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Design AND Development OF Paper Bag Making Machine

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Abstract—Nowadays, carry bags have become a more convenient way to carry daily accessories. The well-known form of such a bag is in the form of plastic bags. Because of using such a bag plastic pollution is increasing day by day. So, to prevent plastic pollution we are using paper bags. 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. So, for this reason, our main aim is to develop a paper bag machine so that human beings can use this bag in day to day life at a low cost. The 3 D model of our project will be drawn with the help of CATIA software. The analytical results are verified with the results of CATIA and the conclusion is drawn.

Index Terms—Carry bags, Plastic pollution, Eco-friendly, Paper bag Machine, 3 D model, CATIA software, Cheaper

1 INTRODUCTION

We need small size bags every day for various purposes like grocery, fruits, and vegetables, beverages, pharmaceutical & consumer product. Plastic bags are cheap which has increased their usage in the last few decades. Although plastic bags are cheap and easily available, their environmental effects cannot be neglected. Plastic shopping bags have a surprisingly significant environmental impact on something so seemingly innocuous. Plastic shopping bags kill large numbers of wildlife each year. One of the most dramatic impacts is on marine life. To avoid the above harmful effects of Plastic Bags, a viable alternative is required which is Paper Bag. Paper Bag is being used but on a very small scale. Conventional Paper Bag requires special paper and the cost of the available paper bag making machine has a high cost which increases the overall cost of the Paper Bag. This is the main cause due to which the use of Paper Bag is less. So it cannot be used for small scale production.

All these problems will be eliminated in our machine. We want to develop a machine whose initial cost is less, which will not require any special paper and can be used for small scale production. The paper bag will be produced from the regular size Paper to reduce the cost of the bags. Once the bag is used it still can be sold to a scrap vendor earning back a small amount of the cost for the paper bag. This not only reduces waste but also promotes recycling.

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1.1 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 distress. If swallowed whole, animals may not be able to digest real food and die a slow death from starvation or infection.

1.2 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.

1.3 Loss of resources

Plastic bags are typically used for a short period but take hundreds of years to break down in landfills. While plastic bags can be recycled, only a tiny proportion of plastic bags are collected and reprocessed.

1.4 Greenhouse gases

Based on using ten lightweight plastic bags per week over 2 years, the greenhouse gas impact has more than three times the greenhouse gas impact of a reusable

'green bag'.

2AVAILABLE ALTERNATIVES TO PLASTIC BAGS:

2.1Jute bags: Jute bags are biodegradable containers made from a 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.

Fig. JUTE BAG

2.2 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 non-biodegradable plastic bags has increased. This has helped to decrease the widespread use of traditional plastics 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 environmental friendly options, they may probably cause similar but further environmental problems.

Fig. Biodegradable Bag

2.3 Paper Bags:Paper bags have traditionally been presented as the environment friendlier option when compared to plastic bags. Before the introduction of jute bags, paper bags were the most commonly used for shopping purposes. The natural fibers of the paper and the renewable resource used has a positive image, as the increase in the volume of the paper bags, likely to be sent to the landfill, has 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.

Fig. Paper Bag

3DESIGN

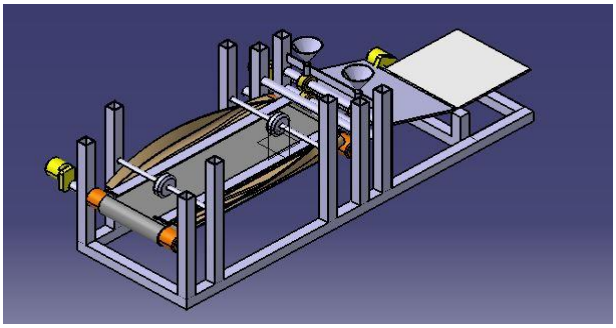

Fig. 4 CATIA Model

3.1 Principal of Operation

Paper is placed in the one end of the conveyor from where the paper travels towards the gluing station through the provided guides above the conveyer. Once the glue is stick to the folded edges of the paper it is further sent to the folding mechanism where the paper is folded. While the folding paper is allowed to stick properly. Then the bag is ready. The machine will be able to perform this different operation simultaneously on a different paper bag to increase the efficiency of the machine.

3.2 Main Components

A. ROLLER & CONVEYOR

A **conveyor belt** is the carrying medium of a **belt conveyor system** (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.
Conveyors are durable and reliable components used in automated distribution and warehousing, as well as manufacturing and production facilities. In combination with computer-controlled pallet handling equipment, this allows for more efficient retail, wholesale, and manufacturing distribution. It is considered a labour saving system that allows large volumesto move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labour expense.

