

Sanitary Napkin Vending Machine with Incinerator for Menstrual Hygiene

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Abstract—Sanitary napkin utilization is essential for menstrual hygiene in women. In India, only 57.6%, i.e. around 30 million women use hygienic sanitary napkin during their monthly menstruation. This is significantly less when compared with 96% rate seen in developed countries, like the United States and UK. In a recent survey, major metropolitan areas of India face with inadequate menstrual protection in everyday life. Indian women resort to methods of feminine hygiene that have been practiced for generations like old strips of cloth or napkins fashioned out of natural fiber husk that can be reused. It is also observed disposable sanitary napkins are not utilized by poor consumers, because it is either not feasible for them and a lack of awareness also limits women's comprehension of how sanitary napkins should be used and how they promote good health

and hygiene.

The problem of safe and hygienic disposal of the used sanitary napkin is also one of the most burning issues. The used sanitary napkins should not be disposed in toilet, as they can pollute the streams and rivers, that cause hormonal changes in wildlife. It is essential for the educational institutions to create an educating course to bring awareness among girls at an early stage. Government should take the initiative to provide the napkins free of cost at government schools/colleges through a vending machine where a fixed number of usage can be configured. It is also essential to bring awareness to use biodegradable material and dispose them with an incinerator to avoid further landfill. They become a breeding ground for harmful bacteria or germs when it comes time to dispose of them.

To overcome the above challenges, the work presents the utilization of Sanitary pads and its safe disposal through an incinerator. The Final design specifically is customized for girl students/women in Schools and colleges with an authorized RFID card. A Student/Staff can use the authorized RFID card for vending of the sanitary pads housed in the vending machine. For a single swipe of the card, one sanitary pad is dispensed from the machine. The idea is focused to provide the pad free of cost and hence coin operated or note operated machine is not included. The used sanitary pads can later be disposed using the incinerator which burns the dry/wet pads. Three compartment slots with 8 sanitary pads/compartment is designed in the vending machine. Incinerator can burn up to 20pads in a single iteration. Here we have utilized biodegradable pads and the dispensing time, burning time is tabulated with satisfactory results. Sanitary Napkin Vending Machine with Incinerator which can be used in Schools, Colleges, Train compartments, Railway stations, Public toilets for the betterment of the society.

Keywords- Hygiene, Incinerator, Machine, Napkin, Sanitary, Vending.

I. INTRODUCTION

Vending machine is an electronic machine used to dispense an item to a purchaser after a specific amount of cash has been placed into the machine. Incineration/Burning is a waste treatment measure that includes the ignition of natural

substances contained in waste materials. Sanitary napkins are very important for women to maintain their menstrual health, so the central government has launched biodegradable sanitary napkins priced at ₹2.50 per pad on the eve of women's Day on 2018. This is available at Pradhana Mantri Bharathiya Janaushadhi Pryojana Kendras (PMBJP). The sanitary napkins are available in a pack of four across over 3200 in PMBJP Kendra's from 28 May 2018 at a time the price of sanitary napkins was ₹32, the government has launched Oxo-biodegradable at ₹1.10 for 4 pads. The nature of the sanitary vending machine is to automatically provide sanitary napkin after using the RFID authorization and to notify the personal about the availability of the napkins, if the stock is not available in vending machine. After the usage of sanitary napkin an incinerator is also designed that is used to dispose it without any pollution which can be used to reduce the contamination and utilize for alternative purposes. End product of this system is beneficial to the farmers. Availability of sanitary napkins in public places and Sanitary waste or menstrual waste disposal is a crucial issue in today's scenario; not only in India, but all over the world. Menstrual Hygiene Alliance of India (MHAI) has approximated that there are 336 million menstruating women in India, of which 36% utilize sanitary disposable napkins that aggregates to 121 million women.

The quantity of clean napkins utilized per monthly cycle at a moderate eight or more that for the year, infers that India has 12.3 billion dispensable sterile napkins to deal with consistently, dominant part of which are not biodegradable/compostable.

