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Speech Recognition Writing Robotic Arm

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***Abstract* —** Robotics is a key technology in the modern world. Robots are a well-established part of manufacturing and warehouse automation, assembling cars or washing machines, and, for example, moving goods to and from storage racks for Internet mail order. More recently robots have taken their first steps into homes and hospitals, and seen spectacular success in planetary exploration. Yet, despite these successes, robots have failed to live up to the predictions of the 1950s and 60s, when it was widely thought - by scientists and engineers as well as the public - that by turn of the 21st century we would have intelligent robots as butlers, companions, or co-workers. Robotics is the branch of mechanical engineering, electrical engineering and computer science that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing.

These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century.

***Keywords* –** *LPC 2148 Microcontroller, Mechanical assembly, SAPI (Speech Application Programming Interface)*

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I. INTRODUCTION

Robotics performs very important role in every field. Robotics combines several engineering areas such as electronic, electrical, and mechanical and computer software for programming. There is metal working for the body. There is mechanics for mounting the wheels on the axles, connecting them to the motors and keeping the body in balance. We need electronics to power the motors and connect the sensors to the controllers, software to understand the sensors and drive the robot around. Throughout history, robotics has been often seen to mimic human behavior, and often manage tasks like humans. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots do jobs that are hazardous to people such as defusing bombs, mines and exploring shipwrecks.

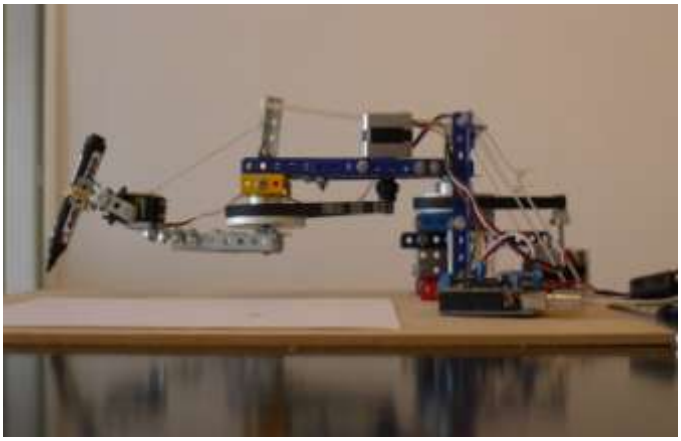

Figure 1: Robotic Arm Showing Writing Skills By Speech Recognition

Robotics can be defined as the science or study of the technology primarily associated with the design, fabrication, theory, and application of robots. While other fields contribute the mathematics, the techniques, and the components, robotics creates the magical end product. Robotics can be described as the current pinnacle of technical development. Robotics is a confluence science using the continuing advancements of mechanical engineering, material science, sensor fabrication, manufacturing techniques, and advanced algorithms. The study and practice of robotics will expose a dabbler or professional to hundreds of different avenues of study. For some, the romanticism of robotics brings forth an almost magical curiosity of the world leading to creation of amazing machines. A journey of a lifetime awaits in robotics. The practical applications of robots drive development of robotics and drive advancements in other sciences in turn. Crafters and researchers in robotics study more than just robotics. The promise of robotics is easy to describe but hard for the mind to grasp and implement. Robots hold the promise of moving and transforming materials with the same ease as a computer program transforms data. Today, robots mine minerals, assemble semi-processed materials into automobile components, and assemble those components into automobiles. On the immediate horizon are self-driving cars, robotics to handle household chores, and assemble specialized machines on demand. It is not unreasonable to imagine robots that are given some task, such as reclaim desert into photovoltaic cells and arable land, and left to make their own way. Then the promise of robotics exceeds the minds grasp. Robotics is the field related to science and technology. It stands tall by standing the accomplishments of many other fields of study. It is very essential to study the robotics for today's technology. [1]

In this project Robotic arms are programmed robot manipulator with similar functions of a human arm. Several kind of high technology prostheses are available for doing the basic functions of human arm. Aim of our project is to develop a robotic arm which helps the physically handicapped person

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to write. The robotic arm is to be fitted to the patient's amputee hand, and will write down the words that the patient pronounces to the microphone. The special feature of this robotic arm is that it is fitted with a pen which performs the writing operations.

