

Automated Paper Bag Making Machine

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Abstract— Carry bags has become a more convenient way to carry daily necessities and for packaging in small quantities. The well-known form of such bags is in the form of plastic bags. Despite of all known hazards of plastic pollution, it's prevalent and pervasive in India. Plastic bags are one of the worst and most unnecessary plastic polluters of the earth. Plastic bags are used on a large scale by retailers for a simple reason that plastic bags are much cheaper than paper, cloth or other eco-friendly bags. This paper presents the designing and development of a system to automate the procedure of paper bags production so as to make its production cost comparable to plastic bags and inherently increase its production rate so as to fulfill the ever increasing demand. We have used micro-controller based design approach which has kept the cost of the system significantly low as compared to PLC based designs and have automated the manufacturing process.

I. INTRODUCTION

We need small size bags every day for various purposes like grocery, fruits, and vegetables. We use plastic bags for such purposes. Plastic shopping bags have a surprisingly significant environmental impact for something so seemingly innocuous. Plastic shopping bags kill large numbers of wildlife each year. One of the most dramatic impacts is on marine life.

So to avoid above harmful effects of Plastic Bags, viable alternative is required which is Paper Bag. Actually, Paper Bag is being used but in very small scale. Conventional Paper Bags require special paper which increases the overall cost of the Paper Bag. This is the main cause due to which use of Paper Bag is less. Also initial investment cost is very much in conventional Paper Bag Machine. So it cannot be used for small scale production.

All these problems are eliminated in the presented machine. A machine whose initial cost is less, which does not require any special paper, which can be used for small scale production, is developed. This machine will help a poor family to earn money through small scale production of paper bags. The paper bag will be

produced from the regular size newspaper to reduce the cost of the bag. Once the bag is used it still can be sold to scrap vendor earning back small amount of the cost for the paper bag. This not only reduces waste but also promotes the recycling.

Even governments are trying to reduce the impact of plastic bags. This news definitely proved to be our strong hold as we are also the one who are trying to oust the plastic bags.

The environmental impacts of plastic bag use include:

- Danger to animal life, especially when they find their way into the sea
- Plastic bags are quite commonly mistaken for food by animals, especially when the bags carry food residues, are brightly colored or are animated by the movement of water. A great variety of animals, land and especially marine, can choke to death on bags, experiencing much pain and distress. If swallowed whole, animals may not be able to digest real food and die a slow death from starvation or infection.
- Pacific Trash Vortex: The amount of floating plastics in the world's oceans is increasing dramatically. The Pacific Trash Vortex is a 'gyre' or vortex of marine litter in the North Pacific Ocean. The vortex is characterized by exceptionally high concentrations of suspended plastics, such as plastic bags, bottles, containers and other debris, that have been trapped by currents. It is now estimated to be twice the size of Texas. Its impact on marine ecosystems is catastrophic due to its toxic nature and threat to marine life as seen in Fig.1
- Litter problem: Plastic bags are a highly visible, ugly component of litter. Local and State

Governments around Australia spend more than \$200 million per year picking up litter. If plastic bags continue to be used, the number of bags littering the environment will increase over time. Plastic bags are typically used for a short period of time but take hundreds of years to break down in landfill. While plastic bags can be recycled, only a tiny proportion of plastic bags are collected and reprocessed. The scare of plastic bags is expressed in Fig. 2.

- Greenhouse gases : Based on using ten lightweight plastic bags per week over a 2-year period, the greenhouse gas impact has more than three times the greenhouse gas impact of a reusable 'green bag'.



Fig 1: Pathetic state of marine life due to plastic bags.



Fig 2: Trivia about plastic usage

II. RELATED WORK

The global environment is changing day by day and now it has become a challenge to living life forms due to the very ugly fact that every nation is trying to develop their countries without taking into consideration of environmental impact of degradation and pollution of agricultural lands. More and more factories are being steadily established and harmful chemicals and materials are being used in the production process. People are using plastic bags, which are environmentally dangerous products, for their daily needs mainly for shopping purposes as a result of which, the environment and agricultural lands are thereby being polluted [1].

