ROBOTIC ARM CONTROL WITH WEIGHING SCALE

Abhirami Hariharan[1], Salmiya S J[2], Sneha PP[3], Sreesanth k[4], Prof. Binsa Mathew[5]

[1,2,3,4]*Department of Electronicss and Communication MGMCET*

[5]*Prof. Binsa Mathew, Department of Electronicss and Communication MGMCET*

Abstract - *Pick and place robot is widely used in different fields now-a-days. It is used in packaging, manufacturing, logistics etc. The intervention of robots have reduced the human labour tremendously. In our pick and place robot , a load cell is used to measure the weight of the object picked. Our robot consists of a robotic arm which could weigh while picking up an object, a stationary base and LCD screen to display the weight of the pick object. An electromagnet is used to pick the object up so metallic objects are picked easily. A sensor is placed in the stationary base of the robot that detects the presence of object. Position of target is fixed. Once the object is picked up the arm rotates, places the object at the target. Now the robot is free to pick up objects again. This can be used to sort the object on the basis of weight.*

Key Words: **Robotic arm, Load cell, Electromagnet, Pick and place roboy, Wheatstone bridge.**

1. INTRODUCTION

In this era of emerging technologies, robots have and will be replacing roles of human in various fields like manufacturing and logistics. Robots are of various types of which pick and place robots have been discussed here. Few models of pick and place robots are Robotic arm , Cartesian, delta, fast pick ,and collaborative based. Pick and place robots have speeded up the automation processes in manufacturing industry. Also, the time consumption can be reduced.

1. Pick and place robot consists of a base which is stationary here.
2. Rigid bodies are connected using joints which are movable and designed according to required degree of freedom.
3. The end effector, here and electromagnet is attached to the second rigid body.

1.1 Problem definition

Usually in industries, it requires human labor to pick heavy weights and also weigh them simultaneously. Lifting heavy weights for long time can be tiring to human and thus we have a machine controlled factories and industries. Likewise, to tackle the major problem of labor and time, a pick and place robot is introduced here. The second problem being encountered here is the weight measurement which happens simultaneously while picking the object in the proposed system. Thus, this system is an integrated approach towards the problems in a shipping and packaging industry.

2. LITERATURE SURVEY

Separation of degradable and non-degradable waste using a robotic arm is being done in [1] This is done using android mobile connected via Bluetooth to a microcontroller which in turn controls robotic arm. AVR microcontroller is used to control the pick and place robot, there is a gripper which open according to size of object picked. It is controlled using android application via Bluetooth [2]. Using Atmega328p microcontroller, a robotic arm on a moving vehicle is built. Upward and downward movement controlled by push buttons. Soft catching arm to handle explosives. Based on microcontroller based electrical pressure sensor [3]. To perform functions of a library by a robot. this has developed in [4]. From fast detection of required book to picking it up and giving to user is done in here. Design and implementation of 5 DOF pick and place robot is discussed in [5]. It is designed using SOLIDWORKS18 and fabricated using 3D printing technology. Controlled using Arduino microcontroller with Bluetooth module connecting over a smartphone. [6] gives an idea on how a pick and place robot is constructed using a moving base and a gripper. 5 motors are used for movement of the base and the arm structure.

3. PROPOSED SYSTEM

The system consists of three motors for providing gripper and shaft movement. The end effector or the gripper is attached with electromagnet to attract the object which needs to be picked up. This is ensured by controlling the arm motors through proper command and using a microcontroller Atmega 328p. An IR sensor is placed in order to detect the presence

of object within its proximity, the object is picked up when the IR sensor signal goes high. The weight of the picked-up object is measured using a load cell and the signal from this is amplified using an instrumental amplifier HX - 711. The main parts of the system include.

1. Rover/manipulator: Rigid bodies like cylinder or sphere, joints and links.
2. End effector: It is attached to last joint of rover and is used for gripping the object. It's analogous to human hand.
3. Actuators: components like motors, hydraulic cylinders etc, which constitute drivers of robot.
4. Sensors: To sense the conditions of robot and surroundings and helps in functioning of robot.
5. Controller: It is used to control the actuators based on the feedback from sensors.

3.1 Block diagram

The position of object is sensed using IR sensor. The weight of the picked-up object is calculated using load cell HX-711. Atmega 328p is the use which controls the function of the pick and place robot. The movement of arm is controlled using servo motors. And electromagnet picks up the object. The weight is displayed in an LCD. When object is sensed by the IR sensor, signal goes high confirming the presence of object. Now the arm rotates with the help of servo motor and is bent down. The electromagnetic circuit switches on and picks the object up. Once the object is picked up the motor rotates, thus the base rotates and arm bent down to the position of target. Simultaneously the weight of the object is measured and after planning the object in the target, the weight is displayed on the LED screen. Now the sensor is free to sense the presence of another object.

