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Accelerometer and Arduino Based Gesture Controlled Robocar

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ABSTRACT: This paper presents a model for hand motion control vehicle which also have auto driving feature and voice interacting capability that identifies trends in technology, application and usability. The Robot that is being constructed here is attributed with the qualities of being the multitasking machine. The different mechanisms those cannot be assembled together rather the features which are difficult to posit unanimously, are synthesized together within the structure of a wholesome project called “Mili 4.2: A Multipurpose Robot”. The whole mechanism of the project is based upon the device namely Arduino. The feature of “hand gesture” helps it to move wirelessly depending upon the Radio Frequency, which is placed upon the hand of the user. “Self-driving” is another governing factor which is attributed with the ultra-sonic sensor that helps the machine to measure the difference of distance between the obstacle and itself so that it can take the stance to avoid any kinds of collision. Another striking aspect of the project is that it can recognize the command of the user in other words it is a “voice controlled” Robot. This hand gesture controlled robot can be modified in the later future to be used in the field of technology.

KEYWORDS: Accelerometer, RF, Arduino (microcontroller), Motordriver, Ultra sonic sensors, Servo motor(sg90), Bluetooth module(HC-05).

I. INTRODUCTION

To make daily life more easy and effortless, we have to take the help of technology may be autonomous or manual. But life of human being can be smoother if the technology becomes hands free. If human can control machines totally by their voice, gestures and other activities, then interactions will be easier. There are many high tech bots which can do these things but still normal people are still far away from that types of technology mainly due to high price of that products. Our target is to make low cost smart products which can easily be bought. Not only that but also it will be easier to operate that types of machines. Our dream is to make such kind of bots which will made of wires and circuits but acts like personal assistant in more realistic way. The robot works on gesture sensors, accelerometer, gyro sensors, motion sensors, heart beat and pulse sensors etc. Gesture Controlled robot is a kind of robot which can be controlled by our hand gestures not by old buttons. We just need to wear a small transmitting device in our hand which included an Accelerometer. This will transmit an appropriate command to the robot so that it can do whatever we want.

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II. RELATED WORK

The paper[7][8] focuses on the development of the robotic Arm by using Flex Sensor, Zig Bee and 3 Servo motor connected to the Arduino Uno which is controlled by processing software and a computer mouse. These robotic Arm are cheap and easily available which makes it free from unnecessary wire connection, reducing its complexity. But still there is a requirement of adding new ideas and functionality. The central goal of the paper is to implement a system through which the user can give commands to wireless Robot using gesture. Here, the user control or navigate the robot by using gesture of palm. The command signals are generated from these gesture using image processing and signals are passed to the robot to navigate it in the specified direction. The paper[4] explain about the implementation and design of gesture controlled robot by using FlexSensor, Ultra sonic Sensor, Electronic compass and accelerometer connected to Atmega16 Microcontroller. The research paper[6] describes the Robot, which is controlled by a hand Glove Wirelessly via Bluetooth. The Robot is developed by using the input section consisting of sensor, LCD, Display and a Bluetooth Device and the output section which is consisting of NXT Microcontroller, Motor and Camera. The programming is developed in MATLAB.

III. OVERALL WORKING MODEL

Our robot (as shown in fig 1) MILI 4.2 is a very first implementation of our ideas. This is a bot which can be controlled via Bluetooth, hand gestures and voice simultaneously. It is totally wireless and chargeable. This is really a new attempt where we are giving chances to operate a bot by three common ways at same time. Not only that but also you can change the mode of the operation by speaking to the robot. Robot (as shown in fig 2) will also speak a confirmation dialog to confirm us that its mode is changed. Now I am going to describe modes of the mili 4.2.

