Assistive Device for Stroke Patients to Execute Required Movements Using Robotic Arm

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Abstract- **Hand impairment after stroke is quite debilitating. Present hand rehabilitation approaches, although useful, are still limited as they often require the constant help of a technician or caregiver and also because they are based on repetitive training which may be demotivating. This system only provide a rehabilitation approach for the stroke patient, assistive device for stoke patients has been developed by using robotic arm. A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm, robotic arm has been controlled by the motion of the user's healthy arm, sensors are used to detect the movements of the user' healthy hand, microcontroller makes the robotic arm to performs the functions based on the input from the sensors**

Keywords: assistive device;data glove;microcontroller;

I. INTRODUCTION

The ever increasing population trend of the new millen- nium expects new technical innovation to meet the new challenges being faced by human beings. The integration of medical science and engineering has made the task like complicated surgery by robotic arm simpler. To capture the motion of human limbs, sensors can be used. Some companies have designed units, which can inte- grate accelerometers, gyroscopes, magnetometers and can be attached to human limbs. These units can be worn for video game character modelling, virtual reality, activity recognition. A sensor is a device that can measure some attribute of motion, being one of the three primitives of robotics (besides planning and con- trol), sensing plays an important role in robotic para- digms. Robotic arm manipulators can have different con- figurations and kinematic constraints. Few of these con- straints can be effectively mapped from the human arm domain to the robot's restricted joint space. In this paper a general method of mapping human motions to the ro- botic arm domain has been demonstrated. The arm mo- ment is reciprocated almost exactly by the robotic arm. Data capture is achieved with the special motion capture sensor called "Shape Tape" that is worn by the human operator. Any human arm (or even leg, neck or spine) moment can be mapped on to any of the robotic arm ma- nipulator. Below is the outline of this paper. Section 2 describes related work, which gives a detail discussion about the various works that are taking place in this field. Section 3 describes the data hand glove controller and micro controller used. Section 4 shows the flow of action in the presented work. Section 5 discusses results. Finally Section 6 discusses about conclusion and future work.

II. PROPOSED METHOD

In this paper a assistive device for the stroke patients which can be useful for executing the required tasks which the user want to performs in the impaired hand side of the body. The user wears the data glove in the healthy hand where the glove senses two kinds of data as spatial and gestural data, spatial data provides the details about the motion of the hand and gestural data provides the data related to which what the user want to do with that motion like pick, grab, upward and downward actions of the hand movements. These data have been fetched by the two flex sensors and accelerometer sensors which has been present in the data glove. These data is transferred to the PIC microcontroller which makes the robotic arm to performs the desire task. This is an assistive method which makes the user to performs the tasks by using the robotic arm controlled by the arm movements of the healthy arm of the user.

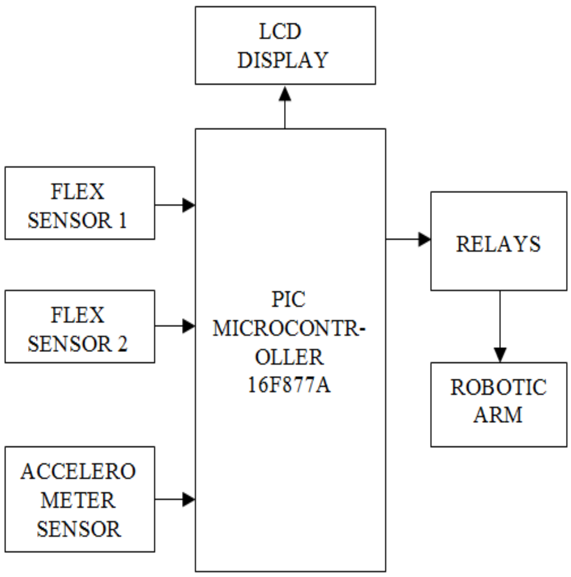

Fig1. Flex sensor based robotic arm using micro controller

II. PERFORMANCE METRICS

FLEXI FORCE SENSOR:
This manual describes how to use Tekscan's Flexi Force Sensors. These sensors are ideal for designers, researchers, or anyone who needs to measure forces without disturbing the dynamics of their tests. The Flexi Force sensors can be used to measure both static and dynamic forces (up to 1000 lbf.), and are thin enough to enable non-intrusive measurement.

The Flexi Force sensors use a resistive-based technology. The application of a force to the active sensing area of the sensor results in a change in the resistance of the sensing element in inverse proportion to the force applied.
The Flexi Force sensor is an ultra-thin and flexible printed circuit, which can be easily integrated into most applications. With its paper-thin construction, flexibility and force measurement ability, the Flexi Force force sensor can measure force between almost any two surfaces and is durable enough to stand up to most environments. Flexi Force has better force sensing properties, linearity, hysteresis, drift, and temperature sensitivity than any other thin-film force sensors. The "active sensing area" is a 0.375" diameter circle at the end of the sensor.

