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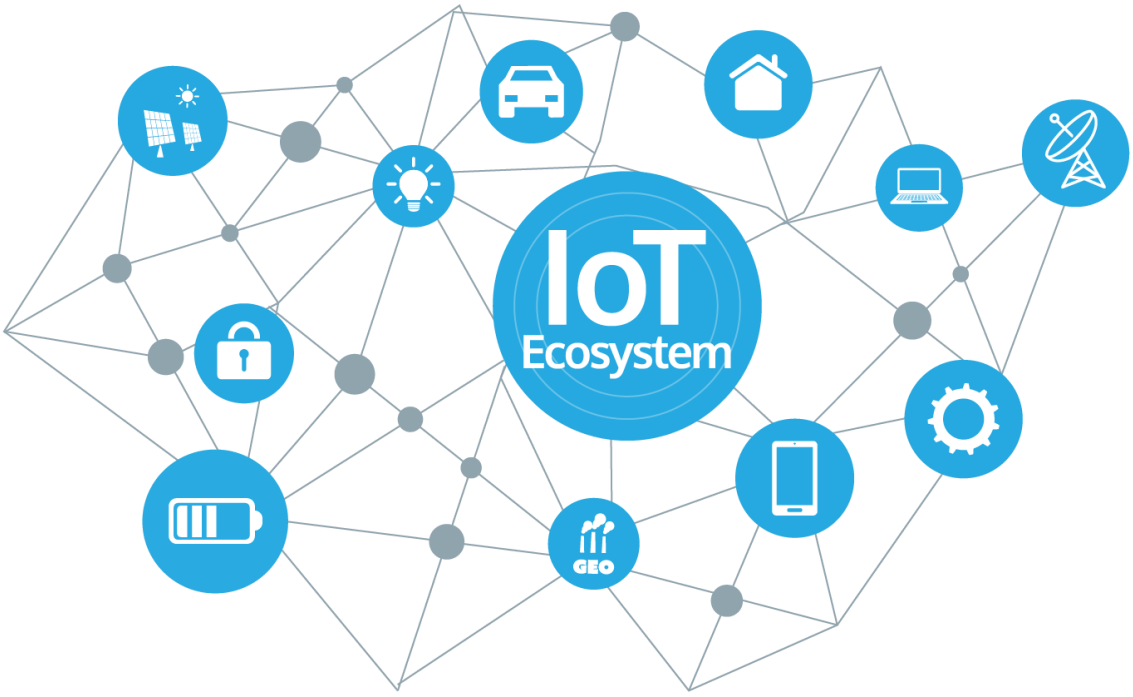
hackHub | Trojan Horse



Problem Statement

Fault tolerance and detection is increasingly important for robots, especially those in remote or hazardous environments. Robots need the ability to effectively detect and tolerate internal failures in order to continue performing their tasks without the need for immediate human intervention. Recently, there has been a surge of interest in robot fault tolerance, and the subject has been investigated from a number of points of view.

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Abstract

We aim to create a cloud based system which aims to create a feedback system which takes values from control systems placed far away from each other, and with minimal human intervention, moderates the power supplied to industrial machinery and at the same time if any of the received data shows abnormal variations or shows sign of some potential mishap, predict any such disasters and notify concerned personnel immediately.

Specifications

- **One Master server** with ‘n’ raspberry pi / smart devices
- Easily Scalable on demand
- **Plug & Play**
- Communication rate at **9600 bps** (can be increased if instantaneous readings are required)
- **Full duplex** communication between master and slaves
- **Easy integration** with amazon alexa to handle erroneous situations instantly
- **Mobile App Support t**hrough amazon alexa with custom skills
- **Google cloud based server** platform
- On-board sensor-based fault prevention in case of extreme situations to protect the IoT devices
    - **No human intervention required**
    - Sensors like

