

Design and Manufacturing of Pad Dispensing Machine by Using Online Payment Gateway

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Abstract

Women hygiene is of utmost important and is to be taken care of. Women in India are still shy of buying napkins from medical shops and other stores. A solution to this problem is installing napkin dispensing system. It is a kind of computerized sanitary napkin storage system which can be easily accessed by the people in emergency without approaching any pharmacy. It is a microcontroller and motor-based system to dispense the medicines when accessed by the user through an input event. The main drawback of the existing coin operated dispensing system is that there is only specific size and weight of coin accepted so our work aims at installing an automatic napkin dispenser in toilets and places like long highways, remote tribal areas by using online payment gateway. Also increase number of sanitary napkins availability in the system at once, so we don't need to fill napkins in the system regularly.

Keywords- Sanitary Napkin, Dispenser, Microcontroller, DC Motor, Payment Gateway

I. INTRODUCTION

As we know the concept of complete automation has hit the industry but there is still lack in the way how the new system is designed and integration of the same with the existing system to achieve automation partially or completely our project is concern with the vending machine that dispenses sanitary napkins .Vending machine is nothing but mechanism which dispenses items of your need to you by insert currency or credit into the machine. As we know girls have menstruation cycle every month and during that period they need to change napkins every three or four hours else they getting easily affected by cancer or any other related disease, generally they carried pads with them but today girls do job and many other activities so they can't keep pad with them every time and don't change pad .which lead them to uncomfortable zone and it is not possible to go every time to shops for purchasing also go to the shop and ask for sanitary napkin feels embarrassment to her. So, as concern with above problem we proposed the sanitary napkin dispensing machine which is personal hygiene product for a woman with online payment gateway. This machine can be implemented in different way by using processor or controller after paying amount a product may become available to user by the machine releasing it. The machine is built also keeping in consideration of space constraints which help it in places such as shopping malls, wholesale retail outlet, offices and colleges which reduce the

time and also reduces the human effort require to recognize search count and deliver the product also keep health of women's by getting them the napkins as and when require.

II. OBJECTIVES

The aim of the project may be summarized as follows:

To design and construct this dispensing unit, by using online payment gateway for feed girls' requirements during their periodic cycles even when they are at their work or at their colleges. For that following objectives should be achieved.

- To study various vending machines available in market and its materials study.
- To fit maximum numbers of pads in a compact design with no physical damage.
- To achieve required rotation of general dc motor.
- To design and implement an Arduino programs and integrate the payment gateway to the system.

III. RELATED WORK

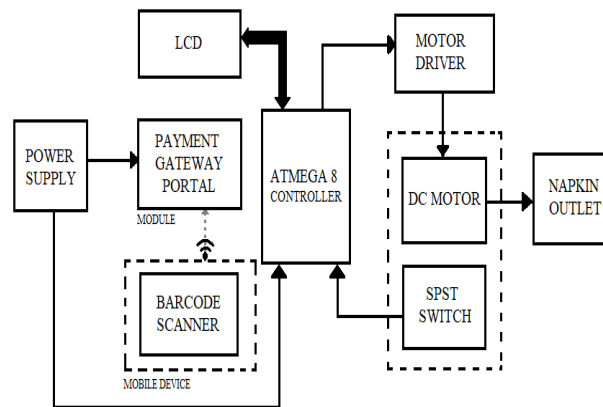
K. Samba Siva Rao.al. in “Solar Powered IOT Based Intelligent Sanitary Napkin Dispenser” 2018 [1] discussed the design of vending machine based on PLC, RFID and Solar Panel. Also discussed about the short message on availability of napkin in machine by using GSM module.

Mohan SukraGond.al. in “Design and fabrication of automatic dispensing machine” 2018 [2] discussed the idea of user interface, decision making and action layer in which they comprise mechanical and electrical component to performed the work by using microcontroller.

Prof. S.S. Desai.al. in “Automatic Chocolate Vending Machine by Using Arduino Uno”2017 [3] discussed about the idea of interfacing RFID along with Arduino to provide solution on coin based vending machine which is not returning the money.

Kamalanathan.P.al. in “Automatic Paper Vending Machine”2015 [4] discussed about the idea of mechatronics principal to reduce the human effort for searching, recognizing and buying the product. Also discussed various components like Dc motor, transformer, microcontroller, power supply board and LCD.

IV. BLOCK DIAGRAM



supply. Because, we required two different voltage one for DC Motor and second for controller. Which is 12 V and 5 V respectively.

B. Payment Gateway

A payment gateway is a merchant service provided by an e-commerce application service provider that authorizes direct payments processing for e-businesses, online retailers. The payment gateway may be provided by banks to its customers, also be provided by third party service providers.