II. DESIGN OF ROBOTIC ARM

Figure 2 shows the actual robotic arm which is to be implemented.

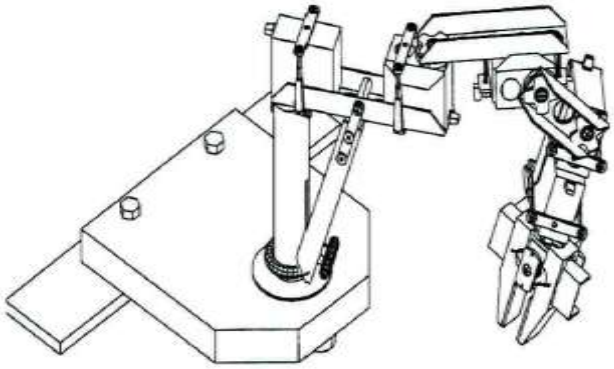

Figure 2: Robotic arm

The construction, working and principle of robotic arm is mainly divided into two parts. The first one is software part and the second one is the hardware part. Robotic arms are programmed robot manipulator with similar functions of a human arm. Several kind of high technology prostheses are available for doing the basic functions of human arm. Aim of our project is to develop a robotic arm which helps the physically handicapped person to write. The robotic arm is to be fitted to the patient's amputee hand, and will write down the words that the patient pronounces to the microphone. The special feature of this robotic arm is that it is fitted with a pen which performs the writing operations.

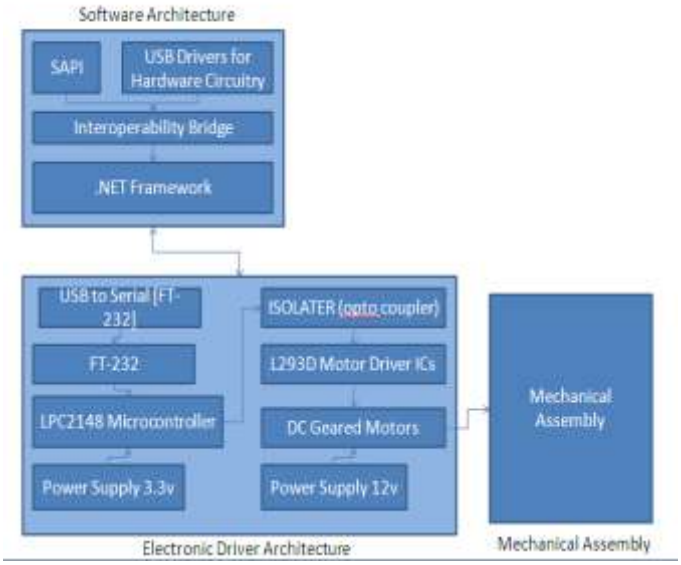

Figure 3: Block diagram

The figure 3 shows the general block diagrams of robotic arm. This consists of three basic units that is software architecture, electronic driver architecture and the mechanical assembly.

A. SOFTWARE ARCHITECTURE

In software system we have used interoperability which creates bridge between regular .net language and our usb serial driers to communication with hardware. That bridge is required because driver support is having windows functionality and .NET architecture has its own. SAPI is a set of regular API's(functions library). Which helps us to perform speech related operations. In SAPI we can create grammar or we can directly extract words those are spoken by user and perform operations over those words.

- Interoperability: It describes how .NET components can communicate with existing COM components without migrating those COM components into .NET components.
- Speech Application Programming Interface (SAPI) :The Speech Application Programming Interface or SAPI is an API developed by Microsoft to allow the use of speech recognition and speech synthesis within Windows applications. Broadly the Speech API can be viewed as an interface or piece of middleware which sits between applications and speech engines (recognition and synthesis). In SAPI versions 1 to 4, applications could directly communicate with engines. The API included an abstract interface definition which applications and engines conformed to. Applications could also use simplified higher-level objects rather than directly call methods on the engines.
- .NET Framework: The Microsoft .Net Framework provides tools and technologies that we need to build Networked Applications as well as Distributed Web Services and Web Applications. It also provides the necessary compile time and run-time foundation to build and run any language that conforms to the Common Language Specification (CLS).There are two main components of .Net Framework: Common Language Runtime (CLR) and .Net Framework Class Library (FCL).The Common Language Runtime (CLR) executes and manages all running code like a Virtual Machine. It is runtime environment of the .Net Framework. The .Net Framework Class Library (FCL) is a huge collection of language-independent and type-safe reusable classes. The .Net Framework Class Libraries (FCL) are arranged into a logical grouping as per their functionality and usability is called Namespaces.[5]

