Design and Development of Cylindrical Robot for Library Application

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Abstract: A cylindrical coordinate system is a three-dimensional coordinate system that specifies point positions by the distance from a chosen reference axis, the direction from the axis relative to a chosen reference direction and the distance from a chosen reference plane perpendicular to the axis, The design of three degrees-of-freedom (DOF) cylindrical robot, covering the entire mechatronic process, involving kinematics, control design and optimizing methods. To accelerate the construction of the robot, 3D printing is used to fabricate end-effector parts. The parts are modular, low-cost, reconfigurable and can be assembled in less time than is required for conventionally fabricated parts. The controller, including the control algorithm. Robotics have become a common course in a lot of higher institutions. Although there are many robots available in the market, most of them are for industrial purposes and are costly. There is a need to develop low cost robots for students in higher institutions to learn the elements of robotics such as design, kinematics, dynamics, sensing and control.

Index Terms **-** Library, Cylindrical Robot, 3-D Coordinate system, Pick and place

1. Introduction

Robotics is an applied engineering science that has been referred to as a combination of machine tool technology, electrical, electronics and computer science. It includes such seemingly diverse fields as machine design, control theory, micro-electronics, computer programming, artificial intelligence, human factors, and production theory. Research and developments are proceeding in all of these areas. Advancements in technology will enlarge the scope of the industrial applications of robots. Industrial robots are available in a wide variety of sizes, shapes, and physical configurations. The vast majority of today's commercially available robots possess one of four basic configurations: Cartesian, Cylindrical, Polar (Spherical) and Jointed-arm configurations. The notation for cylindrical coordinate system is P(ρ ϕ, z) .

The cylindrical coordinate robot, illustrated in Fig.1b, uses a vertical column and a slide that can be moved up or down along the column. The robot arm is attached to the slide so that it can be moved radially with respect to the column. By rotating the column, the robot is capable of achieving a work space that approximates a cylinder. Robotics course is essential for engineering education and is included in the undergraduate-level syllabus. Also, robotics is a unique educational tool for many reasons including its ability to inspire students and motivate them to be creative.

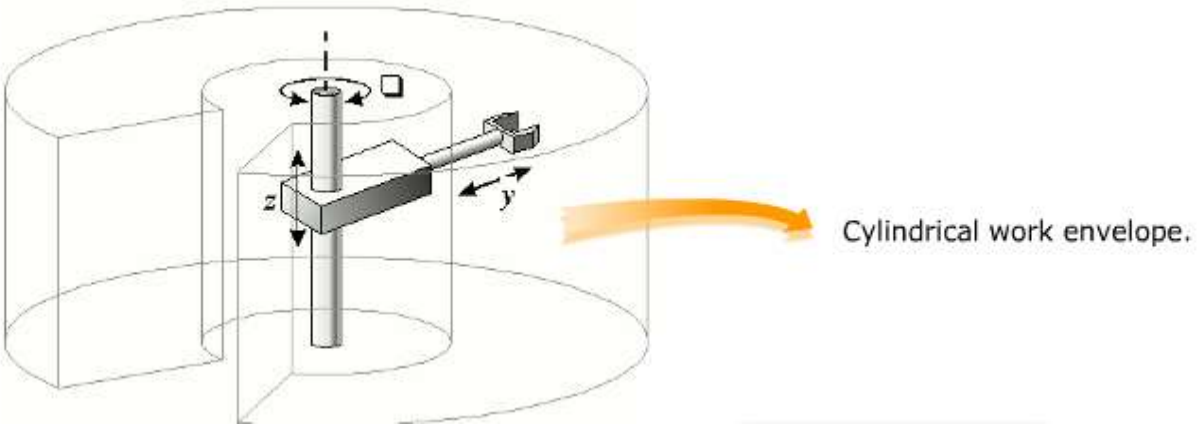

Fig. 1 Cylindrical work envelope.

Motion of the main arm is up and down. The robot can perform this motion by extending a cylinder that's built into the arm. In most cylindrical robots, the up-and-down motion is provided by a pneumatic cylinder, and the rotation is generally provided by a motor and gears.

Mainly used is as the "Industrial Robot" which is a programmable multi functional Manipulator designed to move materials, parts, moves , tools or special devices through variable programmed motions for the performance of a variety of tasks.

Commercial and industrial robots are now in widespread use performing jobs more cheaply or with greater accuracy and reliability than humans. They are also employed for jobs which are too dirty, dangerous or dull to be suitable for humans. Robots are widely used in manufacturing, assembly and packing, transport, earth and space exploration, surgery, weaponry, laboratory research, and mass production of consumer and industrial goods.