Fig. 5 Belt & Conveyor System

B. ELECTRIC MOTOR

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and winding currents to generate force in the form of rotation. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles, or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters, or electrical generators. An electric generator is mechanically identical to an electric motor, but operates in the reverse direction, accepting mechanical energy (such as from flowing water) and converting this mechanical energy into electrical energy.
Electric motors produce linear or rotary force (torque) and can be distinguished from devices such as magnetic solenoids and loudspeakers that convert electricity into motion but do not generate usable mechanical force, which is respectively referred to as actuators and transducers.

Diameter of Roller

D_1 = 20mm

N_1 =10rpm

Fig.6 D.C. Motor

C. ARDUINO System

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analoginputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

3. ARDUINO System

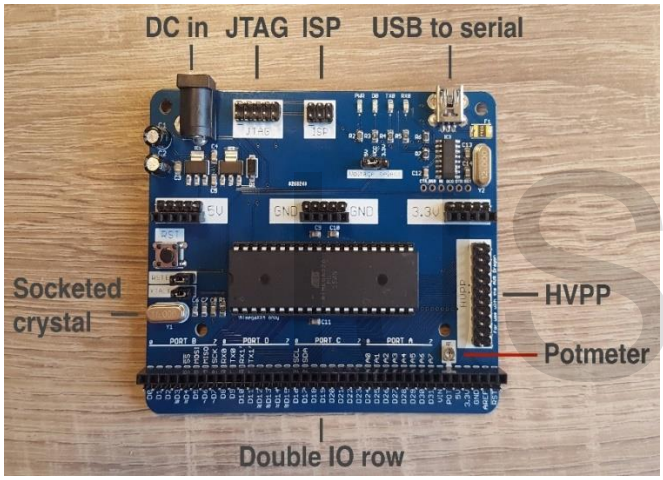

Fig 7: Arduino Atmega 328

D. Simple Layout of Electronic Component

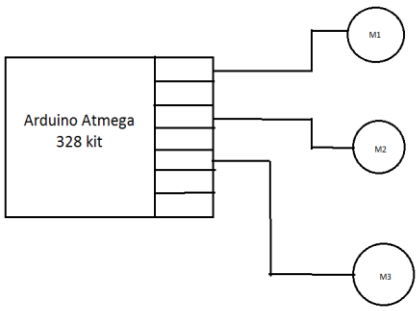

Fig 8.: Layout of Electronic Component

Where

M1- Motor Used for Conveyer

M2-Motor used for gluing Mechanism

M3-Motor used for the folding mechanism

All the motors of the machine are controlled by Arduino Atmega 328 kit. When the machine will be started firstly M1 will be started which will control the rotation of the roller of the conveyor, M2 will operate the roller of the gluing mechanism and M3 will operate the moving plate of the folding mechanism. All three motor will be controlled in synchronization to the operation of the paper bag making. This system is an open-loop system so according to the need changes are to be done manually.

4.CALCULATIONS

Belt Conveyor Design

Assume,

Belt Material = Rubber

Density of the Belt Material (ϱ_{rubber}) = 1522kg/m^3

Thickness of Belt (t) = 5mm-0.005m

Diameter of Roller (Φ) = 0.02m

Width of Belt(b)=0.3m=Width of Roller

Length of Conveyor (l)=0.762m

Length of Belt = (2*Length of Conveyor) + [2*(1/2* Circumference of Circle)]

= (2*0.672) + 0.062

Length of Belt =1.6m

Mass of Belt is calculated as,

$M_{belt} = \varrho_{belt} * l * b * t$

$=1522*1.6*0.3*0.005$

$M_{belt} = 3.6528kg$

Mass of Rollers,

$M_{roller} = \varrho_{roller} * \pi/4(D)^2 * 0.3$

$=7860*(\pi/4(0.02)^2 * 0.3$

$=0.7407kg$

$=1.48kg$

$M_{roller} = 1.5kg$

Mass of Conveyor calculated as,

Mass of Conveyor = Mass of Belt+ Mass of Rollers

= 3.6528+1.5

$M_{conveyor} = 5.2kg$

Mass of Paper Bags placed on Conveyor calculated as,

$M_{paper\ bag} = 250\ kg/m^3$

For a Paper Bag A=(0.3*0.3) & thickness=9.90*10^{-5} total 5 paper bag can be placed on conveyor at a time

