ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 8, Issue 9, September 2021

Gesture Controlled Mobile Robot with Dynamic Hand Gestures using ADXL335

[1] R.V. Nanditta*, [2] R. Gowtham, [3] Nagulash Rahul B, [4] Atthreya Venkatesan, [5] Nirab Kumar Das, [6] R. Rohit, [7] J Daniel Glad Stephen

[1][2][3][4][5][6] Student, B.Tech , Department of Mechanical Engineering, SRM Institute of Science and Technology, Kattankulathur, Chennai, India
[7] Assistant Professor, Mechanical Engineering, SRM Institute of Science and Technology, Kattankulathur, Chennai, India
Email: [1] rvnanditta@gmail.com

Abstract--- **The future of autonomous vehicles over fuelled vehicles has numerous advantages such as prevention of crashes, traffic management, environmentally friendly and reliability. Gesture and speech control are the techniques of natural interactions to guide and control mobile robots. This project experiments the working of gesture-controlled robots with the use of accelerometer. An accelerometer is a device which measures the acceleration of an object. ADXL335 having a capacitive type of 3-axis is the accelerometer which used in this project due to its light weight and compact size to fit in the vehicle. The accelerometer is controlled by the gestures of the human hand. If the accelerometer is tilted towards right, the robot makes a right turn, if the accelerometer is tilted towards left, then the robot makes a left turn, the robot moves forward and reverse when accelerometer is tilted forward and backwards. The movement of the vehicle is assisted by the motor controller which connects to the DC motors attached to the wheels.**

Index Terms— **Gesture control, Autonomous systems, mobile robots, robotics, vehicle safety**

I. INTRODUCTION

Gesture recognition has always been an important technique to minimize the path between the digital and physical world. In this paper, we are introducing the Arduino based robot vehicle system that is no longer required in manual controlling cars. [1] The aim of this paper is to illustrate how a robot can be controlled using an accelerometer and human hand tilting. Signals from the accelerometer are obtained and aided by wired communication. The robot moves in response to a signal from your hand and a separation. In this paper, we discuss about a gesture control robot that you can control with your daily hand gestures.

These robots are now used in a variety of settings, including offices, military communications, treatment centres, hazardous environments, and agriculture. Furthermore, performing particular activities, such as acquiring sensitive chemicals, decontaminating pumps or, in the worst-case scenario, lowering, tracking, and maintaining them in organizations can be difficult or risky.[2]

Robots are used to complete tasks that humans are unable to complete. To increase the use of robotics in situations where there are no mandatory constraints, such as firefighting or security. The computer receives the user's feedback and performs exercises in accordance with it. The wire attached to the accelerometer detects human hand motion.[3] The user's hand tilting causes the robots to move. The Arduino and accelerometer are used to achieve the goal of this wired control unit. The accelerometer's analogue input values (x axis, y axis) are received by the Arduino microcontroller, which transforms them to digital values. After titling, the Arduino Uno microcontroller receives the data. When we tip our palm to the left or right, the robot turns left or right. When the palm is tilted forward, it pushes towards the front, and the unit comes to a halt when corresponding to the floor. As a result, we will be able to use the system to complete tasks that will be beneficial to humans. In this project, we depict a signal-controlled robot that can be controlled with a simple hand motion. The Arduino IDE is used to plan the program here. [4]

II. METHODS AND MATERIALS

The materials and equipment used for building this robot involves a wooden chassis, 2 DC motors, 2 wheels, ADXL335 Accelerometer, 2 wheels, L239D motor driver, Breadboard, male to male pins, male to female pins, double sided takes, 9V battery, nuts and bolts.

2.1 Arduino UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read the inputs provided and turn them into desired output. The inputs can be- light on a sensor or a twitter

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 8, Issue 9, September 2021

message and the corresponding outputs might be activation of a motor or publishing something online.

Fig 1: Arduino UNO Microcontroller

The Interaction Design Institute Ivrea (IDII) in Ivrea, Italy is where began the Arduino project. At the beginning, the students worked with BASIC Stamp microcontroller, at a cost that can be called a considerable expense for many students. In 2003, a development platform called *Wiring* was created, under the supervision of Massimo Banzi and Casey Reas, by Hernando Barragán as his Master's thesis project at IDII. The supervisors were known for work on the Processing language. The goal of the project was to aid non-engineers in creating digital projects using simple tools and at low costs. The Wiring platform was made of a printed circuit board (PCB) with an ATmega168 microcontroller, an IDE based on Processing, and library functions to aid the programming of the microcontroller.[8] In 2003, Massimo Banzi, with David Mellis, another IDII student, and David Cuartielles, added support for the cheaper ATmega8 microcontroller to Wiring.[5] But, they forked the project and renamed it *Arduino*, instead of continuing the work on wiring. The FTDI USB-to-serial driver chip and an ATmega168 was used in the primitive Arduino boards . The Uno differed from all preceding boards by featuring the ATmega328P microcontroller and an ATmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter[6]

