Modeling and Designing of Gesture Control Robot

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Abstract-*This paper presents a model for gesture controlled user interface (GCUI), and identifies trends in technology, application and usability. It is an integrated approach is real time detections, gesture based data which control vehicle movement and manipulation on gesture of the user using hand movements. A three-axis accelerometer is adaption. As the person moves their hand, the accelerometer also moves accordingly. The gesture is capture by accelerometer and processed by gesture. Today human machine interactions, is moving away from mouse and pen and is becoming pervasive and much mouse compatible with the physical world. With each passing day, the gap between machines and human is being reduced with the introduction of new technology is easy the standard of living. Its having future scope of advanced robotic arms that are designed like the human hand itself can easily controlled using hand gesture only. It also having proposed utility in field of construction, medical science, hazardous waste disposal etc.*

Keywords-Accelerometer,AT89C51 microcontroller, Receiver & Transmitter module, motor driver.

I. INTRODUCTION

In the existing system, human hand movements are sensed by the robot through sensors and it follow the same. As the person moves their hand, the accelerometer also moves accordingly sensor displaces and this sensor senses the parameter according to the position of hand. In this system, a gesture driven robotic vehicle is developed, in which the vehicle movements and manipulations i.e., handling and control is depends on the gesture of the user. In this system, gesture is captured by accelerometer and it is processed by software namely, microcontroller software and the parameters are sent to microcontroller and encoder circuit, it is further transmitted (transmitter section) by RF433 MHZ transmitter. In the receiver section, the RF 433 MHZ receiver holds down the received parameters and process with microcontroller and gives those parameters to the robotic vehicle so that it acts accordingly to the gesture. By this system, it is possible to achieve processing of long distance. This system is knowingly developed to apply in medical field for nursing assistance to physicians and in surgeries. An Accelerometer is a kind of sensor which gives an analog data while moving in X, Y,Z direction or maybe X,Y direction only depends on the type of the sensor. In accelerometer, there is some arrow showing if we tilt these sensors in that direction then the data at that corresponding pin will change in the analog form. 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 high or low voltage as shown in figure 1.

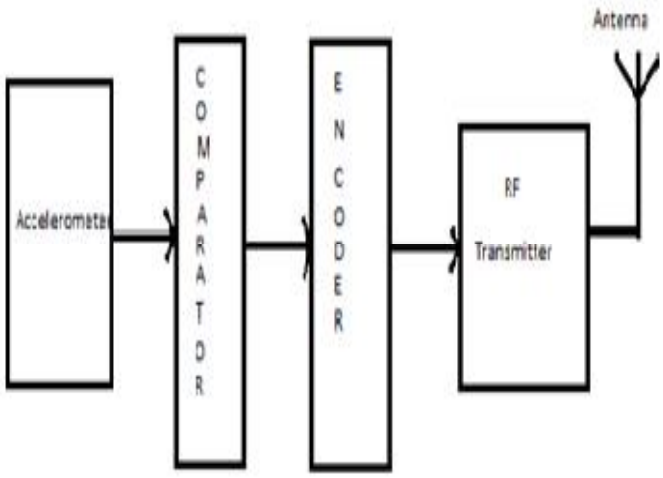

Figure 1:Block diagram of transmitter module [2]

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. Now the last pin ANT this is connected to a small wire as an antenna. RF Receiver Module (RX):The RF receiver module will receive the data which is transferred by the gesture device. It is also working as likethe 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. 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 indicated by a high signal at VT pin that is pin no1.Microcontroller:AT89C51 is microcontroller used in an integrated circuit with a processor and other support devices like program memory, data memory, I/O port, serial communication interface etc. integrated together. Transmitters

are usually subject to Regulatory Requirements which dictate the maximum allowable Transmitter power output, Harmonics, and band edge requirements as shown in figure 2.

