Chapter: 01

INTRODUCTION

The current emerging technology in the field of science is Robotics. It is the new emerging booming field of great use to people in the coming years. These days a number of wireless robots are being developed and put to various applications and uses. In order to enhance the contribution of robot in our daily lives we need to find an effective way of communicating with robots. For this purpose, there have been certain developments in area of human-machine interaction. One common form of communication is Gestures that are not only limited to face, body and fingers but also hand gestures. In order to increase the use 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 accordingly. This proposes an integrated approach of tracking and recognition of hands which is intended to be used as human-robot interaction interface.

A hand Gesture Control Robot is a kind of robot which is controlled by the hand gestures and not by using buttons. The robot is equipped with two sections - Transmitting section and Receiving section. In the Transmitting section, the Accelerometer is mounted on hand of the user capturing its gesture and moving the robot accordingly. For assigning proper levels to the input voltages from the accelerometer comparator IC is used. Encoder IC is then used to encode the four bit data which will later be transmitted by an RF Transmitter module. In the receiving section, the received encoded data by RF receiver module is then decoded using a decoder IC which is then processed by a microcontroller and passed onto a motor driver to rotate the motors in a special configuration to move the robot in the same direction as that of the hand. So, the primary basic aim of design is to make the robot move as soon as the operator makes any gesture. The goal of this paper is to develop methods that helps user to control & program a robot with high level of abstraction from robot specific language. Various hand movements performed are: FORWARD, BACKWARD, LEFT and RIGHT. The standard input methods do not provide a natural instinctive interaction between humans & robot making it essential to create models for understandable communication between humans & robots.

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LITERATURE SURVEY

Using Teach box for Programming and control of a robot is a tiresome and time-consuming task that requires technical knowledge. Therefore, the approach is to have new and more intuitive ways for programming & control of robot. In the robotics field, several research efforts have been made to create user-friendly teach pendants, implementing user interfaces such as color touch screens, a 3D joystick. But, these techniques are not efficient to control the robot as they do not give accurate results and provide slow response time. In the past years the manufacturers of robot have made efforts for creating "Human Machine Interfacing Device".

Using gesture recognition concept, it is possible to move a robot accordingly. Accelerometers are the main technologies used for human machine interaction which offer very reasonable motion sensitivity in different applications. Motion technology makes easy for humans to interact with machines naturally without any interventions caused by the drawbacks of mechanical devices[7]. Accelerometer-based gesture recognition has become increasingly popular over the last decade compared to vision based technique. The factors that make it an effective tool to detect and recognize the human gestures are its low-moderate cost & relative small size of the accelerometers.

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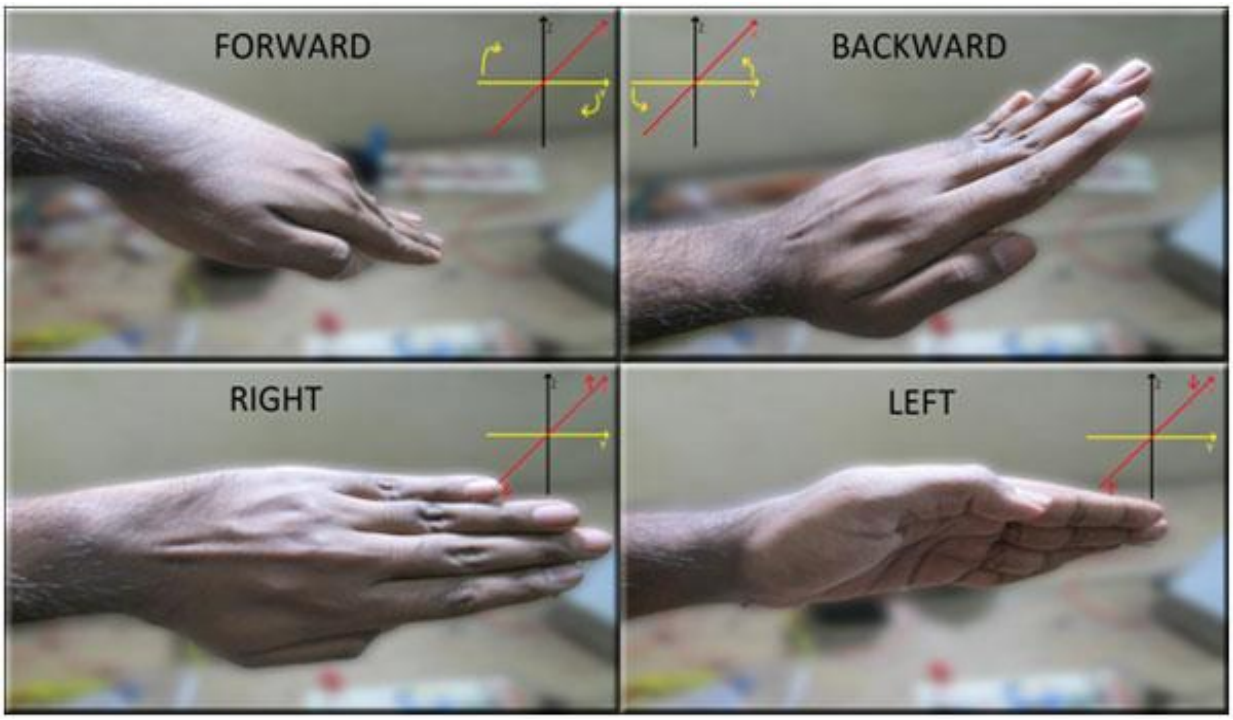
PURPOSE

