DESIGN OF VOICE ENABLED ROAD RAGE DETECTION ON RASPBERRY PI 3B+

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Abstract

Road rage is aggressive behaviour exhibited by a vehicle driver while commuting. Various types of behaviour which include rude and offensive gestures, verbal insults, physical threats, dangerous driving methods targeted towards another driver or non-drivers such as pedestrians, cyclists in an effort to intimidate/release the frustration. Road rage may lead to serious accidents due to the imbalanced mental state of the driver. The main objective of this project is to detect the instances of road rage based on the audio expression of the four wheeler drivers. The notion of the project is to detect when the user yells, uses any insulting words to let out frustration over a certain period of time, store such word count and process using Raspberry Pi 3 module.

I. Introduction

India, ranks 1st in the number of road accident deaths across 199 countries reported in the World Road Statistics, 2018, followed by China and US. As per the WHO Global Report on Road Safety 2018, India accounts for almost 11% of the accident related deaths in the World.

National Highways which comprise of 1.94 % of total road network, accounted for 30.2 % of total road accidents and 35.7% of deaths in 2018. State Highways which account for 2.97% of the road length accounted for 25.2% and 26.8% of accidents and deaths respectively. Tamil Nadu and Uttar

Pradesh remain accounted for the highest number of road accidents and death on account of road accidents respectively in 2018, the report revealed. For three consecutive years now, young adults in the age group of 18~45 years accounted for nearly 69.6% of road accident victims. The working age group of 18~60 accounted for a share of 84.7% in the total road accident deaths [1].

Some of the factors contributing road rage include excessive Speeding, tailgating, passing on the shoulder of the road, making rude gestures, pulling into a someone's parking space, changing lanes without signaling, flashing high beams at car in front, drive through yellow lights turning red, merge in the last second with traffic on the highway [2].

Consequences of the road rage are aggressive speeding, obstructing other commuters, dangerous overtaking, abusing, making offensive gestures to other commuters, deliberately hitting another commuter or vehicle with one's vehicle, harming a commuter or a pedestrian with a weapon, threatening to injure, use of a weapon, causing revengeful harm, causing physical injuries or death, obstructing the traffic [3].

The proposed design aims to implement a voice enabled Road Rage Detection Monitor System (RRDM). It detects the scream of a four-wheeler driver and sends an appropriate message based on the level of road rage detected. An algorithm is developed to detect the level of road rage. From different surveys conducted on road rage, statistics are taken and Figure 1 indicates different statistics of Road rage in various scenarios [4].
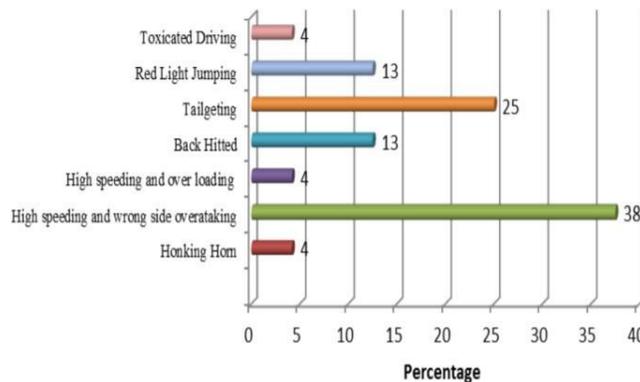
Figure 1. Type of traffic rule violence involved in road rage.

Section II describes the system level block diagram. Section III describes the detailed block diagram. Section IV describes the hardware setup and results. Section V describes the future scope. Section VI describes the conclusion.

