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HAND GESTURE CONTROLLED ROBOT USING ACCELEROMETER AND ANDROID APPLICATION

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ABATRACT

Today human-machine interaction is moving away from keypad and is becoming pervasive and much more compatible with the physical world. Gestures have played a vital role in diminishing this problem. The main purpose of using gestures is that it provides a more natural way of controlling and provides a rich and intuitive form of interaction with the robotic system. There are some systems that have been developed in the same field using various techniques. This paper deals with design and implementation of an accelerometer based hand gesture controlled robot controlled wirelessly using a small low cost, 3-axis accelerometer and an android application. A novel algorithm for gesture identification has been developed to replace the approach of conventional controlling mechanism of robots via buttons etc, by an innovative hand gesture based controlling. Using a microcontroller system the program has been written & executed.

KEYWORDS: Accelerometer, Gesture, Microcontroller, Robotics.

I. 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.[2] 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.

II. LITERATURE SURVEY

Using Remote controller for controlling the 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. 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.

III. HARDWARE REQUIREMTNS

a. Accelerometer Sensor

The ADXL335 is a small, thin, low power 3-axis accelerometer which measures acceleration with a minimum fullscale 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.

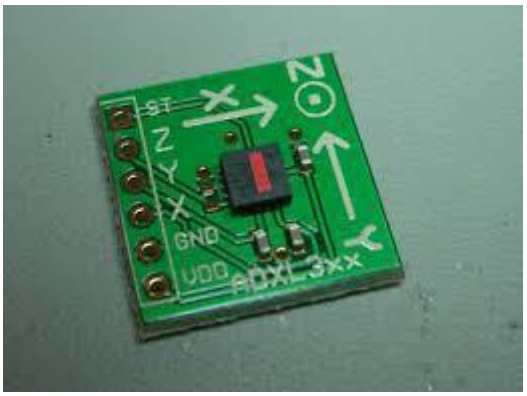

Fig.1: Accelerometer

As shown in Fig.1, there are three axes that can be measured by accelerometer and labelled 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.

b. RF Module

RF stands for Radio Frequency. This module consists of further two parts: Transmitter (Tx) and Receiver (Rx). It is a small electronic device used to transmit and receive signal between two devices. It is available in different operating frequencies with different operating range. An Encoder Circuit & a Decoder Circuit is used along with the Transmitter & Receiver respectively in order to transmit & receive the message/signal. As shown in Fig.3 below, the RF Module operates at the frequency of 315MHz with an operating range of 400-500 meters.

RF transmission is better than IR because signals through RF can travel through larger distances while IR mostly operates in line-of-sight mode and also RF signals can travel even when there is an obstruction between transmitter & receiver. Moreover, RF transmission is more strong and reliable than IR transmission.

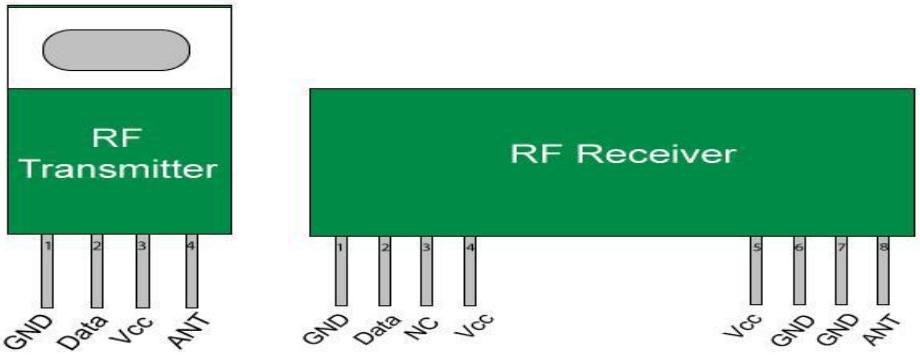

Fig.2: RF Module

c. Microcontroller

ATmega16 microcontroller is used as the hardware platform. It is the controlling unit, to which all other components (Accelerometers, Motors, RF modules etc.) are interfaced. It is a low voltage, high performance CMOS 16-bit Microcomputer with 2K bytes of Flash Programmable & Erasable Read-Only Memory. It is an 8-bit high performance microcontroller of AVR family with low power consumption and is based on enhanced RISC) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. It can work on a maximum frequency of 16MHz. It has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. It is a 40 pin microcontroller and have 32 I/O (input/output) lines. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