Robotics is a branch of engineering and science that includes electronics engineering, mechanical engineering and computer science and so on. This branch deals with the design, construction, use to control robots, sensory feedback and information processing. These are some technologies which will replace humans and human activities in coming years. These robots are designed to be used for any purpose but these are using in sensitive environments like bomb detection, deactivation of various bombs etc. Robots can take any form but many of them have given the human appearance.

The robots which have taken the form of human appearance may likely to have the walk like humans, speech, cognition and most importantly all the things a human can do. Most of the robots of today are inspired by nature and are known as bio-inspired robots.

Robotics is that branch of engineering that deals with conception, design, operation, and manufacturing of robots.

There was an author named Issac Asimov, he said that he was the first person to give robotics name in a short story composed in 1940's. In that story, Issac suggested three principles about how to guide these types of robotic machines. Later on, these three principles were given the name of Issac's three laws of Robotics.
These three laws state that:

- Robots will never harm human beings.
- Robots will follow instructions given by humans with breaking law one.
- Robots will protect themselves without breaking other rules.

1.1 Characteristics of the Robot :

There are some characteristics of robots are as followed ;
Appearance: Robots have a physical body. They are held by the structure of their body and are moved by their mechanical parts. Without appearance, robots will be just a software program.
Brain: Another name of brain in robots is On-board control unit. Using this robot receive information and sends commands as output. With this control unit robot knows what to do else it'll be just a remote-controlled machine.
Sensors: The use of these sensors in robots is to gather info from the outside world and send it to Brain. Basically, these sensors have circuits in them that produces the voltage in them.
Actuators: The robots move and the parts with the help of these robots move is called Actuators. Some examples of actuators are motors, pumps, and compressor etc. The brain tells these actuators when and how to respond or move.
Program: Robots only works or responds to the instructions which are provided to them in the form of a program. These programs only tell the brain when to perform which operation like when to move, produce sounds etc. These programs only tell the robot how to use sensors data to make decisions.
Behaviour: Robots behaviour is decided by the program which has been built for it. Once the robot starts making the movement, one can easily tell which kind of program is being installed inside the robot.

1.2 Types of Robots :

There are some types of robots given below are as follows,
Articulated: The feature of this robot is its rotary joints and range of these are from 2 to 10 or more joints. The arm is connected to the rotary joint and each joint is known as the axis which provides a range of movements.

Fig.2 Articulated robot.

Cartesian: These are also known as gantry robots. These have three joints which use the Cartesian coordinate system i.e x, y, z. These robots are provided with attached wrists to provide rotatory motion.

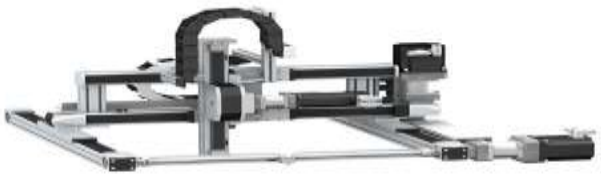

Fig.3 Cartesian Robot.

Cylindrical: These types of robots have at least one rotatory joints and one prismatic joint which are used to connect the links. The use of rotatory joints is to rotate along the axis and prismatic joint used to provide linear motion.

Fig.4 Cylindrical robot.

Polar: These are also known as spherical robots. The arm is connected to base with a twisting joint and have a combination of 2 rotatory joint and one linear joint.

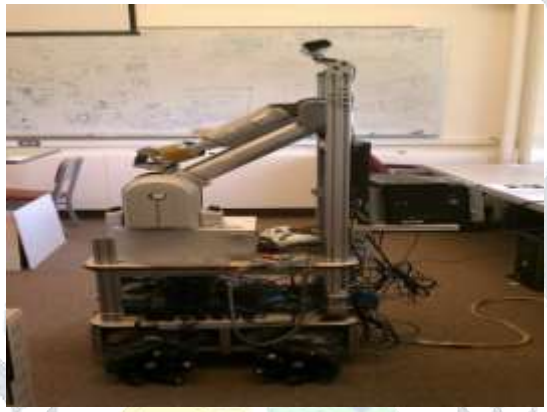

Fig.5 polar robot.

Scara: These robots are mainly used in assembly applications. Its arm is in cylindrical in design. It has two parallel joints which are used to provide compliance in one selected plane.

Fig.6 Scara Robot.

Delta: The structure of these robots are like spider-shaped. They are built by joint parallelograms that are connected to the common base. The parallelogram moves in a dome-shaped work area. These are mainly used in food and electrical industries.

Fig.7 Delta robot.

