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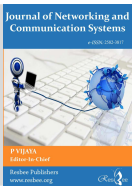

Intelligent Vehicle Systems: A Wireless Sensor-Based Approach

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Abstract: Recently, smart vehicle systems adopting wireless sensors have received huge attention, and are also considered a promising area. Generally, the wireless sensors utilized in this system are small, low-cost devices that can be easily installed in diverse parts of the vehicle. This research aims to design and develop a smart vehicle system using wireless sensors. The system will alert the driver if necessary. With the increasing use of sensors in daily life, people are looking for similar intelligence in their vehicles. This research is divided into three categories: air pollution detection, auto-driving, and accident detection. The system installed in the vehicle will detect air pollution levels, send the location in case of an accident, and automatically detect lanes and obstacles. Although there have been many studies on this topic, most have not been practically implemented or combined. This research provides a more reliable solution, with the possibility of future improvements.

Keywords: WSN, Transportation, Vehicle, Safety, Image Processing, Accident.

1. Introduction

There is 1.32 billion vehicles excluding off-roading vehicles and heavy machinery in 2016 [1]. 1.35 million vehicle crashes are increasing every year, where 3700 people are dying and causing 50 million injuries, and in 2016, for every 1,00,000 vehicles, the total death is 64. Wireless Sensor Networks (WSNs) are created to gather and communicate data from the environment in which they are installed [9] [10]. Generally, sensors in a WSN are low-power devices powered by batteries, and they possess restricted processing abilities. These sensors can identify the various environmental parameters, like temperature, humidity, pressure, vibration, and light, and transmit the data to a central processing unit for analysis [11] [12]. With the help of a WSN, it is possible to build a future transportation system that can reduce the percentage of accident. There are 1.42 billion vehicles in the world in 2018, which will produce 2.23 billion metric tons of Carbon Dioxide [2]. This research also can help to maintain the environment inside of the car as well as outside of the car [13]. This system will also detect the obstacle and lanes automatically. If there is any accident, the system will detect and send the location automatically [15]. To implement this system a prototype model was built which will give a demonstration of the actuality of the proposal.

This feature is all about detecting the accident location and sending it to an emergency number. PiezoElectric works as a detection module. If it perceives a certain amount of pressure, then it will detect it as an accident. The GPS module will continuously locate the location. And the GSM module will send the saved SMS. At the time of the accident, Arduino UNO receives the location from GPS and the GSM module will sends the SMS with that location to the emergency number.

Auto-driving means the vehicle can detect obstacle and lanes with the help of the system. If there is any obstacle, the system will detect it through the Camera Module. Then, the vehicle will stop. If the side lane is empty, then it will change the lane and continue moving. Sometimes, the driver cannot notice the obstacle, and as a result, the accident happens. But, this system can prevent accidents and also it will detect the lane with the same camera module and maintain the lane [15].

The system is developed to solve the issue.

Air pollution is a very common and major problem in the present world [16]. It may not be possible to maintain the environment outside [17]. But, sometimes, the inside environment of vehicles is also polluted [18]. Though people are surrounded by pollution, it is impossible to know if there is any pollution inside the car. Different gasses, produced by passengers and Air conditioning can cause pollution [19]. MQ 135 sensor detects the percentage of these gasses and shows it in the display. It will also activate the

buzzer if the pollution rate exceeds the limit. DHT 11 sensor detects the temperature and humidity and is shown in the display continuously [20]. If the window of the vehicle is open, then, there is a possibility that the dust density will increase inside the vehicle. Optical Dust Sensor detects the dust density and is shown on the monitor continuously after a certain period of delay.

2. Background Study

Road monitoring systems using GPS can help to avoid collisions and give an update about the road situation [3]. If there is any issue with a road, then the system will notify the driver and the driver can choose a better route. But there are many disadvantages such as delay of the troposphere, multiple signals, orbital error, satellite's signal intentional corruption, receiver periodical errors, etc.

Automatic vehicle accident detection is a life-saving application that is vital in today's high-speed motorways [4]. In some accidents, people die because the rescue team does not get to the location in time. To solve the issues, it tried to gather more information such as car id, passenger number, etc. which will take more time to send the location. This can be a shortcoming of this research. Air pollution detection is the procedure to measure the level of air pollution in an environment. In the context of smart vehicle systems, air pollution sensors are installed in vehicles to identify the pollutants in the surrounding air.

