ISSN 2515-8260 Volume 07, Issue 8, 2020

Study of IoT sensors for vehicle detection

Ashwini N[1] ,S.Mahalakshmi[2],Bhagya G[3]

[1]*Department of Computer Science and Engineering BMS Institute of Technology and Management* Bangalore, India
[2]*Department of Information Science and Engineering BMS Institute of Technology and Management* Bangalore, India
[3]*Department of Information Science and Engineering*
BMS Institute of Technology and Management
Bangalore, India

Email :[1]ashwinilaxman@bmsit.in, [2]maha.shanmugam@bmsit.in,
[3]bhavyasati@bmsit.in

ABSTRACT :

With the probability to develop road safety and grant economic benefits, intelligent vehicles have evoked a symbolic amount of interest from both academics and industry. A respectable vehicle detection and tracking system is one of the key modules for intelligent vehicles to perceive the surrounding environment. In this paper, we considered the features of different sensors to detect vehicles for having safe vehicular traffic across the expressway. A real-time monitoring has become a vital need for the today's intelligent traffic monitoring systems (ITS). Vehicle detection systems are widely used in practice for various purposes, e.g. monitoring traffic, improving the efficiency of traffic control systems, enhancing safety, or detecting intrusion to protected areas. Existing vehicle detector systems utilize several sensory technologies, the most popular ones being inductive loop detectors, pneumatic road tubes, weight-in-motion system, microwave radars, ultrasonic sensors and video image processors.

Keywords—Sensors;applications of vehicle detection;

1. INTRODUCTION

The Internet of Things (IoT) is taking mold as an ever-present always-on global computing network . The Internet of Things is the network of physical devices, vehicles and other items entrenched with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. All things are distinctly identified through its entrenched computing system and it is able to work with another system within the existing Internet infrastructure.

The IOT grants the objects to be sensed or controlled remotely across existing network infrastructure, and creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved adeptness, accuracy and economic profit in addition to decreased human intervention . These devices collect useful data with the help of various existing technologies and then autonomously flow the data between devices.

Vehicle detection and surveillance technologies may be characterized as three basic components, the transducer, a signal processing device, and a data processing device. The

ISSN 2515-8260 Volume 07, Issue 8, 2020

transducer is used to detect the passage or presence of a vehicle or its axles. The signal-processing device is used to
convert the transducer output into an electrical signal. The data-processing device normally resides computer hardware and firmware that converts the electrical signal into traffic parameters. Traffic parameters mainly include vehicle presence, count, speed, class, gap, headway, occupancy, weight and link travel time. The data processing device may be a unit of the sensor, as with devices that produce serial output data, or may be controllers external to the sensor as utilized with sensors that have optically-isolated semiconductor or relay outputs. Sensor is a device that detects any variations in physical or electrical or any other quantities and there by produces an output as an acknowledgement of variation in the quantity is called as a Sensor. Generally, the sensor output will take the form of electrical or optical signal. There are wide range of sensor technologies available for vehicle detection .e.g, Microwave/Millimeter wave radar, Photoelectric sensors, Infrared sensors, Optical sensors.

2. MOTIVATION

Traffic surveillance is the most active research topic in computer vision for humans and vehicles. The aim is to detect vehicles using IoT sensors. The increasing number of automobiles has facilitated human life but it has also lead to various issues of traffic congestions, parking problems, accidents etc. The motivation in doing is to detect the vehicles in real time using visual surveillance techniques. Vehicle detection and tracking application play an important role for civilian and military applications such as in highway traffic surveillance control, management and urban traffic planning.

3. OBJECTIVE

To study different IoT sensors to detect vehicles such as Optical sensor (infrared),Radar sensor, Wireless magnetometer, Video image processor and To compare their performances.

4. LITERATURE SURVEY

[1] "ON-ROAD VEHICLE DETECTION AND TRACKING USING MMW RADAR AND MONOVISION FUSION", IEEE 2016

The paper [1] aims at merging MMW radar and monocular camera for on-road vehicle detection and tracking. The MMW radar firstly detects the potential vehicle and provides region of interest. The vision processing module employs symmetry
detection and active contour detection to identify the vehicle
inside the region of interest provided by MMW radar. The
vehicle tracking is also employed for the two sensors. In addition, the two trajectories generated by MMW radar and mono vision are further compared to verify and produce the detection and tracking result. The experimental results show that the proposed system can achieve a 92.36% detection rate and 0% false alarm rate under real-world dataset. Evaluation results clearly demonstrate that the proposed system achieves a better trade-off among detection rate, false alarm rate and real-time.