1.3 Scope and limitations of robots

The advance version of machines are robots which are used to do advanced tasks and are programmed to make decisions on their own. When a robot is designed the most important thing to be kept in mind is that What the function is to be performed and what are the limitations of the robot. Each robot has a basic level of complexity and each of the levels has the scope which limits the functions that are to be performed. For general basic robots, their complexity is decided by the number of limbs, actuators and the sensors that are used while for advanced robots the complexity is decided by the number of microprocessors and microcontroller used. As increasing any component in the robot, it is increasing the scope of the robot and with every joint added, the degree of the robot is enhanced.

1.4 Advantages:

The advantages of using robots are given below:

- They can get information that a human can't get.
- They can perform tasks without any mistakes and very efficiently and fast.
- Maximum robots are automatic, so they can perform different tasks without needing human interaction.
- Robots are used in different factories to produce items like plane, car parts etc.
- They can be used for mining purposes and can be sent to earth's nadris.

1.5 Disadvantages :

The disadvantages of using robots are given below:

- They need the power supply to keep going. People working in factories may lose their jobs as robots can replace them.
- They need high maintenance to keep them working all day long. And the cost of maintaining the robots can be expensive.
- They can store huge amount of data but they are not as efficient as our human brains.

1.6 Applications:

Different types of robots can performs different types of tasks. For example, many of the robots are made for assembly work which means that they are not relevant for any other work and these types of robots are called Assembly Robots. Similarly, for seam welding many suppliers provide robots with their welding materials and these types of robots are known as Welding Robots. While on the other hand many robots are designed for heavy-duty work and are known as Heavy Duty Robots.

There are some applications given below:

- Caterpillar plans which is aiming to develop remote-controlled machines and are expecting to develop heavy robots by 2021.
- A robot can also do Herding task.
- Robots are increasingly been used more than humans in manufacturing while in auto-industry there are more than half of the labours are "Robots".
- Many of the robots are used as Military Robots.
- Robots have been used in cleaning up of areas like toxic waste or industrial wastes etc.
- Agricultural robots.
- Household robots.
- Domestic robots.
- Nano robots.

2. LITERATURE SURVEY

1. Cylindrical robot for multi-purpose operations-_The various operation required multiple manpower to perform it on single production line which is time consuming and may decrease the production rate. We have to perform various operation on single job which require tools to perform it. So a system performing multipurpose operations like drilling, fitting, grinding, etc. Needs to be developed.

2. Developing new application fields for Industrial robots – Several factors contributing to the success and failure of academia industry partnerships related to their own project experience are discussed.
3. Different types of robots used in the society – Literature survey and review on structural properties of different types and shapes of robots used.
4. Cylindrical robots approaches - Research into autonomous driving using smaller robots typically follows one of the two approaches, i.e. A mathematical modelling of vehicle and it's surrounding are generated.
5. Survey of robotic arm and parameters- This is a survey paper on a robotic arm and their development. It gives a technical introduction to some of the recent research work in this field. This is a working field of research in which there are a number of outstanding open problems and an area of exploration. Robotic arm uses in the different fields like a household, workplace, and working station.
6. Structural properties of different types of robots-Cylindrical robots have two prismatic joints which is one rotary joint for positioning task and the end- effector of the robot forms a cylindrical workspace.
7. Design and development of Cylindrical Robot for various applications – The main concept of this research is to deliver the book to the Students using a robot in a library. This study is essential in Order to increase the efficiency of delivering books to the Student in library. In other words, it decreases the waiting time During peak hours. The robot uses a ATMEGA microcontroller To run a program with a combination of RFID technology, IR Sensors for detecting the path, a simple gripper.

3 Scope of Research

The basic idea in this project is implementation of cylindrical robot. Though it can be implemented in various methods, when different parameters are taken into consideration this method is the most feasible way of implementation. Other wasys of enactmenting the model is enabling them to adapt to the surroundings.

So the robot defects the respective path by using IR sensors which is placed in the robot and it follows the path and it fetches the respective book and delivers it to the student.

When we enter in library first we have to enter the name of book which we want to issue. The input is given through the switch. This information provides to the microcontroller AT mega 8. According to the information motor is moved and because of movement of motor whole robotic structure is moved.

4. DESIGN AND NUMERICAL ANALYSIS

Screw Rod Calculations.

Helix Angle : $\alpha = [\![(\tan)^{(-1)} [\![l/\pi D]\!]$

Where l : lead in mm

D : pitch Dia i.e D=given dia-P/2

P : pitch in mm

Torque:$T=FD/2\ ((\mu\pi D+l\cos\alpha)/(\pi D\cos[\![\alpha-\mu l]\!]))$

Where μ:coeffecient of friction

F:force / load carrying capacity

Problem:

Given dia=8mm

Lead=8mm

T=280Nmm

$A=\tan^{(-1)}[\![8/(\pi\times7)]\!]=19.99\approx20$

$280=(F\times7)/2\ ((0.07\pi7+8\cos20)/(\pi7\cos20-0.07\times8))$

F=177.58N

F=18.10kg

But practical load carrying capacity, F=9.05kg

Calculations for first Degree of freedom,

Base rotary axis and we are using pulley and belt calculations.