The collision monitoring system is a very good approach to indicate the accident location. On the collision features of the simulation of the car guardrail, the vibration features of the guardrail within the accident have a good performance in accident identification [5]. But the entire city road should be redecorated with the base station, camera, accelerometer, etc. for implementing this solution which can be very costly and time-consuming.

The use of WSN can reduce the weight and cost which is caused by wired sensors as well as notify the driver if there is a vehicle nearby [6]. But, if the vehicle is too close then there will be no way to avoid the collision because the system will take the minimum time to inform. So, this is not a feasible solution. Only this solution cannot be enough to avoid a collision. There are many more important issues for collision.

Collision avoidance can be done by Laser sensor [7]. Using laser technology to detect the nearest vehicle can be a good solution to avoid the collision in real time but every time there doesn't need to be a collision if there is a nearby vehicle. The maximum time it will give a false alarm which can distract the driver and can be another cause for the accident.

They are detecting lanes and also tracking also they think about street conditions. They consider vision systems, which cannot only look out of the vehicle to detect and track roads and avoid hitting but simultaneously look inside the vehicle to monitor the attentiveness of the driver and even predict her intentions [8]. In the improvement of a continuous, hearty unique setting catch framework for a vehicle, PC vision, and AI strategies assume significant jobs. They utilize cameras, radars, sound, and so on to consider the foundation of portrayals of the condition of the earth, the vehicle, also, the driver with precise unique vulnerability portrayal.

In this paper, a strategy to make a self-driving robot vehicle is introduced. The diverse equipment segments and their get-together are obviously depicted [9]. A tale technique to decide the lopsided, checked, or plain street edges is clarified in subtleties depending upon OpenCV. Utilizing ultrasonic sensors, the impacts with deterrents are maintained at a strategic distance. The calculation referenced in the paper has been effectively executed on a little independent vehicle.

3. Research Methodology

Research methodology is the specific procedures or techniques used to identify, select, process, and analyze information about a topic. From various research methodologies, the experiment is suitable for this particular project. This project is very sensitive because lives are depending on it. One mistake can cause hundreds of lives. That is why, every part especially, the auto driving and accident detection needed to experiment with every time after any modification. On the other hand, it is not possible to confirm that the system is working properly without some test experiments. In this project, it takes at least hundreds of experiments that the project is working in this way or that way. Fig 1 demonstrates the flow chart of the research methodology.

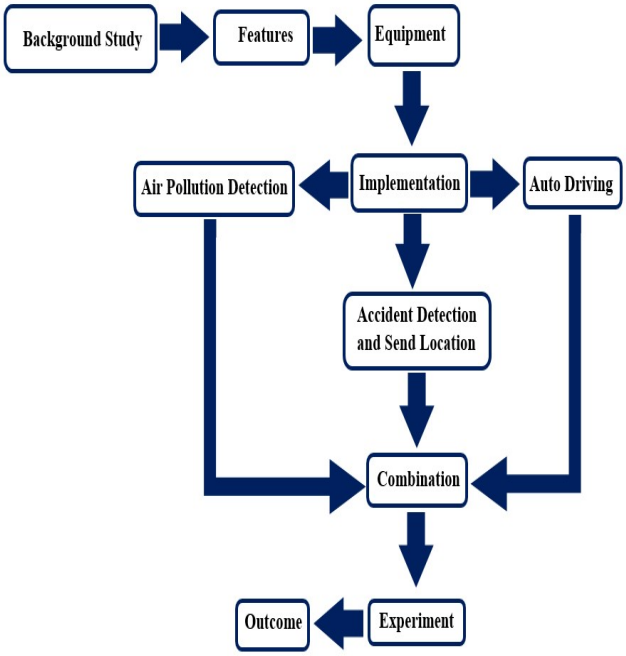

Fig. 1. *Flow Chart of Research Methodology*

4. Implementation

This work is divided into three major parts for the implementation of the smart vehicle system using wireless sensors.

4.1. Auto Driving

After starting the vehicle, the system will start to detect the lane. It will take left or right or go forward turn according to the type. At the same time, it will also detect traffic signs and obstacles. If it finds any, then it will stop. Otherwise, it will continue the process from the beginning. Fig 2 demonstrates the flow chart of auto driving.

