

# Current Sensing in Washing Machine

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Team Pentagon

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# INTRODUCTION

- As the first phase of the 'Current Sensing in Washing Machines' project, the required components were assembled together to form the circuit and proceed with the current detection. The circuit was tested on various devices, such as air cooler, water kettle, iron and laptop charger before actual deployment on the allocated washing machines.
- The basic circuit built comprised of the output of the CT sensor directly given as input to the analog read pin of Arduino UNO wi-fi. Assuming a linear relationship between the output voltage and the current to be measured, the current values are calculated.
- Rms current is mathematically calculated to present the actual current information. The data gathered is sent to Thingspeak cloud and presented graphically on the Thingspeak dashboard.



**Figure 1:** Circuit

- Since the sensor works on the principle of electromagnetic induction, directly clamping it around the main supply wire leads to error values due to following reasons:
  - Main wire can be magnetically insulated
  - It consists of both live and neutral wires, hence the core can't be magnetized accurately.
- Thus, we plug the main wire into a socket board and use an external wire to connect the switch to one pin of the socket. This allows us to clamp the sensor around this external wire which basically carries the current of the live wire.

## Code Implementation

- The analog voltage output of the sensor is plugged into the analog read pin of the Arduino. The ADC digitizes this measured voltage to a value between 0 (for 0 V) and 1023(for 5 V).
- Using code in the IDE, we read the values at an interval of 1ms and rms value of voltage is obtained by averaging over 1000 samples. This is repeated every 5 seconds.
- Using calibration factor from the datasheet, the voltage is converted to current by dividing by it, assuming linear relationship from 0A to 15A current flow in the device. For the sensor used by us, it is  $1/15(0.06667)$ .
- This current value is then sent to Thingspeak cloud through MQTT communication protocol.

- First we created a channel having two fields for measuring current in two devices.
- Then we created a MQTT Broker by adding a new device for our channel on Thingspeak.
- Then we are sending the current values for each device at the interval of 5 seconds through the wifi client via MQTT broker to the channel. While sending the data for the two devices, there is a delay of 1 second.

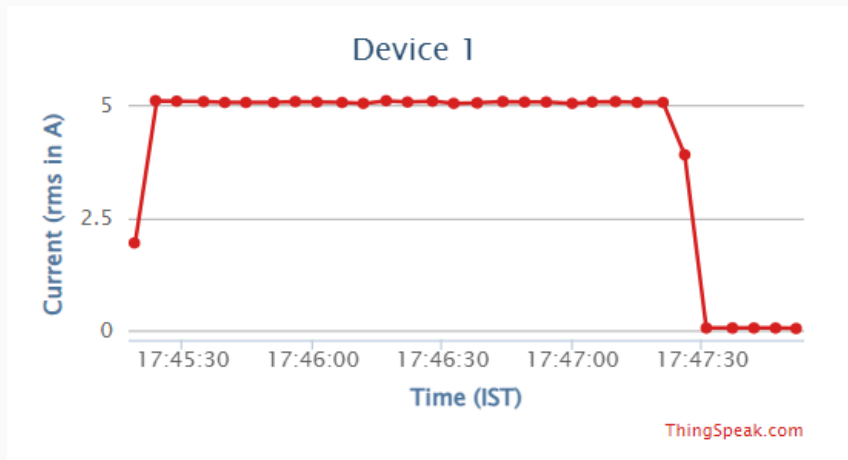


Figure 2: Kettle

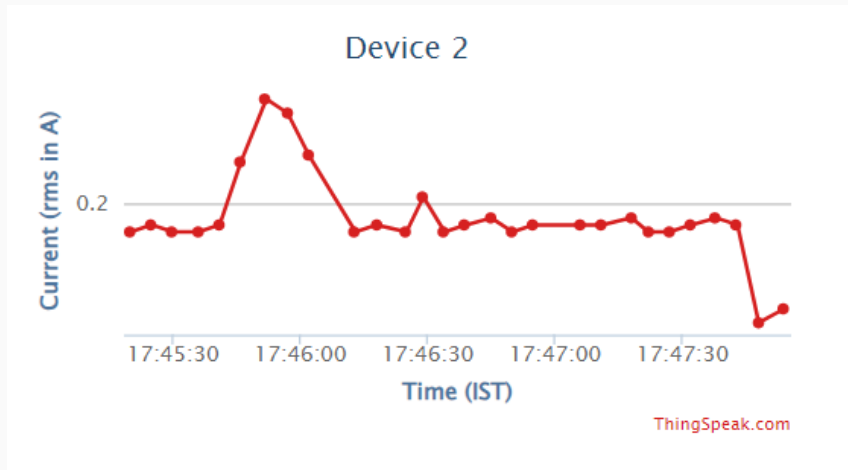


Figure 3: Laptop Charger



## Future Plans

- Creating a 3D model of the device with just the socket board at the exterior
- Putting circuit on the PCB
- Collecting data from washing machine by using the device
- Analyzing the data and doing inference