The purpose of project is to control a toy car using accelerometer sensors attached to a hand glove. The sensors are intended to replace the remote control that is generally used to run the car. It will allow us to control the forward and backward, and left and right movements, while using the same accelerometer sensor to control the throttle of the car.

The gesture controlled robot is a wireless operated robot and has two parts: Transmitter and Receiver. When the robot is powered on, the transmitter part, which consists of ADXL335, Comparator, Encoder and RF Transmitter, will continuously monitor the ADXL335 sensor.

This data is converted into digital by the comparator, which then transmits a corresponding data to the Encoder, based on the ADXL335 Sensor. The parallel data received by the encoder is converted into serial data and this serial data is transmitted by the RF Transmitter. At the receiver section, the RF Receiver receives the serial data and transmits it to the Decoder IC.

The Decoder will convert the serial data to parallel data and this parallel data is read by the comparator and then given to the motor driver IC. Based on the data, the movement of the motors, and hence the movement of the robot is defined.



(Fig 1)[3]

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COMPONENT REQUIREMTNS

4.1 Arduino:- Arduino Uno It is a microcontroller board based on ATmega328 which has 14 digital I/O and 6 analog pins. It has everything that is needed to support the microcontroller. Simply connect it to the computer with a USB cable to get started with the Arduino Uno board. It is flexible, easy to use hardware and software. Arduino Uno can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators.

(Fig 2)

4.2 Accelerometer Sensor[9]:- The ADXL335 is a small, thin, low power 3-axis accelerometer which measures acceleration with a minimum full-scale range of ±3g along with measurement of the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. Tilting an accelerometer along its measured axis, gives the gravitational force relative to the amount of tilt.

There are three axes that can be measured by accelerometer and labeled as X, Y and Z with each axis representing separate degree of freedom (DOF) and the data at that corresponding axis is turned into analog form. They are used in Mobile devices, Gaming systems, Disk drive protection, Image stabilization, Sports and health devices applications.

(Fig 3)

Pin Description of accelerometer:-

1. Vcc 5 volt supply should connect at this pin.
2. X-OUT This pin gives an Analog output in x direction
3. Y-OUT This pin give an Analog Output in y direction
4. Z-OUT This pin gives an Analog Output in z direction
5. GND Ground

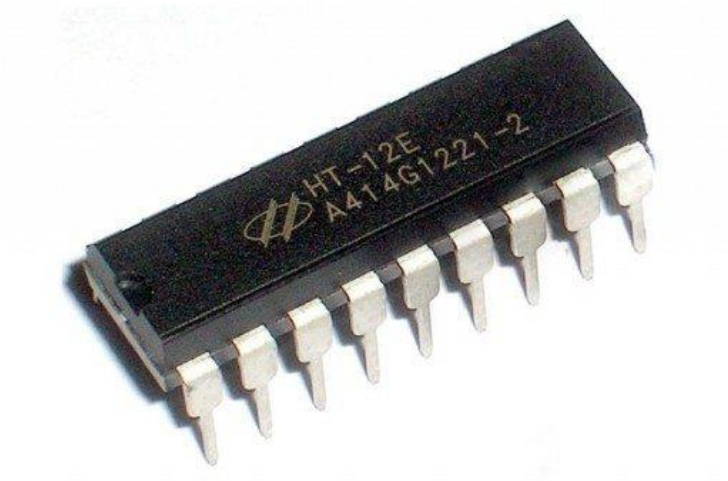
4.3 Comparator: - For the purpose to change the analog voltage into digital we use comparator which compare that analog voltage to a reference voltage and give a particular high or low voltage.