Pulley Calculations.

Torque:$T=FD/2\eta i$

Where F:force

D : dia of pulley

I : gear ratio

H : effeciency of motor

Problem:

Given D=12.7mm

T=280mm

280=(FX12.7)/2=45.82N

Load Carrying capacity 4.67kg

velocity:

$=\Pi*D*Rpm$

$=3.142*12.7*300=11969.5mm/min=199.5mm/sec$

5. COMPONENTS TO BE USED

5.1 20×20 Aluminium Profile .

The Astro Industrial Duty Aluminium 2020H European Standard Anodized Profiles made of High Grade tempered Aluminium Alloy 6063 – T5. The dimensions are as per European Standard and the structural cross section thickness is minimum

of 1.5 mm. The profile can be used for structural elements in automation machinery, laser cutting machines or 3d printers. Also many prototype CNC router machines, XY tables or camera sliders can be made using the same.

The profile is anodized in natural aluminium colour to provide a hard layer to prevent corrosion and wear.

We have a number of accessories available to easily assemble various structures using the 2020 profile. Please check out the same in the Aluminium Profile Accessories Section.

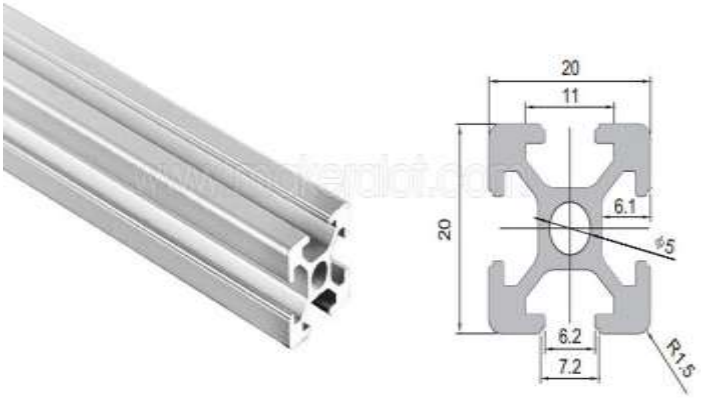

Fig. 8 Aluminium components.

Specifications,

Profile size : 20X20.
Type : European Standard new aluminium alloy 20X20 aluminium profile .
Material : High Strength Tempered Aluminium Alloy 6063 – T5.
Anodized : Clear(Silver) Anodized colour.
Diagonal Section Thickness: 1.5 mm.
Weight: approx. . 0.5 kg / meter.
Dimensions : OD 20 mm x 20 mm.

5.2 Acrylic components

Acrylic sheet is a material with unique physical properties and performance characteristics. It weighs half as much as the finest optical glass, yet is equal to it in clarity and is up to 17 times more impact resistant. Cast acrylic sheet is made in over 250 colours, in thicknesses from .030" to 4.25' and can transmit ultraviolet light or filter it out, as required.

Aircraft manufacturers use Cast Acrylic sheet in jets and helicopters. Because of its light and energy transmission properties architects find Cast acrylic sheet ideal for skylights, sun screens, fascia panels and dome structures.

Fig. 9 Acrylic laser cutting components.

5.3 GT2 20T PULLEY

Fig.10 GT2 20T Pulleys.

This is Aluminium GT2 Timing Pulley 20 Tooth 8mm Bore For 6mm Belt. For precise motion control, GT2 belts and pulleys offer excellent precision at a great price. This pulley is meant for use with GT2 6mm wide belts only – MXL belts will slip due to the different tooth profile.

This pulley has 20 teeth and an 8mm inner bore. Two set screws can be used to attach it firmly to any 8mm diameter shaft. Full aluminium construction means these are very light and very durable.

Table 1 : Technical Specifiation

Material	*Aluminium*
Inner Diameter (ID) (mm)	*8*
Outer Diameter (OD)(mm)	*16 mm*
Width (mm)	*16*
Compatible With	*M4x4*
No. of teeth	*20*
Weight (gm)	*8*

5.4 GT2 BELT

Fig.11 BT2 Belt.

The Timing Belt is also called as the synchronous belt is popularly known for its non-slipping mechanical drive belt. It is composed of the flexible belt which contains a row of teeth embedded on the inner surface of the belt. Timing Pulley and belt works when the toothed parts become compatible with each other.