$M_{5paper\ bag} = 5(250*0.3*0.3*9.90*10^{-5})$

$M_{5paper\ bag} = 0.01kg$

Total weight of the system= $M_{belt} + M_{roller} + M_{5paper\ bag}$

= (3.6528+1.5+0.01) * 9.81

W=50.64N

As the process is continue we have to maintain speed hence N=10 rpm is constant through the system

So, Linear Speed of Belt(V)= $2\pi*N/60$

V=1.047 m/s

Now,

Total Belt Pull (T) = (Weight of Conveyor *(Coefficient of Friction between

Belt with Bag) Belt and Conveyor)

= (50.64) * (0.4)

Total Belt Pull =20.256 N

Slack Side Tension (T2) = T*k

= 20.256*1.6

= 32.40 N

Where k-drive factor

Tight Side Tension(T1) =T+T2

=20.256+32.40

=52.656N

Total Power required to Belt(P)= (Total Belt Pull) * (

Belt Speed)

= (20.256)*(1.047)

P =21.2080 watt

So accordingly we can select 12v & 2A battery which generate 24 Watt power.

Motor attached to Glue Mechanism

For 12v & 2A motor for N=10 rpm

Power of Motor (P)=24 watt

The torque of the Motor=T=23 Nm (Available Target) ……..A

Mass of Roller applying glue is given as,

ϱ_{roller}=7860kg/m^3

Inner dia. of shaft=0.02m

Outer dia. of shaft=0.04m

M=ϱ * v

M_{roller} = [7860*(0.04-0.02)^2*0.02]

M_{roller}=0.05kg

For Two Rollers,

M_{roller} = 0.01 kg

Mass of Shaft,

M_{shaft} = ϱ_{shaft} * v

M_{shaft} = 0.740kg

Total weight of shaft= [M_{roller} +M_{shaft}]*9.81

F=7.35N

Required Torque to Motor Shaft,

T=F*R

=7.35*0.02

T=0.147 ……..B

A>B So, Design is Safe.

Motor Folding the Paper

12 volt & 2A motor at 10 rpm

P=24 watt &

T=23Nm (Available) …...……..C

Here Thickness of Plate 0.005m

Height of Plate = 0.3m

Required Torque=F*R

= [(0.3*0.3*0.05*7860)*9.81*0.3]

T=10.40 Nm ……D

C>D So, Design is Safe.

Shaft Design

In our design, the power supplying motor is directly connected to the roller, and the rollers considered as shaft. Now at the starting point of calculation to calculate the total weight of the belt and conveyor system, we have taken the diameter of roller(Shaft) as 20mm. So, for the safe design, the calculated shaft design diameter must be less than the considered value of the shaft diameter.

From Design Data Book -V. B. Bhandari- Page no-9.4, we can find out the outer diameter of the shaft.

As we are using 24Watt power motor, with constant 10 rpm rotations, we can find out the required torque value as,

P=(2*3.14*N*T) / (60)

T=22.91 N-m.

This torque(T)=Mt=Torsional Moment Torque acting on Shaft.

Hence,

$D^{4=}$ (584) * (M_t) * (L) / (G)*(ϴ).

L=Length of the Shaft=300mm.

G=Modulus of Rigidity=79300 N/mm^2(For steel shafts)

ϴ=Angle of Twist= 3 Degree per meter Length for Line Shafts.

The diameter of the Shaft (D) =2.02 mm.

So, as our calculated shaft diameter value is much less than the considered value for the same amount of power and torque transmission, our design is safe.

Design of Bearing

From design data book V.B.Bhandari-Page no-15.7, we can select bearing for the shaft diameter of 20 mm.

Here we select single row deep groove ball bearing designated as-6304(SKF)

Dimensions, Load Capacities of Bearings is given as,

Inner Diameter of Bearing=20mm

Outer Diameter of Bearing=52mm

Width of Bearing=15 mm

Basic Load Ratings (C) =15900 N and (C_0) =7800 N

4.1 Structural Analysis

Software used - ANSYS R19.2

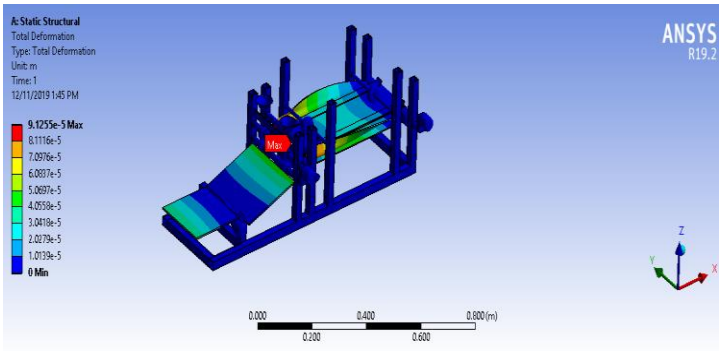

Fig 9 Static Structural Analysis: Total Deformation

Total deformation acting on the system is very less when applied with various tensions and stresses.

