Proposed Technique of Hand Gesture Recognition for Operational Behavior of the Robot

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Abstract – *The Hand gesture recognition is a simpler and more natural way of human computer interaction. The goal of this paper is to detect the continuous gestures and use them to convey information for the robot movement control. So the hand gesture recognition requires fast and extremely robust.*

Navigating and controlling a robot in an indoor and outdoor environment by using the range of body-worn sensor is becoming an increasingly interesting research area in the robotic community. In such a scenario, hand gesture offers some unique capabilities for human-robot interaction inherent to nonverbal communication. Therefore in this paper, we propose an effective inertial – sensor-based system, worn by the user, along with the Arduino microprocessor and wireless module for communication with robot at some specific distance.

Key Words: Human-Robot interaction, Arduino, Accelerometer, Sensors, Hand Gestures

1. INTRODUCTION

A robot is usually an electro-mechanical machine that can perform tasks automatically. Some robots require some degree of guidance, which maybe done using remote controlled or with a computer interface. The robot can be autonomous, semi- autonomous or remotely controlled. The robots have evolved so much and are capable of performing multiple tasks with quiet ease. The robots are basically used for reducing human efforts. 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. Gesture recognition technologies are much younger in the world of today. At this time there is much active research in the field and little in the way of publicly available implementations. Several approaches have been developed for sensing gestures and

controlling the robots. Glove based technique is a well known means of recognizing the hand gestures. It utilizes a sensor attached to a glove that directly measures the hands movement. Earlier the robots were basically controlled using IR sensor, RF technology, DTMF technology and Bluetooth modules. So a new concept is introduced to control the machine with the movement of hand which will simultaneously control the movement of robot. Gesture controlled robot is basically a robot which can be controlled by simple gestures. The user just needs to wear a gesture device which includes a sensor. The sensor will record the movement of hand in the specific direction which will result in the movement of the robot in the respective direction. The robot and the gesture device are connected wirelessly using a RF module.

The wireless communication enables the user to interact with the robot in the more friendly way. 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. A Gesture controlled robot is a kind of robot which can be controlled by hand gestures and not the old fashioned technology of using buttons. User just needs to wear a small transmitting device on his hand which includes a sensor which is an accelerometer in our case. Movement of the hand in the specific direction will transmit a command to the robot which will then move in a specific direction. The accelerometer and an encoder IC which is used to encode the 4-bit data and then it will be transmitted by an RF transmitter module. At the receiving end an RF receiver module will receive the encoded data and decode it by the decoder IC. This data is then processed by a Arduino and passed onto a motor driver to rotate the motors in a special configuration to make the robot move in the same direction as that of the hand.

1.1 Arduino

Arduino refers to an open source electronics platform or board and the software used to program it. Arduino is designed to make electronics more accessible to artists, designer, hobbyists and anyone interested in creating interactive objects or environment. An Arduino board can be purchased preassembled or, because the hardware design is open source, built by hand.

Open source Arduino is open source and commercial, we are allowed if you make clone, it's not biggest issue. Its open

source hardware so company or school can use it without per set licensing. There's no risk that it will be discontinued & software goes on forever. Arduino connected to all kind of light, motor, sensor, and other devices and is easy to learn programming language.

1.2 Objective

Our objective in the proposed system is to that the developed system will simple as well as cheap. So that it would be mass produced and can be used for number of purposes. We want to provide a hands free access to people and try to reduce the human efforts in controlling robots using remotes and providing a better and maximum efficiency at the output.

2. Literature Survey

The robots play an important role in automation, medical and manufacturing industries. The robots are the advanced and a faster way to increase the productions. The robots work with a better accuracy and efficiently then the manpower. We have seen robots been controlled by DTMF technology. Robots are also controlled using RF technology, IR technology and Bluetooth module. But with the advancements in technology the remotes, Bluetooth and IR became old and were replaced by hands free gesture controlled methods to move the robot. The DTMF, IR technology were tedious to handle and would confuse the user. The DTMF technology also had the problems of signals as the audio jack signal would be loose then the robot movement would stop. In the earlier days, the wired technology was available to control the devices and various movements of the robot. The wired technology was later replaced by wireless communication for easier and quick access. The wireless includes the Radio Frequency, Bluetooth modules, and the new addition of accelerometer sensor. The accelerometer sensor is the key to control the robot using hand gestures. The paper focuses on the development of the robotic Arm by using Flex Sensor, ZigBee and 3 Servo motor connected to the Arduino Uno which is controlled by processing software and a computer mouse.