II. System Layout Block Diagram
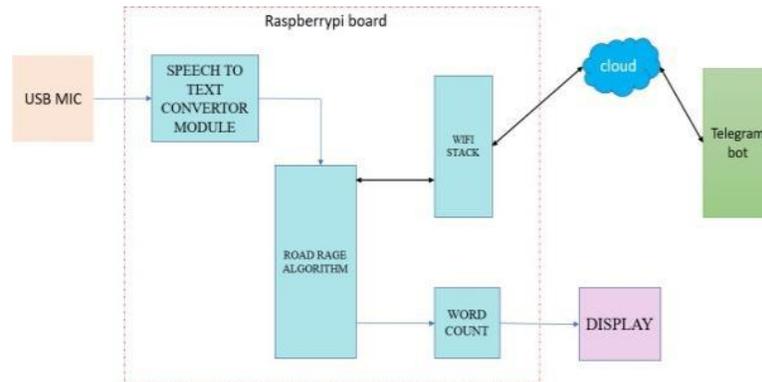

Figure 2. System level block diagram.

The system level block diagram is shown in figure 2. It consists of raspberry pi 3b+ board, USB Mic and display. The board sends the emergency message to the telegram Bot via cloud.

A. Raspberrypi 3b+. It is a small sized computer with quad core processor running at 1.4GH. It has a built-in Wi-Fi and Bluetooth stack, micro SD card slot, 28x GPIO pins, 1GB RAM, USB and Ethernet ports. It uses Raspbian OS, to be flashed on 8GB Micro SD card [5].

B. USB Mic. It is compatible with Raspberry pi 3b+.

C. Display. The output is displayed by glowing and blinking LEDs.

III. Detailed Block Diagram
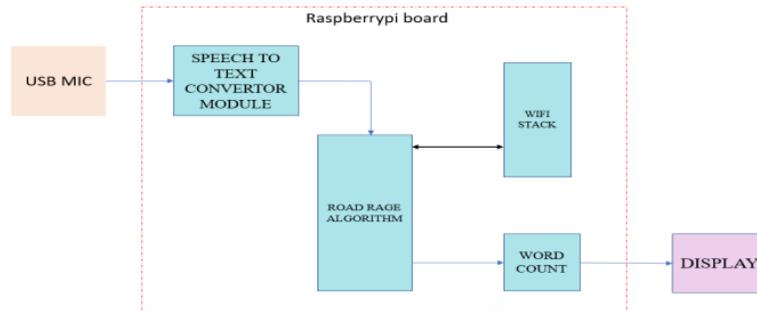
Figure 3. Detailed block diagram.

Detailed block diagram is shown in Figure 3 and the explanation of each functional block is explained below.

(A) USB MIC. A USB Microphone is an easy way of making high quality recordings on computer. It is used to record the abusive words uttered by the four-wheeler driver. It sends the voice signals to the Raspberry pi board. It Interfaces between Mic and speech to text block.

(B) Speech to text block. Mic output converted to text using the Speech Recognition package in phrases, words, phones are stored and also a recognition model to compare input speech with the set of references built in the code [6].

(C) Word count block. The converted text is then compared with words already stored in the list of code and if the word matches with the default words, count is incremented by 1.

(D) Wi-Fi stack. When road rage is detected, SMS is sent through wi-fi module via cloud to the telegram bot.

(E) Display. Red, green and yellow LEDs are used. The output is shown by blinking or glowing respective LED.

(F) Algorithm block. GPIO pins and microphone parameters resolution, channel, sample rate, chunk size, device index, recording time are set. Telegram credentials are printed and chat id and command are sent to telegram bot. Command is printed and according to the command, time can be obtained and program can be started or stopped. When the program starts,

microphone reads the input for the prescribed time in the code and word count is stored. Initially word count is set to zero. Word count is incremented when the text matches to the list in the program. According to the word count, appropriate output is displayed through SMS in telegram bot. If any keyboard interrupt occurs, program is terminated or stop command through telegram can terminate the program.

(G) Telegram Bot. It is a third-party applications that run inside Telegram. Users interact with bots by sending them messages, commands and inline requests. One control bots using HTTPS requests to our Bot API. At the core, Telegram Bots are special accounts that do not require an additional phone number to set up. Users can interact with bots in two ways:

• Sends messages and commands to bots by opening a chat with them or by adding them to groups. This is useful for chat bots or news bots like the official TechCrunch bot.

• Sends requests directly from the input field by typing the bot's @username and a query. This allows sending content from inline bots directly into any chat, group channel.

