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IoT Based Accident Prevention & Alerting System Using Raspberry Pi

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Abstract: The IoT-based Car Accident Prevention and Alerting System using Raspberry Pi is a solution designed to enhance road safety. The system utilizes a Raspberry Pi along with sensors like IR, MEMS, ultrasonic, vibration, alcohol, GPS, and MPC30008. Its primary objective is to detect accidents and promptly notify emergency services to minimize response time and save lives. The system continuously monitors both the vehicle's surroundings and the driver's condition through an array of sensors. In the event of an accident being detected, the system immediately sends an alert to emergency services containing information such as the vehicle's GPS location. To further enhance safety measures, the system also includes a DC motor and motor drive for controlling vehicle speed and direction.

Index Terms - Internet of Things (IOT), Raspberry Pi, GPS, Sensors, etc.

I. INTRODUCTION

For reducing accidents, the reasons behind it must be understood. According to the records it is found that many accidents take place due to rash driving caused by the alcoholic state of drunken drivers [1]. When someone is driving long distances in the dark without getting enough sleep, it might lead to a second type of accident : drowsy driving. India has the world's highest population density. As the population rises, so does the demand for automobiles, resulting in circumstances such as road accidents and the number of people killed in car accidents [2]. According to the 2019 Traffic Accident Report, there were 449,002 collisions [2]. An alcohol sensor installed on a steering wheel can help control and avoid accidents caused by an individual in a condition of associate degree intoxication. On the other hand, one of the main issues that negatively affects people's everyday lives globally and puts strain on individuals in various ways is road traffic. In some cases, lives could have been saved if the medical team would have arrived timely [1]. There are also cases where mishap occurs due to crossing a certain speed limit [1]. In this project, all the major possible conditions have been taken care of and are expected to see many more creative and useful solutions in this field as IoT technology develops further.

II.AIM

To ensure accident prevention. The system has the capability to utilize sensors to monitor potential hazards. In the event of detecting any risks, it can promptly notify the driver. Take measures to prevent accidents from occurring.

To mitigate the impact of accidents. When an accident occurs, the system possesses the ability to swiftly and efficiently alert emergency services. This prompt response can contribute to minimizing the severity of accidents and ultimately save lives.

III.PROPOSED SYSTEM

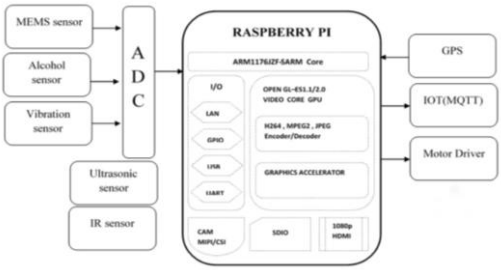

fig.2 block diagram of IoT based accident prevention and alerting system using raspberry pi

The Raspberry Pi acts as a microcontroller, functioning as the processing unit for the system. An IR sensor is employed to identify objects in front of the vehicle. This valuable information helps prevent collisions with vehicles or pedestrians. A MEMS sensor measures the vehicle's acceleration, velocity, and orientation. This data aids in detecting accidents like rollovers and collisions. The ultrasonic sensor determines the distance between the vehicle and nearby objects. By utilizing this information, we can avoid collisions with vehicles, pedestrians, and obstacles. Vibration sensors are used to detect vibrations within the vehicle. This enables the identification of accidents such as collisions or rollovers. An alcohol sensor is used to detect the presence of alcohol in a driver's breath. This crucial information helps prevent accidents caused by driving. The GPS module tracks the vehicle's location accurately. In case of accident detection, this information is transmitted along with a message to emergency services. The DC motor and its corresponding motor drive play a role in managing the speed and direction of the vehicle. They are instrumental in ensuring safety by allowing for adjustments such as slowing down or stopping the vehicle when required. Another component involved in this process is the MPC30008 microcontroller, which not only controls the motor drive but also facilitates communication with the Raspberry Pi.

IV.WORKING PRINCIPLE

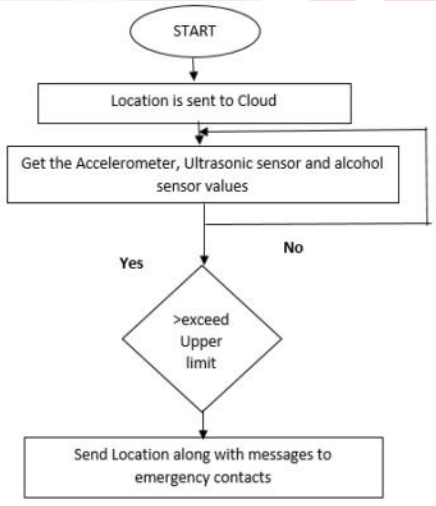

fig.1 operational flowchart of the system.

The system works as follows:

Step-1: After the power supply provided in the system, the sensors start initializing such as alcohol sensor, ultrasonic sensors and accelerometer [7].

