Abstract

Objective: The main objective of our project is to reduce the speed of the vehicle based on driver emotions. Methods: To achieve our objective, we used brainwave sensor which is responsible for sensing the emotions of the driver. The frequency signals obtained from the brain wave sensor are useful for analyzing the type of emotions the person is possessed when he was driving at high speed. These frequency signals are transferred to the relay through the arm processor. Based on PWM signals the speed of DC motor is controlled. Findings: As per previous reports, the speed is controlled by sensing the pressure in the fuel tank by using the piezoelectric sensor. Accordingly, if the pressure inside the fuel tank exceeds a certain limit, the fuel will not be pumped to the wheels. Thus the speed of the vehicle can be reduced, but it cannot stop the vehicle completely. In our project, we have developed a method which can reduce the speed of the vehicle as well as it can stop the vehicle based on emotions. Our project is unique as we used only one sensor to sense different types of human emotions and we analyzed it based on their frequencies. Improvement: The project we have developed is applicable in all type of vehicles whether it may be two wheeler or four wheeler. We have improved the flexibility for drivers to reduce the speed of the vehicle. We have also improved a method to stop the vehicle.

Keywords: ARM Processor, Brainwave Sensor, PWM Signal, Piezo Electric Sensor, Relay

1. Introduction

Driving had become the most important part of the human life. Different types of transport vehicles are used by the people to travel from one place to another place. Which results in the rapid growth of accidents resulting damage to the life of the people and also to their families. It is observed that the major number of accidents are caused due to over speed of the vehicle when the driver is in an unbalanced state to overcome this problem in this project we have designed a new method that can slow down or stop the speed of the vehicle. When the driver is suffering from sudden heart attacks, heart failure, dizziness and fainting, then the driver will be in the unconscious state.

The main aim of this project is when the driver is facing any of the above mentioned problems, while driving the vehicle, the speed of the vehicle is reduced automatically based on Brainwave sensor and the speed of the vehicle is reduced by varying the PWM signal. Thus the rotation per minute of the wheel is changed based on the PWM signal which in turn reduces the speed of the vehicle. Therefore the maximum number of accidents can be prevented.

1.1 The Existing Methods that can Prevent Accidents

ABS (Anti-lock Braking System) helps the driver to have a free braking experience when the vehicle is moving in an uneven road or on the water surfaces by avoiding skidding and locking the wheel. In the "Automatic Pneumatic Braking System", the fuel supply to the engine is cut down automatically when the speed of the vehicle had exceeded the limited speed and the caution is given to the driver by reducing or stopping the vehicle by using the solenoid valuation mechanism. The Volvo's new XC60 SUV, it is efficient in detecting the collision until 50 mph and the brakes are applied by itself automatically. Using Ultrasonic sensor in front of the vehicle, it will sense the distance and sends back, the reflected ultrasonic signal which gives the between the car and the obstacle. This detected signal is given to the microcontroller which is
used to control the speed of the vehicle by pushing the braking pedal. Therefore, accidents can be prevented by intimating the driver about the obstacles in advance.

1.2 Drawbacks in the Existing Methods

ABS helps the driver only when the driver applies it in the correct time only and the distance should also be maintained because it has its own braking. In the Pneumatic braking system even though the fuel supply to the engine is stopped the vehicle will not stop because the wheel still rotates. The XC60 SUV will not work in heavy rainfall and snowfall. It is not much capable in unfavorable atmospheric conditions. Ultrasonic sensor can only sense the obstacles only up to certain limits. The frequency above 20,000 hertz can be detected by the ultrasonic sensors. There is another limitation also, that is, the sensor will detect any object above its frequency range whether it is a danger to the vehicle or not. In our study we are using brainwave sensor to detect the mental condition of the driver based on different frequencies of the sensor. The speed of the vehicle is reduced or stopped automatically considering the emotions of the driver.

2. Description of Project

2.1 Proposed Model

The behaviour of the vehicle and its operation can be executed by maintaining the vehicle speed, brainwave signal generation and varying the PWM signals. The Figure 1 describes the outline of the project.

