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MODELLING OF GANTRYROBOT FOR OBJECT VALIDATION OF PALLETS

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Abstract

The Project presents the modelling and implementation of a gantry robot, which performs pick and place mechanism. Picking and placing manually is the inefficient flaws for the production line industries. It became less productive, slow and non-flexible processing when it comes to manual mechanism. To overcome this problem, 3 Axis rectangular plane gantry robot has been modelled. This is a Cartesian coordinate robot, which performs pick and place mechanism and also detects the obstacles which encounters in its path. The system comprises of gantry robot with a conveyor system, and completely controlled by programmable logical controller. This provides the effective modelling of the system. The most important requirement to take into account were those regarding accuracy, weigh of the object, metal and non-metal detection, obstacle detection and overall cost of the system.

Index Terms : Gantry ,OpenCV, Concept robot.

I. INTRODUCTION

Nowadays Robots are playing a vital role in all the activities in human life including industrial needs. In modern industrial manufacturing process consists of precise and fastest proceedings. Human operations are needed to perform a various task in a robotic system such as set-up, programming, trouble shooting, maintenance and error handling activities. Hazardous conditions exist when human operators interfere into the robotic work zones.

The ultimate object is to save human lives to increasing productivity and quality of high technology work environments. Effective safety training programs for work with industrial robots should be developed. One of the major areas of Research & Development (R&D) that has made a radical improvement in Computer Science and electronics is “Automation” and “Artificial Intelligence”. Autonomous Systems are self-governed and does not require any manual interventions. The Project presents the modelling and construction of 3 axes rectangular plane Gantry Robot.

The development of manipulation system for different application purposes has been carried out at the department of electronics control and instrumentation of the University of Petroleum and energy studies. The system indented for the most general application scope ranging from industrial application to more specific application such as medical tasks. For the accurate analysis, the Cartesian coordinate robot has been chosen with 3 degree of freedom, working in X, Y and Z axis. Due to the need of a modular structure so that, the components of the robot can be easily substituted and removed without disturbing the whole structure. For instance, in this system, we have added an end-effecter in Z axis which is now a vacuum cup for pick and place mechanism that can be replaced easily with some different actuator according to the requirement.

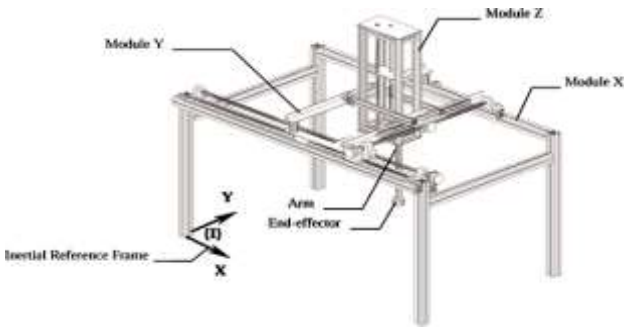

Fig 1 Gantry Robot for Pick and Place Application

In any case the supportive structure should be cost effective and easy to control which led to the choice of a gantry robot. The project is described in various sections like controlling and monitoring through PLC, motion of three axis through DC motors, Ladder logics in Indra logic software for working with Rexroth PLC, Circuit Modelling in a supportive system (3DOF robot), conveyor system and sensor arrangements. Programmable logic controller (PLC) also known as programmable controller is a digital computer. The automation of typically industrial electromechanical processes such as control of assembly lines, amusement rides or light fixture is controlled through these controllers. PLC's are modelled for multiple arrangements of digital and analog inputs and outputs. PLC's are immune to electrical noise and also resistant to vibration and impact. The non-volatile memory stores the program of PLC's used for controlling machine operation. Human machine interface is a platform which allows the interaction between automation equipment's and users. It allows effective operations and control of machines from the human end, while the machine
simultaneously feeds back information that aids the operators' decision-making process. The advantage of this pick and place gantry robot are its capabilities to move in X, Y and Z direction. It rigidly allows for more precision. It is easy to program and is strong dependable mover. Its payload is larger and fully supported. The main goal of this work is to implementation of a pick and

place mechanism gantry robot which can detect the obstacle which comes in their path and stops the complete system in such situation. This is evaluated using the base gantry system, conveyor system, sensors, HMI and the PLC. To develop the robots for this application needs more information; hence literature survey has been done and discussed in the next chapter.