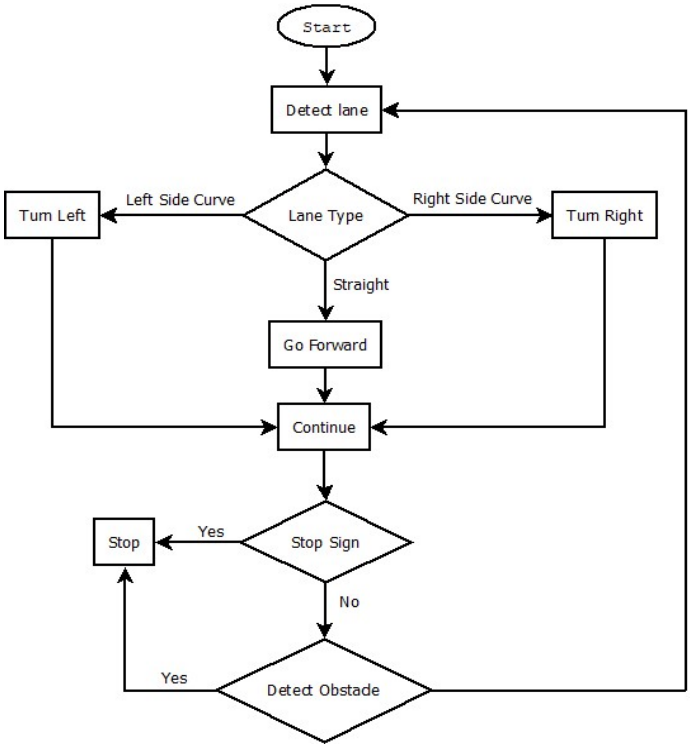

Fig. 2. *Auto Driving Flow Chart*

4.2. Accident Detection and Send Location

Here, the sensors and GPS technology are used to detect accidents in realtime. When the vehicle will start, the system will collect data via GPS Module continuously. Then, the Piezoelectric will measure the pressure. If it measures the pressure normally, then it will start to collect data again via GPS. But, if it finds the pressure high, then it will send the data to the GSM Module. And GSM will send the location with a prewritten message to the emergency number. Fig 3 demonstrates the flow chart of the Accident Detection and Send Location.

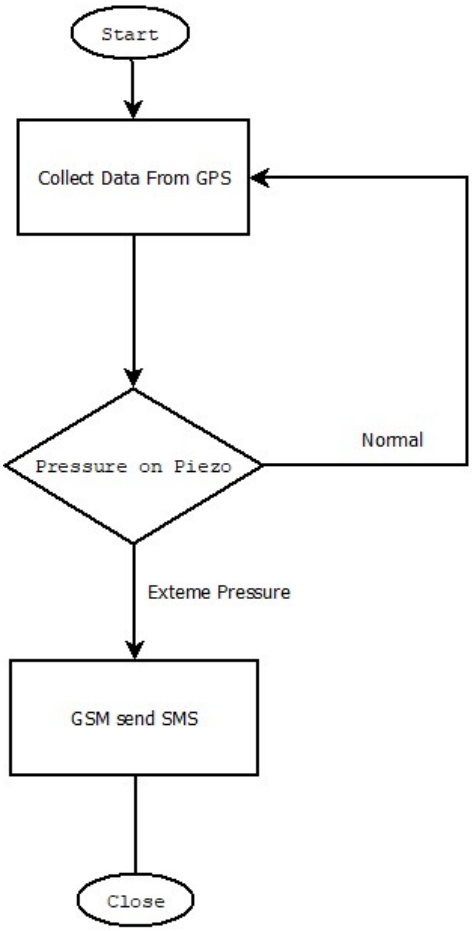

Fig. 3. *Accident Detection and Send Location Flow Chart*

4.3. Air Pollution Detection

After getting the power, this system will measure different gasses via the MQ135 sensor. If it finds the harmful gas and the level of the gas crosses the given ppm level, then it will set an alarm and show the result in the display and will move to the next phase. But, if the gas level does not cross the given ppm level then it will also show the result in the display but no alarm will be activated. Then it will detect the temperature and humidity and the dust density and will show the result in the display respectively. Generally, Machine Learning algorithms are utilized to determine the data and provide feedback to persons on the air quality in the surroundings. After completing three phases, we will continue from the beginning and continue the process in a circle to collect and analyze the data. Fig. 4 demonstrates the flow chart of air pollution detection.

