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Real-Time Hand Gesture Controlled Advanced Security System for Robotic Vehicle

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ABSTRACT: *Distracted driving is one of the main causes of vehicle collisions in the United States. Passively monitoring a driver's activities constitutes the basis of an automobile safety system that can potentially reduce the number of accidents by estimating the driver's focus of attention. This paper proposes an inexpensive vision-based system to accurately detect Eyes Off the Road (EOR). The system has three main components: 1) robust facial feature tracking; 2) head pose and gaze estimation; and 3) 3-D geometric reasoning to detect EOR. Gesture Controlled Car is a robot which can be controlled by simple human gestures. The user just needs to wear a gesture device in which a sensor is included. The sensor will record the movement of hand in a specific direction which will result in the motion of the robot in the respective directions. The robot and the Gesture instrument are connected wirelessly through radio waves. User can interact with the robot in a more friendly way due to the wireless communication. It will allow user to control the forward, backward, leftward and rightward movements, while using the same sensor to control the throttle of the car. Movement of car is controlled by the differential mechanism. The mechanism involves the rotation of both forth & rear wheels of left or right side to move in the Anticlockwise direction and the other pair to rotate in the clockwise direction which makes the car to rotate about its own axis without any kind of forward or backward motion. The main advantage of this mechanism is the car with this mechanism can take sharp turn without any difficulty.*

Keywords:MEMS,GSM,GPS,Zigbee.

INTRODUCTION

Driver distractions are the leading cause of most vehicle Crashes and near-crashes. According to a study Released by the national highway traffic safety administration and the Virginia tech transportation institute [6], 80% of crashes and 65% of near-crashes involve some form of driver distraction. In addition, distractions typically occurred within three seconds before the vehicle crash. Recent reports have shown that from 2011 to 2012, the number of people injured in vehicle crashes related to distract driving has increased 9% [1]. In 2012 alone, 3328 people were killed due to distracted driving crashes, which is a slight reduction from the 3360 in 2011. Distracted driving is defined as any activity that could divert A person's attention away from the primary task of driving. Distractions include texting, using a smart phone, eating and drinking, adjusting a CD player, operating a gps system or Talking to passengers. This is particularly challenging nowadays, where a wide Spectrum of technologies have been introduced into the car Environment. A Gesture Controlled robot is a kind of robot which can be controlled by hand gestures and not the old fashioned way by using

buttons. The user just needs to wear a small transmitting device on his hand which includes a sensor. Movement of the hand in a specific direction will transmit a command to the robot which will then move in a specific direction. At the receiving end an RF Receiver module will receive the encoded data and decode it by using a decoder IC. This data is then processed by a microcontroller and passed onto a motor driver to rotate the motors in a special configuration to make the robot move in the same direction as that of the hand.

METHODOLOGY

In this project, it was having two methods used for two sections. Whereas, firstly we consider the transmitter section and then receiver section.

TRANSMITTER SECTION:

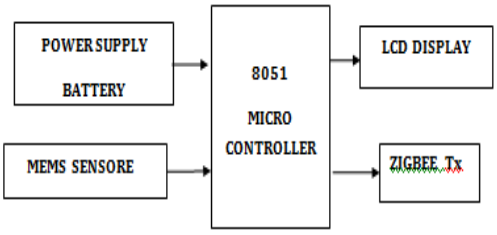

Fig 1: Block diagram

- In this transmitter section, considering a wireless remote which was respective of the car is used.
- After dismantle the remote, using only the transmitter circuit which consists of RF module along with 4 tap buttons.
- As per the project, developing this wireless remote car to gesture control using a micro controller.

Micro controller

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

Fig 2: Micro controller

MEMS:

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. Microelectronic integrated circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow micro systems to sense and control the environment. Sensors gather information from the environment through measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision making capability direct the actuators

to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost.