It is a belt that usually features teeth on the inside surface, while a timing chain is a roller chain. Widely used in mechanical devices, printers/photocopiers, 3d printer, robotics, automation, etc.

Table 2 : Technical Specification

Material	*Neoprene Rubber With Fiberglass Core*
Shape	*Open Loop*
Total Length	*10 M*
Pitch	*2*
Width (mm)	*6*
Tooth Height	*0.76*
Belt Height(mm)	*1.52*

5.5 WHEEL WITH BEARINGS.

Fig.12 bearing wheels used for sliding.

These type of pulleys are produced by high-precision automatic lathe machining, with machining error within 0.005mm. The bearings we use are high quality 625ZZ Bearings. The features and advantages include: Smooth motion, low noise, high printing precision, can greatly improve the printing speed.

Specifications,

Type : Pulley
Outside Diameter: about 24mm
Bore : 5mm
Thickness : about 10.23mm
Size : about 24*16*10.23mm
Material : POM
With Bearings : YES
Bearing : 625zz bearing.

5.6 NEMA 17 STEPPER MOTOR

Fig.13 stepper motor.

A stepper motor, also known as step motor or stepping motor, is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. Switched reluctance motors are very large stepping motors with a reduced pole count, and generally are closed-loop commutated.

Brushed DC motors rotate continuously when DC voltage is applied to their terminals. The stepper motor is known by its property of converting a train of input

This hybrid bipolar stepping motor has a 1.8° step angle (200 steps/revolution). Each phase draws 1.7 A at 2.8 V, allowing for a holding torque of 3.7 kg-cm (51 oz-in). The motor has four color-coded wires terminated with bare leads: black and green connect to one coil; red and blue connect to the other. It can be controlled by a pair of suitable H-bridges (one for each coil), but we recommend using a bipolar stepper motor driver or one of our Tic Stepper Motor Controllers. In particular, the Tics make control easy because they support six different interfaces (USB, TTL serial, I²C, RC, analog voltages, and quadrature encoder) and are configurable over USB with our free configuration utility.

Specifications,

- Size: 42.3 mm square × 38 mm, not including the shaft (NEMA 17)
- Weight: 285 g (10 oz)
- Shaft diameter: 5 mm "D"
- Steps per revolution: 20
- Current rating: 1.68 A per coil
- Voltage rating: 2.8 V
- Resistance: 1.65 Ω per coil
- Holding torque: 3.7 kg-cm (51 oz-in)

- Inductance: 3.2 mH per coil
- Lead length: 30 cm (12″)
- Output shaft supported by two ball bearings.

5.7 Arduino Mega Microcontroller Board

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It is intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

Fig.14 Arduino microcontroller board.

The Arduino Mega 2560 R3 is an open source precise microcontroller board Successor to the Arduino Mega based on the ATmega2560 SMD chip. The Mega 2560 R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes. The Mega 2560 R3 works with all existing shields but can adapt to new shields which use these additional pins.

This Board has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. Using the board is also very easy, simply connect it to a computer with a USB cable or power it with DC adapter or battery to get started.

