Design for IoT Middleware: Final Project Report

WUKONG **SMARTCAN**

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GOALS

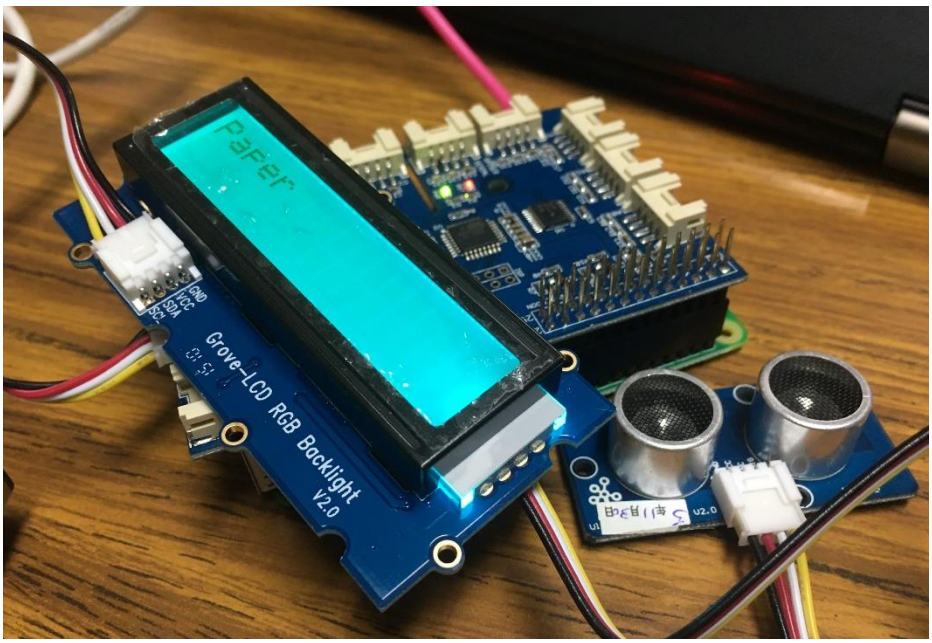
With the ever-growing population in cities, people are creating more and more trash. Often we see trash cans overflowing with garbage and no means of control. We wanted to make an application that would help resolve this problem.

- Design a single-spot trash can system with multiple trash cans
- Dynamically assign garbage types to trash cans (ex. general, paper, plastic)
- Lock a trash can when it is full or not assigned a type

HARDWARE

For each trash can, using the design above, we decided the following devices would suffice:

- a Raspberry Pi with a GrovePi on top
- an ultrasonic sensor
- an LCD displayer
- a cabinet lock (this was not used in the demonstration)



DESIGN & IMPLEMENTATION

To achieve our goals, we designed our application with 3 major components:

1. Assigner: a centralized controller that assigns a type to each trash can
2. Controllers: for each trash can, a controller controls the functionalities of the can and communicates with the assigner.
3. Alerter: an interface for cleaning squads to see the condition of the trash cans

