International Journal of Research in Engineering, Science and Management
Volume-1, Issue-11, November-2018
www.ijresm.com | ISSN (Online): 2581-5792

Hand Gesture Controlled Robot Using Arduino

Suryarajsinh T. Vala
Student, Dept. of Electronics and Communication, Chandubhai S. Patel Institute of Technology, Changa, India

***Abstract*: Now-a-days, as a result of the advancements in technology, human-machine interaction is widely increasing that reduces the gap between machines and humans for easy standard of living. Gestures have played a vital role in diminishing this gap. Robots are playing a crucial role in automation across all the sectors like construction, military, medical, manufacturing, etc. This paper describes regarding how the conventional hand gestures can control a robot and perform our desired tasks. The transmitter will transmit the signal in line with the position of accelerometer and your hand gesture and therefore the receiver will receive the signal and make the robot move in respective direction**

***Keywords*: Arduino Uno, Accelerometer, RF Modules**

1. Introduction

In the physical world, humans interact by the means of five basic senses. However, gestures are a vital means of communication in the physical world from earlier period, even before the invention of any language. In this era of digital technology taking control of each complex tasks, interactions with machines have become more vital than ever. The rising trend currently in the field of science is artificial intelligence. Lately a number of wireless robots are being developed and put to varied applications and uses. In order to reinforce the contribution of robot in our daily lives we need to find an efficient approach of communication with robots. There are many various types of robots available, each created for different tasks and behavior, and works on completely different platforms. Robots may be built for recreation, knowledge, competitions, domestic help, industrial uses, surveillance etc. each of these robots may be classified as autonomous, controlled or semi-autonomous based on the way they're controlled.

For this purpose, there are certain developments in area of human-machine interaction. One common sort of communication is Gestures that are not solely restricted to face, body and fingers but also hand gestures. So as to extend the utilization of robot in places where conditions are not certain like rescue operations, robots can be made to follow the instructions of human operator and perform the task consequently. This proposes an integrated approach of tracking and recognition of hands that is intended to be used as human-robot interaction interface.

2. Related works

The emergence of robots can be traced back to the 90's with Helpmate Robots and Robot-Caddy [1]. Since then, there is an exponential development in the field of robotics, and controlling robots through human gestures have been the topic of research for as long time. With the implementation of gestures to control robots, there have been several methodologies to perform the action. Some of the related works are being described in this section:

A. Light-based Gesture Recognition

Light or illumination tracking and controlling robots with light sensors are being done in a lot of cases. Such robots are autonomous in nature. Generally, there are some light sensors associated with the robot. The sensors send some rays of light and track them as they gets absorbed in the surface or reflected back to it. According to this, the robot can be line-sensing robots where it is made to follow a black or a white path autonomously [1].

B. Vision-based Gesture Recognition [3]

Several robots are designed to be controlled by vision-based gestures. In such robots, there are, generally, some cameras as the sensor, which also acts as an interface to control the robot with some manipulators. The input gesture can be some patterns, movements of hands, color tracking, face recognition, finger tracking, or some templates. They are also used in ball tracking and Robo-football games where the robots play the traditional game of football by tracking the movement of the ball. Though it has paved a way for advanced robot operations, but it is affected by factors such as illumination, foggy weather, background lights, etc. [4]

C. Motion-based Gesture Recognition

The motions can be used to control a robot. This is generally done by incorporating an accelerometer to control the robot wirelessly. This can also be done using sensors. This method is beneficial over other methods in the sense that it can interact with machines naturally without being intruded by the factors that affects the mechanical devices [3]. One important development in this field is done by Sauvik Das et al in 2010, where he designed a spying device yielding location and activities of the user without his/her knowledge [5].

D. Sixth Sense Technology

The Sixth sense technology begins in 1990 by Steve Mann who implemented a wearable computing device via neck projector or head-mounted projector coupled with a camera. Later, following his idea, Pranav Mistry, a young research

scientist at MIT at that time came up with new applications of this technology. Pranav Mistry came up with the name „Sixth Sense Technology" and has since been named Wear Ur World (WUW). This technology applies all of the techniques mentioned above and designing applications that give an intuitive output with the connection of internet [1].

