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RASPBERRY PI BASED PASSENGER CAR FOR ROAD SAFETY

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Abstract:

Nowadays world's major health and injury prevention problem is "road accidents'. According to World Health Organization (WHO), more than one million children are killed in road accidents in every year, across the world. The motivation behind this project is to make a raspberrypi based passenger car that makes the passenger's journey even saferand more secure. This project handles the road discipline such as speed control in specific areas and Horn control in horn prohibited zones. The features involved in this proposed system are Vehicle speed control in school zone, bridges, cities, highways and suburbs. Horn control of vehicle is also included for No honking zones such as hospitals, schools, public libraries and courts. Alcohol detector is also there to prevent drunken driving.

I. INTRODUCTION

Road traffic crashes are one of the world's largest public health and injury prevention problems. According to the world health organization (WHO), more people die on roads in India than anywhere else in the world. At least 13 people die every hour in road accidents in our country; the latest report of the National crime Records Bureau reveals. In 2007, 1.4 lakh people in India lost their lives in road mishaps. Improper road infrastructure, failure to follow the speed limits, an increase in drinking and driving habits are among the major factors contributing to deaths from road crashes, WHO said in its report on 'Decade of action for Road Safety 2011-2010'. Currently Road safety systems are available in high end luxury cars such as Audi, Mercedes Benz etc. to name a few. Example: On Star Corporation provides subscriptions-based communications, in-vehicle security, hands free calling, turn-by-turn navigation, and remote diagnostics systems throughout the United States, Canada and China Turn-by-Turn Navigation, and Roadside Assistance.

The motivation is an attempt to make an embedded system to bring a Positive difference in the field of road accidents such as breaking traffic signals and drunken driving. It also has a major objective of exercising road discipline such as speed control in different areas and horn control in horn prohibited zones.

This paper presents Vehicle Speed Control in Variable Zone-in this feature; speed of the vehicle is controlled in different areas such as flyovers, bridges, highways, schools, cities and suburbs.

Horn control of vehicle in No Honking Zone-Controlling unwanted disturbances in horn prohibited zones such as hospitals, public libraries, courts, schools etc.

Alcohol detection- The alcohol sensor prevents the ignition key from working if the driver breathes into it and a significant quantity of alcohol is detected.

II. SYSTEM ARCHITECTURE

In this work, the chips and the ICs used are encoder chip, decoder chip, Transmitter-Receiver module, Raspberry pi controller, relay driver, alcohol sensor, relay contactor, and LCD display.

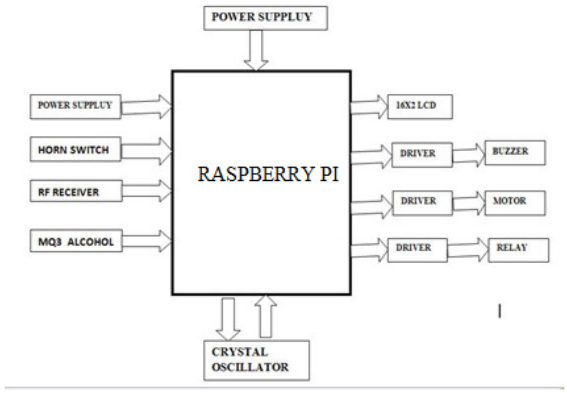

Fig.1. Block Diagram

1) *HT12E* encoder*: HT12E* encoder is an encoder integrated circuit of 2^{12} series of encoders. They are paired with 2^{12} series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format

Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits [5].

HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium.

HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

2) HT12D Decoder*: HT12D Decoder is* a decoder integrated circuit that belongs to 2^{12} series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 2^{12} series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format.

In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin.

3) RF TX/RX Module: The transmitter/receiver (TX/RX) pair operates at a frequency of 433 MHz the transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received

by an RF receiver operating at the same frequency as that of the transmitter [6].

4) MQ3 Alcohol sensor: This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time Sensor provides an analog resistive output based on alcohol concentration.

5) Relay Contactor*:* Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. A type of relay that can handle the high power required to directly control an electric motor is called a contactor [8].

6) Max232: MAX232 is a 16 pin IC. It converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals [9].

B. Design details

This model consists of two modules - Transmitter and Receiver Section. Receiver module will be placed on the car and the Transmitter module can be fitted on a sign board. Following are the circuit diagram details:

To transmit the information, RX TX module is needed. In this circuit, 433 Mega Hertz frequency transmitters are being used. Parameters: ASK modulation and transmission range is 100-300 square feet (10-15 feet). There are 4 pins:

1. Antenna: there is a built in helical antenna
2. Data Pin-To receive Data for transmission
3. Ground pin-connected to ground
4. VCC - 3 Volts Power Supply

a. Encoder*:* HT12E Encoder is used, there are 4 data lines D0, D1, D2 and D3. On Data Lines, 4 switches are connected. This will generate the data for the project and will be decoded on vehicle side. On receiver side, each switch closure will have a particular meaning. There is a TE pin which is active low, when this pin goes low, transmitter is enabled.