2.1.1 Advantages and Disadvantages

Using Arduino UNO has numerous advantages. The pre-requisite knowledge to get started is quite low, depending on shields you need, fairly cheaper. A lot of sketches and shields available, and there is no requirement of external programmer or power supply. However, there are also few limitations. It might be difficult to modify the sketches and shields. Without knowledge of basic C programming, it will be difficult to code and there are no inclusion of debugger for checking scripts. [7]

2.2 Accelerometer

An accelerometer is an instrument used to measure proper acceleration. Proper acceleration is different from coordinate acceleration; the former is the acceleration of a body in its own instantaneous rest frame, and the latter is acceleration in a fixed coordinate system.

There are three different types of accelerometers, and they are each designed to efficiently function in their intended environments. The three types are: piezoelectric, piezoresistance and capacitive.

The ADXL335 is a small, low power, complete 3-axis accelerometer with voltage outputs that are signal conditioned. It can achieve feats like measuring the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration as result of motion, shock, or vibration.

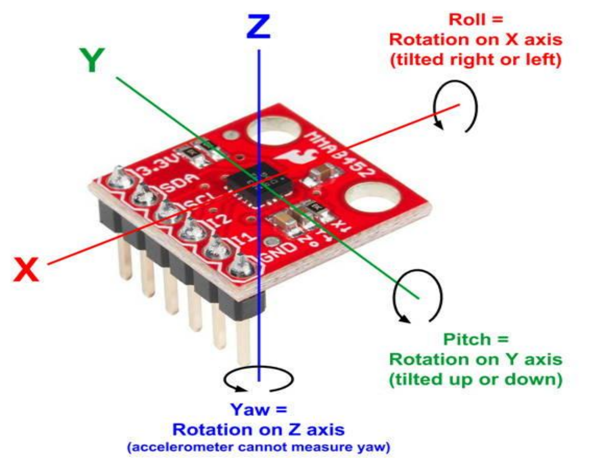

Fig 2: Image of ADXL335 Accelerometer

Power and communication lines are the basic pre-requisites for connection of most accelerometers. Accelerometers that use an analog interface show accelerations through varying voltage levels. One can observe the fluctuations of these values between ground and the supply voltage level. The value can be read using an ADC on a microcontroller. These are generally cheaper than digital accelerometers.[8]

2.2.1 Working Principle of ADXL335

ADXL335 is a 3 axis accelerometer with on board voltage regulator IC and signal conditioned Analog voltage output. ADXL335 from Analog Devices make up the module of the device.The acceleration is measured by the device with a minimum full-scale range of ±3 g. As mentioned above,

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Vol 8, Issue 9, September 2021

it can measure both the static as well as dynamic acceleration.

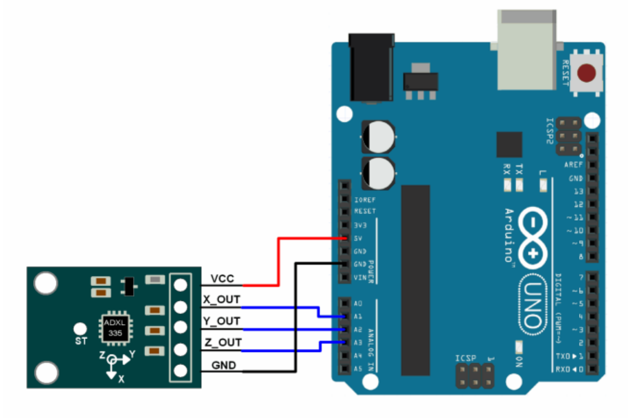

Fig 3: Connection of ADXL335 accelerometer to Arduino UNO

The bandwidth of the accelerometer is selected by the user using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axis, and a range of 0.5 Hz to 550 Hz for the Z axis.The holy grail of accelerometers, are the latest in a long series of analog sensors. Accelerometers are generally low-power devices. The required current typically falls in the micro (µ) or milli-amp range The ADXL335 has extremely low noise and power consumption – only 320uA! Also, the sensor has a full sensing range of +/-3g. An on-board voltage regulation is at place, that enable you to power the board with 3V to 6V DC. Board comes fully assembled with external components installed and the necessary tests done. The included 0.1uF capacitors set the bandwidth of each axis to 50Hz.[9]

2.3 Motor Driver

Sometimes direct power supply from Arduino cannot efficiently run the DC motors. A motor driver acts as an interface to control the motion of DC motors. It takes low current input and converts it into high current signals. In this work L239D motor driver has been used. It is capable of running 2 DC motors at the same time. It is equipped with 16-pin motor driver IC. This motor driver is capable of controlling the speed of the motors.