II. LITRATURE REVIEW

Modelling of machine vision based gantry robot involves modelling of structure, selection of electrical components and suitable softwareto operate the robot. Hence literature survey has been done. The details are as follows

Surinder Pall et.al [1]: Research is to survey the field of web-based control, and to modelling and development of its control over the Internet for remote experimentation of SCARA robot. The Gantry Mechanism is used to observe the working space of the SCARA robot through the Internet. A web CAM mounted on the Gantry mechanism provides a three-dimensional view of Adept manipulator and its work space. A web-based application with Graphic User Interface (GUI) is developed for user to remotely control the mechanism that drives the web CAM. In addition, Algorithms are explored to reduce the vibration effecton the web CAM so that a steady image of working space is presented on the client side. The 3D view provided by the web CAM driven by the Gantry Mechanism enhances the user's visualization of working area, object, and robot working in the real time environment.

Shubhi Thatere et.al [2]: have implemented a gantry robot, which performs pick and place mechanism and also detect the obstacles coming in its path. Picking and placing manually is the inefficient flaws for the production line industries. They developed Cartesian coordinate robot, which performs pick and place mechanism and also detects the obstacles which encounters in its path. The system comprises of gantry robot with a conveyor system, and completely controlled by programmable logical controller.

Doral Vall, Judith et.al [3]: their work consists of a Cartesian robot, also called Gantry robot whose objective is the realization of a program that allows the robot to draw eights with a linear motor technology and move their axis.

Lasheen A, Hassan M et.al [4]: work consists of storage and retrieval system using a conveyer system. Light sensor is installed at the beginning of the conveyer belt in order to identify the object and a light switch at the stop station that informs the object reached the pick-up point.

University of Massachusetts et.al [5]: their work explains about the eliminating the oscillation of a suspended object on a fast motion gantry robot.

S. Sentil Kumar et.al [6]: their pick and place robot is a microcontroller based mechatronic system that detects the object, picks that object from the desired location and places it in the desired location. For the detection of the object infrared sensors are used which detects presence of object as the transmitter the transmitter to receive path for infrared sensor is interrupted by placed object.

From literature survey it is found that, most of the robots are Cartesian robots with webcam and movements are controlled by programmable controller. Therefore, in this work Cartesian type robot to be modelled with machine vision and controlled by suitable controller. The details of modelling and fabrication of gantry robot is discussed in the next chapter.

III. OBJECTIVES

The development of low cost Gantry Robot is to full fill the demand of industrial robot from small scale to large scale industries with optimized low cost. The objectives of the work are

- Modelling of robot using available parts
- Fabrication and assembly of robot
- Selection of suitable software for operating and controlling of robot
- Testing of robot

The robot has to be modelled with above objectives by using locally available materials to reduce the cost. The robot must be easy to operate and accessible to suitable software which must be free of cost. The entire robotic system must consume less power.

