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Fabrication of Low Cost Automatic Form, Filling and Sealing Machine

Sandeep Prajapati[1], Ankit Maurya[2], Rahul Yadav[3], Nitish Shukla[4], Dilpesh Jain[5], Kevin Bhandari[6]

[1-5]Department of Mechanical Engineering, Laxmi Institute of technology, Sarigam
[6]Assistant Professor Department of Mechanical Engineering, Laxmi Institute of Technology, Sarigam, Gujarat, India

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Abstract - *We observed that cheapest machine which automates the form, filling and sealing processes costs around 1.25 lakhs (INR) so it is not affordable for small scale businessmen. Thus it limits their production as well as business profits.*

This project develops a machine which will form the plastic bags, fill the plastic bags with required quantity and then seal the plastic bags automatically using some sensors, heater, servo motors, micro controller (arduino UNO). The machine design is based on simple mechanism which require less space, less maintenance, and easy to operate. Reducing the machine cost is major advantage of this project.

Key Words: **Cyclone Separator, *Form, fill and seal, Packaging Machine, Arduino UNO, Low Cost Automation.***

1. INTRODUCTION

The combination of mechanical, electrical, electronic and computers in industries developed lots of useful, efficient, reliable, accurate and high speed working machines for the packaging of dry fruits, seeds, and pharmaceutical etc. But these entire machines rate is equal or above Rs. 1.2 lakhs approx. The rate is high because of types of mechanism used, types of material used, capacity of the machine, type of automation etc. But when it comes to small and medium scale business these machines are not economic. So, the aim of our project is to develop a low cost machine which works fully automatic for forming plastic bag, weighting product, filling Product in the formed plastic bag, and sealing the bag. There are major four works for which machine should be automated and that is to form the plastic bags, to weight the product (quantity measurement), to fill the product in the bag, and to seal and to cut the sealed bag. These four major works in industries is done by using different types of mechanism like cam system, pneumatic systems, draw bar mechanism or belt draw down mechanism, mechanical and electrical systems. These all system is quite good in design and working and is reliable too. But these systems are higher in cost and their automation is also high in cost.

The automation in industries in present days is a global trend in production. Most of the automation in the industries is based on the PLC programming. If we are designing a low cost packaging machine(FFS machine) and automation is done by using PLC programming the cost of the machine is definitely going to increase because PLC based automation is costlier.

We are going to use arduino UNO for the automation of our packaging machine. Servo motor is used for giving different kind of relative motion to the different mechanisms and load cell for the weight of the product. Arduino based automation may result in low cost automation of the machine which we are fabricating by using some different mechanism for weighting the product as well as the sealing and cutting action of the pouch.

2. OBJECTIVE AND SCOPE

2.1 OBJECTIVE

As we know that the small and medium scale dry fruit and seeds production business owners cannot afford packaging Machines which are currently available in market because of their high rate. So our main objective is to reduce the cost of the packaging machine.

Major objective of our project are:

1. To fabricate a low cost automatic packing machine.
2. To simplify the working and operation of the machine, So that it would be easy to operate.
3. To fabricate a machine which requires less space and Stable at the time of working

2.2 SCOPE

This machine can be used by the small and medium scale food production business owners so that they can expand their business. This machine can also be used by the farmers, they can pack their agriculture product (daal, rice, seeds, dry fruits etc.).And can be used by the many shops owners who packs their product manually with the help of candles.

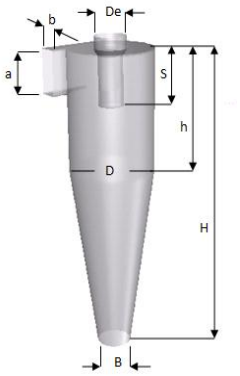
3. METHOLOGY

- Making rough model of the machine and clear the concept. And making the list of the required components.
- Collecting the required material for making the required Components.
- Making the suction part of the machine with cyclone

Separator, induction motor and blower.
- Making the bag forming structure using tin sheet.
- Making the valve after calibrating the load cell sensor.
- Making of the heat sealer.
- Assembly of the different components.
- Programing on arduino UNO.

