International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 7 July 2022, pp: 184-189 www.ijaem.net ISSN: 2395-5252

Design and Development of Material Handling Device

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Submitted: 01-07-2022 Revised: 04-07-2022 Accepted: 08-07-2022

ABSTRACT:Use of Robotics is today's need and material handling device are becoming popular among there people as they help to eliminate dangerous jobs for humans because they are capable of working in hazardous environments. They can handle lifting heavy loads, toxic substances, and repetitive tasks. This has helped companies to prevent many accidents, also saving time and money. Our project is that type of device that runs on electricity that will help to handle manufactured pipe and loaded on oven's rack for further heat treatment process.

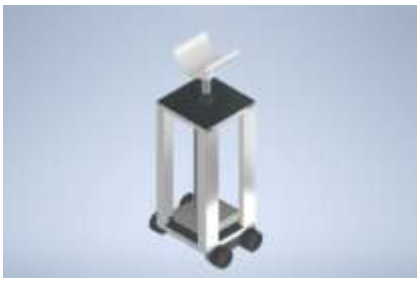
KEYWORDS: Material Handling, Plastic Pipes, Automation, Electronics, design.

I. INTRODUCTION

The industries require manpower for handling of PVC pipes. We have designed a prototype model which will reduce the manpower as well as ideal time of process. The prototype is a type of device that runs on electricity which will help to handle manufactured pipe and loaded on oven's rack for further heat treatment process. The main specifications of our project are given below:

- The prototype model is a combination of two robots which will be operated by single remote-control unit.
- The device can reduce a great amount manpower.
- The prototype is going to operate on 12V and 5AMP current.
- The total height of the device is within 28 inches and width is within 8 inches.
- The current load carrying capacity of the prototype is 3Kg.

SPECIFICATION OF ROBOT



- The device can be operated within range of 1000 meters.
- The device can move forward and backward while facing in front, back, right, and left directions.
- The device can move 360 degrees around the vertical axis while moving on the floor.
- We can control the robots individually or both as per our requirements.

SPECIFICATION OF HOLDING TRAY

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- Due to change in the standard diameter of pipe we made a replaceable tray holder which can be replaced as per procedure manufacturing.
- The tray can be rotated up to 360 degrees at vertical axis.
- The mounting is easy to remove and easy to replace from the shaft.

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SPECIFICATION OF ACTUATOR

- We manufacture a piston of length 203mm having diameter of 25mm.
- The total time required for extension or retraction stroke of piston is 11seconds.
- During extension or retraction stroke, we can control the stroke length as per our requirement.

II. LITERATURE REVIEW

I. Mr.S.S.Chougule

Concept of implementing material handling system in small scale industries.

Research Topic- Designof storage and material handling for pipe industry.

II. Fang Tai'an1

With the continuous development of automatic pipe handling equipment, various new automatic drilling rigs continue to bring forth new ideas, and the unmanned operation of the racking board and drilling floor have been fully realized.

Research Topic- Automated Pipe Handling System Suitable for Retrofitting Servicing Rigs

III. Hsieh, T.Y.

Compare the productivity between a prototype pipe manipulator and a telescopic rough-terrain crane in handling pipes in a piping material laydown yard.

Research Topic- An Evaluation of the Pipe Manipulator Performance in a Material Handling Yard.

IV. Riyaz Ahmed

Study various material handling equipment & systems used in an Industry for various material handling, and Study various Modern Technique. Material Handling and is required by many safety regulations, national consensus standards and manufacturers.

Research Topic- A review paper of Various Industrial Material Handling systems.

III. MODEL

IV. 3D DIMENSIONAL FIGURE OF MATERIAL HANDLING DEVICE

V. PARTS

1. CT6B Transmitter and Receiver-

CT6B 2.4Ghz 6 Channel Transmitter and Receiver (FS-R6B) Remote is the popular 6 Channel Radio CT6B. It Is 2.4GHZ 6 Channel Transmitter is an entry level 2.4 GHz radio system offering the reliability of 2.4 GHz signal technology and a receiver with 6 channels. CT6B 2.4GHZ 6 Channel Transmitter radio is ideal for quadcopters and multicopters that require 6 channel operation.