ACCELEROMETER SENSOR:
Accelerometer sensor have been developed to measure acceleration in a variety of application,a three dimensional accelerometer sensor has been created for measuring involuntary human hand motion.the sensor uses three single axis accelerometer fabricated at MIT Microsystems technology laboratory. the size and mass of the sensor werelimited to avoid altering hand motion being measured. To measure the three dimensional acceleration of human hand motion with adequate accuracy and precision ,the necessary bandwidth for normal human motion, and the amplitude range required for the highest normal acceleration. At the same time ,the physical presence of the sensor should not alter the hand motion .the application of measuring something sensitive to external mass like human hand requires the accelerometer sensor to be extremely small and lightweight.

CALIBRATION:
Calibration is the method by which the sensor's electrical output is related to an actual engineering unit, such as pounds or Newtons. To calibrate, apply a known force to the sensor, and equate the sensor resistance output to this force. Repeat this step with a number of known forces that approximate the load range to be used in testing. Plot Force versus Conductance (1/R). A linear interpolation can then be done between zero load and the known calibration loads, to determine the actual force range that matches the sensor output range.

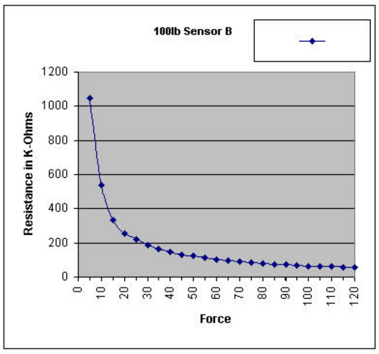

Fig2.Graphical representation of calibration.

LCD DISPLAY:
Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarizer's are pasted outside the two glass panels. These polarizer's would rotate the light rays passing through them to a definite angle, in a particular direction

When the LCD is in the off state, light rays are rotated by the two polarisers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarisers, which would result in activating / highlighting the desired characters.

The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations. The LCD's don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range.
Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly. The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used

for the display of text and graphics, and also in small TV applications.

PIC MICROCONTROLLER:

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877. The PIC start plus development system from microchip technology provides the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The pic start plus development system includes PIC start plus development programmer and mplab ide.The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software running under mplab provides for full interactive control over the programmer.

ROBOTIC ARM:

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand.The end effector, or robotic hand, can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. For example robot arms in automotive assembly lines perform a variety of tasks such as welding and parts rotation and placement during assembly. In some circumstances, close emulation of the human hand is desired, as in robots designed to conduct bomb disarmament and disposal.

RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contact or. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

DC MOTOR:

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.
Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

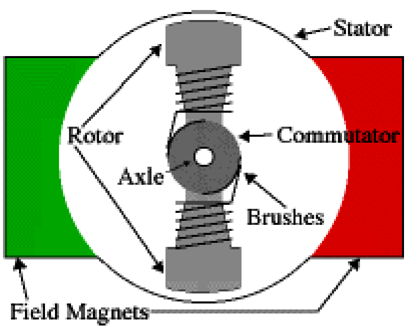

Fig3. DC motor.

Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes. In most common DC motors (and all that Beamers will see), the external magnetic field is produced by high-strength permanent magnets1. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotors (together with the axle and attached commutator) rotate with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets.

III. EXPERIMENTAL RESULTS AND DISCUSSION

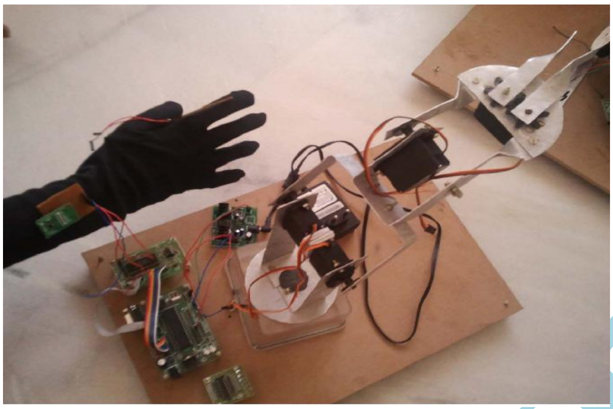

Fig4. Experimental set-up.

FLOW OF ACTION FOR THE ROBOTIC ARM

Read values of the sensor;
Micro controller processes the sensor values;
Send values from microcontroller to servomotors;
Pick up the objects;
Place at the required position;
Bring arm at original position.

IV. CONCLUSION

The progress in science & technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place. The proposed system based on PIC microcontroller is found to be more compact, user friendly and less complex, which can readily be used in order to perform. Several tedious and repetitive tasks. Though it is designed keeping in mind about the need for industry, it can extended for other purposes such as commercial & research applications. due to the probability of high technology (pic microcontroller) used The paper discussed a hardware and software co design of robotic arm controller using four servomotors employing micro controller. Micro controller programming can be done with an ease to suit the requirements. Unlike [7] which employ FPGA based control. Micro controller based programs can be flexibly modified to suit the necessary drive control of the serve motor. Researcher can work for wireless control of the robotic arm by employing some wireless application protocol. Then the robotic arm can be more efficiently employed The principle of the development of science is that “nothing is impossible”. So we shall look forward to a bright & sophisticated world

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