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Driver warning System in Hill Bends

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***Abstract*—Hill stations are always favourite vacation spots for all age groups. The often used mode of transportation by many people to reach a destination is roadways. Road accidents are undoubtedly more frequent and are responsible for many deaths worldwide. The roads in these hilly regions are always filled with many hectic and endless curves such as hair-pin curves, salient curves and re-entrant curves. The curves provide either partial or no-visibility of the incoming traffic to the drivers. In this regard to address this problem a system is developed to warn drivers about the approaching traffic in hill curves. This system has ultrasonic sensors placed on both the sides of the road. The output of the ultrasonic sensor is interfaced to the Raspberry Pi 3 Board. When a vehicle is detected by ultrasonic sensor, Raspberry Pi triggers the camera to capture the image of the vehicle. The image of the vehicle is then compared with the images already uploaded in the database. The match is found and the data is send to the receiver side through Bluetooth. The output is displayed as "Two wheeler" or "Four wheeler" in the Liquid Crystal Display(LCD). An upgrade is done to the project in identifying the specific vehicle type as car, bike, lorry, jeep, etc. Instead of using solar panels which are costly, piezoelectric sensors are used for the generation of current and supplied to the components. Voice module is interfaced with Arduino to play the audio in the speaker as "car is arriving" or for respective vehicles.**

Keywords— Raspberry Pi 3, Liquid Crystal Display

I. INTRODUCTION

In the developing countries such as India, accident is the major cause of death. The top 10 dangerous roads in the world are the mountain roads and curve roads. In the mountain roads, there will be tight curves and the roads will be narrow. According to Road Accident Statistics, more than 1.2 million people are killed in road accidents worldwide, every year while the number injured is as high as 50 million. In India, over 80,000 persons die in the traffic crashes annually, over 1.2 million are injured seriously and about 3 Lakh are disabled permanently. Whenever there is a U-turn either on a ground level road or in mountain area, the place becomes prone to accidents, particularly if the speed of vehicles is more or there is no signalling of horn and light while taking the U-turn. The main reason for these kinds of situations is that the driver of a vehicle is unaware of vehicles coming from the opposite side. Safety studies have found that a majority of accidents occur either due to the driver's error or due to the negligence of the safety norms. The prevention of road accidents and to save life is extremely important and will be ensured not only by strict laws and police controls but also by the obligation of the drivers to adapt their speeds at corner.

The solution for this problem is giving an alert to the driver about the vehicle coming from opposite side. This is done by keeping an ultrasonic sensor in one side of the road before the curve. The ultrasonic sensor output is interfaced with Raspberry Pi. When the vehicle is detected, Raspberry Pi triggers the camera to capture the image of the vehicle. The captured image is processed by OpenCV tool to identify the type as 2 wheeler or 4 wheeler. The identified vehicle data is send to the vehicle approaching in the opposite side through Bluetooth and displayed in LCD where Bluetooth and LCD are interfaced to the Arduino Nano controller board. By seeing this, driver becomes alert and slows down the speed of the vehicle. The power supply is given by solar panels. The problem associated with this system is that the driver cannot specify the vehicle type such as car, bike, lorry etc. The power supply is given through generation of current through piezoelectric crystals. The driver is also notified by voice play with the help of apr33a3 voice module.

II. EXISTING SYSTEM

A. Introduction

Being in developed country to reduce the accidents occurring mainly in hill bends, curves, driver has to be given alert about the vehicle on the either side. The main reason for accidents in hill side is that up going or down coming vehicles aren't aware of the vehicle coming on either side. A system has been proposed to face this problem.

Ultrasonic sensors are placed on both sides of the road. When a vehicle arrives, ultrasonic sensor detects the arrival of vehicle. The detection triggers the camera which is connected with the Raspberry Pi board. The camera captures the image of the vehicle. The captured image is processed and compared with the images in the database. Once processed, the result is displayed as either 2 wheeler or 4 wheeler. The result is send to the opposite side through Bluetooth and displayed in the screen in the oppositely arriving vehicle.

B. Block Diagram

Ultrasonic sensor 1 and Camera 1 are interfaced with Raspberry Pi 3 Board. The output from the Raspberry Pi 3 Board is send to the Bluetooth 2 and displayed in LCD 2 where Bluetooth 2 and LCD 2 are interfaced with Arduino Nano.