The voltage signal from the brainwave sensor is given to the personal computer via Bluetooth. On the PC the math lab code is written to get the frequency of different voltages that are produced by brainwave sensor. This is given to the ARM processor by the protocol which is responsible by the UART. The ARM will process the signal and the corresponding emotion is displayed on the LCD display and the speed of the DC motor is reduced or increased based on the voltage and by changing the duty cycle of the PWM signal which is derived by the relay driver and the below diagram represents the serial data transmission to the arm through UART and driving the output to different devices which is responsible by the GPIO. The speed of the wheel is reduced based on the generated frequencies and their cross-bonding emotions by differing the PWM signal which is done by writing the embedded C program in Keil software and it is processed by using the ARM processor.

2.2 Hardware Components

2.2.1 Brainwave Sensor

The emotions, thoughts and behaviour of the human is the communication between neurons within the brain. Synchronised electric pulses are produced for the communication with each other. This brain wave signals are detected by placing the sensor on the scalp. To describe the functions, it is divided into bandwidth over the continuous spectrum. The brainwave changes based on what a person is doing and feeling. Slower brain waves are more when the person feels tired, slow, sluggish or dreamy and higher brain waves are more when the person feel weird, or hyper-alerted. Figure 2 shows the view of brain wave sensor.

The speed of the brain wave is measured in hertz and are divided into bands depending on the slow, moderate and fast waves.
2.2.1.1 Infra-Low (<.5HZ)
Infra low brain waves are also known as Slow Cortical Potentials which are the lower rhythms that lie under the higher brainwaves. They are very slow and it is difficult to note and measure. The timing and network functions are done by infra-low brainwaves.

2.2.1.2 Delta Waves (0.5 to 3 HZ)
Delta waves are low frequency, slow and loud brain waves similar to that of drum beat. They are produced when the person is in deep meditation or if the person goes to the sleep. Healing takes place in this state, this need deep sleep so the person we will get sleep at this stage of frequency.

2.2.1.3 Theta Waves (3 to 8 HZ)
The theta waves help in learning and memory and are generated when the person is in sleep or in meditation. This is normally found when we wake or intend to sleep. In this range of frequencies the person will be dreaming or imagining.

2.2.1.4 Alpha Waves (8 TO 12HZ)
Alpha brainwaves are generated when the person is in the quiet flowing state. Alpha waves are powerful as they are produced when the brain is in the resting state. In this range of frequencies calmness, mental coordination and alertness of a person is detected.

2.2.1.5 Beta Waves (12 to 38 HZ)
Beta brainwaves are produced when the person is consciousness and alert. They are fast and are generated when the person is alert, attentive and mentally focused. They are further divided into three brands. Lo-Beta (Beta1, 12-15 Hz) indicates musing and fast idle. Beta (Beta2, 15-22 Hz) generates when the person is more active. Hi-Beta (Beta3, 22-38 Hz) generates when the person is in high anxiety and excitement and when he’s having the high complex thoughts. It takes more energy to generate these signals because they are produced by high frequency and are not an efficient way to run the brain.

2.2.1.6 Gamma Waves (38 to 42 Hz)
Gamma brainwaves very high frequency brain waves similar to that of the flute and are very fast and they process different information produced at the different parts of the brain. The information is passed very fast through gamma waves. This wave detects consciousness and spiritual emergence. Figure 3 represents the various types of frequency signals obtained from the brain wave sensor. Table 1 describes activity frequency bands and their applications.