IV. METHODOLOGY

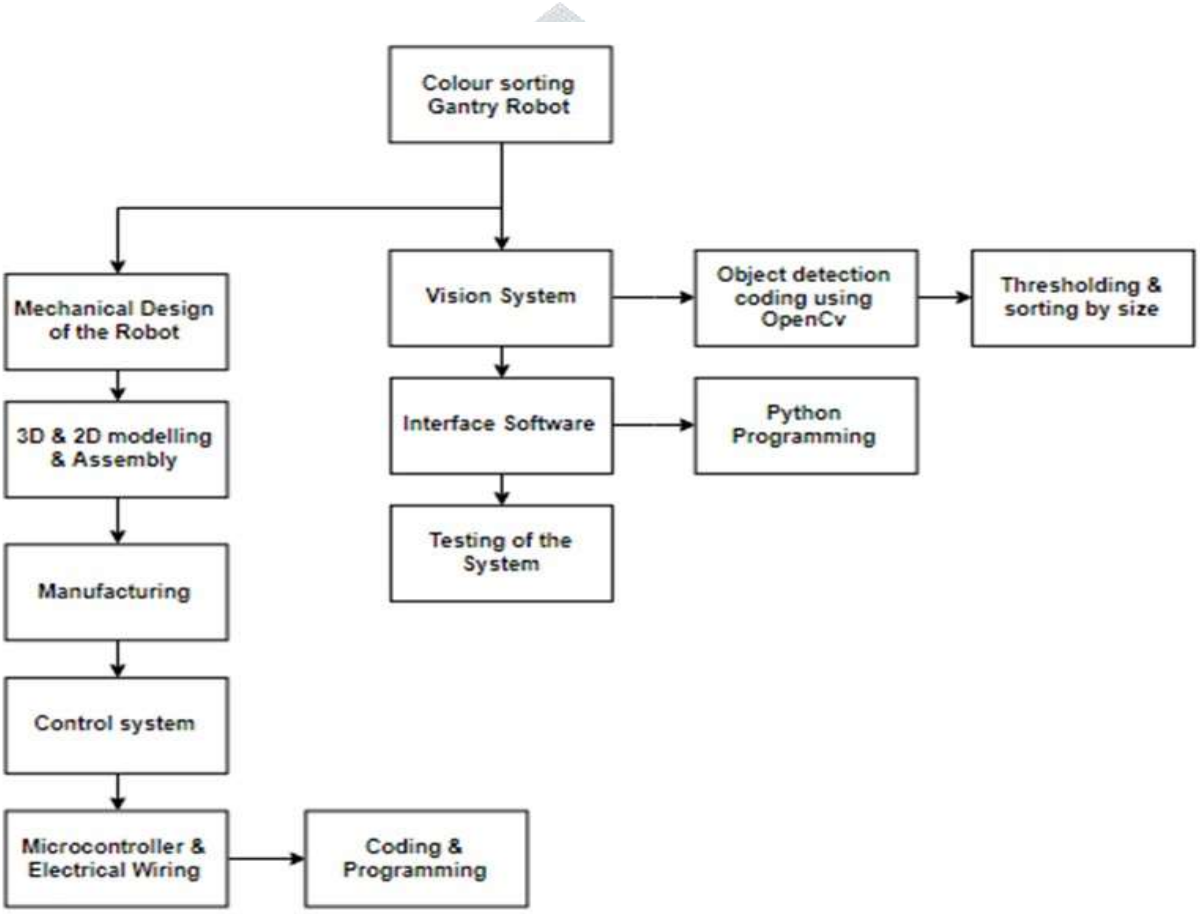

Fig.2 Methodology

In this work it was addressed the task of sequentially driving a robot towards several objects, for pick and place task. The purpose is to develop a robot control system that brings the end-effector onto each object, hereafter referred as target, to perform an operation of interest such as picking, painting, soldering, etc. A few assumptions regarding the system under study are made, the robot's end effector and the robot has a Cartesian kinematic structure alternatively, can be controlled in the Cartesian space.

V. FABRICATION AND ASSEMBLY

The Robot has built on a base plate of 600x500mm having a thickness 8mm plywood sheet. At each corner have located with 20x20mm aluminium profile of 300mm height by using 3D printed L brackets to support the aluminium profile. SK10 end support is \used to mount 10mm circular shaft as a y axis having a length of 500mm at both the side

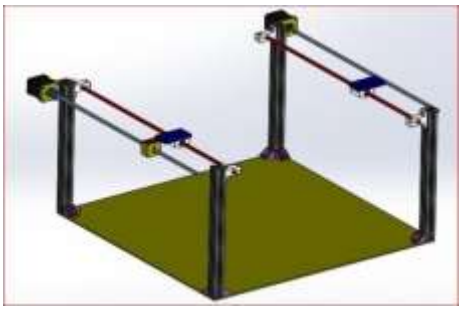

Fig 3 Assembly 1

On Y axis shaft SE10UU bearing is mounted for sliding along the axis, to obtain movement in y axis T8 lead screw is located parallel to the Shaft and connected to the motor using coupling bush.

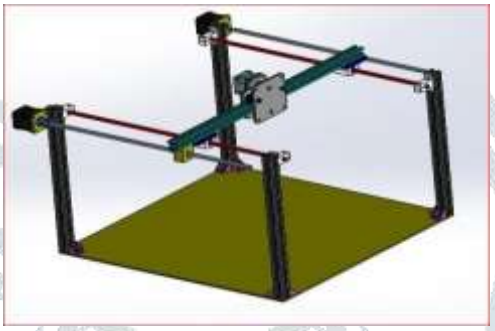

Fig 4 Assembly 2

The X axis 20x20 al prof is mounted over the Y axis with a help of 3D printed part placed over SE10UU bearing. Belt drive is used to move x axis plate assembly on 20x20 profile With help of Acrylic plates, wheels and a DC motor.

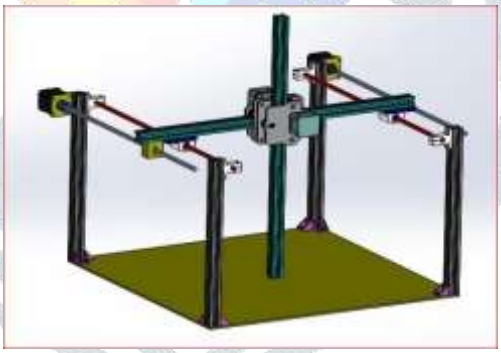

Fig 5 Assembly 3

Over the x axis plate the z axis assembly is placed and 20x20 al prof is moving in z axis assembly to produce vertical moment. A 3D printed gripper Holder (end effector) fixed at the bottom end of Z-axis profile over that Pneumatic Gripper is placed to do pick and place of the objects.

