IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-4, Special Issue-6, Aug 2016 E-ISSN: 2347-2693

Hand Gesture Controlled ARM

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Available online at: www.ijcseonline.org

Received: Jun/26/2016 Revised: July/08/2016 Accepted: July/26/2016 Published: Aug/12/2016

***Abstract*—** Robotic hands so far made were done by usingmicrocontroller and were wired based. Though number of degrees of freedom can be increased as well as precision of the arm increases with the help of using microcontroller, but eventually the roboarm used to become costly. In this paper we have tried to make a Roboarm capable of enacting human hand gesture which is microcontrollerless and more over it is based on Wireless communication technique. For picking purpose we have used Servo Motors and for controlling the servos we used Servo driver using 555 Timer. Humans pick things up without thinking about the steps involved in it. In order for a robot or a robotic arm to pick up or move something, someone needs to tell it to perform several actions in a particular manner such as moving the arm, to rotating the "wrist" to opening and closing the "hand" or "fingers".

Keywords— *Pwm based, Wireless(434Mhz Radio Frequncy have been used instead), Degrees of Freedom, Microcontrollerless*

I. INTRODUCTION

Robots are used where working conditions are unsuitable for humans. As well as working at a constant rate, robots are capable of handling dangerous substances without fear of contamination and it can also be built to function in extreme environment condition. Thus, a robotic arm is a robotic manipulator, capable of imitating the human gestures. Now a days the most commonly used robots in industry is a robotic manipulator or a robotic arm. Robotic arm is basically an open closed kinematics chain of rigid links interconnected by movable joints. The end of the arm is connected to the end-effectors. The end-effector may be a tool and its fixture or a gripper or any other device to do the work. The end-effector is similar to human hand with or without human hand.

II. EASE OF USE

a) Microcontroller less

The roboarm doesn't uses any microcontroller and is driven by Servo driver which generates PWM signals for the Servo motors. Hence, it is less costly.

b) Wireless Communication Technology

The roboarm is based on wireless communication technology. So it has no fixed range of operation. It can be accessed within a room from anywhere which makes it very user friendly.

III. ABBREVIATIONS AND UNITS

- In the voltage divider and as well as comparator circuit we have dealt with the voltage which is expressed in terms of Volt
- The encoded voltage signal is transmitted as RF signal in MHz range of frequency
- The required capacitance in the PWM driver is calculated in terms of nanofarad which along with the variable resistance(in terms of KΩ) is responsible for the angle of rotation- 0° and 180°

IV. SYSTEM DESIGN

Systems design may be defined as the process of defining the system such as architecture, components, modules and data for a system which is used to satisfy different specific requirements. Systems design could be seen as the way to apply the systems theory to product development. In practical cases there is some relation between the disciplines of systems analysis, systems architecture and as well as systems engineering.

A. Block Diagram

The mechanism is divided in two parts

Part A:

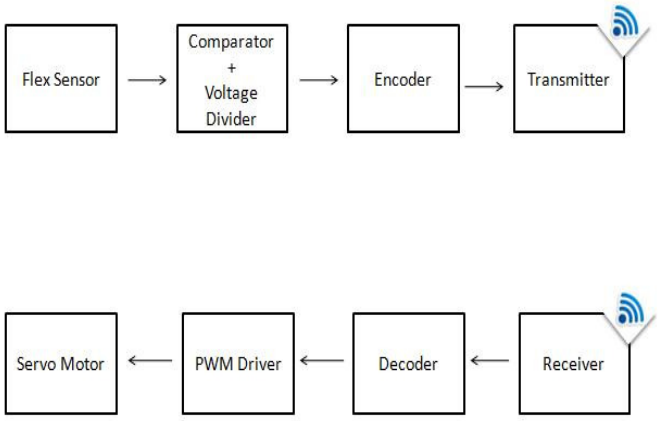


Figure: PWM Based Servo Controlled Arm

Part B:

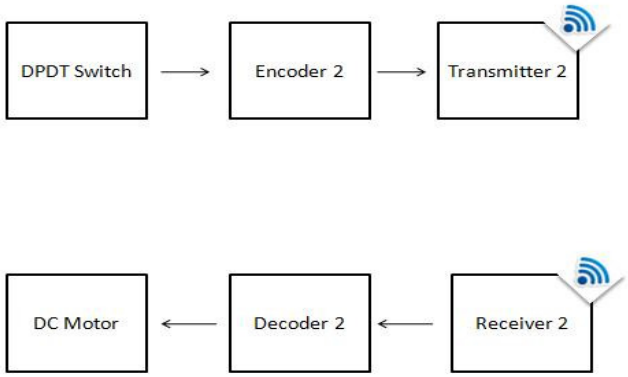


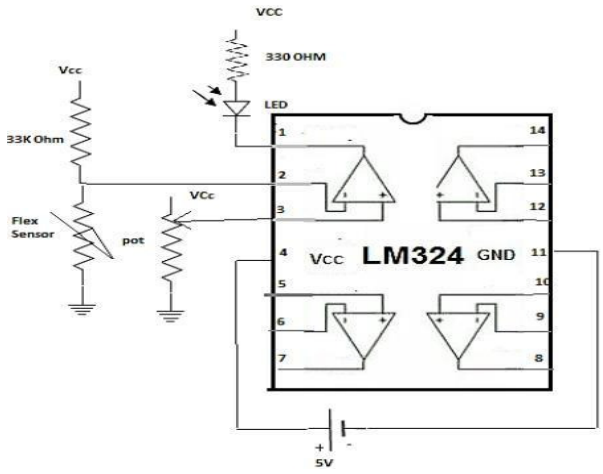
Figure: DPDT Switch Driven DC Motor Control

a) Voltage Divider and Comparator Circuit

This part consists of a quad comparator (LM324) and a voltage divider circuit. A fixed resistance of 33 KΩ and the variable resistance of the flex sensor which are attached to the fingers of the person form the voltage divider part. The resistance of the flex sensor varies from 19 KΩ to 45 KΩ. Hence the variable output voltage in this case

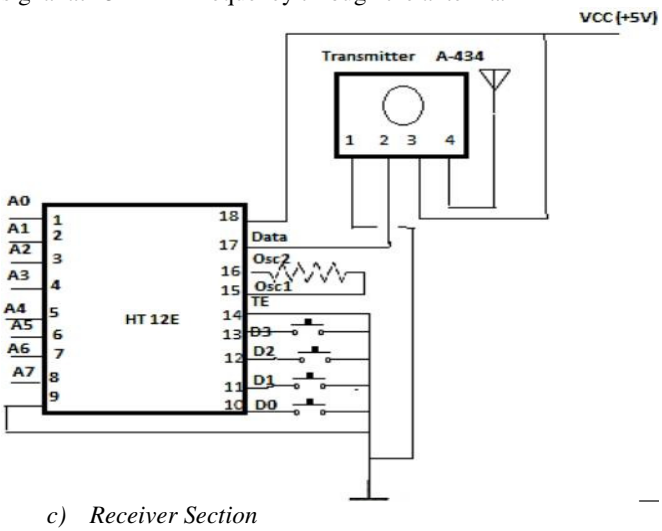
V_{Out} =variable resistance of flex sensor.V_{CC}Variable flex resistance+33 KΩ

Since we have used only 2 states of the claw position, the output signal of the flex sensor is fed to the comparator (LM 324). The variable output voltage V_{Out} is applied to the non-inverting input (A) of the comparator, which is compared with the reference value. The reference input (B) of the comparator is the variable POT resistance having a value of of 25KΩ across the voltage source. If A>B the output of the comparator is a high signal i.e. 5V. If A<B the output of the comparator is a low signal i.e. 0V.