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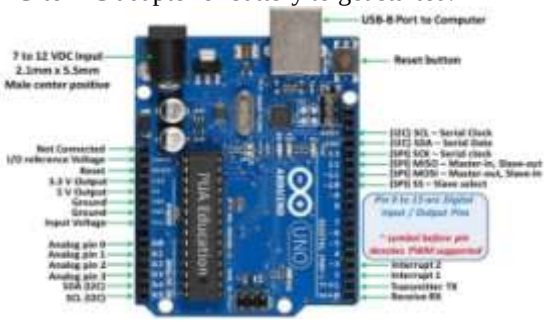
CT6B TRANSMITTER

2. ADRIUNO UNO AT-MEGA-

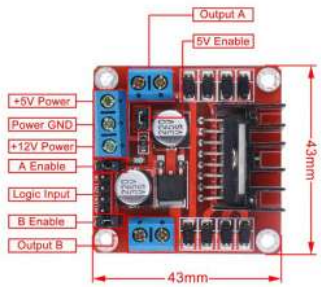
Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.



ADRIUNO UNO AT MEGA

3. L293D-

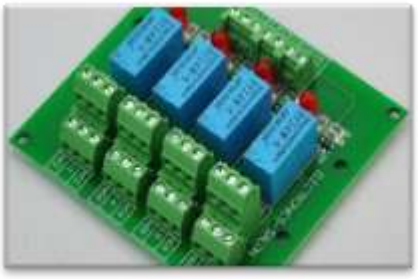
L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). The L293d can drive small and quiet big motors as well.



L293D

4. DPDT RELAY MODULE

DPDT stands for double pole double throw relay. Relay is an electromagnetic device used to separate two circuits electrically and connect them magnetically. They are often used to interface an electronic circuit, which works at a low voltage to an electrical circuit which works at a high voltage.



DPDT RELAY MODULE

5. SERVOMOTORS-

A servomotor is a rotaryactuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

6. DC MOTORS (12 VOLT)

A DC Motor is any of the electrical machines that convert the direct current electrical power into the mechanical power.DC motors speed can be controlled over wide range, using either a variable supply voltage or by changing the strength of the current in its field windings

7. 12V, 5 AMP AC TO DC CONVERTER

Converts 240 V AC supply to 12 V DC supply.

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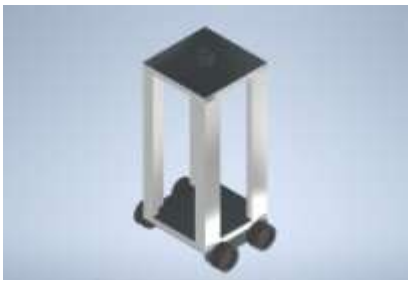
8. LIMIT SWITCH

They are used for controlling machinery as partof a control system, as a safety interlocks, or to count objects passing a point. A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object meets the actuator, the device operates the contacts to make or break an electrical connection.

VI. DESIGN OF PARTS

1) DESIGN OF FRAME



Part specifications:

1. Aluminium channel (2*1 inch) x 8 Qty, 19 inch long
2. Wooden board (8*8 inch) x 4 Qty, 5 inch thick
3. Wooden block (2*1 inch) x 16 Qty, 2 inch long
4. Star head screw (1, 1.5,1/2) x 2 dozen
5. Motor bracket x 8 Qty
6. 1000 rpm motor x 8 Qty

First, we took an Aluminium channel of 2 inch and cut it down in 8 parts of length 19 inch. After that we place a wooden block in each corner of the Aluminium channel and fixed it with the help of glue. After completing this we place the channel at the corner of wooden board and tight this assembly with the help of screws. In the last part, we painted the frame using spray paint and fixed the motor bracket at each corner.