The data out pin is connected to data pin of TX. Here pulse stream is generated and given to TX. This pulse stream will consist of 8 bit address and 4 bit data.

b. Receiver Module*:*

The ATmega328 has 32 KB (with 0.5 KB used for the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). The Raspberry pi Uno has a number of facilities for communicating with a computer, another Raspberry pi, or other microcontrollers [10]. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). To receive the data from the road side transmitter, RF Receiver is needed. RX will have 4 pins same as that of Transmitter.

HT12D decoder IC is used. D0, D1, D2 and D3 are the data lines, so whatever information is received from the transmitter is fed to these data lines that are connected to P3.The output of RF RX is fed to the Data In pin of the Decoder. VCC is connected to 5 Volts. Valid Tone Pin goes high on receiving data. To indicate reception of data, LED is connected to Valid Tone pin.

Alcohol sensor MQ3 is connected to P1. It has 2 heater plates and a sensor plate. Sensing plate is connected through a variable resistor to the controller which controls the sensitivity. Gas ions will fall on the sensing plate and will generate the electron current flow that will be given as voltage and this voltage will be sensed by the controller. Valid Tone Pin goes high on receiving data. To indicate reception of data, LED is connected to Valid Tone pin. So whenever alcohol is sensed, it will give a high logic output which will stop the car.

To show the driver the exact condition by which the vehicle is being controlled, the LCD display is connected on port 0. LCD display is 16 characters by 2 rows.

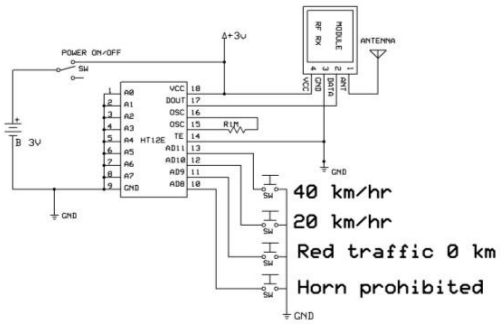

Fig. 2. Transmitter Circuit

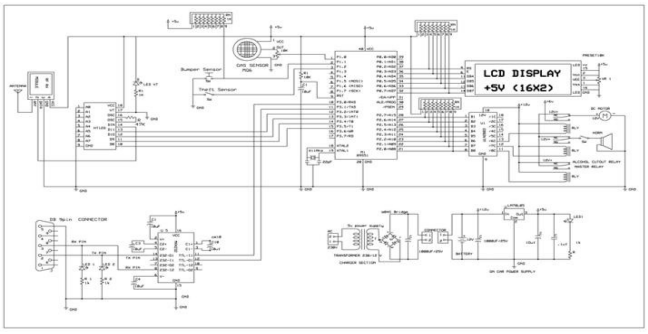

Fig. 3. Receiver Circuit

To control the vehicle, on port B, three relay contactors are connected to control the motor of the vehicle. Relays have two sets of contacts- normally open and normally closed.

The first relay is connected such that when it is normally closed, motor operates at 12 V and in normally open it operates in 0 V. This relay halts the vehicle in case of collision and the alcohol detection is sensed by the MQ3 Sensor. The second relay is connected such that when it is normally closed, motor operates at 6 V and in normally open it operates at 0 V. It is used when speed limit condition is receipted by the receiver circuit. The car will move at half the voltage.

The third relay is used for horn control. When horn prohibition condition is receipted, this relay's normally open contact is active thereby which the buzzer will go off. On port C.

C. relays:

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches.

III. RASPBERRY PI SOFTWARE

The Mega 2560 board can be programmed with the Raspberry pi Software (IDE) [10]. The ATmega2560 on the Mega 2560 comes pre-programmed with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Raspberry pi ISP. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source

code is available in the Raspberry pi repository.

The Raspberry pi Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the Raspberry pi environment. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Mega 2560 board is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB).

IV. RESULTS

A. Environment: A toy car is used with the receiver circuit placed on it and the transmitter with a range of 10 feet for implementing various features of the project.

B. Speed limit Control: To control the speed of the toy car, relays have been used to control the motor. In Normally closed state, Car is driven by the complete 12V of the motor. In normally open state the car is halted because motor is brought to 0V. Motor will operate at 6V if speed limit condition is transmitted.

