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# A 5 Degree Feedback Control Robotic Arm (Haptic Arm)

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***Abstract:*** **Haptics is the science of applying touch sensation and control for interaction with virtual or physical application. In this project, our aim is to make a robotic arm that will copy the actual movements of a human hand. Motion of the hand will vary the potentiometer resistance which is placed on the human arm. This change in resistance produces an equivalent output voltage which is given to the microcontroller. The microcontroller converts this analog signal to digital and produces corresponding PWM signals which are required for the servomotors on the robotic arm to run. Servomotors are connected to the receiver microcontroller. PWM pulses are sent to the receiver controller. The hardware of this project is very user friendly, portable, easy to handle and also very light in weight. It has a very simple design and also very easy to assemble. We have used 5 Degrees of Freedom i.e. Shoulder, Elbow, Wrist and Finger**

***Keywords:*** **Atmega 16L, Potentiometers.**

## 1. INTRODUCTION

Robots of the current generation have been used in fields isolated from the human society. They suffer major shortcomings because of their limited abilities for manipulation and interaction with humans. In order to represent the robotic technology in the field of human-machine interaction and wire communication for allows interactivity in real-time with virtual objects it is very necessary to develop some or the other technology that makes the maximum use of robot to help people do their work in an efficient way in their day to day life. The main objective of the project is to design and develop the Robot that is used to move using wire system by recognizing hand motion that is controlled by haptic technology for virtual environment & human-machine systems capable of haptic interaction. Without risking human life or limb, this research has applications in many areas, including robot assisted surgery, simulation and training, rehabilitation, exploration of hazardous or remote environments, enabling technologies, manufacturing, design, mobile computing, and education.

## 2. HAPTICS TECHNOLOGY

As the research progressed, robots were recognized not only as simple action performer but as a machine that have diverse and variety of purposes and usages. The report focuses on design and implements a robotic arm and control it using a human arm by means of haptics technology. Haptics is the science of applying touch Sensation and control for interaction with virtual or physical applications. Haptics is one of the growing areas in human-computer collaboration which deals with sensory interaction with computers. The word haptic is derived from the Greek word haptikos which means pertaining to the sense of touch. Haptic is used in engineering systems to create virtual environment. It is a tactile feedback technology which takes advantage of sense of touch by applying motions, vibrations or forces to the user.

Haptics can be divided into three areas:

A. ***Human haptics*** - the study of human sensing and its control through touch.

B. ***Machine haptics*** - the design, construction, and the use of machines to replace or augment human touch.

C. ***Computer haptics*** - algorithms and software associated with generating the touch and feel of virtual objects.

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The basic idea is the sensors on the haptic device work as transducers and converts hand motions into electrical signals. These hand movements can be replicated using a robotic arm. Our research is devoted to developing the principles and tools needed to realize advanced robotic and human-machine systems capable of haptic interaction.

## 3. BLOCK DIAGRAM

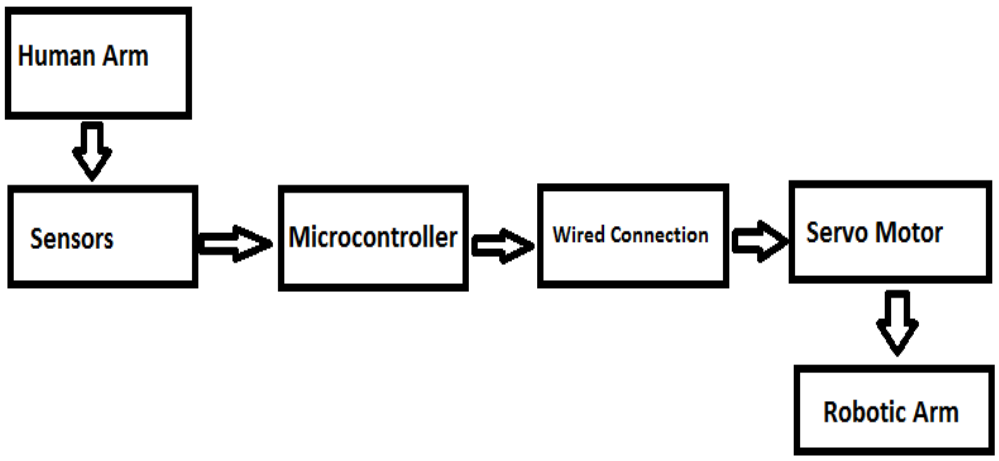


**Fig1: Block Diagram**

At the transmitter side, we are going to connect the sensors to sense the haptic movements. So to sense the haptic movements we are using potentiometer as a sensor. Potentiometers will change its output voltage as the haptic movement is sensed And the output of potentiometer is converted into its equivalent electrical form and given to the microcontroller.Controller output is given to servo motor and robotic arm is moved accordingly.