![Figure 3. Frequency signals.](image)

**Table 1. Activity frequency bands**

| Band       | Frequency  | Applications                                      |
|------------|------------|---------------------------------------------------|
| Delta      | 1-3 Hz     | Found During Continuous Attention Tasks           |
| Theta      | 4-7Hz      | Drowsiness In Adults                               |
| Alpha 1    | 8-9 Hz     | Relaxed Closing The Eyes                          |
| Alpha 2    | 10-12 Hz   |                                                   |
| Beta 1     | 13-17Hz    | Active Thinking , Hi AlertFocus                   |
| Beta 2     | 18-30 Hz   |                                                   |
| Gamma 1    | 31-40Hz    | Shown In Short –Term Memory Matching And In Cross Model Sensory |
| Gamma 2    | 41-50Hz    |                                                   |

2.2.2 ARM7 LPS2148
The LPC2148 microcontrollers are 32/16 bit ARM7TDMI-S CPU core. It is the real-time impersonation and trace support that combines the microcontroller with embedded high speed flash memory of 512 kb. The 32-bit code execution with the maximum clock rate is done as it has unique architecture which consists of 128-bit wide memory location. It consist of 16-bit Thumb mode for critical code size applications with more that 30% performance penalty.

As it was tiny in size and had low power consumption, LPC2148 is used for the application where the size of the device is considered. It has serial communications interfacing range from a USB 2.0 full speed device and it also consist of UARTS, SPI, SSP and I2Cs. It consist of on-chip SRAM of 8 kb to 40 kb. Thus making the device most suitable for communication and for protocol con-
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verting, soft modems, voice recognition providing high performance and large buffer size. It also consists of 32-bit timers, single 10-bit DAC, 10-bit ADC(s), PWM channels and 45 fast GPIO lines with up to nine edge or it also have level sensitive external interrupt pins.

2.2.3 Level Converter
As RS232 will not match microprocessors and microcontrollers in today’s devices so we need a voltage converter that is the line driver to change the RS232’s signals to TTL voltage levels which are compatible to the ARM7 LPC2148 TxD and RxD pins. The MAX232 is responsible for voltage to TTL and vice versa. The source voltage for ARM 7 LPC2148 and for MAX232 Chip is same that is +5 volts. There is no need for dual power supply that are most common in the older ones.

2.2.4 Relay Driver
The relay is an electro-magnetic switch. It is useful when a low voltage circuit to reduce or increase the speed of the DC motor. This chip takes low level signals and it will act as a relay itself, switching on or off a signal on the other side of the relay driver.

2.2.5 DC Motor
In the factory, motors are commonly used for machinery operating and are used for variety of applications. This is the first type of energy converters used in the industry. Based on the voltage signal sent to DC motor the speed of the motor is controlled. DC motors need a DC voltage in large amount for operation.

2.2.6 LCD Display
The 16x2 LCD is famous as it consists of HD44780 interface module. This makes it suitable to interface an LCD to any device with inbuilt character set and command structure. One of the great feature of this device is we can build our own characters. Thus, this device is very flexible for during experiments for easy iteration between the device and the user who is using the device.

2.3 Software Required

2.3.1 Neurosky Software
The Neurosky Mind Wave is the Brain-Computer Interface (BCI) device turns our brainwaves into actions. It will report all the emotional states of the human beings producing the raw wave and representing frequency bands of different emotions generated by a person. The mind wave drivers and mind wave software must be installed before interfacing the Mind wave Wireless USB adapter to the computer.

2.3.2 Keil Software
The Keil vision IDE toolset provide a powerful and easy way to use the environment for developing embedded applications. It also consists of the components needed to create, debug and assemble the C/C++ source files, and simulation of microcontrollers and related peripherals. It helps to implement complex and time-critical software.

2.3.3 Mat-lab
The Mat-lab is a high-performance language for technical computing, visualization and programming in an easy environment where mathematical notation is used to express the solution to the problem. Mat-lab’s basic element is an array which helps to overcome many technical computing problems, thus providing high interactivity towards the tool.

