SMART VEHICLE PROTOTYPE OF ARDUINO BASED VEHICLE

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Abstract— The objective of this paper is to design and implement Smart Vehicle using microcontroller. This smart vehicle is controlled through PC by ZigBee communication using an application software. The microcontroller gets the command from PC and transmit the information to the vehicle, receives the data and performs the necessary action. Motor driver is used to control the motors Arduino UNO is used to command the motors to a particular direction controlled by wireless communication. GPS is used to determine the speed of the vehicle. Gyro meter sensor is used to balance the vehicle and accelerate on the basis of the force applied on the vehicle. Magnetometer sensor is used to determine the direction of the vehicle. Battery indicator is installed to indicate the level of the battery. GSM is used for accident detection using piezo sensor.

SMART VEHICLE controlled by the controller attached to a computer running through XCTU software. The vehicle is powered Arduino UNO and can be expanded upon the addition of sensors over other devices. Using XCTU the vehicle direction can be controlled. Using Arduino ID, one can easily modify the controller program and expand the features of the SMART VEHICLE with very little programming knowledge.

I. INTRODUCTION

The global warming is increasing day by day and humans are prone to new types of diseases. This is mainly due to pollution caused by vehicles used in cities. The harmful smokes let out of vehicles are disturbing the internal organs of the human system function. Yearly, many are dyeing due to pollution. One more major problem is the accident. Many are let unattended when accidents occur on road due to fear of police.

Need for Smart Vehicle:

i. Pollution free: due to use of chargeable battery no pollution
ii. Accident indication: it sends message to concerned person when accidents occur.
iii. Space: as only one can travel much of space is not utilized.

II. LITERATURE SURVEY

We aim to develop a smart vehicle which will be efficiently used to reduce the traffic and pollution. Being able to achieve wireless communication and the vehicle being ecofriendly is an important open area of research in the field of Robotics.

A. Smart vehicle control

Controlling of this kind of vehicle and programming is a highly tedious job that consumes more time and requires technical expertise. Therefore, new and more intuitive ways for robot programming and control is required. The goal is to develop prototype that helps the users to control and programthe vehicle, with high level of abstraction from the specific language.

There are several researches made to create user friendly teach pendant, implementing intuitive user interfaces such as 3D joystick, remote control. But, neither of this techniques were efficient to control the vehicle as they do not give accurate results and have slow response time.

B. Communication

Wired communication is not suitable for transmitting data over long distances as wiring itself is a problem. The next option is to adopt wireless communication which includes Bluetooth, Wi-Fi and ZigBee. When thinking about vehicle controlling the technique adopted should be such that it can cover wide distance and provide good battery backup. Considering all this aspect we have used ZigBee as better option than others.

In this project, we have used stored program concept for control application and ZigBee networking technology to communicate between pc and vehicle.

III. OBJECTIVE

Smart vehicle implemented till date suffer some limitations as follows:

1) speed,
2) Cost,
3) Inefficiency in detecting and correcting errors,
4) Manual controlling,
5) Battery consumption.

To overcome all the difficulties, we are using the following features:

1)less rpm based motor with higher diameter wheel,
2) by using efficient materials,
3) error detection and correction mechanism inbuilt,
5) precise wireless controlling using ZigBee communication,
6) less rpm so battery consumption is reduced.

IV. DESIGN AND IMPLEMENTATION

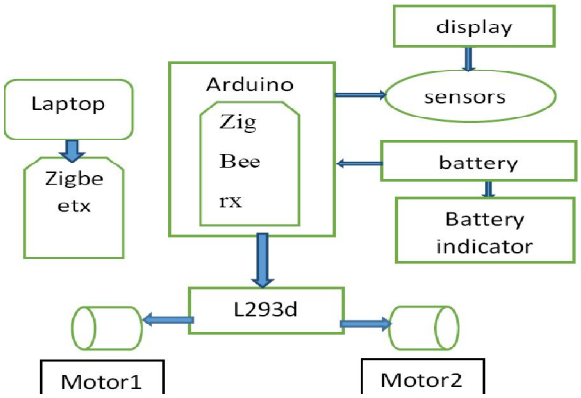

Fig 1. Block diagram of smart vehicle

The block diagram of the project is as shown in the figure 1. It completely determines all the components connected to the Arduino UNO and the ZigBee communicator. It shows the transmission and reception of packets for the movement of vehicle. Sensors here represent gyro meter, magnetometer, GPS, GSM. It also shows the motor connected to motor driver and to the Arduino UNO and it has the battery indicator to indicate the battery level. The vehicle is made to move with the help of Laptop communicated through ZigBee transmitter, received by ZigBee receiver which in turn sends the command to L293d motor driver to drive the motor based on the command. Gyro sensor is used to determine the acceleration and balancing. Magnetometer is used to determine the direction of the vehicle. GPS is used to determine the speed of the vehicle precisely and GSM is to send message when accident occur. Battery indicator to indicate that the battery needs to be charged.