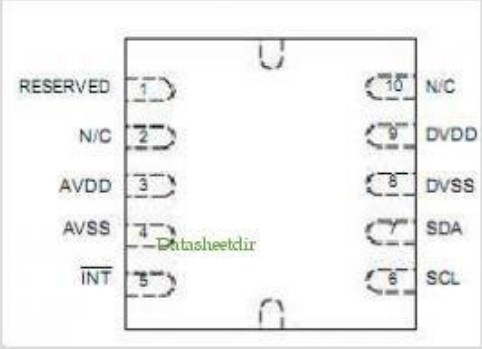

Fig 3: MEMS IC

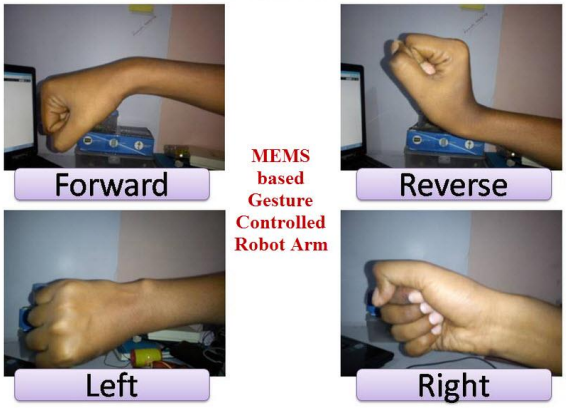

Fig 3.1:MEMS hand directions

RECEIVING SECTION:

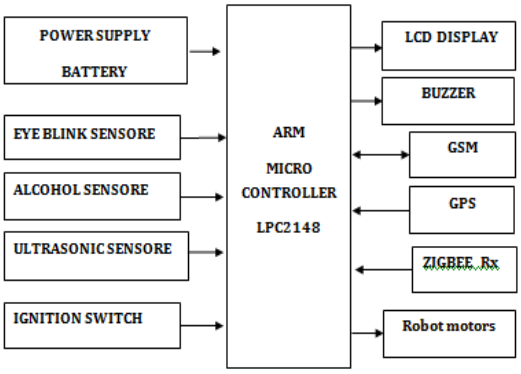

Fig 4: Block diagram

HARDWARE SYSTEM

We can overcome the disadvantage of the existing method by improving system prototype is built on the base of one embedded platform ARM which controls all the processes. Experimental results illuminate the validity of this car security system. In this proposed embedded car security system, IRS (Iris recognition System) is used to detect the iris of the driver and compare it with the predefined iris. For example, in the night when the car's owner is sleeping and someone theft the car then IRS obtains images by one tiny web camera which can be hidden in the car. IRS compares the obtained image with the predefined images if the image doesn't match, then the information is sent to the owner through SMS. So now owner can obtain the alert of the thief in his mobile as well as.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too.

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The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Fig 5:ARM7

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

GSM:

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service.

Fig 7:gsm

The network is structured into a number of discrete sections:

- Base Station Subsystem – the base stations and their controllers explained
- Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network"
- GPRS Core Network – the optional part which allows packet-based Internet connections
- Operations support system (OSS) – network maintenance

SMS was intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. However, GSM is vulnerable to different class of attacks, each of them aiming a different part of the network.

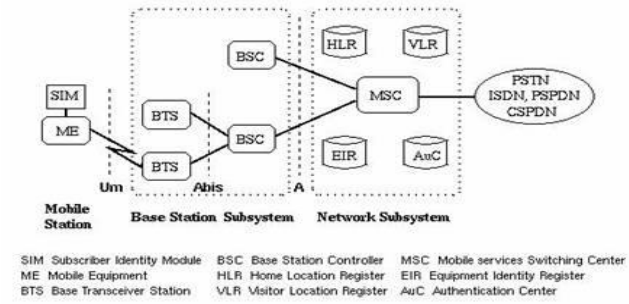

Fig 7 .1:GSM architecture

Buzzer:

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave ovens, & game shows. The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

A car alarm is an electronic device installed in a vehicle in an attempt to discourage theft of the vehicle itself, its contents, or both. Car alarms work by emitting high-volume sound (often a vehicle-mounted siren, klaxon, pre-recorded verbal warning, the vehicle's own horn, or a combination of these) when the conditions necessary for triggering it are met. Such alarms may also cause the vehicle's headlights to flash, may notify the car's owner of the incident via a paging system, and may interrupt one or more electrical circuits necessary for the car to start. Although inexpensive to acquire and install, the effectiveness of such devices in deterring vehicle burglary or theft when their only effect is to emit sound appears to be negligible.

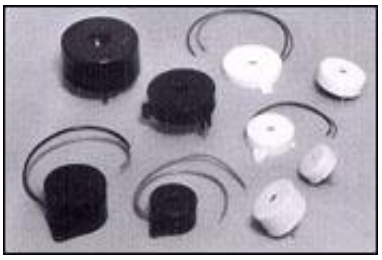

Fig 8: Types of Buzzers

Eye Blink sensor:

This project involves measure and controls the eye blink using IR sensor. The IR transmitter is used to transmit the infrared rays in our eye. The IR receiver is used to receive the reflected infrared rays of eye. If the eye is closed means the output of IR receiver is high otherwise the IR receiver output is low. This to know the eye is closing or opening position. This output is give to logic circuit to indicate the alarm. This project helps in controlling accidents due to unconsciousness through Eye blink. Here one eye blink sensor is fixed in vehicle where if driver looses consciousness, then it is indicate through alarm.

