International Journal of Scientific Engineering and Research (IJSER)
www.ijser.in
ISSN (Online): 2347-3878
Volume 3 Issue 3, March 2015

Design and Implementation of Robotic Vehicle Can Be Controlled Using Hand Gesture

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Abstract: ***This paper represents hardware implementation of controlling a robotic vehicle wirelessly with the help of hand gestures. Accelerometer based hand gesture control system depends on the hand movement of the user. For different types of hand movement the Robot works in different directions. A robot which can be controlled wirelessly with the help of hand gesture is much easier than other controlling methods. The gesture control system gives a new dimension in the world of controller. The focus of the project was to sense the hand gesture wirelessly. Different types of gesture can give the different value to the sensor, so by observing various data of sensor for hand gesture we tried to implement it on a gesture sensing wireless robot. A robot which gives an idea of the hand movement controlling with the help of accelerometer. The argument proposed in the project was that wireless Hand gesture movement can response faster and also can give accurate direction in the receiver side.***

Keywords: Gesture, Accelerometer, Wireless, communication

1. Introduction

After the revolution of robots in various sectors, people are trying to control them more accurately and easily. Over the past few years people are finding simpler way to communicate with robots in order to enhance their contribution in our daily life. Humans and robots are combining more than ever before to overcome the new challenges. From the very early stages it was one of the main objectives to control the robot smoothly and comfortably. So rather using traditional remote or keyboard it's better to control a robot with the help of our hand gesture. Because hand gesture is very natural way of communication in our human history. Hand gesture technology being used more spontaneously in many sectors nowadays. It's becoming very popular also in the robotic industry as well. There are many hand gesture technologies available nowadays but one of the most popular form is accelerometer based hand gesture technology. The accelerometer can measure the static acceleration of gravity in tilt sensing application, as well as dynamic acceleration due to motion, shock or vibration [1]. Accelerometer is used to capture human hand gestures. By sensing the gesture its works accordingly. Our project is not an invention; it is a modified version and the inexpensive one. Before we started the project we studied about a lot of hand gesture controlled car and understood the operation of their project.

Our main objective was to reduce the delay and make the response time faster. On the other hand we made this such an inexpensive that it's cheaper than the traditional gesture control robotic car.

2. Literature Survey

From the very beginning it was one of the major concern in the industry of robot to control the robot smoothly and accurately. The hand gesture controlling system is becoming very popular day by day. The first glove prototype was developed in Massachusetts Institute of Technology (MIT) in 1977. The first glove to use multiple sensors was offered by the 'Digital Entry Data Glove' which was developed by Gary Grimes in 1983. It used different sensors mounted on a cloth [2]. For gesture recognition one of the first product that came in the market was Nintendo's power glove. Which was released in 1989.Nowadays many projects are developing in the basis of hand gesture technology. Wheel chair based on hand gesture [3] technology is one of the most popular projects nowadays. Also the data gloves are developing more than ever before. The objective of this work was to recognize the hand gesture and transmit the data from hand glove to robot to control the robot. Also the project was intended to make wireless to ignore the wired complexity and easy movement.

3. Methodology

The whole project was mainly divided into two main parts. The transmitter part was attached in the hand, where it can sense the human hand gesture. The popular and easier way for making robot is using microcontroller to control them. So we decided to go with microcontroller to move ahead with our

project. So we studied about various types of microcontroller before starting our project and chose the best one for our project. Another important component in this project is Accelerometer, Which will sense our gestures. We tried to gather as much knowledge as possible about accelerometers. For our project first we wanted to use 'MPU 6050' as an accelerometer but then we move on to ADXL335 because of availability of the product in our market and also because of the price. 'MPU 6050' would have cost us doubled than ADXL335. And another important part of our project was to send the data wirelessly. We studied lot about wireless technology in order to send our transmitting data correctly and accurately in the receiving end of our robot. After our research we have agreed to use RF module for wireless data transmission. Because it covers decent amount of area and its data rate is quite good. Primarily we wanted to use X-bee as our transmitter and receiver because it has much higher data rate and covers huge area but it would have make the project much more expensive. Wireless transmitter and receiver is used separately to ignore any kind of complexity. Serial data communication is used here for a single bit data transmission. Gear motors were used as the wheel of the robot, normally DC motor been used in robots but gear motors gives high torque which means better speed. L293d was used as motor driver of the circuit because it's flexible and simple to use also its not expensive. We also make inquiries about other necessary components which was used in our project and chosen them wisely.