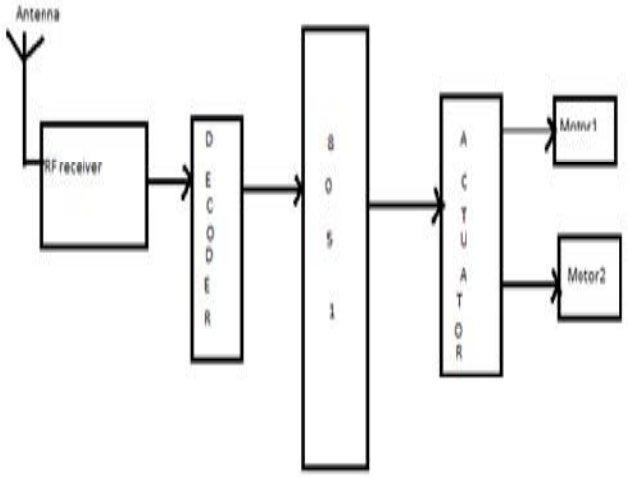

Figure 2: Block diagram of receiver module [2]

II. LITERATURE REVIEW

The emergence of service robots in early 90's (Helpmate Robots and Robot-Caddy) followed by the development of natural language interface through keyboard has been given by Torrance in 1994[1]. Speech recognition evolved as an upgradation of the past work to communicate with machines but it lacked the standardization of commands due to varying languages, pitch and accent of different users. Hence, researchers [1-2] proposed vision-based interface that included gesture recognition through camera to provide geometrical information to the robots. They develop mobile robot systems that were instructed through arm positions but those robot systems couldn't recognize gestures defined through specific temporal patterns. Other limitation faced by the cameras was the poor illuminations at night and in foggy weather [3-4]. Motion technology facilitates humans to interact with machines naturally without any interventions caused by the drawbacks of mechanical devices. Using the concept of gesture recognition, it is possible to move a robot accordingly [5]. Gyroscope and Accelerometers are the main technologies used for human machine interaction that offer very reasonable motion sensitivity, hence, are used in large array of different applications [6]. A lot of work has been done on motion technology using accelerometers [7]. In 2008, Chinese traffic police system used two 3-axis accelerometers fixed on the back of their arms that were synchronized with traffic lights. However, data could only be extracted while the arms would be steady [3]. In 2010, Sauvik Das et al have used an accelerometer as a potential spying device to show locations and activities of user without one's knowledge [9]. One of the limitations was that inbuilt accelerometer smart phone would have to be in the same place as was in the training mode to make accurate predictions [7]. In late 90's the smart phones started gaining popularity. The usage of mechanical accelerometer was cumbersome as it possessed the complexity of connections and portability was a major challenge. With the emergence of smart phone, the technology became lucid as it was equipped with several accessories in concise form [8]. In 2010, Smart phones were used to control Universal Robot Control System by the students of Kyung pook National University, Korea, to design a real-time robot control system in ubiquitous environment. However, gestures involved were complex and an extra robot control manager unit was required [9].

III. METHODOLOGY

Methodology for hand motion recognition - The handheld controller is a 3D rigid body that can be rotated about the three orthogonal axes. Yaw, pitch and roll are referred to as rotation. These rotation takes place as Z-axisis called yaw, the next rotation X-axis is called pitch and last rotation about the Y-axis is called roll. Any orientation can be achieved by the composing those three-elemental rotation. In our work, all the planned hand motions for robot control are simple gestures, each of which contains only one of the three elemental rotations. Gestures composed of more than one elemental rotation are too complicated for such kind of application. Methodology for communication signal-Transmitter Module: An RF transmitter module is a small PCB i.e., printed circuit board sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which is transmitted. RF transmitters are usually subject to regulatory requirements which dictate the maximum allowable transmitter power output, harmonics and band edge requirement. Receiver modules - An RF Receiver module RF433-RX is 433 MHz radio receiver receives the modulated RF signal, and then it demodulates. There are two types of RF receiver module. Super-regenerative modules are usually of low cost and low power designs using a series of amplifiers use to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies in a fair amount with temperature and power supply voltage. Super heterodyne receivers having a performance advantage over super-regenerative; they offer increased an accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in turn leads to a comparatively more expensive product. Radio receiver which receives the transmitted coded from the remote place these codes are converted to digital format and output is available to the pin no 2 of the ic2 master microcontroller; this is the pin of

inbuilt art of the microcontroller. We Based on the input codes master will give command to slave microcontroller and robot will behave as follows.

