Design and Development of Palletizing SCARA ROBOT for Food Processing industry

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Abstract- 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. The aim of this project is to design and develop a mechanical structure of a SCARA robot that can perform certain tasks for educational, research and exhibition purposes such as pick and place operation. There report discusses the steps used in design and development of a 3 degree of freedom SCARA robot which includes specification definition, conceptual design, product development, and testing. the specifications of the SCARA robot are first determined. the best conceptual design of the SCARA robot is chosen after making concept evaluation in the conceptual design phase. Then, in third phase which is the product generation, the chosen design of the SCARA robot is fine-tuned. The direct and inverse kinematics, dynamics of the robot are then modeled. Off shelf parts are also selected based on the derived parameters from calculations. Electronic parts such as sensors and dedicated controller using low cost microcontroller are then developed. Finally, the developed SCARA robot is tested to see whether it fits the targeted specifications.SCARA robots are among the most widely used robots in industry due to their inherent rigidity and high accuracy. The design process included, joint design, link design, controller design as well as selection of mechanical and electrical components. SCARA robot offers impressive performance such as ~±0.2 mm repeatability, maximum linear velocity of 8.5 m/s in XY plane, 0.8 seconds pick and place cycle time and a flexible control system. These specifications are in line with existing industrial robots. However, unlike the existing commercial robots, the control architecture in SCARA is designed to allow for simple implementation of new python control algorithms.

1 INTRODUCTION

During the last 45 years, robotics research has been aimed at finding solutions to the technical necessities of applied robotics. The evolution of application fields and their sophistication have influenced research topics in the robotics community. This evolution has been dominated by human necessities. In the early 1960s, the industrial revolution put industrial robots in the factory to release the human operator from risky and harmful tasks. The later incorporation of industrial robots into other types of production processes added new requirements that called for more flexibility and intelligence in industrial robots. Currently, the creation of new needs and markets outside the traditional manufacturing robotic market (i.e., cleaning, demining, construction, shipbuilding, agriculture) and the aging world we live in is demanding field and service robots to attend to the new market and to human social needs.

1.1Roboticarmdefinition

SCARA Robot SCARA (which stands for Selectively Compliant Articulated Robot Arm) is a specialty robot which has two parallel rotary joints to provide compliance in a plane. A third prismatic joint allows the arm to translate vertically. SCARA robots differ from articulated robots in that its workspace consists of two concentric cylinders, demonstrated in figure 1. This robot arm is specialized for assembly operations that involve placing parts on top of one another. The gripper can raise, lower, and rotate to orient the component to be assembled.SCARA industrial robot with a high degree of flexibility and versatility, has been in the electronics, semiconductor,pharmaceutical pharmaceuticals, automotive, consumer goods and other industries so as to obtain a wide range of applications. Multi-DOF SCARA industrial robot is a highly non-linear, strong coupling, time-varying systems, so to design a high- precision SCARA robot control system, for the corresponding robot body kinematics modeling is one of the key technologies used to verify the correctness of the model. More and more Control Session scholars began to be interested in studying SCARA robots.

The purpose of using robotic arm is to reduce errors and human efforts. As the robotic field is having an application in various department of engineering such as production, inspection, material handling etc. This type of robotic arm is famous for its characteristics like high speed, good accuracy, less maintenance and repeatability in pick and place operation which is required in assembly. This case study is relate with design, manufacturing and analysis of mechanical structure of SCARA. The SCARA stands for Selective Compliance Assembly Robot Arm having 3 degrees of freedom in which one is linear motion and three rotational motions.

2.LITETURESURVEYS

1. Design and Fabrication of Pick and Place Robot to be used in Library by AnushaRonanki, M. Kranthi….[1]

The use of robots in library is becoming more popular in recent years. The trend seems to continue as long as the robotics technology meets diverse and challenging needs in educational purpose. The prototype consists of robotic arm along with grippers capable of moving in the three axes and an ATMEGA 8 microcontroller. Software such as AVR Studio is used for programming, PROTESUS is used for simulation and PROGISP is used for dumping the program. RFID is used for identifying the books and it has two IR Sensors for detecting the path. This robot is about 4 kg in weight and it is capable of picking and placing a book of weight one kg.s.

2.ROBOT ARM CONTROL WITH ARDUINO By Abdellatif Baba….[2]

Today, technology is developing in the same direction in line with rapidly increasing human needs. The work done to meet these needs makes life easier every day, and these studies are concentrated in robotic arm studies. Robot arms work with an outside user or by performing predetermined commands. Nowadays, the most developed field of robot arms in every field is the industry and medicine sector. Designed and realized in the project, the robot arm has the ability to move in 4 axis directions with 5 servo motors. Thanks to the holder, you can take the desired material from one place and carry it to another place, and also mix it with the material it receives. While doing this, robot control is provided by connecting to the android application via

Bluetooth module connected to Arduino Nano microcontroller.

