TECHNICAL APPLICATIONS OF REAL WORLD PROBLEMS

(TARP)(MEE3999)

SANITARY NAPKIN DISPENSER

PROJECT REPORT

Asher Nehemiah 17BME1136

Govind Suresh 17BME1202

Haridh Vinu 17BME1210

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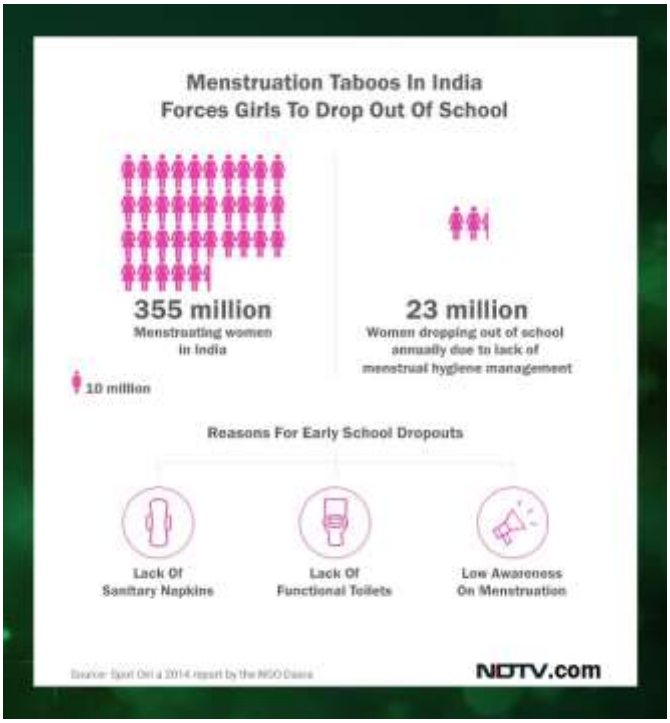
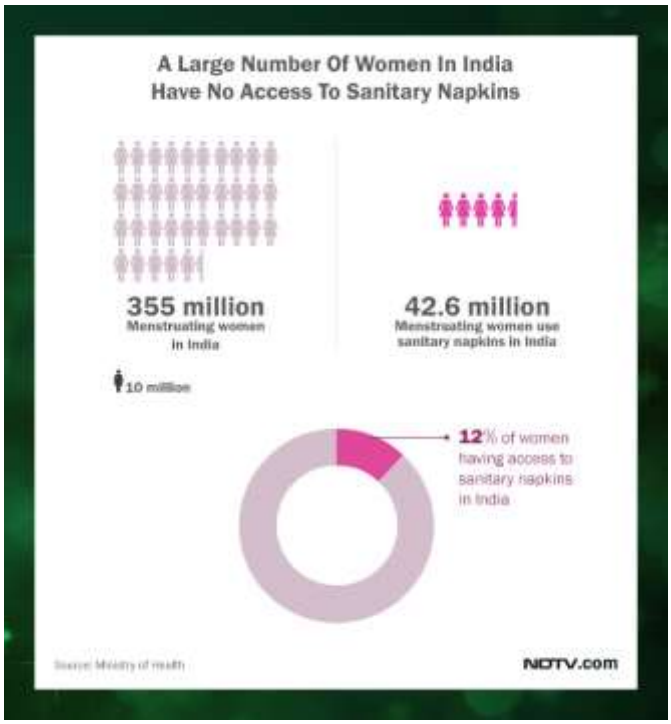
Introduction

Why the need for Sanitary Napkins?

As many as **210 million** people lack access to improved sanitation in India and 88% of people who get periods use unsafe materials like rags and sawdust instead of sanitary napkins. These dangerous alternatives to period products put 70% of women at risk of severe infection, according to the Indian Ministry of Health. The cultural shame attached to periods and a shortage of resources stop people who menstruate from going to school and working every day. It has been estimated that as many as **1 in 5** girls in India drops out of school after they get their periods because they don't have access to safe facilities or period products. 23 million girls are forced to drop out of schools every year once they begin menstruating. Only 2 to 3 per cent women in rural India are estimated to use sanitary napkins.





Beneficiary

The most common users of the product will be school girls in rural region where the accessibility of Sanitary Napkins is poor.

The NGO working with us is 'Aid India', a Chennai based NGO that helps educate rural children and also raise awareness about health and safety. The NGO did commendable work during the Chennai Floods to provide food and clothing for flood stricken rural areas.

Questionnaire

Research is a very important part of any product development and questionnaires are a very good way to collect data and see if your product satisfies a need and will be useful to people. The questions in the below questionnaire have been constructed to identify the need of product and its target audience. The questionnaire was made on google forms.

Sanitary Napkins Dispenser

Obtaining data to understand the need for Sanitary Napkins Dispenser. All information entered will remain private and will be viewed only by the research group. Thank you for your co-operation.

* Required

1. **Age** *

2. **Where do you live?** *

Awareness towards Sanitary Napkins

3. **How easy is it to access Sanitary Napkins for you?** *
   Mark only one oval.

	1	2	3	4	5	
Very Easy	◯	◯	◯	◯	◯	Very Difficult

4. **Which of these products have you heard of?** *
   Check all that apply.

- [ ] Tampon
- [ ] Disposable Sanitary Pad
- [ ]
- [ ] Menstrual Cup

Reusable Pad that can be washed (Home-made)

5. **What do you normally use during your period?** *

Check all that apply.

- [ ] Cloth/Towel Tampon
- [ ] Purchased Sanitary Pad
- [ ] Menstrual Cup
- [ ] Toilet Paper Cotton
- [ ] Natural materials (mud, cow dung or leaves) Other: _____

6. **Have you bought disposable Sanitary Pads from a shop in the last six months?** *

Mark only one oval.

- ◯ Yes
- ◯ No

7. **Have you ever wanted to buy disposable Sanitary Pads from a shop but been unable to ?** *

Mark only one oval.

- ◯ Yes
- ◯ No

8. **I do not have enough money to buy disposable Sanitary Pads from a shop.** *

Mark only one oval.

- ◯ Yes
- ◯ No

9. **There are no Sanitary Pads in the shops near you.** *

Mark only one oval.

- ◯ Yes
- ◯ No

10. **How far do you have to travel to obtain Sanitary Pads?** *

Enter time taken to reach a shop in mins.

11. **Do you feel, that the cost of Sanitary Pads are too high?** *

Mark only one oval.

◯ Yes ◯ No

Sanitary Napkin Dispensers in School

Obtaining information to understand the need for sanitary napkins in schools.

12. **What kind of area do you say you live in?** *

Mark only one oval.

◯ Urban ◯ Rural

13. **What kind of area is your school in?** *

Mark only one oval.

◯ Urban ◯ Rural

14. **Do you miss school due to your period?** *

Mark only one oval.

◯ Yes ◯ No

15. **How many days of school did you miss the last time you had your period?** *

Mark only one oval.