[2] "IOT-DRIVEN AUTOMATED OBJECT DETECTION ALGORITHM FOR URBAN SURVEILLANCE SYSTEMS IN SMART CITIES", IEEE 2017

The paper [2] designs a novel filter which is unified to detect either the vehicle license plates or the vehicles from the digital camera imaging sensors of urban surveillance systems in smart cities. To the best of our knowledge, they are the first to design this kind of filter to detect the vehicle/license plate objects. They tested their filter with different images. The results showed that their filter can automatically detect the highest energy frequency areas out from the images, which makes their proposed algorithm a simple and effective method to automatically detect vehicle objects for IoT and smart cities applications. This method can also be used to reduce the big data volume which is generated every day from urban surveillance systems in smart cities.

5. DESIGN

1) *Radar Sensor*

The merging of MMW radar and monocular camera for vehicle detection is more efficient. This method makes use of efficient vision-based vehicle detection in the ROI provided by MMW radar, to improve the detection accuracy and reduce the false alarm rate from MMW radar. ROI make use of the active contour method to detect vehicles.

The designed vehicle detection method includes two modules,

- ✓ Rectangular boundary generation and
- ✓ Active contour detection.

The designed symmetry detection algorithm includes, the Sobel operator which is used to calculate the edge image and then for each line of the edge image, the numbers of symmetrical and non-symmetrical point pairs are calculated.

Then the rectangular boundary is generated, and the active contour algorithm is applied to obtain the accurate contour of the rear image of the detected vehicle. Then, the vision processing module accomplish a square boundary in the image frame according to the transmitted information on ROI and applies the active contour method to detect vehicles within the obtained square boundary. If the active contour method fails, it is a false alarm of MMW radar and vision processing module should invalidate this detection; otherwise, the detected contour is used by the following vehicle tracking and trajectory generation in the video sequences. The radar processing module also produces a trajectory using the information from MMW radar. These two trajectories, produced from vision and radar, were then compared and validated to approve whether the detection and tracking are valid. The synergy between vision and radar should be on the same reference plane. This condition can be achieved by applying projective transformation, the parameters of which are producing during sensor calibration.

The proposed method has the following advantages:

- The computational intensity of vision processing can significantly reduce by using the ROI .
- The active contour detection method employed in vision processing can effectively eliminate the false alarm.
- Comparison and verification of trajectories generated by vision and radar can improve the overall accuracy of vehicle detection.

ISSN 2515-8260 Volume 07, Issue 8, 2020

Fig 1 Radar sensor detects large trucks at a loading dock.