To detect the yell or abuse of four-wheeler drivers, we set the threshold values for the determination of abusive words. Whenever the word count reaches the threshold values road rage is detected. After the yell is detected it must be verified whether it is recognised or not. The speech is immediately captured after the yell is detected through the USB Mic attached to the port of raspberry pi3b+.

The speech captured from the Mic is converted into text using the Speech Recognition package in raspberry pi. Google Speech API uses a language model to convert the sounds into letters and recognition model for the mapping.

This text is compared with the stored words of the code. If the text from the speech to text block matches with any of these words, then yell is detected, word count is incremented for each matched word. When the four-wheeler driver uses abusive words and if the word count exceeds the respective threshold values then level (low, medium, high) of road rage detected. The count is processed and the respective output is shown by

glowing and blinking LED's. For high abuse detection, red LED glows, for medium abuse, yellow LED glows, for low abuse, green LED blinks for 5sec. If no road rage is detected, green LED glows for 10sec.

When a response is received, an immediate SMS is sent to the verified numbers through the Wi-Fi module via cloud. If the speech is not recognised by the Google, it sends a message that „Google speech recognition couldn't understand audio. If there is no Wi-Fi connection, it sends a message that couldn't request Google.
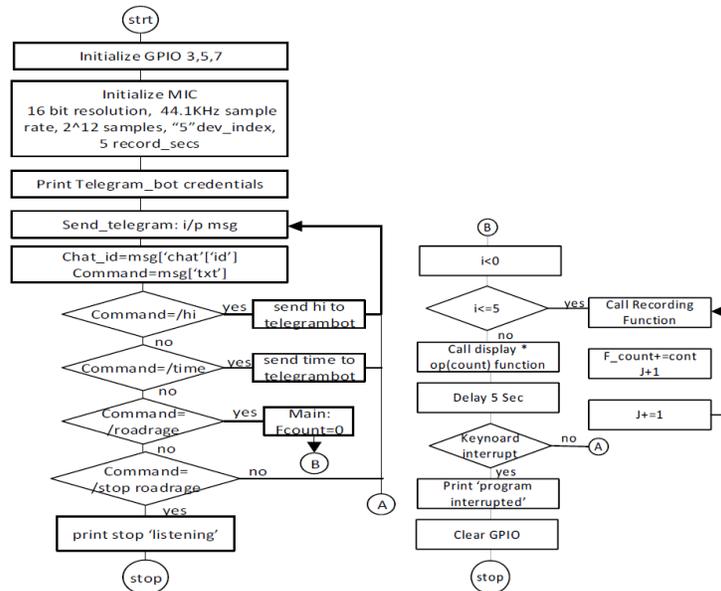
Figure 4. Flowchart for road rage algorithm.

Figure 4 shows the flowchart for road rage algorithm. Functions used in the flowchart are explained below:

A. Recording function:

Take a list of words like "hello", "insane", "stupid", "mad" with count = 0. After the installation of pyAudio, Open stream with microphone variables with frames and now add data listened from stream to frames, now close the stream and terminate pyAudio. Now, open test 1.wavfile in write mode with set channel = chans, resolution = 16bit and sample rate = samp_rate. Now, write frames in test 1.wav and close it.

B. Create Chunk_name = "test1.wav", with sr.audiofile (chunk_name) as chunk_audio and Chunk_listened = recognizer listen chunk_audio. Content = recognizer. recognizer_google (chunk_listened). Print content. Txt=content. splite.

If List 1 in txt is "yes" then go to count++, "no" then go to unknown value error.

If unknown value error is "yes" then print google speech recognition count understand audio, "no" then go to request. If request is "yes" then print couldn't request google, "no" then return count.

C. Display-output function:

Give input f count, enter chart_id 1080730151. If count>=5 is "yes" then print Road rage with high abuse detected, by sending Road rage with high abuse detected and then call led-ON with pin_num = 3, finally goes to return. "no" then go to count > = 3. If count > = 3 is "yes" then print "Road rage with medium abuse detected", by sending "Road rage with medium abuse detected" and then call led-ON with pin_num=5 and finally goes to return. "no" then go to count > = 1. If count>=1 is "yes" then print "Road rage with low abuse detected", by sending "Road rage with low abuse detected" with f-count and then call blink with pin_num=7 and finally goes to return. "no" then print "No road rage detected", by sending "No road rage detected" and then call led-ON with pin_num=7 and finally goes to return.