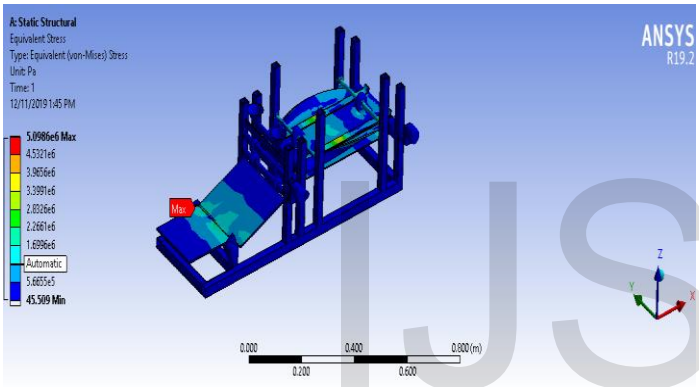

Fig 10 Static Structural Analysis: Equivalent Stress

Stress acting on the system during the application of the various forces are very less;
which shows, the design is safe.

WEIGHT OF 5 PAPER IS CONSIDERED AS 0.01 KG AS 0.01 X 9.81 = 0.0981 N

4.RESULT AND DISCUSSION

The design is quite simple as compared to earlier available machines. Tensions acting on the various conveyer in the machine is very low. The analysis shows that the deformation in the system is very low. Stresses in the system are also less. The design seems to be safe.

5.CONCLUSION

The paper bag machine is developed. This machine is used to make the paper bags having good quality so that it will diminish the use of all types of plastic bags. This reduces the efforts & also reduces the time.
From the analysis result, it is clear that the equivalent stress value is less than that of the Yield strength of the material so, it is clear that the design is safe.

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7.REFERENCES

[1] "S. Shashank Rajath, Nayan Kumar V, Harish A. G. S. M. Narasimhan "Portable Paper Bag Making Machine," International Journal of Engineering Science and Computing, April 2017, Volume 7 Issue No.4

[2] Rahul Mishra "Manufacturing Paper Bag: Semi-Automatic," International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES), June 2018, Volume 4, Issue 6

[3] Shubham Bodekar, Abhishek Gawade, Prashant Hatiskar, Akash More, Prof. Abhishek Rane" Paper Bag Making Machine," International Journal for Scientific Research & Development (IJSRD), 2019 Vol.7, Issue 02

[4] Shubham Bodekar, Abhishek Gawade, Prashant Hatiskar, Akash More, Prof. Abhishek Rane" Paper Bag Making Machine," International Journal for Scientific Research & Development (IJSRD), 2019 Vol.7, Issue 02

[5] D.M. Kalai, Pratik D. Kamble, Shubham S. Kamble, Shubham Shinde "Low-Cost Automated Paper Bag Making Machine," International Journal for Research in Applied Science & Engineering Technology (IJRASET), April 2019, Vol. 7, Issue 4

[6] Jonathan Lobo, Aqueel Madki, Rohit Bhande, Shreepad Bodhankar "Automated Paper Bag Making Machine," International Journal of Innovative Research in Technology (IJIRT), May 2017, Vol. 3, Issue 12

[7] Subramanian Senthilkannan Muthu, Yi Li, Ph.D., J.Y. Hu, Ph.D., P, Y. Mok, Ph.D., Xuemei Ding, Ph.D. "Eco-Impact of Plastic and Paper Shopping Bags, "Journal of Engineered Fibers and Fabrics, 2012, Vol.7, Issue 4

[8] Maniandan V. Reddiar, Dr. Anil Suthar" Design and Implementation of Motion Controller for Industrial Paper Cutting Machine," International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), April 2017, Vol. 5, Issue 4

[9] Abdullah Y. Alshahrani"Paper Airplane Building Machine: Pa-

per Folding Mechanism,"(2016) All Undergraduate Projects, Paper 29

[10] Ankit A. Jagtap, Shubham D Vaidya, Akash R Samrutwar, Rahul G Kamadi and Nikhil V Bhende" Design of Material Handling Equipment: Belt Conveyor System for crushed Biomass Wood Using V Merge Conveying System" International Journal of Mechanical Engineering and Robotics Research, April 2015, Vol. 4, No.2

[11] www.sparkbelting.com