5.8 Connecting Stepper motor to TB6600

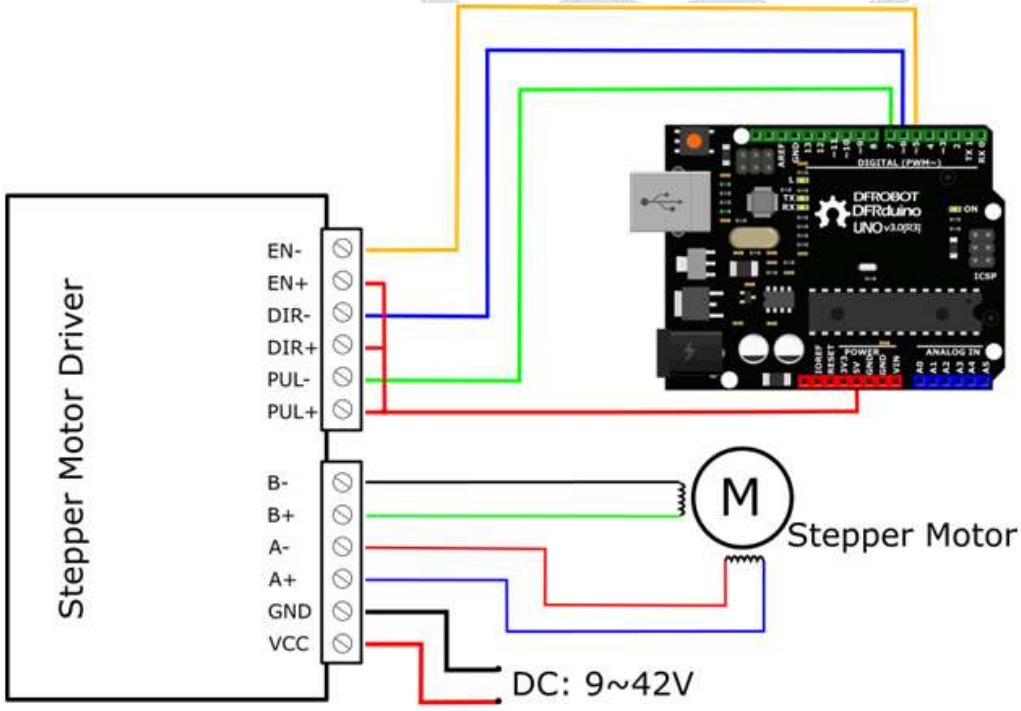

Fig.15 Line diagram of Arduino microcontroller and stepper motor.

6. WORKING PRINCIPLE

6.1Cylindrical Coordinate System

A cylindrical coordinate system is a three-dimensional coordinate system that specifies point positions by the distance from a chosen reference axis. The origin of the system is the point where all three coordinates can be given as zero. This is the intersection between the reference plane and the axis.

The axis is variously called the cylindrical or longitudinal axis, to differentiate it from the polar axis, which is the ray that lies in the reference plane, starting at the origin and pointing in the reference direction.

The distance from the axis may be called the radial distance or radius, while the angular coordinate is sometimes referred to as the angular position or as the azimuth. The radius and the azimuth are together called the polar coordinates, as they correspond to a two-dimensional polar coordinate system in the plane through the point, parallel to the reference plane. The third coordinate may be called the height or altitude (if the reference plane is considered horizontal), longitudinal position or axial position.

Cylindrical coordinates are useful in connection with objects and phenomena that have some rotational symmetry about the longitudinal axis, such as water flow in a straight pipe with round cross-section, heat distribution in a metal cylinder, electromagnetic fields produced by an electric current in a long, straight wire, and so on. It is sometimes called “cylindrical polar coordinate “and “polar cylindrical coordinate”, and is sometimes used to specify the position of stars in a galaxy (“glossocentric cylindrical polar coordinate”).

6.1.1 Robot Control System

Robot control systems consists of 3 major sections,

1. Mechanical structure of the robot: Mechanical section Includes, all mechanical parts such as Stepper motors, Linkages, Supports, bearings, pulleys & belts, screw rod & Guides rods etc.
2. Controller & Drives: Controller Drives incudes, Microcontroller & Stepper Drives used to control the Movements & positions of Robots.
3. Control Software: Control Software is interfacing Software used to teach the positions of the robot & Applications based on the requirements..

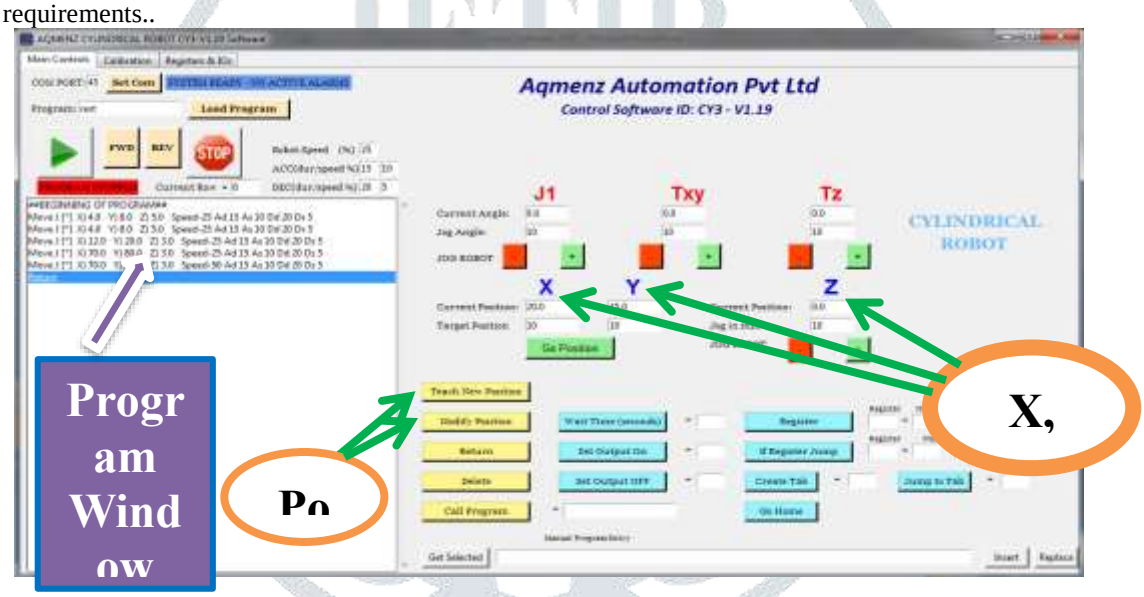

Fig.16 Startup Window of Software

6.1.2 Testing of Motor

Before the motor is implemented into the robot, it has to be Tested to know the working condition of the motor. The Testing of the motor was done in aqmenz cylindrical robot Control software.