With just two urban areas in India Bengaluru and Pune carrying out strong waste management to successfully isolate and recognize feminine waste during routine trash assortment, the Solid Waste Management Rules 2016 highlights the test. [5] In spite of the under utilization of appropriate sterile items in India, feminine waste is expanding step by step inferable from the steadily expanding populace. A normal lady discards around 150 kg of non-biodegradable waste each year. According to a scientific study 100000 bacteria's development in a mere 4 seconds when the used sanitary napkins are exposed to air.

Biodegradable sanitary pads are of two types, i.e. one made of cloth and the other made of biodegradable materials such as bio-plastic/alternatives such as banana. While cloth pads could be produced at a lower price, the second type can be expensive. A pack of 10 pieces of Carmesi sanitary napkins (biodegradable) costs ₹239 whereas, A pack of 48 XL Active Ultra Healthy Hamesha costs ₹336. A pack of Whisper Ultra Soft napkins (non-biodegradable) costs ₹375. When prices are competitive, the choice of lower cost pads are more appealing to customers. This can lead to dangerous natural hazards as non-biodegradable pads take 500-800 years to decompose as per Menstrual Hygiene Alliance of India. Hence, it is suggested to go for incineration by the Central pollution control board.

II. LITERATURE SURVEY

A. Existing Technology

Vending machines are of various types to dispense beverages, foods, snacks, medical needs, customized machines for specific needs etc. Existing Vending machines measure coins and read paper cash. Each machine varies marginally, yet all in all, it recognizes each coin with an electromagnetic field which estimates thickness and breadth. Bills are checked with a laser, which communicates to a little PC that translates every category. However, these machines won't determine when stock is depleted and will return the cash when a merchant accidentally puts his cash.

Commonly used Incinerators of sanitary napkin are monitored processors/controllers. When the waste is incinerated due to heat/combustion the ash is collected and a notification is provided ash tray is full. There will be a maximum capacity for every incinerator. There are different types of incinerators such as Rotary Klin, Fluidized Bed, Liquid Injection. Multiple Hearth, Waste Gas-Flare, Catalytic Combustion, Direct-Flame.

B. Review of developed model technology

[1] Presents a design where RFID and GSM is used for Dispensing and Monitoring of Sanitary Napkin Vending Machine for Menstrual Hygiene condition among Women. [2] presents an Incinerator machine using an Arduino as controlling unit for automatic switching action upon placing a pad. The energy produced is harvested as discussed in the paper. [3] Presents and incinerator machine and offers solution to dispose napkin waste. Microcontroller is used for controlling the commands to the output of the machine where heater coil is provided.

[4] presents method to incinerate sanitary pads. The system designed dispose menstrual waste by burning the napkin using electrical fire based burner without allowing smoke generate in the process to escape into the atmosphere.

[5] Studies were directed among discharging school young girls in class 8-10 (over 12 years old) of 43 government

schools chose through delineated arbitrary inspecting in three Indian states (Maharashtra, Chhattisgarh, Tamil Nadu) in 2015. For examination, ten model schools upheld by NGOs or UNICEF with a focussed feminine cleanliness instruction program were chosen intentionally in similar states to address the better-case situation. [6] presents a patented technology for dispensing items using vending machine. Coin operated system is explained in the process along with approval process.

Based on the literature survey we studied the shortcomings addressed in the existing schools/colleges through [5]. The team decided to go for RFID based vending machine as against coin operated/note operated machine since the idea of dispensing in government schools/colleges should be free of cost. The benefit of adopting RFID technology and vending machine technology was done by referring through [1,6] and the concept of incinerator machine and its technology through [2,4].

III. PROBLEM IDENTIFICATION AND OBJECTIVES

A. Problem Identification

Based on the above study we identified the following issue which needs to be addressed There is lack of sanitary napkin from health centers to public places and to remote care centers for women/girls. So there should be vending machine of sanitary napkin at such places at a reasonable price/ free of cost in placed like government schools. It is also inferred, there is no proper disposal systems available for the disposal of used sanitary napkins especially in public places, as a result environmental hygiene is not properly maintained. To address the above, our work aims at developing a cost effective design which can be incorporated to overcome the issues. Further a low cost Sanitary Napkin Vending Machine with Incinerator will be designed for the benefit of the society.

B. Proposed Objectives

Based on the Survey, we achieved the following design objectives.

