DESIGN AND FABRICATION OF ROBOTIC ARM CONTROLLED RASPBERRY PI

Abstract: This work involves designing and manufacturing a simple pick-and-place arm robot that can be used to handle parts in various production processes. The manufacturing process includes machining, sheet metal working, simple part assembly, etc. This problem becomes very specific with design goals to accommodate objects such as plastic caps, glass blanks used in the watchmaking industry, and small sheet metal parts. , from one workstation to another. This research work helps integrate different disciplines such as mechanical, pneumatic and electrical. We have introduced a systematic design process from literature research to manufacturing. During the conception stage of the design, the latest CAD software tools were used to create 3D models, assemblies and 2D drawings. The robot arm has a simple structure consisting of a pneumatic cylinder and a suction pad. The entire electropneumatic circuit was developed using Festo-Fluidsim software. The robot implementation was successfully completed and evaluated for initial cost, time required to move parts, and number of parts moved. Since the robot works electro-pneumatically, the initial cost is slightly higher than manual work, but the amount of parts to be transported is doubled, and the time it takes to transport the parts is shortened. As a result, it was found that the time required to transfer parts from one station to another was greatly reduced and the number of parts transferred was greatly increased. Distance between central axis of beam and axis of cylinder, m Young's modulus, GA gravitational acceleration, moment of inertia, arm length on one side, mass of cylinder, mass of sucker and its attachment, mass of object, arm mass of one side,

1.Introducation:

For many years, people have tried to replace human labor with machines. Machines called robots are faster and more efficient than humans. The term robotics is actually defined as the study, design and use of robotic systems for manufacturing. Robots are commonly used to perform dangerous, risky, highly repetitive and cumbersome tasks. They have a variety of functions such as material handling, assembly, arc welding, resistance welding, machine tool loading and unloading functions, painting and spraying. Many elements of the robot are inspired by nature. The structure of the manipulator as a robot arm is based on the human arm. Robots have the ability to manipulate objects such as: B. Pick-and-place operations. It can also work by itself. The development of robot system technology in the electronics industry is expanding more and more. One such application has recently been developed for service robots with machine vision capabilities. In this rapidly developing society, time and manpower are critical constraints to accomplishing large-scale tasks. Automation plays a key role in saving human effort in most regular and frequently performed tasks. One of the most important and commonly performed jobs is picking and placing orders from source to destination. Today's industry is increasingly moving towards computerized automation, primarily due to the need to increase productivity and deliver a consistent quality end product. Fixed automation systems historically used for automated manufacturing tasks are inflexible and generally costly, so costs can be reduced by using mechanical arms that can perform a variety of manufacturing

functions in a flexible environment. There is widespread interest in reducing The use of industrial machine arms characterizes some of the current trends in manufacturing process automation. However, today's industrial machine arms also exhibit monolithic mechanical structures and closed-system software architectures. They focus on simple, repetitive tasks that typically don't require high accuracy. A mechanical pick-and-place arm is a human-controlled system that detects an object, picks it up from a source location, and places it in a destination location. Object detection involves humans detecting the presence of objects and moving machines accordingly.

2.LITERTURE REVIEW:

In order to accomplish this research's mechanical design and kinematic analysis goals, Chin-Lung et al. suggested a kinematic analysis for a pick-and-place mechanism (PPM), which is used in the automation equipment and press manufacturing sectors. A programming application is created using the Visual Basic (VB) language to acquire all conceivable dimension of gear pairs. The geometric connection between the planetary gear and internal gear will produce an approximative square path (ASP) from the line of motion[1]

A technique for calculating servomotor parameters of a parallel robot for quick pick-and-place operations was proposed by Huang, T. et al. This research proposes a technique that enables the servomotor parameters of parallel robots for pick-and-place tasks to be computed effectively utilising the singular value decomposition employing high-speed translational parallel manipulator as an object of study. These characteristics include the motor's speed, torque, and power needed to produce the end effector's desired velocities and accelerations. For the purpose of determining these device characteristics for the rechargeable battery quality check, an example is provided[2]