In this work, Payment gateway is used for online transaction without including any physical currency. When transaction is complete then payment gateway triggers the dispensing mechanism through micro controller for dispensing the required amount of sanitary napkin.

C. AT mega 8 Microcontroller

AT mega 8 controller, in that all pins support two signals except 5 pins (i.e. VCC, GND). It contains 28 pins and divided in to 4 ports (i.e. A, B, C, D). Its maximum operating frequency is 20 MHZ.

In this work, AT mega 8 microcontroller is used as a control device which control the DC motor rotation by using single pole single throw switch which is push type through L293D motor driver. Controller gives input to the motor according to the response from payment gateway and get feedback from SPST switch, whether motor rotate or not required rotation and after confirming stop the motor.

D. Motor Driver (L293D)

This motor driver or motor driver IC is allowed dc motor to rotate on either direction. It is a 16 pin IC which can control a set of two DC motor simultaneously. It works on H-Bridge concept where driver alter the voltage and control the direction of motor which is either clockwise or anticlockwise.

In this work we used this driver. Because, we need to control our dc motor rotation to dispense the sanitary napkin. To achieve this, we used logic table values of motor driver.

E. DC Motor

A DC motor is any kind of electrical rotary mechanism which converts electrical energy in to mechanical energy. All dc motors have an internal mechanism that can be electromechanical or electronic. DC motor's rotation speed can control over a wide range by changing its voltage.

In this work, three dc motors are used which are controlled by respective motor driver and to achieve its rotation on off control, we introduced SPST switch and the motor shaft end is connected to the coil spring mechanism to dispense the sanitary napkin within time.

F. Single Pole Single Throw Switch

SPST is a contact type electromechanical switch which consist one or more sets of movable electrical contacts connected to the external circuits. When a pair of sets or pair connect, current can pass between them otherwise current cannot flow between them.

In this work, three SPST switches are used for each of the dc motor on off rotation control at particular position respectively to achieve particular coil spring rotation to obtained respective napkin

outlet. To obtain that, SPST switch need to signal to the AT mega 8 microcontroller at every point contact.

G. Coil Spring Mechanism

Coil spring is a dispensing mechanism for vending machine which connected to the AT mega 8 microcontroller through dc motor and motor driver to achieved required rotation for napkin outlet. To allow rotation predetermined value have been paid through barcode scanner via payment gateway as shown in fig.1. Coil spring comprises closely spaced neighbouring loops, which capable of supporting and transporting the product to be vended. As the coil is turned napkin is transported towards dead end until it reaches the distantly spaced loops where it drops from the dead end to the dispense slot which can accessible by customer.

VII. MODEL DIAGRAM OF SYSTEM

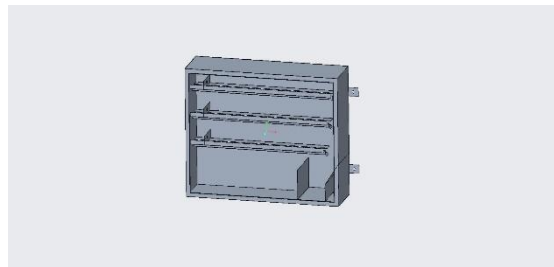


fig.2. Body Frame Diagram

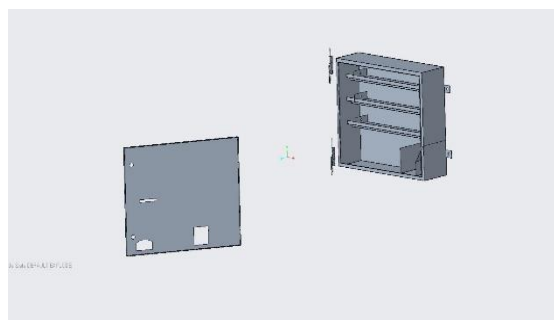


fig.3. Exploded View of Dispensing Machine

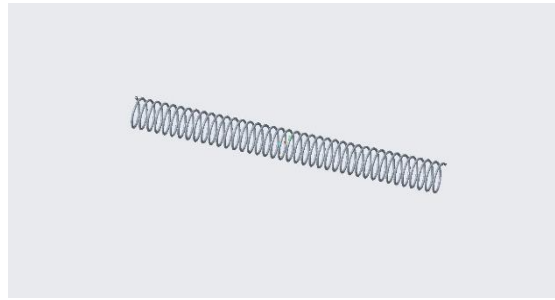


fig.4. Coil Spring Mechanism

VIII. MATERIAL SELECTION

The four basic factors, which are considered in selecting the material are availability, cost, mechanical properties and manufacturing consideration. As we know our project is related to fabrication, we need material with high weldability which is mild steel.