Objective 1: To Design Sanitary Napkin Vending Machine

This objective is achieved by designing a vending machine which works on RFID Scanner for the supply of sanitary napkin vending machine which can hold up to maximum of 50 napkins.

Objective 2: To design an Electric Incinerator.

This objective is achieved by designing an incinerator for the proper disposal of used sanitary napkin. An incinerator is by and large characterized as any heater utilized during the time spent consuming strong waste to lessen the volume of the loss by eliminating ignitable matter.

IV. DESIGN AND DEVELOPMENT

For the machine to vend Sanitary Napkins each at a time by spring mechanism. We selected the following specifications for the design of the vending machine:

- Servo Motor Rest Position = 0
- Servo Motor Target Position = 360°
- Servo Motor Detach Time = 2sec
- Diameter of Helical Spring = 5cm
- Width of the compartment = 9.5cm
- As width of Sanitary napkin = 10cm
- Hence to control the speed of motor

$$\begin{aligned} &= \frac{\text{ServoMotorTarrgetPosition}}{\text{ServoMotorDetachTime}} \\ &= \frac{360^\circ}{2} = 180^\circ \end{aligned} \quad (1)$$

- To accommodate 8 sanitary napkin, pitch of Helical spring =16cm

- Hence for 1 Napkin = $16/8 = 2$ cm
- Thickness of sanitary pad = 0.8cm

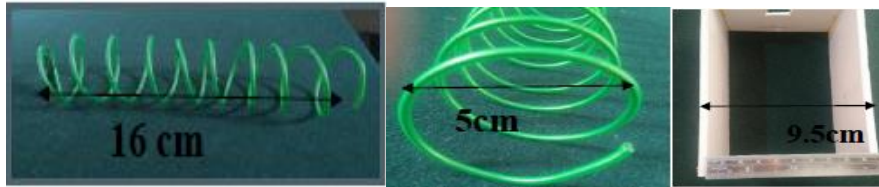


Figure 1: Length, Width of the Spring; Width of the compartment

A. Hardware and Software requirement for Vending Machine

In the work we have used an RFID Scanner. A RFID Scanner is a device that uses radio-frequency waves to wireless transfer data between itself and is used in order to identify, categorize and track assets. A RFID reader can identify objects quicker, more accurately at a various points of the object's lifecycle. An Arduino Mega with microcontroller is used for the controlling operation to the motors. Four servo motors along with a relay are used for the dispensing mechanism where spring is attached. A 16x2 LCD is utilized at the front panel for the end user benefit. IC 7805 Voltage regulator IC 7805 is a 5V Voltage Regulator that restricts the output voltage to 5V to provide the input voltage to the controlling unit. A 4X1 keypad is used for compartment selection by the user in the front end. An ESP 8266 WiFi Module for communication purpose is used.