- Moves in forward direction
- Moves in reverse direction
- Speed controls in both the direction
- It can even turn left or right while moving forward or in reverse direction
- In case of bump, moves reverse turn left or right and wail for the next instruction
- On the spot left or right turn to pass through the narrow space
- We have also added head light, back light and turning lights to leave a right.

Methodology for Motion Control - L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers as they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In 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. 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. This project controls a remote robot through RF. The ordinary 433 MHz RF modules are used in this project. AT89C51 microcontroller is used in this project. This robot can perform their operations without direct human guidance. They are used basically for industrial applications and can be made laser guided. Navigation is achieved by one of the several means, including following a path defined by buried inductive wires, surface mounted magnetic or optical strips; or alternatively by the way of laser guidance. This is an improved version of my previous robot which we designed years ago. Intelligent spy robot project has been designed for the spying purpose .it is radio controlled and can be operated at a radial distance of 100m radius. Most probably our army youth need to venture into the enemy area just to track their activities which is often a very risky job and may cost precious life. Such dangerous job could be done using small spy robot all the developed and advance nations are in the process of making it, a robot that can fight against enemy. Our robot us just a step towards similar activity.

IV. WORKING

This robot is radio operated which is, self-powered, and has all the controls like a normal car. A laser gun has been installed on it so that it can fire on enemy remotely whenever required; this is not possible until a wireless camera is installed. Wireless camera will send real time video and audio signals which could be seen on a remote monitor and action can be taken accordingly. Being in size small of it, will not be tracked by enemy on his radar. Robot silently enter into enemy canopy or tent and send us all the information through its' tiny camera eyes. It can also be used for suicide attack, if required. Heart of our robot is microcontroller 8051 family, we are using at89C51 in two microcontrollers where first microcontroller which acts as master controller, decodes all the commands received from the transmitter and give commands to slave microcontroller. Slave microcontroller is responsible for executing all the commands received from the master and generating pulse width modulation pulses for the speed control driver circuit which drives 4 nos. of motors. Two no bumper switches are added bmp 1 and bmp2 so that in case of accident our battery dose not drains out. Both the motors will stop instantly and after few second robots will move in opposite direction take turn to left or right direction and stops and stop as shown in figure 3& 4.Program Explanation - In program first, we have defined output pins for motors. And then in setup we have given the directions to pin. After this we read input by using 'if statement' and perform relative operation. There are total five conditions for this Gesture controlled Robot which are giving below Table 1:

Table 1:Conditions for the gesture Controlled robot

Movement of hand	**Input for Arduino from gesture**				**Direction**
Side	**D3**	**D2**	**D1**	**D0**	
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

