IoT Based Intelligent Sanitary Napkin Disposer


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ABSTRACT
Background: Disposal of sanitary napkins is a global problem. The napkins are commonly disposed either by flushing them in the drains or by burning them. Flushing the napkin in drains results in clogging of drain line and associated plumbing problems. Burning the sanitary napkins often causes air and soil pollution. Objective: To overcome this problem, a solar based sanitary napkin disposal has been proposed, which burns the napkin to ashes and ensures pollution is minimal. To make the disposal unit more user friendly, voice commands are used, which guides the user through the process. As this system is aimed at rural parts of a country, it is powered by solar energy, which is available in abundance. Results: When the napkin is dropped in the disposal system, it is burnt in the furnace. The smoke emitted during the process contains carbon dioxide and is removed using CO2 filter. The whole system is controlled by raspberry pi. Conclusion: Performance of this system is analyzed by means of time taken for the napkin to be burnt and converted to ashes. It was observed that when the input supply voltage was less than 12 V, it took a long time for the napkin to be burnt to ashes. When 12V supply was given it took only 50 Sec for the napkin to turn to ashes. As CO2 filter was used here, the pollution was minimal. Thus the proposed work helps the people to dispose the napkin in a simple way and creates a pollution free environment.

KEYWORDS: Sanitary Napkins, CO2 filter, Raspberry pi.

INTRODUCTION

In [1], the problems associated with disposing of a napkin are elaborated. Disposal of used sanitary napkins has been a very common problem everywhere. Women do not like to carry their used sanitary napkins to a household bin in front of family and friends. Sanitary napkins can’t be kept in normal bathroom bin as it leads to embarrassing visuals and odor. Packing the sanitary napkin in plastic bag and dropping it in dustbin is also not feasible in many cases. A study says that over 80% Girls flush their used sanitary napkins because they are messy, smell bad and is embarrassing. Both the above mentioned means of disposing sanitary napkins create problems. The flushing in drain results clogging in drain (drainage line check-ups/plumbing line blocking problems) and throwing in dustbins results in health related problems due to hazardous contents in the used Sanitary Pad.

In [2], [3] the health hazards associated with unsafe disposal of napkin have been presented. Almost 90 percent of a sanitary napkin is plastic. The thin top layer on napkins, known as the dry-weave top sheet, is made of polypropylene (a plastic polymer). The padding is mostly wood pulp mixed with super absorbent polymers and the leak-proof layer is made from an impermeable polyethylene. The plastic used in sanitary napkins, which is non-biodegradable, is not only harmful for health, but also has negative consequences on the environment. Since it is non-biodegradable, the soiled napkins stay in the landfills for about 800 years. The informal practice of burning soiled napkins in the open releases toxic gases like dioxins and furans. Hence safe disposal of napkins is very important.

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In [4], the use of Raspberry pi for automation applications is described. The ease of programming of Raspberry pi makes it a suitable candidate for automation of home appliances. This advantage coupled with scope for sending sms or mail makes it most suitable for napkin disposal applications. In [5], the technique for capturing CO2 emitted by automobiles is elaborated. Since the burning of Sanitary napkin emits lot of CO2, this technique was adopted for this work. In [6], the basic idea behind incinerator and how it is used for municipal waste disposal is proposed. This idea can be used for sanitary disposal, as the technique adopted here is incarnation of the used napkin.

The correct way to dispose the used sanitary napkins is by burning and converting it into ash and ensuring that toxic gases are not let into the atmosphere. So the need of the hour is a portable automatic napkin disposal system, which should avoid soil and air pollution.

II. Existing System:

The existing system of sanitary napkin disposal is named as ‘Ashuddhi-Nashak’. It is shown in fig.1. This system contains two openings/lids. The napkin to be disposed is thrown from the top opening. Newspaper is put into the system and from the bottom opening, fire is lit. As the newspaper burns, the napkin too gets burnt. The ash is collected at the bottom, which can be thrown away manually. This system overcomes the problem of soil pollution but air pollution is an unaddressed issue here. The Carbon dioxide gas that gets emitted from this system causes air pollution.

![Fig. 1: Ashuddhi-Nashak](image)

III. Proposed System:

The proposed system of sanitary napkin disposal aims at reducing both air and soil pollution. Solar power is utilized for working of this system. When the sanitary disposal system is turned ON, a voice system prompts the user to place the napkin in the tray provided for the purpose. When the napkin is placed in the tray, the IR sensor detects the napkin and sends a signal to raspberry pi. The raspberry pi in turn gives command to turn ON spider coil. The spider coil burns the sanitary napkin to ashes. The collected ash can be flushed out via the drain of the toilet. The carbon dioxide emitted from this system is absorbed by a CO2 filter. The entire process is controlled by a Raspberry Pi Processor.