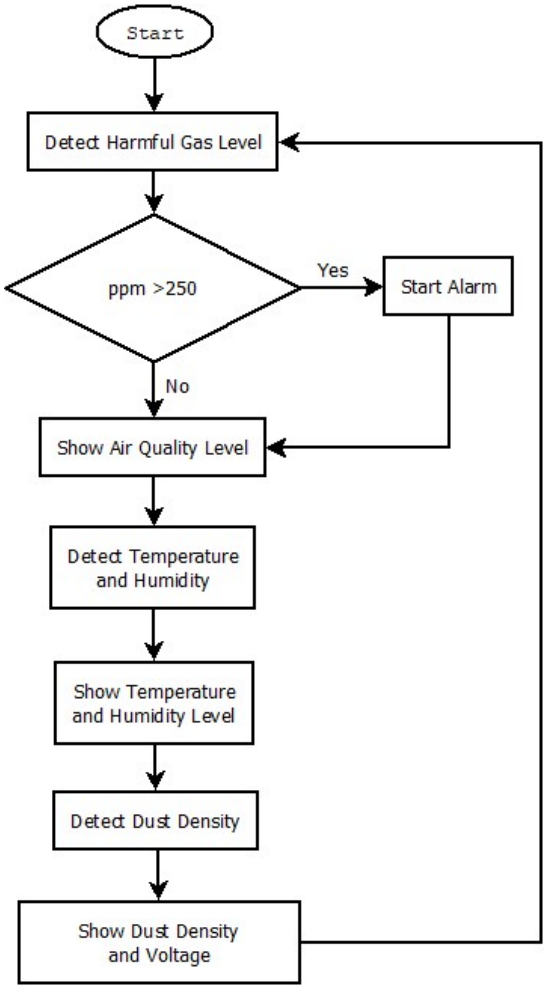

Fig. 4. *Air Pollution Detection Flow Chart*

5. Result Analysis

The vehicle will detect the lane continuously. If the region of interest detects the lane in parallel from a bird's eye view, then it will continue the journey (Shown in Figure 5). According to the measurement, the vehicle will turn right or left to maintain the lane.

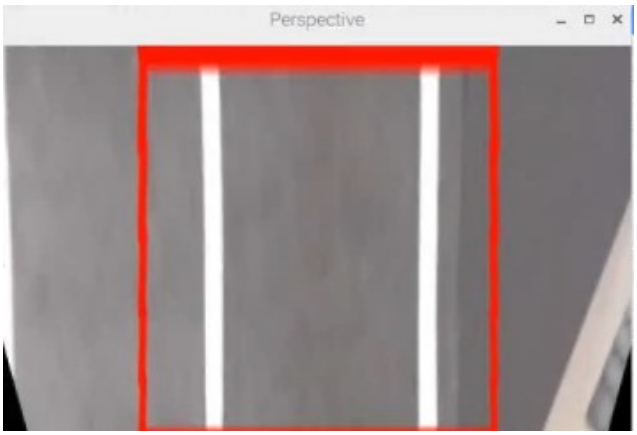

Fig. 5. *Lane Detection*

When the perspective view detects any object, it will start measuring the distance then after a particular distance the vehicle will stop (Shown in Figure 6).

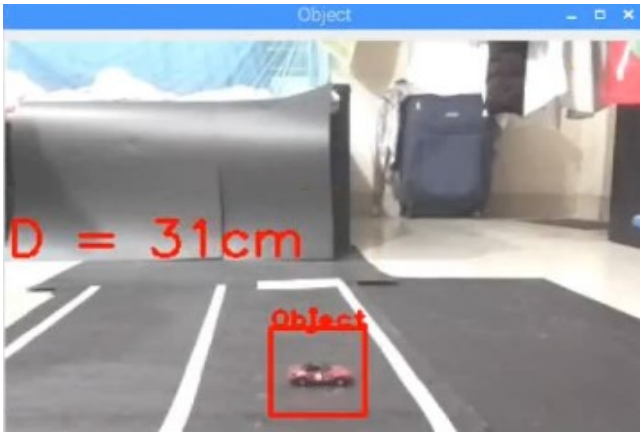

Fig. 6. *Object Detection*

Meanwhile, it will also stop if detect any stop sign. The stop sign's distance also measures by the perspective view (Shown in Figure 7).