A. MODES

1. Hand Gestures

MILI^[11] can follow the hand gestures. What is need to do you that you have to wear a glove where sensors (accelerometer, Arduino nano, RF transmitter) are fitted. Basically by measuring position of the hand in X and Y axis, glove send a signal to the bot, according to which the bot moves. Our robot uses radio frequency of 433 MHZ to communicate with glove. It can sense radio signals from 80 m round from the bot. Bending the wrist downward gives a signal to the bot by getting which the bot will move forward. If you bend the wrist upward then another signal will generated due to which the bot will move backward. If the wrist is bended right or left then bot will move according to that directions respectively. If the wrist is kept horizontal then the bot will be in stop condition. There are two antennas which are already connected with bot and glove. The length of the antenna can be expanded according to the requirement. There is tap switch in the glove, if we turn it off then, the bot will continue it's last command, it will not follow the hand gestures more.

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Vol. 7, Issue 8, August 2018

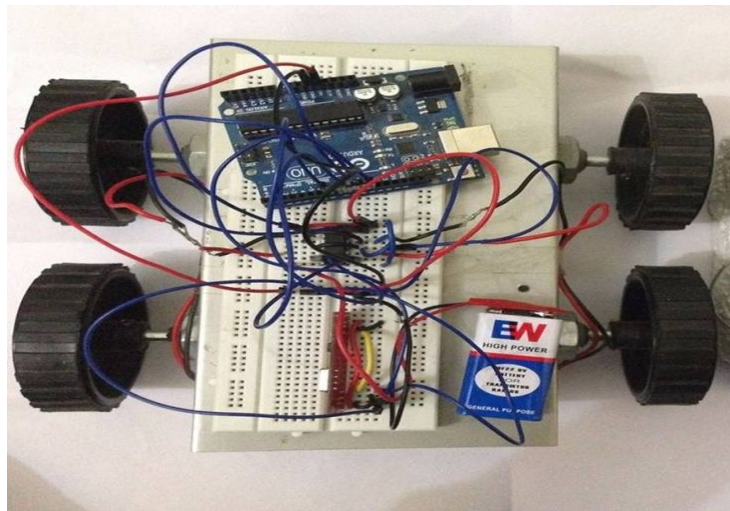


Fig 1: A prototype of the gesture controlled Robocar

2. Auto Drive

Excluding this hand gesture sensing capability, our bot can drive itself automatically when it is in self driving mode. It can sense all the static objects in front of it and avoid them. Front two corners of the bot are totally safe because there are two sensors. Ultra sonic sounds are using to avoid the obstacles. Basically sonar technology means calculating the time of reflection of sounds we are doing this. If any obstacle is sensed by the sensors, then at first the bot moves backward then it's sensor which is mounted on a servo motor rotates left to right. And then it decides where it can turn, left or right by calculating the respective distances. After turning if the obstacle is avoided successfully then it moves to the forward direction. If not the whole process will run continuously until the front obstacle is avoided. Two other sensors which are mounted on the corners are always active to stop collision with any obstacles. It will work in all environment. Changing slightly the main code, user can change the sensitivity of the each ultrasonic sensors.



Fig 2: The final model which was created according to the design as stated

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Vol. 7, Issue 8, August 2018

3. Voice Interaction

By giving some specified instructions to our smart phone, we can change its mode from hand gesture control to self-driving very easily^[12]. The smart phone has to be connected with the bot through Bluetooth. Using a definite app, just saying "FOLLOW", the bot will start to follow my hand gestures and saying "AUTO", the bot will start its self-driving mode. We have connected another Bluetooth speaker (which is in the robot with that smart phone) through which dialogs from the bots will come.

IV. WORKING OF DIFFERENT PARTS

1. Accelerometer

An accelerometer is an integrated device that measures proper acceleration, the acceleration experienced relative to freefall. Single and multiaxis models are available to detect magnitude and direction of the acceleration as a vector quantity, and can be used to sense orientation, acceleration, vibration shock, and falling. Micro machined accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input. It is capable of measuring how fast the speed of object is changing. It generates analog voltage as the output which is used as an input to the control system. The accelerometer used in this automated system is ADXL345^[9]. It is a three axis accelerometer, which senses the tilt in two directions only. The supply voltage ranges from 2 to 3.6v.