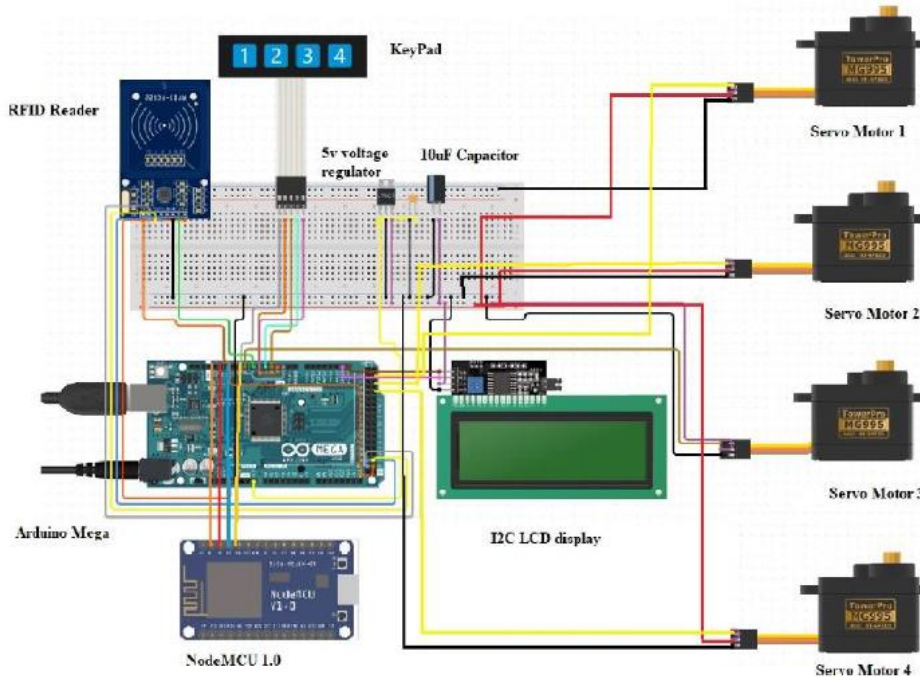


Figure 2: Circuit Diagram of Sanitary Napkin Vending Machine

For Programming the microcontroller and simulating the program we have used Keil μ Vision 4. Arduino Integrated Development Environment for Programming the Arduino and simulating the program. Proteus Design Suite is used for electronic design Automation and also for simulation

B. Flowchart for Sanitary Napkin Vending Machine

The process of execution of vending machine is explained through the flowchart and an algorithm as shown in Figure 3

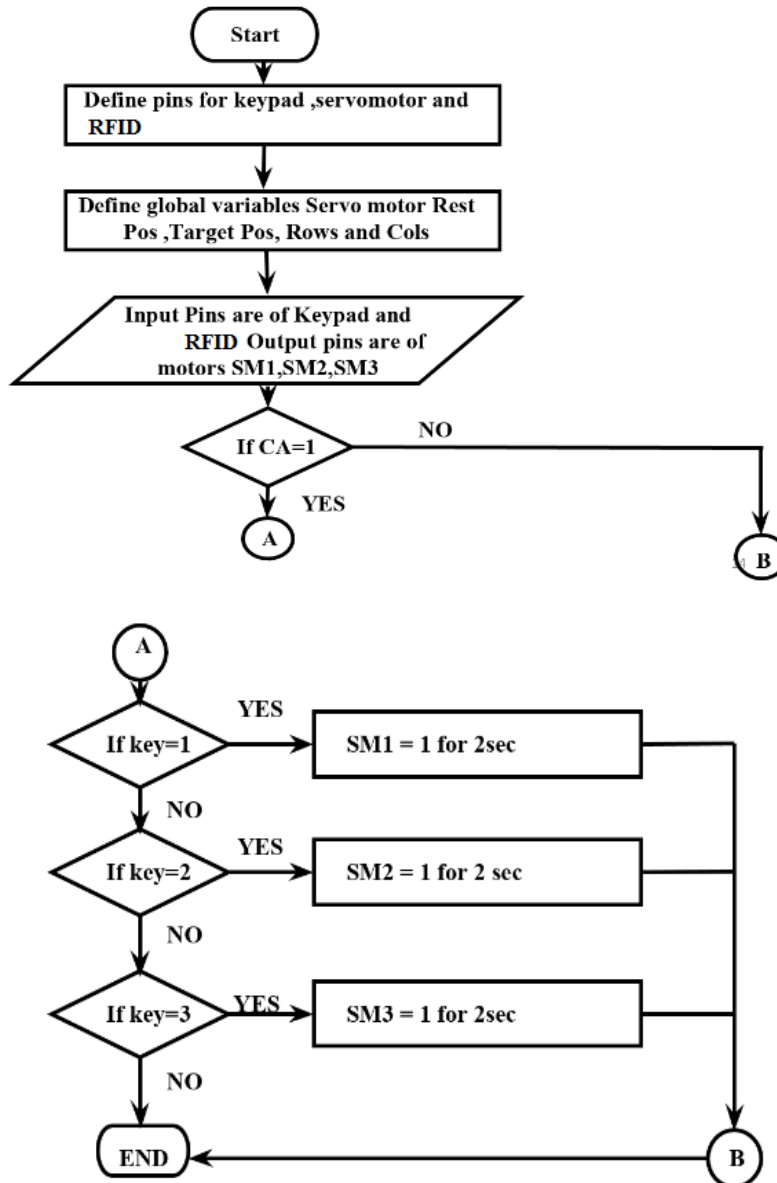


Figure 3: Flowchart of Vending Machine dispensing

C. Hardware and Software requirement for Incinerator

Here in the circuit we have used an Arduino Uno Microcontroller for controlling unit programming. 4X1 Keypad as a selection switch. 16X2 LCD to provide information to the end user. A relay module and heater coil of 1.25 kW capacity. Same software tools as used for vending machine is utilized here.