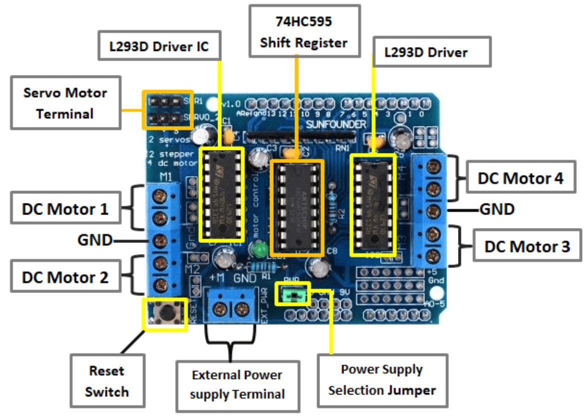

Fig 4: Parts of motor driver

2.3.1 Working principle

The signals are received from the microprocessor that is the Arduino Uno to L239D IC. TheL239 transmits the relative signals to the DC motors. It is equipped with two voltage pins, one of which is used to draw current for the working of the L293D and the other is used to apply voltage to the motors.

2.3.2 Specifications of L293D Motor Driver

The L239D motor Driver has a supply voltage range of 4.5V-36V, it has high-noise immune inputs, and automatic thermal shutdown system. There are several advantages of using L239D motor drivers. These motor drivers can be used in the temperature ranging from 0°C to 70°C. It also has internal ESD protection and a separate input-logic supply.

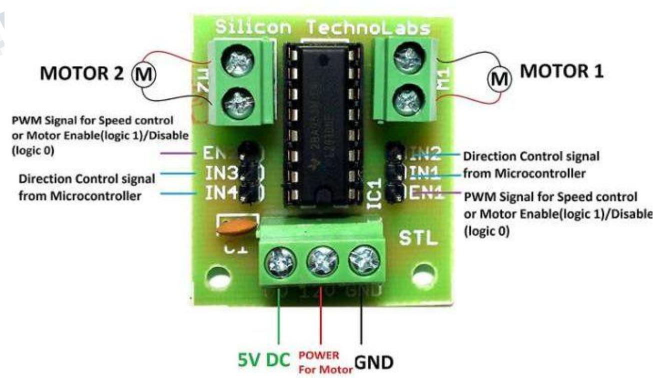

Fig 5: Parts of L239D motor driver

2.3.3 L239D Motor Driver Connection

The motor driver is connected to the Arduino which is connected to the power source of the computer. The L239D motor driver is placed near the breadboard to make the connections easier. The connections to the Arduino UNO are made with the help of male to male and male to female pins. The 5V pin of the Arduino is connected to the enable pin A that is "EN A", The ground pins of the motor driver are connected to the ground pins of Arduino UNO. The 5V and Ground (GND) pins from the Arduino are connected to the breadboard using male to male pins. The following table depicts the connections of L239D motor driver and Arduino UNO. [10]

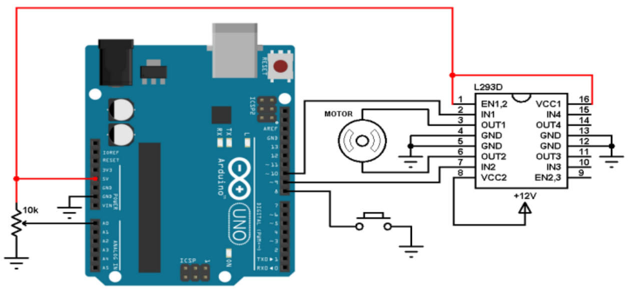

Fig 7: Connection between Arduino and L239d motor driver

Table 1. Connection between DC motors and Motor Driver L239D

Component 1	Terminals 1	Terminals 2	Component 2
Left Motor	+ve Terminal	MB 1	Motor Driver
Left Motor	-ve Terminal	MB 1	Motor Driver
Right Motor	+ve Terminal	MB 2	Motor Driver
Right Motor	-ve Terminal	MB 2	Motor Driver

III. RESULT & DISCUSSION

The objective of this work is achieved. The robot is able to move according to the navigation of human hand. The robot moves in the right direction when the accelerometer moves towards the right. The robot moves in the left direction when the accelerometer is tilted towards the left side. The robot moves forward and in reverse, when the accelerometer is tilted in the forwards and backwards direction. This robot model enhances the knowledge especially for students and robot enthusiasts. The materials used while building the robots are available at any electrical stores and the cost of them are inexpensive.

