Hand Gesture Controlled Robot

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Abstract — The work consists of the working model of hand Gesture controlled robot. A robot is the approach which deals with construction, design and operation. This procedure acts as a medium between the human and the robot through physical change such as tilting of the hand. This approach is related to robot and their design, manufacture, flexibility, redundancy, fault tolerance and some other researchers are on completely automating a manufacturing process or a task, by providing sensor based to the robot arm. As the whole world is now moving on to make the repeated tasks that were made by humans for all these years through robots. To save human efforts the automation is playing an important role in the system. This approach is used for regular and frequently carried work. This device can be very useful for surveillance, military operations and industrial grade robotic arms physically challenged people. The way a hand gesture-controlled robot works is with the help of a sensor module called as accelerometer, which detects the motion made by the user hand and act accordingly. The design and implementation of a gesture-controlled robot using MPU6050 sensor is proposed. The controller is made to imitate the human hand movements using a hand glove which is attached to the accelerometer that is mounted on it.
Keywords — Hand gesture, Transmitter, Receiver, Motor Driver, Microcontroller**.**

I. INTRODUCTION

In the physical world, [1] we humans interact by the means of five basic senses. However, gestures are a vital means of communication in the physical world from earlier period, even before the invention of any language. In this era of digital technology taking control of each complex tasks, interactions with machines have become more vital than ever. The rising trend currently in the field of science is artificial intelligence. [2] Lately a number of wireless robots are being developed and put to varied applications and uses. In order to reinforce the contribution of robot in our daily lives we need to find an efficient approach of communication with robots. There are many various types of robots available, each created for different tasks and behaviors, and works on completely different platforms. Robots may be built for recreation, knowledge, competitions, domestic help, industrial uses, surveillance etc. Each of these robots may be classified as autonomous, controlled or semi-autonomous based on the way they're controlled.

For this purpose, [3] there are certain developments in area of human-machine interaction. One common sort of communication is Gestures that are not solely restricted to face, body and fingers but also hand gestures. So as to extend the utilization of robot in places where conditions are not certain like rescue operations, robots can be made to follow the instructions human operator and perform the task consequently. This proposes an integrated approach of tracking and recognition of hands that is intended to be used as human-robot interaction interface.

II. LITERATURE SURVEY

The paper includes, hand gesture sensor depends on accelerometer and gyroscope. [4] Gyroscope is a sensor which is used to capture the position the operator hand when he is working in operated vehicle, and it is attached with a hand. The expert operator may use the joystick for manage system easily and it is little bit complex for the starting users. This system has two main part, ground station this paper the hand gesture recognizing sensor used by the user and the floor station and he can be able to control the hands of robot at the. Here accelerometer and gyroscope are fitted in hand joints. The device assesses the screen, wireless mouse and with the keyboard. This paper explains how people machine communicating device, most intuitive communicating device, to interacts to the device and the other appliance. In case of communicating to the machine commands are being implemented use of hand gesture.

III. BLOCK DIAGRAM

We make our task simpler by dividing it into two major parts (Fig 1,2), which mainly consists of a transmitter part and receiver part.

Transmitter section includes the following parts
1. Arduino Nano
2. MPU6050
3. 9volt battery

4. nRF24L01 transceiver

Receiver section includes the following parts
1. Arduino Nano
2. DC (BO) motor
3. L298D motor driver
4. nRF24L01 transceiver

