It made the use of python coding along with the lynx motion AL5A module.

An accelerometer-based gesture-controlled arm for an ROV (Remotely Operated Vehicle) was developed using a simple gyroscope and joystick and discussed in [3]. Hence this required no previous training for the operator as well as provide for a smooth and accurate movement.

A wireless robotic arm that uses GUI for wireless communication was evolved in [4]. It had five separate movements controlled by five servo motors. Going to wireless from wired is much easier with less hassle and GUI helps to communicate between systems in an easier way.

A simple hand gesture robotic arm using accelerometer was put into effect. An algorithm for gesture sensing has been developed in [5] to replace the approach of traditional controlling mechanism of robots, by an innovative hand gesture-based controlling. It made use of WIN AVR STUDIO 4.0, PROTEUS for coding and had a large range of communication.

The light weight robotic arm using a joystick was implemented in [6]. The arm is constructed almost entirely of plastic elements: inflatable links, airbag actuators, and acrylonitrile butadiene styrene (ABS) joints. A new method of control was used and this was especially designed for medical and healthcare purposes.

A joystick-controlled arm with auditory feedback was developed in [7]. Joystick-based operation is a popular method for operating various types of robots, such as excavators, cranes, and space tele robotics. The goal is to create efficient methods for controlling such devices.

A gesture-controlled car using simple methods was implemented in [8]. It shows a robotic system that allows anyone, especially normal people with no technical background, to instruct a robot just showing it what it should do.

A solely military purposed gesture-controlled robot was developed in [9]. There are numerous robots using commands from user or self-controlled, the requirement for gesture controlled robots are on the rise for military purposes, which is called as Unmanned ground vehicles (UGVs). The main advantage of this is that it is gesture functioning without base station assistance.

A Hand Motion Controlled Robotic Vehicle with obstacle detection which identifies trends in technology applications and usability are discussed in [10]. An approach is presented that is based on detection of motion of hand which will control vehicle movement and refrains movement of vehicle if an obstacle is detected in path.

3.System Description

Figure 2 shows the block diagram of Transmitter section of Gesture Controlled Robot. Here, the accelerometer initiates the process by point data to the ATMEGA 328 microcontroller (8-bit) based on the gesture performed by the user. This data is processed by the microcontroller towards the RF transmitter module (433.92 MHz frequency range).

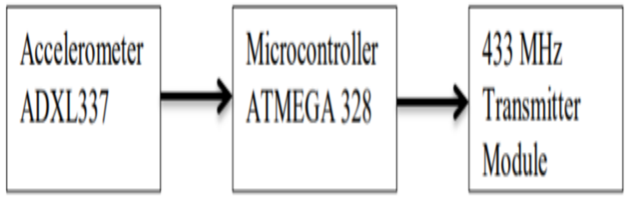

Figure 2- Block schematic of Transmitter section of Gesture controlled robot

Figure 3 shows the Block schematic of Receiver section of Gesture controlled robot. The receiver RF module receives (433 MHz frequency range) the data sent by the transmitter and processes it further to the microcontroller at the receiver end. And thus, the microcontroller (8-bit) directs the given signal to the L293D motor driver which eventually performs the required corresponding physical tasks.

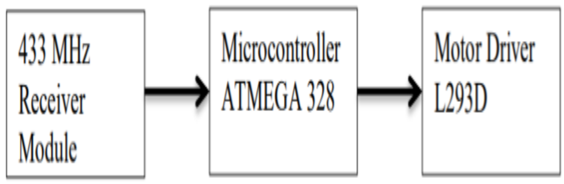

Figure 3- Block schematic of Receiver section of Gesture controlled robot

Figure 4 shows the block diagram of Transmitter section of Gesture Controlled Robot. The USB joystick (analog) is used by the user at the transmitter end. Once the user performs a specific gesture on joystick, based on the assigned threshold values the message is transmitted to RS232 which processes the corresponding message and sends it towards the receiver end.

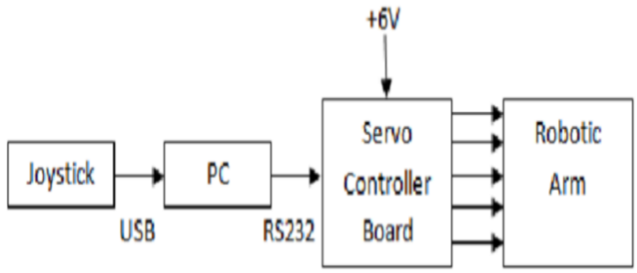

Figure 4- Block schematic of implemented Robotic arm

At the receiver end the message is received and decoded by the SCB (Servo Controller Board) and responsible for required moment of the robotic arm.