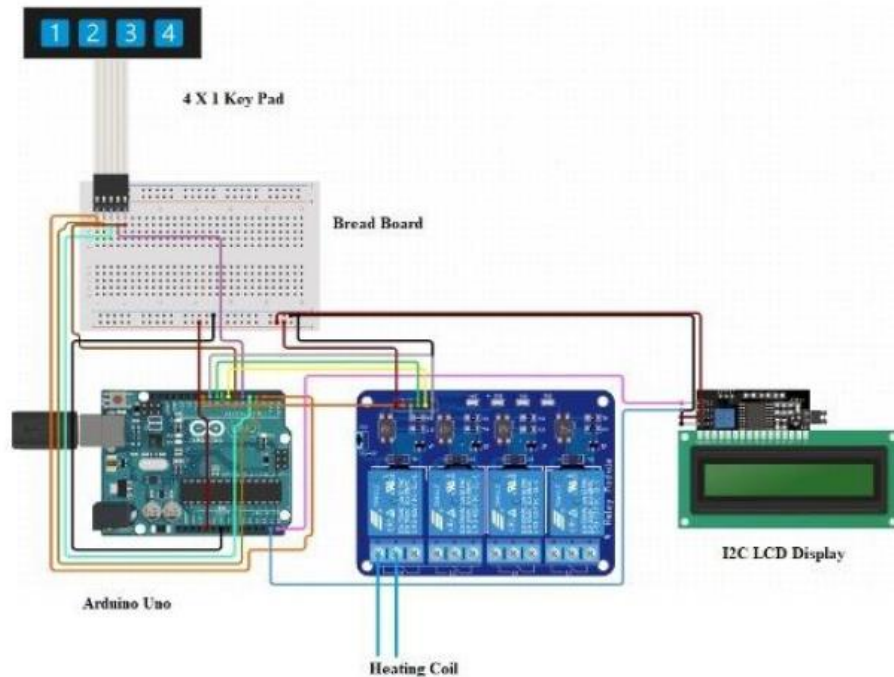


Figure 4: Circuit Diagram of Incinerator

D. Working Principle of Vending machine and Incinerator

The vending machine has been designed to make the availability of sanitary napkin relatively easy for the user, once the consumer scans the registered ID card it undergoes validity test which is pre-configured for 500 cards in the proposed model. With the help of Arduino, the LCD display is enabled which allows the user to select the product and the quantity of the product from the keypad provided. Further, the servo motors runs which makes the spring in the compartment to rotate according to spring mechanism. At the last process the user will be able to receive product from the napkin holder box provided. Finally, holder box closes after each process and will be ready to start the process with same procedure.

The incinerator has been designed to provide path for proper disposal of used sanitary napkin, the person need to dump the used sanitary napkin in the napkin holder and is allowed to press the start/stop button provided. Once the process is started the green LCD glows indicating that the machine is in working condition further relay driver starts to operate which heats up the heater and burning process starts, the machine is provided with the temperature sensor which maintains the temperature within the machine, the time and the temperature will be displayed in the panel. At the end of the process red LCD glows indicating the completion of process and the ash can be collected from the ash tray. The process is shown in Figure 5 and 6 respectively.