1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

16. **Would you like to have a Sanitary Napkin dispenser in the restroom in school?** *

Mark only one oval.

◯ Yes ◯ No

17. **Would you miss less days of school during your period, if Sanitary Napkins**

are available in schools? *

Mark only one oval.

Yes No

18. **Do you feel the cost of Sanitary Pads should be included in the school fees paid?** *

Mark only one oval.

Yes No

Construction Costs & Pricing

Is it affordable?

In 2018, India declared tampons and sanitary napkins tax-free, but most sanitary napkins cost between 5 to 12 Rs per napkin, which is a luxury for the nearly 800 million people who live on less than 140 Rs a day. Minimum wage workers, in almost all cases do not even know of what a sanitary napkin is, or consider it the last priority. Recently however, the costs of sanitary napkins have been slashed to Rs 1. The outreach problem still needs to be solved.

Sanitary Napkins are essential items that should be available for all menstruating girls and women, regardless of their background and geographical location. It is a basic human right. The end goal of this project is to design a device that has the ability to store sanitary napkins like that of a vending machine, in all schools and also provide a message to signal when the contents are emptied, for refilling.

Cost of our product

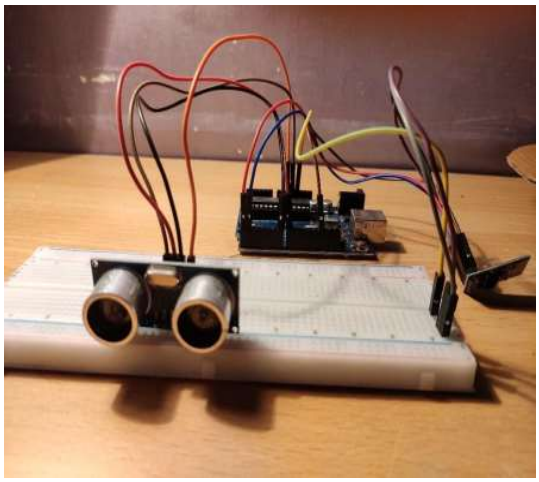
One of the key advantages of our product is that it is cheap compared to the other options available in the market allowing it to become easily accessible to the market including schools and NGOs. The cost can be split to electrical components and mechanical components. The mechanical cost includes the cost of wood slabs for the outer body construction. This also includes screws, nuts, and metal wire to make the springs of the dispensary. The overall mechanical cost will come around 2000 Rs.

Spring components.

Body framematerial.

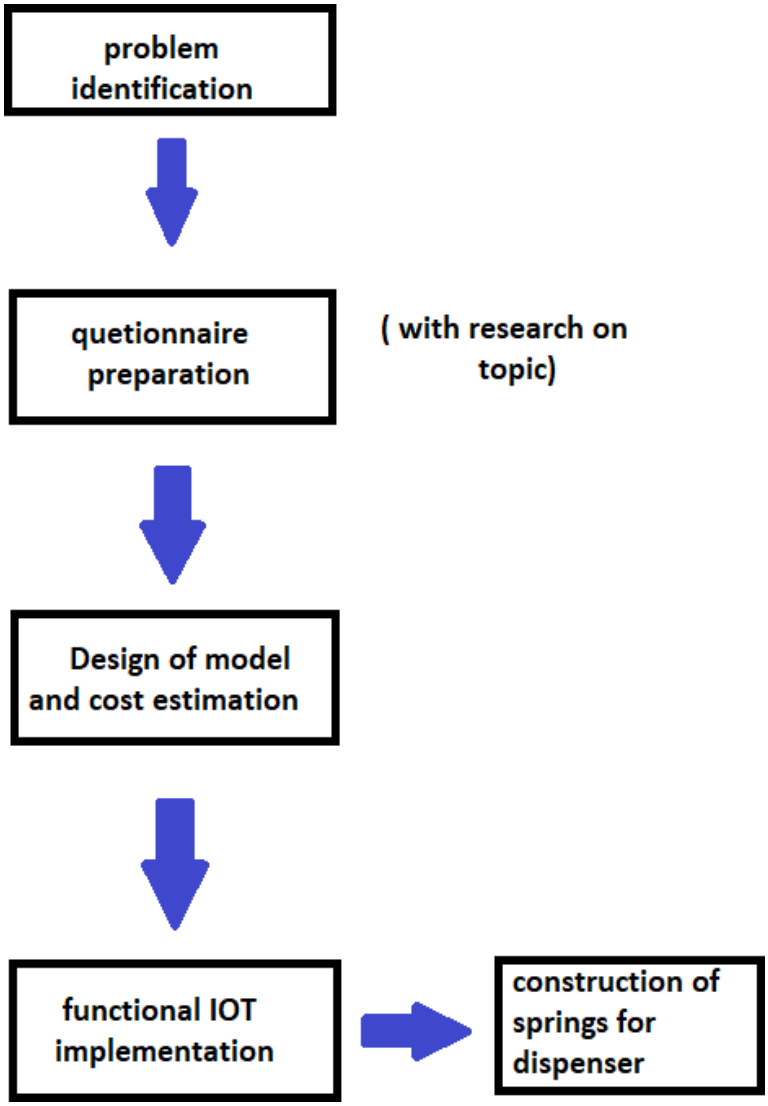
ELECTRICAL COMPONENT COST:

Product Name	Model	HSN	Qty	Price	Total
Tower Pro SG90 Servo - 9 gms Mini/Micro Servo Motor	EC-0107		3	Rs.82.00	Rs.246.00
Ultrasonic Distance Sensor Module - HC-SR04	EC-0143		1	Rs.67.00	Rs.67.00
Jumper Wire - Male Connector - 2 Pieces Pack	EC-0180		10	Rs.6.40	Rs.64.00
Jumper Wire - Male to Female Connector - 2 Pieces Pack	EC-0276		10	Rs.9.00	Rs.90.00
Bread Board for MB102 Power Supply	EC-0574		1	Rs.175.00	Rs.175.00
ESP-01 ESP8266 Serial WIFI Transceiver Module	EC-0804		1	Rs.145.00	Rs.145.00
Arduino UNO R3 Development Board - Clone Model - High Quality	EC-1166		1	Rs.345.00	Rs.345.00
Sub-Total					Rs.1,132.00
Flat Shipping Rate					Rs.49.00
Cash on Delivery Fee					Rs.59.00
IGST (18%)					Rs.223.20
Total					Rs.1,463.20



Final IOT circuit diagram.