4.System Methodology

Figure 5 shows the process of the transmitter section, the process is initiated by setting the X and Y pin of the joystick. Further the X and Y pins are read and the threshold values are set for adjusting the sensitivity.

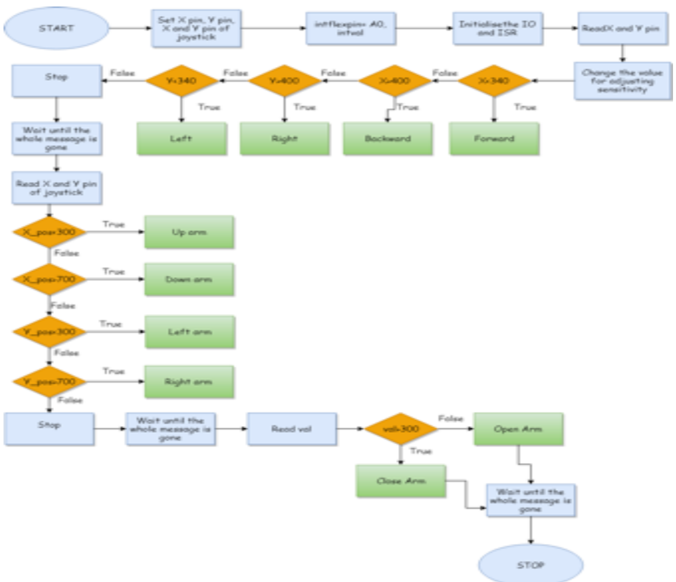

Figure 5-Flowchart of Transmitter section

A particular threshold is assigned for every particular gesture in a loop. If X < 340 is true, a forward move is directed else it moves to the next input that is if X > 400 is true, a backward move is directed. Similarly, If Y < 340 is true, a right move is directed, else it moves to the next input that is if Y > 400 is true, a left move is directed.
This step terminates and stops until the whole message is gone and waits for the next message to come. In a similar way, the X and Y pins of the joystick are set. If X-pos < 300 is true, an up arm move is directed else it moves to the next input that is if X-pos > 700 is true, a down arm move is directed. Similarly, If Y-pos < 300 is true, a left move is directed, else it moves to the next input that is if Y > 700 is true, a left move is directed. Again, this step terminates and stops until the whole message is gone and waits for the new message to come. The following message determines the opening and closing of the robotic arm. The values of this corresponding message are read and if Val<300 is true then the arm closes and if Val<300 is false then the arm opens. After the processing of this message the entire cycle of one particular gesture is terminated and the system waits for a new message signal.

Figure 6 shows the flow of the receiver section, that once it receives signals from the transmitter, it initializes Q1, Q2, Q3 and Q4 servo pins. After this the receiver's PLL is started and the output for the motor control is set. Next are the non-blocking signals which are determined by using loops in the receiver's code. If the statement is true then it goes to the next block that is int i = 0, which directly follows the next iteration that is i++. And if the condition is false it goes to the next block int i = 0 followed by i < buffer and if this is true it refreshes, otherwise checks the first data received.

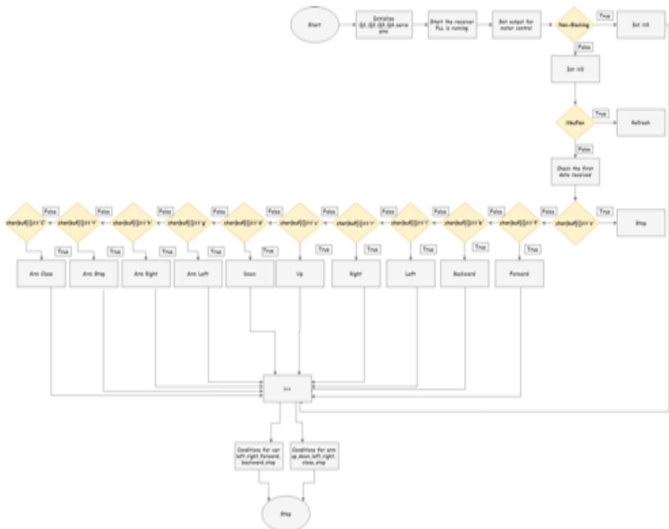

Figure 6- Flowchart of Receiver section

Now if the data received is char (buff[i])== 's' ('s' represents Stop) and is true then it stops and if false then it moves to the next statement char (buff[i])== 'f' ('f' represents Forward) and when this statement is true it processes a forward move signal otherwise it moves to the next statement char (buff[i])== 'b' ('b' represents Backward) which when true processes a backward move signal otherwise moves to the next statement char (buff[i])== 'l' ('l' represents Left) which when true processes a left move signal otherwise moves to the next statement char (buff[i])== 'r' ('r' represents Right) which when true processes a right move signal otherwise moves to the next statement char (buff[i])== 'u' ('u' represents Up) which when true processes an upward movement signal otherwise moves to the next statement char (buff[i])== 'd' ('d' represents Down) which when true processes a downward move signal.