3. Proposed work

The whole project is divided into two sections one is transmitter section and other is receiver section.

The brain of the robot is an Arduino Uno (Atmega32). It is fed with a set of codes. The gestures/motion made by hand is recognized by the acceleration measuring device called accelerometer (ADXL335) [6].

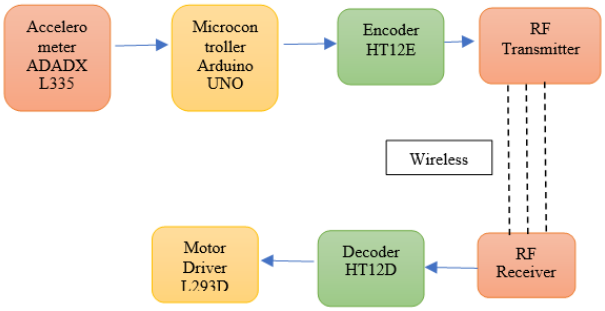

Fig. 1. Block diagram

In transmitter part, an accelerometer, Arduino UNO, Encoder HT12E and a RF transmitter unit is used [6]. The Accelerometer above reads the X Y Z coordinates when we make hand gestures. It then sends the X Y Z coordinates to the Arduino. We don't need the Z axis. We need only X and Y. The Arduino checks the values of coordinates and sends a 4-bit data to the Encoder IC in accordance with the data received from the accelerometer. The Encoder passes the data to RF Transmitter. And the transmitted data is received by the RF Receiver.

The receiver sends the 4-bit data to Decoder IC which decodes it and passes to Motor Driver IC. Later the motor driver makes decision to turn the two motor in required direction. The receiver circuit consists of 2 ICs (HT12D decoder and L293D motor driver) and an RF receiver module.

This robot is designed to recognize five sets of hand gestures. Forward, backward, left, right, and stop [6].

Fig. 2. Five different hand gestures for each control command [6]

4. Implementation

A. Software used

The program is written in Arduino Integrated Development Environment (IDE). Here, the version used is 1.8.1. It connects to the Arduino hardware to transfer programs. But before uploading the program there is a necessity to choose acceptable Microcontroller so, "Arduino Uno" from the Tool menu has been chosen. And for proper communication with computer and Arduino Uno boards there is a need to select COM port from the Tool menu.

B. Hardware used

1) Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 [7]. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything required to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started [2].

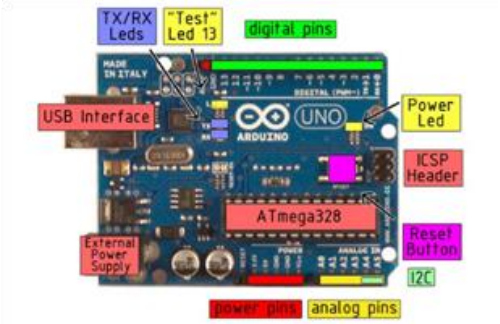

Fig. 3. Arduino UNO

2) Accelerometer sensor

The ADXL335 [8] is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. It has 6 pins. 3 pins are for X, Y, Z axis. First pin for power supply (VCC), second pin for ground (GND) and the last one for self-test (ST). It operates on 3.3V from the Arduino Uno board. X and Y axis pins are connected to A0 and A1 pin of Arduino Uno board correspondingly. It can measure the static acceleration of gravity from tilt sensing applications as well as dynamic acceleration ensuing from motion, shock or vibration and gives corresponding analog values through X, Y, Z axis pins. The ADXL335 is available in a small, low profile, 4mm x 4mm x 1.45 mm, 16-lead, plastic lead frame chip scale package. The low cost and small size of 3-axis accelerometer are the two factors that make it effective to detect the hand gesture [2].

