Survey on Road Traffic System and Violation Using Sensor Networks

B. Vinoja¹, L. Thomas Robinson², P. Joselin Vinisha³

¹M.Pill Research Scholar, Nanjil Catholic College of Arts and Science Kaliyakkavilai
²Assistant Professor, Nanjil Catholic College of Arts and Science Kaliyakkavilai
³Assistant Professor, Nanjil Catholic College of Arts and Science Kaliyakkavilai

Abstract: Road Traffic in crowded cities like Tokyo, Mumbai, Pune, Kolkata, Bangalore, New Delhi, Bangkok, Mexico, Romania, Indonesia, Russia China and India. Traffic accidents occur for various reasons. While problems with roads or safety facilities lead to some accidents, Unsafe road environments, Insufficient driver knowledge, Improper thinking and Wrong driving habits are the dangerous behaviors. Traffic congestion in the larger cities of the world is a growing problem that has to be taken into explanation critically. After a general survey in the field of Vehicle and Highway System, different alternatives are analyzed to solve this problem and the concept of Intellectual Transportation System is proposed as the best solution. Intellectual Transportation System includes to detect wrong way vehicles and at a time to measure speed of the vehicles using traffic sensor. This contains separate entirely-functional units with their own characteristics organized to each other to conform a flexible system that can respond in an effective way to solve the problem of traffic blocking. Increasing the efficiency and of the existing traffic monitoring network is today’s requirement due to the continuous increase in traffic volume and the limited construction of new highway facilities in urban and rural areas. Smart street systems that contain real-time signal control systems, traffic monitoring detectors, motorist communications media and control to develop smart corridors that increase the effectiveness of the transportation network. The infrastructure improvements and new technologies are being integrated and public access areas to intelligent transportation systems. Car accidents happen all the time – one drive down the freeway can attest to that. To avoid getting into one yourself, you need to account for yourself as a driver and for those around you, too. Not only will this lead to safer driving, but it can also save you time and unnecessary expenses.

I. INTRODUCTION

Driving is an essential part in the life of many people with the huge use of vehicles in day to day life unplanned death has shown. Due to these unplanned death, in most of the cases, people lose their life. A Wireless sensor network (WSN) consisting of thin autonomous devices using sensors. The development of wireless sensor network were originally motivated by its various application in military, natural, physical condition, home and other commercial fields. Wireless sensor networks (WSN) are generally used in 4-wheelers to perform various management functions, such as finding empty parking place, automatic toll ticket generation, security, to detect wrong way vehicles, management etc. Now a days there are various types of speed sensors are available but I am choosing piezoelectric sensor. A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. In this paper provide implementing piezoelectric sensor to improve multiple access performance in VSN(Vehicular Sensor Networks).
1.1 Inductive-loop
Vehicle detection loops, called inductive-loop traffic detectors, can detect vehicles passing or arriving at a certain point, for instance approaching a traffic light or in motorway traffic. An insulated, electrically conducting loop is installed in the pavement.

1.2 Magnetic Sensor
Here the magnetic sensor is based on Hall effect. The effect is based on the interaction between moving electric carriers and an external magnetic field. In metal, these carriers are electrons. When an electron moves through a magnetic field, upon it acts a sideways force
\[ F = qvB \]

1.3 Acoustic detector
This detects vehicles by the sound created as the vehicle passes. The sensor is mounted on a pole pointing down towards the traffic. It can collect counts for one or more travel lanes. Some can communicate their counts wirelessly.

1.4 Passive Infrared
Passive infrared devices detect vehicles by measuring the infrared energy radiating from the detection zone. When a vehicle passes the energy radiated changes and the count is increased. Slow changes in road surface temperature, caused by changing weather conditions, are ignored. Lane coverage is limited to one to two lanes.

1.5 Doppler and Radar Microwave Sensors
Doppler microwave detection devices transmit a continuous signal of low-energy microwave radiation at a target area and then analyze the reflected signal. The detector registers a change in the frequency of waves occurring when the microwave source and the vehicle are in motion relative to one another. This allows the device to detect moving vehicles.