In a Similar manner with continuation the movement of arm to open and close are also described as follows: If the condition of the downward movement is wrong then the code moves to the next statement which is char (buff[i])== 'g' ('g' represents Right arm) which when true processes a right move signal for the arm otherwise moves to the next statement char (buff[i])== 'h' ('h' represents Left arm) which when true processes a left move signal for the arm otherwise moves to the next statement char (buff[i])== 't' ('t' represents Stop arm) which when true processes a stop signal for the arm otherwise moves to the next and the final statement char (buff[i])== 'c' ('c' represents Close) which when true processes a close move signal for the arm.
Amongst all the conditions if any 1 condition is true then it directly progresses to next iteration i++ which is followed by the conditions of the robotic car and conditions of the joystick controlled robotic arm. And this is further followed by the termination step that is 'Stop'.

5.Hardware and Software Modules

L293D Motor Driver

- It drives the DC motors and is used to drive induction loads. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motors with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

Car chassis

- Provides room for the DC motors as well as other Modules.

RF Module (Transmitter and Receiver)

- RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly.

Wheels

- They are attached to the chassis with the help of screws and then connected to the DC motors for movement.

Microcontroller (ATMega328)

- A single-chip microcontroller having a 8-bit AVR and is used in many autonomous systems.

Accelerometer (ADXL337)

- It is a device that measures proper acceleration.

Analog Joystick

- It is used to control the robotic arm.

6.Implementation

In this prototype, the gesture-controlled car is developed using an accelerometer, RF module and is controlled using microcontroller ATMega328. The accelerometer and the transmitter module along with the microcontroller comprise of the transmitter section. The data is transmitted using radio frequency via the transmitter's end. The receiver section consists of the receiver module and the microcontroller which in turn commands the motor drivers. Hence the data is received by the receiver RF module and the commands are given to the motors via the motor driver. The weight of the car is precisely evaluated and calculated in order to balance out the weight of the robotic arm which is mounted on the car and thus allows the arm to move freely without any dominance.

Specific set of threshold values are assigned for respective hand gesture moments such as forward, backward, left and right. On the transmitter end the accelerometer will be mounted on a human hand glove which will be used to perform hand gestures which will be responsible for the moment of the robotic car. While on the receiver end, there is a motor driver which takes the message sent by the transmitter and received by the receiver and converts these signals into mechanical moments via the motor driver.

The robotic arm will be a 3D printed prototype in order to keep it light weight and for easy mounting on the robotic car. The design of the arm is kept simple to implement and easy to handle. The joystick is used to control the arm for smooth movement. With the help of the microcontroller the commands of the joystick are transferred to the arm and the movements are done. Commands like forward, backward, left, right and stop are being used.
Similar to that of the robotic car, even the joystick comprises of a transmitter and a receiver end. And in a similar way, specific set of threshold values are assigned for respective joystick commands which include up arm, down arm, left arm, right arm, arm close and arm open.