Mild steel is a low carbon steel which is more easily welded than a high carbon steel. Higher carbon content tends to harden the welded joint as a result of which the weld is susceptible to cracks. For ease in welding, maximum carbon content is usually limited to 0.22%. Now as we say about availability and cost then mild steel is easily available and cheap in cost and of course highly malleable and ductile material and also easier to cold-form, making them easier to handle and provide better accuracy. So, this material suits our project better than any other material.

IX. CALCULATIONS

A. Design of Coil Spring Mechanism

Considering maximum load condition (at this point spring will not rotate.)

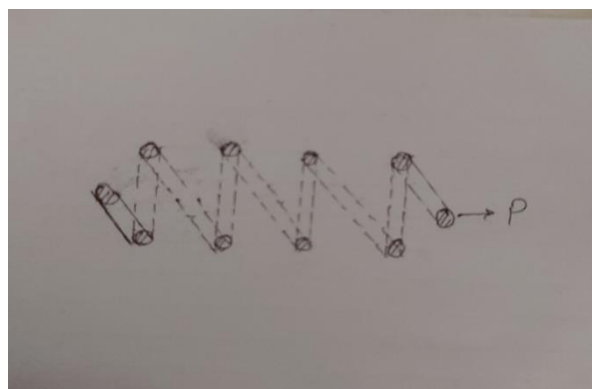


fig.5. Cut Section View of Spring

Hence, torsional stress (τ_1) acting on spring given by, fig 6 (a)

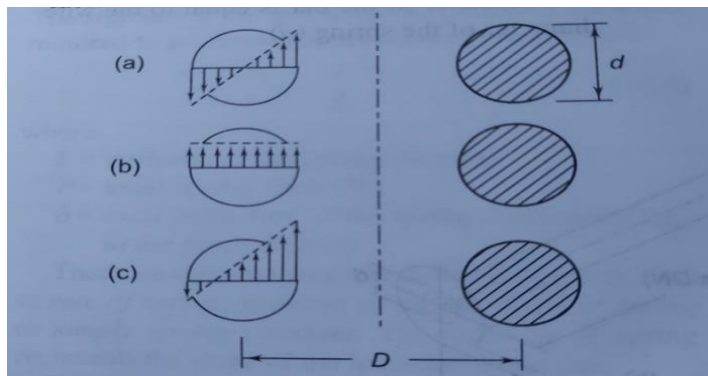


fig 6. Stresses in spring wire: (a) Pure Torsional Stress (b) Direct shear stress (c) Resultant Shear Stress

$$\tau_1 = 16M_t / \pi d^3 \quad \dots \text{ (Torsional moment } = PD/2)$$

$$\tau_1 = 16 (PD/2) / \pi d^3$$

$$\tau_1 = 8 (PD) / \pi d^3 \quad \dots (1)$$

Now, as equivalent bar bent in the form of helical coil, additional stress will act. i.e. Direct or Transverse shear stress in wire τ_2 . (at maximum load condition)

Given by,

$$\tau_2 = P / (c/s) \text{ Area} = P/A$$

$$= P / (\pi/4) d^2$$

$$\tau_2 = 4P / \pi d^2$$

Now, to take common factor as equation (1)

multiplying above equation by $2/2 * D/D * d/d$

Therefore, above equation becomes

$$\tau_2 = 4P / \pi d^2 * 2/2 * D/D * d/d$$

$$\tau_2 = 8PDd / 2\pi d^3 D$$

$$\tau_2 = (8PD / 2\pi d^3) (1/2 * d/D)$$

$$\tau_2 = (8PD / 2\pi d^3) (0.5d/D) \quad \dots (2)$$

Taking cross-section from fig 6(b), stress distribution due to τ_2 given as,

Superimposing the two stress τ_1 and τ_2 the resultant shear stress (τ) the spring wire is given by,

$$\tau = \tau_1 + \tau_2$$

from equation (1) and (2)

$$\tau = (8PD/\pi d^3 + 8PD/\pi d^3) ((0.5d)/D)$$

$$\tau = (8PD/\pi d^3) (1+(0.5/C) \dots (3)$$

$$\dots C=D/d \text{ (spring index)}$$

Taking c/s from figure 6 (c),

Resultant shear stress distribution on spring element (c/s) shown as,

hence, at inner fire more stress concentration can be seen, than the outer one,

Now considering Max shear stress theory,

$$\text{Maximum shear stress} = 0.5 S_{ut}$$

Spring material is MS Grade 1 having

$$S_{ut}=440 \text{ MPa}$$

$$S_{sy}= \text{Max shear stress} =0.5*440$$

$$S_{sy}= 220 \text{ MPa.}$$

Checking design safety,

Considering maximum weight (e g. In project we are using sanitary napkin with pouch whose weight is of 8gm each =0.008kg) of 2 kg. Which includes dead weight of coil spring and live weight of napkins with each coil turns one napkin resp. (i.e. 36 turns=36 pouch)