***Microcontroller (ATmega16)***

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

➢ ***Basic features:***

- High-performance, Low-power Atmel AVR 8-bit Microcontroller.
- Advanced RISC Architecture

–131 Powerful Instructions

–Most Single-clock Cycle Execution

□□□□□□□□–32 x 8 General Purpose Working registers.

–Fully Static Operation

–Up to 16 MIPS Throughput at 16 MHz

➢ ***Peripheral Features***

- Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Four PWM Channels
- 10-bit ADC, 8 Single-ended Channels
- On-chip Analog Comparator.

The ATmega16 provides the following features: 16 Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 512 bytes EEPROM, 1 Kbyte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary scan, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes.

## 4. SENSORS

Potentiometers are used as a sensor to trace the movement of the hand. Here 5 motions are given to the arm hence using 5 pots as described below:

***a. Shoulder Sensor:***

The voltage at the variable terminal of the pot varies according to the movement of the shoulder. There are 2 shoulder movements; one is up-down and other is slide movement. So for these 2 movements 2 pots are used.

***b. Elbow Sensor:***

The voltage at the variable terminal of the pot varies according to the bending of the elbow.

***c. Wrist Sensor:***

The voltage at the variable terminal of the pot varies according to the rolling movement of the wrist.

***d. Finger Sensor***

The voltage at the variable terminal of the pot varies according to the grabbing movement of the finger.

## 5. SERVO MOTOR CONTROL

The servo can be commanded to rotate to a particular angle (say 30) and then hold the shaft there. Servos also employ a feedback mechanism, so it can sense an error in its positioning and correct it. This is called servomechanism.

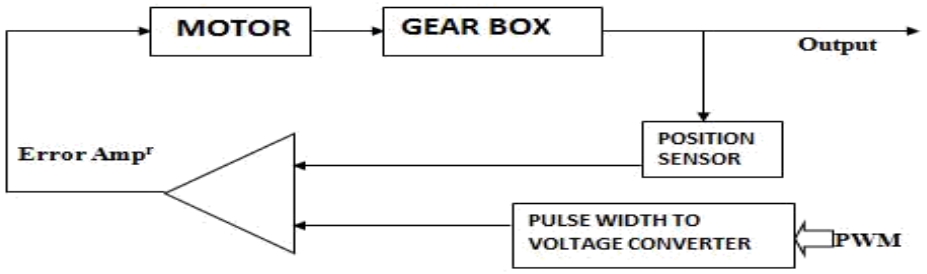


**Fig2: Block Diagram of Servo Mechanism**

Controlling a servo is easy by using a microcontroller, no external driver like are required. Just a control signal is needed to be feed to the servo to position it in any specified angle. A pulse width modulated (PWM) signal is applied as a control signal. It is then converted to equivalent voltage. This voltage and the output from the position sensor is compared using error amplifier. In this way the feedback from the shaft of the motor controls the rotation of the motor. The time period of PWM signal should lie between 14 ms to 20 ms and the ON time should lie between 1ms to 2ms. The width of positive pulse (ON time) controls the angle. Controlling a servo is easy by using a microcontroller, no external driver like are required. Just a control signal is needed to be feed to the servo to position it in any specified angle. A pulse width modulated (PWM) signal is applied as a control signal. It is then converted to equivalent voltage. This voltage and the output from the position sensor is compared using error amplifier. In this way the feedback from the shaft of the motor controls the rotation of the motor.