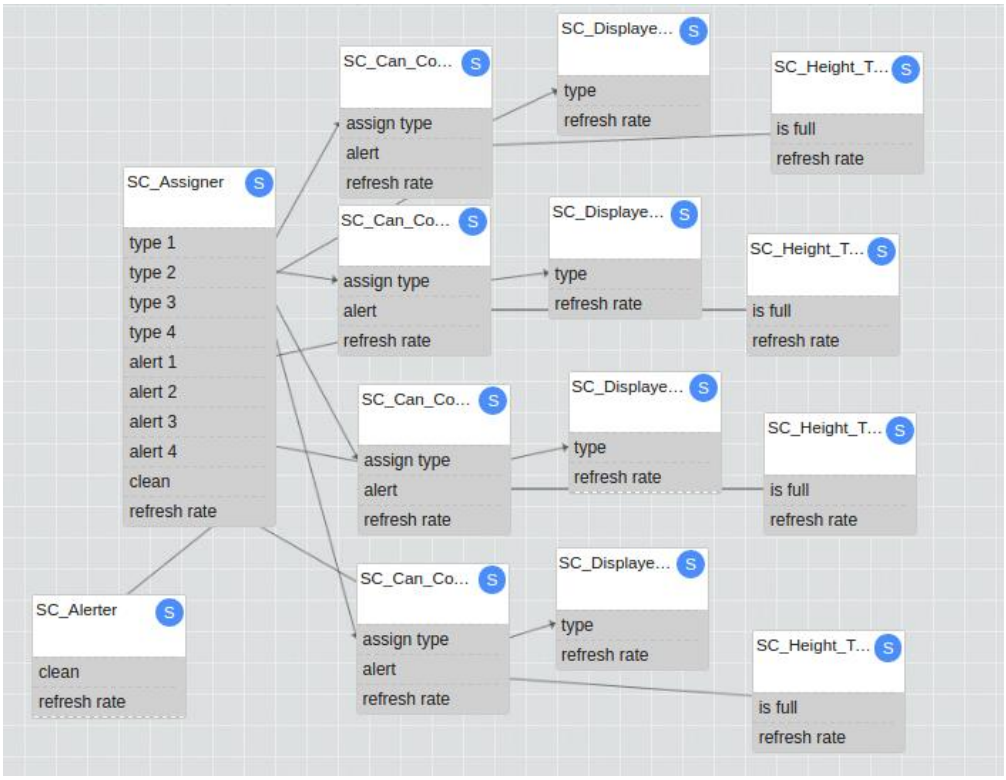
and defined the following WuClasses:

1. SC_Assigner: the assigner class
2. SC_Can_Controller: the controller classes
3. SC_Alerter: the alerter class
4. SC_Height_Tracker: the class in charge of collecting information from the ultrasonic sensor and determining whether the can is full
5. SC_Displayer: the class in charge of displaying information on the LCD displayer

ACCOMPLISHMENT

A. Hard-wired Communication

Our original idea was that since there are usually a static amount of trash cans places in the same spot, we could make our application using hard-wired linking through WuKong. The application setup is as shown:



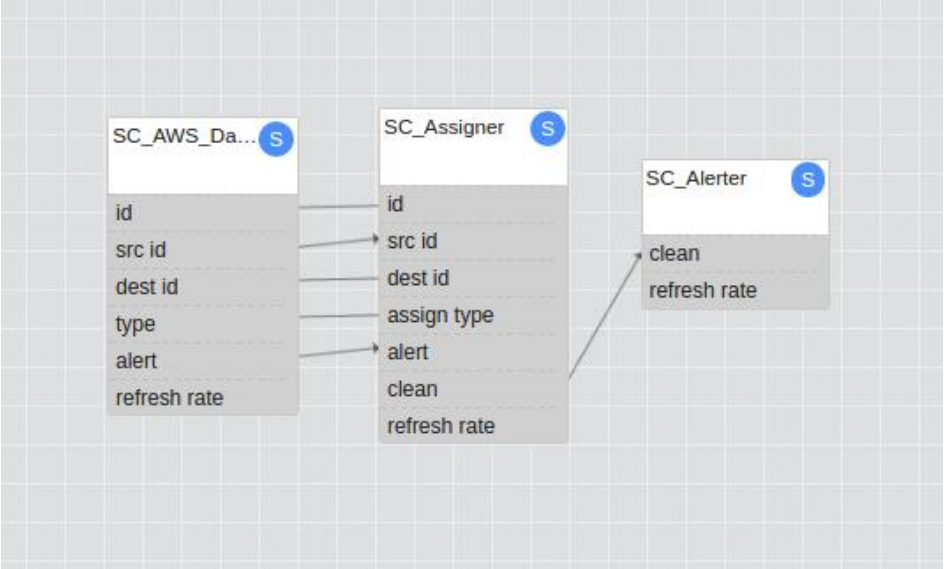
This method is sufficient to achieve our goals; however, as the professor pointed out, this would be difficult to scale up or modify, should there be the need to do so.

