Automated System for Road Safety Enhancement using Big Data Reports

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Abstract - *The road safety and enhancement is very important in today's world. There are many new technologies which emerge to minimize the accidents that occur. As a complete system, this paper gives a useful idea for both controlling the speed accordingly to the situations and to give suggestions by using simple algorithms. Even though there are many projects to control the speed of the vehicle, the suggested system can control the vehicle but at the same time can collect data and manipulate it using the big data technologies. The system on the whole gives us some necessary information regarding the road safety. The basic information required for storage is fetched from the ultrasonic sensor. And the efficient communication between the sensor and the Hadoop storage is done by the Universal Asynchronous Receiver/Transmitter. This project is cost efficient and at the same time provides help for the road safety department to work for its betterment.*

Key Words: automated, big data technologies, Hadoop storage, road safety department, suggested system

1. INTRODUCTION

Recently, the developing big data technology provides efficient managing and decision making ideas. The major issues that have to be considered regarding loss of lives is where, more accidents occur i.e. transportation system mainly roadways. When we consider a roadway, we need to follow a certain relationship i.e. Leader-Follower car relationship. We are supposed to follow the leader car, until we get some space to overtake it. Though we overtake one, it isn't certain that there won't be any leader car in front of us. Our action taken to simulate the car is directly proportional to that of the leader car. Over 3 people are getting killed every 10 minutes only because of distracted driving. Based on the safety measures that have been implemented, there is a need to enhance it further. This subject of road safety has gone far beyond and many technologies arise rapidly, but those haven't been implemented in every nook and corner of the country. This paper explains a simplified system where both accidents can be prevented and reports can be generated.

Warren Cornwall gave an introduction about mixing the model and data for predicting [3]. Data Mining is a technique applied for simulation and decision making. In big data the results are predicted directly where noise is included. Google

flu predicting model in big data is an example for the above operations. The Google flu was a successful predicting model at early stages but then was proved to be wrong [2].The location of the vehicle is as in every case detected by the GPS technology. Arne Kesting used radar sensor to get the relative speed and distances [5]. Martic developed a model to monitor individual's task of driving. He developed a combinational model on human dynamics with 136 volunteers for individual movement prediction using GPS data [6]. Bazzani projected the relationship between the trip distance and exponential distribution, the travel time and power-law distribution in distributed private cars with GPS [7].

The upcoming parts of this paper are arranged in the following manner. In section 2, this paper reviews about how the data acquisition process is done using sensors. In section 3, the data processing and decision making is discussed. In section 4, the process of data transmission for further processing is explained. In section 5, the management of data in Hadoop environment is presented. Section 6 gives us an idea of how a suggestion system works. Section 7 depicts the overall structure of the system by explaining the architectural model. The section 8, describes the tools involved to achieve the successive environment. The following section 8 consists of the future work to be carried out later. Finally the section 9 summarizes all the possible outcomes. These all together functions in a single system and provides efficient real-time application through big data technology.

2. SENSOR DATA ACQUISITION

Many situations require the data in digital form to store it either as record or as a necessary condition to control and device. As the systems became smarter and more complex, the machine minder's task became more strenuous and, in some systems, impracticable. But nowadays, a computer can read more information and act upon it more quickly, to achieve real time control. "Data Acquisition" is the qualified name for the branch of engineering which deals with the collection of data from a number of analogue sources and converting it into digital form suitable for transmitting it to a computer.

Sensors are the electronic devices which generate the data for the system to require. Ultrasonic Sensor used to sense the

object which found in the route. This ultrasonic module measures the distance precisely within 0cm - 400cm with a gross error of 3cm. This system uses the application of Pulse Width Modulation (PWM). The trajectory data obtained by means of mobile phones is the easiest way. This can be found in several applications for motor control, power delivery, voltage regulation, telecommunications and so on. Here we use HC-SR04, ultrasonic sensor which can be used for remote measurement of some physical quantities via ultrasonic waves. These waves are generally inaudible to human's ear. This device has an ability to detect a distance of 400cm approximately.