B. ELECTRONIC DRIVER ARCHITECTURE

We are suppose to use two DC geared motors to drive robotic arm in operating all directions and maximum area (as above 180^0).Two motors needs one L293D and to drive four we are using two L293D. We are having 2 different types of power supplies one is of 3.3 volts for LPC2148 (ARM Microcontroller) and another 12v for Motor driver. L293D works similar to relay architecture. We use DC Geared so that it performs each operation in a specific angle which helps us to calculate degree and direction in proper manner. FT-232 is a USB to serial converter IC.

- LPC2148 Microcontroller:

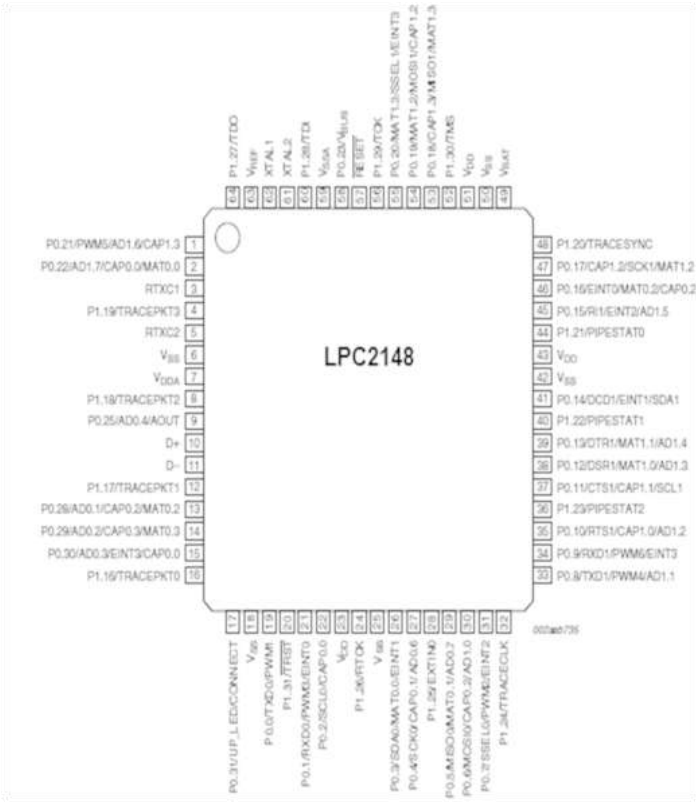

Figure 4: LPC2148Microcontroller

The heart of the circuit is microcontroller, here we used LPC2148 ARM 7 based Microcontroller. The above Figure 4 shows the pin diagram of LPC2148.LPC2148 is ARM 7 based Microcontroller and widely used in many applications. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.LPC2148 Microcontroller Socket is used with LPC2148 Pro Development Board i.e. standalone board for LPC2148. It has power on reset circuit with MCP130T brownout monitoring chip and power decoupling capacitors. This board can be used for LPC2148 based generic development. Its crystal frequency is 12MHz for system clock and 32 KHz for RTC. [3]

- OptoCouplers:

An Optocoupler is another very important component of this project. It is also called as, photo coupler, or optical isolator. It transfers electrical signals between two isolated circuits by using light. Opto-isolators prevent high voltages from affecting the system receiving the signal. A common type of opto-isolator consists of an LED and a phototransistor in the same opaque package. Other types of source-sensor combinations include LED-photodiode, LED-LASCR and lamp-photo resistor pairs. Commercially available opto-isolators withstand has input-to-output voltages up to 10 kV and voltage transients with speeds up to 10 kV/µs. Usually it transfer digital (on-off) signals, but some techniques allow them to be used with analog signals. An opto-isolator contains a source (emitter) of light, almost near infrared light-emitting diode (LED) that converts electrical input signal into light. A closed optical channel (dialectical channel), and a photo sensor, which detects incoming light and either generates electric energy directly, or modulates electric current flowing through external power supply. The sensor can be a photo resistor, a photodiode, a phototransistor, a silicon-controlled rectifier (SCR) or a triac. As LEDs can emit light as well as sense it,construction of symmetrical, bidirectional opto-isolators is possible. An optocoupled solid state relay contains a photodiode opto-isolator which drives a power switch, usually a complementary pair of MOSFETs.