        - Temperature | **Monitors real time heating and trips to a cooling circuit**
        - Current | In case of fluctuation or high current spike, trips to protection mode
    - Hardware based fault prevention - Protects circuits from potential harm
- Admin access to **visualise status of every sensor** and raspberry/arduino in an interactive and dynamic UI
- Custom **Server based processing** of data in real time
- Automatic **pinpoint restart of devices** in case of failures

Methodology

- Reading Sensor Data
    - Using a microcontroller , all sensor values are recorded and using **Serial Peripheral Interface**(SPI) is sent to the microprocessor (PI)
    - Our sensors include Hall current sensor which **detects change in current** throughput through a particular device
    - **Temperature sensor** which works in an environment **independent** from the rest of our system which enables it to function even during system failures
- Parsing and Uploading Sensor Data
    - All sensor data being received is parsed and **sent to the cloud to process** in **real time**
    - The data is **updated on ThingSpeak Servers** | For cost cutting and faster performance, custom server based database can be implemented
- Processing Incoming Data and Taking Actions
    - Server processes **incoming data and provides visualisation of sensor values** over time
    - Abnormal Sensor data is immediately identified and appropriate actions are taken
        - Faults occured are **immediately displayed on the UI**
        - Faults such as high current throughout are automatically addressed by **circuit switching or power management**
    - Option for user intervention by integration of **Amazon Alexa**
        - **Custom skills added** on Amazon Web Services to handle fault recovery
    - Server can handle **multiple incoming requests** based on severity of problem
    - Server provides capabilities for **autonomous or/and manual intervention** during state of distress

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FAULT PREVENTION:

Instead of using resources for fault rectification, any such system's main priority should be prevention of the faults in first place.
Our system continuously monitors the data and analyses whether the current trend shows any deviation from the nominal configuration of the device.
For example, if some servo motor, which is a part of an industrial robotic arm, starts behaving erratically

Requirements

To develop a system that can:

1. Smartly detect fault
2. Restart faulty device
3. Implement fault prevention
4. Fault avoidance
5. Fault detection
6. Fault recovery strategies

Plan of Action

- Making a IOT network with pi and arduino and multiple sensors which constantly send value to pi
    - Interface arduino with sensors
    - Interface a servo motor, dc motor, stepper with Arduino and temp module.
    - Send data serially to pi
    - Upload data to server

- Interface for user
    - Status of multiple devices
    - Sensor Values being received- real time monitoring of sensors
    - Mapping of devices present in the network
    - Option for scalability
    - Show added devices
    - Show status if a device is removed

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Results and Conclusion/Inference:

1. An IoT network was established.
2. A central server was established.
3. A web based UI was established to help user easily check the status and action of the system.
4. The UI was made with **plug-and-play** functionality for all devices for **future easy scalability**.
5. The system used various sensors to detect faulty devices.
6. Based on the sensor values, alerts were generated and appropriate action was taken for fault recovery.
7. An innovative solution was introduced by integrating an **Amazon Alexa skill** to the IoT system, for **voice-based fault recovery** options.
8. The skill was developed and deployed on **Amazon Alexa.**
9. **Socio-factors:**
    a. Discourages hazardous job conditions for employees by providing a remote system to control the IoT network.
10. **Economic-factor:**
    a. The system requires virtually no extra components as the companies usually already have feedback mechanisms; our system just automates feedback analysis and subsequent action. Hence, it is cheaper as compared to human employees.

Business model:

To be provided to companies as an IoT chargeable service.
Our service would be in the form of a subscription charged in terms of use, maintenance and scale.
Our easy to use system would require minimum prerequisites and no coding skills.
We'll use Google CLoud Platform to provide cloud based services

Future Work

- Develop a **mobile application** to monitor every sector from your pocket
- Add **custom alexa skills** in a very easy and interactive method
- Provide **dynamic visualisation** and data flow to better analyse IoT network