D. LED-on function: Give pin_num as input, pin_num.output is low, Delay=10, Pin_num.output as low then return 1.

E. LED-blink function: Input is pin_num, L=0 and L<=5. If L<=5 and pin_num.output=HIGH then Delay 1, pin_num.output=LOW then Delay 1 make L++ which returns to L<=5 and the process repeats until pin_num.output=LOW, finally returns to 1.

IV. Hardware Setup and Results
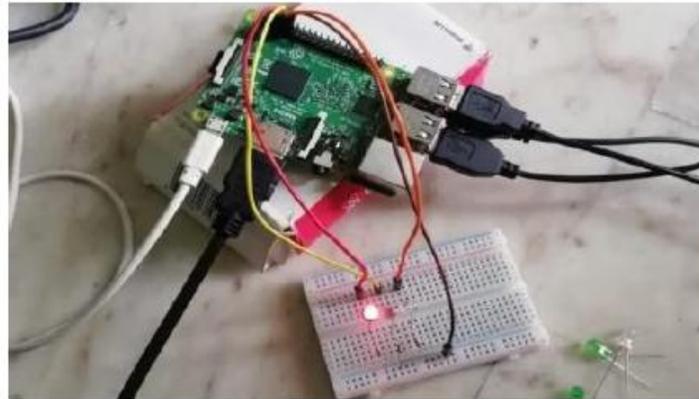
Figure 5. Road rage with high abuse detected.
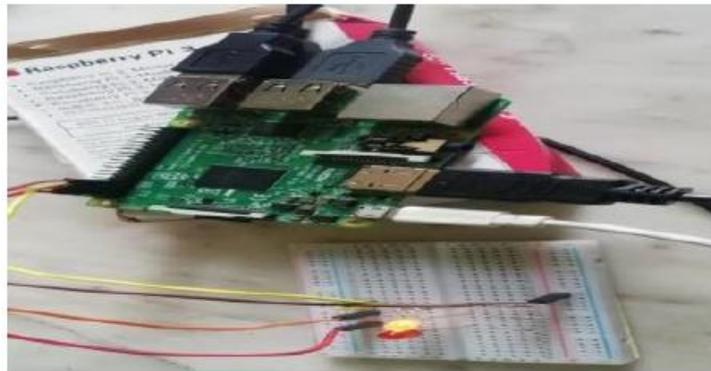
Figure 6. Road rage with medium abuse detected.

Figure 7. Emergency message sent to telegram API.

Figure 5 shows the case of road rage detection with high abuse and the word count ≥ 5. The red LED glows for 10sec. Figure 6 shows the case of road rage detection with medium abuse with and the word count ≥ 3. In this case yellow LED flows for 10 sec. To detect the abuse of the four-wheeler driver on other commuters, programmable threshold values are set for determining the level of the road rage detected. The telegram message image for medium abuse is shown in Figure 7. According to the commands sent by the user, program can be initiated or terminated and corresponding messages regarding road rage detection are sent to telegram API.

V. Future Scope

Offline Road rage detection messages could be sent by interfacing raspberry pi with GSM module. The road rage detection, Longitude and Latitude parameters could be processed by interfacing GPRS with raspberry pi board. This information could be sent to the traffic police station. Thermal cameras may be integrated to detect blood pressure along with another camera to track the drivers hands when he makes offensive physical gestures, the car could be made to slow down or brake. In-car microphone monitors the speech of the driver.

VI. Conclusion

In this project we have developed a voice enabled road rage Detection System in which the input is taken using USB Mic and output is detailed using the display. An Algorithm features to send an emergency message when the road rage took place and output is shown by display based on level of road rage detected. The hardware results targeted on Raspberry pi 3b+ is discussed.

References

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