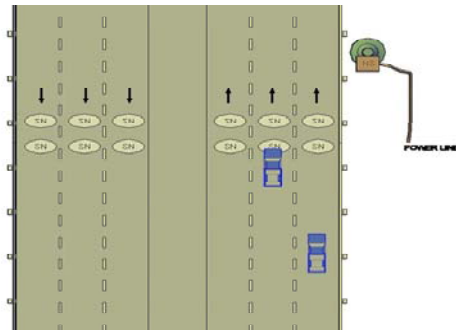
WITH SENSOR NODES
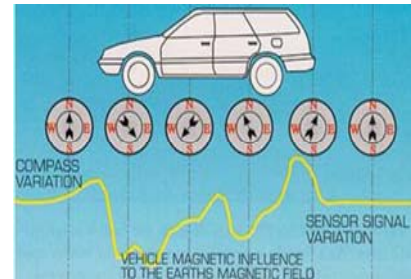
Perturbation of Earth's magnetic field by a ferrous metal vehicle

In a freeway the sensor will be placed in between lane. Since there are no traffic lights or other disturbance from a freeway, we can directly take the average speed of the roadway and determine the road's traffic condition.

Hardware Specification:
A WSN node consistsof a microcontroller, some sensors, and a communication module

a) Microcontroller:
We use Arduino USB Board which use the chip ATMEGA328 as a processor, controlled by the computer via USB port. Arduino composed of 5 pins Analog I/O and 13 pins Digital I/O which can interface with the other devices such asI2C, SPI, digital and analog.
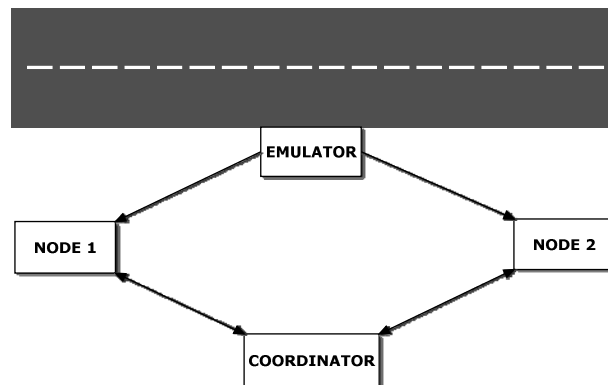
b) Sensor:Magnetic sensors
Count vehicle numbers, speed, and type are placed under or on top of the roadbed.

The Magnetic Loop Vehicle Detector is used to detect the presence of a vehicle as it passes over a loop of wire, which has been set into the ground.

When a vehicle passes the sensor, disturbance in the earth's magnetic field due to the vehicle would be detected by the sensor. Once an object passes through the sensor the output voltage would vary in mill volt range depending on the ferric content of the object

Block diagram

c) Communication:
The node end consists of an emulator, microcontroller, LCD display and zigbee module. The emulator will generate the signal that is identical to the magnetic sensor. The emulator's signal is generated by using a FPGA. The signal is given as an input to the microcontroller and it will detect the vehicle passing on each node of road. The controller will classify the vehicle according to its categories as well as it will store its count accurately and also the respective data of node will be displayed using a LCD module.

The coordinator end consists of a zigbee module and LCD display that continuously receives the data from both the nodes end and compares it and as there is a respective difference in the count of both ends it will display a congestion message on the LCD display.

We use Xbee in our system. The xbee module is compliant to the IEEE 802.15.4.It is a series 2 version which supports mesh networking, fixes the address to 64 bits and has 20 pins.

In summary, the system consists of two types of nodes: co-coordinator and end device as shown in fig. The Coordinator consists of Arduino, Xbee, Xbee shield, . On the other hand, End Device consists of Arduino, Xbee, Xbee shield, and a sensor

3) Software specifications:
a) Microcontroller:
We use Arduino IDE as a code editor.
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Implementation of the ATMEGA328p Microcontroller
The ATMEGA328p Microcontroller programming would be done using C PROG. A threshold voltage is configured to the Microcontroller. This threshold voltage would identify if the object that passes through the nodes would be a noise or a ferrous object. When a ferrous object passes through the node A (sensor) data will send to xbee, xbee sends data to microcontroller and starts counting, the Microcontroller sends the data to the PC .

3. FINITE ELEMENT FORMULATION

Value of counter= Frequency of FPGA/2(Required frequency)

Frequency = 1/Time.

For coordinator:-

Length of vehicle = (Time between sensor1 + Time between sensor2)/ Time between single sensor

4. RESULTS AND DISCUSSIONS

The numerical procedure that has been used to solve the traffic congestion .It will give which type of vehicle is going on highway whether two wheeler, three wheeler or four wheeler. It provides smooth solutions in highway traffic congestion detection .

Sr No	Type Of Vehicle	No of Vehicles
1	2 Wheeler	4
2	3 Wheeler	6
3	4 Wheeler	10
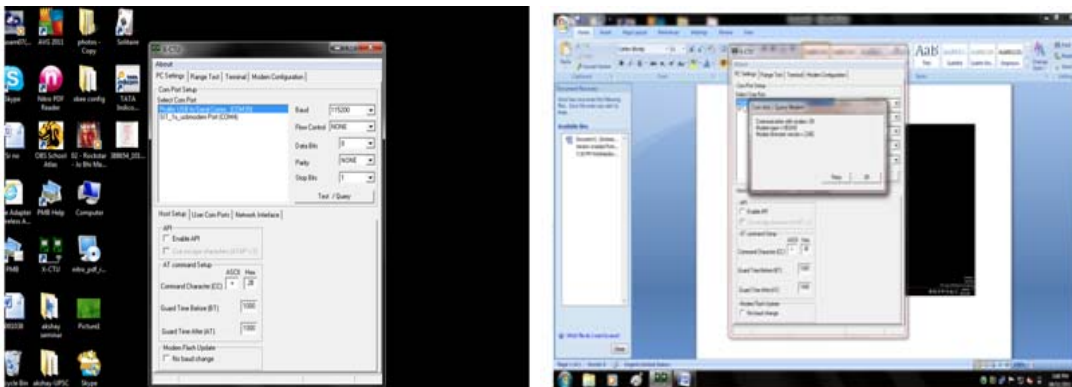
Use either peizo sensor or magnetic sensor.Measure the distance between sensor nodes which will be in meters.

5. CONCLUSION

Nowadays, road traffic is an important problem in a lot of industrialized countries. This fact make essential to build a road and transport system characterized by high dynamicity and low congestion and incidents. In this paper, system of traffic control based on WSN has been proposed. The advantages of technology applied to the traffic control allow designing and developing systems with a high level of autonomy and intelligent.

Vehicle detection using magnetic/peizo Sensors is possible through proper signal conditioning and use of data processing.

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