Current Sensing in Washing Machine

Team Pentagon

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Problem Statament

- The washing machines in community living places, such as hostels, are generally limited and their usage should be done in an efficient manner.
- By sensing the current the machine draws, we can obtain the information about the state of the machine,i.e, vacant or in use.
- By displaying the state on a website, we can save the hassle of physically going checking the state of the machine.

Device Overview and Explanations

- The components used are : CT Sensor, Arduino UNO WiFi, SMPS Down Converter, Extension board, Audio Jack,PCB, Jumper Wires.
- The Current Transformer(CT) Sensor outputs a certain voltage based on the current in the wire around which it has been clamped.
- This votage is input to the microcontroller, which samples at a certain rate,digitizes the values and pushes the data collected to Thingspeak cloud, using IEEE 802.11ah WiFi over MQTT protocol.
- The data collected is processed as per the thresholds for on and off stage, and the state of the website, along with the current consumption graphs are displayed in real time on our website.

Device Block Diagram

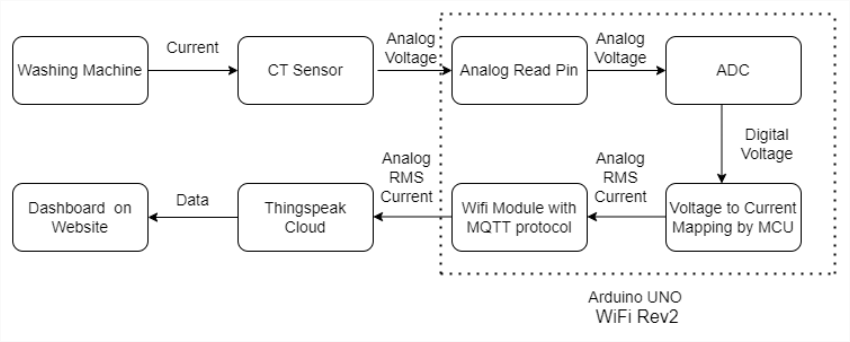

Figure 1: Block Diagram

3-D Model

- A 3-D Model was made for the device in Tinkercad. The Model helps in making the device look compact.
- The Model has been made such that the only thing required to get the device to work is to plug any device(for eg Washing Machine) and turn on the switch.
- The Current consumed by the device will be sent to the cloud(Thingspeak). These are then displayed on a webpage along with on-off status of the device.

3-D Model

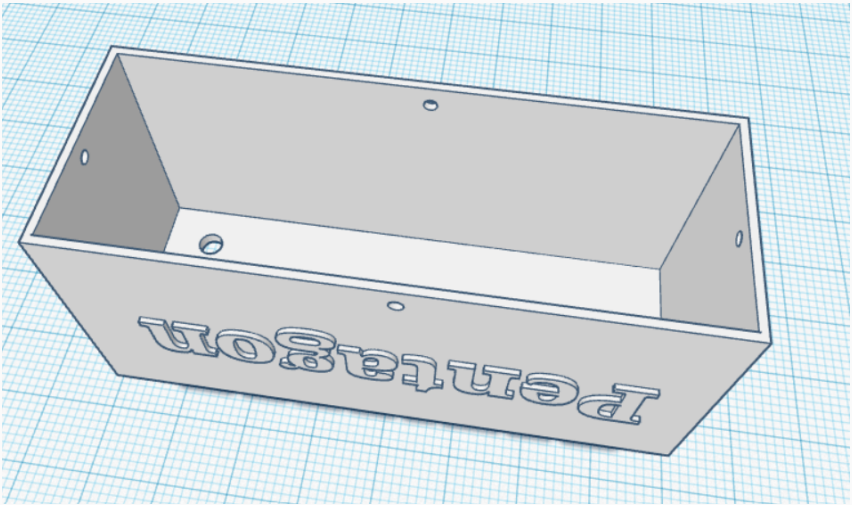

Figure 2: 3D Model

Deployable Device

- Using the 3D printed model, a deployable device has been made. In order to power the Arduino, SMPS Step Down Converter is used. It converts 220V AC power supply to 5V DC.
- Circuit has been shifted from Breadboard to PCB and soldering has been done.
- Finally, the switch board has been screwed to the box to make the device compact.