3. Detecting Process of Accidents
The emotions are detected by using the brain wave sensor. The brain produce different electrical waves and due to the contraction of the muscles it also generates a specific electric wave. The voltages that are produced by the neurons are detected by the brain wave sensor. If the voltage is high, it represents the particular type of emotion and if it is low it will represent a different type of emotion. The voltages are taken from the left side of the brain without touching the hair because the brain signals are strong on the left side for the right handers. The analogue signal produced consists of neuron signal and noise. We need only the neuron signal, so in order to eliminate the noise signal from neuron signal, the brain wave sensor will use another sensor known as dry electrode. It is kept at the ear lobe of the person where there are no brain waves so only the noise signal is produced; by manipulating both the above signals, only very low neuron signal is produced which is amplified within the brain wave sensor. The brain secret card contains an EEG sensor to sense the human brain and the signal is sensed by the brainwave headset which is represented by the Neurosky. Power should be
supplied to the brainwave headset which is given by the AAA battery. This neuron wave is sensed by the brain wave sensor and are converted into packets which are transmitted through Bluetooth medium. In personal computer, the signal is extracted and processed by using the Mat lab software and for the presentation purpose we are using the Think gear and Neurosky software. In the Neurosky software the waveforms and its corresponding emotions are displayed in the graph form and in the think gear software the emotions are displayed in the meter form representing different frequencies for different types of human emotions. Figure 4 describes EEG signal processing via Bluetooth.

These signals are given to ARM processor by using the USB to serial transmit. The signal from the computer is taken in the serial manner by combining them into packets and it is transmitted bit by bit on a single wire between the computer and the ARMLPC 2148 processor. This serial communication is done by using the Universal Asynchronous Receiver/Transmitter. The LPC 2148 consists of two serial interfaces: UART0 and UART1. In this study we used UART0 pin for receiving the data from the PC via P1.1 pin. The PC and ARM Processor are denoted by using the baud rate. The baud rate of the PC and ARM processor should be the same to transmit the data correctly. The baud rate used in this project is 57600. The data are transmitted by using the protocol RS232 it enables point-to-point data transfer, but the voltage levels of the PC and ARM processor are not directly compatible so MAX232 level transition buffer is used. The ARM LPC2148 microcontroller will synthesize this signal by processing and storing it in the inbuilt memory location which is interfaced to the DC motor through a relay driver. Figure 5 shows the interfacing of arm processor.

The corresponding code is programmed by using keil and it is dumped into the ARM by indicating alpha, beta, theta and delta with their respective frequencies and based on their emotions the speed of the vehicle is controlled by varying the PWM signal that is by calculating the rotation per minute of the wheel. If the person is feeling drowsy then the speed of the vehicle is reduced automatically and if the driver is alert and conscious then they will be no change in the speed of the vehicle and if the driver is feeling anxiety then the speed of the vehicle is limited or reduced if the vehicle is moving very fast. Thus preventing the maximum number of accidents and saving the life’s of many people.

4. Methodology

The workflow of the Emotion based intelligent vehicle is illustrated in the form of design flow for controlling the speed of the vehicle. Initially the Neurosky brain wave sensor is turned on which is responsible of gathering the neuro signals from the brain then the received signal is executed by using the math lab software, based on the emotions detected the vehicle speed is estimated. If the driver is in the sleepy state the wheel movement is slowed down and if the driver is relaxed there is no change in the moment of the vehicle and if the driver is feeling anxiety then the speed of the vehicle is limited and slowed down. Thus the accidents are prevented by reducing the speed of the vehicle. The Figure 6 describes the working flow of the project.

5. Results

The EEG bio sensor that is the brainwave sensor is used to detect the electric signal from the brain by locating it on the front lobe (FP1). The other sensor is used as the references and it is placed on the earlobe. Figure 7 represents the location of the EEG sensor which is used for the recording Neuro signal.
6. Conclusion

Our findings can be used in any type of vehicles, weather it may be two wheeler or four wheeler. Controlling the speed of the vehicle considering the human emotions is a bit difficult task, so here we have made a prototype of it by replacing the vehicle’s wheel with the DC motor. The project is cost efficient and very flexible because we used brainwave sensor which is very well organized to detect many emotions by sensing the voltage produced by the neurons by using a signal sensor. Thus the speed of the vehicle is made, limited or stopped based on the person’s emotions.

7. References

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Figure 6. Flowchart.

Figure 7. Red line indicates attention strength and black line indicates the blinking strength.

Figure 8. Interfacing all the modules.
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