Transmitter block

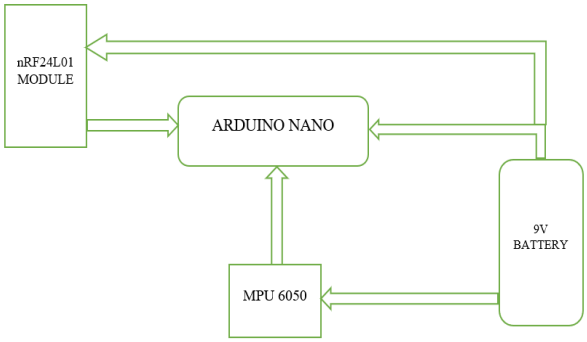

Fig 1. Transmitter block

Receiver block

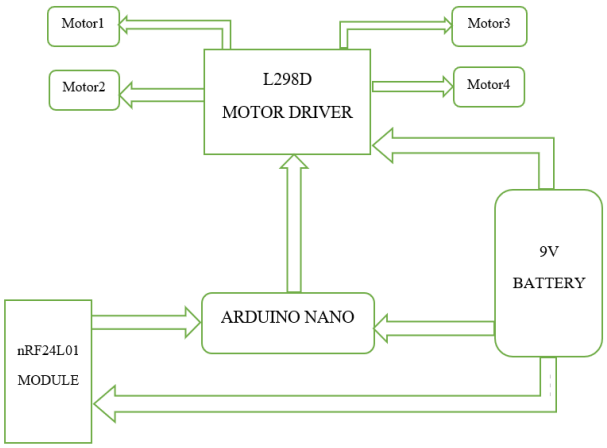

Fig 2. Receiver block

IV. HARDWARE DESCRIPTION

Arduino Nano

The Arduino Nano is a small, complete and breadboard-friendly board based on Atmega328 microcontroller. The Arduino Nano contains 30 male I/O headers, in a DIP-30 like configuration, which can be programmed using the Arduino Software Integrated Development Environment (IDE), [5] which is common to all Arduino boards are available both online and offline. The board can be powered through type B USB cable or from a 9volt battery. The ATmega328 microcontroller also supports I2c and SPI communication.

MPU6050

The MPU6050 is the unique, [6] first and only 6-axis motion tracking devices designed for the low power, low cost and high-performance requirements of smartphones, and wearable sensors. MPU6050 is a Micro Electro mechanical system, it consists of three axis accelerometer and three axis gyroscope, which is also available on smartphones etc. It helps us to measure velocity, orientation, acceleration, displacement and other motion like features or changes. MPU6050 consists of Digital Motion Processor , which has the ability to solve complex calculations. MPU6050 is made up of a 16-bit Analog to Digital converter hardware. Due to this, it captures three-dimensional motion at the same time. This module uses the I2C communication mode for interfacing with Arduino.

nRF24L01 Transceiver

To have two or more Arduinos communicate with each other wirelessly, there are many possibilities such as remotely monitoring sensor data, controlling robots, home automation, etc. [7] And when it comes to an affordable but reliable 2-

way RF solution, none does a better job than the nRF24L01+ transceiver module. The nRF24L01+ module is designed to operate in 2.4 GHz worldwide ISM frequency band and uses GFSK modulation for data transmission. The data transfer rate is configurable and can be one of 250kbps, 1Mbps and 2Mbps.The module's operating voltage ranges from 1.9 to 3.6V, but the good news is that the logic pins are 5 volt tolerant, so you can use it with your all the devices of 3.3V or 5V microcontroller without worry. And the best part is that it consumes 26 μA in standby mode and 900 nA in power down mode. That's why it's a go-to wireless device for low-power applications.

L298D Motor Driver

This bidirectional motor driver is based on the very popular L298 Dual H-Bridge Motor Driver IC. [8] This module of motor driver will allow you to easily and independently control two motors of up to 2A each in both directions. It is compatible for robotic applications and also well suited for connection to a microcontroller requiring just a couple of control lines per motor. [9] In this module, the rotation directions of all the motors are controlled by Motor Control Pin. The IN1 and IN2 are controlling Motor 1 where as IN3 and IN4 are controlling Motor 2. Beside motor rotate direction, this Motor Driver Module is able to control motor's speed also with the help of Motor PWM Control Pin. This pin ENA is controlling speed of Motor 1 while ENB is controlling speed of Motor 2.

DC Motor (Battery Operated Motor)Battery Operated light weight DC motor which is portable it also produces good torque and rpm at lower voltages. This motor can run at a speed approximately 150 RPM when driven by a single Li-Ion cell. [10] This is great for battery operated light weight robots, as they are very light weight. A specific type of DC geared motors that can be operated through a portable battery and that is why it is also known as Battery Operated (BO) motors. It is used for light weight applications mostly. Available in different torque and RPM, for vast use.

V. SOFTWARE REQUIREMENT

Arduino ID

The Arduino Software (IDE) makes it easy to write code and upload it to the board, it is an open-source software. This software can be used for any Arduino board. The Arduino's Integrated Development Environment or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to Arduino hardware to upload programs and communicate with them.

VI. METHODOLOGY

Methodology for communication

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 and encoding it to carry data. Transmitter modules are usually implemented along with a micro controller which will provide data to the module which is transmitted. RF transmitters are usually used to regulatory requirements which requires the maximum allowable transmitter power output, harmonics and band width requirement.