Fig 9: Eye blink sensor

Alcohol sensor:

Sensitive material of MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target alcohol gas exist, the sensor's conductivity is higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to disturb of gasoline, smoke and vapor. The sensor could be used to detect alcohol with different concentration; it is with low cost and suitable for different application.

Fig 10: Alcohol sensor

Fig 11: Ultrasonic sensor

Ultrasonic sensor:

The sensor is primarily intended to be used in security systems for detection of moving objects, but can be effectively involved in intelligent children's toys, automatic door opening devices, and sports training and contact-less-speed measurement equipment. Infrared sensors are characterized by high sensitivity, low cost and are widely used. But, these sensors can generate false alarm signals if heating systems are active or temperature change speed exceeds some threshold level. Moreover, infrared sensors appreciably lose sensitivity if small insects penetrate the sensor lens. Ultrasound motion detection sensors are characterized by small power consumption, suitable cost and high sensitivity. That it why this kind of sensor is commonly used in home, office and car security systems. Existing ultrasound sensors consist of multiple passive and active components and are relatively complicated for production and testing. Sensors often times require a laborious tuning process.

GPS:

Global Positioning System (GPS) technology is changing the way we work and play. You can use GPS technology when you are driving, flying, fishing, sailing, hiking, running, biking, working, or exploring. With a GPS receiver, you have an amazing amount of information at your fingertips. Here are just a few examples of how you can use GPS technology.

Fig 12:gps

- SIM908 module identify your phone number when you call it and if it is correct, the GPS fixes the GPS satellites. The GPRS+GPS shield will connect to the network and will send the GPS data throught HTTP request.
- Then we can show the position of the device in Google Maps. It's very simple: a GPS module to get position data and the 3G module that sends the HTTP request with

the coordinates of the car. It starts to send the HTTP request every few seconds with data of the position (latitude and longitude).

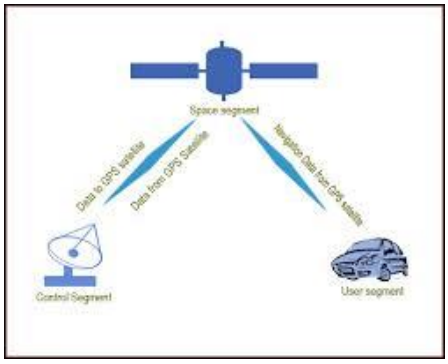

Fig 12.1: GPS Working

ZIGBEE:

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this case is ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The X- Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device.

Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

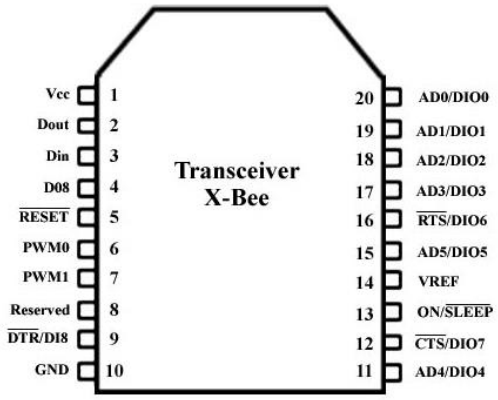

Fig 13: ZIGBEE pin diagram

DC Motor:

Fig 14: DC Motor

A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnetic field can be switched on or off or by switching the direction of the current in the coil

the direction of the generated magnetic field can be switched 180°.

Motor driver (L293D):

DC motors are typically controlled by using a transistor configuration called an "H-bridge". This consists of a minimum of four mechanical or solid-state switches, such as two NPN and two PNP transistors. One NPN and one PNP transistor are activated at a time. Both NPN and PNP transistors can be activated to cause a short across the motor terminals, which can be useful for slowing down the motor from the back EMF it creates. H-bridge. Sometimes called a "full bridge" the H-bridge is so named because it has four switching elements at the "corners" of the H and the motor forms the cross bar. The switches are turned on in pairs, either high left and lower right, or lower left and high right, but never both switches on the same "side" of the bridge. If both switches on one side of a bridge are turned on it creates a short circuit between the battery plus and battery minus terminals. If the bridge is sufficiently powerful it will absorb that load and your batteries will simply drain quickly. Usually however the switches in question melt.