The motors are connected to the microcontroller, which is Further connected to SMPS. The software computer by giving The value of X, θ, Z as shown in Fig.2 We can jog the robot by Entering the jog distance in mm as shown above. By clicking ‘+’ button we can jog in forward movement & using ‘-‘button Robot can jog in reverse direction. Hence we can conclude that The motors are running in good working condition.

6.1.3 Mechanical part assembly

The mechanical components required for the robot were Accurately made by different machining processes. Some of The components were directly brought from the market and Some parts were manufactured using a 3D printer. After this The different parts where assembled mechanically as per the Above design configurations. The cut parts are assembled Together with the NEMA 17 motors and assembly of the robot Arm is completed. The robot arm moves by 3 joints and performs this movement with 3 Mini Stepper Motor.

There is one stepper motor in the stationary lower part of The robot arm and this forms the rotary joint. This joint Provides rotation of the robot arm to the right or left. There are Two stepper motors in the moving upper body part. Since These stepper motors must operate parallel to each other, Both start and end positions are set simultaneously. These Two stepper motors are connected to the X axis and Z axis Respectively. The task of 2nd motor is to move the robot arm Up and down and the task of the 3rd motor is to move the Robot arm to the left and right positions.

The components here used are Arduino board, CNC Shield + A4988, Proximity Sensor, Tb6600 Stepper Motor Driver, NEMA 17 stepper motor . Now talking about it stepper motors they are Excessively used when there is a need for an accurate shaft Movement or position. These are not proposed for high speed Applications. Stepper motors are proposed for low speed, Medium torque and accurate position application. So they are Best for designing robotic arm. Stepper motor are available at Different shapes and sizes. We are going to use NEMA 17 Stepper motors (three). A stepper motor will have mainly Three wires

positive voltage another is for ground and the last One is for position setting. The red wire is connected to power, The brown wire is grounded and the orange wire is for signal.

1. The arm has been built with cardboards and the individual Parts have been locked to servo motors. Arduino is Programmed to control stepper motors. Stepper motors are Acting as joints of Robotic arm here.
2. This Robotic Arm is controlled by three Arduino Stepper Motor Driver which is attached to each stepper motor. We can Move these motors by rotating the stepper motor to pick some Object, with some practice we can easily pick and move the Object from one place to another. Here we use low torque Motors, but we can use more powerful servos to pick heavy Object.

7. SOFTWARE REQUIREMENTS

The hardware components which are used are programed by means of the software tools. The various software which are included are presented briefly.

Our Project involves two major Software Parts,

- Arduino Programming
- Python based Control Software

7.1 Arduino Programming:

The main control system of the project is the Microcontroller Which controls the movements of the robot by driving Stepper Motors with respect to the robot kinematics. Arduino Microcontroller board is used in this project which is Programmed in such a way that robot can move depends on The input received from the python based control software From PC.

The hardware components which are used are programmed By means of the software tools. The various software which Are included are presented briefly. The software used to Program the microcontroller is Arduino IDE.

A program for Arduino hardware may be written in any programming language with compilers that produce binary machine code for the target processor. Atmel provides a development environment for their 8-bit AVR and 32-bit ARM Cortex-M based microcontrollers: AVR Studio (older) and Atmel Studio (newer)

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

7.2 Python based Control Software:

This the User interface software which guides the robot to Move to required position based on the kinematics of the robot By sending x, y & z position commands to Robot.