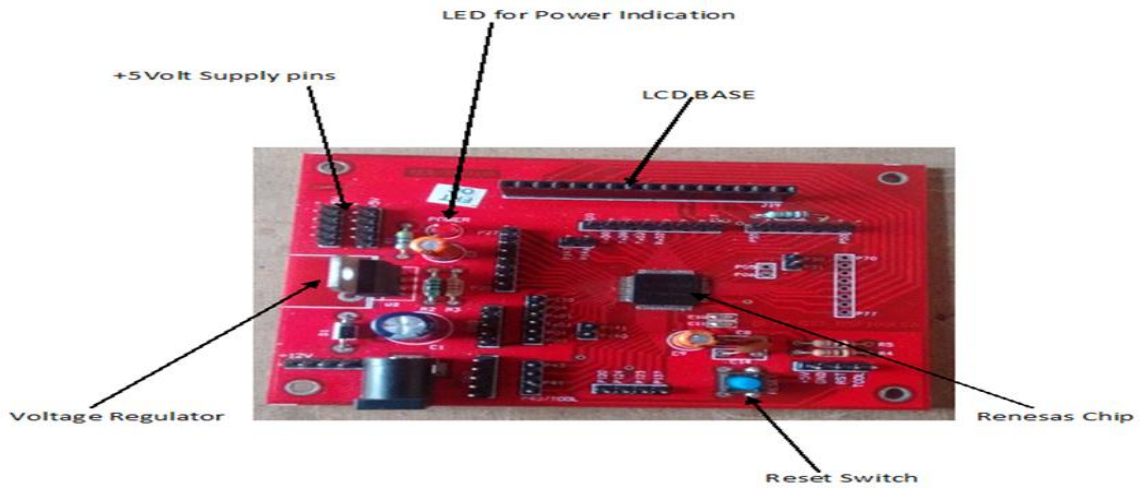

Fig.3: Renesas Microcontroller

d. Motor Driver

The primary need is to supply current to the motors as it cannot be done through the microprocessors. The L293D is a 16-pin IC dedicated to controlling of motor. It consists of two H-bridge which is a simplest circuit for controlling low Current rated motor. H-bridge has four switches rotating motor in clockwise or anti-clockwise direction.

IV. SOFTWARE REQUIREMENT

e. Cubesuit

The Renesas Electronics "CubeSuite+" integrated development environment. Use the Pin configuration function to create device top views and pin lists by selecting multi-purpose pins and used/unused pins.Using the code generating function, a program for implementing peripheral functions built in the microcontroller can be automatically generated just by selecting the items or entering numerical values even when you don't know the name of register or method of configuration. You can customize the screen as you like using such features as "docking", "floating" or "automatic hiding" to manipulate various panels of CubeSuite+ at will. CubeSuite+ now provides a function to save the development environment in addition to the conventional function to save the project environment. All of these features help you develop a microcontroller system more smoothly.

f. Renesas Flash Programmer

Renesas Flash Programmer(known hereafter as RFP) is software that erases, writes,and verifies programes on target system or program adapter on which a Renesas Electronics single chip microcontroller with on-chip flash memory is mounted by using an E1 emulator(E1), E20 emulator(E20), or the on-chip debug emulator with programming function, QB-MINI2(known hereafter as MINICUBE2), or a serial interface. It provides usability and functionality optimized specifically for flash programming.

Features:

- Graphical User Interface(GUI) optimized for flash programming
- Ability to save programming setting in workspace files
- Support for two types of programming windows(basic mode and full mode)
- Scripting support

V. BLOCK DIAGRAM

Control Section

As shown in Fig.4, the analog data at the corresponding axis from the accelerometer is applied as an input to the microcontroller where it is processed resulting in an 8-bit data.