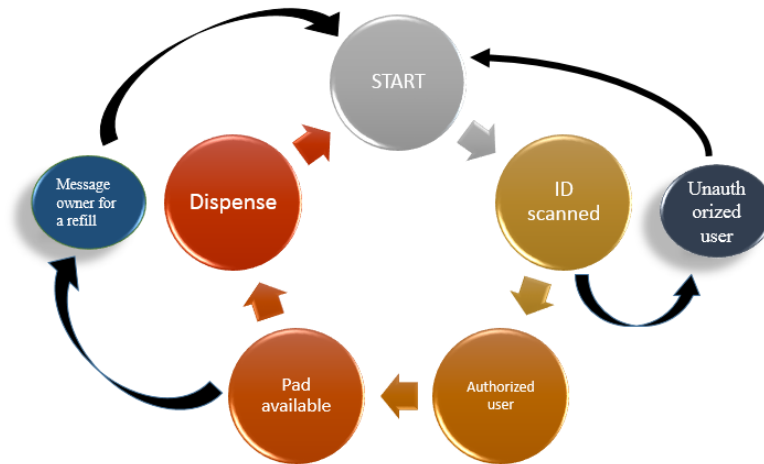


Figure 5: Flow process of Vending Machine

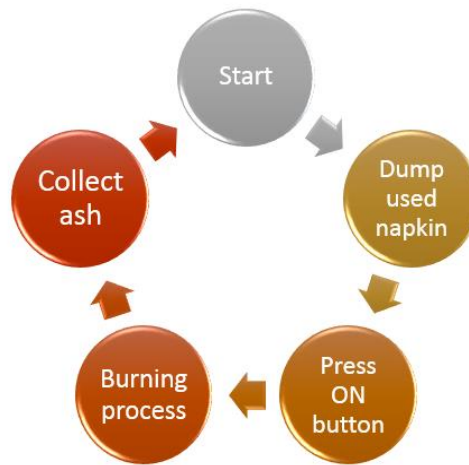


Figure 6: Flow process of Incinerator

V. RESULT AND DISCUSSION

The design went through various changes and improvements. In the initial conceptualized design, both Vending machine and incinerator were planned to be designed as a single unit. To encourage the mounting of the unit and studying the benefits of placing the incinerator near windows where smoke can be vented out, the team decided to go for separate machine units. Designing of incinerator and its temperature control was also the main challenge faced in the design.

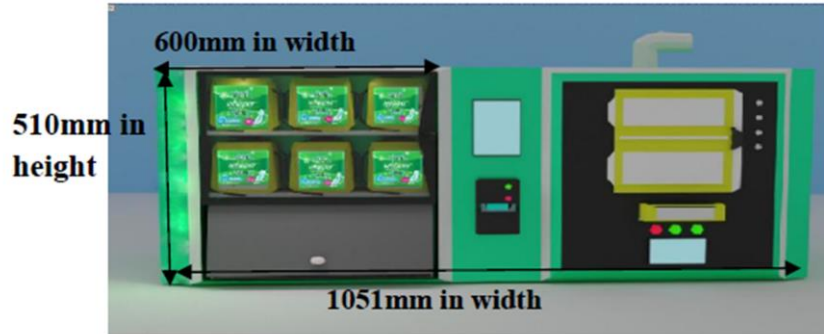


Figure 7: Initial Conceptualized Design

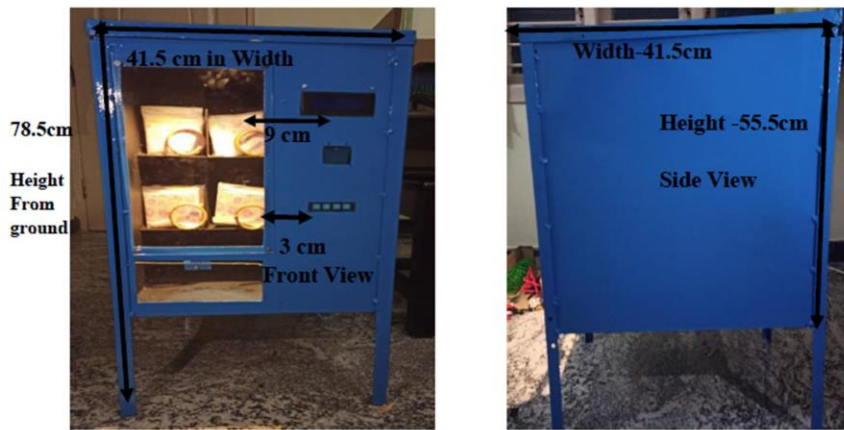


Figure 8: Final Sanitary Napkin Vending Machine

TABLE I. VENDING MACHINE RESULTS

| Compartment | VENDING MACHINE RESULTS TABULATED | | | |
|-------------|-----------------------------------|---------------------|----------------------------------|----------------------------------|
| | <i>Pads available</i> | <i>Action Taken</i> | <i>Dispensing Time(sec) /pad</i> | <i>Remarks</i> |
| 1 | 10 | ID is scanned | 3 | Successfully dispensed |
| 2 | 5 | ID is scanned | 3 | Successfully dispensed |
| 3 | 0 | NIL | NIL | Message send to owner for refill |

Programming is done as part of the controlling unit, where if a pad is not available message can be sent to the owner for refill. This is shown in Figure 9.