4.4 RF Transmitter Module (TX):- The transmitter module is working on the frequency of 433MHz and is easily available in the market at nominal cost. In the circuit, Vcc pin is connected to the + terminal. The data pin is connected to the HT12E (pin no-1) that is transmitted or we can say that encoded data. The next pin is GND that is connected to the ground terminal[11]. Now the last pin ANT this is connected to a small wire as an antenna.

4.5 RF Receiver Module (RX):- The RF receiver module will receive the data which is transferred by the gesture device. It is also working as similar to the transmitter module- Connect the +Vcc pin to the 5volt terminal. Connect the ground pin to the ground terminal .The data pin is then connected to the HT12D (pin-2) .So that we can get the decoded 4 bit data.

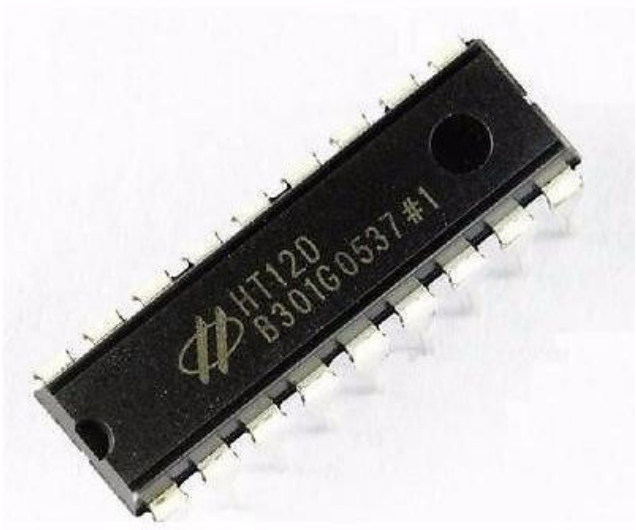
(Fig 4)

4.6 Encoder (HT12E):- HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.



(Fig 5)

4.7 Decoder (HT12D):- We can say that an HT12D converts that serial data into parallel which is received by the RF receiver module. The input data is decoded when there is no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin that is pin no1.

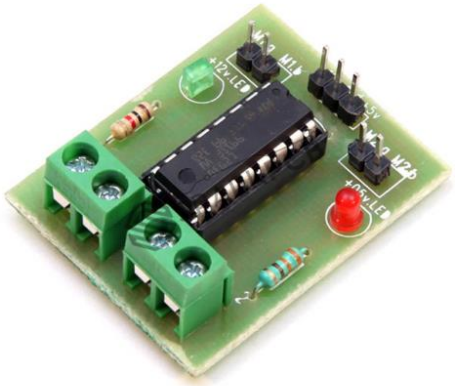


(Fig 6)

4.8 DC Motor: - As the name suggests DC motors takes the direct electric current as source of energy. DC motors are attached to all the wheels of the robot. So whenever the gesture signals reached the DC motor it will formulate the wheel to move forward and backward. The rotation speed is deliberated in terms of Revolution per Minute (RPM). There are 4 wheels used in this robotic body, two wheels on the front side and another two wheels on the back side of the robot.

(Fig 7)

4.9 Motor Driver: - Motor Driver works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to flow in either direction. As voltage need to change its direction for being able to rotate the motor in clockwise or anti-clockwise direction. Therefore H-bridge IC is ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due to its size it is very much used in robotic application for controlling DC motors.



(Fig 8)

4.10 Battery: - A battery is a device consisting of one or more electrochemical cells. A battery is device that directly converts chemical energy to the electrical energy. The purpose of battery is to supply 12 volts to operate DC motors.

4.11 Software program

The software program is written in Arduino programming language. We programmed a fresh ATmega328 microcontroller with the help of Arduino IDE 1.0.5 and an Arduino Uno board.