The values on the accelerometer decide the direction in which the robot needs to move. If the value of X-axis is less than 350 (X-axis< 300), then the robot tends to move in the forwards direction. If the value of X-axis is greater than 360 (X-axis>360), then the robot moves in backward direction. If the value of Y-axis is greater than 360 (Y-axis<360), then the robot moves in left direction. If the value of Y-axis is greater than 360 (Y-axis>360), then the robot moves in right direction. The following table shows the motion control of ADX335 accelerometer and the robot motion.

Table 2. Control motion of accelerometer and robot movement

ADXL335	X AXIS	Y AXIS	ROBOT MOTION	PIN 10	PIN 11	PIN 12	PIN 13
Flat	~360	~360	Stop	Off	Off	Off	Off
Tilted Forward	<300	~360	Forward	On	Off	On	Off
Tilted Backwards	>300	~360	Reverse	Off	On	Off	On
Tilted Right	~360	>300	Right	Off	On	On	Off
Tilted Left	~360	<300	Left	On	Off	Off	On

IV. CONCLUSION

The gesture-controlled robot has been built successfully with the help of ADXL335 accelerometer. The robot moves forward when the accelerometer is moved in the forward direction, the robot moves in reverse direction when the accelerometer is taken backwards, the robot takes a right turn when the accelerometer is moved to the right and a left turn when the accelerometer is moved towards the left. This robot can be used in various applications ranging from surveillance, autonomous maze solving robot, human assisting robots, cleaning bots and many more. This work can further be improved by using metal detectors. So that instead of human beings can be employed to detect any dangerous item thereby reducing the chance of human casualties to a great extent. It can also be advanced by mounting a surveillance camera on top of the chassis for security purposes and many more.

REFERENCES

[1] Benjula Anbu Malar M B,Praveen R, Kavi Priya K P, "Hand Gesture Control Robot", international Journal of Innovative Technology and Exploring Engineering (IJITEE), December2019

[2] A. Parimala, W. Nancy, M. Benisha, N. Nandhagopal, N. Krishnaraj, "Gesture Control Robot Using Arduino", nternational Journal of Advanced Science and Technology, Vol. 29, No. 6, (2020)

[3] Sathananthavathi, C.Arthika "Hand Gesture Controlled Robot, International Journal of Innovative Research in Technology (IJIRT) Volume 4 Issue 8, ISSN: 2349-6002, January 2018

[4] Dheeban Ss, Harish Dhanasekaran Velayutha Rajan, A Hari Vignesh, Prasanna Marimuthu "Arduino Controlled Gesture Robot", 2018 IEEE 4th International Symposium in Robotics and

Manufacturing Automation (ROMA), December 2018
[5] Eka Susanti, Rosita Febriani, Sholihin, R. A. Khalimah Thusyadiyah "The design of hand gesture robot software based on wireless technology", International Conference on Information and Communications Technology (ICOIACT), March 2018
[6] Hirotaka Osawa, Jarrod Orszulak, Kathryn M Godfrey, Joseph F Coughlin "Improving Voice Interaction for Older People Using an Attachable Gesture Robot", Institute of Electrical and Electronics Engineers (IEEE) Xplor, October 2010
[7] N. H. Prasad, A. Mariyan Richard, B. N. Lakshmi Narayan, "Hand Gesture Controlled Robot", International Conference on Communication, Computing and Electronics Systems, March 2021
[8] Alexander McGregor, Gordon Dobie, Neil Pearson, Anthony Gachagan "Mobile robot positioning using accelerometers for pipe inspection", AIP Conference Proceedings 2102(1):060004, May 2019
[9] Hugh Liu, Grantham Kwok Hung Pang "Accelerometer for mobile robot positioning", IEEE Transactions on Industry Applications 37(3):812 – 819, June 2001
[10] Zdzislaw Kowalczuk, Tomasz Merta, Modelling an accelerometer for robot position estimation, 2014 19th International Conference on Methods & Models in Automation & Robotics (MMAR), September 2014