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Robotic Bottle Capping Arm Using Arduino Uno

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Abstract - *Over the year's man have developed machines to increase the efficiency in industries. One such type of industry is the bottle making industry. We use all kinds of bottles in our day to day life. So man invited A bottle filling and capping machines to increase the production rate of bottle filling and capping. We are progress to focus on bottle capping machine in this paper. This paper tells us about the application of mechatronics system in the capping of bottle in beverage industries across the world. We personally developing a modular mechatronics system (MMS) which is a combination of mechanical and electronics systems. This robotic arm will also sense the torque while capping the bottle and display it on Tft display. The torque is sensed using load cell and the load cell will be connected to the Arduino using hx711 weighing senor for measuring the torque output.*

***Key Words*: Arduino Uno, Capper, IR Sensor, Load Cell, Robotic Arm, Stepper Motor.**

1. INTRODUCTION

Since past years' people tried to replace human work with machines. Machines called robots are faster and simple than people. The term robotics is defined as the study and design of robot systems which are used for manufacturing. Robots are generally accustomed to perform unsafe, hazardous, highly repetitive, and unsightly tasks. They have many various functions like material handling, assembly, arc welding, resistance welding and machine load and unload functions, painting, spraying, etc. Many elements of robots are built inspirationally from natural phenomena. Construction of the manipulator like the arm of the robot is derived on human arm. The robot has the power to control objects like pick and place operations. it's also ready to function by itself. The development of electronic industry robot system technology has been expanded increasingly. Together such application, the service robot with machine vision capability has been developed recently. In today's time bound society, time and man power are in shortage for completion of task in large scales. The automation is playing important role to save lots of human efforts in most of the regular and regularly carried works. one among the major and most ordinarily performed works is picking and placing of jobs from source to destination. Present day industry is increasingly turning towards computer-based automation mainly thanks to the necessity for increased productivity and delivery of end products with uniform quality. The inflexibility and usually high cost of hardautomation systems, which are used for automated manufacturing tasks within the past, have led to a broad based interest within the use of mechanical arm capable of performing a spread of producing functions during a flexible environment and at lower costs.

The use of commercial mechanical arm characterizes a number of contemporary trends in automation of the manufacturing process. However, present day industrial mechanical arm also exhibits a monolithic mechanical structure and closed-system software architecture. They're targeting simple repetitive tasks, which tend to not require high precision. The bottle capping arm will be a human programmed capping device used in beverage industries.

1.1 History of the Robotic Arm

The first robot was built as the general-purpose machine to move heavy objects. Engel Berger and Devon understood the devices value in manufacturing department as well. The automotive industry is now the largest market know for robotic automation, but there are other industries including electronics assembly; life sciences; food and beverage; and metal and plastics manufacturing which are rapidly using robots as part of a push towards automation. Engel Berger was also interested in the ways that robots could serve for betterment of human life. For example, he was especially interested in how robotics could be helpful in the service industries and healthcare sectors.

1.2 History of the Bottle Capping

When running smoothly the Callahan press produces approximately 1.3 million crown caps per 24 hours but lately there has risen a requirement to revamp the

machine so on minimize die misalignment, develop an efficient maintenance strategy to reduce down time and increase safety of the operator at point of operation by developing an impression system for the removable guard barrier. The Callahan machine is an old machine that has begun experiencing problems and is lagging behind in terms of other features as compared to the recently designed press machines for instance the recently acquired SACMI press. Also with the advancement of technology and with the continual advancement within the engineering field there's always room for improvement in terms of machine design. With the ever development of latest machines, old model machines may easily get replaced with improved versions. However, the procurement of a replacement machine may prove costly. Watching the poorly performing Zimbabwean economy, this procurement isn't as easy because it used to be when the manufacturing industry was fully operational (most manufacturing companies have closed). Rather than procuring a replacement machine, the already existing machine could even be redesigned to reinforce efficiency, improving its performance in engineering the term design modification is used to elucidate the changes made to a process or machine during its use with a view to increase efficiency of the system or process. The advantage of design modification is that it is cheaper compared purchasing a replacement machine altogether. With design modification, problem areas are identified and style changes made to those areas to curb the matter areas. The corporate that manufactured the Callahan press in 1972 has since close and thus the supply of spare parts could also be drag. However, with design modification, spare parts can also be made readily available since the designers are getting to be at hand. This is often mentioned as import substitution. Rather than importing spare parts. The spare parts are made readily available locally. Locally available goods are always cheaper than imported goods.