Step-2: Using GPS, the location is always sent to the cloud.

Step-3: If the front and back ultrasonic sensors find the distance of the surrounding vehicles nearer, then the vehicle driver becomes alert with the help of a buzzer [7].

Step-4: Now, when these sensors exceed the limit go to STEP-4.If not again go to STEP-3.

Step-5: If the collision occurred is noticed by accelerometer, immediately the message along with the location is sent.

Step-6: This message is send to the controller then the controller does three tasks simultaneously

a. Message will be sent to the given mobile number with the help of the GSM Module along with location [7].

b. This location is stored in the Cloud [7].

V. METHODOLOGY

IoT-based accident prevention and alerting systems develop a solution using various hardware components.

- Raspberry Pi
- ADXL345 (MEMS sensor)
- HC-SR04 (Ultrasonic sensor)
- SW-420 (Vibration Sensor)
- MQ3 (Alcohol Sensor)
- L293D (Motor Drive)
- MCP3008 (ADC)

Description of hardware :

- RASPBERRY PI :

The Raspberry Pi is an affordable computer that has applications, including coding practice, robot building and home automation projects. It is powered by a 64-bit, quad-core Broadcom BCM2711 ARMv8 processor. It has four different capacities for LPDDR4 3200 SDRAM: 1GB, 2GB, 4GB, or 8GB. It also has ports including a 40-pin GPIO header, two mini HDMI connections, two USB 3.0 ports, two USB 2.0 ports, and a microSD card slot.

fig 3.raspberry pi 3 model B

Processor: 1.8GHz 64-bit Quad-Core Cortex-A72
Memory: 1GB/2GB/4GB/8GB
USB: 2 USB 3.0 & 2 USB 2.0 ports
Power: 5V DC, 2.5A via micro USB
Dimensions: 85.6 mm × 56.5 mm × 24.2 mm

- MEMS SENSOR :

The ADXL345 is a three-axis accelerometer that is made to be small and low-power consumption. It provides 13-bit high-resolution acceleration measurements up to ±16 g. This makes it perfect for usage in devices where dynamic acceleration from motion or impact, as well as static acceleration from gravity, are required for tilt sensing applications.

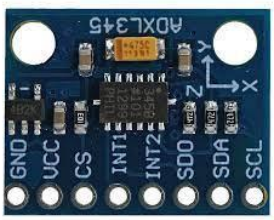

fig 4. ADXL345

Measurement range: ±2 g, ±4 g, ±8 g
Resolution: 13 bit
Sensitivity: 4 mg/LSB
Supply voltage: 2.0 V to 3.6 V

- ULTRASONIC SENSOR :

The HC-SR04 is a range sensor that allows for contact distance measurements ranging from 2 cm up to 400 cm. This sensor operates by emitting a pulse and calculating the time it takes for the echo to return. The object's distance is determined by calculating it using the speed of sound.

fig 5. HC-SR04

Measurement range: 2cm to 400cm
Operating frequency: 40KHZ
Operating voltage: 5V DC
Operating current: 15mA

- VIBRATION SENSOR :

The SW-420 sensor module detects hits and vibrations at different levels. This sensor module is inexpensive and easy to use, and it may be included into circuits.

fig 6. SW-420

Voltage: 3.3V to 5V DC
Current: <15mA
Response time: <20ms
Operating temperature: -10°C - +80°C

- ALCOHOL SENSOR :

The purpose of the MQ3 is to detect alcohol vapors in the ambient air by the use of a semiconductor alcohol detector. Because of its low cost and adaptability to many uses, it is extensively used.

fig 7. MQ3

Resolution: 13 bit
Sensitivity: 4 mg/LSB
Supply voltage: 2.0 V to 3.6 V
Power consumption: 100 µA (typical)

- MOTOR DRIVE :

The L293D is an integrated circuit motor driver known for its H bridge configuration. When it comes to operating DC motors in robotics and other related sectors, it is the recommended choice. This integrated circuit is noteworthy for its ability to regulate the speed and direction of two DC motors.

fig 8. pin diagram of L293D

Voltage: 4.5V to 36V DC
Current: 600mA per channel
Output: Dual H-bridge
Inputs: 4 logic inputs
Operating temperature: -40°C to +125°C

- ADC :

The MCP3008 stands out as a 10-bit analog to digital converter (ADC) featuring eight input channels. This particular device is highly sought after for its ability to effectively incorporate analog input functionalities into microcontrollers and other electronic devices. Additionally, it offers ease of use and a price point.

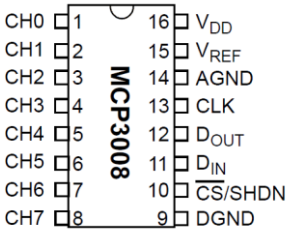

Fig 9. pin diagram of MCP3008

Resolution: 10 bit
Sampling rate: 200kSPS.
Input channels: 8
Supply voltage: 2.7V to 5.5V

VI. ACKNOWLEDGEMENT

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