II. SURVEY ON SPEED MONITORING SYSTEM FOR VEHICLES IN ROAD TRAFFIC

2.1 Vehicle Detection and Car Speed Monitoring System using GMR Magnetic Sensors

Objectives
A new simple circuit can detect the magnetic perturbation caused by the cars with two GMR Magnetic Field Gradient Sensors located on the pavement of a highway or fast road without wires. When a car passes above the hoard, a Microcontroller processes the signal of sensors to obtain the speed and length of the car in real time. The dates of more than one thousand vehicles could be stored in ROM until it is full. At this point the microcontroller sends the dates through a FSK modulation, that a PC stored permanently, and after present it with a software. The affordable system could be used to automatic traffic measurements and control at many places, replacing the expensive systems like the ultra sonic sensors and the video cameras to cover an extended area.

Working principles of Giant Magnetoresistance (GMR) Seems
Giant magnetoresistance (GMR) is a quantum mechanical magnetoresistance effect observed in multilayers composed of alternating ferromagnetic and non-magnetic conductive layers. Although the term "giant" in giant magnetoresistance (GMR) seems incongruous for a nanotechnology device, it refers to a large change in resistance (typically 10 to 20%) when the devices are subjected to a magnetic field, compared with a maximum sensitivity of a few percent for other types of magnetic sensors.

The main application of GMR is magnetic field sensors, which are used to read data in hard disk drives, biosensors, MicroElectromechanical Systems (MEMS) and other devices. GMR
multilayer structures are also used in magnetoresistive random-access memory (MRAM) as cells that store one bit of information.

![Graph showing magnetoresistance](image)

Magnetoresistance is the dependence of the electrical resistance of a sample on the strength of an external magnetic field. Numerically, it is characterized by the value

\[
\delta_H = \frac{R(H) - R(0)}{R(0)}
\]

where \(R(H)\) is the resistance of the sample in a magnetic field \(H\), and \(R(0)\) corresponds to \(H = 0\). Alternative forms of this expression may use electrical resistivity instead of resistance, a different sign for \(\delta_H\), and are sometimes normalized by \(R(H)\) rather than \(R(0)\).

**Learning Outcome**

GMR sensors can be a good election to get multiple information about traffic event in extremely conditions and with noise presence. The compound system with this sensors have a good stability, with respect the temperature, and immunity in front of any kind of ambient noise. The final result is a cheap system with a very low installation and maintenance cost that it could be adapted to many applications like the trains circulation control or ferromagnetic pieces movement in industry. It could be possible to recognize the kind of vehicle with the placement of more oriented sensors in the highway to obtain a three dimensional signals. A complex software could analyze the signals to compare it with stored patterns.

**2.2 Improved multi-objective weighted clustering algorithm in Wireless Sensor Network**

**Objectives**

A well-designed clustering algorithm, WSN’s energy consumption can be decreased evidently. In this paper, an Improved Multi-Objective Weighted Clustering Algorithm (IMOWCA) is proposed using additional constraints to select cluster heads in WSN.IMOWCA aims at handling a WSN in some critical circumstances where each sensor satisfies its own mission depending on its location. In addition to fulfill its mission, the sensor tries to improve the quality of communication with its neighboring nodes. Our proposed algorithm divides the network into different clusters and selects the best performing sensors based on residual energy to communicate with the base station (BS).

**Clustering in wireless sensor networks**

Wireless Multimedia Sensor Networks (WMSNs) are comprised of small embedded audio/video modes capable of extracting the surrounding environmental information, locally processing it and then wirelessly transmitting it to sink/base station. Multimedia data such as image,
audio and video is larger in volume than scalar data such as temperature, pressure and humidity. Thus to transmit multimedia information, more energy is required which reduces the lifetime of the network. Limitation of battery energy is a crucial problem in WMSN that needs to be addressed to prolong the lifetime of the network.

Types of clustering
- Static: local topology control
- Dynamic: changing network parameters
- Single hop and multi hop
- Homogeneous and heterogeneous

Learning Outcome
In this work we have proposed an improved multi-objective weighted clustering algorithm in order to resolve the energy problem in critical WSNs where each node tries to minimize the weighted sum of mission and communication cost in a distributed way. The proposal approach is based on advanced techniques of genetic algorithms. The different simulations display that total consumed energy in the network has decreased remarkably with around 45%. This means that the presented algorithms minimize more and more the energy which is the great challenge of WSN’s researches.