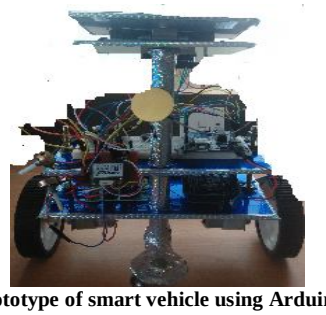

Fig 13. Prototype of smart vehicle using Arduino UNO

V. METHODOLOGY A. HARDWARE

1) ARDUINO UNO

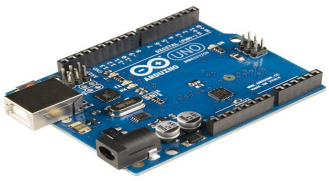

Fig 2. Arduino UNO AT mega328 microcontroller board

The Arduino Uno used here is basically to program for all the sensors and the motors to work according to the instructions. Arduino Uno has 28 pin AT mega328 microcontroller IC with 14 digital pins and 6 analog pins, 2 ground pin, +5V VCC, 3.3V VCC, reset pin and remaining pins for other purposes. It works on 16MHz frequency and has a power jack and USB connector for programming. It has internal memory of 32 KB, EEPROM of 1KB and SRAM of 2KB. It is user friendly for programming with language C and C++. The board can operate with 6 to 20v supply without much heat dissipation. [1]

2)ZIGBEE

ZigBee is based on IEEE 802.15.4 standard. It operates on 2.4GHz frequency band wirelessly. It can communicate within a range of 10meters to 100meters. It is a system with coordinator, router and end system to communicate wirelessly. For covering a very large range, router is used as the in-between medium. As in this project large range is not opted router is not considered, so coordinator and end system are configured to send packets to and fro the transmitter and the receiver as per required direction. ZigBee utilizes the incorporates power saving mechanisms for all device classes by using sleep modes. [2]

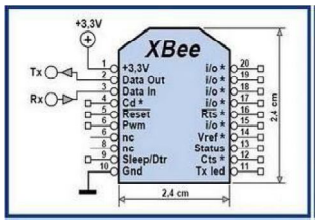

Fig 3. ZigBee module

3) L293D MOTOR DRIVER

Motor driver consists of 16 pin IC. It has the capacity to drive two motors at a time with synchronization pulse. Pin 1 and Pin 9 is used for enabling the motor 1 and motor 2 depending on the pulse applied. Pin 2, Pin 7, Pin 10 and Pin 15 is used for providing logic values to rotate the motor in either directions, but these pins are not used for enabling the motor. Pin 3, Pin 6, Pin 11 and Pin 14 is connected to motor which are output pins of IC. The IC is given two ground and one VCC pin for powering the complete system. Two grounds are provided to overcome the heating of the IC which can damage it, as it can take voltage ranging from 5 to 36V. [3]

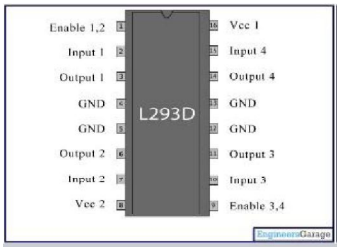

Fig 4. L293D motor driver pin IC schematic

4)MOTOR

The motor that needs to be selected should satisfy all the conditions of the vehicle such as speed, battery

consumption and precise movement. The motor that has to be used should have less rpm so as the torque is more and battery consumption is less as dissipation can drain the battery. If dissipation increases the battery needs to be charged all the time. So using a motor with 60rpm and 12v, the battery can stay up to 6 hours in this prototype. Use a larger diameter wheel to increase the speed. [4]

Distance covered =2πr

Where r is radius of the wheel.

Fig 5. DC geared motor

5) GYROMETER

Gyro meter is based on MEMS technology. It is highly accurate and precise16-bits analog to digital conversion hardware for each channel. The +x axis and -x axis the tilt angle is determined. The balancing of the vehicle is based on this tilt angle with the +255 and -255 as the scale to determine the wheel tilt from 0 or constant position. It also has the acceleration sensor inbuilt which can be used for moving the system. The FIFO buffer is used together with the interrupt signal; the buffer can be read by the Arduino. [5]

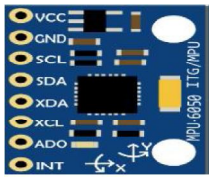

Fig 6. Gyro meter sensor

6) MAGNETOMETER

It is used to determine the direction of the vehicle using the earth's magnetic force. It plays role as a compass. The magnetometer is similar to the gyro meter. It produces the magnetic field which tries to the sync with the earth's magnetic field, this data can be displayed to know the direction of the vehicle movement.