WORKFLOW FOLLOWED



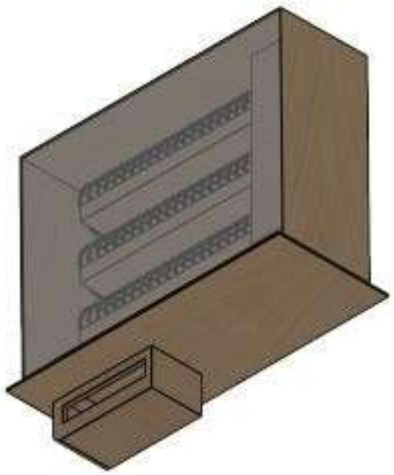
Design Methodology & Structure of Dispenser

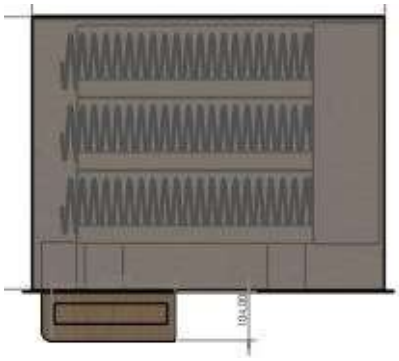
We took inspiration to create this dispenser from traditional vending machines and traditional machines that are used to in our current day. We realized that there isn't a sanitary napkin dispenser in the market that is made using ecofriendly and sustainable materials and they all are unintentionally structured in such a way that refilling is hard and often small components inside the machine often fail making them harder to repair as well.

We decided to tackle these problems by making a dispenser by using eco-friendly recyclable materials. The entire body structure is made using wood and all the components are readily accessible through a hatch that has been made on the top, whether be it restocking napkins or repairing any components on the inside.

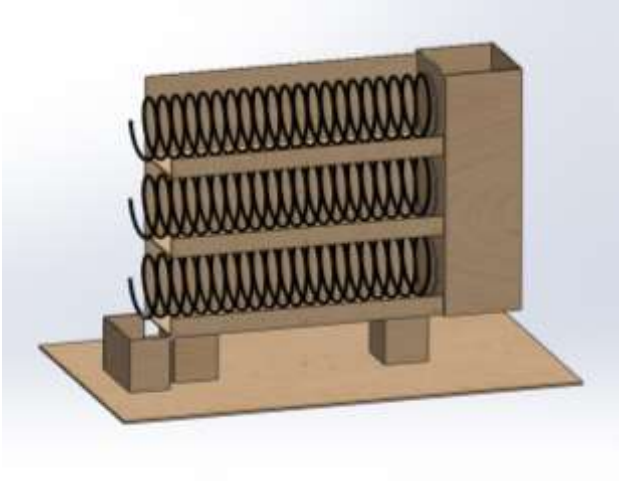
Another issue that we noticed is that the dispensers that are currently available all have few too many mechanical components on the inside. Such as tight springs that pressure the napkin and sometimes damage it or knobs that require too much force to turn in order to open the setup or dispense a napkin. We have made our dispenser in such a way that there is minimal working components and they are simple mechanism and can be easy fixed if any issues, we have made use of plastic springs that are not sharp and do not damage the napkins and the control module is an Arduino board, connected to a motor driver that runs a server motor, instead of complex internal mechanical knobs and springs.

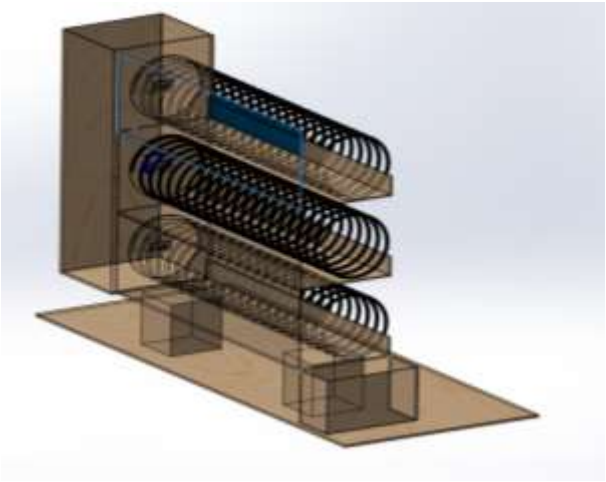
We have also added IoT functionality to our dispenser, such that it can alert the refilters that the napkins are running out and need to be refilled, thus ensuring that they are never empty and always available for the people in need. This is also an advantage that our dispenser has over the dispensers that are available in the market as of now.



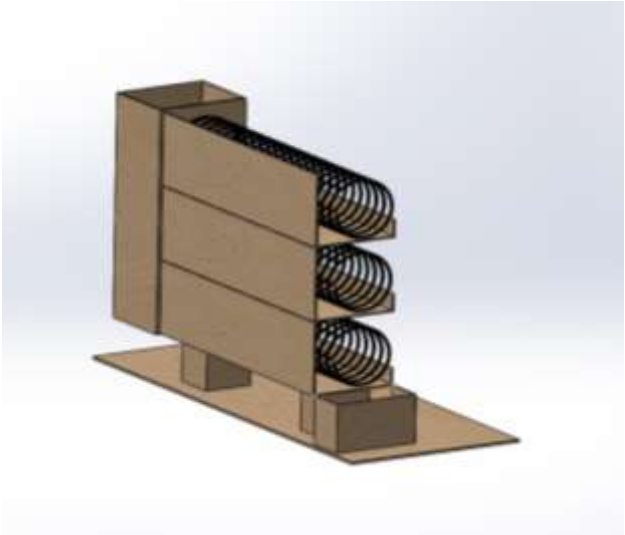


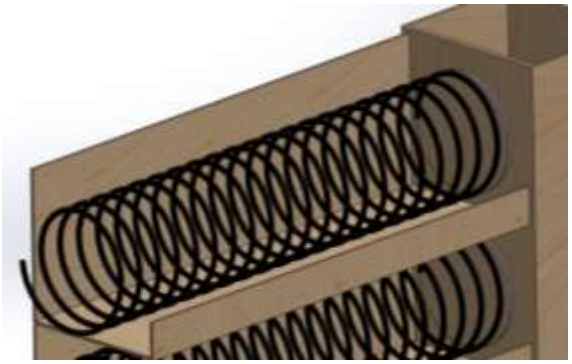
Design



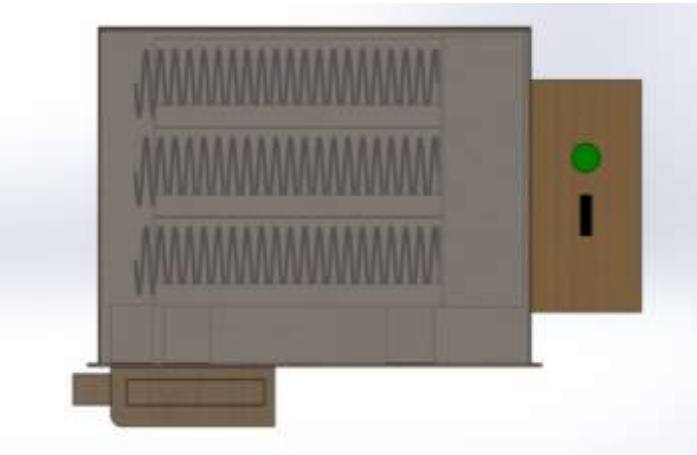


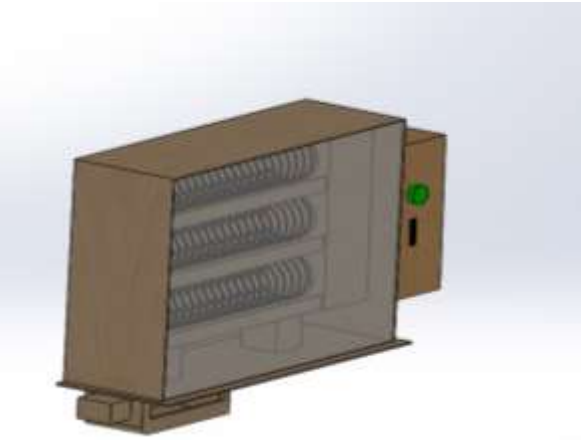
the above picture shows the outer body frame and spring set up of the dispensary. Each level is capable of holding a capacity of 10 sanitary napkins and the overall capacity sums up to 30.