Paper bags have traditionally been presented in this paper as the environment friendlier option when

compared to plastic bags. Prior to the introduction of jute bags, paper bags were the most commonly used. The natural fibers of paper, and the renewable resource used has a positive image, as the increase in volume of the paper bags, likely to be sent to the landfill, have now taken over a new role in the recycling options which are firmly established. It has been scientifically proven that paper bags are not harmful to the environment as plastic bags.

A] Available alternative to plastic bags

1. Jute bags

Jute bags are biodegradable containers made from plant fiber called jute. They are usually used for storing and holding grocery materials. Heavy duty jute bags or sacks are popular for packaging agricultural commodities.

2. Biodegradable Plastic Bags

The generation of biodegradable plastics has been considered as an alternative to the toxic producing traditional plastic bags. This provides the same environment friendly positive image of natural fibers and bio-degradability that paper or jute bags possess. Thus the need to stop using the non-biodegradable plastic bags has increased. This has helped decreasing the widespread use of traditional plastics [2] whilst simultaneously it also increases the market potential of the new generation of biodegradable plastic products for a much broader global usage.

Although biodegradable plastic bags are marketed as an environment friendly [3] option, they may probably cause similar but further environmental problems.

3. Paper Bags

Paper bags have traditionally been presented as the environment friendlier option when compared to plastic bags. Prior to the introduction of jute bags, paper bags were the most commonly used for shopping purposes. The natural fibers of paper, and the renewable resource used has a positive image, as the increase in volume of the paper bags, likely to be sent to the landfill, have now taken over a new role in the recycling options which are firmly established . It has been scientifically proven that paper bags are not harmful to the environment as plastic bags.

B] A New Approach to Architectural Logic and Structural Design.

How does an architect use a sheet of paper and a digital system is our question of concern [4] . Paper is a two-dimensional support on which the architect

carries out the creative drawing process. However, if we fold the paper, the architect is now able to begin to manipulate and even create space. A digital system [7], to put it succinctly, uses “electronic technology to manage, store and process information “allowing its user to work quickly.

C] Paper bag machines:

Margaret E. Knight (February 14, 1838 – October 12, 1914), an American inventor, while living in Springfield, Massachusetts, Knight invented a machine that folded and glued paper to form the flat bottomed brown paper bags familiar to shoppers today [5]. What was significant in this invention was that flat bottom bags were thereafter used widely world over. On June 12, 1883 the U.S. Patent office issued to Chas Stilwell a patent for a paper bag machine.

In the summer of 1883, Stilwell put into operation the first machine to produce paper bags. The bags had flat bottoms for standing up straight by themselves and pleated sides that made them easy to fold and stack. U.S. Patent office issued to, black inventor, William Purvis [6] for a paper-bag machine, the combination of two suction-formers having perforated surfaces, between which the ends of the paper tube are fed, and provided with two independent grooves arranged at different positions of the length of the formers and out of line with each other. Initially, the machines manufacturing involved two stages. This type of mechanism was especially used for square bottom bags.

We discussed about the first design which the Chinese had employed for making square bottom bags. Now we will see the V-bottom bags forming process which was fully automated. It consisted of following processes:-

1. A roll of paper was loaded on a roller which would carry it continuously to the folding mechanism [7] .
2. The paper would pass through the formed shape of the sheet where it would be folded.
3. Glue application would immediately take place after folding would be completed.
4. The roll of paper after folding, gluing would pass through a mechanism which would cut the paper continuously with the help of blades.
5. The end portion of the paper would be again glued, after which it would be pressed by the

rollers and eventually the paper bag would be formed.

6. It was a highly automated process and bags were produced in the range of 100 bags/min.

The approximate cost the machine would be around 5-7 lakhs considering the paper rolls required.