Receiver module-

An RF Receiver module nRF24L01-RX is 433 MHz radio receiver receives the modulated RF signal, and then it de-modulates. There are two types of RF receiver module. Super regenerative modules are usually low in cost and low power consumption designs using a series of amplifiers that are used to extract modulated data from a carrier wave. Super regenerative modules are generally not accurate as their frequency of operation varies in a fair amount with temperature of environment and power supply voltage. Super heterodyne receivers are having a performance advantage over Super regenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in turn leads to a situation of comparatively more expensive product. Radio receiver which receives the transmitted code from the remote will place these codes are converted to digital format and output is available to the pin no 2 of the I2C master microcontroller; this is the pin of inbuilt art of the microcontroller.

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

- The nRF24L01+ module transmits and receives data on a certain frequency called a channel. If two or more modules are to communicate with each other, then they must be on the same channel.
- This channel can be any frequency in the 2.4 GHz ISM band, or to be more precise, it can be between 2.400 to 2.525 GHz (2400 to 2525 MHz). Each channel requires range of a bandwidth of less than 1MHz. As a result, there are 125 possible channels available with 1MHz spacing.
- This means the nRF24L01+ can use 125 different channels, allowing you to create a network of 125 independently working modems in one place.
- The nRF24L01+ has a feature called Multiceiver. It is a short form for multiple Transmitter Single Receiver. In a multiceiver network each RF channel is actually divided into 6 parallel data channels called data lines. In other words, the data line is one of six logical channels in a single physical RF channel. Each data line has its own unique address called a data pipe address. Only one data pipe can receive one packet at a time.

- To start, connect the VCC pin on the module to 3.3V and the GND pin to ground on the Arduino.
- Pins CSN and CE can be connected to any digital pin on the Arduino. In our case, these are connected to digital pin no8 and no9 respectively.

Methodology for motion control

The L298D Motor Driver module consists of an L298 Motor Driver IC, This Voltage Regulator, resistors, capacitor, Power LED, 5V jumper in an integrated circuit. This particular Voltage regulator will be enabled only when the jumper is placed. When the power supply is less than or equal to 12Volt, then the internal circuit will be powered by the voltage regulator and the 5Volt pin can be used as an output pin to power the microcontroller. The jumper cable should not be placed when the power supply is greater than 12Volt and separate 5Volt should be given through 5V terminal to power the internal circuitry. ENA and ENB pins are speed control pins for Motor A and Motor B while IN1 and IN2 and IN3 and IN4 are direction control pins for both Motor A and Motor B.

VII. IMPLEMENTATION

In this paper, a mobile robot that is controlled by the gestures made by the hand, is designed. As mentioned earlier, the gesture-controlled robot has accelerometer sensor (MPU6050), Arduino Nano, Motor driver (L293D) as main parts. When the robot is powered on, the Accelerometer Sensor senses the input and transmits it into Arduino Nano. This data is captured by the Arduino, which in turn transmits a corresponding data to the Motor Driver Circuit. Based on the data, movement of the motors are specified and hence the movement of the robot is defined. The movement of robot is as follows:

- The robot moves forward when x-axis of MPU6050 is greater than 6000
- The robot moves backwards when x-axis of MPU6050 is less than -6000
- The robot moves left when y-axis of MPU6050 is less than -6000
- The robot moves right when y-axis of MPU6050 is greater than 6000
- The robot stops or stays still when x-axis of MPU6050 is less than 6000 and greater than -6000 and y-axis data to be less than 6000 and greater than -600

Design

A gesture control robot (Fig 3) is controlled by using hand in place of any other method like buttons or joystick. The user only needs to move hand to control the robot. A transmitting device is used which is mounted on the hand glove which contains RF Transmitter and accelerometer. This will transmit data the two robots so that it can do the specified task like moving forward, reverse, turning left, turning right and stop. All these tasks will be performed by using hand gesture made by the user.

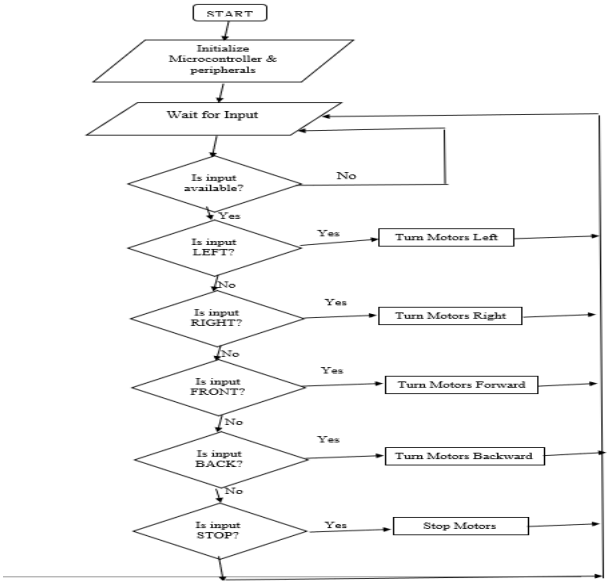

Fig 3. Design flow of the robot

Forward move

The forward movement (Fig 4) of the hand will act as the input command to the robot which will follow the instructions that are predefined, and the robot will move in the forward direction.