2. Motor Driver and controls

Motor receives power from the Motor driver IC. This power is utilized to do physical works, for example move the Wheel chair. DC motor orientation, speed and operation can be controlled with microcontroller. We can start it, stop it or make it go either in clockwise or anti clock wise direction. The speed of the Motor is controlled by the help of PWM (pulse width modulation).

3. RF transmitter and receiver module

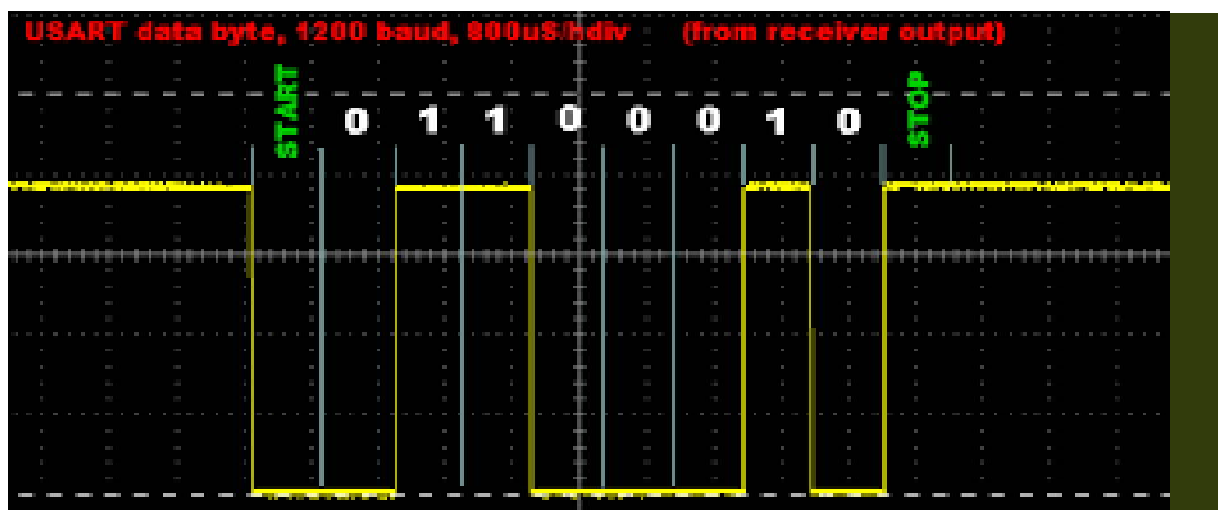


Fig 3- The signal diagram of rf model

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 8, August 2018

Transmitter And Receiver Module RF(as shown in fig 3) stands for radio frequency. It is available in different operating frequencies and with different operating range. We have used 433 MHz RF TX/Rx module. RF module is often used along with a pair of encoder and decoder. It can transmit the signal up to 500 ft of range at rate of 1 Kbps to 10 Kbps. Transmitter module consists of 4 pins (GROUND, VCC, DATA, ANTENNA). DATA pin is connected to encoder (pin 17). A 17 cm single strand wire antenna is used which is connected to antenna pin of TX module. Transmitter receives serial data and transmits RF signal wirelessly to the receiver through this antenna. To test the RF^[10] transmitter module just connect the DSO with the data pin of the transmitter module and check that a train of pulses are coming or not, shows in fig. 1 if no pulses will occur then it means that modules are not working. Receiver module consists of 8 pins. 3 ground pins, 2 VCC pins, 2 DATA pins and 1 antenna pin. DATA pins are connected to decoder (pin 14). In this module also, a 17 cm single strand wire antenna is used for receiving RF signal from transmitter.