2.3 Road Vibrations as a Source to Detect the Presence and Speed of Vehicles
Objectives
Transportation is to interconnect vehicles and road infrastructure in order to correct information about the road conditions all the time. Traffic detectors like video-cameras or inductor loops are typically installed on fixed points on the roads. They limited information about the traffic conditions, being not possible if a driver was speeding before approaching to a detection zone, or if an accident has occurred beyond their measuring range. Sensor networks are attractive solution to communicate or connect roads, infrastructure, and vehicles. Each node can operate independently and communicate with its neighbouring nodes. Driving assistance systems implemented on modern vehicles can be enhanced by interchanging information with the net of sensors. As a result, in these assistance systems would be more affordable contributing to a faster adoption in entry models and not only in the most expensive ones.

Measurement Setup
The system was designed to measure one lane, but big vehicles from the opposite lane were occasionally detected. The distance between sensors varied between 1m to 3m. Sampling frequencies between 2 kHz to 10 kHz were used with data acquisition times between 5min to 10min. The vibrations are damped as they travel along the road’s surface due to its multilayer composition. In this paper the measurement: example with the distance between sensors of 2m, sampling frequency of 2 kHz and measuring time of 5 min is used to demonstrate the functionality of the algorithms.

Vehicle Detection
Since the vibrations on the roads propagate faster than the vehicles average speed of 70 km h-1. In the sensors detect the vibrations before the vehicles are in front of them.

Speed Calculation
The speed of vehicles communicate with the detected vibrations. This method considered all the distance between sensors from the first to last one to minimizing the error in the calculated speed. Where n is the total number of sensors and k is the number of sensors to be combined. The resulting number of combinations of two sensors out of four is six combinations. The biggest challenge to
calculate the speed is to set the reference point in the signal to obtain the time difference between signals. Four points are investigated: The start, end, middle, and maximum points.

**Travel Detection**

The sensor with higher number is the leading sensor and the other is the trailing sensor. The convention is used if the time difference is greater than zero, the vehicle was traveling in the measuring lane, but if it is less than zero, the vehicle was in the opposite lane. From the video recordings, 83 vehicles (including bicycles) were counted on the measuring lane and 43 vehicles on the opposite lane. The number of vehicles detected from the opposite lane is very low, because of the attenuation of their vibrations due to the road composition.

**Learning Outcome**

In conclusion, smart roads are a necessary technology to improve the efficiency of current infrastructure and the quality of life of the people. They are more reliable than traditional detectors, because each node can measure more than one source using different sensors. Particularly, vibrations are of special interest because they can also be used for energy harvesting to power the nodes. Moreover, the low cost per unit of each MEMS sensor node is ideal for smart roads, where large number of devices are required.

### 2.4 Portable Roadside Sensors for Vehicle Counting, Classification, and Speed Measurement

**Objectives**

This paper focuses on the development of a portable roadside magnetic sensor system for vehicle counting, classification, and speed measurement. The sensor system consists of wireless anisotropic magnetic devices that do not require to be embedded in the roadway—the devices are placed next to the roadway and measure traffic in the immediately adjacent lane. An algorithm based on a magnetic field model is proposed to make the system robust to the errors created by larger vehicles driving in the nonadjacent lane. Vehicle classification is done based on the magnetic length and an estimate of the average vertical magnetic height of the vehicle. Vehicle length is estimated from the product of occupancy and estimated speed. The average vertical magnetic height is estimated using two magnetic sensors that are vertically spaced by 0.25 m. Finally, it is shown that the sensor system can be used to reliably count the number of right turns at an intersection, with an accuracy of 95%. The developed sensor system is compact, portable, wireless, and inexpensive. Data are presented from a large number of vehicles on a regular busy urban road in the Twin Cities, MN, USA.

**Vehicle detection and counting**

This behaviour makes the detection more reliable, because large oscillations in the signals can cause errors due to the double detection of a single vehicle. In particular, it was observed that the signals measured along the $z$-axis have very similar patterns for a large variety of vehicles. Hence, magnetic readings of the $z$-axis of sensor 1 are used for detecting and counting the passing vehicles in the adjacent lane. A threshold of 30 counts was used as the vehicle detection threshold. This threshold was experimentally selected. If it is set very high, smaller vehicles will not be detected, and if it is set very low, a higher percentage of vehicles that pass in the nonadjacent lane will be detected.

**Learning Outcome**

This paper has proposed a portable and low-cost sensing system based on magnetic sensors that can be placed adjacent to the road and be used for traffic counting, speed measurement, and vehicle classification in the lane adjacent to the sensors. The vehicle classification and speed measurement in this paper are enabled using multiple spatially separated magnetic sensors. Through experimental data from 188 vehicles, it is shown that the traffic counting accuracy of the system is 99%.
III. PROPOSED METHOD

In this article we are about to see the problem of the major road accidents due to safety facilities lead to some accidents, Unsafe road environments, Insufficient driver knowledge, Improper thinking and Wrong driving habits are the dangerous behaviours.