3.Pick and Place Robotic Arm Implementation Using Arduino Ashly Baby1 ,Chinnu Augustine2, Chinnu Thampi3, Maria George4 , Abhilash A P5 ,Philip C Jose6 …..[3]

A robotic arm is designed using arduino to pick and place the objects via user commands. It will pick and place an object from source to destination safely. The soft catching gripper used in the arm will not apply any extra pressure on the objects. The robot is controlled using android based smart phones through Bluetooth. Based on the commands given by the user the robot moves accordingly. At the receiver end there are four motors interfaced with the micro controller. Two for the vehicle movement and the remaining two are for arm and gripper movement. Blue control application is used for the controlling of robot. Keywords: Pick and place robotic arm, Blue control app, soft catching gripper

4.Design And Development Of A 4–DofScara Robot For Educational Purposes by KsmSahari and Hong WengKhor….[4]

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5.Auto & Manual Control of Robotic Arm Using PLC by R. Jagan1 ,P.Rana Singh2 , CH .Ashirvadam3 , K .Navitha4 ……[5]

The main objective of this project is to control the Robotic Arm manually and automatically by using Programmable Logic Control(PLC) to pick the moving object on a conveyor belt. In industries highly advanced robots are used, but still the controlling is done by manually or processors like arduino, microprocessors etc. There are several disadvantages by using these processors like micro controllers cannot work in the environments with the high levels of vibrations, corrosion, humidity, and other environmental factors. All these problems are overcome by using Programmable Logic Controller (PLC) which acts as a brain to control the robotic arm. This project focuses to create and build more compact, useful and cheaper robotic arm to perform various functions where human is proven too dangerous to perform a specific task and also to eliminate human errors to get more precise work

6.Review on Development of Industrial Robotic Arm by Rahul Gautam1, Ankush Gedam2, Ashish Zade3, Ajay Mahawadiwar4 ……..[6]The use of industrial robots is increasing in areas such as food, consumer goods, wood, plastics and electronics, but is still mostly concentrated in the automotive industry. The aim of this project has been to develop a concept of a lightweight robot using lightweight materials such as aluminum and carbon fiber together with a newly developed stepper motor prototype. The wrist also needs to be constructed for cabling to run through on the inside. It is expensive to change cablesand therefore the designing to reduce the friction on cable, is crucial to increase time between maintenance. A concept generation was performed based on the function analysis, the the specifications of requirements that had been established.

3 Components used :

1. Mechanical Components:

- Acrylic sheet
- Flexible couping
- Coupling hub
- GT2 20T pully
- GT2 60T pully
- GT2 Belt-280
- LM10UU Linear Bearing
- Rod-10
- SHF10 End Support
- T8 Lead Screw with Nut

2.Electrical components

- A4988 Stepper Driver
- Arduino Mega microcontroller Board
- CNC Sheild
- Nema 17Stepper Motor
- Proximity Sensor
- Arduino interface with sensor
- SMPS
- TB6600 Stepper Motor Driver

4**.METHADOLOGY**

The Design of robot SCARA required knowledge of diverse disciplines of engineering including topics of mechanics, electronic, control, and programming, for the success of the project it was developed the methodology .

The first step is the search study and analysis of information in databases, magazines and specialized books in accordance with the classic methodology of investigation. With base in this information one carries out the first geometric model, necessary to make the cinematic and dynamic models of the SCARA. the mathematical models its possible make the simulations and the first control design, mechanical design, electronics design, and interface control design. they were developed with the help of specialized software.

the mechanical design in solid edge and Ansys Work bench, the design of the control and the control interface in Matlab, the electronic design in circuit maker and mplab. Once facts the models in each software that was made that denominate mechatronics integration, this integration is the synergy among the mechanical design, electronic design and control design, achieving a virtual model that allows to modify the design variables with easiness, that is to say a model of flexible design was gotten that allowed to make modifications to the robot from the disciplines of the mechatronic, evaluating its influence and acting. Finished design stage one carries out the construction of the prototype of the SCARA.

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CONCLUSION

In this project, The Design and Fabricaton of palletizing of SCARA Robot for food processing industry is carried out. A low cost 3-DOF SCARA robot has been designed, and fabricated.It is concluded that this robotic arm is working properly under the specified working envelope and at a given speed with good accuracy with the help of NEEMA 17 motor in testing.Now the SCARA ROBOT is made only for the prototype and hence it can be used for exhibition , educational purpose and small scale industry.The robotic arm has only DC motor to drive the joints .therefore the usefulness of the method for other types of motor can be carried out.

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