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

8. Modeling

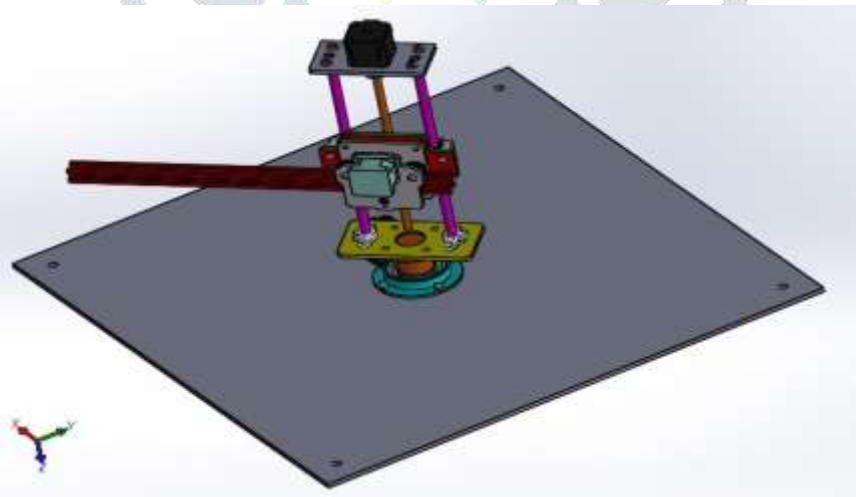

Fig.17 3-D model on solidworks

The above figure is the isometric view of the final assembled Model of the cylindrical robot where all the three sub assemblies are fitted on to the base plate of dimensions (600*600mm). The complete design and modelling was done using solidworks software.

9. MECHANICAL ASSEMBLY

Fig.18 Mechanical Assembly underwork

10. RESULTS AND DISCUSSIONS

Starting with rough drawings of robotic arm and by using a 3D parts & Aluminium profiles, model is created to find its working area, movements and degrees of freedom. The designed model working has been studied by moving all links with respect to its motions (Linear and Rotary) with the help of DC stepper motors. During this experimental study it is found that the model is working as per the required movements and motions of the links and end effector successfully. The type of parts required, quantity of motors and location where motor is to be fitted can be identified from experimental model.

11. Our Contribution to the Society

Robots can be classified by intended application field and the tasks they perform. We mentioned industrial robots which work in well-defined environments on production tasks. The first robots were industrial robots because the well-defined environment simplified their design. Service robots, on the other hand, assist humans in their tasks. These include chores at home like vacuum clears, transportation like self-driving cars, and defence applications such as reconnaissance drones. Medicine, too, has seen increasing use of robots in surgery, rehabilitation and training. These are recent applications that require improved sensors and a closer interaction with the user.

12. Expected Outcomes

- Pick & Place the objects like book in our case very accurately.
- Position can be programmable.
- Reliability will be more.

13. SCOPE FOR FUTURE WORK

The technology is advancing rapidly in almost all the fields, not in a minute but in every second. With this quick development in technology, tremendous growth has been observed in the global automation industry. The usage of automation techniques is in continuous growth and it is anticipated for the predictable future. The robotic process automation is one of the revolutions in the automation industry, and it is expected to increase higher potential in terms of utilization and staff implementation in the upcoming year. Robotic Process Automation, particularly focuses on the process automation of those industries which are mostly business oriented and are handled by humans. Using RPA, all the operations would be automated easily, but it is expected that it will replace the human jobs because in the future the robotics oriented automated tools will be highly effective.

Future enhancement can include further Improvement that is by adding 360 degree rotary servo motor and making it more stable. Setup can be modified that will pick more weight compared to present model.

Ultrasonic sensor can even be placed on the arm so that it can detect and simultaneously pick the object and keep it on other place.

13. CONCLUSION

Today we find most robots working for people in industries, factories, warehouses, and laboratories. Robots are useful in many ways. For instance, it boosts economy because businesses need to be efficient to keep up with the industry competition. Therefore, having robots helps business owners to be competitive, because robots can do jobs better and faster than humans can, e.g. Robot can built, assemble a car. Yet robots cannot perform every job; today robots roles include assisting research and industry. Finally, as the technology improves, there will be new ways to use robots which will bring new hopes and new potentials.

Cylindrical robotic arm was developed using pneumatic linear actuators to carry out material handling tasks for industries where the usage of electric components can be hazardous. The design of the Robot employed Open loop control using a microcontroller and Stepper Motors provided precise and improved control of the joint angle with high accuracy & very good performance.

We have presented the design of a low-cost cylindrical robot useful for manipulation research. In gearing, we traded off the space and complexity of a timing belt and zero-backlash cable drive circuit in place of the cost of an expensive gear head. In

motor selection, we used stepper motors for their high torque at low speeds, in exchange for a highly-reduced brushless or brushed motor.

These design trade-offs were chosen for the envisioned target application of robots interacting with unstructured Environments such as a typical home or workplace, where the safety of intrinsic mechanical compliance is an important design consideration. The cost- controlling trade-offs described in this paper were made as an effort towards designing affordable compliant manipulators, an area of research which, to date, has received little attention, and which we propose could have a large impact on the speed of adoption of robots into library and workplaces.

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