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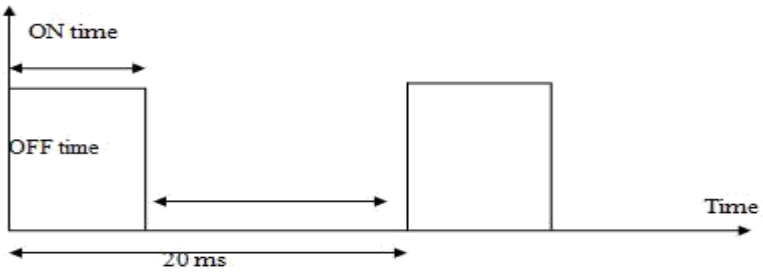


**Fig3: PWM signal servo control.**

A pulse width modulated (PWM) signal is applied as a control signal. It is then converted to equivalent voltage. This voltage and the output from the position sensor is compared using error amplifier. In this way the feedback from the shaft of the motor controls the rotation of the motor.

The width of positive pulse (ON time) controls the angle. Servo motors are capable of rotating between 0 and 180 degrees. Every servo motor has fixed ON time and OFF time for particular angle.

For Servo MG-995, the ON time and corresponding angles are:

0.800ms = 0 degree.
1.264ms = 90 degrees. (neutral position)
2.54ms = 180 degrees.