3) Encoder

Here, HT12E [9] is 212 series encoder is used. It is capable of encoding information that consists of N address bits. It consists of 18 pins. Pin (1-9) and 14 are connected to ground. Pin number 10,11,12,13 of encoder are connected to 13,12,11,10 of Arduino Uno board respectively. A resistor of 750KOhm is connected to 15 and 16 number pin. Pin 17 is connected to Data pin of 433MHz RF transmitter module. It operates on 5V power supply to which 18 number pin is connected.

4) Decoder

HT12D [10], 212 series decoder is employed that is capable of decoding information that consists of N address bits. It consists of 18 pins. Pin (1-9) connected to ground. Pin number 10,11,12,13 of decoder are connected to 10, 15, 7, 2 of Motor driver respectively. A resistor of 47KOhm is connected to 15 and 16 number pin. Pin 17 is not connected. Pin 14 is connected to Data pin of 433MHz RF receiver module. It operates on 5V power supply to which 18 number pin is connected.

5) RF transmitter and receiver module

RF stands for radio frequency [11]. It is obtainable completely different in operation frequencies and with different operating range. We have used 433 MHz RF Tx/Rx module. RF module is commonly used along in conjunction 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.

6) Motor driver L293D

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors [12].

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state [12].

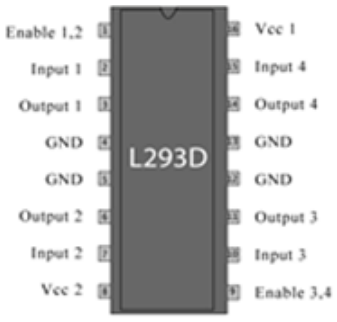

Fig. 4. Motor driver L293D

5. Design and working

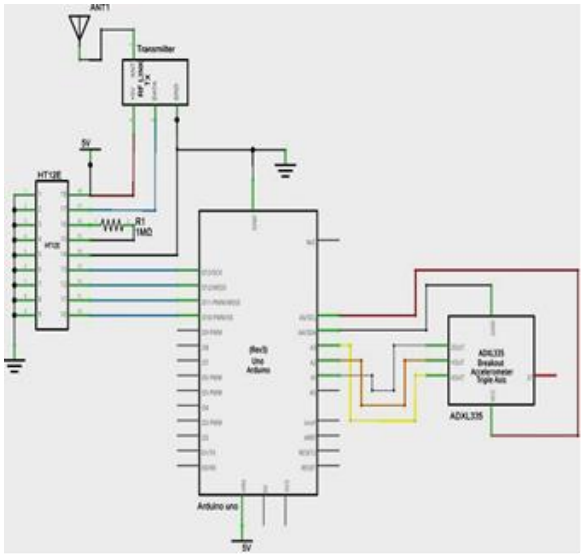

Fig. 5. Transmitter circuit

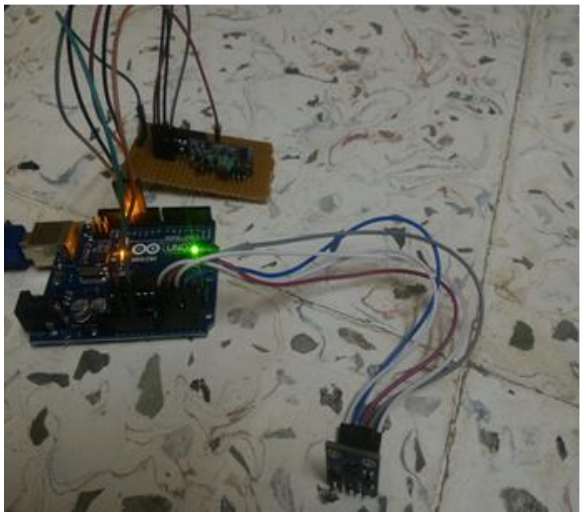

Fig. 6. Transmitter model

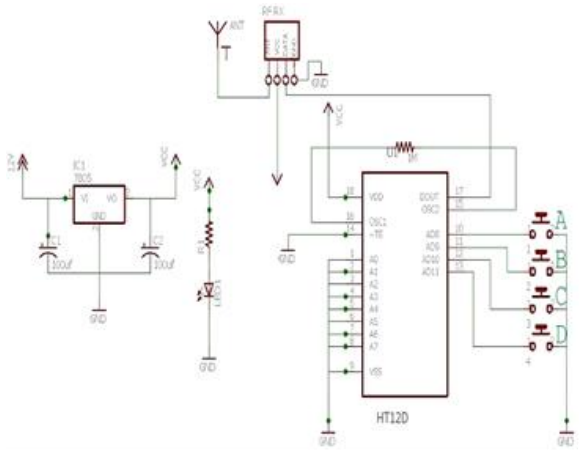

Fig. 7. Receiver circuit

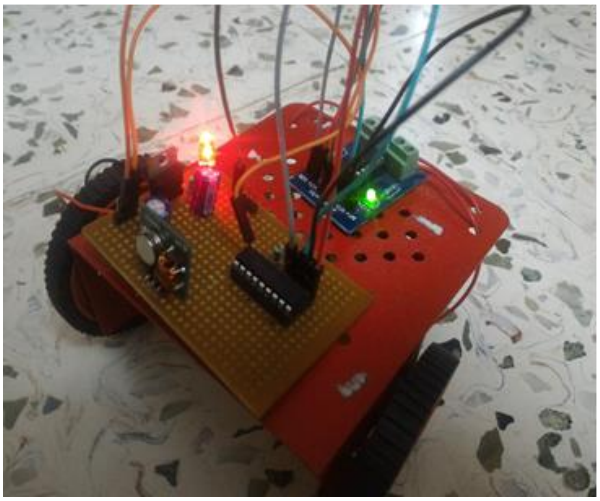

Fig. 8. Receiver model

6. Conclusion