D] Low Cost Automated Machine for Paper Gathering and Folding

The present study was to design and development of a low cost, automated machine which performs gathering, folding, stamping and processing neatly with a high speed. The machine consists of accuracy gathering detector, paper jam detector and preset counting system. It is supposed to gather two papers and fold them into letter or fold [7] . The paper gathering, folding and stamping functions were automated by using an electromechanical motor driven system. Almost all the single paper gathering and folding machines currently available in the market are very expensive. Also none of the machines found with the stamping mechanism. Initial cost for this automated system is very low and running and maintaining costs are also low. This automated system is portable and capable of working independently without much human intervention. Selected materials for the system are also durable and the machine is less of disruptions. Therefore continuous running is possible. Also selected sensors and Arduino Control board for the system is very common and inexpensive.

Design of Automated Packaging Machines: Due to a Chinese factory’s pressing need to increase the speed of paper clip packaging and decrease operating costs, a machine that would fold boxes and load them with paperclips was designed. To make this machine as simple as possible, it was decided to make it primarily linkage based [4]. Using both the graphical and analytical methods for linkage synthesis and with the aid of computer aided design software, Modes of failure specific to the individual mechanisms include:

- 1) In the stage 1 mechanism [8], the paper may fall out of the linkage unless the coefficient of friction between the linkage and the box is high enough or another mechanism serves to stabilize the paper.
- 2) The slider-crank mechanisms and the hooks in the stages 2 and 4 mechanisms must be

coordinated properly for the mechanism to work correctly. This will require accurate synchronization of the step-motors used in the mechanism.

III. METHODOLOGY

The output of the system developed is a paper envelope when paper is input into the machine. This machine mainly consist of components namely MS frame, belt and conveyor, motor, folding machine and electronics circuit.

Paper is inserted in the machine which will pass to the folding mechanism by using belt and conveyor.

Lead screw mechanism is used in the system to apply glue on the paper.

Three motors are used in the system which are used to operate conveyor, lead screw and folding mechanism.

The electronics circuit consist of Arduino and two L293D which able to control the whole envelope making mechanism. The system developed is visualized in Fig. 3.

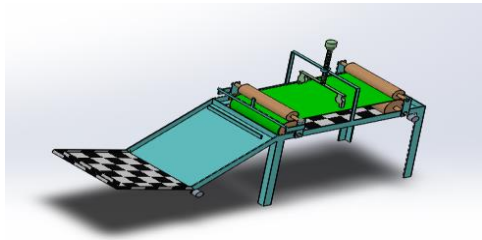


Fig 3: Automated paper bag making machine.

IV. MACHINE DESIGN

The design of the system was created using Solidworks 14. The draft sheet of the entire assembly is as shown in Fig.4.

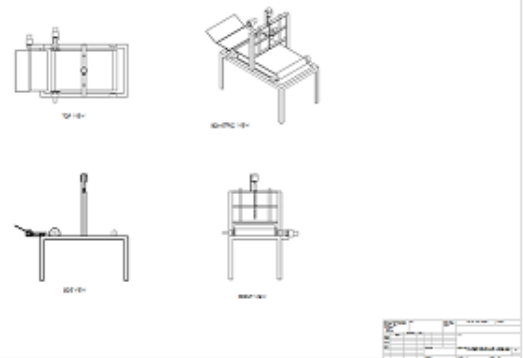


Fig 4: Draft Sheet of Final Assembly.

V. MACHINE COMPONENTS

A] Motor:

For conveyor and folder motor used is Johnson gear motor .Refer Fig. 5.