3.1 Equipment's

For this project many equipment's can be used to make the project successful. They are:

1) Micro Pic16f73 (Microcontroller)
2) RF Module
3) Accelerometer (ADXL335)
4) Motor Driver (LM293d)
5) Voltage Regulator (L7805)
6) Power supply (9v battery)
7) Gear Motor
8) Heat Sinker
9) Crystal oscillator

Micro Pic16f73: A microcontroller is a compact microcomputer which was designed to control robot, office machine and many more useful devices. The name PIC initially referred to "Peripheral Interface Controller". A typical microcontroller includes a processor, memory, and peripherals. [4]. PIC microcontrollers are electronics circuit that can be programmed accordingly to the particular task. It has 28 Pin, 35 instruction set, operating speed DC – 20MHz clock input, operating speed DC – 200 ns instruction cycle. Low power high speed CMOS Flash technology is also used in this microcontroller.

RF Module: RF module is a small electronics device which is used to receive, transmit or transceiver radio wave on one of a number of carrier frequencies. It covers a certain amount of area depend on bandwidth frequency. When RF module gets any motion signal then converts it to motion signal to electrical signal then transmitter transmit it through receiver end, a decoder is connected through receiver end to decode the signal. It's one way communication type and working frequency is around 433.875MHz to 434.650MHz. Frequency response of the device is150Hz to 2.4 KHz and baud rate is 300 to 4800bps [5].

Accelerometer (ADXL335): It's a low power, thin 3-axis accelerometer with signal conditioned voltage outputs device which sense the tilt and gesture movement of human. The user selects the bandwidth of the accelerometer using the Cx, Cy and Cz capacitors at the X_{out}, Y_{out} and Z_{out} pins. Bandwidth can be selected to suit the application, with a range of 0.5Hz to 1500Hz for the X and Y axes, and a range of 0.5 Hz to 550Hz for the Z axis. The Operating voltage of ADXL335 is 3V & it operates within 1.8-3.6V and sensitivity at X_{out}, Y_{out}, Z_{out} is 3V. It has no external filter to consume signals noise. Operating Temperature range is -40 to 85 ° [1].

Motor Driver (L293d): The L293D is quadruple high-current half-H drivers. It can provide bidirectional drive current of up to 600-mA at voltages from 4.5V to 36V. It is also designed to drive inductive loads such as inductive relays, solenoids, dc and bipolar stepping motors, as well as other high current/high voltage loads in positive-supply applications. All inputs are TTL compatible, each output is a complete toten-pole Drive circuit, with a darlington transistor and a Pseudo darlington source [6].

Voltage Regulator (L7805): The voltage regulator is a device which controls the voltage in the electrical equipment's. These devices are also used as current limiting device.

Power Supply: It's a hardware which supplies the required voltage to the device. It's usually take the input as AC and gives DC output to the device as required.

Gear Motor: In a Gear motor, the magnetic current (which can be produced by either permanent magnetic or electromagnets) turns gears that are either in a gear reduction unit or in an integrated box. A second shaft is connected to those gears. The result is that the gears greatly increase the amount of torque the motor is capable of producing while simultaneously slowing down the motors output speed. The motor will not need to draw as much current to function and will move more slowly, but will provide greater torque.

Heat Sinker: The combination of a heat sink and fan (HSF) is referred to as an active heat sink. It absorb the extra heat in the circuit which helps to overcome the overheat problem.

Crystal Oscillator: A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency.