2. LITERATURE REVIEW

In this paper, we presented the dynamical analysis and development of a 6-DOF arm of an anthropomorphic telerobot system controlled and commanded in real-time by a tele-operator in using the Man Machine Interface. The Man machine interface was implemented on the real robotic platform. The presented model of the robotic arm has also provided correct joint angles to maneuver the arm gripper to any position and orientation within its workspace. Results obtained from the model were compared with the particular performance of the robot in accomplishing a task e.g. pick and place of an object. It's been found that with the joint angles computed, the robot achieves position precision within ±0.5cm. This tiny deviation is due of many reasons namely, mechanical coupling of the joints, non-linearity in mapping angles to low-level encoder ticks. Proposed robot has two robotic arms with 6 Degree of Freedom (DOF), with each arm having two fingered gripper controlled by high torque servo motors. We have used Raspberry Pi and Arduino because the controller and other robot sensors, respectively, that are used for stable functioning and robustness. This design helps in both small scale and large scale industries; wherein various levels of torque capacities are often built supported grasping force required for an application. In small scale industries, manual control is incorporated where it eliminates computation required for motion planning of robot and it's also cost effective compared to the automated robots. For control of robot, android application is developed using MIT App Inventor. A robotic gripper with variable stiffness using shape memory alloy (SMA) and a model for grasping force is proposed by Haibin Yin et al. in 2017. It's verified employing a two jawed robotic gripper. The stiffness of gripper varied using the connection between temperature and coefficient of elasticity of SMA wires. Results show that the grasping ability increases by at minimum of 30% of normal two fingered grippers but the disadvantage is, it's applicable for less than small weights [4]. W. Gauchel has proposed a model individually movable two jawed pneumatic gripper using closed-loop position controller of jaws. But in pneumatic based approach cost and energy consumption is high [6]. Paul Glick et al. have designed a robotic gripper with a mixture of fluidic and elastomeric actuators and geckoinspired adhesives. This has increased the soft gripping property. But the disadvantage of this system is position and speed of gripping is complex to regulate and wishes more computation for lifting heavy parts.

3. METHODOLOGY

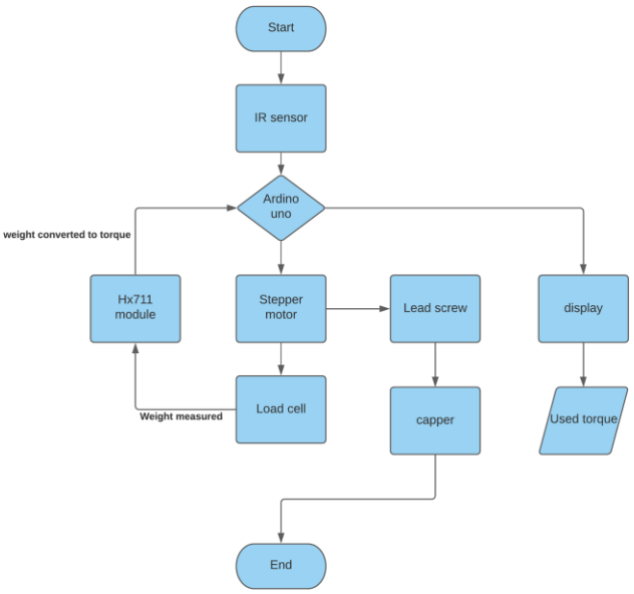

Chart 1- Flow Chart of Methodology.

Arduino Uno in the transfer of the movement from motor to the screw. Next, through this the lead screw the capper attached to it will be rotated. At the tip of the lead screw, there also will be a sensor which will detect the exact height of the bottle and according to that, it will get adjusted. After knowing the exact height is essential as it will help to cap the bottle, or the bottle might be damaged in the process. After attaining the proper height of the bottle, the input will be again sent by the Arduino for achieving the second rotary movement of the motor which will have low speed but higher torque so that the process of capping is performed successfully. Moving ahead by the rotary movement, the bottle will be capped and while capping, torque will be calculated with the help load cell and Arduino Uno and will be displayed in smoothly.

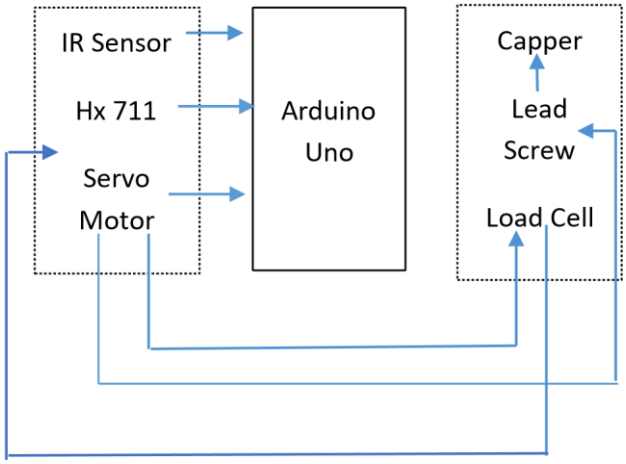

Chart 2- Flow Chart of the proposed system.