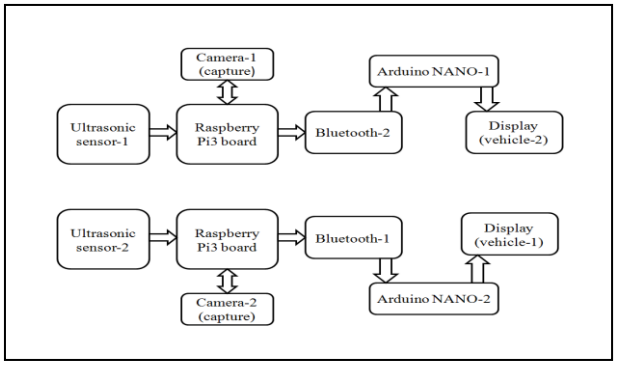

Fig. 1. Block diagram of existing system.

Similarly for another side, Fig 1 shows the block diagram of existing system where the ultrasonic sensor 1 senses the presence of vehicle 1 and the message is sent to the vehicle 2 to indicate the presence of vehicle 1. Similarly, vehicle 2 presence is indicated after being sensed by the ultrasonic sensor 2 and information is sent to the vehicle 1.

The disadvantage of this type of system is that the type of vehicle is not known and also the user have to view the LCD installed at the vehicle to know about the vehicle. As per the work of Siddharth Saxena [22], the conversion of text data to the audio recording based on the type of vehicle is done. Another main disadvantage is the requirement of power supply for continuous time interval. This is avoided by the use of piezo electric crystal.

III. Proposed System

Due to partial or no visibility in the hill bends and curves, thousands of people lose their lives. To overcome this problem, lot of ideas have been proposed. A simple system that depicts the movement of vehicles is done previously. Ultrasonic sensors detect the vehicles and turn on the light attached to the opposite pole. So the vehicles coming in the opposite side can see the glowing of light and slow down the vehicle. As an upgrade to this idea, the type of the vehicle is detected by image processing and sending to the vehicle coming in the opposite side using ultrasonic sensor. As soon as the vehicle is detected, camera captures the image of the vehicle. The captured image is processed by Template Matching method in OpenCV tool. After image processing, the vehicle type is discovered and it is sent through Bluetooth which is attached in the opposite vehicle and is displayed it in Liquid Crystal Display (LCD). The vehicle type is played in the receiver side by using apr33a3 voice module. Both Bluetooth and LCD are interfaced with Arduino Nano Microcontroller board. All the components are powered by voltage generation by piezoelectric crystals placed in the middle of the road.

A. Block Diagram

Ultrasonic sensor 1 and Camera 1 are interfaced with Raspberry Pi 3 Board. When a vehicle is detected by Ultrasonic sensor 1, Raspberry Pi 3 triggers camera to capture the image and it is processed. OpenCV tool is used for image processing. Template Matching is the used processing method to compare the captured image with the existing image uploaded in the database. After detecting the vehicle type, the data is send to the opposite vehicle. Bluetooth and LCD interfaced with Arduino Nano setup is placed in the opposite vehicle. The output of the image processed from Camera 1and the type of vehicle is send through Bluetooth 2 and display the data in LCD 2. The vehicle type is played in the speaker in the receiver side.

Ultrasonic sensor 2 and Camera 2 are interfaced with another Raspberry Pi 3 Board. The same process is done as the opposite side. The data is send to the opposite vehicle which is fitted with Bluetooth 1 and LCD 1 that are interfaced with Arduino Nano. The vehicle type is played in the speaker in the receiver side.

Fig 2 shows the block diagram of proposed system where the additional voice module is interfaced with the Arduino board to convert the message to the audio file format.

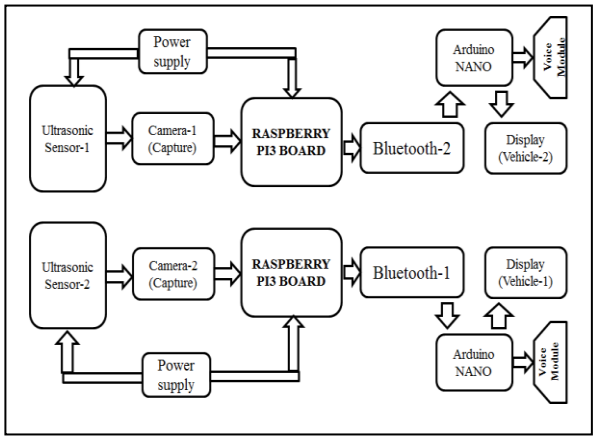

Fig. 2. Block diagram of proposed system.