4. COMPONENTS USED

4.1 CYCLONE SEPARATOR



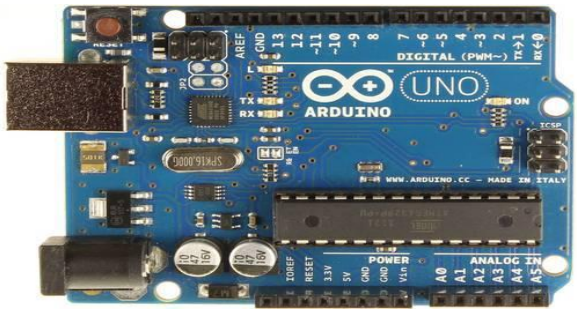
Here, Cyclone separator is used for the feeding the product into the machine. In cyclone separator there is sudden pressure drop so the dense material fall down and the dust particles exhausted from the blower side.

So, here if we want to pack the dry fruits or some seeds then if we suck it in the cyclone separator then if there is dust in the product then it get clean and the dust will exhausted through the blower. *Our system suction speed is (For Daal) 12 second per kilogram*.

4.2 BLOWER AND INDUCTION MOTOR

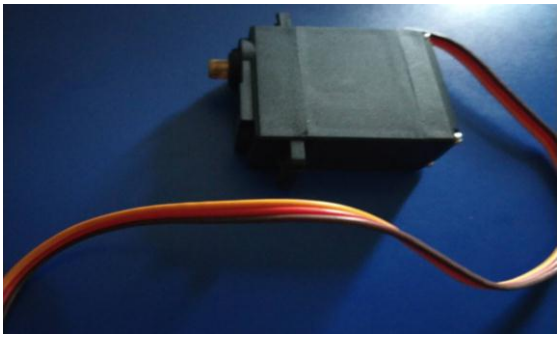
The product will sucked in the cyclone separator by creating the vacuum with the help of the blower and induction motor.

4.3 ARDUINO UNO



The Arduino UNO is a microcontroller board.. It contains 14 digital input/output pins (of which 6 is used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB port, a power supply, an ICSP header, and a reset button. Arduino uses C programming, also some programs of C++ can be used and python can also be used for the arduino programming.

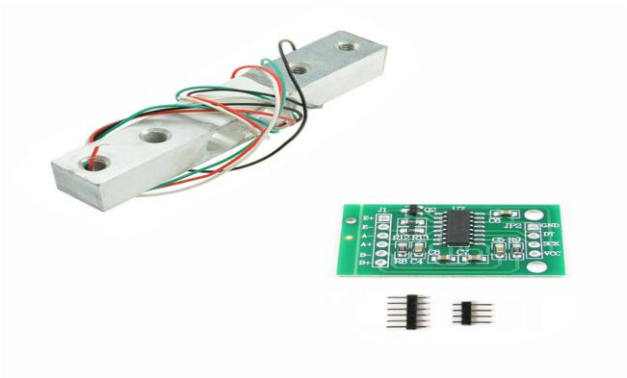
4.4 SERVO MOTOR



A Servo motor is a rotary actuator or linear actuator which provides precise control for the angular motion and linear motion.

It consists of a geared motor coupled with a sensor for position feedback. It has three wires: First is red wire which is for the power supply to the motor, this red wire should be connected to the 5V pin. The second is black or it may be brown which is for the grounding, it should be connected to the ground pin of the arduino, The third one is yellow or it may be orange, this wire is pulse width modulation (PWM) for receiving signals/commands from the arduino this should be connected to the PWM output pins of the arduino. We are using servomotor for the valve control, motion of the continuous heat sealer and for the control of sealing and cutting action of the pouch because servo motor can be control easily by arduino UNO for the required angle of rotation, speed and acceleration.

4.5 LOAD CELL SENSOR



Load cell is a kind of transducer which converts the load, force or weight into an electronic signal. It contains a strain gauge. Strain gauge is basically an elastic material, so when force or load act on it, it deflects, so the resistance change within the strain gauge, so if we supply voltage the output voltage gets vary this variation is used for measuring the load or force acting on it..

For the required quantity to be packed the load cell sensor we are using here below the valve plate. As the required quantity is recognized by the controller the valve plate will get open.

4.6 HEAT SEALER

Heat sealers apply the heat and pressure to the pouch for sealing and cutting the pouch. It is work on the DC current of 5 Ampere and 12 volt supplies.

4.7 PLASTIC BAG FORMING STRUCTURE

Tin sheet is used for making this structure because it is cheap and easy to bend and mounting is also easy on this tin sheet.