Device Circuit

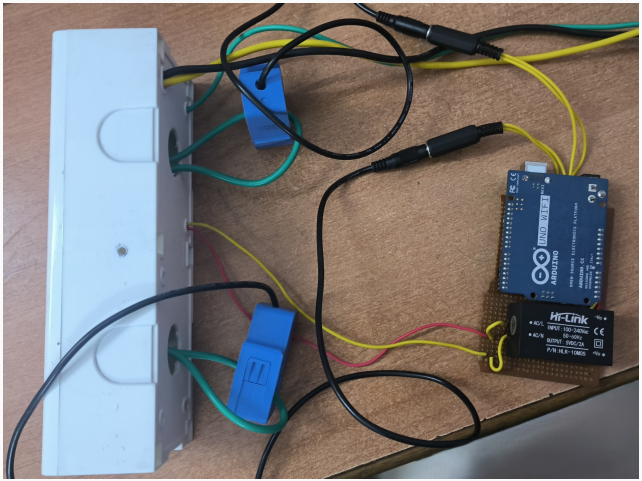

Figure 3: Device Circuit

Device Internals

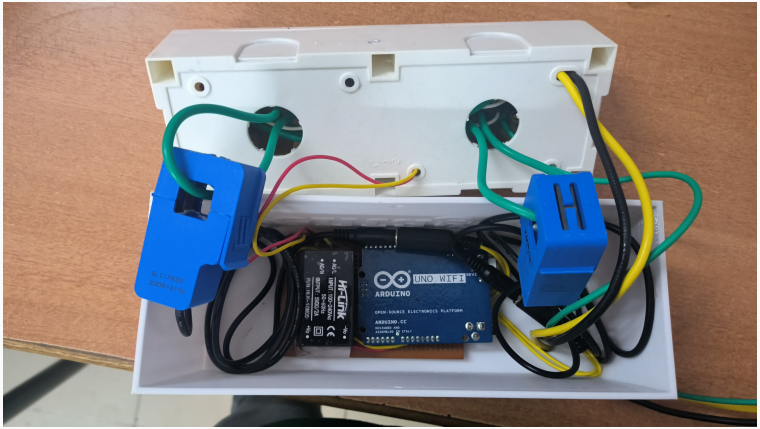

Figure 4: Internal Arrangement

Deployable Device

Website

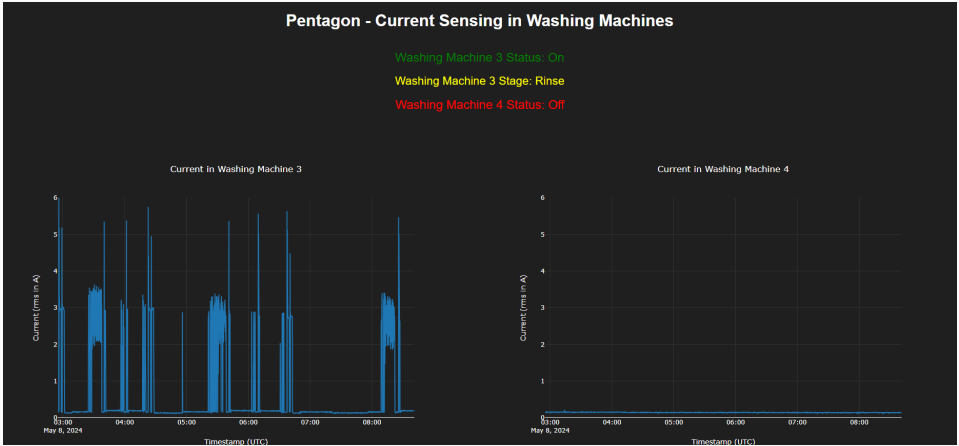

Figure 6: Website

Deployment Details

- Deployed on : 17 April,2024 .
- Deployed at : Washing Machines - 3 and 4 in Bakul Nivas Hostel.
- The user count of the website done using Plausible analytics.
- Constant monitoring of the device was ensured, along with inputs from users of the website.

