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Research Paper

HUMAN HAND IMMITATING ROBOT

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Robots of the current generation suffer major shortcomings because of their limited abilities for manipulation and interaction with humans. The main purpose of this project is to design and develop the Robot with 3DOF that moves by, recognizing hand motion, exploiting the movements of the human elbow, wrist and knuckles. It can be applied in haptic technology for virtual environment & human-machine systems interaction. It has applications in areas where risking human life is involved, like manipulating radioactive elements, robot assisted surgery, simulation and training, rehabilitation, exploration of hazardous or remote environments, manufacturing, design, mobile computing and education. The proposed method of execution involves the usage of atmega8l micro controller through which the imitation of the human hand by the robot at reduced complexity and cost.

Keywords: Human-machine interaction system, Robotic arm control, Kinesis, Exoskeleton system

INTRODUCTION

Robotics is a special engineering science which deals with designing, modeling, controlling and robots' utilization. Nowaday robots accompany people in everyday life and take over their daily routine procedures.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 paper focuses on design and implements a robotic arm and control it using a human arm by means of haptics technology. The basic idea applied here is the use of haptic device astransducers and convert hand motions into electrical signals.These hand movements can be replicated using a robotic arm.Our research is devoted to developing the principles andtools needed to realize advanced robotic and human-machinesystems capable of haptic interaction. The project is divided into two modules namely, Hapticsglove (Transmitter) & Robot side (Receiver).

Haptics Glove Side

This device fits over the user's entire hand like anexoskeleton has potentiometers on finger, wrist

& picks upchange in resistance with hand movement.

Robotic Arm

A robotic manipulator is a device capable of moving indifferent directions (base, shoulders, elbow, yaw, pitch, rolldirections) elative to base and controlled by Haptics, Its baseis actuated by a D.C motor mounted beneath it.The degrees of freedom, or DOF, are a very important termto understand. Each degree of freedom is a joint on the arm, aplace where it can bend or rotate or translate.

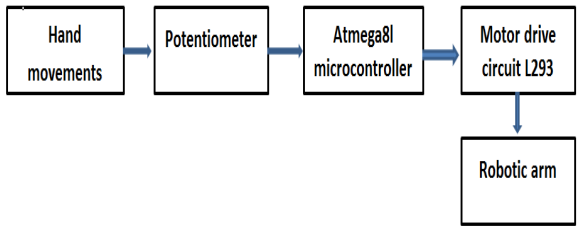
Locomotive Module

This feature to be installed in to the system requires a separate control mechanism. It would include the installation of two motors to control the movements of the four wheels. The directionality of the bot is controlled by a basic tank like mechanism where the wheels on the right rotate to turn the bot right and vice versa for left. This mechanism also has the usage of the atmega8l microcontroller to interpret the gestures in to respective movements.

Proposed System

The proposed methodology has an potentiometer for an input device and then the signals from it is processed by the microcontroller which then provides the appropriate instructions to the motor drive circuit which actually controls the motors attached to the robotic arm.The descriptive representation of the system that is proposed has been show in the figure 1.

Figure 1



Hand Movement Sensors

A sensor (also called detector) is a device that measures a physical quantity and converts it into equivalent electrical signal.. The user in order to move the robot should make a hand movement. This different movement is sensed by potentiometer attached to haptics gloves. Potentiometer is used in haptic suit along with ADC for position feedback of joints. It gives the feedback in the form of voltage. Accelerometer is connected to on other glove for position feedback of hand movement either left or right. The output of this sensors are in analog form, therefore they are connected to analog port of microcontroller Atmegs8l.

Atmega8l microcontroller

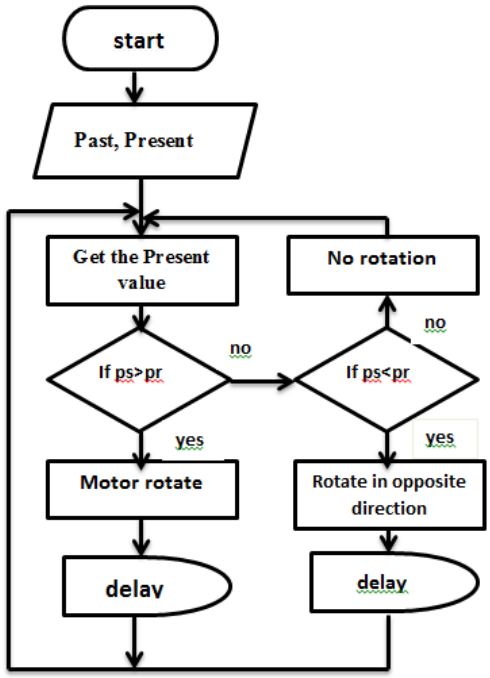
The ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1 MIPS per MHz, allowing the system designer to optimize power consumption versus processing speed. Then according to look up table, micro-controller gives command (pin-1 t0 6) through PB0 to PB5 of port B to the motor driver IC. Now driver IC operates motor connected to the arm.

Programming Logic

Initially the two values that play a major role in the functionality of the robotic arm are declared. The values are the present and past reading from the potentiometer. The logic provided here is for only one joint of the arm the same logic is to be followed for the remaining joints of the robotic arm. Initially the past value is set to zero and present valve is

fetched from the potentiometer. The potentiometer provides us values in the form of varying voltage as the hand movements are made. This varying voltage is a result of the variation in the resistance. After the values are obtained from the potentiometer it is compared with the past value of the potentiometer to determine whether the value has increased or decreased thus the controller will be able to deduce whether the hand was raised or dropped. On determination of the movement made by the hand the motor is provided with appropriate control signals to rotate in clock wise or anti clock wise direction.