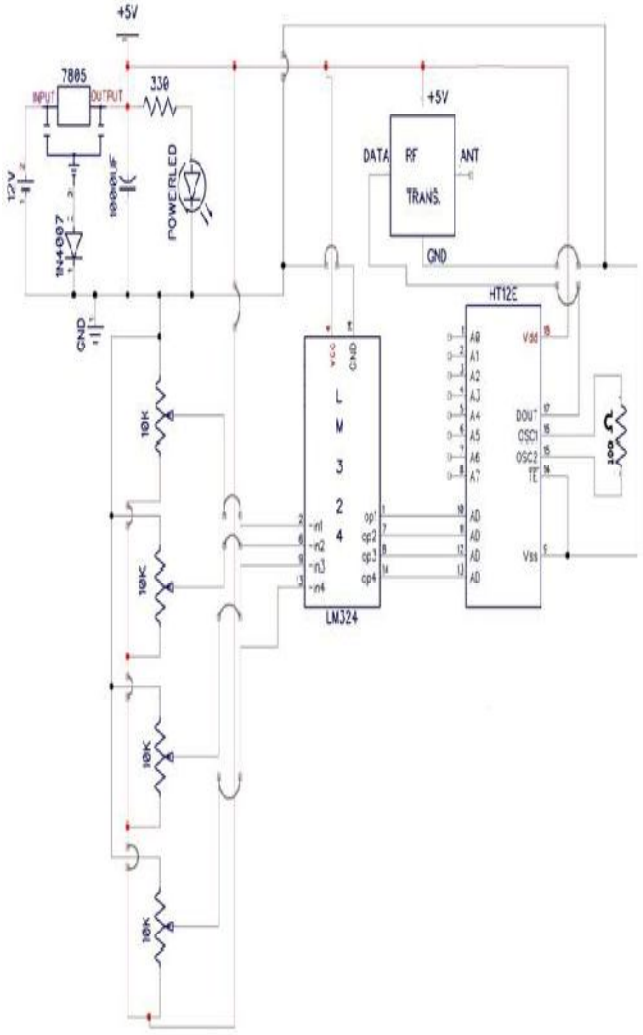

Figure 3: Transmitter circuit for the system [2]

IV. CIRCUIT ELEMENT

Axis accelerometer: MMA7361L is a three axis Low-G accelerometer with user selectable having 1.5g or ±6g acceleration range. Board has all the necessary components required for the accelerometer. As board comes with on board 3.3V Low Drop voltage regulator. Accelerometer module can be powered from 2.2Vto 6V. MMA7361L accelerometer has self-test, 0g-Detectwhich detects linear freefall, user selectable g range of 1.5gand 6g and sleep mode to reduce power consumption. Possible applications of this board include Robotics, Tilt and Motion Sensing, Freefall Detection, Image Stabilization, Navigation and Dead Reckoning, Tilt Compensation in inertial sensors, 3D-Gaming. transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps-10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitted.

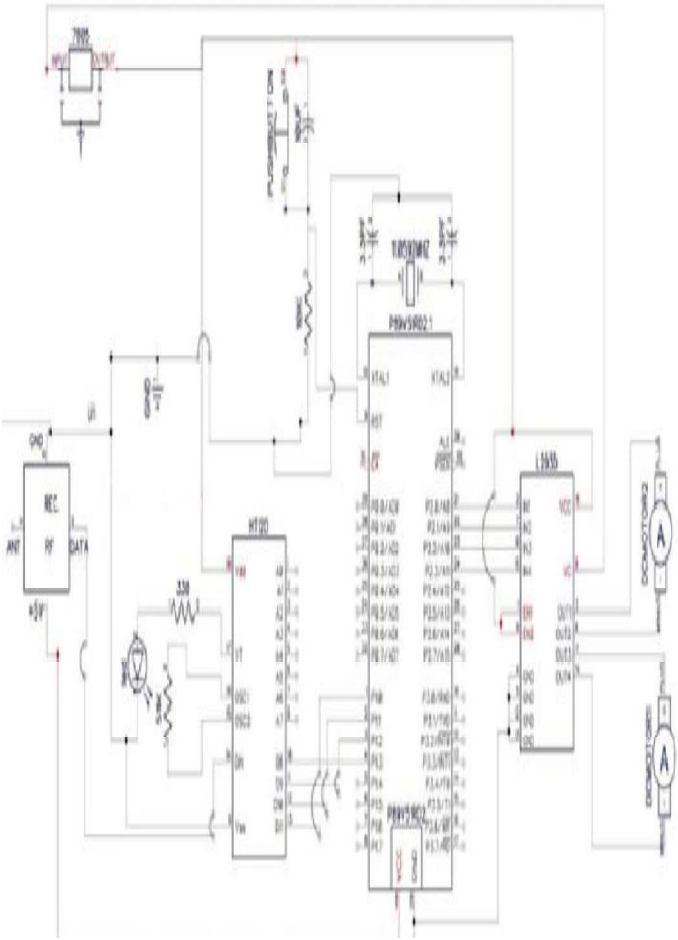

Figure 4: Receiver circuit for the system [2]