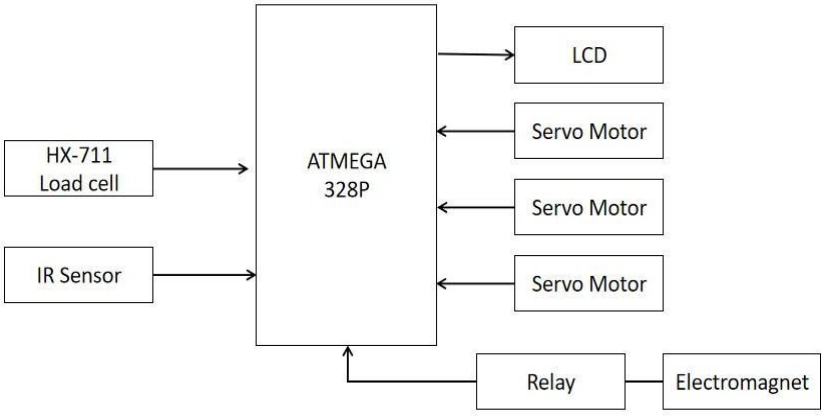

Fig -1: Block diagram

3.2 Flow Chart

The device work by first detects the object. The sensor detects the object on the arm turns to the position of the object. Then the electromagnet is turned ON and the object is picked up. The weight is also measured and display on the LCD screen. Once the target is detected, arm move towards the target. Then, the electromagnet demagnetises and place the object on the target. After placing the target arm return to normal position.

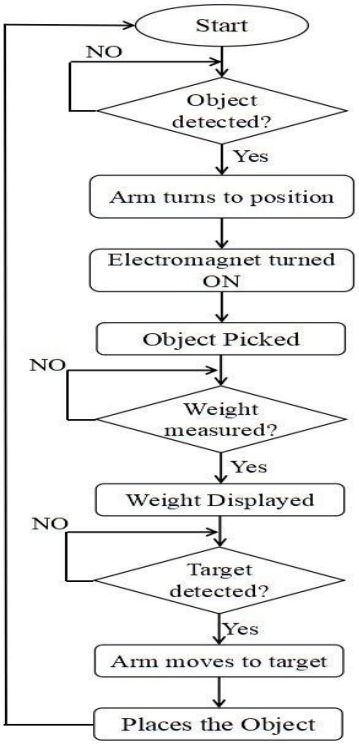

Fig -2: Flow chart

3.4 Circuit Diagram

Typically mounted on a stable stand, robotic arm is positioned to reach different areas to perform work. This type of robotic arm can be redesigned and used for many uses like packaging, item categorization, weight measurement etc. For example, pick and place robot systems may be used to pick up items for an order and place them in a box for packaging, or may be integrated with bar code scanners for categorizing of shipping objects. In the presence of an object, signal in the IR sensor goes high, this means the object is detected. Then the three servo motors work together to rotate the arm and turns the arm towards the object. Electromagnetic circuit is turned on and the object is picked up. After this the arm is turned towards the target position with the help of motors and object is placed at the target, simultaneously the weight is also measured using load cell, which is wheat stone bridge configuration. the signal obtained from the load cell is amplified using a HX-711 load cell amplifier. The weight is displayed on LCD screen while the object is placed in the target.

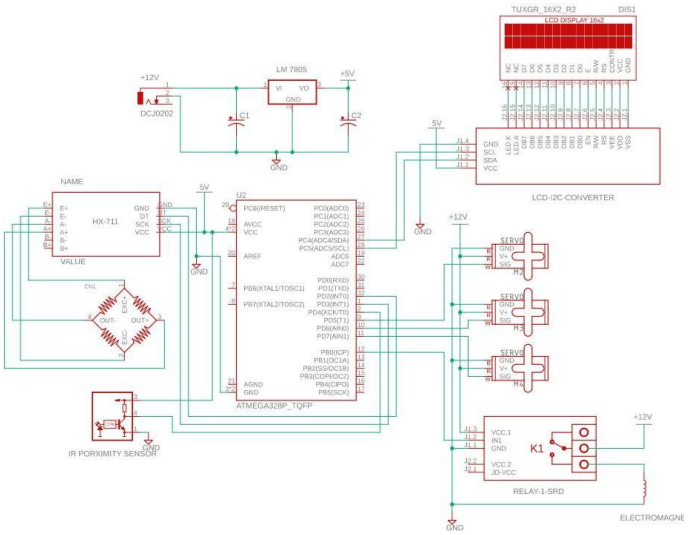

Fig -3: Circuit Diagram

4. ADVANTAGES AND DISADVANTAGES

4.1 Advantage

1. Reduce human labour.
2. Decreases time consumption.
3. Increases accuracy with which job is done.

4.2 Disadvantage

1. Only magnetic object can be picked up.
2. Decreases human interference in various fields.

5. RESULT AND DISCUSSIONS

5.1 Result

Pick and place robot with an electromagnetic arm can be used to pick metallic objects and thus sort metals from non metals. The object is placed on a fixed target. The use of sensors have helped to detect the presence of object while placed in vicinity to the device. Since there isn't any changes in the infrastructure of warehouse space is needed for the robot to function. Pick and place robot only needs minimal maintenance despite of the complexity in technology.