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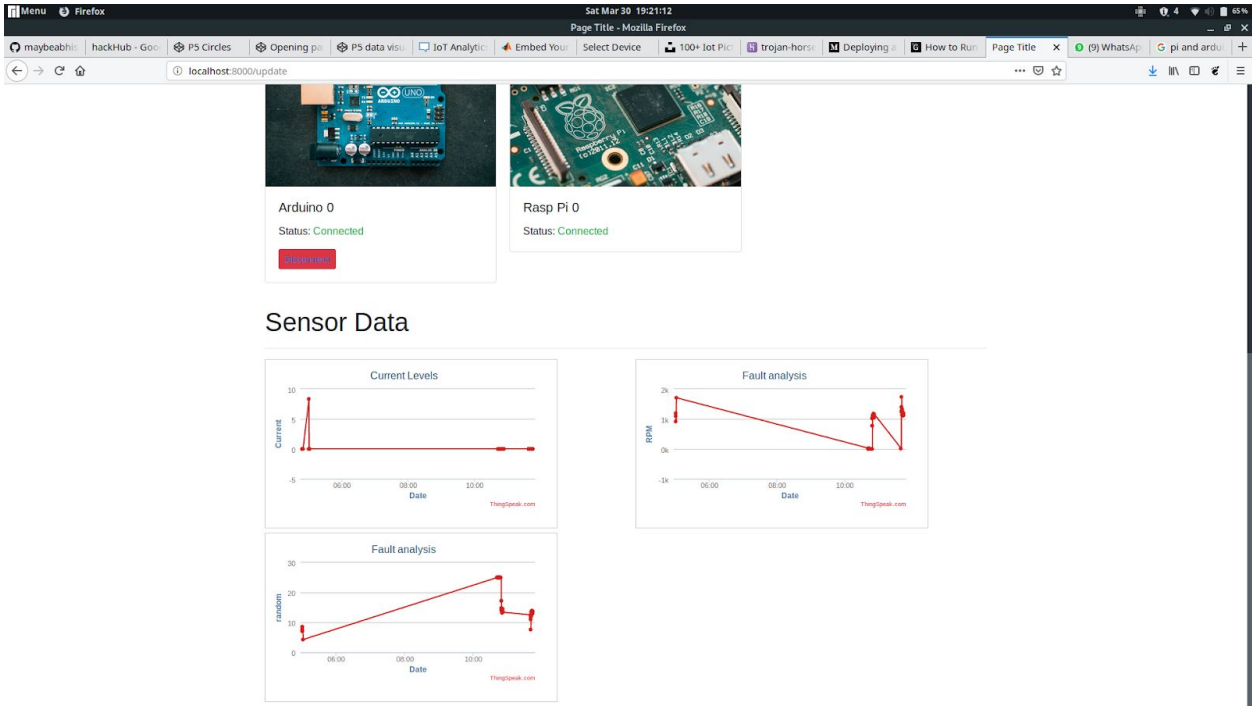