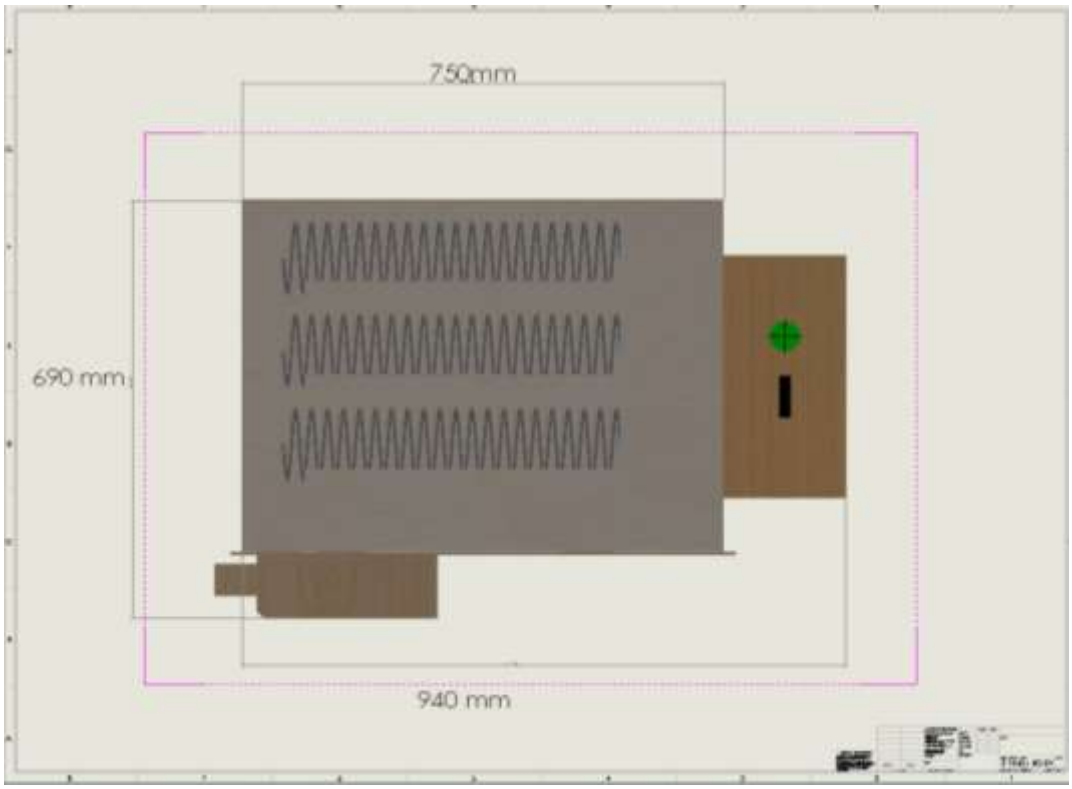
Here we can see the spring mechanism much more clearly. Napkins will be placed between the gaps between consecutive turns and move forward as the spring rotates. The space considerations have been made based on the dimensions of the sanitary napkins and there is also sufficient spacing for the implementation of the IOT design