- 200RPM
- 12V DC motors with Metal Gearbox and Metal Gears
- 18000 RPM base motor
- 6mm Dia shaft with M3 thread hole
- Gearbox diameter 37 mm
- Motor Diameter 28.5 mm
- Length 63 mm without shaft
- Shaft length 30mm
- 180gm weight
- 32kgcm torque
- No-load current = 800 mA,
- Load current = upto 7.5 A(Max)

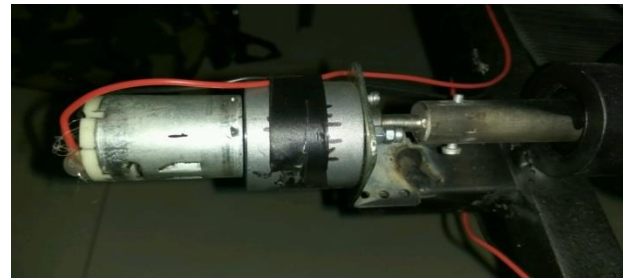


Fig 5: Motor used in Final Assembly.

B] Motor used for lead screw.

- 10RPM 12V DC motors with Gearbox
- 125gm weight
- 5kgcm torque
- No-load current = 60 mA(Max),

- Load current = 300 mA(Max)

Refer Fig.6.



Fig 6 : Motor used for lead screw of Final Assembly.

- Length:1m(end to end)

- Thickness:8mm

Refer Fig.9 for belt used.



Fig 9: Belt used in Final Assembly.

C] Frame:

- Material:Mild steel(MS)
- Size:600*360mm
- Height:400mm

Refer Fig 7.



Fig 7: Frame used for Final Assembly.

D] Roller:

- Materiel:mild steel
- Length:285mm
- Diameter:50mm
- Roller support:4mm

Refer Fig.8 for visualization.



Fig.8 :Roller used for Final Assembly.

E] Belt:

- Materiel: Rubber

F] Techinal Specifications of Arduino board:

Specifications of Arduino board are given in Table 1.

Table 1: Specifications of Arduino board

• Microcontroller	ATmega328
• Operating Voltage	5V
• Input Voltage (recommended)	7-9V
• Input Voltage (limits)	6-20V
• Digital I/O Pins	14 (of which 6 provide PWM output)
• Analog Input Pins	6
• DC Current per I/O Pin	40 mA
• DC Current for 3.3V Pin	50 mA
• Flash Memory	32 KB (ATmega328) (0.5 KB used by bootloader)
• SRAM	2 KB (ATmega328)
• EEPROM	1 KB (ATmega328)
• Clock Speed	16 MHz

Fig. 10 shows the actual Arduino board.

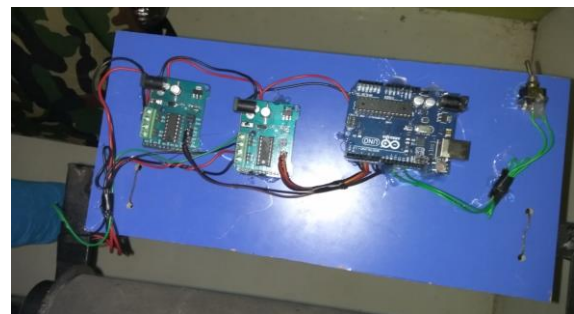


Fig. 10 : Arduino board

VI. COST ANALYSIS

The actual cost of the system is as shown in Table 2. 2.

Table 2: Actual cost of the system.

Components	Cost in Rs
Arduino UNO board	600
L293D(2)	600
Motor(3)	2300
Sheet metal	200
Conveyor	1000
Roller	400
Stud	150
Frame	900
Fabrication	3000
Assembly	3000
Other process charges	1850
Total	15800/-

VII. CONCLUSION

We have been able to design and develop an automated Paper bag making machine for different objectives and to integrate all the objectives together using Arduino. Compensating for the shortcomings of other already available systems, our work is not only of good feasibility, high efficiency, but also with high robustness.

Objectives Accomplished:

- Main purpose of this study was to automate paper envelope machine in order to reduce the man power and to increase the efficiency and quality of the product and ultimately to increase the preparedness to face emergency situations.
- This system contains the parts which are easily available.
- Almost all the single paper folding machines currently available in the market are very much expensive. Simple and easy mechanisms are used in this system that’s why this system is easy to operate.
- As compared to other machine this machine is cheaper.

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