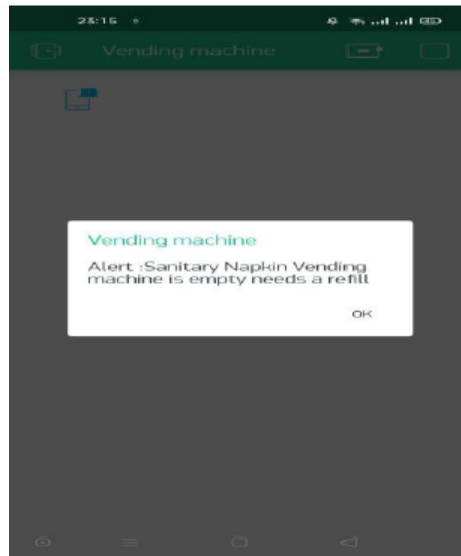


Figure 9: Notification picture

The incinerator dimensions and its final design is shown in Figure 8. We have designed the machine for 550*1100mm in size and heater power output of 1kW. The temperature inside the Oven designed could reach up-to 500° C. The used pads can be dumped into the machine through an inlet. As the pad(Wet/dry) is placed in the fire protected mesh, the heater coil is turned on with the help of the controlling unit Arduino microcontroller. The LM35 Temperature is used for sensing. The temperature inside the oven is displayed in front of the LCD panel and the burned ash can be disposed without any further harm to the nature.

TABLE II. INCINERATOR DESIGN

| Capacity of Incinerator | INCINERATOR MACHINE SPECIFICATIONS | | | | Sensor Used |
|-------------------------|------------------------------------|--|------------------------------|----------------------------|---|
| | <i>Pads used</i> | <i>Weight of Dry Pad</i> | <i>Operating Temperature</i> | <i>Heater Power Output</i> | |
| 1-20 pads | Biodegradable | 7-10 grams Wet Weight is 90-93% More than the pad | 28 to 502° C | 1kW | LM 35 temperature sensor(-50 to +600 ° C) |

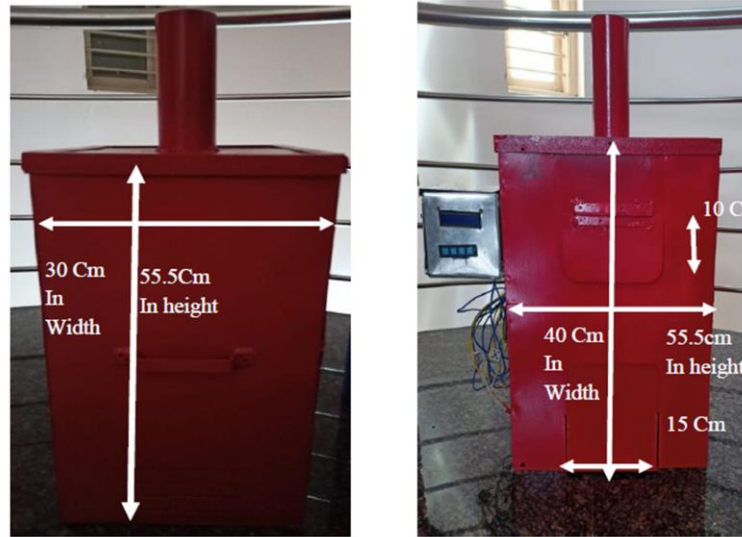


Figure 10: Final Incinerator Machine (Side and Front View)

TABLE III. INCINERATOR RESULTS

| Trial No. | INCINERATOR MACHINE RESULTS TABULATED | | |
|-----------|--|------------------|-------------------------|
| | <i>Pads available</i> | <i>Condition</i> | <i>Time Taken(Se c)</i> |
| 1 | 1 | Wet | 180 |
| 2 | 2 | Dry | 130 |
| 3 | 1 | Dry | 60 |