B. Steps Involved in the Proposed System

- The The vehicle 1 is initially detected by Ultrasonic sensor 1 (US-1).
- Detection of vehicle by Ultrasonic sensor 1 (US-1) triggers the camera 1.
- Camera 1 is connected to the Raspberry Pi 3 board. It captures the image of the vehicle after the camera is triggered.
- The captured image is processed by template matching in OpenCV tool.
- The type of the vehicle is identified by comparing images uploaded in the database.
- The data is sent to the vehicle 2 through Bluetooth 2 which is interfaced with Arduino Nano.
- The information is displayed in LCD 2.
- Arduino Nano selects the correct audio type according to the data received and plays the audio in the speaker.
- Similarly, vehicle 2 is detected by Ultrasonic sensor 2 (US-2).
- Detection of vehicle by Ultrasonic sensor 2 (US-2) triggers the camera 2.
- Camera 2 is connected to another Raspberry Pi 3 board. It captures the image of the vehicle after the camera is triggered.
- The captured image is processed by template matching in OpenCV tool.
- The type of the vehicle is identified.
- The data is sent to the vehicle 1 through Bluetooth 1 which is interfaced with Arduino Nano.

- The information is displayed in LCD 1.
- Arduino Nano selects the correct audio type according to the data received and plays the audio in the speaker.

C. Power Supply

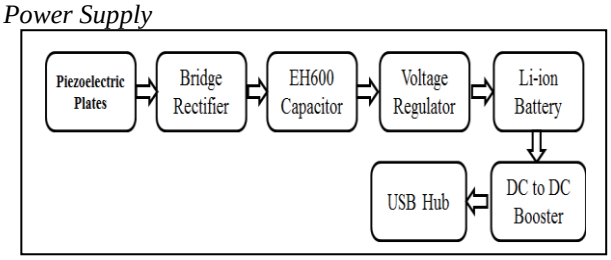

Fig. 3. Power supply

- Fig. 3 shows the block diagram to convert power from piezo electric plates to store it in the battery.
- Piezoelectric sensors are used for the current generation for the equipments.The current produced from the piezoelectric sensors is alternating current. So,we need some rectifier circuit to convert that into direct current.The solution is by using the Bridge rectifier circuit. Bridge rectifier is used to convert AC to DC voltage.The output of the bridge rectifier is given to the EH600 capacitor. This capacitor is used to maintain storing voltage. EH600 capacitor stores the high incoming voltage and produces stabilised voltage output.Then it is supplied to voltage regulator to maintain constant voltage to DC battery. Since the produced voltage may be insufficient, DC to DC booster is used to boost the voltage voltage.Atlast the voltage is supplied to the components through the USB ports.
- Piezoelectric sensors are used for the current generation for the equipments.
- Bridge rectifier is used to convert AC to DC voltage. Capacitor is used to maintain storing voltage.
- EH600 capacitor stores the high incoming voltage and produces stabilised voltage output.
- Voltage regulator is used to maintain constant voltage to DC battery.
- For connecting USB ports, DC to DC booster is used to boost the voltage.
- The voltage is supplied to the components through USB ports.

IV. Results and Discussion

The system involves the use of both software to give command to the interfaced hardware and image processing to detect the type of vehicle Open CV is used. Based on the requirement, the specification of the hardware components are chosen.

A. Software

Template matching is a technique for finding areas of an image that match (are similar) to a template image (patch). Two primary components are required.

1) *Source Image (I):* The image in which we expect to find a match to the template image
2) *Template Image (T):* The patch image which will be compared to the template image

$$R(x,y) = \frac{\sum_{x',y'}(T'(x',y') \cdot I'(x+x',y+y'))}{\sqrt{\sum_{x',y'} T'(x',y')^2 \cdot \sum_{x',y'} I'(x+x',y+y')^2}}$$

This shows the resultant image calculated from the reference image and the obtained image. The system should store the database of the type of vehicle to compare with the captured one.

B. Hardware

The interfacing of hardware components such as bluetooth , voice module and LCD with Arduino is used because the port required for interfacing is three. The memory required to store the database for comparing the obtained with the reference and for processing the image requires a lot of memory based on which Rasperry Pi 3 board is used. As the system is operated in hilly areas where the temperature is low based on which the efficient operating piezo electric crystal is used.