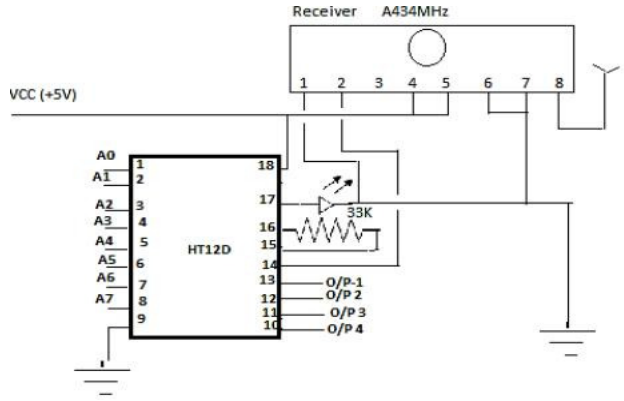
b) Transmitter Section

The transmitter module we have used for the project is -A 434(434 MHz radio frequency) along with the encoder HT12E. The Encoder consists of four input data pins and only single output data pin. It also has 8 address pins used for locking the addresses so no 2 434MHz signals gets interfered to each other. Through these 4 input pins the corresponding voltage outputs of the comparator circuit i.e. logic 1(5V) and logic 0 (0V) is sent. The encoded signal is sent out through the data out pin. The data out pin of the encoder is connected with the data pin of the A-434 Transmitter. Through this pin the transmitter receives the encoded signal and it transmits the signal at 434 MHz frequency through the antenna.



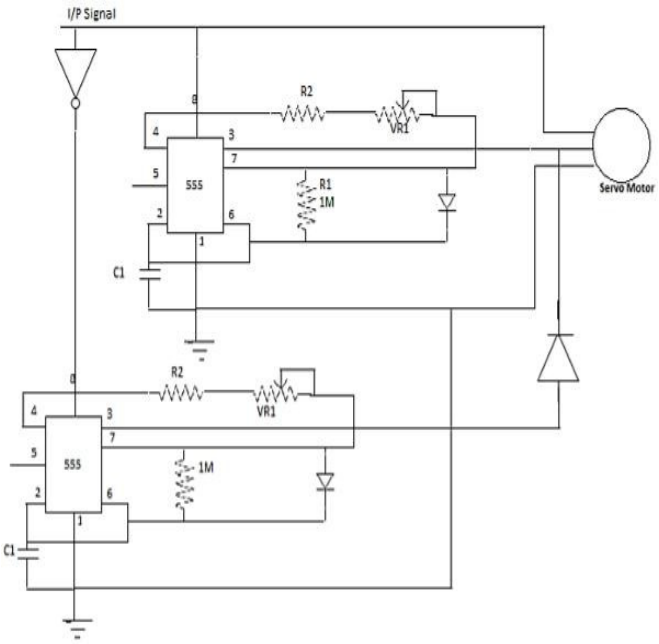
c) Receiver Section

The receiver module we have used for this project is A-434 (434 MHz radio frequency) along with the decoder HT12D. It has single input pin and 4 output pins. It also has 8 address pins used to demultiplex the addresses which were multiplexed earlier. The signal which will be transmitted received through the antenna of the receiver. The corresponding received data is sent through the data pin of the receiver. The data pin of the receiver is connected to the data input pin of decoder. The decoder decodes the received encoded signal and the logic 1(5V) and logic 0(0V) signal is again fetched back.