RESULTS

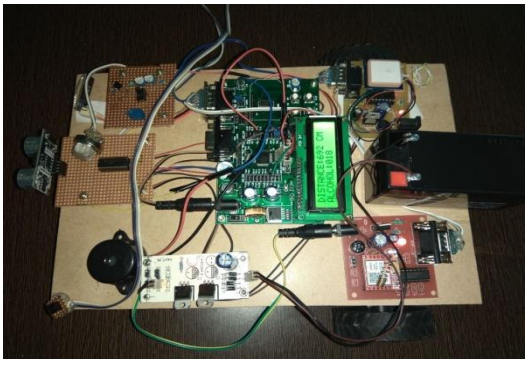

Fig 15:Foward Gesture

The figure shown above represents the car moving when the hand is tilted downwards.
That is, since the gesture is down, the movement is forward.

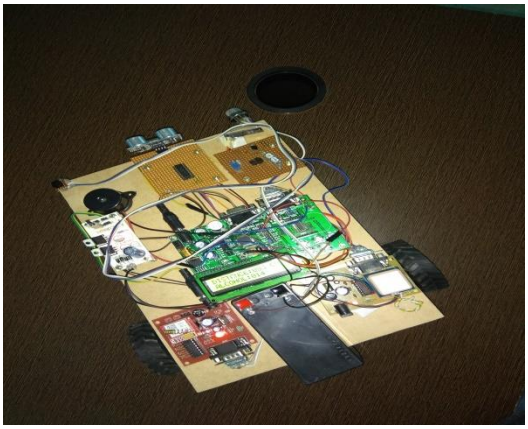

Fig 16:Left Gesture

The figure shown above represents the car turning towards left and the lights are indicated when the hand is tilted towards left. That is, since the gesture is left, the movement is sideways (left).

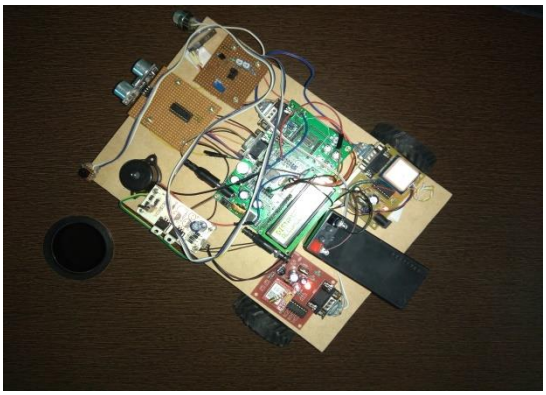

Fig 17:Right Gesture

The figure shown above represents the car turning towards right and the lights are indicated when the

hand is tilted towards right. That is, since the gesture is right, the movement is
sideways (right).

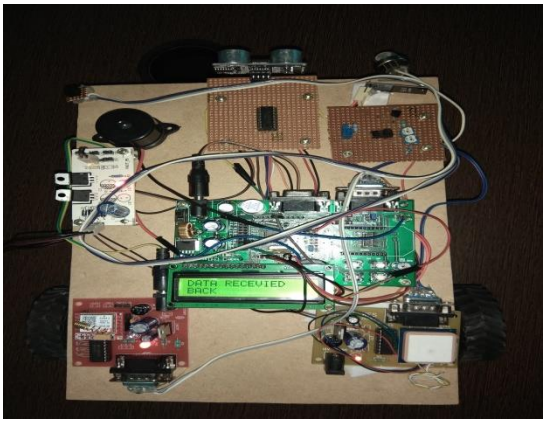

Fig 18: Backward Gesture

The figure shown above represents the car moving when the hand is tilted backwards.
That is, since the gesture is down, the movement is backward.

CONCLUSION

The goal of the system is to detect eye gaze direction and head pose direction to detect if eyes off the road. Another goal is to detect drowsiness condition of driver and alert driver in both conditions. Viola Jones algorithm is implemented in Open CV for rapid face detection with eyes extraction. Real time eye gaze tracking is proposed with CAMSHIFT algorithm. Pupil tracking is achieved Head pose estimation is proposed with ARM and POSIT. Different gaze zones are defined and eyes off the road can be detected by combining eye gaze and head position. Fatigue detection can be achieved by detecting closed eyes. If driver eyes are off the road or if he is drowsy then alert will be generated. System is robust as two methods are combined to find gaze. If one method is failed to detect properly, other will work. System is also robust under night or low light conditions due to use of IR illuminators and build on raspberry pi to be compact and low cost. Future work can include improving driver monitoring system with help of automatic calibration, determining vehicle states, weather conditions, vehicle speed etc.

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