B. Implementation with AWS

Since we have a centralized topology, we had to implement an AWS daemon that could connect to both the assigner and the controllers. Therefore, we added a few more assets to the assigner and controllers.

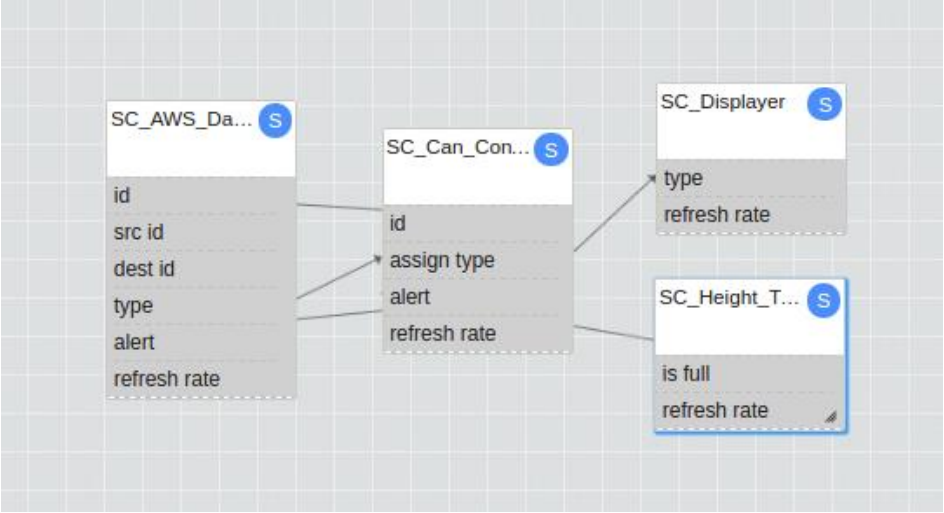
- Assigner-side AWS application

For the assigner, since it communicates with multiple controllers, we added a source ID and a destination ID to its assets for communication with the AWS daemon. With these, the AWS daemon is able to know where its alerts are coming from and where the assign requests are going.



- Controller-side AWS application

For the controller, since it only communicates with the assigner, it only needs to inform the daemon of its own ID.



EXECUTION

In the wukong-darjeeling/wukong/gateway/udpwkpf folder, there are a few files that start with 'sc_'. These are the files that we used to execute our application. For easier execution purposes, we made an sc_workshop_*.py file that includes a controller, a height tracker and a displayer in one.

1. $ cd wukong-darjeeling/wukong/gateway/udpwkpf
2. for each trash can: $ python sc_workshop_[id of can].py ip_of_gateway ip_of_device:port
3. for the assigner: $ python sc_assigner.py ip_of_gateway ip_of_device:port
4. for the alerter: $ python sc_alerter.py ip_of_gateway ip_of_device:port

DEMONSTRATION

For the demonstration, we simulated a scenario with 4 trash cans and 3 garbage types, which are general, paper and plastic. The first two aren't equipped with ultrasonic sensors since we had only 2; we used touch pads instead. The LCD displayers show the status of the trash cans, and as mentioned above, the locks are not used in this demonstration.

Video link (please watch in 1080p): https://drive.google.com/open?id=0Byer5VuYgQ0Ia1NyOGh4OU03cXM

DISCUSSION: CITY-SCALING SMARTCANS

Our original idea was to simulate trash cans in a specific building. However, if we were to scale up the application to city size, there would be a few prerequisites and future goals:

- Every location with SmartCans would need WIFI
- Assign separate trash cans to different cleaning squads for better alerting methods and efficiency
- Make a GUI for easier management (ex. location management & editing number of trash cans)
- Machine learning for knowing which types of garbage are the most used during specific time of day
- Automatic trash sorting

MODIFIED FILES

SmartCan/

|__wukong-darjeeling/wukong/ComponentDefinitions/WukongStandardLibrary.xml

|__wukong-darjeeling/wukong/gateway/udpwkpf/sc_*.py