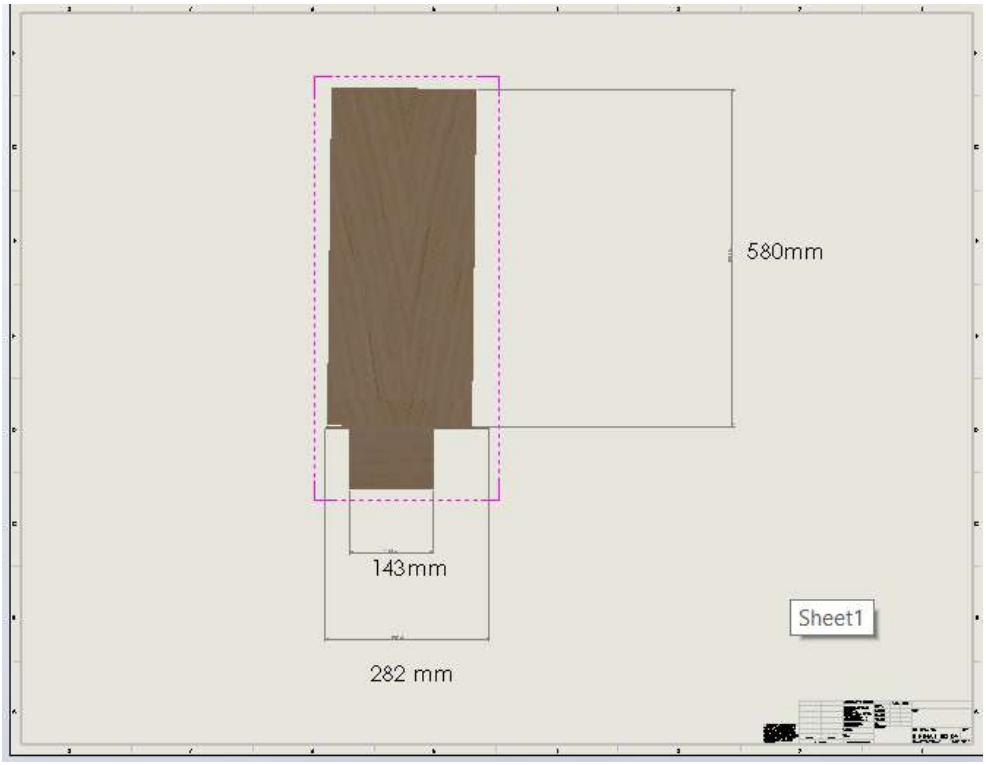


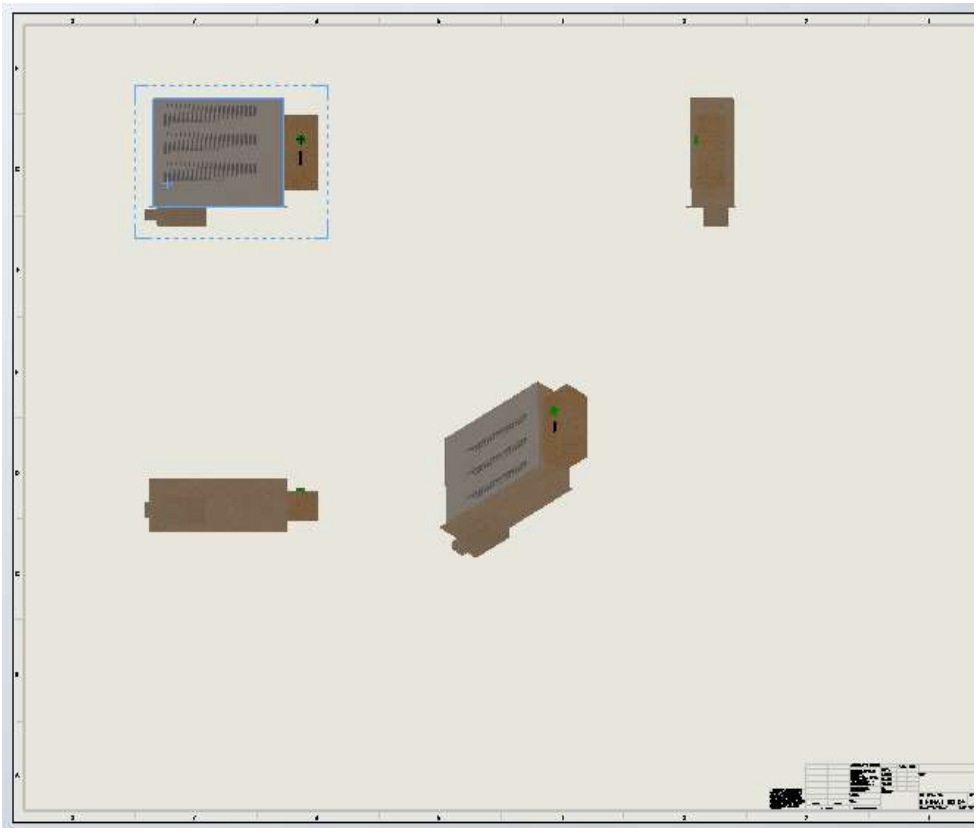


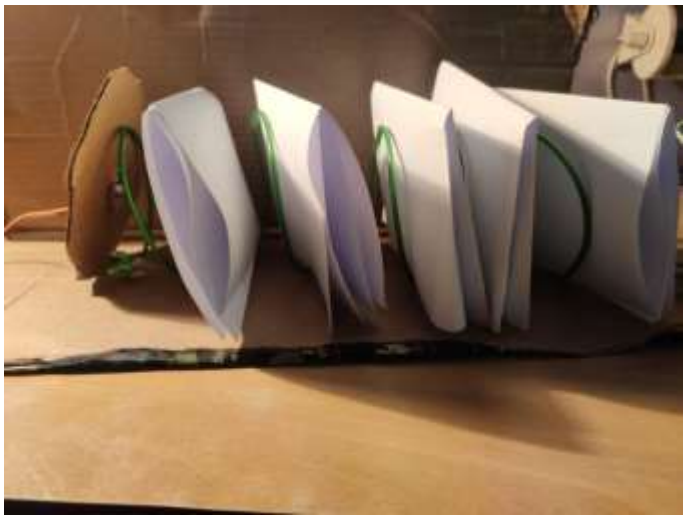
This is the final final product design. The dispensary will accept money through the slot and wen the user pushes the button, the spring will begin to rotate using the servvo motors and allows the napkin to fall into the pickup slot.

Dimentioning




580mm
143mm
282 mm
Sheet1





Visual Reprsentation Of User Interaction With The Product

Artistic Illustration to show a visual reprenstation of size and usage of product

IOT Implementation (Multidisciplinary component)

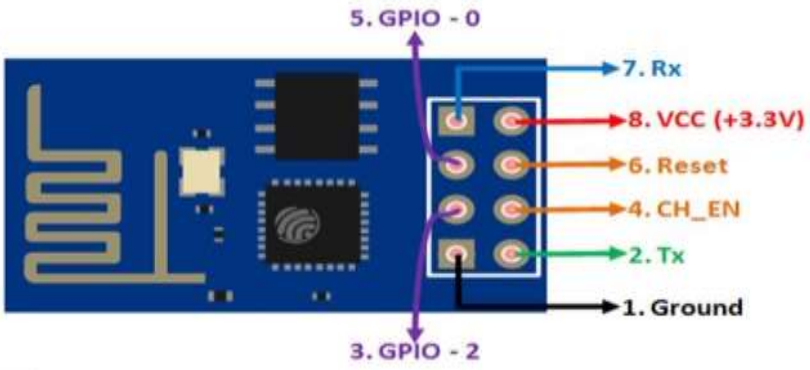
In this project we are implementing IOT using sensors to count the number of napkins that are being removed from the dispensary and send a message to the concerned organization when it is nearly empty informing them to refill the dispensary.

Physical Setup:

Components used:

1. Bread board
2. Jumper wires (male connectors, male to female connectors)
3. Ultrasonic Distance Sensor Module HC-SR04
4. ESP-01 ESP8266 Serial WIFI Transceiver Module
5. Arduino Uno R3 Development Board.

WIFI module:

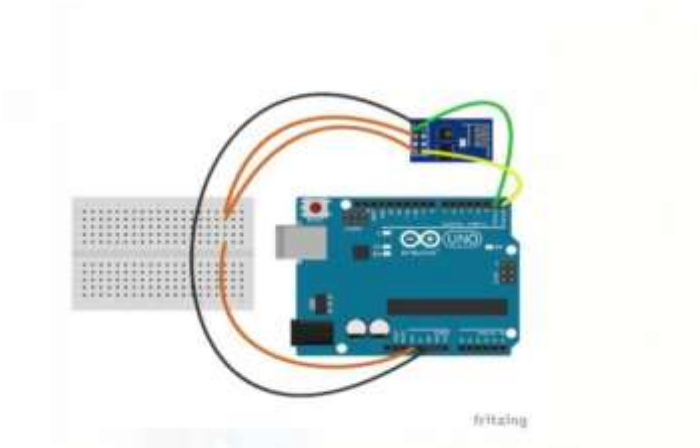


With the popularity of WiFi IoT devices, there is an increasing demand for low-cost and easy-to-use WiFi modules. ESP8266 is a new player in this field: it's tiny (25mm x 15mm), with simple pin connections (standard 2×4 pin headers), using serial TX/RX to send and receive Ethernet buffers, and similarly, using serial commands to query and change configurations of the WiFi module. This is quite convenient as it only requires two wires (TX/RX) to communicate between a micro-controller and WiFi, but more importantly, it offloads WiFi-related tasks to the module, allowing the microcontroller code to be very light-weighted.