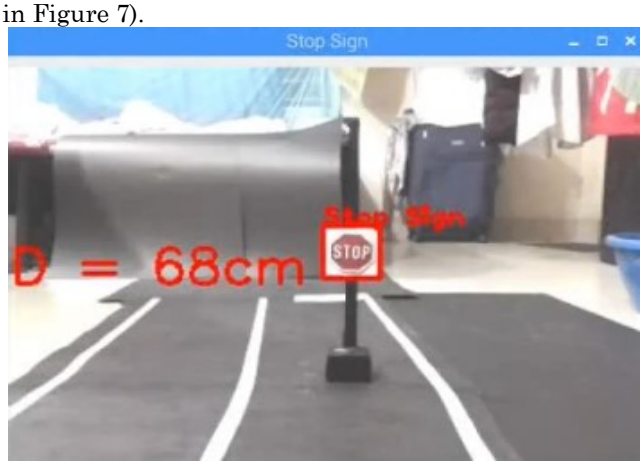

Fig. 7. *Stop Sign Detection*

It will continuously detect the location via GPS. But will send the location via SMS through GSM if the accident happened. The SMS will contain a default message and the latitude and longitude of the location (Shown in Figure 8).

Fig. 8. *Receiving Message*

If we searched the location by latitude and longitude on the map it will show the exact location (Shown in Figure 9).

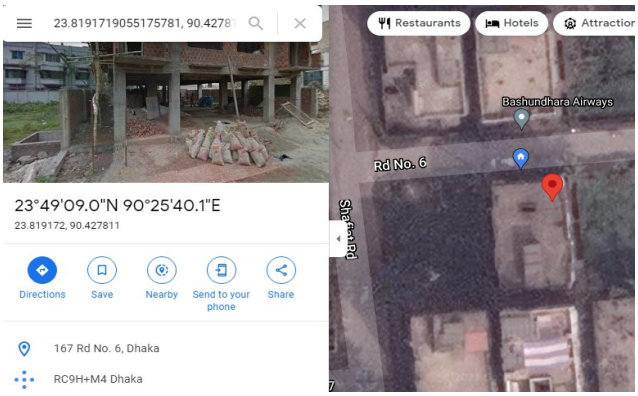

Fig. 9. *Location Search in Map*

The display will show the air quality level first and according to the level, it will show whether the air quality is good or harsh (Shown in Figure 10). If the level is high, then it will activate the alarm.

Fig. 10. *Display Air Quality*

Next, it will show the temperature and humidity in the display (Shown in Figure 11).

Fig. 11. *Display Temperature and Humidity*

Finally, dust density will be shown in the display and it will also show the voltage which is needed to measure the density (Shown in Figure 12). After that, it will continue from the beginning.

Fig. 12. *Display Dust Density*

6. Conclusion and Future Work

This project is based on the daily incident through the vehicle. Daily life is improving day by day with the help of technology. However, there is not using plenty of smart technology in transportation systems or

vehicles. They are using the same technology with a little modification only. In this research, the main focus is on the safety issue of using technology. This research does not show any feature which makes the vehicle more stylish or more capable of performance. Though, this may not be the ideal solution or the equipment may not be the smart solution. But, this research shows that it is not impossible to build a future-generation vehicle. If a prototype can be made with such a small budget and small labor and time, then for the vehicle manufacturing company it is not very tough. On the other hand, they have huge labor to work on it and research it. This research may not be enough to build future-generation vehicles but, it takes the research one step closer to success. Technology is developing day by day. If a system is developed today then, there is a possibility that it will be modified tomorrow. In the future, many features will add to that system. Some of the existing features of this project can be modified in the next step. There is only one traffic sign used in the auto-driving part of this project. More signs can be added in next-generation work. For air pollution, there is no alarm system for excess dust or temperature. But it can be added at any time. On the other hand, an auto window open system can be useful instead of an alarm system. Using the speed limit can be extra future work in terms of auto driving. A sensor will measure the width of the road and the processor will set the speed limit suitable for that road. There are also some extra features of air pollution. AC temperature can be set automatically according to the temperature inside the vehicle.

Compliance with Ethical Standards

Conflicts of interest: Authors declared that they have no conflict of interest.

Human participants: The conducted research follows the ethical standards and the authors ensured that they have not conducted any studies with human participants or animals.

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