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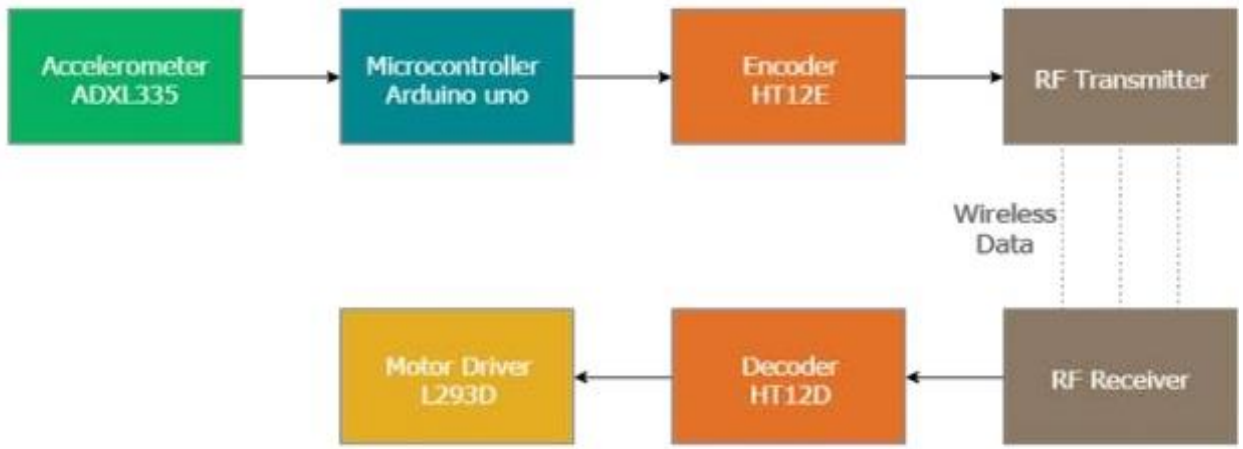
ARCHITECTURE

5.1 BLOCK DIAGRAM



(Fig 9)

If we divide it into 3 parts-
The first part is getting data from the ADXL335 Accelerometer Sensor by the Comparator. The 4 channel comparator will continuously acquires data that are in analog form from the ADXL335 and converts it into digital, and then send a data to HT12E and it sends data to the RF Transmitter.

The second part of the project is the Wireless Communication between the RF Transmitter and RF Receiver. The RF Transmitter, upon receiving data from comparator (through the Encoder IC), transmits it through the RF Communication to the RF Receiver.

Finally, the third part of the project is decoding the Data received by the RF Receiver and then read by using arduino, then sending appropriate signals to the Motor Driver IC, which will activate the Wheel Motors of the Robot.