## 6. CIRCUIT DIAGRAM

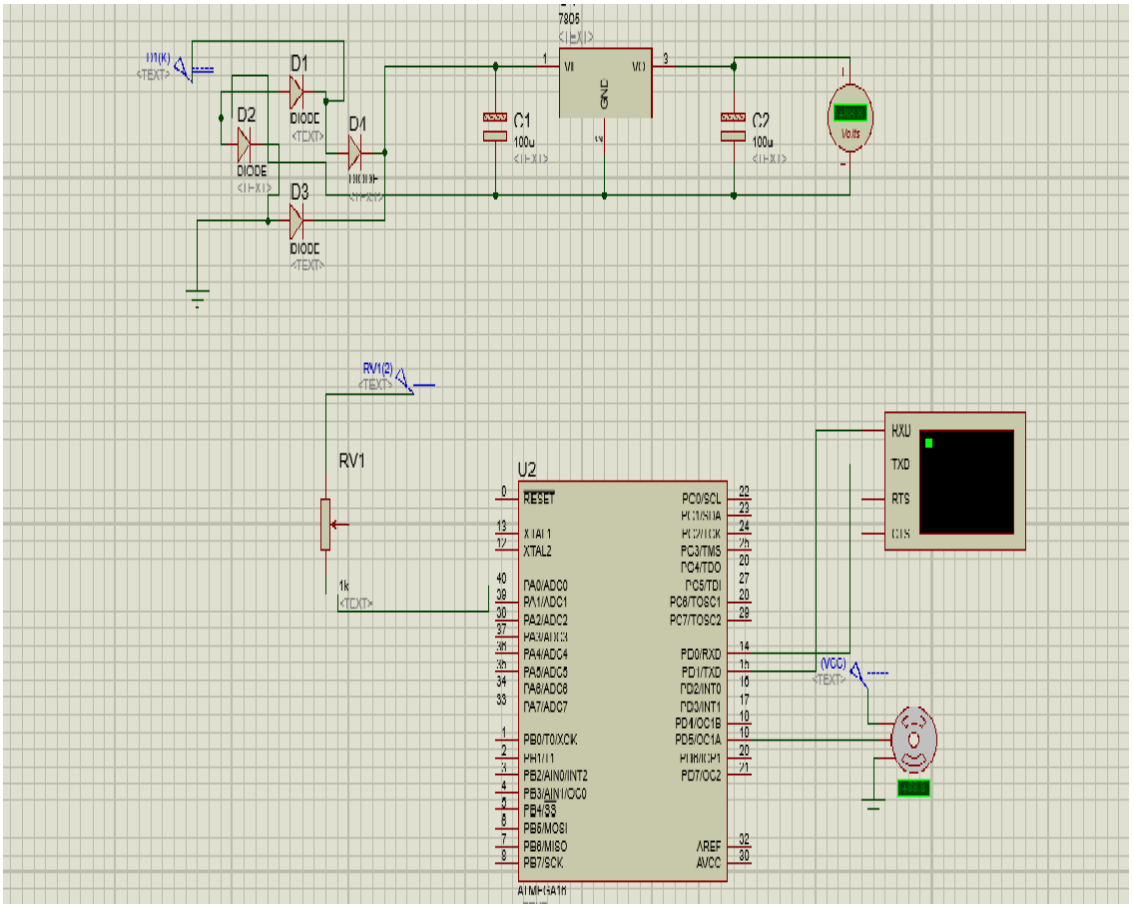


**Fig.4: Circuit Diagram**

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## 7. HAPTIC ROBOTIC ARM

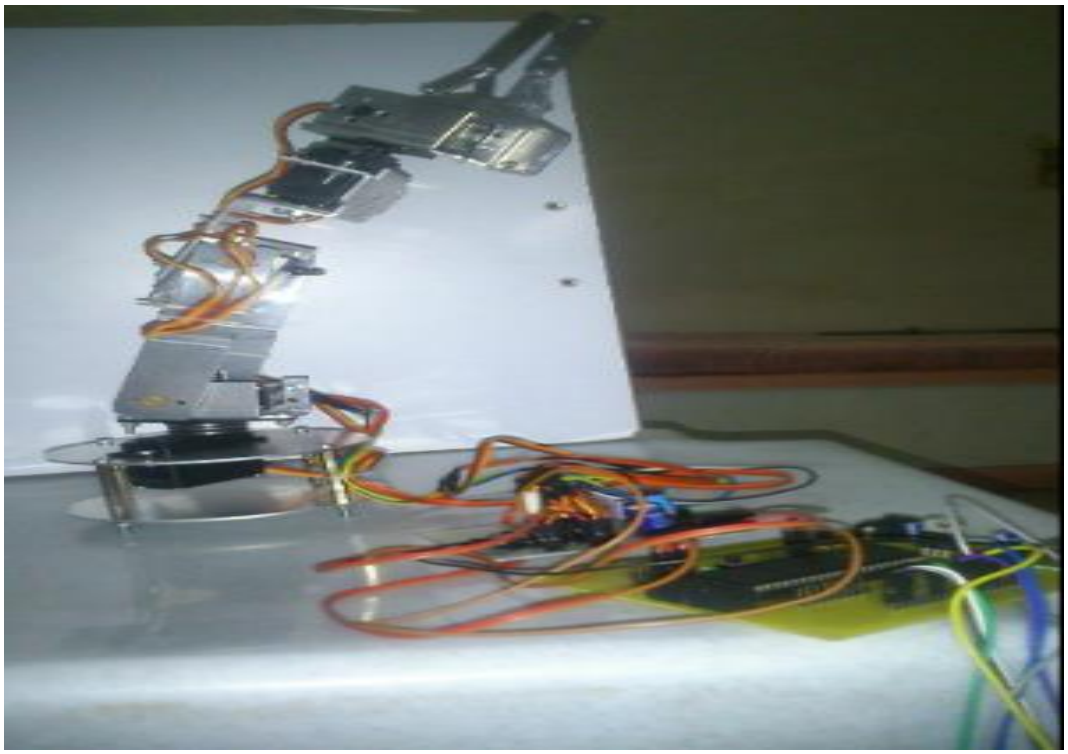

**Fig5: Robotic Arm**

**Fig6: Haptic Robotic Arm Assembly**

## 8. SOFTWARE USED

Atmel Studio is the integrated development platform (IDP) for developing and debugging Atmel AVR microcontroller-(MCU) based applications. The Atmel Studio gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code.

## 9. CONCLUSION

In this project a robotic arm has been designed and controlled using haptics. We tested the angle of servo motor by changing the output resistance of the potentiometer. This result information of the pot angle (sensor output) and servo angle (actual output) and for what angle the pulse should be ON. So we controlled the angle of DC motor with respect to the output of the sensor (potentiometer).

Human safety is prior consideration in designing this project.

## REFERENCES

[1] ROBOTICS ARM CONTROL USING HAPTIC TECHNOLOGY Vipul J. Gohil, Dr. S D. Bhagwat, Amey P. Raut, Prateek R. Nirmal.

[2] Design and Implementation of A Robotic Arm Based On Haptic Technology A. Rama Krishna, G. Sowmya Bala, A.S.C.S. Sastry, B. Bhanu Prakash Sarma, Gokul Sai Alla.

[3] "Surgical Robot Teleoperated Laparoscopic Grasper with Haptics Feedback system, Apu Sarmah, U.D.Gulhane.

[4] "Universal haptic drive: A robot for arm and wrist rehabilitation, Jakob Oblak.

[5] "Design of a Haptic Arm Exoskeleton for Training and Rehabilitation, Abhishek Gupta.