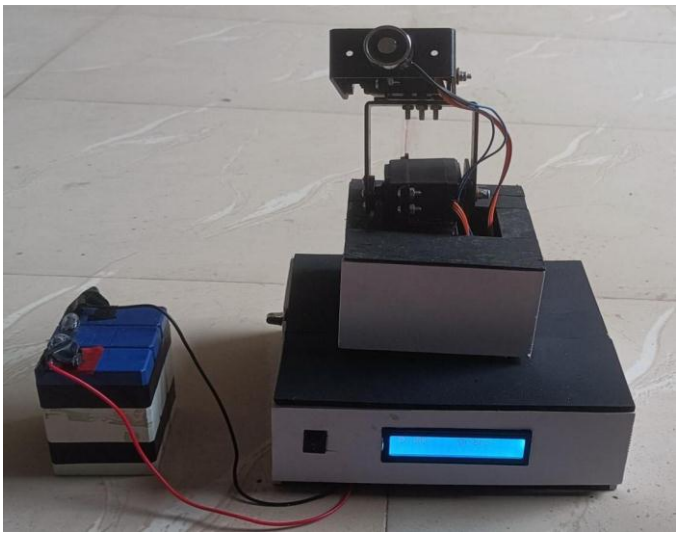

Fig -4: Pick and place Robort

Using the proper cleaning techniques and maintenance guidelines, the pick and place robot can be maintained. This makes the total cost for ownership of pick and place robot much lesser than warehouse automation technologies, which is almost three thousand rupees for the product in small scale. This project is very much economical.

5.2 Discussion

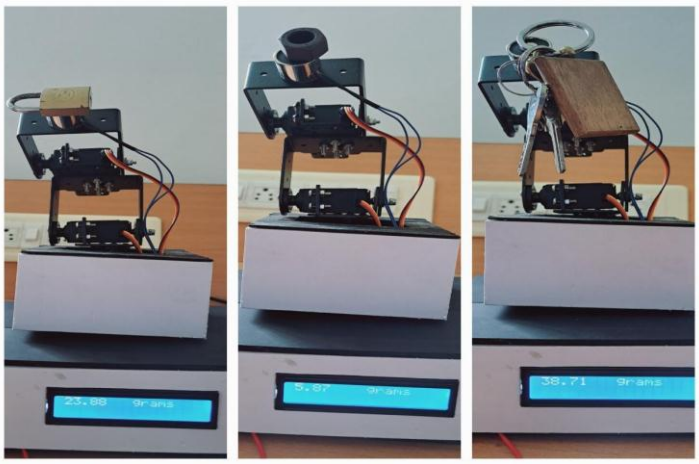

Fig -5: (Fig A, Fig B, Fig C) Images of picking different objects

A. The IR sensor senses a lock , electromagnetic circuit switches on, attracts the object moves towards the target while measuring the weight which is 23.88 g and then places in the target, B. A metallic nut is detected at the IR sensor, picks it up and measures it's weight which is 5.87 g and positions it in the target. C. A key is detected, picked up and weight measured and displayed - 38.71g and places in the target.

Table -1: Comparison of Weight

Item	Original weight	Weight measured by Prototype
Lock	36.04g	29.07g
Nut	12.4g	5.87g
Key	45.07g	38.71g

Weight of the items picked up when measured in both digital weighing machine and the prototype are comparable.

5.3 Future scope

It has certain limitations which is that only metallic object can be picked up. While implementing in large scale the weight of the object picked up will also the varied, thus a more precise weighing scale should be used. This robot could also be made moving by added wheels and extra motors which could be useful in warehouses, to move around and pick stocks and place them while measuring its weight simultaneously. But this would make it costlier. Various other sensors like QR sensor can be incorporated to sort packages in courier service or supermarkets. Various other applications like calculating the cost while picking the item can be implemented in these robots.

5. CONCLUSION

We have successfully reviewed several research papers published by different authors for the better understanding of development of robotic arm. The robotic arm moves to pick and place object successfully by using sensors and simultaneously weight of the object picked is also measured. From the existing pick and place robot, we have added different features to it. The main feature added is measuring weight of the picked-up object. The secondary feature we have introduced in our prototype is electromagnet which is placed in the gripper portion of the picking arm. The measurement of picked up object is beneficial in areas lick courier services, supermarket, etc where sorting items according to the weight is required for easy functioning of the system and customer feasibility. This project aims at reducing the labour of human.

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BIOGRAPHIES

Abhirami Hariharan, Btech student, Department of Electronics and Communication Engineering, MGM college of engineering and technology, ernakulam, Kerala.

Salmiya S J, Btech student, Department of Electronics and Communication Engineering, MGM college of engineering and technology, ernakulam, Kerala.

Sneha PP, Btech student, Department of Electronics and Communication Engineering, MGM college of engineering and technology, ernakulam, Kerala.

Sreesanth K, Btech student, Department of Electronics and Communication Engineering, MGM college of engineering and technology, ernakulam, Kerala.

Asst.Professor, Dept of Electronics and Communication, MGM Colleage of Engineering and Technology, pampakuda.