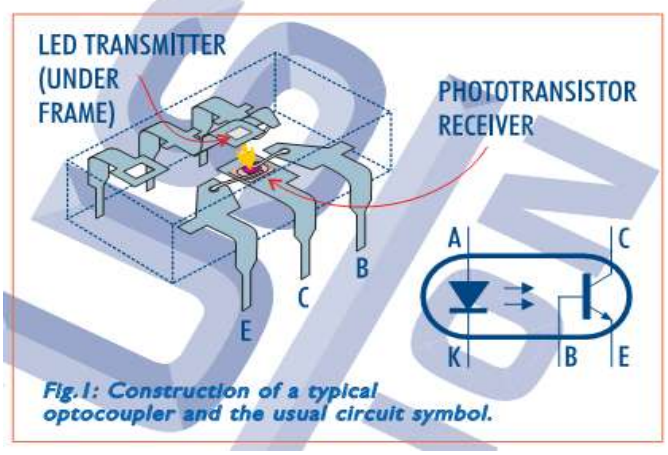

Figure 5: OptoCouplers

The above figure 5 shows construction and symbol of typical optocoupler. A slotted optical switch contains a source of light and a sensor, but its optical channel is open, allowing modulation of light by external objects obstructing the path of light or reflecting light into the sensor.[4]

- L293D:

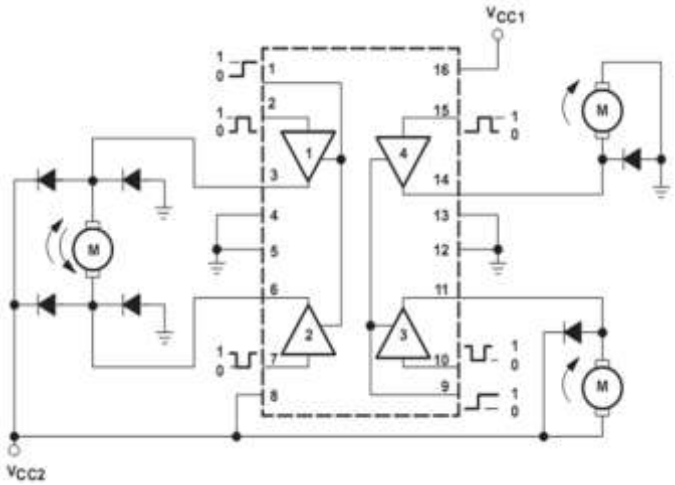

Figure 6: L293D

Figure 6 shows the L293D, motor driver IC. This allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that we can control two DC motor with a single L293D IC. The L293D is quadruple high current half-H drivers. It provides bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V, designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All

inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. A V CC1 terminal, separate from V CC2, provided for the logic inputs to minimize device power dissipation. [8]

- DC geared motor:

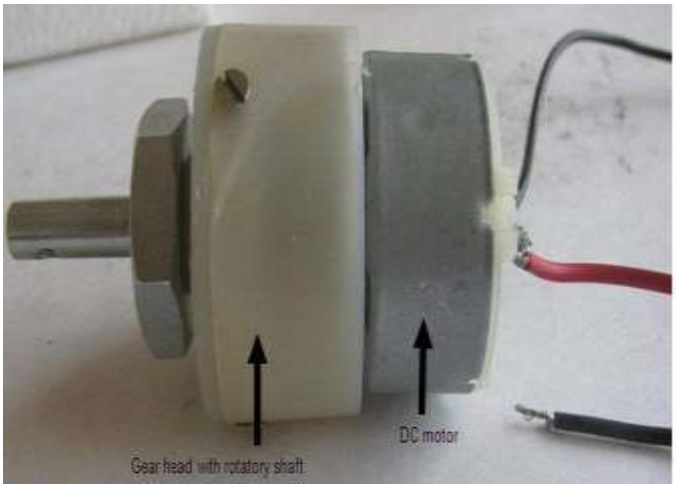

Figure 7: DC Geared motor

Figure 7 shows the dc geared motor with the arrow indicating names as gear head with rotary shaft and dc motor. Geared DC motors can be defined as an extension of DC motor which already had its Insight details demystified here. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute i.e. RPM .The gear assembly helps to increase the torque and reduce the speed. Its speed can be reduced to any desirable figure with the correct combination of gears in a gear motor. Gears reduce the speed of the vehicle but increase its torque is called as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.[14]

DC geared motor performs very important role in this project, without dc motor the project would be incomplete. A gear motor is a type of electrical motor. Like all electrical motors, it uses the magnetism induced by an electrical current to rotate a rotor connected to a shaft. The energy transferred from the rotor to the shaft is used to power a connected device. In a gear motor, the energy output is used to turn a series of gears in an integrated gear train. There are number of different types of gear motors, but the most common are AC (alternating current) and DC (direct current).In a gear motor, the magnetic current (which can be produced by either permanent magnets or electromagnets) turns gears that are either in a gear reduction unit or in an integrated gear box. A second shaft is connected to these gears and because of this the gears increases the amount of torque, the motor is capable of producing while simultaneously slowing down the motor's output speed. The motor will not need to draw as much current to function and will move more slowly, but will provide greater torque, performing gear reduction.

C. MECHANICAL ASSEMBLY

The third and very important part of the robotic arm is mechanical assembly by which the mechanical movement of the robotic arm is carried out. After the software, Programming part there is an electronic driver part in which working of microcontroller, dc motor and motor driver IC is carried out. The mechanical assembly part is completely dependent on mechanical movement of the arm.

Figure 8: Mechanical movement of robotic arm

A Microphone is fitted to the robotic arm which acts as the input to for the speech signal from the user. The microphone receives the audio signals (speech signal).i.e. the word pronounced by the patient and converts it into an electrical form. A PC sound cord transfers this signal to a MATLAB TOOL BOX where the signal acquisition process takes place. Then this information is matched with the preprogrammed DSP algorithm, where signal text conversion takes place. This text then is transferred to a microcontroller unit via serial port. This microcontroller unit converts the text signal from the MATLAB toolbox into mechanical action. The microcontroller controls the stepper motors which in turn controls the movement of the pen connected with the robotic arm. The Programming and working of our robotic arm mainly consists of two parts. The first part involves receiving the speech signal from the user and converting it into a text form for further processing and second part consists of using this

text data to obtain a suitable required mechanical action of the motors.

III. CONCLUSION

Robots, like computers, are powerful tools that open horizons to their human creators. They do not tire, and can stand up to environmental conditions that we cannot endure. In my senior design project, I have used the robotic arm to demonstrate speech recognition and writing skills of robot. The insertion control device demonstrated the usefulness of passive compliance devices in assembling tasks by compensating for any misalignment between the mating parts. In addition, performing such tasks using robots avoid the passive repetition of the movement that would bore a person assigned to the task and minimize human errors throughout the process. Meanwhile, the XR-4 robotic arm is able to perform the task continuously without tiring and with minimal errors. The force control device proposed can provide a suitable solution in robotic applications in industry where a constant amount of force onto a surface contact is required to accomplish a task, such as polishing a surface. Requirements for such a task would be impractical for a person to carry out since it is impossible for a person to gauge and maintain the amount of force that is applied onto a surface. Therefore active force feedback control devices are usually used in industries. With the advancement of robotic technology, more tasks are being performed by robots to reduce the execution time and minimize human errors, such as slips caused by exhaustion and negligence. Today we find most robots working for people in industries, factories, warehouses, and laboratories. Robots are useful in many ways. The robots are amazing technological advancement, which will allow people to save their time and precise life in more productive manner. The robots provide number of positive contributions to human being. The degree of accuracy is very high. Robotics is a rapidly growing field, as we continue to research, design, and build new robots that serve various practical purposes, domestically, commercially, or defense. Robotic arms are used in most industries such as material handling, welding, medical fields, and agricultural activities

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