The transmitter sends the signal alerting that the particular area's speed limit is 40 Kmph as example. The toy car initially runs in full speed. When this condition is transmitted, the receiver receives the signal, gives to microcontroller which then directs the relay to reduce the motor speed. Thereby the toy car runs at a visibly lesser speed as compared to the initial speed. To test the operation of the micro controller, 40kmph and 20kmph have been used as examples in the coding.

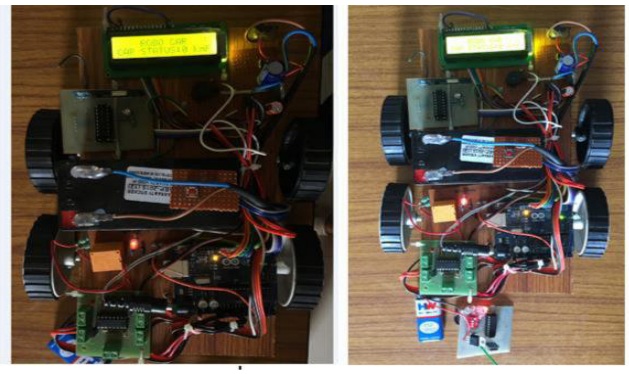

Fig. 4. Speed limit Condition

C. Alcohol Detection: To test this feature, the MQ3 alcohol sensor is being exposed to a liquid solution that has 30% or more alcohol content in it "Alcohol Sensed" message is also displayed on the L.C.D.

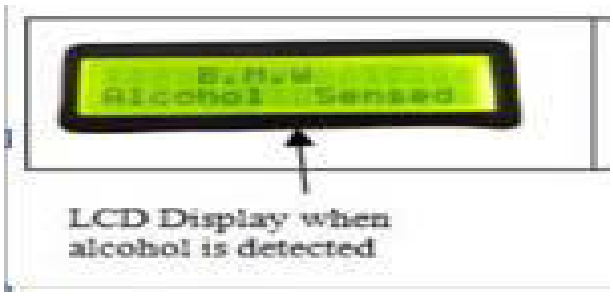

Fig.5. Alcohol Detection Condition

D. Horn Prohibition: The encoder will be fed that it is a no honking zone, so the transmitter will be transmitting the RF signal with the no honking condition among others such as speed limit etc. RF Receiver will receive signal which the decoder will decode and give to microcontroller. In the toy car a buzzer will be installed as a horn substitute. If buzzer is ON, and horn prohibition condition is being transmitted, the sound won't come.

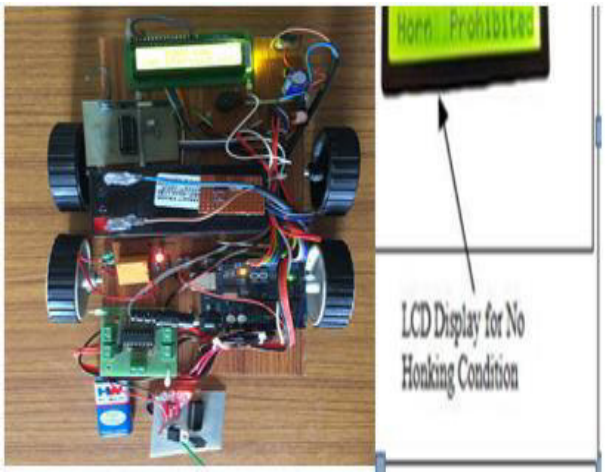

Fig.6.Horn Prohibition Condition

V. CONSTRAINTS

A. Extreme weather conditions affect RF Reception:

Rain fade refers primarily to the absorption of a microwave radio frequency (RF) signal by atmospheric rain, snow or ice, and losses which are especially prevalent at frequencies above 11 GHz. It also refers to the degradation of a signal caused by the electromagnetic interference of the leading edge of a storm front [11].Rain fade usually does not last long. Once a heavy shower or squall has passed, normal communications returns. However, during tropical storms or severe winter storms at northern latitudes, fadeouts can persist for hours at a time [12]

VI. CONCLUSION

Since speed plays a crucial role while travelling, using the concept of TRAVOLUTION, which include the technology of Raspberry pi the passenger's journey will become even more safe and secure.

VII. FUTURE SCOPE

Future Scope Using Radar Vision Fusion technology, the collision can be avoided using Breaking functionality by identifying the distance between the car and the obstacle. Using the Longitude and Latitude values, the car's location can be tracked and alert messages can be sent to mobile phone regarding the remote information and the mobile number can be changed at any time.

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