Flexible Internet of Things Middleware

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Abstract

The Internet of Things is a rapidly growing system of sensors and connected devices, enabling an advance in usability and information gathering. However, IoT must be backed up with middleware that allows consumers and programmers to interface in a user-friendly way, despite the differences in each user's IoT system. To that end, our software attempts to begin to bridge the gap between users and programmers. Through the use of GSN (an existing IoT middleware), Firebase (a cloud storage service), and our own code, we have created a system that takes the first steps towards a ubiquitous middleware for IoT.

Motivations

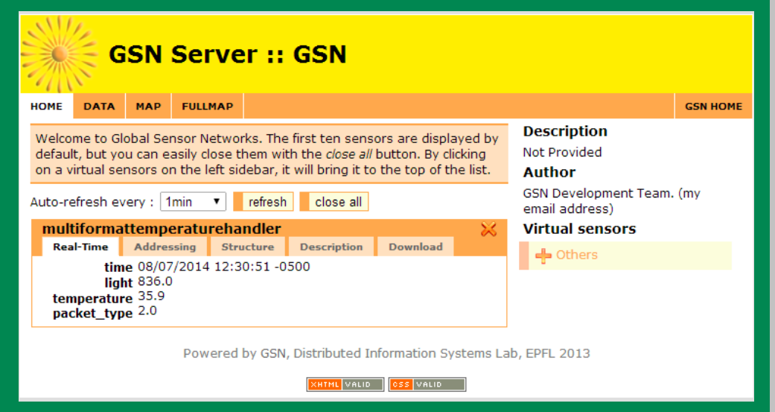
- Users of the Internet of Things are going to need a middleware that allows them to connect sensors, interpret data, connect to 3rd party applications, and view the data as raw data and as interpreted information
- Current middleware solutions focus entirely on allowing addition of more sensors or interpretation of the data, none combine the full features of both

Related Work

Xively, along with LogMeIn, is a public cloud that has tools that allow developers to connect their sensors to Xively's framework. Xively's API is difficult to work with, making adding sensors time consuming and code intensive. Also, in order to interpret or use the data, the data must be sent to some other application

Pariampu is a web-service that connects sensors to the web, and can send data to social media. It only allows users eight sensors and actuators. Any sensor not supported by Paraimpu has to use a 3rd party app to interface with the system

GSN is a middleware that enables users to connect sensors to the system provided that they create an XML file and wrapper telling GSN how to handle the sensor



Welcome to Global Sensor Networks. The first ten sensors are displayed by default, but you can easily close them with the *close all* button. By clicking on a virtual sensors on the left sidebar, it will bring it to the top of the list.

Auto-refresh every : 1min

multiformattemperaturehandler

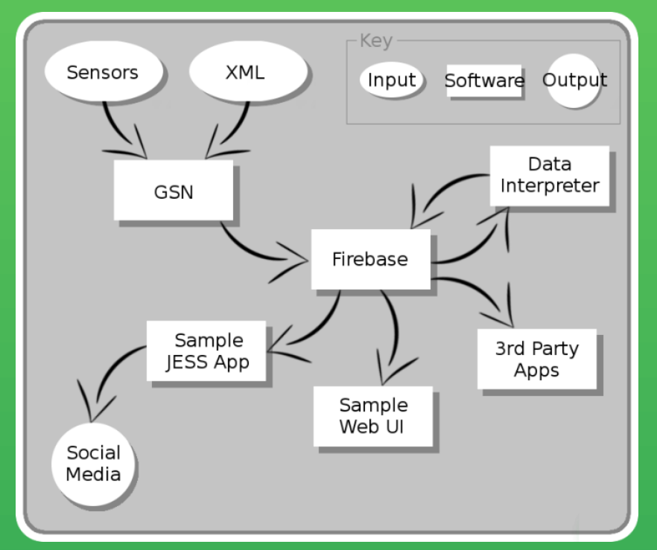
time	08/07/2014 12:30:51 -0500
light	836.0
temperature	35.9
packet_type	2.0

Description
Not Provided
Author
GSN Development Team. (my email address)
Virtual sensors
Others