The x-axis reading is 11756 and y-axis reading is 1316

Fig 4. Forward Gesture

Backward movement-

The backward movement (Fig 5) of the hand will act as the input command to the robot which will follow the instructions that are predefined, and the robot will move in the backward direction.

The x-axis reading is -11006 and y-axis reading is -2764

Fig 5. Backward Gesture

Left movement-

The left movement (Fig 6) of the hand will act as the input command to the robot which will follow the instructions that are predefined, and the robot will move in the left direction.

The x-axis reading is -408 and y-axis reading is -14276

Fig 6. Left Gesture

Right movement-

The right movement (Fig 7) of the hand will act as the input command to the robot which will follow the instructions that are predefined, and the robot will move in the right direction.

The x-axis reading is -784 and y-axis reading is 13872

Fig 7. Right Gesture

The above figures are the sample outputs that were visible on the serial monitor of the Arduino IDE software, in which the values were set for the operation of MPU6050 accelerometer. There were many number of samples done in order to get the accuracy with the hand gestures. Gesture controlled robot will moves according to hand synchronized movement as we place transmitter in our hand. When we tilt hand in front direction, robot start to move forward and continues moving forward until next command is given. When we tilt hand backwards, robot change its state and start moving in backwards direction until other command is given or interrupted. When we tilt the hand towards left, it in left side Robot will turn left

till next command. When we tilt hand in right side robot will take a right turn, and for stopping the robot we keep hand in a stable position.

VIII. CONCLUSION

Hand Gesture Controlled Robot gives a more natural way of controlling any robotic devices. The purpose of project is to control a car using accelerometer sensors attached on a hand glove. The sensors which use gestures are intended to replace the remote control that is generally used to run the car, which will allow us to control the forward, backward, and left and right movements in the car, while using the same accelerometer sensor to control the speed or acceleration of the car. based on the hand movements. By using the above-mentioned component's, in the description the hardware was setup, thus resulting in the formation of a robot. At the beginning the robot will stay idle in a stop mode. As the hand makes a gesture from rest to forward, the robot moved in the forward direction. As the hand moved from rest to top, the robot will move in the backward direction. As the hand gesture was shown as an acute angle towards the left, the robot moved towards the left direction. As the hand gesture was shown as an acute angle towards the right, the robot moved towards the right direction. As the hand is kept stationary or still with respect to the environment, the robot was in the stop mode. The gesture control robot design gives an alternative way of controlling robots. Gesture control being a more natural way of controlling devices makes control of robots more efficient and easier.

IX. FUTURE ENHANCEMENT

The proposed paper is applicable in hazardous environment, where a camera can be attached to the robot and can be viewed by the user who is far away from the war station. This system can also be used in medical field where miniature robots are created which can help doctors to perform efficient surgery operations which requires precision for more efficient response, these threshold values can be used to detect gesture and to perform advanced features such as finger counts that provide different functional commands can be used in various fields.

Entertainment Application

Most videogames today are played either on game consoles such as play stations, arcade units or PCs, and all require a combination of input devices. Gesture recognition can be used to make a player feel like they are in the game world like never before.

Physically Challenged

One of the biggest challenges faced today is providing separate and equally non burden services to the differently abled and handicapped. While there are many special provisions available around the world, there's still a huge room for improvement and also to bring all lives on equal footing. Gesture recognition technology will eliminate a lot of manual labor or possibility of error and make life much easier for those who are not as fortunate as most of us are. In future we are going to design an automated wheelchair for handicapped people. This wheelchair can be operated by a wireless remote which can reduce the wiring arrangements. Instead of using acceleration motion we can use eye retina using optical sensor to move the wheelchair accordingly.

Military Survaillance

During any wars or for surveillance in the battlefields, with the help of a camera mounted on it. It can be used as a spy bot. It can also detect the enemies that are in the hideouts during a war and so on.

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