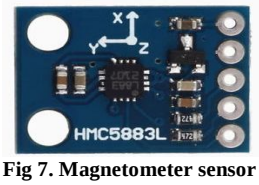

Fig 7. Magnetometer sensor

7) GLOBAL POSTIONING SYSTEM (GPS) MODULE

GPS is used here for determining the speed and location of vehicle. It is used to track all the satellites in view and provides accurate satellite positioning data. The GPS track three satellites in range for accurate position and another satellite for time synchronization. Based on this satellites the speed can be determined and on the same basis it is used to determine the latitude and longitude for accident informing. [7]

Fig 8. GPS module

8) GSM MODULE

This GSM modem is a highly flexible plug and play quad band **SIM900A** GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack. GSM module is to send message to the concerned person when accidents occur. It uses sim900A which is CDMA based. It consists of a cellular system and works exactly like a mobile cellular system. It tracks the location and intimates the concerned person using the cellular system. [8]

Fig 9. GSM module

9) PIEZO SENSOR

This piezo electric sensor is based on converting the mechanical energy to electrical energy. This is also used to sense the vibrations based on the same principle. The project denotes the utilization of this for determining the accident prone. This sensor is highly precise in sensing and has a high accuracy over such situations. [9]

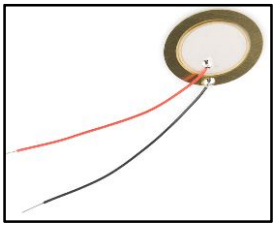

Fig 10. Piezo sensor or vibration sensor

B. SOFTWARE

1) ARDUINO IDE

The programs written in Arduino IDE are mentioned as sketches where each sketch can be stored with different name with the file extension number. It is user friendly as it helps in editing at any point of time. The bottom right-hand corner of the window displays the configured board and serial port. The

toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Serial monitor helps in verifying the output of any device connected to the Arduino. Arduino IDE is an open source software which is easily available for programming. [10]

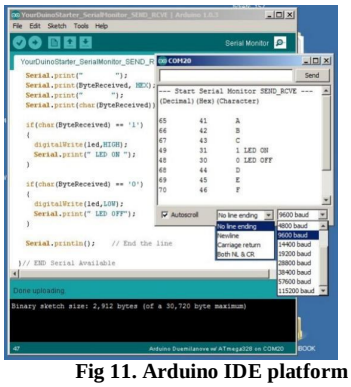

Fig 11. Arduino IDE platform

2) XCTU SOFTWARE

XCTU software is used as a bridge to communicate wirelessly through xbee radio modules with transmitter and receiver. The IEEE 802.15.4 is a point-point/point-multipoint communications protocol designed for low-power devices. This software helps to send packets to receiver with a delay, so there is no loss of packets. As all the Xbee radio modules are same this software helps in configuring the modules as coordinator and end device for short range. This software displays both the ASCII as well as hexadecimal character in terminal window.

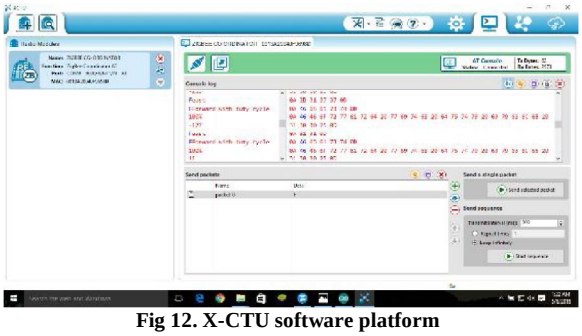

Fig 12. X-CTU software platform

V. ADVANTAGES AND APPLICATIONS

1) ECO Friendly
2) Efficient and reliable
3) User friendly
4) Applicable to all ages
5) ZigBee transmission is faster
6) Prone to less errors
7) Speed can be varied as it generates different values of PWM signals.
8) Easy to handle.
9) No hazardous components or battery power so safe to use.

1) Used on road for travelling within city.
2) Can be used by handicapped.
3) Used within buildings with more area.

CONCLUSION

As India or any part of the world is prone to high traffic and pollution this SMART VEHICLE has all the capacity to overcome as it has more advantages on the road. No strain to handle, no practice required to use it, so it is smart and affordable for this generation.
This smart vehicle satisfies all the planned goals that this research seeks for.

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