Powered by GSN, Distributed Information Systems Lab, EPFL 2013

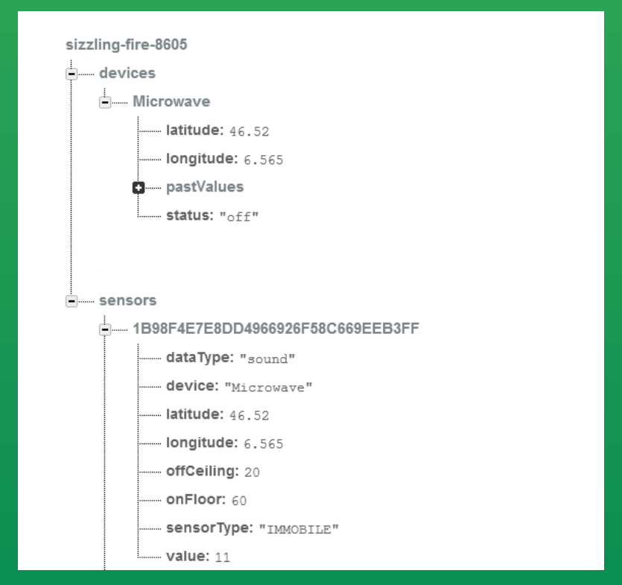
Google Nest consists of a smart thermostat and smoke detector, but does not allow addition of any other sensors. Nest's data is sent to Firebase, and this storage of data in the cloud allows flexibility, which is why we chose to do the same with our software

System Architecture



The flow of data through our software and sensor network

GSN – The sensors and an XML file send data to GSN, which forwards the data to Firebase



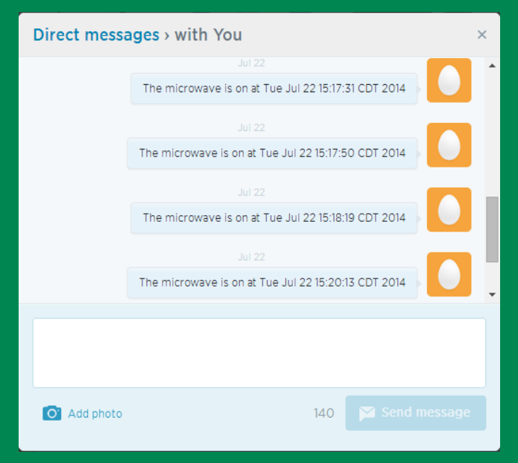
```
sizzling-fire-8605
⊟ devices
   ⊟ Microwave
      latitude: 46.52
      longitude: 6.565
   ⊞ pastValues
      status: "off"

⊟ sensors
   ⊟ 1B98F4E7E8DD4966926F58C669EEB3FF
      dataType: "sound"
      device: "Microwave"
      latitude: 46.52
      longitude: 6.565
      offCeiling: 20
      onFloor: 60
      sensorType: "IMMOBILE"
      value: 11
```

Firebase – Firebase collects the data and sends the data to other programs that request it

Data Interpreter – Takes the raw sensor data from Firebase and the parameters from the XML file to draw conclusions about devices

Contributions

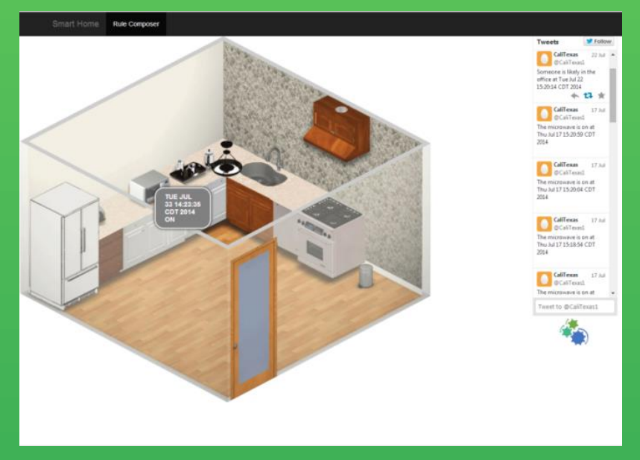
- Allows the user to add any type and number of sensors
- Based on sensor readings and trigger values, automatically infers the status of devices
- Allows any 3rd party application to use the system through the data stored in Firebase to display data or fire actuators
- Web UI and JESS App are examples of these 3rd party applications
  - JESS App allows the user to create rules that send data to social media



Jul 22
The microwave is on at Tue Jul 22 15:17:31 CDT 2014
Jul 22
The microwave is on at Tue Jul 22 15:17:50 CDT 2014
Jul 22
The microwave is on at Tue Jul 22 15:18:19 CDT 2014
Jul 22
The microwave is on at Tue Jul 22 15:20:13 CDT 2014

Contributions (cont.)

- Web UI displays the data from Firebase in a user friendly format



Conclusions

- The future of IoT consists of sensor networks that store their data in the cloud
- Other applications will pull the data and interpret it, either displaying the data, or firing actuators based on the data
- Our software, although simple, is a step towards this system, as it decouples IoT, allowing for interfacing with 3rd party applications and adding sensors

Future Work

Development of a Rule Composer

- Create a system that allows users to create rules during runtime
- This system would replace the JESS App and make adding rules/actuators more user friendly

References

Xively, Paraimpu, GSN, Google Nest

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