5.2 Circuit Diagram

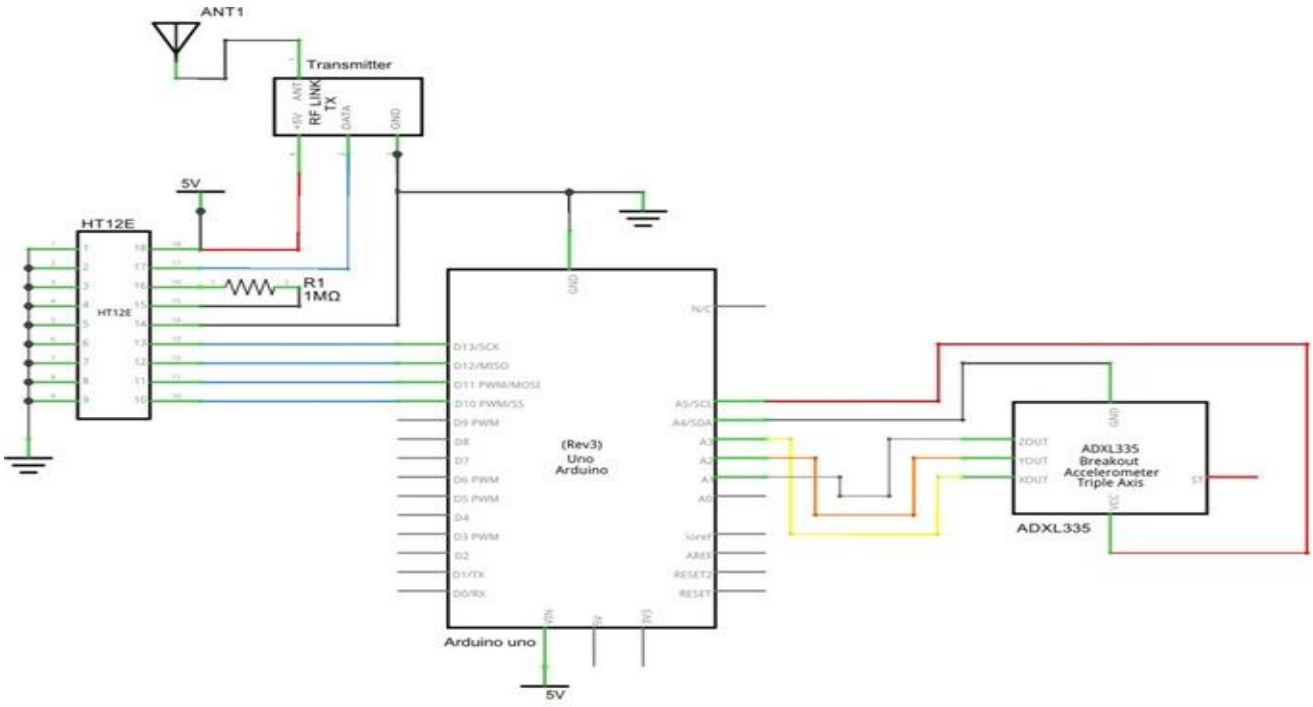


Fig 10- Transmitter Section

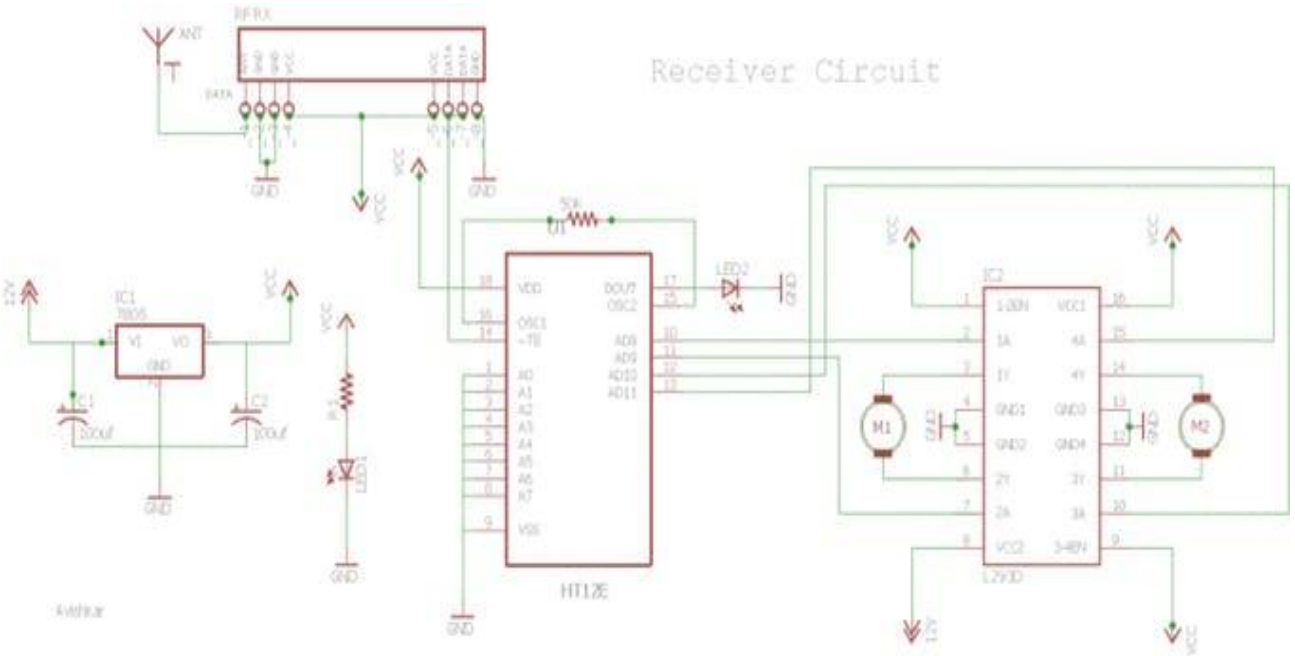


Fig 11-Receiver Section

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WORKING

In this project, a mobile robot that is controlled by the gestures made by the hand is designed. The working of the robot is explained here.

6.1 Transmitter Section

In transmitter part an accelerometer and a RF transmitter unit is used. As we have already discussed that accelerometer gives an analog output so here we need to convert this analog data in to digital. For this purpose we have used 4 channel comparator circuit in place of any ADC. By setting reference voltage we gets a digital signal and then apply this signal to HT12E encoder to encode data or converting it into serial form and then send this data by using RF transmitter into the environment.