The working principle of the ultrasonic sensor is the same as that of bat's object detection ability. An ultrasonic transmitter sends a RF wave of 40 KHz in the air at the speed of 346 meter per second and the ultrasonic receiver receives the signal reflected from the object. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the SONAR sensor and the object. Therefore the analogue signal received is converted to digital signals. As the speed of the ultrasonic wave in the air medium is constant and known, it is simple to find the distance.
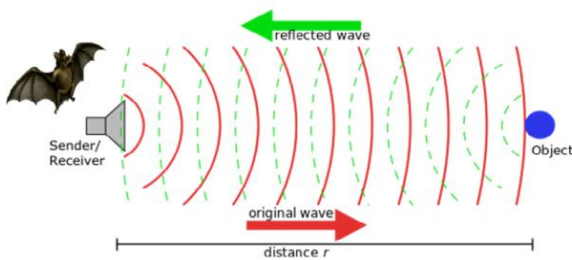

Fig -1: Ultrasonic wave propagation and distance calculation

Here the full bridge converter, phase shifted, 600-w high-efficiency power supply is used. This converts a 370-v to 410-v DC input in to a regulated 12-v output.

The UCC28950 is operated in the burst mode. The DCM (Discontinuous Current Mode) function is used to improve no-load efficiency and to meet the green mode requirements.

3. DATA PROCESSING AND DECISION MAKING

The data processing is the task of checking the various sensors data received from the sensors with the already fixed threshold values. The connection is established between Arduino, Ultrasonic sensor, then from relay to motor. The threshold value will be programmed in the Arduino. To regulate the speed, the distance value is checked with the threshold value. If the distance between the SONAR and the object goes beyond the threshold value, then the motor speed will be reduced and will be stopped slowly. Here the object refers to the leader car.

3.1. Arduino and Ultrasonic sensor

In the ultrasonic sensor, these four pins are to be considered: (VCC+5v): The +5V pin is needed for connection in the Ultrasonic Sensor HC-SR04 Pin, (Trigger): Triggering has to be done for sending the sensor signals, (Echo): The sensor signals are transmitted and received by bouncing back. While receiving the sound wave the echo pin goes high, (GND): Ground connections are given. These pins help to detect the objects in front of it or to measure the distance between the objects. The sensor is triggered by using a signal of +5v over the trigger pin for 10 seconds. Once the trigger signal is received, the ultrasonic sensor transmits the ultrasonic waves. If there is some object in front, the waves will be reflected back. The ultrasonic receiver then captures the signal reflected, thereby making the echo pin high. The time for which the echo pin goes high is read. On the basis of this time calculated, we can find the actual distance of the object i.e. how far it is from the car. The Arduino and ultrasonic sensor can be interfaced. The code where the SonarSensor() function is used to generate pulse of 10 microsecond and sending it to the trigger pin of Ultrasonic sensor. The PulseIn() function is used to say how long the echo pin is high. By using this time (echo pulse width) we can calculate the distance.
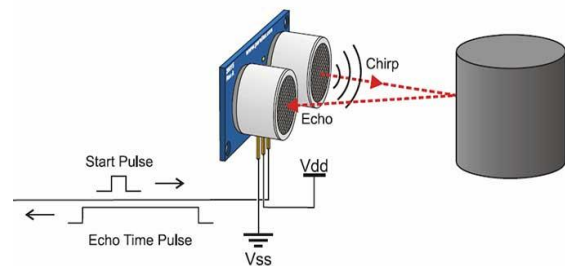

Fig -2: Echo Time Pulse Generation

The distance is divided by 2 because the sound waves travels to and fro. The value is again divided by 29.1 which is the speed of the sound. At the last the distance value is obtained in cm. The distance will be displayed in the LCD. The LCD will be connected to the Arduino by collecting the following pins. LCD RS pin with digital pin 12, LCD enable with digital pin 11, LCD D4 pin with digital pin 5, LCD D5 pin with digital pin 4, LCD D6 pin with digital pin 3, LCD D7 pin with digital pin 2.