$$P=2 \text{ Kg} \quad 8*36=288\text{gm}$$

$$= 0.288 \text{ Kg}$$

Resultant induced shear stress,

$$\tau = (8PD/\pi d^3) (1+(0.5/C)$$

$$C=D/d$$

$$\tau = 40.33 \text{ MPa} < S_{sy} 220 \text{ MPa}$$

Therefore, design is safe....

[Ref. V.B Bhandari – Design of Machine element page no: 395 to 399.]

B. Calculations for Selection of Motor

$$\tau = F*r \quad \dots \dots \text{(By considering torque factor)}$$

$$\tau = (\text{Dead weight} + \text{light weight}) * r$$

C. Specification of Motor

Torque	Speed	Current	Power	Efficiency
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N.m	RPM	(A)	(watt)	(%)
0.525	2020.5	0.505	0.785	16.90

D. Coil Spring Dimensions

Project Parameter	Element	Dimensions
Free Length		600 mm
Outer Diameter		53.6 mm
Coil Diameter		4 mm
Pitch		15 mm
No. of. Coils		39 turns
Mean Diameter		49.6 mm
Body Frame		21 cm×77cm×60cm

table. 1. Project element dimensions

E. Design Calculation

- Inner Diameter:

$$\text{Outer Diameter} - 2(\text{Wire Diameter}) = \text{Inner Diameter}$$

$$\text{OD} - 2\text{WD} = \text{ID}$$

- Outer Diameter:

$$\text{Inner Diameter} + 2(\text{Wire Diameter}) = \text{Outer Diameter}$$

$$\text{ID} + 2\text{WD} = \text{OD}$$

- Wire Diameter:

$$\text{Outer Diameter} - \text{Inner Diameter} = \text{Wire Diameter}$$

$$\text{OD} - \text{ID} = \text{WD}$$

- Mean Diameter:

$$\text{Inner Diameter} + \text{Wire diameter} = \text{Mean Diameter}$$

$$\text{ID} + \text{WD} = \text{MD}$$

OR

$$\text{Outer Diameter} - \text{Wire Diameter} = \text{Mean Diameter}$$

$$\text{OD} - \text{WD} = \text{MD}$$

- Spring Index:

$$\text{Mean Diameter} \div \text{Wire Diameter} = \text{Index}$$

$$MD \div WD = I$$

- Total Coils:

$$\text{Body Length} \div \text{Wire Diameter} - 1 = TC$$

$$BL \div WD - 1 = TC$$

X. MANUFACTURING OF FIXTURE

A. Vendor Selection

After approval of Design, in order to manufacturing of model, it is decided to purchase a M.S. Sheet of 2mm thickness from vendor to save the time and to achieve good quality of product. For selection of appropriate vendor need to study quotation available in market.

B. Follow up of Manufacturing

The manufacturing of model was done in tool room. Follow-up in manufacturing becomes necessary as manufacturing department has no control on factors which may cause slight irregularities. Therefore, we visited tool room many times for proper follow-up of manufacturing processes and to study various stages of manufacturing. manufacturing and assembly, both were carried out at same workshop.



fig 7. Model after manufacturing

Various stages of manufacturing parts were as:

Material procurement, cutting of material, basic manufacturing operations, Finishing of parts and spray painting of chromium on model.

C. Final Assembly

After the manufacturing of parts, all parts assemble at same workshop with all electrical equipments and fittings. All assembly done by manually so it increases assembly time also.

XI. FUTURE SCOPE

The system can be designed with Multiple coin detection and utilized as an extra option for customers in a rural area. Also, system will use for other applications (e.g. pallet holding in manufacturing Industries) by changing its spring design. Also integrated with napkin disposer to achieve dispensing and disposing in a single unit.

XII. CONCLUSION

Woman hygiene is our utmost important factor to be considered and also to eliminate coin operated mechanism as Indian currency has many more different size and material coin and it is not possible to bring coins with us all the time. So, we use online payment gateway as online payment is easily available and everyone has very known of it. Also, this vending machine reduces customer retailer cycle as many girls feel shy of purchasing sanitary napkin on medical store.

This system can be designed to load more napkins than any other dispenser. So, that frequent loading of napkins can be avoided. Also conclude that system is design to operate on online payment gateway and it was observed that the system was successful in this regard.

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