2) DESIGN OF HOLDING TRAY

Part specification:

1. PVC pipe 100mm diameter x 1 Qty, 24 inch long
2. 6201 Bearing x 2 Qty
3. M – Seal x 1 Qty
4. Vetra Solution x 1 Qty

For the tray, we cut the pipe of 100 mm length PVC pipe into two parts from the centre and made semi curved parts. After that we cut the pipe of 180 mm length. And here we put the bearing at the centre of the pipe. After fixing it with the help of M-Seal and we put Vetra Adhesive solution on it. At the last we painted it with spraypaint.

3) DESIGN OF ACTUATOR

Part specification:

1. 500 rpm gear motor x 2 Qty
2. Foam sheet x 1 Qty
3. Pipe connector x 2 Qty
4. Screws
5. M8 Bolt x 2 Qty
6. 1 inch PVC pipe, 24 inch long
7. Aluminium channel (2*1 inch) x 2 Qty, 12 inch long
8. Motor bracket x 2 Qty

For the construction of actuator, first we design a bolt as per our specifications. The design calculations are as follows:

Calculations:

BOLT VALUE OR STRENGTH OF BOLT

- Shearing strength of bolt

d= 8mm, Clearance dia. do= 8+2= 10 mm

Ultimate strength of bolt

Grade = 4.6

Fub = 100 x 4 = 400 MPA

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Nut width across flats = 16 mm (ISO 898-2 TABLE A), Hole dia = do = 10 mm

1. Nominal Gross area

$Ag = \pi do^2/4$

$= \pi \times (10)^2 /4$

$= 78.53 mm^2$

2. Tensile stress area

$As = 58 mm^2$ (ISO 898-1 TABLE 4)

STEP 1- TO CHECK THE STRENTH OF M8 BOLT

A. Tensile strength of the bolt

$Ft = (K2. Fub. As) / Ym2$

Ft = Tensile strength

K2 = 0.9

Fub = 400 MPA

$As = 58.0 mm^2$

$Ft = (0.9 \times 400 \times 58) / 1.25$

$Ft = 16.70 \times 10^3$ MPA

$Ft = 16.70 \times 10^3 \times 10.1972 = 170.29 \times 10^3 kg/cm^2$

B. Shear Strength of bolt

$Fv = Av. Fub. As / Ym2$

Av= coefficient that 0.6 for bolt classes 4-6

$Fv = 0.6 \times 400 \times 58 / 1.25$

$= 11.13 \times 10^3 N/mm^2$

$Fv = 11.13 \times 10^3 \times 10.1972 = 113.55 \times 10^3 kgf/ cm^2$

STEP 2

a) Lead = pitch x no. of threads

Pitch = 2 mm (for bolt M8)

No. of start = 1

Lead = 2 x 1 = 2 mm

b) Linear speed (IPM)

IPM = L x (rpm)