In this paper, an automated robot 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 by adding robotic arm which can also lift the bomb as well as in general terms, a robotic arm can be added which can be used in our day to day activities making human life easy.

References

[1] Gesture Controlled Robot Using Arduino And Android Premangshu Chanda, Pallab Kanti Mukherjee, Subrata Modak, Asoke Nath Department Of Computer Science, St. Xavier"S College(Autonomous), Kolkata, West Bengal, India
[2] Accelerometer Based Gesture Controlled Robot Using Arduino Swarnaprabha Jena, Sworaj Kumar Nayak, Saroj Kumar Sahoo, Sibu Ranjan Sahoo, Saraswata Dash, Sunil Kumar Sahoo Electronics And Communication Engineering, Centurion University Of Technology And Management, India
[3] S. Waldherr, R. Romero And S. Thrun, 2000, "A Gesture Based Interface For Human-Robot Interaction", In Autonomous Robots In Springer, Vol. 9, Issue 2, Pp. 151-173Available At Http://Www.Cs.Cmu.Edu/~Thrun/Papers/Waldherr.Gestures-Journal.Pdf
[4] Wang, B., And Yuan, T., "Traffic Police Gesture Recognition Using Accelerometer", IEEE SENSORS Conference, Lecce-Italy, pp. 1080-1083,Oct. 2008.
[5] Song, M., Kim, B., Ryu, Y., Kim, Y., And Kim, S., "A Design Of Real Time Control Robot System Using Android Smartphone" The 7th International Conference On Ubiquitous Robots And Ambient Intelligence (URAI), Busan- Korea, Nov. 2010.
[6] Https://Diyhacking.Com/Hand-Gestures-Robot/
[7] Shruthi B. N, Shivraj, Sumathi S, "Hand Gesture Based Direction Control Of Robocar Using Arduino Microcontroller", International Journal Of Recent Technology And Engineering(IJRTE), Volume-3, Issue-3,PP.-32-35, July 2014.
[8] Http://Www.Analog.Com/Media/En/Technicaldocumentation/Data-Sheets/ADXL335.Pdf
[9] Http://Www.Holtek.Com/Pdf/Consumer/2_12ev120 .Pdf
[10] Http://Www.Eleinmec.Com/Datasheets/Ds_Holtek_ Ht12d.Pdf
[11] Http://Oap.Sourceforge.Net/Datasheets/Rf.Pdf
[12] Https://Www.Engineersgarage.Com/Electronic-Components/L293d-Motor-Driver-Ic