6.2 Receiver section

At the receiver end we have used RF receiver to receive data and then applied to HT12D decoder. This decoder IC converts received serial data to parallel and then read by using arduino. According to received data we drive robot by using two DC motor in forward, reverse, left, right and stop direction.

Circuit for this hand gesture controlled robot is quite simple. As shown in above schematic diagrams, a RF pair is used for communication and connected with arduino. Motor driver is connected to arduino to run the robot. Motor driver's input pin 2, 7, 10 and 15 is connected to arduino digital pin number 6, 5, 4 and 3 respectively. Here we have used two DC motors to drive robot in which one motor is connected at output pin of motor driver 3 and 6 and another motor is connected at 11 and 14. A 9 volt Battery is also used to power the motor driver for driving motors .

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CONDITION FOR GESTURE

There are total five conditions for this Gesture controlled Robot which is giving below:

Movement of hand	Input for Arduino from gesture				
Side	**D3**	**D2**	**D1**	**D0**	**Direction**
Stable	0	0	0	0	Stop
Tilt right	0	0	0	1	Turn Right
Tilt left	0	0	1	0	Turn Left
Tilt back	1	0	0	0	Backward
Tilt front	0	1	0	0	Forward

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CONCLUSION

An automated robot has been developed which works according to your hand gesture. The robot moves wirelessly according to palm gesture. The 3- axis accelerometer selected to be the input device of this system captures the human gestures. When compared with the other input devices accelerometer[1] is easier to work and offers the possibility to control a robot by wireless means.

The low price and short set-up time are other advantages of the system but an important limitation to consider is the reliability of the system . Physical hardship to the user is avoided through the use of accelerometer as with the twist of the hand, the user gets the ability and freedom to turn the robot into the desired direction. The RF module is working on the frequency of 433 MHz and has a range of 50-80 meters.

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FUTURE SCOPE

- The on-board batteries occupy a lot of space and are also quite heavy. We can either use some alternate power source for the batteries or replace the current DC Motors with ones which require less power.
- As we are using RF for wireless transmission, the range is quite limited; nearly 50-80m. This problem can be solved by utilizing a GSM module for wireless transmission. The GSM infrastructure is installed almost all over the world. GSM will not only provide wireless connectivity but also quite a large range.
- An on-board camera can be installed for monitoring the robot from faraway places. All we need is a wireless camera which will broadcast and a receiver module which will provide live streaming.

Chapter: 10
REFERENCES

[1] Premangshu Chanda, PallabKanti Mukherjee, SubrataModak, AsokeNath, "Gesture Controlled Robot using Arduino and Android", IJARCSSE, Volume 6, Issue 6, June 2016.

[2] P.V.Patil, M.B.Shete, T.M.Padalkar, "Wireless Hand Gesture Robot using Accelerometer,Volume: 03 Issue: 04 , Apr-2016.

[3] Saurabh A. Khajone, Dr. S. W. Mohod, V.M.Harne "Implementation of a Wireless Gesture Controlled Robotic Arm" in IJIRCCE Vol. 3, Issue 1, January 2015.

Pedro Neto, J. Norberto Pires, member IEEE, and A. Paulo Moreira, Member,IEEE Accelerometer-Based Control of an Industrial Robotic Arm 18th IEEE International Symposium on Robot and Human Interactive Communication Toyama, Japan, Sept. 27-Oct. 2, 2009,page No.1191-1197.

[4][http://www.engineersgarage.com/contribution/accelero meter-based-hand-gesture-controlled-robot] Accessed 3 November, 2013.

[5]Jochen Triesch and Christoph Von Der Malsburg "Robotic Gesture Recognition (1997)"URL Available [http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1. 1.37.5427] Accessed 15 October 2013.

[6] [http://www.robotplatform.com/howto/L293/motor_drive r_1.html] Accessed 5 November, 2013.

[7] [http://en.wikipedia.org/wiki/Gesture_interface] Accessed 5 November, 2013.

[8] [http://www.wisegeek.com/what-is-a-gear-motor.htm] Accessed 6 November, 2013.

[9] [http://www.scribd.com/doc/98400320/InTech-RealTime-Robotic-Hand-Control-Using-Hand-Gestures] Accessed 6 November, 2013.

[10] [http://en.wikipedia.org/wiki/DC_motor] Accessed 8 November, 2013.

[11] [http://electronics.stackexchange.com/questions/18447/w hat-is-back-emf-counter-electromotive-force] Accessed 8 November, 2013.

[12] [http://en.wikipedia.org/wiki/Robots] Accessed 9 November, 2013