A piezoelectric sensor is a device that uses piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. The prefix piezo- is Greek for 'press' or 'squeeze'. The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to $10^6$ N/m². Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This gives piezoelectric sensors ruggedness, an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) are extremely stable at high temperatures, enabling sensors to have a working range of up to 1000 °C. Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezoceramic materials. Gautschi in Piezoelectric Sensorics (2002) offers this comparison table of characteristics of piezo sensor materials vs other types:

![Figure 1: piezoelectric sensor](image)

| Principle       | Strain Sensitivity [V/µε] | Threshold [µε] | Span to threshold ratio |
|-----------------|---------------------------|----------------|------------------------|
| Piezoelectric   | 5.0                       | 0.00001        | 100,000,000            |
| Piezoresistive  | 0.0001                    | 0.0001         | 2,500,000              |
| Inductive       | 0.001                     | 0.0005         | 2,000,000              |
| Capacitive      | 0.005                     | 0.0001         | 750,000                |
| Resistive       | 0.0000005                 | 0.01           | 50,000                 |

Table 1: Piezoelectric sensor valuation

Piezoelectric sensors can also be used to determine aromas in the air by simultaneously measuring resonance and capacitance. Computer controlled electronics vastly increase the range of potential applications for piezoelectric sensors.
In this architecture is based on the sensor node (vehicle), cluster head (server). In this article using Piezoelectric sensor.

IV. CONCLUSIONS

A new simple circuit can identify the magnetic perturbation cause by the cars with two GMR Magnetic Field Gradient Sensors located on the path of a road or fast road without wires. It could be possible to know the kind of vehicle with the position of more orient sensors in the road to obtain a three dimensional signals. A complex software could analyze the signals to evaluate it with stored pattern. In this second work we have proposed an improved multi-objective weighted clustering algorithm in order to resolve the energy problem in crucial WSNs where each node tries to reduce the weighted sum of task and message cost in a dispersed way. Mainly, vibrations are of special concern because they can also be used for energy harvest to power the nodes. Also, the low cost per unit of each MEMS (Micro-Electromechanical Systems) sensor node is ideal for neat roads, where large number of devices are necessary. In the last paper focuses on the development of a moveable roadside magnetic sensor system for vehicle counting, classification, and speed measurement. The above discussed sensor types are some drawbacks due to some climatical changes, rough usage, and power shortages.

According to the above survey the drawbacks are analysed and fulfilled in this paper. The sensor system consists of wireless piezoelectric sensor devices which is embedded in the vehicles as well as the transceivers are placed randomly in the road sides in safer manner which will be used to convert the signal to the main server located in the office space through internet. But I’m concluded the Piezoelectric sensor is the most useful and the measurement is powerful and accurate.

REFERENCES

1. Javier Rivas, Ralf Wunderlich and Stefan J. Heinen, Road Vibrations as a Source to Detect the Presence and Speed of Vehicles, 2016.
2. Saber Taghvaeeyan and Rajesh Rajamani, Portable Roadside Sensors for Vehicle Counting, Classification, and Speed Measurement, FEBRUARY 2014.
3. Robert L. White, Giant Magnetoresistance: A primer. IEEE Trans. Magnetics, vol-28, n 5, June 1992.
4. James h'l. Daughton, GMR and SOT Sensor Applications, IEEE Trans. On Magnetics, V.36, n 5, pp.2773-2778, Sept. 2000.
5. Lo Chun, Lynch Jerome P, Liu Mingyan. Distributed model based nonlinear sensor fault diagnosis in wireless sensor networks. MechSyst Sig Process 2016; 66–67:470–84.
6. S. Gupte, O. Masoud, R. F. K. Martin, and N. P. Papanikolopoulos, “Detection and classification of vehicles,” IEEE Trans. Intell. Transp. Syst., vol. 3, no. 1, pp. 37–47, Mar. 2002.
7. https://en.wikipedia.org/wiki/Piezoelectric_sensor.
8. J. Pelegri, J. Alberola, V. Llario, Vehicle Detection and Car Speed Monitoring System using GMR Magnetic Sensors, 2002.

FEBRUARY 2014