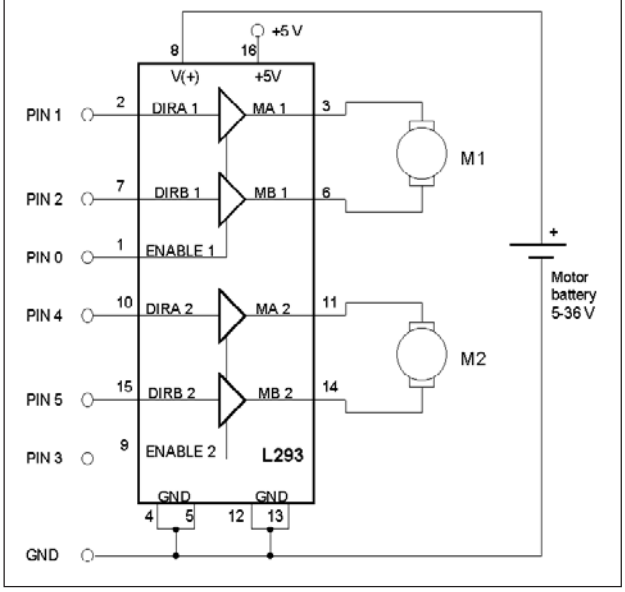
Flow Chart



Motor Drivers

The microcontroller output is not sufficient to drive the DC motors, so current drivers are required for motor rotation. The L293D is a quad, high-current, half-H driver designed to provide bidirectional drive currents of up to 600 mA at voltages from 4.5V to 36V. It makes it easier to drive the DC motors. The L293D consists of four drivers. Pin IN1 through IN4 and OUT1 through OUT4 are input and output pins, respectively, of driver 1 through driver 4. Drivers 1 and 2, and drivers 3 and 4 are enabled by enable pin 1 (EN1) and pin 9 (EN2), respectively. When enable input EN1 (pin 1) is high, drivers 1 and 2 are enabled and the outputs corresponding to their inputs are active. Similarly, enable input EN2 (pin 9) enables drivers 3 and 4. The L293 is an integrated circuit motor driver that can be used for simultaneous, bidirectional control of two small motors as shown fig belo output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver. As seen in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). As we want the o/p to be enabled completely so we have connected Enable to VCC and only 2 pins are needed from controller to make the motor work.

Figure 2: Circuit Diagram of Motor Driver L293



H-Bridge

In order to control the motor in both forward and reverse with a microcontroller, will need an H-Bridge. The L293 has 2 H-Bridges, can provide about 1 amp to each and occasional peak loads to 2 amps. Motors typically controlled with this controller are near the size of a 35 mm film plastic canister.These solid state circuits provide power and ground connections to the motor, as did the relay circuits. The high side drivers need to be current “sources” which is what PNP transistors and P-channel FETs are good at. The low side drivers need to be current “sinks” which is what NPN transistors and N-channel FETs are good at.

Gear Motor:

Geared the motors that operate using gears are used because they are bidirectional. Wisth these motors you can move your robot in both directions (forward and backward) .here 4 motors (12v,30rpm) are used to move robotic arm as well as base in different direction. According to the program in the microcontroller, the robot starts moving.

ROBOTIC ARM:

We have implemented mechanical arm or robotic arm in our robot. The arm is able to pick any light weight item. As well as arm will do other movement given in table below as command given by microcontroller programming. We can operate arm from user haptics glove. Like when we move wrist up/down and arm will move up and down respectively and so on. These functions will be done using microcontroller, motor driver IC and PMDC motor.

MECHANICAL ASSEMBLY

There are two different mechanical assemblies on which the device moves. There is an base assembly to move thedevice back and forth i.e. to move the device in forward, backward, right & left. There is another one axis assembly to open and close the jaws of the object lifter as well as to move the jaws up and down to lift up the object.

ADVANTAGES AND LIMITATIONS

Advantages

- It allows interactivity in real-time with virtual objects
- Can be applied in remote rural areas so as to carry out operations.
- Can be used in military areas where highly skilled doctors may not be present.
- In application like bomb –disposal the human life is not at risk.
- It allows interactivity in real-time with virtual objects.
- Less cutting of skin due to use of advance technology camera and tools.
- Precise control of tools during operation.
- Reduction of no. of peoples needed in operation room.
- Be unaffected by anger, revenge, hunger, fear, fatigue, or stress.

LIMITATIONS

- Robots are not as suitable for making complicated decisions.
- Debugging issues of these are complicated since they involve real-time data analysis.
- Links in telemedicine must have 0% fault rates for extended periods of time.

- The precision of touch requires a lot of advance design.
- The haptic interfaces are basically not portable and they have a limited workspace.
- Auxiliary controls are required to move the workspace of the device to a new location.

CONCLUSION

The synopsis proposes the system robotic arm based on real-world haptics. The primary goal of this project is to aid the laboratories handling hazardous chemicals with a safer means of interaction with chemicals and radioactive materials. The proposed system is utilized to recognize the human motion haptic devices must be smaller so that they are lighter, simpler and easier to use. Haptic technology allows interactivity in real-time with virtual objects.

FUTURE SCOPE

Research is going on to use brain signals to control the robotic arm. This, if achieved will be of great help to the physically handicapped. Currently under research is the clothing retail industry which will help the users to feel the texture of the clothes on the internet.

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