Tsai and other individuals. Designed for material handling systems is a semi-automatic pick and place robot. The creation of a pick-and-place robot for material handling systems is the main objective of this research and development project. With two degrees of freedom, this semi-automatic pick and place robot integrates object recognition with the pick and place process. Specifically, the pick and place process is initiated when an item is detected, which powers the object gripper. The produced model amply displays the application of technology in material handling systems with the goal of producing a user-friendly and cost-effective system[3]

Ashly Baby and colleagues used an Arduino-based robotic arm to pick and position things under the direction of a system user command. An object will be carefully picked up and placed from source to destination. The arm's gentle catching gripper won't put any additional strain on the objects. With Bluetooth, android-based smartphones may operate the robot. The robot moves in accordance with the user's orders. Four motors are connected to the micro controller at the receiver end. Two are for moving the vehicle, while the other two are for moving the arm and gripper. The robot is controlled through the blue control application[4]

This study describes a free piston compressor (FPC) constructed by José A. Riofrio and Eric J. Barth et al. as a pneumatic power source for pneumatically actuated autonomous robots. The FPC is a proposed device that uses combustion and the kinetic energy of a free piston to compress air into a high-pressure supply

tank. Comparatively to previous small-scale portable power supply systems, the device is designed such that thermal energy to stored energy, in the form of compressed gas, is efficiently transferred[5]

Che Soh, S.A. et al. developed an adjustable gripper for robotic systems that can identify the shape and size of objects. This is required in many applications, especially pick and place processes. This is because some gripper designs are limited to specific shapes and sizes, making the pick-and-place process difficult. The main goal is to develop robust grippers that can perform pick-and-place operations more easily and quickly on objects of multiple shapes and sizes[6]

Laksh. N., et al. We propose a 3-DOF slewing robotic arm and propose an inexpensive and effective method for designing and manufacturing a 3-DOF slewing robotic arm. The design process begins by establishing design criteria at the top level and propagating those criteria from the top level of the manipulator structure to all subsequent components. In this proposed approach, a set of design intent is captured, organized, and implemented based on system-wide goals, as opposed to the traditional design process, which targets individual components[7]

S. Premkumar, et al. Integrated Self-Manipulation in Control Robotic manipulators are key components of the motion subsystem of robotic systems for positioning and orienting objects so that the robot can perform useful tasks. The main goal of our work is to operate the gripping mechanism and the vacuum suction mechanism in a single shot and position the robotic arm. The robot can steer itself with a single robotic arm and initiate simple tasks such as grabbing, sucking, lifting, placing and releasing. The main focus of our work is building robotic arms for the above purposes. The robotic arm consists of pivot joints that allow angular motion between adjacent joints[8]

K. Harish et al. I invented the Arduino pick-and-place robotic arm. In recent years, it has been noted that industrial and daily routines are attracted to and implemented by robotic automation. Pick-and-place robots are one of the manufacturing technologies he developed to perform pick-and-place work. The system is designed to eliminate human error and human intervention for more accurate work. There are many areas where human intervention is difficult, but the process under consideration must be manipulated and controlled, leading to areas where robots are applied. Literature suggests that pick-and-place robots can be used in a variety of areas, including: Signal bottling. The chassis is supported by four omni-she wheels for the locomotion of the robotic arm. The implemented robotic arm has two degrees of freedom. Many other features such as line follower, wall hugger, obstacle avoidance, metal detector[9]

Magnus Axelsson and others have proposed parameters for controlling motor robots. The motor robot is based on LinMot's frictionless linear motors, which have become increasingly cheaper in recent years. To make them even more advantageous, his SDT of automation company wants to raise the level of programming to the customer level. This is done by adapting his current LinMot software to the PLC Open Standard. With this library, customers can control motors by simply writing parameters. The robot was also created by calculating with an emphasis on design. The result is a two-axis application that is easily programmed to move at high accelerations and velocities using function library[10]