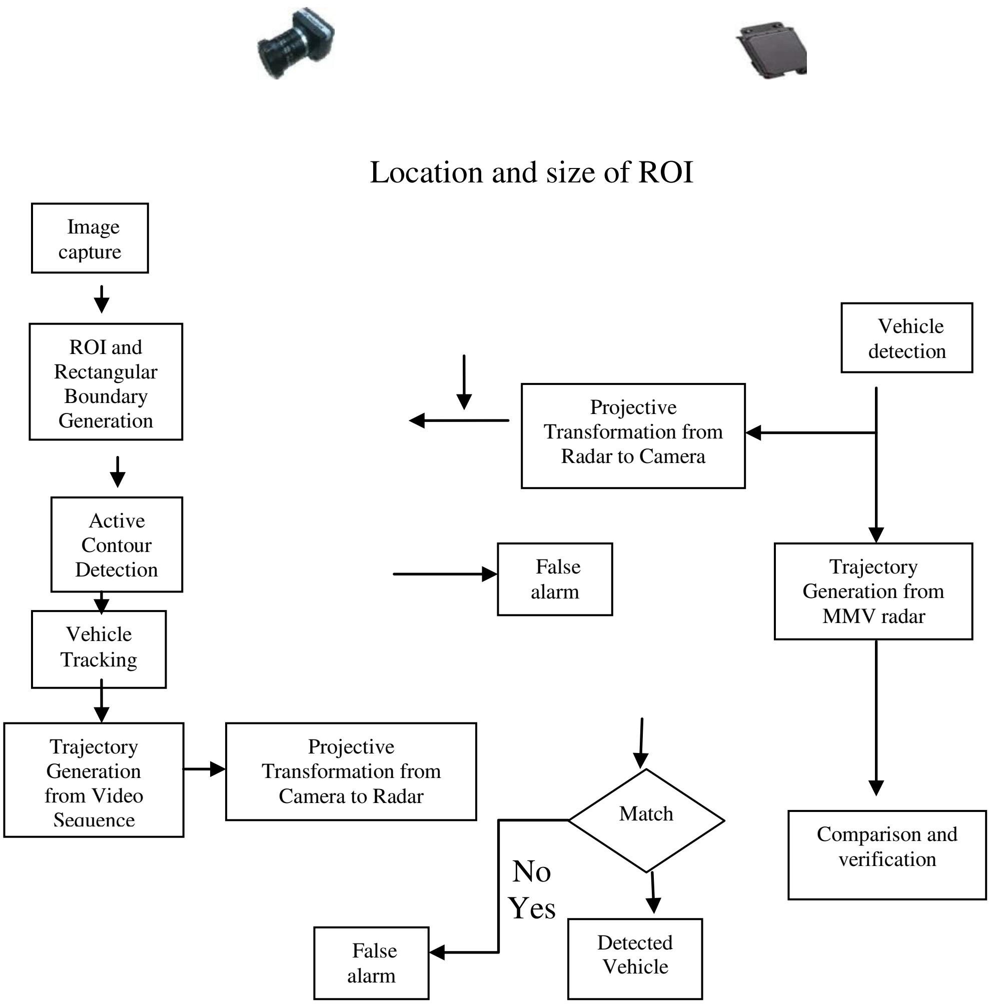

Fig 2 Architecture of the proposed vehicle detection and tracking system

ISSN 2515-8260 Volume 07, Issue 8, 2020

The overall architecture can achieve an flawless balance among accuracy of detection and tracking, real-time performance and computational efficiency. The experimental results of the designed system can detect on-road vehicles with a 92.36% detection rate of and 0% false alarm rate. Each potential vehicle detection and tracking only takes 0.16 s at the frame rate of 60 Hz.

Advantages of Radar sensors:
a) Long Range Detection
b) Immunity to Ambient Weather Conditions
c) Flexible Mounting

2) Wireless Magnetometer Sensor

Magnetometers can be either wired or wireless, but for the purposes of vehicle detection we will concentrate on wireless magnetometers, which offer important advantages to the end user. A magnetometer works by using a passive sensing technology to detect large ferrous objects (for example, a truck, automobile, or rail car) by measuring the change in the ambient magnetic field. When a vehicle changes that magnetic field, the sensor detects those changes. As with other sensors, the range of the magnetometer will depend on the target.
The design of a novel, simple and unified method to search the objects by filtering out the vehicle and/or license plate images expeditiously from the digital camera imaging sensors (Wireless magnetometer sensors).

The algorithm includes the following steps:

a) Pre-treatment of the image:

Converting the original RGB (R: red, G: green, B: blue) image into grey scale image since the color information is not needed in this method, and the size of the image file can be reduced to a lower level and then calculate and obtain the gradient of the grey image

b) Design of novel filter:

Then design a new two-dimensional filter to figure out the horizontal and perpendicular frequency energy curves, and then calculate the inter correlation of the filter and the image matrix.

c) Improvement of the filter:

The filtered image contains the noise that comes from the thin lines of the filter. In order to merge the sharp edges between the lines, so this can be done by expanding the width of the filter. In this way, the filter becomes a long and narrow rectangle. This perpendicular matrix (all the numbers are set as 1's) is used to filter the image in horizontal way

d) Object area in the horizontal direction:

Now the car image has been filtered perfectly, to cut the plate area is not difficult now. As for the horizontal axis, the whole plate area is the brightest area. The width of the filter matrix Brings some blur and expands the width of the car plate, and the filter scans the image from left to right. Hence we only need to gently adjust the final results by shrinking the detected area and move the results a little left. After obtaining the x-axis value, we cut this horizontal area from the original image.

ISSN 2515-8260 Volume 07, Issue 8, 2020

e) Use filter to detect the perpendicular direction area:

Cut out the car area in perpendicular direction. As for the perpendicular axis, the whole car area is the brightest area although there are some interference of noise. According to this trait, we only need to scan the perpendicular axis's brightness values from left to right and choose the threshold as 0.5 for the perpendicular brightness values. In the scan process, we check the picked height between the thresholds. Since the height of the car is within an already-known scale, we can cut out the car in perpendicular direction correctly. After getting the four edge value, we cut out this area from the original car image.