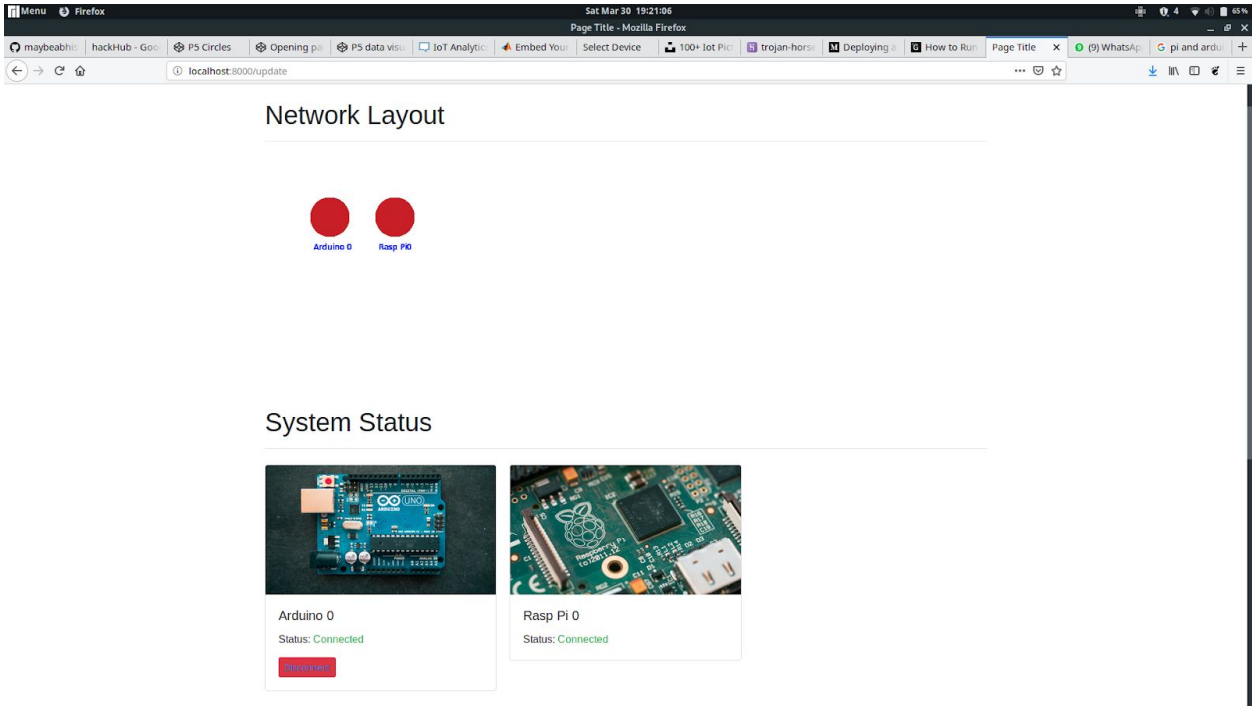

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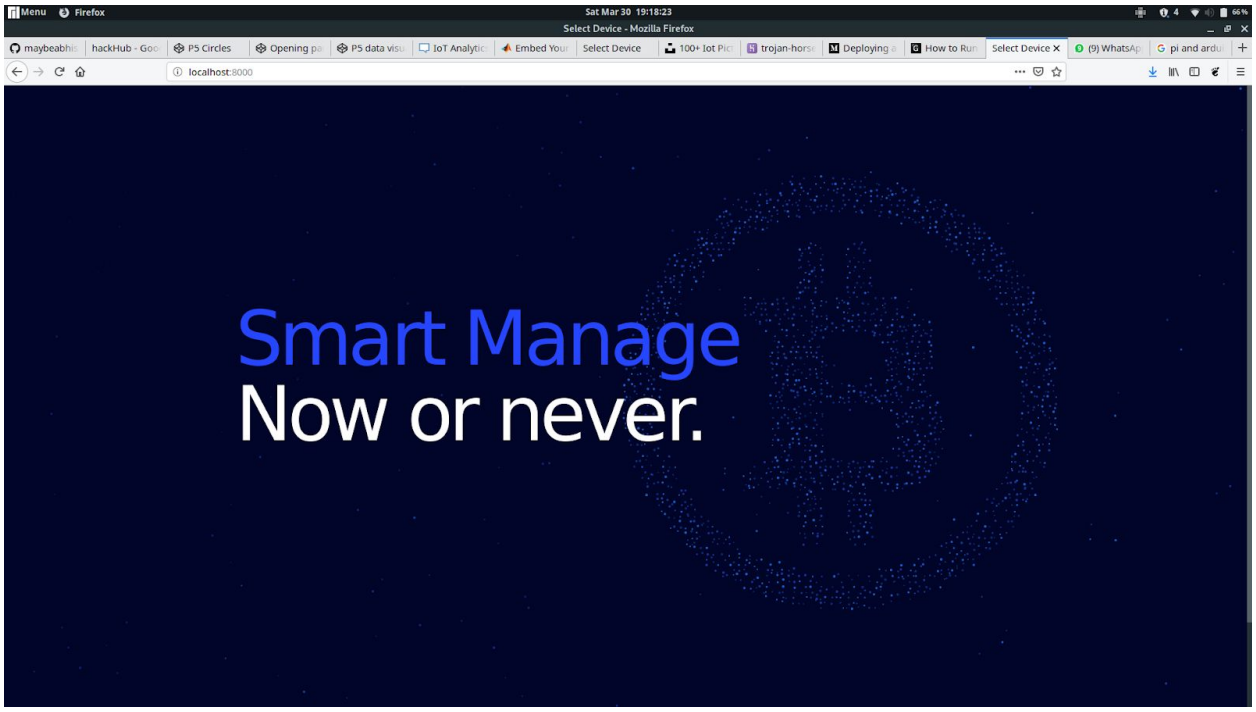