4. WORKING

At first the IR Sensor will check whether the bottle is present on the base or not. If there is a bottle present below the capper the IR sensor will send input to Arduino and help Arduino to start the process of capping. Later, Arduino will send a pulse to the motor which acts as input for the motor. Then the motor will give that rotating output to lead screw with the help of rigid coupling. As we are applying a rigid coupling the backlash will be 0 so that there is no power lost the LCD Display below. We will have to program the Arduino beforehand so it measures torque with the help of weight measure by load cell.

5. FLOW CHART OF PROPOSED SYSTEM

Arduino Uno: The Arduino is the brain of this whole system. It will help us give command to the system. It controls the height of the lead screw, the rpm of servo motor, the measurement of load cell and the display. It takes input from both IR sensors and helps the system run

6. COMPONENTS USED IN PROPOSED SYSTEM

IR sensor: There are 2 IR sensors in the project. The first sensor will be placed on base to sense the bottle placed on the table is in exact position below the capper for it to place and fit the cap on it. The second sensor will sense the height of the bottle and send the information to Arduino so as to adjust the height accordingly.

Fig.1 – IR Sensor, **Fig. 2-** Electronics Mechanical

Stepper Motor: The motor does all the mechanical work in the system which includes height adjustment of lead screw and capping of the bottle. The motor used in this system is a 12V motor with variable rpm so as to meet our needs. The variability of the motor will help us change the rpm as required to us for the process i.e. if we want to lower the lead screw the rpm required will be low and torque will also be low as for capping the rpm and torque will increase. The stepper motor will help us with all the mechanical work in the project.

Fig.3 – Stepper Motor

Lead Screw: The lead screw acts as support which connects the motor and capper to each other. Its primary use is to adjust the height of the capper as required. **Load Cell**: A load cell is used to measure the weight typically. It is a mechanical transducer. In the present project we will be using this load cell to measure torque with the help of Arduino. We have used a 10kg load cell to measure as we doing a conceptual project.

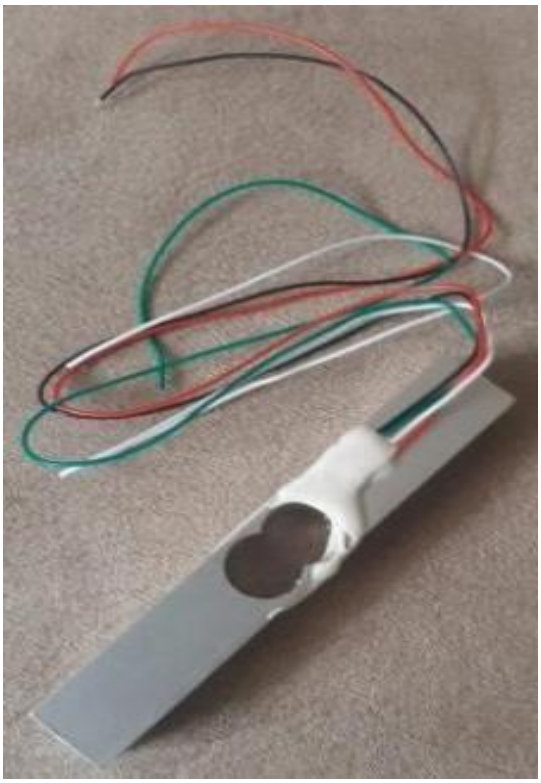

Fig. 4 – Load Cell

Capper: A capper is device which will help us achieve the final outcome of the project. We will cap the bottle using the capper. It will be attached to the lead screw so as to get [4] rotary movement given by the servo motor.
HX711: It is weighing sensor which helps the load cell give input to the Arduino. It is a chip module which will be connected between load cell and Arduino so that the Arduino Uno will be able to read the readings of load cell.

Display: The display will help us to see the torque used in the capping process. Other than that to change the program input of Arduino when required.

Giving this arm simple can help move man power to a more complicated task.

Fig. 5 – TFT Display

Jumper cables: These are small wire used to connect all the electronics part of the system. [1]

7. CONCLUSIONS

It is found that, the robot so implemented has the ability to cap bottle of any height with the help of motor and IR sensors. Further depending upon [controllin[2] g action provided to servo motor it can also sense the torque used in the process. In future] when all the industries are fully automated this arm will be a part of every industry with few changes. When a Bluetooth module is added the arm can be coded wirel[essly through your device. By replacing Arduino with raspberry pi we can speed up the [3] processing time and also will be able to give it] additional tasks. This project will help in increasing the efficiency of the plant.

8. REFERENCES

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