The outcome of the proposed work is smoke with reduced CO2 content, when compared to the existing method. A block schematic of the proposed work is shown in fig.2.
A. Solar panel:
The solar panel converts the energy from sun to electrical energy. In the proposed work, a 12V solar panel is used. This energy is used to charge the battery. The solar panel used in this work is shown in fig.3. The specifications of solar panel used are:
12V, 5watt 18.7 mono crystalline solar panel 370 mm X 350 mm dimensions

B. Battery:
The battery is used to supply electric power to the Raspberry Pi, CO2 and relay. The battery gets charged via the solar panel and supplies power to the devices. The proposed work uses a 12 V battery to store the energy.

C. IR Sensor:
An infrared sensor is an electronic device that emits IR rays in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detect the motion. The sensors that only measure IR radiation and do not emit radiation are passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes. The emitter is simply an IR LED and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the Photodiode, the resistances and their output voltage change in proportion to the magnitude of the IR light received.
IR sensor consists of an IR transmitter and IR receiver. The IR transmitter transmits Infra-red rays. When no obstacle is present, IR rays are not received by the receiver and no action is taken. In case an obstacle is present, the IR rays transmitted by Transmitter are reflected by the object and are received by the IR receiver, which initiates an action.

In this work, the Infrared (IR) sensor assembly is placed at the entrance of furnace to detect the napkin. When no napkin is placed in the tray of the disposal system, no light from the IR source reaches the detector, causing no action. The moment napkin is placed on the tray, the light rays get reflected by the object and fall on the detector, initiating an action to energize the relay via the raspberry pi.

D. Raspberry pi:

The Raspberry Pi is a small, single computer board developed by The Raspberry Pi Foundation. The printed circuit board (PCB) houses the input and output connectors as well as the computer hardware itself. Raspberry Pi Processor is the heart of this proposed work, which controls and automates the entire napkin disposal. The raspberry pi comes in two models; they are model A and model B. The main difference between model A and model B is USB port. Model A board will consume less power and does not include an Ethernet port. But, the model B board includes an Ethernet port. The raspberry pi 2 is the second generation of raspberry pi family. It is replaced by raspberry pi 2 model B. The Raspberry Pi 2 Model B offers a higher level of performance than any other Raspberry Pi board. The sequence of events performed by raspberry in this work is given below:

Once the napkin is placed in the tray, the raspberry pi receives sensory input from the IR sensor. The raspberry pi then sends signal to the relay to switch on the relay, which in turns switches ON the Spider coil. The napkin gets burnt by the heat of the coil. After the napkin is burnt (after a preset time), the raspberry pi issues command to switch ON the CO2 filter, which absorbs the CO2 emitted during the process. After a predefined time, the Raspberry Pi issues command to switch OFF the device.

E. Relay:

It is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which connect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied, the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, and DPDT etc., which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Relay is used to control the coil by heating them when it is turned ON and cooling down the coil by turn OFF.

Relay is used in this project to switch on the Spider coil. It is powered by battery and is controlled by raspberry pi processor.

F. Furnace:

A furnace is a device used for high-temperature heating. The name derives from Greek word Fornax, which means oven. The furnace must be designed such that it withstands high temperatures and has a
longer life. Clay based furnace have been used in India for sanitary napkin disposal. But it is not suitable for indoor use and transportation is also difficult, as handling needs care. Generally stainless steel is preferred as material for furnace. Other materials that can be used for furnace are ceramic, aluminized steel, aluminum, brass, copper, and fiberglass. If refractory lining is provided on the inner side, excellent heat retention can be achieved. To avoid thermal loss, proper insulation needs to be provided. Since the furnace would be very hot after the burning process, insulation must be provided so that people don’t get burns from the heat.

In the proposed work, we have used stainless steel furnace because it has long life compared to other materials, is cost effective and is light in weight. The furnace used in this proposed work is shown in fig.5.

**Fig. 5: Furnace**

The sanitary napkin reaches the furnace section through a slanted arrangement. Inside the furnace is a tray wound with coil. This coil burns the napkin to ashes. The furnace houses a removable tray at the bottom, which collects the ash. The collected ash can either be disposed manually or the ash tray can be directly connected to flush of the toilet.

**G. Spider coil:**

They serve as the heating element for the device. They are responsible for burning the sanitary napkin to ashes. They are easy to make, adjust and to use. They are always preferred over cylinder wound coils. The coil should be strong enough to withstand the force offered by the napkin when it is dropped by the user. It should be thin so that it gets heated quickly without consuming lot of power. It will be turned ON and OFF by a relay controlled by the raspberry pi. The spider coil used in the proposed work is shown in fig.6.