3.2. Controlling the speed

There are 3 different types of motor used in the field of automobiles: AC motor, DC motor and BLDC motor. The speed of the vehicle has to be controlled by 3pwm, varying the potentiometer which is also connected to the Arduino. The circuit connection includes Arduino, transistor, DC motor, diode and 10K ohm resistors. Potentiometer regulates the speed such as, turning in one direction reduces the speed and other increases the speed of the vehicle. The threshold value will be programmed inside the Arduino.

UART is an hardware device for asynchronous serial communication in which the data format and transmission speed is customisable. It is an IC used for serial communication. A DC motor is an electrical machine that converts direct current-electrical power into mechanical power. Relays are simple switches which work in both mechanical and electrical environment. It consists of an electromagnet and also a set of contacts in it. They consist of a load circuit and a control circuit. These are called as motor drivers since they drive the DC motor. Warning systems like buzzers and alarms could be very beneficial in minimizing loss of lives during an accident.
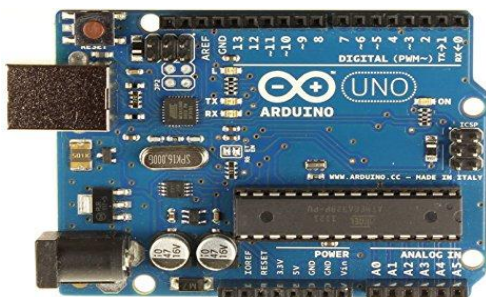

Fig -3: Arduino UNO Board

According to the threshold value the distance value will be controlled by the potentiometer. Therefore the vehicle speed will get reduced automatically. The 5v relay, 4N25 optocoupler are used since the relay regulates the voltage level.

4. DATA TRANSMISSION

The data acquired from the sensors are transmitted to the Web server by using UART. UART is a form of serial communication because the data is processed and transmitted as sequential bits. UART consists of two lines. One for transmitting the data (Tx) and the other line for receiving the data (Rx). Both the lines together form a serial port through which the communication can occur. It is an onboard hardware. It manages the serial data packaging and translation.
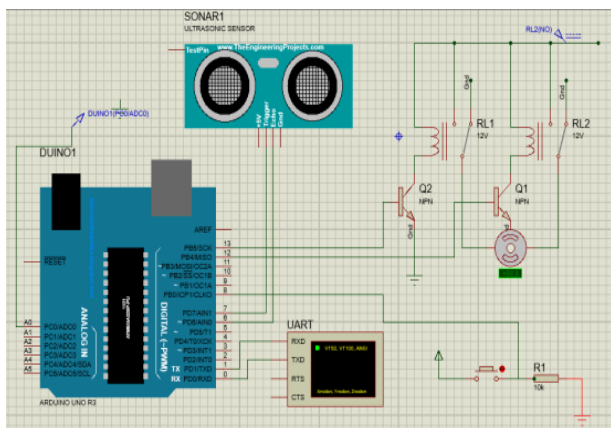

Fig -4: Embedded Kit design using Proteus8 Professional

It is interfaced with the Arduino, which has a serial port dedicated for the communication with the computer on which the Arduino is connected to. UART is asynchronous because the communication does not depend on a synchronized clock signal. In Arduino, the user doesn't have to deal with communication at the bit level. Instead, this platform provides software libraries of higher level.

Specific id is given to each transmitter and receiver. The receiver at the system end is connected to the web server via Ethernet. UART is opted here because of its fast connection establishment and its low cost while interfacing with Arduino microcontroller. Serial communication cable is connected to the Arduino. Address of the web server is given to the Arduino to send request. The web server is designed using java programming language to feed the acquired data values in the appropriate table. The web server processes the request and stores the received data in the Hadoop Distributed File System working under Hadoop environment.