ESP8266 ESP-01 Serial WIFI Transceiver Module is a cheap and easy way to connect any small microcontroller platform, like Arduino, wirelessly to Internet. ESP8266 has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal

loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area. ESP-01 WIFI Transceiver Module is addressable over SPI and UART, making this an exceptionally easy choice for anyone wanting to build an Internet of Things thing. You can use AT commands to connect to WiFi networks and open TCP connections without need to have TCP/IP stack running in your own microcontroller: You can simply connect any microcontroller to this module and start pushing data up to the Internet.

WIFI module connection:



WiFi to Arduino:

The Vcc of the WIFI module is connected to the 3.3V of the Arduino Board.

The Gnd of the WIFI module is connected to the Gnd of the Arduino Board.

The CHPD of the WIFI module is connected to 3.3V of the Arduino Board.

The RX of the WIFI module is connected to the Tx of the Arduino Board.

The Tx of the WIFI module is connected to the Rx of the Arduino Board.

CODE:

```
String mySSID = "itsmine";  // Mobile Hotspot Network ID
String myPWD = "12345678";  // Mobile Hotspot Password
String myAPI = "NDYI8O9OXMLLCF6E";  // Write API key of channel in Thingspeak String myHOST = "api.thingspeak.com";
String myPORT = "80";
String myFIELD1 = "field1"; // distance
String myFIELD2 = "field2"; //counter

const int trig = 8;     // Pin in Arduino where Trig of Sensor is connected

const int echo = 7;     // Pin in Arduino where Echo of Sensor is connected float duration;
int distance;
int counter = 0;
unsigned long time_since_last_reset = 0;
int interval_one = 5000;
int interval_two = 8000;


void setup ()
{
  pinMode (trig, OUTPUT);
  pinMode (echo, INPUT);
  Serial.begin (115200);
  espData ("AT+CWMODE=1", 1000);
  espData ("AT+CWJAP=\"" + mySSID + "\",\"" + myPWD + "\"", 1000);
}
```

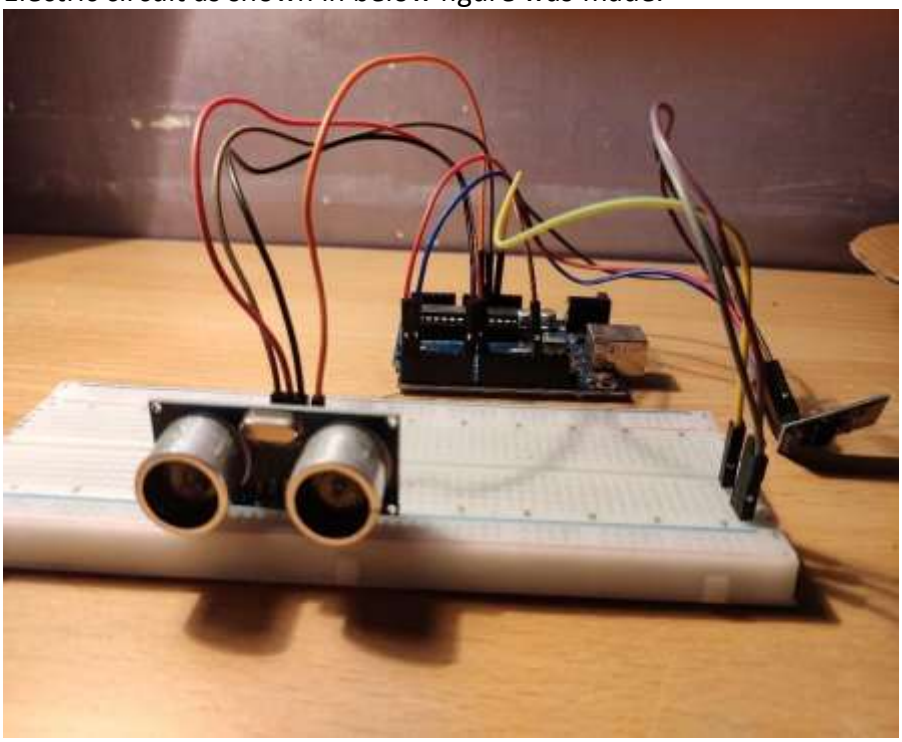
```

void loop ()
{

  time_since_last_reset = millis ();
  while ((millis () - time_since_last_reset) < interval_one)    // initial while loop to calculate data
    {
      dist ();
      if (distance <= 30)
        ++counter;
    // counter=counter-1;
    //String sendData = "GET /update?api_key=" + myAPI + "&" + myFIELD1 + "=" + String(distance) + "&" + myFIELD2 +
    //disp_in_site(sendData);
      delay (50);       //delay to collect data
      if (counter >= 40)
        counter = 0;
    }

  while ((millis () - time_since_last_reset) < interval_two)    // second loop to update data to website
    {
      String sendData = "GET /update?api_key=" + myAPI + "&" + myFIELD1 + "=" +
      String (distance) + "&" + myFIELD2 + "=" + String (counter);
      disp_in_site (sendData);
    }
}
```

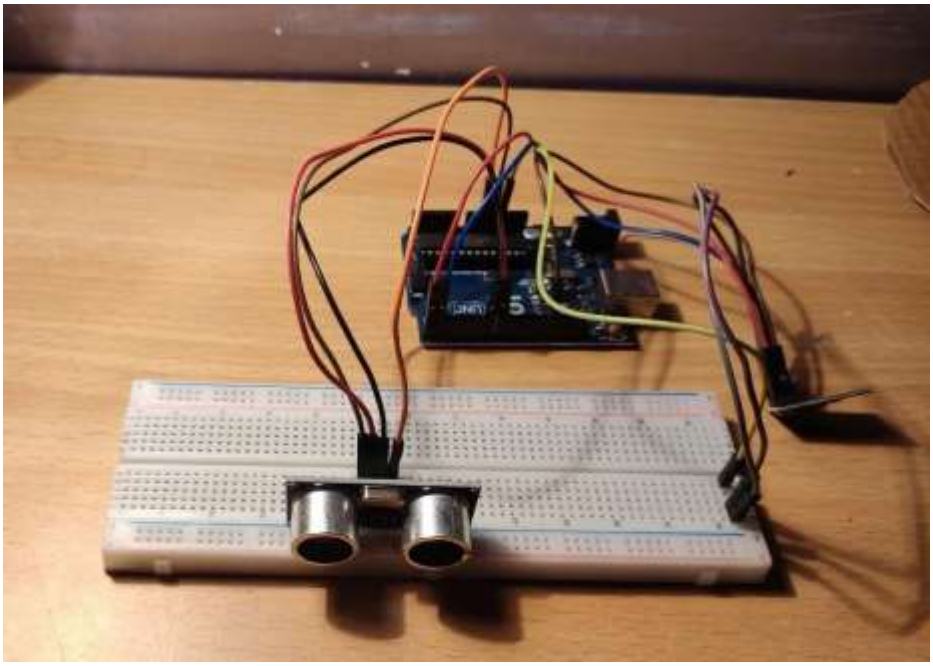
```
int dist ()
{
  digitalWrite (trig, LOW);
  digitalWrite (trig, HIGH);
  delay (1);
  digitalWrite (trig, LOW);
  duration = pulseIn (echo, HIGH);
  float d = duration * 0.017;

  distance = round (d);
  return distance;
}

String espData (String command, const int timeout)
{
  String response = "";
  Serial.println (command);
  long int t = millis ();
  while ((t + timeout) > millis ())
    {
      while (Serial.available ())
        {
            char c = Serial.read ();
            response += c;
        }
    }
    return response;
}
```

```
void disp_in_site (String data)
{
  espData ("AT+CIPMUX=1", 1000);
  espData ("AT+CIPSTART=0,\"TCP\",\"" + myHOST + "\"," + myPORT, 1000);
  espData ("AT+CIPSEND=0," + String (data.length () + 4), 1000);
  Serial.println (data);
  espData ("AT+CIPCLOSE=0", 1000);
}

```

Procedure followed to implement IOT:

1) Electric circuit as shown in below figure was made.