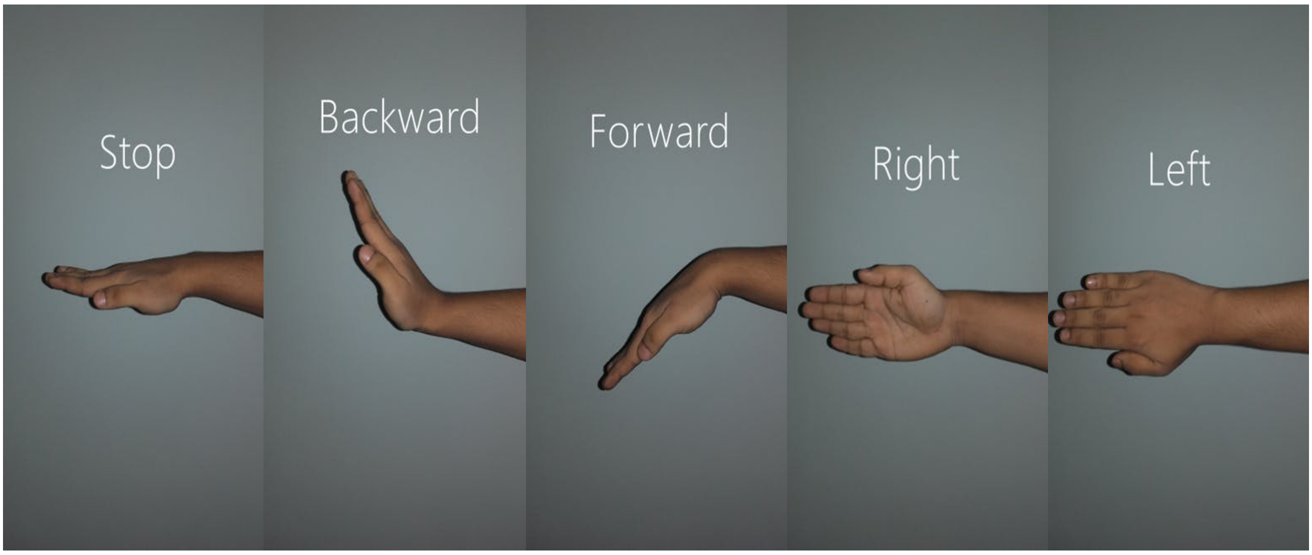

Figure 7- Various gestures for movement of vehicle

7.Result and Conclusion:

Figure 8,9 show the final hardware model of the joystick controlled robotic arm and gesture controlled robotic car respectively.

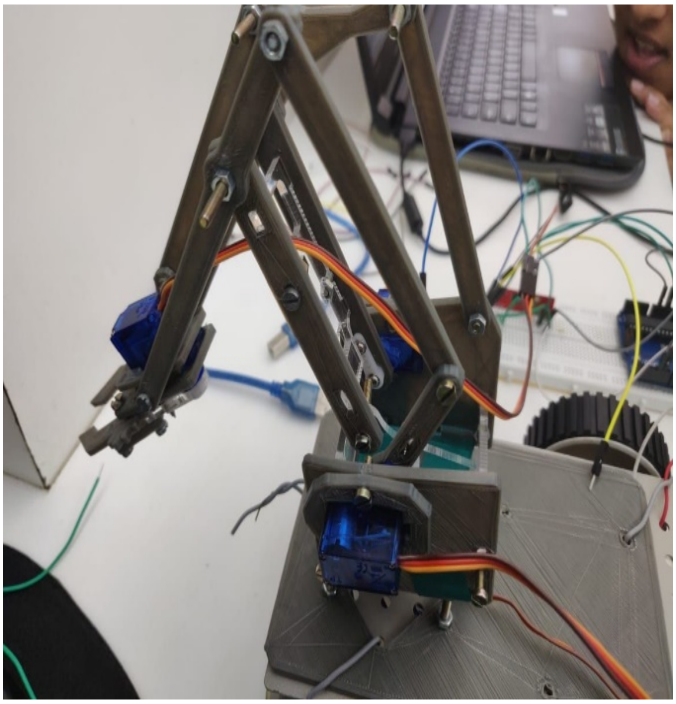

Figure 8- Robotic Arm

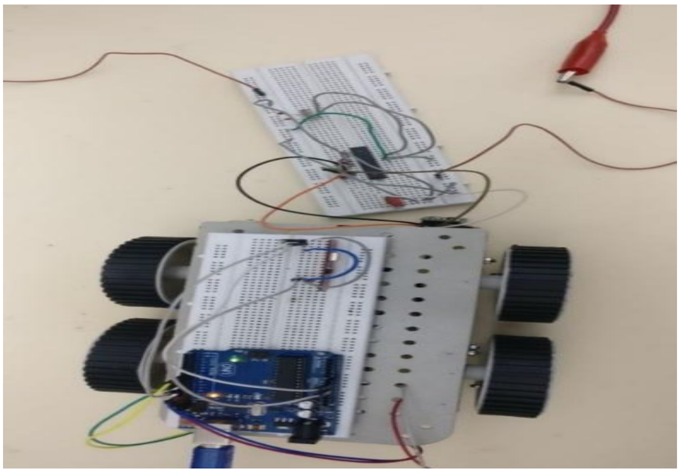

Figure 9- Gesture controlled Robotic car

The objective of this project, of developing the hardware and software for a gesture controlled robotic car and a joystick-controlled arm has been accomplished. From the observations it is clear that the movement of an arm and car is precise, easy to control and user friendly. This robot control method is expected to overcome the problem. It can be used as a fire fighting robot to help the people from the fire accident. These can be used in construction field and also in industries to control trolley and lift. They can also be used in military and medical applications.

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