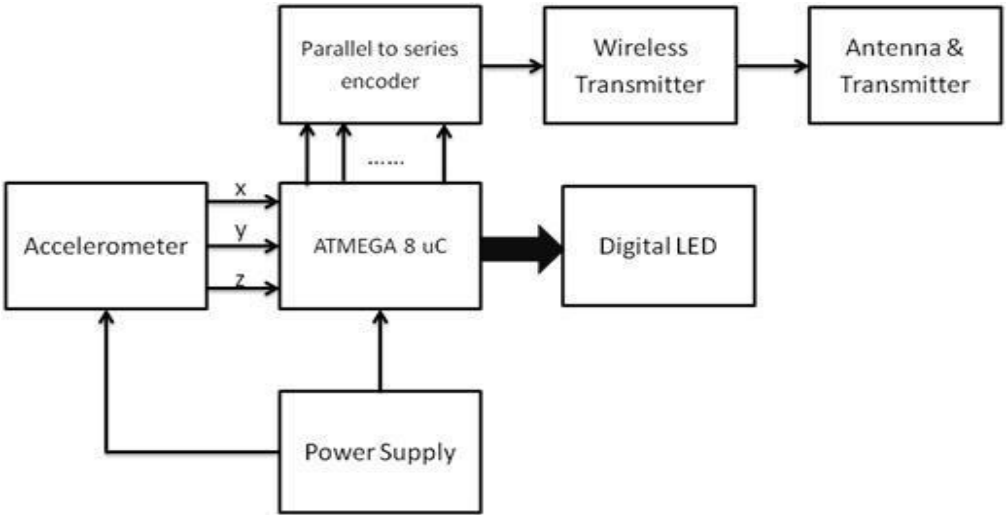

Fig.4: Block Diagram of Control Section.

This data is then encoded into 4-bit data and then transmitted through RF module via an antenna. The accelerometer and microcontroller are controlled through a power supply. A digital LED is connected to one pin of microcontroller to indicate the presence of data at the corresponding pin.

Robot Section

As shown in Fig.5, the received data from antenna is decoded and processed through microcontroller. This processed data operates the motor driver IC to rotate the motor in desired direction.

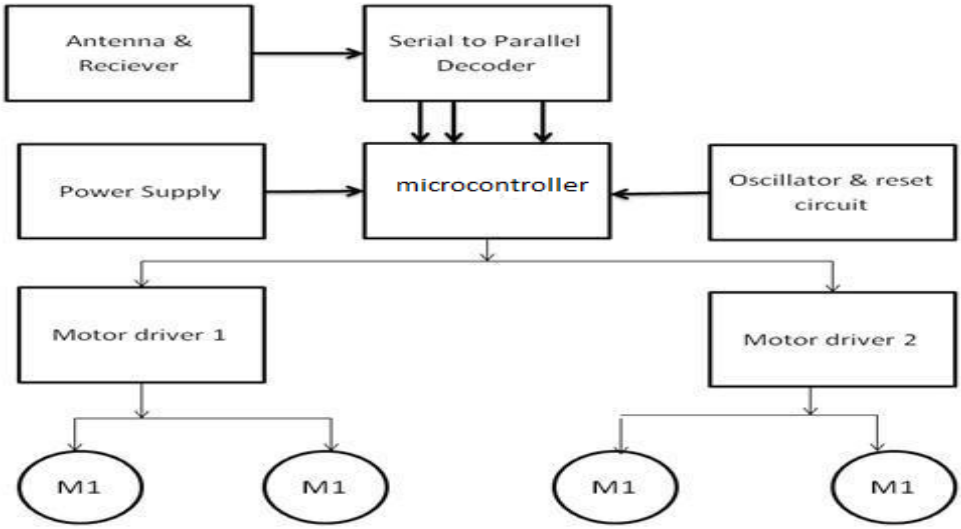

Fig.5: Block diagram of Robot Section

The motor rotates in clockwise or anti-clockwise direction depending on the terminals of motor connected to motor driver IC.

VI. CONCLUSION

Hand Gesture Control becomes an example of companionship between man and machine in the race of man vs. Machine further enhancing the technology to the next level from Speech recognitions and wired connections to wireless hand gesture control technology. There is a rapid growth on application development considering gesture recognition system. So in this paper, we propose a model of a robot based on "Human Gesture Recognition" utilizing hand gestures to communicate with the robot. 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 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.[6] 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.

VII. FUTURE WORK

Future work will build upon the improvement of the correctly recognized the gestures. One approach might be the implementation of a gyroscope into the system, in order to separate the acceleration due to gravity from the inertial acceleration and second approach can be that we can install a GPS in the system to track the position of robot. The use of more accelerometers attached to the arms is another possibility.

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