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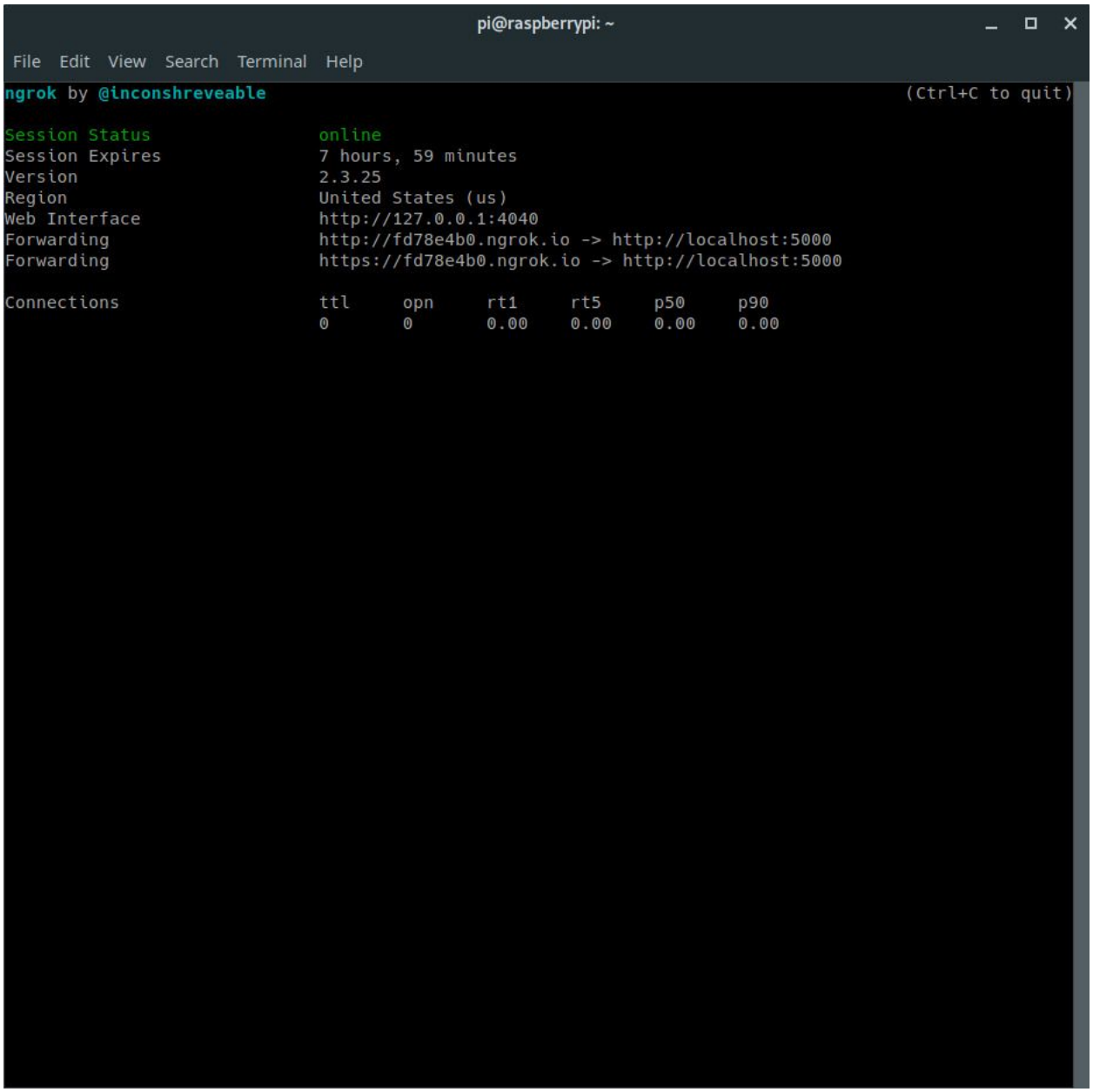
The server for Alexa Skill working on pi:



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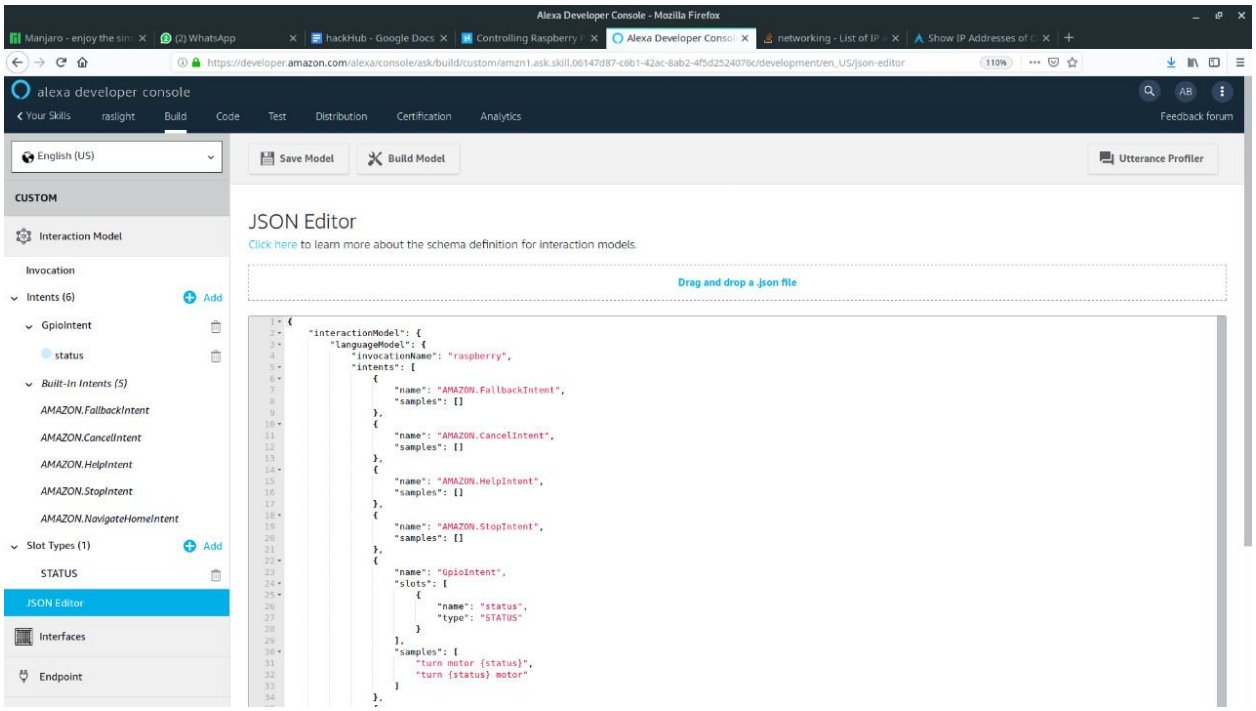
Amazon Developer Console:
JSON Editor shown below with the skill building phase screenshot:



The Skill Developed was deployed on the Amazon Developer Platform for Beta Testing.