To transfer the data from the web server to the HDFS, the software called "Apache Flume" is used. It is a reliable distributed system for collecting, moving and aggregating large amounts of log data from many sources to a consolidated data store efficiently. The events are delivered to the Flume by an external source like a web server. On receiving an event, it stores them into one or more channels. Channel is a passive store that keeps an event until it gets used by a Flume sink. The work of the sink to remove the event from the channel and puts it into an external repository like HDFS or transfers it to the source of the next agent. This is called as the single-hop message delivery semantics. A car following model was analyzed by Ozaki by recording videos of continuous traffic flow [4].This was considered as an initiative for collecting data. Flume provides end to end reliability and supports a durable file channel backed up by the local file system which manages recovery from failure.

5. MANAGING DATA IN HADOOP ENVIRONMENT

The data received from the web server has to be converted to structured data. Preprocessing is done by using Map reduce function, where all the data can be sorted out. After the preprocessing section we can do classification in which the data can be classified based on their nature. In this model we have to classify them as different factors of velocity, speed, acceleration, location and distance. Classification is done by using Naive Bayes algorithm.

6. SUGGESTION SYSTEM

Recommendation system is one of the beneficial systems. Usually these systems are implemented in online shopping and websites to know the customer's priority. But here we take this system's help to just suggest the transportation department to enhance the roads. Not all the methods used in the recommendation system are included in this paper,

because we have to classify and give the analysis details. There must be a huge repository of data to input the recommendation system. After the preprocessing and classification process the data are ready to generate reports by passing through the recommendation system. The algorithms for the system include collaborative filtering models and matrix approach. The union and intersection of the speeds or velocity of different cars can be analyzed and enhanced based on certain conditions such as, if there are some values which go above the threshold at the same place, then that place can be analyzed and seen if any new road signs or zebra crossing may be needed.

7. ARCHITECTURAL DESIGN
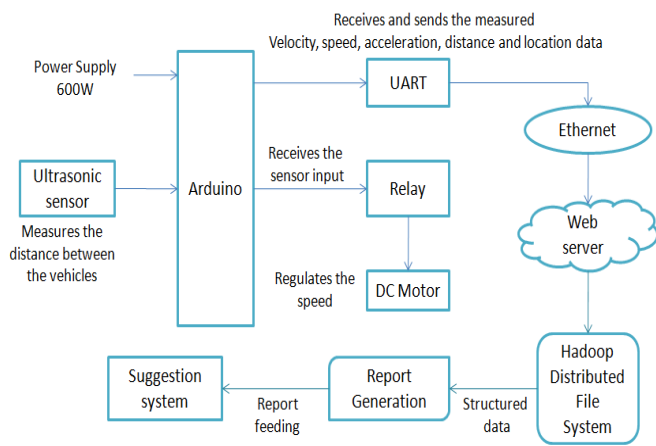
Fig -5: Architectural flow of the project

The overall design of the project is pictured above. It starts with the sensor data acquisition where the sensor calculates the distance between the vehicles and feeds it into the Arduino. The Arduino is given with the high efficiency power supply. This is programmed in such a way that, it processes the sensor data and regulates the DC motor connected to it. Then the measured parameters are transmitted to the web server using the UART via Ethernet. The collected data is then transferred from the web server to the HDFS using single-hop message delivery semantics. The unstructured data are preprocessed and classified using the algorithms like Map reduce and Naive Bayes to get a well formed structured data. The final structured data is fed into the suggestion system which suggests us with the ideas of, how to enhance the quality of transportation in the forthcoming years, by considering the welfare of people in mind.

8. FUTURE WORK

In future the car can also be programmed to function automatically by using behavioral analysis and simulation by the use of motion detectors. Further development in controlling the car could be performed by lane switching process. This will help in building an accident free car in future.

9. CONCLUSION

This idea of preventing the accidents and also suggesting some enhancement on the roadways can be implemented with simple processes. This concept will serve well for some cost efficient people residing countries and where this is more needed. The major goal is to suggest, based on the data collected from vehicles for which the big data storage helps. And in addition the speed of a vehicle can be reduced in case of accidents. The process relies on recommendation system algorithms, and that is just an emerging application in other fields. This is a combinational system and the output will be for the betterment of the roadways.

10. REFERENCES

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