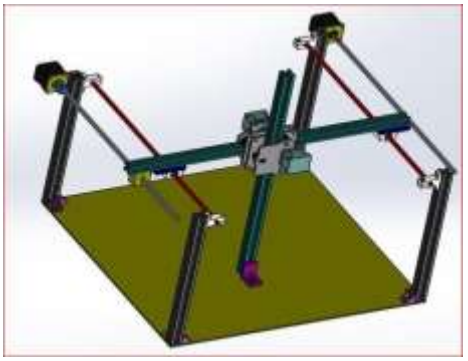

Fig 6 Assembly 4

VI. WORKING

Gantry robot have a rectangular or cubic work envelope (Work volume). This Gantry system is one that moves in three orthogonal axes according to the Cartesian coordinates. Coordinate in the three axis are usually defined as X, Y and Z. Each axis is arranged at right angle allow three degrees of motion. Gantry is further characterized to support at either ends.

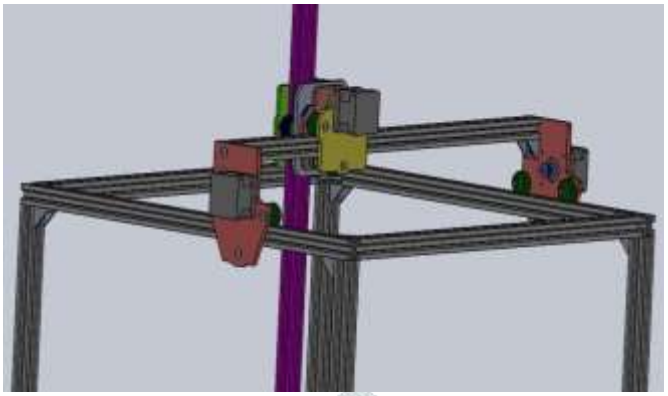

Fig 7 Isometric view of Aluminium Profiles (in all 3 axes)

In Y axis two belts of 2mm pitch are used to move X-axis 20*20 Aluminium Profile (Placed along X-axis) with the help of GT2 20T pulley along Y axis, located Both sides of the robot, for the movement of this Y axis two DC motors are used at both sides.
X-axis mounting plate (Sub assembly) is used to move along 20*20 Aluminium Profile driven by DC Motor using GT2 belt. Over this X-axis Sub Assembly, Z-axis mounting plate is fixed to X-axis plate and driven by belt using DC Motor which is fitted on other side (front side) of Z-Axis and at the end of the aluminium profile(bottom) a Pneumatic gripper holds
the picking objects using suction Cup and a vacuum of suction motor is located in control box to perform the pick and place work accordingly.
The Robot consist of 4 DC motors. The 2 DC motors are used to control Y axis direction, 1 DC motors are used Z axis and another 1 DC motor is used to control X. For controlling of all these three axis motors and a vacuum gripper python based control software is used and programmed according to the task to be performed.

VII. CONCLUSION

To modelling and develop a gantry robot with less cost and maintenance, which can overcome more industrial problems at the stage of inspection, and to make use of it in our daily applications. Hence the prototype of the gantry robot has been modellinged , developed and tested.
The robot has been modellinged, fabricated and assembled using locally available material. The Robot has built on a base plate of 600x500mm with 300mm height. The free software is used to control the robot. The robot has movement of 550 mm in X direction and 450 mm in direction with vertical movement of 250mm. Using the software the gantry robot movement has been tested for the movement and found satisfactory.

REFERENCES

[1] Surender pal, "A Gantry Robot automatic positioning system using computational vision" ISBN: 978-989-20-8771-9; pp. 1031-1042, November 2018.

[2] Shubhi Thatere, Parbbhpreet Arora, Yajush Sharma, Roushan Kumar, Raj Gaurav Mishra ,"Colour-Based Object Detection, inverse kinematics algorithms and pinhole camera model for controlling robotic arm movement system," in electronics computer and computation (icecco), 2015 twelve international conference on, 2015

[3] Dorla Vall,Judith, " a gentle introduction to the art of programming." John Wiley & Sons, 1981. Isbn 0-471-59725-2.

[4] Lasheen A, Hassan M (2009) , "Modelling and Implementation of a Gantry Robot for Pick and Place Mechanism withObstacle Detection using Programmable Logic Controller" e-ISSN: 2321-1814, Volume 20, Issue 1, May 2009

[5] University of Massachusetts (1998), "Modelling and implementation of a Cartesian robot", Published in Advanced manufacturing systems and technology CISM courses and lecture number 437, Springer Wein New York 2002.

[6] S. Sentil Kumar,"Computer Based instrumentation Control", New Delhi: PHI Learning Pvt. Ltd, 2009.