M.J. Richardson et al. proposed an HRI system The path we take together Behavioral Dynamics Algorithms for HRI Pick and Place Tasks Behavioral dynamics models provide an observation-based foundation for HRI algorithms and another tool for creating robust, natural, and interpretable HRI systems. Here, an HRI pick-and-place algorithm based on a behavioral dynamics model of human decision-making dynamics in an interpersonal pick-and-place task was implemented. Participants were able to perform HRI pick and place[11]

Shuay D. Han et al. A proposed robotic pick-and-place (PNP) operation on a moving conveyor finds wide industrial applications. In practice, simple greedy heuristics (such as prioritization based on time to process a single object) are applied to achieve reasonable efficiency. We analytically show that these greedy approaches do not guarantee the time-optimality of his PNP manipulation under the simplified telescopic robot model. To overcome the shortcomings of classical solutions, we develop an algorithm to compute the optimal object selection sequence for a given finite horizon. Using dynamic programming techniques and additional heuristics, the method scales up to 10-100 objects. In particular, our developed fast algorithms provide runtime guarantees, making them suitable for real-time PNP applications that require high throughput. Extensive evaluation of our algorithmic solutions for dominant industrial robots[12]

Ravikumar mourya et al. Robotic Manipulator proposed that it is an integral component of the motion subsystem of the robotic system for positioning and orienting objects so that the robot can perform useful tasks. The main goal of this project is the design and implementation of a 4-DOF pick-and-place robotic arm. This project can be run independently on the controller and can start with simple tasks such as grab, pick up, place and release. This project focuses on an articulated arm with 4 degrees of freedom. An articulated arm consists of a pivoting joint that allows angular movement between adjacent joints. In this project, we used four servo motors to perform four degrees of freedom (4DOF). There are various dimensions in which a robotic arm can be evaluated. For example: B. Torque, payload, speed, range, repeatability, cost, etc. Robotic manipulators are designed to perform desired movements. Equally important is the design of the controller. The robotic arm is controlled by a serial servo controller board. The controller used to drive the servo motors is an atmega 16 development board[13]

Manivannan et al. proposed that In the past two decades the industrial works are found to be implemented through robots. The industrial robots are designed to eliminate error and intervention of human. The pick and place robot is designed to perform pick and place operation. The literature survey suggest that the pick and place robot is used in various fields such as packaging, inspection of jobs and also for military purposes for defusing bombs. The project deals with designing and analyzing the structure of robotic arm with different materials. 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 in the object. The robot is controlled using android based smartphones or pc through blue tooth. The robotic arm has 6-DOF. It has additional features such as mechanical gripper and pneumatic gripper for versatility[14]

3.METHODOLOGY:

In this chapter, a technique for creating a robotic arm that sorts packages depending on colour is discussed. This also provides an explanation of how particular engineering factors were used to identify materials that were suitable for use.

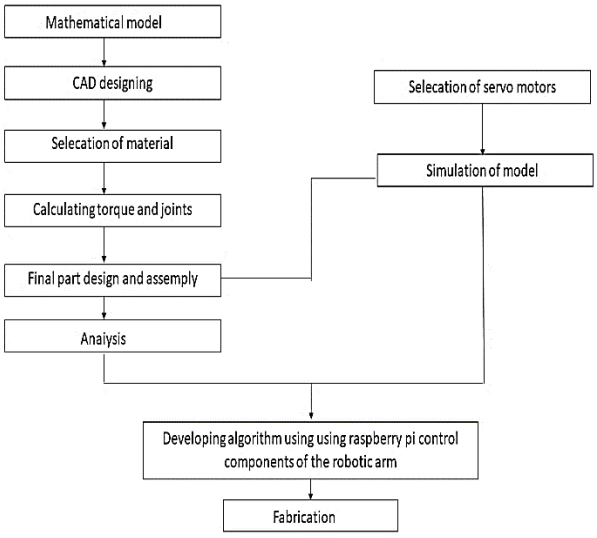

Fig.1. Methodology Flow Chart

4.COMPONENT:

4.1 Stepper Motor:

Fig. 4.1 Stepper Motor

An electromechanical device known as a stepper motor transforms electrical power into mechanical power. Additionally, it is a synchronous, brushless electric motor that has a large number of steps per entire rotation. As long as the motor is correctly designed for the application, the position of the motor may be regulated precisely without the need of a feedback system. Similar to switching reluctance motors are stepper motors. When an electrical pulse is applied, the stepper motor turns the motor shaft a certain amount using the magnetism theory of action. The rotor has six poles, whereas the stator has eight. To move the 24 steps needed for one full rotation, the rotor will need 24 electrical pulses.15

4.2 Gripper Arm:

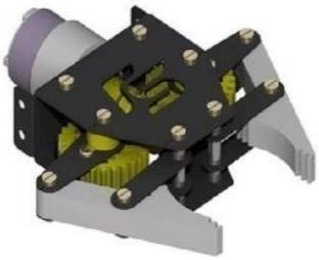

Fig. 4.2 Gripper Arm

The Gripper module is a cutting-edge robotic arm created using a 3D printer. It may be utilised in several 'pick and place' types of robots. It utilises a DC motor (9–12V DC). Jaw opening and closing is caused by a change in the DC motor's rotational direction.

The DC motor can be easily controlled using DPDT switches (manual mode) or using any microcontroller and the L293D motor driver module. Add a fully functional robot gripper to provide additional functionality to your robot.(16)

4.3 Switch Mode Power Supply (DC)

Fig. 4.3 SMPS

A modern switching power supply or SMPS uses solid state switches to convert an unregulated DC input voltage into a regulated smooth DC output voltage at various voltage levels. The input power is either true DC from a battery or solar panel, or DC rectified from AC using a diode bridge and additional capacitive filtering.

4.5 Stepper Motor Driver

Fig. 4.5 Stepper Motor Drive

A motor driver is an important device that supplies the voltage and current necessary for a stepper motor to operate smoothly. It is a DC motor that rotates step by step. To design a stepper motor driver, choosing the right power supply, microcontroller and motor driver is very important. I know I can use a microcontroller to spin a motor, but when designing a driver I need to focus on voltage and current. A single motor driver board can handle motor current and voltage. The stepper motor is rotated precisely by the controller by synchronizing the pulse signal with the driver. This motor driver receives pulse signals from the microcontroller and converts them into stepper motor movements.

4.6 Raspberry Board:

Fig. 4.6 Stepper Motor Drive

The Raspberry Pi is an inexpensive credit-card-sized computer that connects to a computer monitor or TV and uses a standard keyboard and mouse. It's a powerful little device that people of all ages can use to explore computing and learn to program in languages like Scratch and Python. From surfing the web and playing high-definition videos to creating spreadsheets, word processing, and playing games, you can do everything you want on your desktop computer.

Programming Code Used In Raspberry Board:

```
from time import sleep

import RPi.GPIO as GPIO

#output

BASE_PUL = 17

TOP_PUL = 27

#input
```

BASE = 5

TOP = 6

GPIO.setmode (GPIO.BCM)

GPIO.setup (BASE_PUL, GPIO.OUT)

GPIO.setup (TOP_PUL, GPIO.OUT)

GPIO.setup (BASE, GPIO.IN, pull_up_down=GPIO.PUD_UP)

GPIO.setup (TOP, GPIO.IN, pull_Up_down=GPIO.PUD_UP)

while True: if (GPIO.input (BASE)==0) :

GPIO.output (BASE_PUL, GPIO.HIGH) sleep (0.01)

GPIO. output (BASE_PUL, GPIO.LOW) sleep (0.01)

if (GPIO.input (TOP)==0) :

GPIO. output (TOP_PUL, GPIO.HIGH) sleep (0.001)

GPIO.output (TOP_PUL, GPIO.LOW) sleep (0.001)