4.8 SERVO OPERATED VALVE

The valve plate of this valve contains the load cell which will assure the required quantity. When the controller reads the preset quantity the servo motor give motion to the valve plate and then material will falls in the packet trough the tray.

5. WORKINNG OF AUTOMATIC PACKAGING MACHINE

There is no hopper for the feeding product in the packet; here we are using a cyclone separator through which the material will pass ahead. The product is sucked in the cyclone separator by using a blower which is run by an induction motor.

Due to the sudden pressure drop the product will fall down in the cyclone separator.

At the bottom of the cyclone separator there is a valve, and the valve plate is connected with the load cell sensor. As the product falls on the valve plate the controller reads the signal of the load cell and recognizes the quantity with the reference of the preset quantity. When the quantity on the valve plate reaches to the preset quantity the valve get opens.

The opening and closing of the valve plate is powered by the servo motor.

Parallel to the cyclone separator there is a bag forming structure, through which the plastic film will pass and form a cylindrical shape as it reaches to the bottom of that structure.

At the bottom of the bag forming structure there is a heat sealer which seals the both radial end of the plastic and forms a cylindrical bag.

Previously the sealer will seal the bottom end of the continuous plastic film cylinder form, after that the product will fill in the bag and then the sealer will seal and cut the upper end of the pouch.

Here a question arise that how the sealer will seal and cut the exact required position every time as there is no color sensor or color marking on the plastic film? The trick is in the programming, this all depends on the length of the pouch, so when the roller sealer seals the plastic vertically (Center sealing) equal to the pouch length which can be identify by the angle of rotation of the servo shaft, the arduino send signal and then the other heat sealer and cutter will seal and cut the pouch.

6. COST ESTIMATION

Table-1: Cost Estimation

SR NO.	COMPONENTS	QUANTITY	COSTS(INR)
1.	Blower & Induction Motor	1	3000.00
2.	Tin Sheet	--	200.00
3.	Hx T11 Module	1	120.00
4.	5Kg Load Cell	1	300.00
5.	Arduino UNO	2	880.00
6.	Rectifier	1	350.00
7.	Suction Pipe	1	50.00
8.	Servo Motor	4	1400.00
9.	5V Relay	2	250.00
10.	Nichrome Wire	7meter	220.00
11.	Shaft Coupling	4	600.00
12.	Fasteners	--	200.00
13.	Spring	4	320.00
13.	L section MS bar	1	500.00
14.	Keypad Kit	1	200.00
15.	Thermocouple Sensors	2	300.00
16.	Heat Sealer Roller	2	800.00
17.	Wire	--	100.00
18.	Cyclone Separator	1	600.00
19.	Jumper Wire	--	167.00
20.	Teflon Tape	1	240.00
21.	Cater wheel	4	600.00
21.	Miscellaneous	--	500.00
Total			11897.00

7. CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

Automatic form filling and sealing machine is fabricated this machine eliminates the effort for manual weighing, filling and packing of the product. The cost of the machine is Rs. 11897 Approx., as calculated. This will help the small and medium food production business owner in their business. They can purchase this machine because of its low cost, this will increase their production and supply to fulfill the customer demand.

7.2 FUTURE SCOPE

Further research on this project may lead towards the more efficient machine for the wide range of packaging. This project may lead some more projects in the field of

automation because Arduino based automation is not so developed in the industries for packaging machine.

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AUTHORS PROFILE

Sandeep Prajapati
Final year Student of
Mechanical Engineering,
Laxmi institute of technology, Sarigam,
Gujarat, India.

Ankit Maurya
Final year student of
Mechanical Engineering,
Laxmi institute of technology, Sarigam,
Gujarat, India.

Rahul Yadav
Final year student of
Mechanical Engineering,
Laxmi institute of technology,Sarigam,
Gujarat, India.

Nitish Shukla
Final year student of
Mechanical Engineering,
Laxmi institute of technology,Sarigam,
Gujarat, India.

Dilpesh Jain
Final year student of
Mechanical Engineering,
Laxmi institute of technology, Sarigam,
Gujarat, India.

Mr. Kevin Bhandari
Assistant Professor
Mechanical Engineering,
Laxmi institute of technology, Sarigam,
Gujarat, India.