A. Progamming Code:

```
#define FD 16
#define BD 17
#define LD 18
#define RD 19

#define m11 3
#define m12 4
#define m21 5
#define m22 6

void forward()
{
  digitalWrite(m11, HIGH);
  digitalWrite(m12, LOW);
  digitalWrite(m21, HIGH);
  digitalWrite(m22, LOW);
}
void backward()
{
  digitalWrite(m11, LOW);
  digitalWrite(m12, HIGH);
  digitalWrite(m21, LOW);
```

```
                digitalWrite(m22,                HIGH);
}
void                                              left()
{
                digitalWrite(m11,                HIGH);
                digitalWrite(m12,                 LOW);
                digitalWrite(m21,                 LOW);
                digitalWrite(m22,                 LOW);
}
void                                             right()
{
                digitalWrite(m11,                 LOW);
                digitalWrite(m12,                 LOW);
                digitalWrite(m21,                HIGH);
                digitalWrite(m22,                 LOW);
}
void                                              Stop()
{
                digitalWrite(m11,                 LOW);
                digitalWrite(m12,                 LOW);
                digitalWrite(m21,                 LOW);
                digitalWrite(m22,                 LOW);
}
void                                             setup()
{
                  pinMode(FD,                   INPUT);
                 pinMode(BD,                    INPUT);
                 pinMode(LD,                    INPUT);
 pinMode(RD, INPUT);
               pinMode(m11,                    OUTPUT);
               pinMode(m12,                    OUTPUT);
               pinMode(m21,                    OUTPUT);
               pinMode(m22,                    OUTPUT);
}
void                                              loop()
{
              int                 temp1=digitalRead(FD);
              int                 temp2=digitalRead(BD);
              int                 temp3=digitalRead(LD);
              int                 temp4=digitalRead(RD);

   if(temp1==1 && temp2==0 && temp3==0 &&
temp4==0)
 backward();
  else if(temp1==0 && temp2==1 && temp3==0 &&
temp4==0)
 forward();
  else if(temp1==0 && temp2==0 && temp3==1 &&
temp4==0)
 left();
  else if(temp1==0 && temp2==0 && temp3==0 &&
temp4==1)
 right();
                                                  else
 Stop();
}
```

V. RESULT

Transmission through RF (Radio frequency) is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line of sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (TX/RX) pair operates at a frequency of 433MHz an RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps-10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitted.

VI. CONCLUSION

Enormous amount of work has been done on wireless gesture controlling of robots. In this paper, various methodologies have been analyzed and reviewed with their merits and demerits under various operational and functional strategies. Thus, it can be concluded that features like user friendly interface, light weight and portability of android OS based smart phone has overtaken the sophistication of technologies like programmable glove, static cameras etc., making them obsolete. Although recent researches in this field have made wireless gesture controlling a ubiquitous phenomenon, it needs to acquire more focus in relevant areas of applications like home appliances, wheelchairs, artificial nurses, table top screens etc. in a collaborative manner.

FUTURE SCOPE

In the receiver section, a wireless camera is placed to monitor the performance of robot arm along with patient side (Robot arm side) 5 vital parameters (ECG, Respiration rate,

Pulse rate, Temperature, Heart beat) of patient is monitored. This is a preventive measure for any imbalance in victim's metabolism (temperature, pressure, heart rate), ALARM in transmitter's section (physician side) will be ringing, which in turn brings into notice of physician that patient is in some critical situation, so that the physician immediately going to stops the action of robotic arm and he will inform the nearby doctors to take care of patient. This robotic arm developed is to reduce man power in medical field, take care of patient in absence of specialist/surgeon and to impart the robotic in medical areas.

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