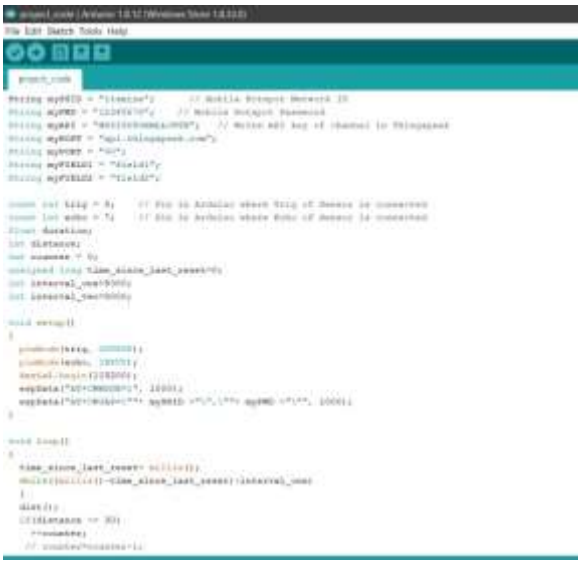




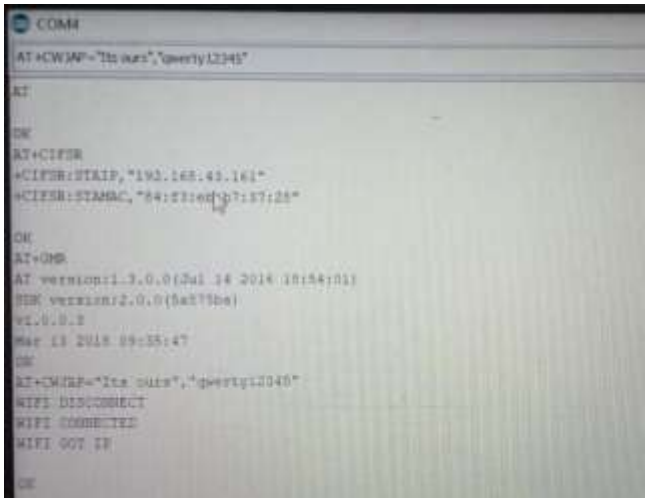
2) Arduino IDE was used to make the code and upload it to the board.

3) The WiFi module was set up through the IDE and connected to the mobile hotspot.it can also be connected to any other required network. The setup of the WiFi module was done through the serial monitor interface. An IFTTT account was set up. IFTTT stands for “if this then that”. It is a freeware web-based service that creates chains of simple conditional statements, called applets. An applet is triggered by changes that occur within other web services such as Gmail, Facebook, Telegram, Instagram, or Pinterest. For example, an applet may send an e-mail message if the user tweets using a hashtag, or copy a photo on Facebook to a user's archive if someone tags a user in a photo. We create an applet using services provided by IFTTT and use Line message to notify the concerned party.

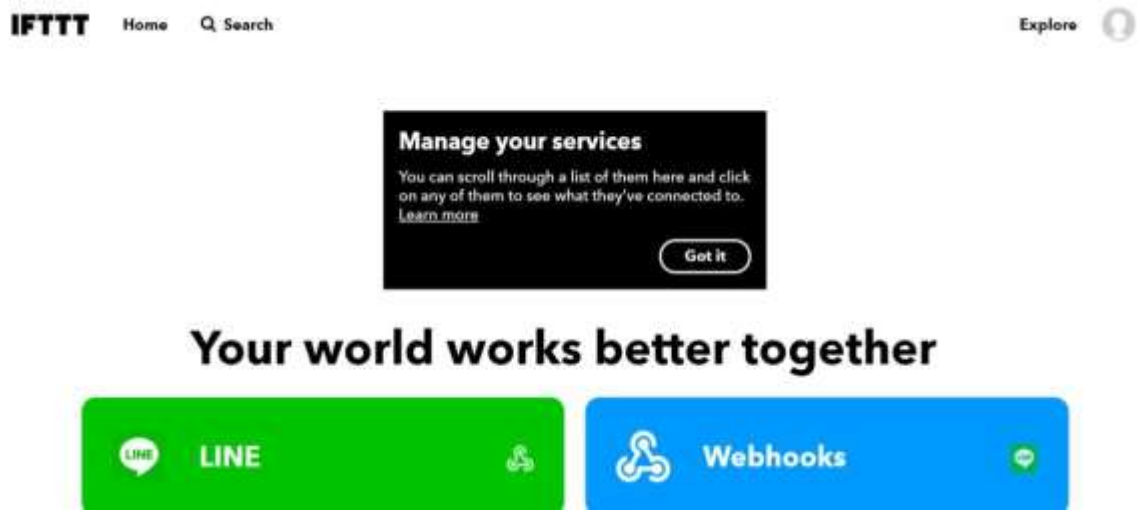
IDE FOR UPLOADING CODE:



<u>IDE SERIAL MONITOR FOR SETTING UP WIFI MODULE</u>



Webhooks Page With Line And Webhooks Integrated:

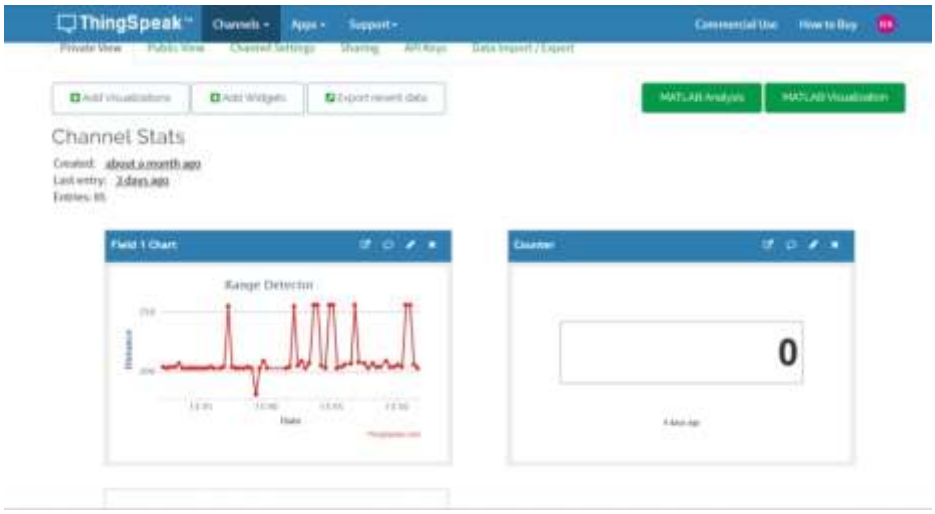


4) IFTTT integrates webhooks, think speak and line message to work together.