Fig 3 Detected Image

Advantages of Wireless Magnetometers for Vehicle Detection:

a)Cost Effective
b)Minimally Invasive
c)Low Maintenance

Fig 4 Wireless Magnetometer detects vehicle near an automated gate

3) Comparison Of Various Vehicle Detection Technologies

TYPES OF SENSORS	MAX SENSING RANGE	SIZE OF TARGET	MOUNTING
Wireless Magnetometer	Depends on the size of target	All sizes	Can be installed above or below grade
Wireless Ultrasonic Sensor	4 meters	All sizes	Must be mounted overhead
Radar Sensor	40 meters	Large, predictable targets(e.g. trains)	Minimum of 6 feet from target
Optical Sensor(Infrared)	200 meters	5 millimeters or greater	Requires mounting for both emitter and receiver
Measuring Light Grid	2 meters	All sizes	Requires mounting for both emitter and receiver

6. APPLICATIONS

Vehicle detection systems are widely used in practice for various purposes, e.g. monitoring traffic, improving the efficiency of traffic control systems, enhancing safety, or detecting intrusion to protected areas.
IR sensor can be used for operating television remote, Passive Infrared sensor used for automatic door opening system of shopping malls.
LDR sensor used for outdoor lighting or street lighting system.
Piezoelectric sensors are utilized to classify vehicles by axle count and spacing and to measure vehicle weight and speed (the latter when multiple sensors are deployed). They are repeatedly used as part of weigh-in-motion systems. Class I piezoelectric sensors are used to detect and weigh axles, while Class II sensors are used only to detect the axle.
Active infrared sensors contribute for vehicle presence at traffic signals, speed measurement, volume, queue measurement, length assessment and classification. Numerous
units can be equipped at the same intersection without interference from transmitted or received installed at the same intersection without interference from signals.

7. CONCLUSION

This paper aims at detecting vehicles/object using iot sensors. As there are many sensors available and choosing best sensor depending on their characteristics are also explained.

ISSN 2515-8260 Volume 07, Issue 8, 2020

Existing vehicle detector systems utilize several sensory technologies, the most popular ones being inductive loop detectors, pneumatic road tubes, weight-in-motion system, microwave radars, ultrasonic sensors and video image processors. This report includes the brief introduction about sensors and their uses, strengths and weakness.

8. REFERENCES

[1] S Mahalakshmi , R. Sendhil Kumar "Smart Toll Collection Using Automatic License Plate Recognition Techniques" Communications in Computer and Information Science, vol 805. Springer, Singapore. https://doi.org/10.1007/978-981-13-0755-3_3

[2] S Mahalakshmi, Tejaswini, "Study of Character Recognition Methods In Automatic License Plate Recognition (ALPR) System" , International Research Journal Of Engineering And Technology (IRJET),2017

[3] Bence Koszteczky, Gyula Simon, "Magnetic-Based Vehicle Detection with Sensor Networks" ,IEEE 2014

[4] Rama Chellappa , Gang Qian And Qinfen Zheng,"Vehicle Detection And Tracking using Acoustic and Video Sensors" ,IEEE 2004

[5] Zehang Sun, George Bebis And Ronald Miller, "On-Road Vehicle Detection using Optical Sensors" ,IEEE Intelligent Transportation Systems Conference, 2004

[6] Hafiz Muhammad Atiq, Umar Farooq, Rabbia Ibrahim,Oneeza Khalid,

[7] Muhammad Amar, "Vehicle Detection And Shape Recognition using Optical Sensors" Second International Conference On Machine Learning And Computing, 2016.

[8] Xiao Wang, Linhai Xu, Hongbin Sun, Jingmin Xin, andNanning Zheng,

[9] "On-Road Vehicle Detection and Tracking Using MMM Radar and Monovision Fusion", IEEE Transactions on Intelligent Transportation Systems, February 2016

[10] Ling Hu and Qiang Ni, "Iot-Driven Automated Object Detection Algorithm for Urban Surveillance Systems in Smart Cities", IEEE Internet of Things Journal, 2017

[11] Hafiz Muhammad Atiq, Umar Farooq, Rabbia Ibrahim, Oneeza Khalid, Muhammad Amar, "Vehicle Detection and Shape Recognition using Optical Sensors", Second International Conference on Machine Learning and Computing, 2016