These robotic Arm are cheap and easily available which makes it free from unnecessary wire connection, reducing its complexity. But still there is a requirement of adding new ideas and functionality. The central goal is to implement a system through which the user can give commands to wireless Robot using gesture. Here, the user control or navigate the robot by using gesture of palm. The command signals are generated from this gesture using image processing and signals are passed to the robot to navigate it in the specified direction. The paper explain about the implementation and design of gesture controlled robot by using Flex Sensor, Ultra sonic Sensor, Electronic compass and accelerometer connected to Atmega16 Microcontroller. The research describes the Robot, which is controlled by a hand Glove Wirelessly via Bluetooth. The Robot is developed by using the input section consisting of sensor, LCD, Display

and a Bluetooth Device and the output section which is consisting of NXT Microcontroller, Motor and Camera. The programming is developed in MATLAB.

3. Proposed System

The system will be divided into two sections one will be transmitter section and other will be receiver section. The transmitter section will consists of one Arduino Uno, one 3-axis accelerometer and one RF transmitter module. The receiver section consists of one RF receiver module, one motor driver IC, two PMDC motor, two wheels. Here we will require two separate 5 volt power supply which will be applied to both the sections. Finally, the Arduino Uno will reads the analog output values i.e., x-axis and y-axis values from the 3 axis accelerometer and convert the analog value to respective digital value. The digital values will be processed by the Arduino Uno and will be sent to the RF transmitter which is received by the Receiver and will be processed at the receiver end which drives the motor to a particular direction. The robot moves forward, backward, right and left when there is tilt in the palm of user in forward, backward, right and left respectively directions. A gesture controlled robot can be controlled by using hand in place of any other method like buttons or joystick. Here one only needs to move hand to control the robot. A transmitting device is used in your hand which contains RF Transmitter and accelerometer. This will transmit command to robot so that it can do the required task like moving forward, reverse, turning left, turning right and stop. All these tasks will be performed by using hand gesture. Here the most important component is accelerometer.
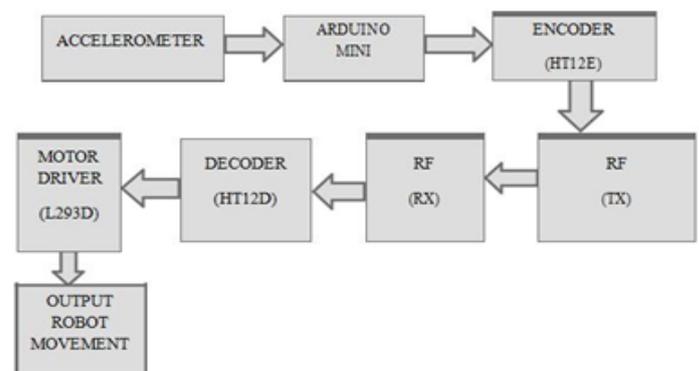
System Block Diagram

Accelerometer is a 3 axis acceleration measurement device with +-3g range. This device is made by using poly silicon surface sensor and signal conditioning circuit to measure acceleration. The output of this device is Analog in nature and proportional to the acceleration. This device measures the static acceleration of gravity when we tilt it. And gives an result in form of motion or vibration. 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 will use four channel comparator circuits in

place of any ADC. By setting reference voltage we will get 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. 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 it will be read by using Arduino. According to received data we will drive robot by using two DC motor in forward, reverse, left, right and stop direction. Gesture controlled robot will move according to hand movements as we place transmitter in our hand. When we tilt hand in front side, robot will start to move forward and continues moving forward until next command is given. When we tilt hand in backward side, robot will change its state and start moving in backwards direction until other command is given. When we tilt it in left side robot will get turn left till next command, when we tilt hand in right side robot will turn to right and to stop the robot we keep hand in stable conditions.

4. Applications

a. Wheelchair control: The wheelchair can be controlled using the hand gesture. The handicapped it will be easy to control the wheelchair using the hand gestures rather than remotes.

b. Surveillance purpose: By attaching a camera this robot can be used for surveillance purpose in the various places.

c. Opening and closing of door: The same hand gesture controlled technology can be used for the opening the closing of the doors in the malls and other places.

d. Trolley and lift control in industries: In the industries it can be used for transfer of materials and goods on the shop floor by controlling the trolleys using the hand gesture.

5. Conclusion

The aim of our proposed system is to construct a accelerometer based Hand Gesture Controlled Robot. As its name implies it will be an efficient circuit (robot), which can be moved in any direction by making simple gestures and the system's sensitivity to gestures can be easily adjusted a per our liking. After studied on this system we can conclude when user movements his hand in Left, Right , Down , Up then accelerometer will detect variations and send that particular signal to the Arduino board and that signal that will sent to the receiver part of the system then on the basis of transmitted signal robot will move. Hence, the hand gesture robot using Arduino will prove to work satisfactorily by using the motion sensor i.e. the accelerometer (ADXL335).

The RF module will test by connecting the receiver to the motor driver. If the robot will move successfully after interfacing the ADXL335. That means the gestures of the hand will control the robot movement. This system will not only provide convenience to the common man in handling tings more swiftly but also will be a boom for the physically handicapped and disabled. Finally, we conclude that Accelerometer Based Gesture Controlled Robot will be very cheap and simple with wide applications as mentioned before.

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