V. METHODOLOGY

A. MODES

1. Hand Gesture—

- It is mainly made by RF (radio frequency) module controlled by arduino mini.
- RF Module is a cheap wireless communication module for low cost application. RF Module comprises of a transmitter and a wires are connected to the arduino board to the transmitter module and all the connecting jumper wires are connected receiver that operate at a radio frequency range. Usually, the frequency at which these modules communicate will be 315 MHz or 433 MHz.
- The RF module mainly transmit the data of accelerometer sensor which is fit in the hand gloves.
- All the connecting jumper to the arduino board to the transmitter module(as shown in fig 4) and accelerometer module.

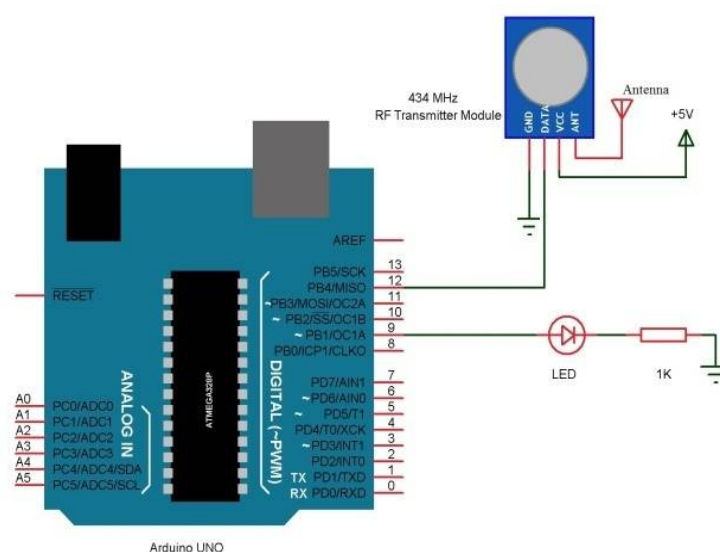


Fig 4-The circuit diagram between arduino and transmitter module

- To increase its range and also strength we connect an antenna to the transmitter.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 8, August 2018

- Then after the uploading the transmitter code in arduino we setup the hand gloves.
- After that the receiver (as shown in fig 5) is connected to the main robot's arduino.

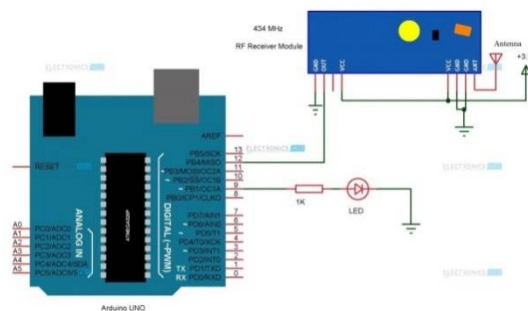


Fig 5-The Circuit Diagram of arduino and receiver module

- Here in the code according to the accelerometer's data we map it to the robot's motor.
- Mainly accelerometer's data is along X axis to -X axis for forward and backward direction. Along Y axis to -Y axis for left to right direction.
- There is created a region where the stop direction is located.
- After that according to this we setup the motor driver.
- After that the code is uploaded.
- The user controls it wirelessly.

2. Self-driving

- Here we use 3 ultrasonic sensors and 1 sg90 servo motor.
- 1 ultrasonic sensor is attached to the servo motor.
- Mainly ultrasonic sensors are measured the distance by ultrasonic sounds waves. It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.

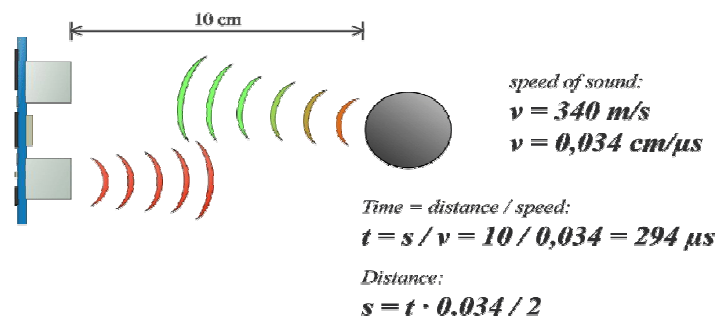


Fig 6-The basic concept of ultrasonic sensor

- The HC-SR04 Ultrasonic Module (as shown in fig 6) has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.
- After that a specific distance is been setting up in the code to avoid the collision of the bot.
- For this distance it will stop.
- As it is attached to the servo so it moves from 0 degree to 90 degree for left and right.