TABLE III provides the results obtained for various trials of Dry and Wet Sanitary Pads. The designed machine results obtained were found satisfactory and gives desired output on par with the industrial make. There are major Sanitary Napkin vending machine vending machine in India like Virgo, SARA etc. The market cost of Sanitary Napkin vending machine varies between `15,000 to `19,000 with a capacity of about 25 to 50 pads. The incinerator with a heater power output of 1200W can burn between 50 to 150 napkins/day with a variable cost of `11,000 up-to `19,000 depending on the requirements of the end user. The feasibility of the machine was the focus and is relatively less as compared to the existing market price.

VI. APPLICATIONS AND ADVANTAGES

Sanitary napkin vending machine with incinerator is of fair price, hence it can be installed in Schools, colleges, public washrooms, Hospitals, Office, Railways, Remote centers in rural areas.

Whole process is automated such that one can be able to use it when the transaction is done in the correct way according to how the machine is programmed. Reduces pollution, solid waste incinerators produces less pollution than landfills a study found that land fill released higher amount of greenhouse gasses, hazardous air pollutants than incinerators.

Diversity in terms of products can be handled by vending machine

VII. CONCLUSION AND FUTURE SCOPE OF DEVELOPMENT

Based on design and fabrication of an effective vending machine the project objective is achieved. In vending machine, the controller part was tested and it was found that automatic slot machine was working as per design. Napkin disposer is fabricated and integrated with vending machine so that dispensing and disposing can be achieved in a single unit. Through our project, sanitary wastes can be reduced, thus reducing the harmful effects of improper disposal of sanitary napkin. The machine can thus be said to have appropriate technology and if further research is carried out on the study, the quantity of output, time of operation and reduction in pollution by reducing the hazard effect of improper disposal of sanitary waste can be achieved.

As an improvement in the existing machine design, We used RFID Scanner for the identification purpose and for the process to continue in vending machine. If commercialization is the target, By using coin and note acceptor we can provide ease of access for public.

Number of compartment are less. By increasing the compartment number we can increase the quantity of product. We have designed the incinerator machine for 550*1100mm in size. Further, we can reduce the size by utilizing trending technology. We have designed for 500 ID's for identification process. By using SD card module we can add up more identification cards.

References

- [1] D Vijendra Babu, P Subramanian, R Karthikeyan, N Akash, U Phanindra and G Hemanth, "RFID and GSM based Automatic Dispensing and Monitoring of Sanitary Napkin Vending Machine for Menstrual Hygiene among Women", IOP Conf. Series: Materials Science and Engineering(ICMECE), vol.993, December 2020
- [2] Chettri, A., Shrestha, S., Tamang, K., Sharma, B., Sherpa, P. T., Kami, J. B., Rasaily, D., "Design and Development of Semi-Automatic Electrical Incinerator Using Arduino" 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT), IEEE Explore, January 2020.
- [3] Rutuja Kulkarni, Rajnandini Lohar, Neha Wani , Nashik. "Sanitary Napkin Disposal System" IJSART, vol. 4, Issue 4, APRIL 2018.
- [4] Chourasia, Sandhya Bhagawati, Dr. Tambolishabanam. S, Mali Satish and Jamdadeamar, "Manufacturing Of Cost Efficient Sanitary Napkins Incinerator Machine", International Journal Of Mechanical And Production Engineering Research And Development (IJMPERD),vol. 9, Issue 3, Jun 2019.
- [5] Sivakami, M., Maria van Eijk, A., Thakur, H., Kakade, N., Patil, C., Shinde, S., Phillips-Howard, P. A., " Effect of menstruation on girls and their schooling, and facilitators of menstrual hygiene management in schools: surveys in government schools in three states in India", Journal of Global Health , vol. 9, Issue 1, Jun 2019.
- [6] I. John Powell, St. Louis, MO (US); Thomas Mark LeVake, Colorado, "Systems and Method for Vending Machine Settlement", Patent Application Publication ,US 2007/0138265 A1, Jun. 21, 2007.