**Fig. 6: Spider coil**

In this work, spider coil has been constructed by using the coils present in the Iron Box. This coil has been chosen because it gets heated up very quickly and is capable of burning even a cardboard into ashes in a few minutes of time.
**H. CO₂ filter:**

The smoke coming from the Furnace contains harmful gases such as CO₂, which can prove fatal to the health. So it should be ensured that CO₂ is filtered before it is let into the atmosphere. Many techniques of filtering CO₂ exist, but the most cost effective and efficient solution is based on the concept of *Electrostatic Charge*, which is illustrated in fig.7.

The smoke emanating from a chimney contains Carbon dioxide, Sulphur dioxide and many small particles of unburnt fuel (mainly carbon). The Chimney has a high voltage negative grid across it. As the smoke goes past the negative grid, the small carbon particles get negatively charged and gain electrons. Further up the chimney, there are positively charged plates, which attract the negatively charged carbon particles. These particles build on a plate until they are heavy enough to fall down into containers. The containers and the plates can be cleaned periodically.

![Fig. 7: CO₂ Filter](image)

**I. Speaker:**

The speaker is used to intimate the user when the system is ready to burn the sanitary napkin. Till the user places the napkin a recorded voice saying “please place the napkin” plays continuously. On detection of napkin by the IR sensor, the voice stops automatically. The voice command is stored as an mp3 file format in a location omxplayer/root/1.mp3.

**J. Amplifier:**

The amplifier is used to amplify the voice signal. The amplifier used here is LA4440 15W amplifier.

![Fig. 8: Amplifier Circuit](image)

**IV. Implementation:**
Results and Conclusion:

The spider coil was supplied with various amounts of voltages and time taken for completely turning to ashes was noted. The results are tabulated as follows:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Supply Voltage</th>
<th>Time (Seconds)</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6 V</td>
<td>NA</td>
<td>The napkin didn’t burn at all</td>
</tr>
<tr>
<td>2</td>
<td>10 V</td>
<td>180</td>
<td>Napkin burnt to ashes</td>
</tr>
<tr>
<td>3</td>
<td>12 V</td>
<td>50</td>
<td>Napkin burnt to ashes</td>
</tr>
<tr>
<td>4</td>
<td>15 V</td>
<td>40</td>
<td>Napkin burnt to ashes</td>
</tr>
</tbody>
</table>

It was observed that till a voltage of 10V, the napkin couldn’t be burnt. Above 10V, the napkin could be burnt to ashes, the time for which depended on the amount of voltage. For an input voltage of 12V, it took just
50 Seconds for the napkin to turn to ashes. Above 12 V, there was no significant change in time to burn the napkin to ashes. Hence an input voltage of 12 V was fixed for the spider coil.

The results of napkin disposal are shown in fig.9

![Napkin Disposal](image1)

(a) Furnace with no napkin  (b) Spider Coil getting heated  (c) Napkin getting burnt

(d) Napkin Reduced to ashes  (e) Ash collected in Ash Tray

Fig. 9: Napkin Disposal

Figure 9(a) shows an empty furnace. Once the napkin is put into the furnace, the spider coil is supplied with power from a 12 V battery. This causes the spider coil to start getting heated, as illustrated in figure 9(b). As the heat starts building up, the napkin catches fire, as shown in figure 9(c). After a few minutes, the napkin is reduced to ashes as shown in figure 9(d). The ash that is generated during this process is collected in an ash tray provided at the bottom, as shown in figure 9(e).

It has been observed that throwing the napkins in open air is making the environment unhygienic and dirty, and burning the napkins is causing air pollution. Though the existing methodology (Ashuddhi - Nashak) has controlled soil pollution, it has not been effective in controlling the air pollution. Moreover it is not a compact system and hence is not feasible for indoor use. A solution to the problem of Napkin Disposal has been proposed here. The proposed method is a compact system that effectively tackles the issues of soil and air pollution. Being Compact, this system can be installed in toilets, making the napkin disposal hassle free.

**VI. Future Work:**

The proposed work can be made even more compact and can be developed into a product. The product can be made aesthetically appealing and cost – effective. Provisions for disposing the ash directly into the flush of toilet can be provided. Also, the sanitary napkin Vending and disposal systems can be combined in a single unit so that women can walk freely without carrying a napkin with them always. Moreover, features in napkin dispenser such as intimating the person when less than a predetermined number of napkins are available can be included. Automatic fault detection and intimation mechanism can be inbuilt with the system, which identifies the nature of fault occurred in the system and automatically intimates the service personnel about the fault. This can help reduce the down time of this system. This system if implemented in public places will help in creating a Cleaner India.
REFERENCES