d) Pulse Width Modulation Driver

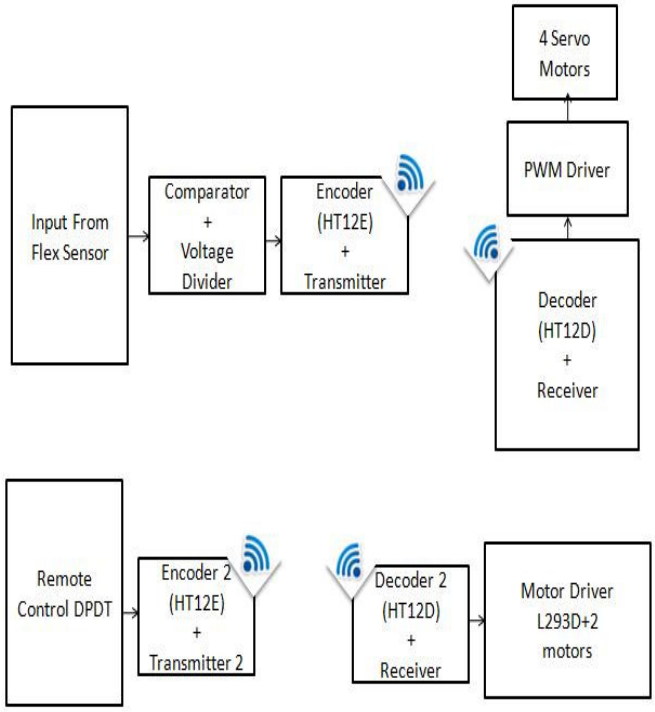
The Pulse Width Modulation is done with the help of NE555 timer. It changes the duty cycle of the pulse. The servo motor can be interfaced with the 555 timer which will supply the required PWM (Pulse Width Modulation). This part consists of two PWM driver for each finger such as one driver has the maximum POT resistance where as the other one has minimum POT resistance. The output pin of both the PWM driver will be connected with the servo control pin. One of the driver is connected through a NOT gate with the input signal. When 0V is received as an input signal the PWM driver will be ON having minimum POT resistance. With the bending of the flex sensors connected on the finger of the human arm a 5V signal will be received as an input and the PWM driver which was ON at that time will go to OFF state and the another PWM driver having maximum resistance will go to ON state. Since there is a change of resistance the servo motor will rotate about the angles - 0 and 180°.



V. CALCULATION AND ANALYSIS

- The flex sensors we have used in this project has a range of 19 KΩ to 45 KΩ which is connected with a resistance of 33 KΩ to form the voltage divider circuit.
- Since we have used only 2 states of the claw position the variable output voltage V_{Out} is applied to the non-inverting input (A) of the comparator, which is compared with the reference value (B) that is taken as POT resistance of 25KΩ across the voltage source.
- When A>B the output of the comparator is 5V. If A<B the output of the comparator is 0V.
- The Encoded signal is transmitted with a radio frequency of 434 MHz
- One PWM driver is connected with another PWM driver through a NOT gate. In one driver the POT resistance is set at 47k (maximum) where as in the other driver POT resistance is 1K (minimum). The Capacitance used in the PWM drivers is 100 nf.
- The PWM driver having a POT resistance of 47K is responsible for the 180° rotation where as the other PWM driver rotates the servo motor by 0°

VI. PROCESS FLOW



VII. EQUATIONS

a) Torque Equation

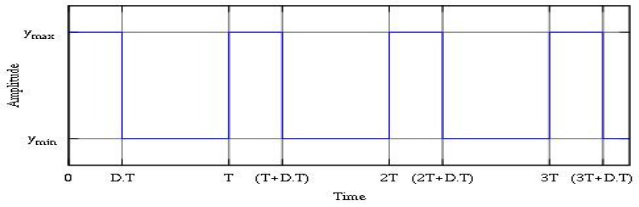
The symbol for torque is typically τ, the Greek letter tau. When it is called moment of force, it is commonly denoted M The magnitude of torque depends on three quantities: the force applied, the length of the arm connecting the axis to the point of force application, and the angle between the force vector and the lever arm.

b) Voltage Divider Circuit Equation

A voltage divider referenced to ground is created by connecting two electrical impedances in series. The input voltage is to be applied across the series impedances say R1 and R2 and the output is the voltage across R2. R1 and R2 may be composed of any combination of elements such as resistors, inductors and capacitors.

c) Pulse Width modulation Equation

Pulse-width modulation uses a rectangular pulse wave whose pulse width is modulated resulting in the variation of the average value of the waveform. If we consider a pulse waveform $f(t)$, with period T, low value , a high value and a duty cycle D (given in the figure) the average value of the waveform is given by:



VIII. CONCLUSION

The robotic claws are used in the industrial field, medical field and bomb disposal squad, defense field area and so on. Future aspects lie on the fact that the artificial intelligence can further increase the efficiency of the arm.

IX. FUTURE ASPECTS

- This project can be improved by implementing proximity sensor which will be used for obstacle detection technique.. The roborm vehicle will be able to detect the obstacles automatically on its own.
- This robotic arm can be controlled with the help of Android and Bluetooth Application instead of DPDT switches.
- Image Sensing technology can also be incorporated with this existing model.

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