5) Webhooks creates a unique API link that allows the trigger to send a message through Line message.

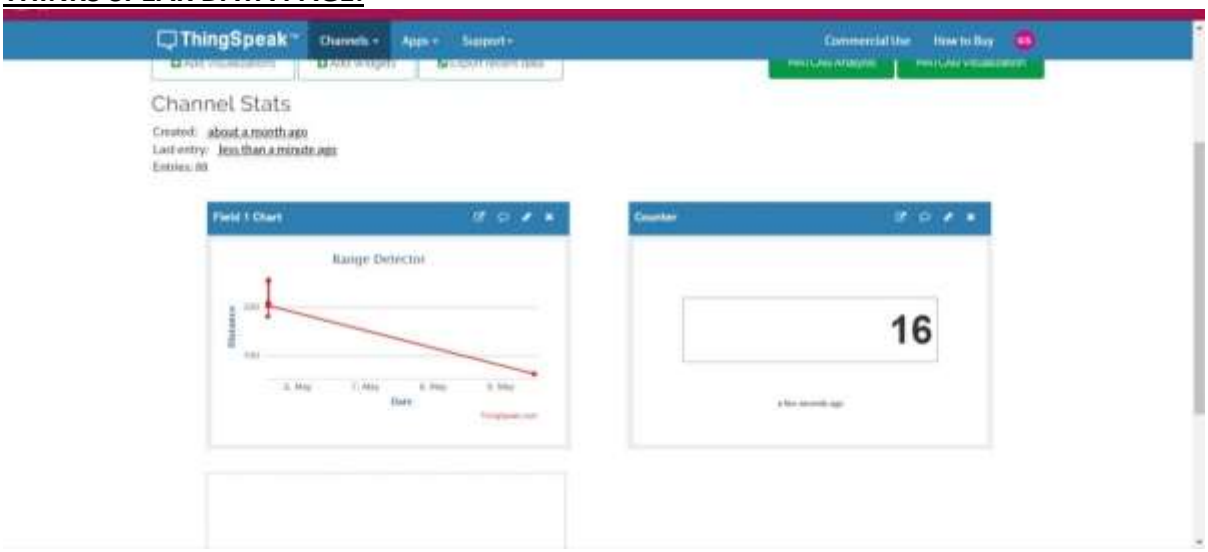
6) Thing Speak is an open-source Internet of Things application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network.

Thinkspeak Page Visualizeing Data Collected By Sensor:



6. When the trigger of counter is met, think speak using IFTTT fires the link provided by webhooks sending a line message to the required individual/organization.

THINKS SPEAK DATA PAGE:



As you can see, the counter keeps increasing every time the distance reaches below a threshold and fires the trigger when counter crosses 30 sending a message on line Message.

Message Received In Line Message:

As you can observe, the message has reached the beneficiary through line message which was integrated with the project using IFTTT.

Working

- This dispenser works on the same principle as the regular food and snack dispensers that are found in the world. The sanitary napkins are placed in between the windings of the springs that is attached to a servo motor connected to an Arduino Uno Microcontroller. As the spring rotates, the napkins move from the back to the front as the spring connected to the servo rotates
- The process begins by the person pressing a button which triggers sends the signal to the arduino which in turn sends power to the motor to only spin for a given time period. This time period is set previously to match with on napkin to move over one screw winding length. In the future this process of the button can be integrated with a payment system such as cash ot a card that can be swiped to trigger a signal.
- The motor rotates and as the napkins move the final screw is placed in such a way that it hangs out of the resting platform, as the napkin goes to the final screw winding it falls from the platform and fall down to a inclined surface that directs the napkin to the collection box , from where the person can retrieve the napkin.
- The napkin count is detected by an Ultrasonic distance Sensor connected to the Arduino Uno Microcontroller. The count is set to a previous value that can be modified based on the size of the dispenser. The distance for a previous napkin is also set to a specified value and the distance sensor keeps count of this distance and also register count of the napkins. If the distance exceeds a certain limit then the IR module sends a signal to the Arduino which indicates that the napkin quantity is very low or empty.
- This signal from the distance sensor sent to the Arduino is then sent to the internet using the WiFi module attached on the micro -controller. This message is sent using a Online interfacing website that allows us to send messages from the Wifi module. This message can then be sent to a smartphone or email to relevant personnel that the amount of napkins in the dispenser is low or empty, which then alerts them to come and replenish the supply.

Future Scope

The IoT functionality can be modified in such a way that we can track the napkins that are being used on a monthly/weekly basis and obtain statistical data to help us restock even more efficiently and also allowing us to use this data for any sort of data analysis that can be performed. The storage capacity of our module can also be increased to store more napkins.

As of now we have not looked at the commercial side of things. This dispenser can be modified in such a way that we can use it is a commercial dispenser that can be put in public restrooms etc with various payment opportunities to purchase these napkins.

IoT functionality such as a tamper alarm to prevent tampering and stealing of napkins, GPS functionality so that people can locate where the nearest dispenser when needed.

App Mockup

In the future we realized that we can create an app for all NGOs and beneficiaries that helping organizations and locations with poor sanitary facilities and this allow them to stay up to date.

We created a quick mockup of the app that can be developed in the future using prototyping tools such
As illustrator and in vision. This is the basic into page when the beneficiary enters the app. The beneficiary has a quick feature of finding dispensaries near him. The app is filled with different functionalities which can be seen in the next picture.

As you can see in the above mockup, the various functionalities of the app can be seen. The user can find nearby sanitary napkin dispensaries and is also told about the cause and mission of the app and can contribute. The beneficiary
Can search for any location he wants and has a list of contact destinations where he s already supporting. When the number of sanitary napkins reduces in a certain machine, the respected beneficiary is notified.

Conclusion

This project was an interesting opportunity to work and understand the real world problem that sanitation and access to sanitation is still a major problem in many parts of our country, this particular issue was helped to identify with the help of the NGO, Aid India, they had initially promised us with help in getting this model certified and helping us to try this out at a rural middle school. However due to the pandemic, we were unable to fully work on the model and complete it.
Nevertheless, we learned a lot from working on the few things and modules that we were able to complete and, in the future, we look forward to complete a fully functioning model and make further changes and implementations to the design.