5.DESIGN OF PROPOSED MODEL

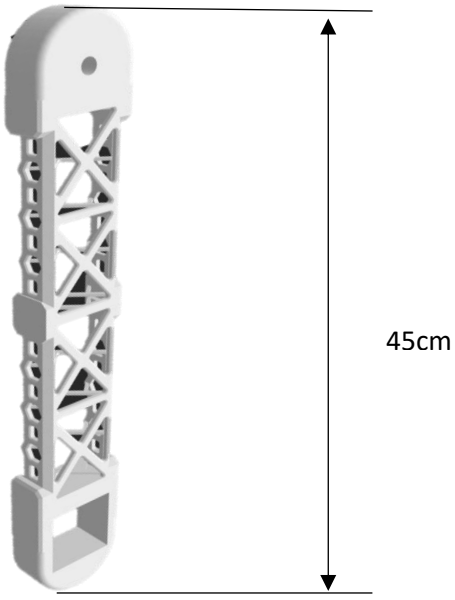

Fig. 5.1 Design of first arm

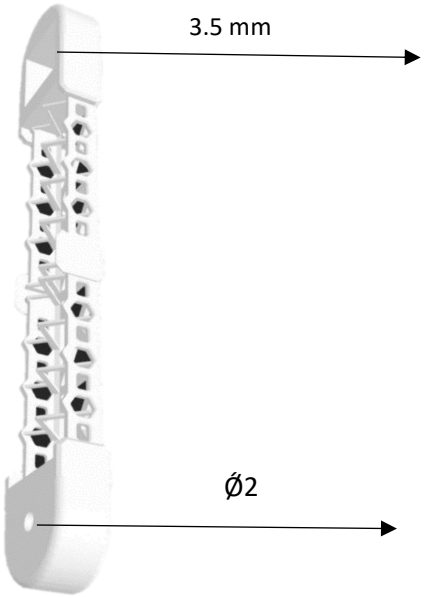

Fig. 5.2 Design of first arm

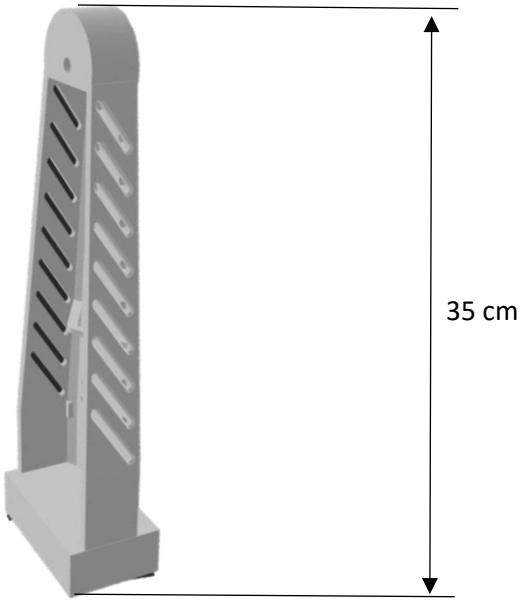

Fig. 5.3 Design of second Arm

6.Assembly

In the assembly of the project all partial models are put together, Provide a

computer model of the robotic arm. i have an idea What the robot arm will eventually look like on the ground process completed .

Fig. 6.1 final assembled model

7.CONCLUSION

Robotic pick and place arms play an important role in industrial automation. Pick and place a robotic arm with 2 links and 3 joints. The stepper motor previously attached to the pick-and-place robotic arm has a torque capacity of 0.42Nm, which is too small to hold its own weight and rotate the connection to a specific position. A torque calculation for the robot arm revealed that the base motor needed to produce a very high torque. The pick and place robot arm has been redesigned with a large 3Nm stepper motor. Adopting an aluminium pole realizes a significant weight reduction. A proposed design of a pick-and-place robot using Arduino is implemented via the RF PlayStation. It turns out that a robot implemented in this way can use carriages and stepper motors to position objects to be lifted wherever available. It also lifts the object and positions it at the desired position according to the control of the servo motor. Low-cost manufactured pick-and-place robotic arms may open up far-reaching opportunities for cost-effective industrial automation in related industries.

8.FUTURE SCOPE

Robots programmed for pick-and-place operations in this way can be made more versatile and efficient by providing feedback and allowing them to operate more independently than human inventions. This is made possible by the image processing tools associated with this raspberry. Features that can be added to improve efficiency allow line following, wall hugging, obstacle avoidance, metal detectors, bomb diffusers and more to operate autonomously without human intervention.

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