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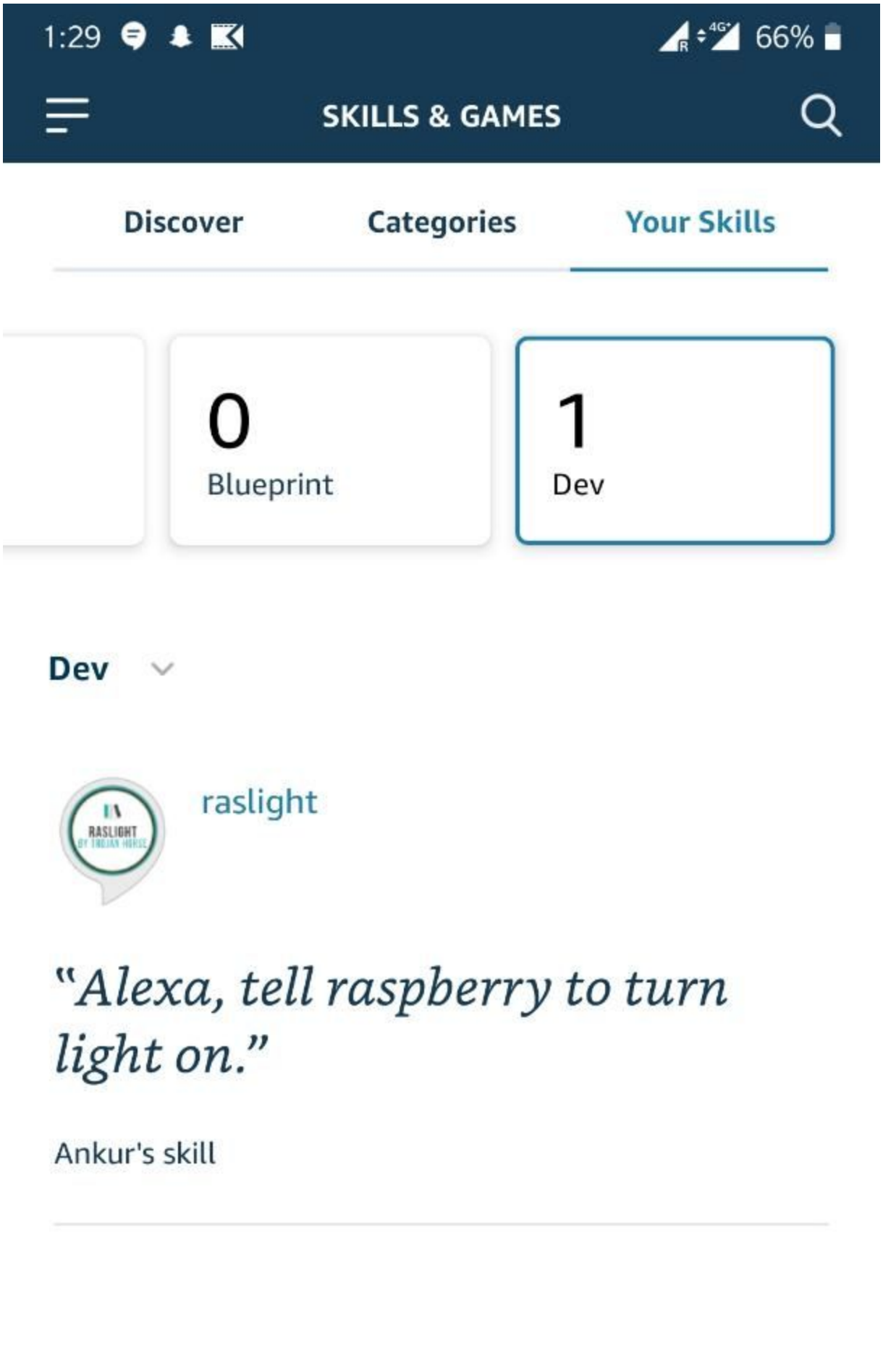

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Automated device turn off on heating, shown below:
This is independent of the whole system, as Fire is one of the most dangerous hazard.