3.2 Working Principle

This was a project based on hand gesture technology in order to control a robotic car wirelessly. At first the hand movement was sensed by the accelerometer than the analog data was passed to microcontroller in the transmitting side. After processing the data from accelerometer microcontroller passed the data to wireless module and the signal than goes to

the receiver part. And from receiver end microcontroller sense it via wireless module in the receiving antenna and pass it to the motors via motor driver. Than the wheels than started to in the direction where the hand gesture commanded it to move. The accelerometer basically moves in three axis. For movement in X, Y and Z axis the robot gets accurate direction. But the main part of the robot basically was to sense the gesture from our hand to try to make it a medium to control the robot.

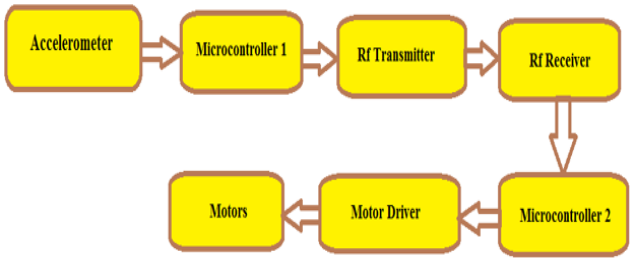
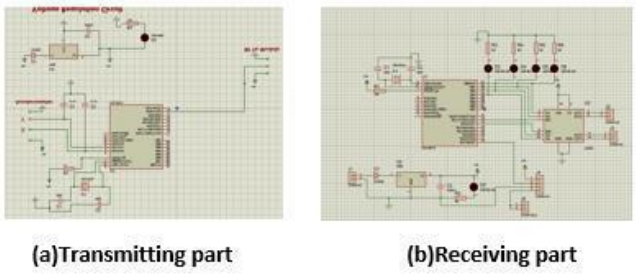


Figure: Block diagram

4. Design



(a)Transmitting part (b)Receiving part

5. Results

AXES	ADXL 335 (Analog values)	DIRECTIONS
+X		Forward
	>1.25V	
-X		Backward
	<1.25V	
+Y		Right
	>1.25V	
-Y		Left
	<1.25V	

6. Application

Wireless hand gesture technology can play an important role in upcoming years. People, device and computing are going to combine more than ever before to enhance the performance of our daily used devices. Wheel chair based on hand gesture technology also is encouraging project to help the paralyzed people [3]. Also many home appliances including TV, Computer etc. can be controlled with the help of hand gestures. Gesture glove is improving rapidly and in future we can hope to have more accurate, flexible and less expensive gesture glove where it will be able to control more devices related to our daily life.

7. Future Work

A lot of project been made on robotic car. And controlling issue is always the main factor. In our project to tried to make easier and simpler controlling system. We focused to make a system which is cheap and reliable. There are lots of opportunities to make many important projects based on our project. We can add a video which will transmit the footage wirelessly in our monitor. A robotic arm can be added in the system and which also can be operated with the help of hand gesture. Hand gesture control wheel chair can be made by following the same mechanism as our project with a bigger and high torque motor. This wireless gesture control system can also be helpful for controlling our home appliances.

8. Conclusion

It's always a challenge for engineers to make the things simpler and cheaper the way they were before. We tried to emphasize on those concepts and that's why we built a wireless hand gesture control robot. People used PC or remote to control the robot car but controlling it via hand gesture makes it easier than ever before to control a robot. Also our main target was to make it less expensive so we were more conscious about choosing the components. Although we tried to make it less expensive but we did not compromise on the quality. We tried to make it more reliable and simple. The biggest advantage of our project is that it's very easy to control. The main problem of this system is that in order to collect the raw data from the hand gesture or from hand movement the transmitting glove must be worn by the user. Also when one trying to control a robot with the hand gesture even the mistaken hand gesture could result a wrong movement of the robot. It's also quite expensive compare to remote control system. Putting those gloves to control robot is time consuming also limit ones range of motion. Also human hand size and shape vary from human to human that's why angle movement for specific direction can also vary.

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