Rpm = 500

= 2 x 500 rev

= 1000 min/rev

c) Time taken to travel a distance in one revolution

Ds= distance travel, sinch standard rev of bolt M8 is 0.125 inch

1 Inch = 25.4 mm

= 0.125 x 25.4

Standard revolution = 3 mm

For time taken to complete 1000 revolution it takes 3 min

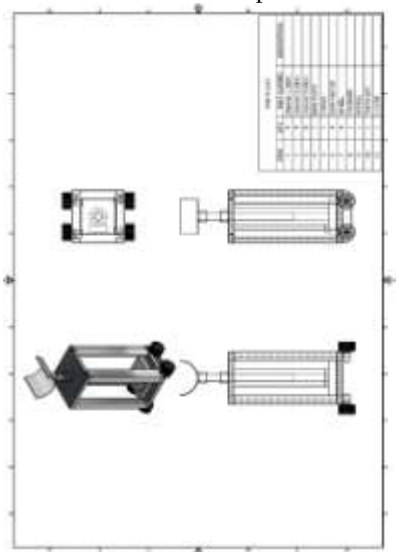
1000/180 = 5.55 rev/sec

Distance travel = 8 inch = 8 x 0.125 = 64 inch

Actual Distance Move = 64/ 5.55= 11.53seconds

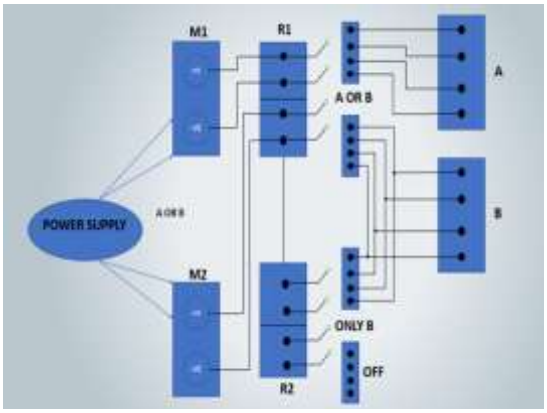
So, actual time require to move is 11.53 seconds.

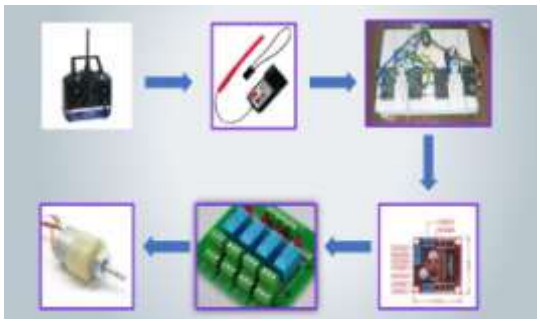
Finally, we select M8 bolt for our actuator. After that we cut the aluminium channel into 12 inches length & place a bracket at the end of the channel. We cut the pipe connector in two sections and make a hole on one side another connector. For fixing this on motor we insert the screw on it. we fix the bolt with the connector with the help of Vetra solution and add a foam support for the bolt stability. After cutting 1inch PVC pipe into desired length we fix the nut at the end of the pipe and assemble the actuator parts.



CAD DRAWING

VII. CIRCUIT DIAGRAM





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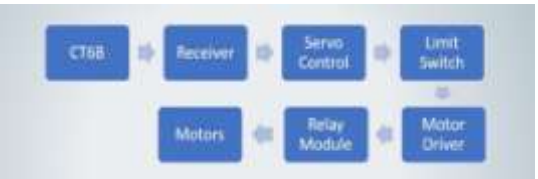

Working of the circuit.

1) Direction Control

- By giving electrical supply to circuit the whole system is powered up.
- After giving the direction control from CT6B transmitter the receiver gets the output signal and give the trigger voltage to the servo motor.
- The Servo Motor trigger the limit switch which further supply current to the motor driver input
- Motor drivers recognize the signal and give the direction to the motors.

2) Extrusion and Retraction control of Actuator.

- By giving electrical supply to circuit the whole system is powered up.
- After giving the direction control from CT6B transmitter the receiver gets the output signal and give the trigger voltage to the servo motor.
- The Servo Motor trigger the limit switch which further supply current to the motors of Actuator
- Hence, we get the desired output.

VIII. FUTURE SCOPE

- The further development, study and research of the material handling device will enable us to add newer, fresher, and advanced utilities in our project.
- Due to large scalability made possible in the material handling equipment, there is huge scope in pipe and construction industry.
- With the use of multiple robots, we can use it for carrying the parcels or loads in logistic unit.
- In further development we are decided to add AI system which will replace the use of remote-control operating system.
- Addition of line following robot system can help to use it in continuous production industry for shipping the material.
- Compact design and light weight, reduces the space required on the floor area after completion of work

IX. CONCLUSION

In industry, handling of pipes is verymuch manpower consuming. Material handling of pipes requires at least 3-4 workers to carry out the work properly. This material handling process is very much time consuming, high labour cost and less effective. To overcome these problems, we have designed a pipe handling device. This device will be controlled by a single workman through a remote control hence it will reduce the labour cost as well as the time required to carry out handling process will get reduced. It will eliminate the risk of accidents and thus handling of pipes would be much safer. Thus, this project will enhance the performance of pipe handling with reduced labour cost, risk of accidents and time required for handling process.

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