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Vol. 7, Issue 8, August 2018

- Then it calculates the distance between obstacle and itself.
- After that by the instruction in the coding it decides which is greater.
- By this instruction it moves in the greater distance.
- This information is sent to the motor driver through arduino.
- Following the instruction in the code it moves according to the command.
- The rest two ultrasonic sensors are kept in the two corners of the bot for better perfection to avoid the collision.
- After that whole codes is being merged and upload to the arduino-uno board.

3. Voice-controlled

- This also an exciting features in this project.
- Here we use the Bluetooth sensor to control it by an android phone.
- HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.
- So this module is connected to the arduino board.
- After that in the code following some command it is instructed to the motor driver to move the bot according to instruction through the Bluetooth module.
- After uploading the code it is set.
- In any android phone by any app (like: arduino voice control) is connected between the Bluetooth module and the phone's Bluetooth.
- After pairing by instructed voice command we give the command (like:forward,back).
- If we see in arduino's serial monitor we see that command. For that we assure that everything is alright

VI. FUTURE SCOPE

- This will be an effective method to eradicate the social problems faced by the physiologically challenged persons. This is directly interfering with the social relevance of the society. The mobility aid which will help to extend for the challenged people for their location. Usually these peoples are bedridden and difficult for their movements from their bed. It is very difficult to make them move from one place to another. The main reason behind the implementation of this project is to give a helping hand for the sufferings of the challenged people. They have no way to get rid of from the bed due to their lack of movements. Degeneration of nerve cells and muscle fibers can lead to the challenges. To defeat the challenges is the main objective of this project. By designing the wheelchair for the challenged people can reduce the sufferings of the patients to an extent. Powered wheelchairs play a vital role in bringing independence to the severely mobility- impaired and allow people to get on with their activities of daily living. Many people who suffer from
- Mobility impairments rely on powered wheelchairs to get out and about.
- Using its hand gesture^[8] sensing capability and self -driving capability this type of robot can be used in agricultural field. This robots can treat all the plants in garden If we include arm which can sense human's hand motion then ,a man can do all the treatment of any plant sitting far away from the field only by seeing the plant in a screen under any shade. Thus it can reduce human effort in a huge level. Having self- driving capability this bot can observe a fields alone without any controller. In any emergency controller can again start to control it via his hands' movement.
- This type of robots are also useful for medical science. Human hands are not so small to do micro surgery, but mini version of this type of robots can also do micro surgery following our hands' gesture. It also can give us internal information of any sensitive human body parts.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 8, August 2018

VII. COMPARISONS WITH EXISTING SYSTEM

The major advantage of this system over other systems is that it provides real time palm gesture recognition, leading to an effective and natural way of controlling robots. Additional advantage- existing system have used Bluetooth wireless control to interact via voice by which we can change the modes, and 3 ultrasonic sensors are always ready to avoid the bot from all static obstacles not only that but also it analysis the best direction to move.

VIII. CONCLUSION

In this paper, an automated robotic vehicle has been developed which works according to your hand gesture. The robot moves wirelessly according to palm gesture. The RF module is working on the frequency of 433 MHz and has a range of 50-80 meters. This robot can be upgraded to detect human life in earthquake and landslide by implementing the sensor accordingly. It can also be upgraded to bomb detecting robot as it has robotic arm it can also lift the bomb. GPS system can be added to the robot by the help of which its location can be tracked.

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