Deployment Site

Plausible Analytics

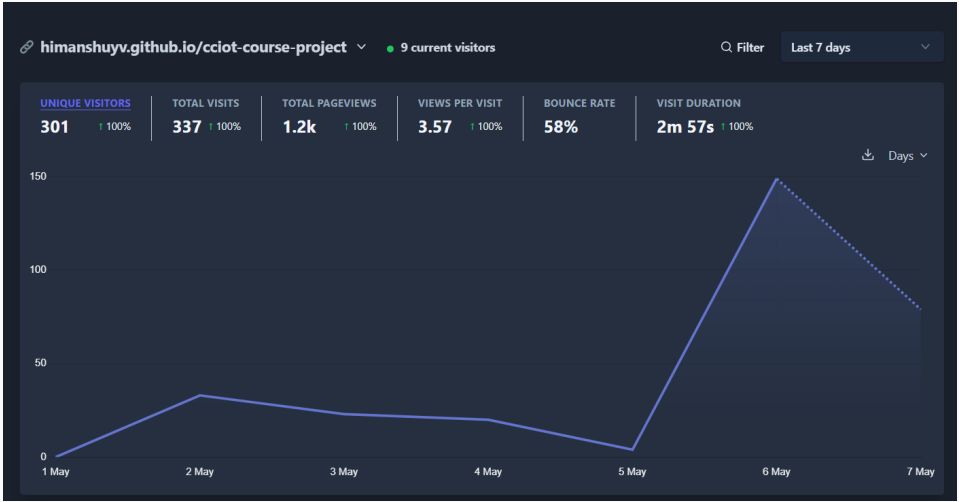

Figure 8: Users

Channel Usage

Figure 9: Channel Usage

Data Analysis

- The data of the rms current for complete wash cycles was studied and analysed for both state detection(i.e., on or off) and stage detection(i.e., wash, rinse or spin).
- Average of 5 samples are taken and if it less than the threshhold,it is OFF,else ON.
- When it is ON, to determine the stage it is in, we first try to find the point where the machine has turned ON. Then, 20 samples are taken and sorted. 20 percentage samples from either side(Highest and lowest) are removed and average of the remaining is taken.
- If it greater than 2, it is in wash stage and a wash flag is set. If average falls below 2, when wash flag is set, it is in rinse stage and a rinse flag is set. When rinse is set, if current rises, it is in spin stage and spin flag is set.

Complete Wash Cycle Plot

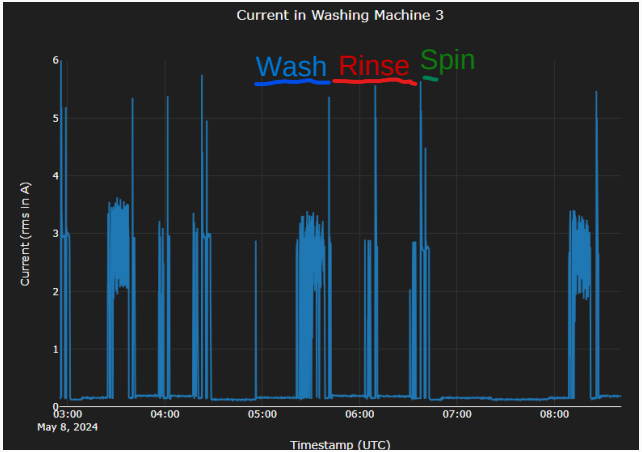

Figure 10: Users

Challenges Faced

- The erratic nature of current.
- Classifying between ON/OFF stage was not easy as we thought as even in OFF stage some current is taken by the Washing Machine and in ON stage, there are times in between where the current taken by Washing Machine is almost as low as the current taken by it when it is OFF.
- The rinse stage has a slight spin mode while in rinse state. This leads to it being classified as spin
- The washing machines were giving errors E1,E3,C3.etc. so many times that we were not able to get even one wash cycle continuosly 90 percentage of the time.

Future Scope

- The project can be extended to be deployed on all washing machines in Bakul Hostel, and then eventually in all hostels.
- The website could be made open source and a team can be elected each year to maintain the website and the deployment.
- The project developed has tremendous application and can also be used further to monitor the energy and water consumption of the machines.