C. System Setup and Results

Fig. 4. System setup

Fig. 4 shows the system setup on either side of U turn in hilly areas. When a vehicle is passed over ultrasonic sensor, the signals are cut by the vehicle. The output is connected to the Raspberry Pi. Raspberry Pi triggers the camera to capture the image of the vehicle when the vehicle is detected. The image is processed by CCOEFF_NORMED method in Template Matching. Once a match is found, the vehicle type is send through Bluetooth and displayed in LCD. According to the text, audio file is chosen by voice module and played in the speaker. Similarly, the process is done for the other side.

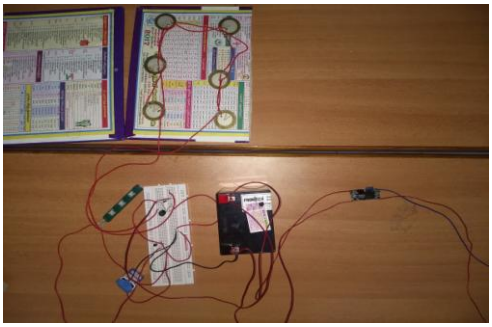

Fig. 5. Piezoelectric setup

Fig. 5 shows the setup of piezoelectric sensor for

production of piezoelectricity.

The average weight of a 4-wheeler is in the range of 1.5-44 tons. When piezoelectrice plates are arranged in series in 3mX3m, the voltage produced will be in the range of 800-5000V. Similarly, the voltage produced for a 2-wheeler is 53V. The piezoelectric plates used here belong to the type DSC25/0.5-PX5-N.

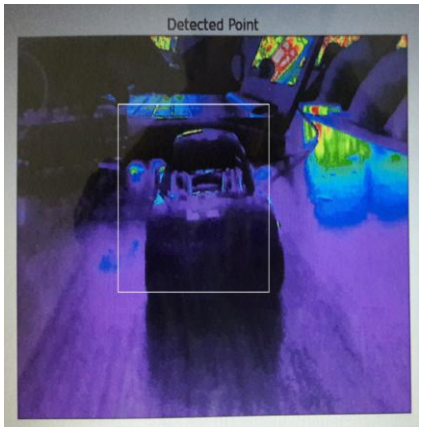

Fig. 6. Detection of Car

Fig. 6 shows how the car that is captured from the camera is processed. The car detected by the ultrasonic sensor , sends the information to Raspberry Pi that triggers the camera to take the picture. The image is identified by CCOEFF_NORMED method in Template Matching. This method compares the mean of both template and captured image. After comparison, result is produced. The output is displayed in LCD of opposite vehicle which is interfaced with the Arduino. Arduino Nano gets this information as it is interfaced with the Bluetooth which in connection with Raspberry Pi board.

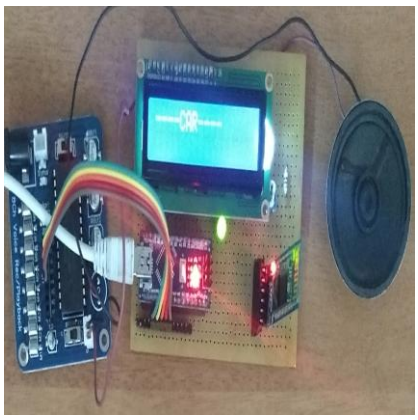

Fig. 7. Car Detection

Fig. 7 shows the result at LCD whwn a car is detected. The information of the type of the vehicle is sent to the receiver side through Bluetooth and displayed in LCD as well as played in the speaker. Based on type of text, the audio file is retrieved from voice module. Bluetooth, LCD and voice module are interfaced to the Arduino Nano microcontroller

V. Conclusion And Future Scope

Due to curves and bends in the mountain roads and cliffs, accidents occur at a large rate. In these kinds of situations the driver of a vehicle cannot see vehicles coming from opposite side. Thousands of people lose their lives each year due to non-visibility of approaching vehicle. Thus using the above stated method, drivers are made alert about the vehicle coming in the opposite side. On seeing the information displayed in the LCD and hearing audio from the speaker, drivers reduce the speed of the vehicles and this avoid accidents.

The system can be developed by using different matching techniques. Other matching techniques reduce the time delay which improves the efficiency. It can also be further developed using IOT. In future, if the network signal is stronger in the hilly regions, IOT implementation can be done. The cost of the project also reduces. Vehicle detection and the transmission of data will be faster in IOT.

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