Milestone V Progress Evaluation

Project Title: Autonomous Multi-Cycle Farming in Space

From CSE [coordinator and project sponsor: Philip Chan, pkc@cs.fit.edu]:

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Clients:

Some potential clients: NASA, SpaceX, Blue Origin, Virgin Galactic.
Current client: Dr. Philip Chan Associate Professor, Computer Engineering and Sciences at Florida Institute of Technology, coordinator and project sponsor.

Progress Matrix

Task Matrix for Milestone 5

#	Task	Progress
1	Functional setup of actual actuators and sensors working with system ● Seeding head on track ● Light and fan ● Linear actuator ● Nema motors ● Moisture sensor ● Seeding end-effector	90%
2	Working POC of application to configure and manage device	70%
3	Working config feature in application	60%
4	Metrics for reports	100%
5	Testing in selenium and sonarqube	10%

Discussion

Task 1

All sensors and actuators have been connected to the growth chamber and interfaced with it's software. However, due to the shutdown of the HSDC, all further development has been halted and the hardware can no longer be used with the growth chamber.

- Time lost working on configuring hardware
    - Water pump linear actuator was working now hardware is disassembled
    - Solenoid valves disassembled
        - Before HSDC closed valves worked together to allow water flow
    - No moisture sensors due to not having a water tray
    - All time debugging axes lost
        - Numerous hardware issues found and fixed during
        - Every axis could move with installed limit switches
            - All XYZ movement possible
    - Seeding end effector was working and could dispense seed but no video was taken since no one foresaw the HSDC closing
    - All components installed and at %90+ operating capacity
    - We spent days at HSDC perfecting the hardware operation in anticipation of creating a timelapse video of the farming chamber operating

Task 2

Dynamically building the GUI has been troublesome as was expected. Key Value pairs have been very difficult to manage for multiple variations. The application can parse in the file and build out the fields dynamically for START and END except for modes. MONITOR is not yet finished due to the complexity of the key value pairs. We expect it to be done later this weekend as we figure out where to focus. Initially key value pairs could not be accessed but we found that it was a casting problem; we tried to get the key with strings but the keys were objects. The reason we are using objects is because they allow the most variety in subclasses.

Task 3

The config feature will be a mysql database of config files where the user will be able to load and save a library of configurations for the device. Currently the config feature only loads the one file on a local directory but out of all the changes to be made this feature is actually easy to implement. This feature was a lower priority to the config editor which was even below getting the device to work in the first place. All of the Spring Break was dedicated to getting the hardware working together since the GUI and Config library are just organization channels for

abilities the system as a whole already has. The database will associate a user-friendly icon with a config file to load into the, now decommissioned, growth chamber.

Task 4

With the addition of an internal database, system runtimes, system cycle counts, and actuator/sensor uptimes are recorded by the system and queried by the application to provide the user with useful metrics. Additional metrics may be added or calculated with ease via their respective sensor and actuator classes.

Task 5

The SonarQube server still needs to be set up, custom rules added, and existing rules tweaked. Research on developing those rules is currently underway. Additional tools for GUI testing, such as Selenium are also being considered.

Team Discussion

Notes are given based on interactions between CSE. They do not necessarily reflect the team member's entire contribution.

- Christopher Millsap <cmillsap2013@my.fit.edu>:
    - Primary on hardware interfaces
    - Primary on GUI application
    - Primary on abstract planning
    - Primary electrical for team
        - Spent every day of Spring Break at HSDC to create safe circuits with no voltage spikes and drops.
    - Primary on YAML to C# parser
- Giampiero Corsbie <gcorsbie2018@my.fit.edu>:
    - Provided python expertise
    - Primary on internal database metrics
    - Primary on systemd service configuration
    - Provided linux expertise
    - Assisted in application to growth chamber communication

Each member contributed fully. Communication was always immediate and thorough.
Giampiero and Christopher met several times over Spring Break to work on the Growth Chamber and Farming User Station requirements. Both team members managed to get the majority of the system operational before HSDC closed.

Plans for Next Milestone - Due April 20th

#	Task	Christopher	Giampiero
1	Finished Application	80%	20%
2	Config library	20%	80%
3	Finished reports	80%	20%
4	User Manual	20%	80%
5	Poster	50%	50%
6	Another hardware demo	80%	20%

Task 1

A finished version of the application. Features include operating the growth chamber, modifying configurations, and view reports. The main feature of the application is manual control and we have this feature pretty much flushed out. The second feature is a GUI form that builds off the YAML config file. Currently the YAML config file can be parsed into the view and individual elements can be displayed and edited but this feature is not fully functional. The last main feature is the config library which will be a mysql database of config files where the user will be able to load and save a library of configurations for the device. Currently the config feature only loads the one file on a local directory but out of all the changes to be made this feature is actually easy to implement.

Task 2

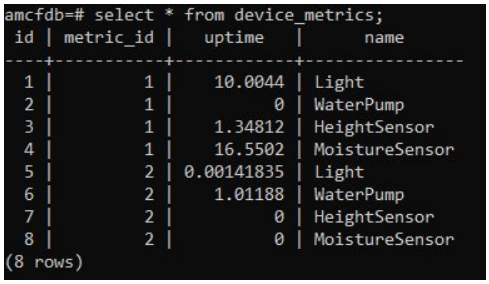
Config library to store different configuration files and relevant data. Here we would like to fully develop the config library feature so that users can select various crop types and load it into the growth chamber. The library config files will be created by botanists and given to system admins to load into the database. We are thinking about leaving the input of config files in a more complex state where the system admin would run SQL queries to put the required files into the FUS instead of building another GUI for this. We will have a simple document to associate icons with crop types and how to add new icons to the database. The config library, when accessed, will give a list of crops to be used, then clicking on a crop will create a form where the user can change fields of the YAML document, once edited or opened the user can choose to add the config to a device or save the changes made.

Task 3

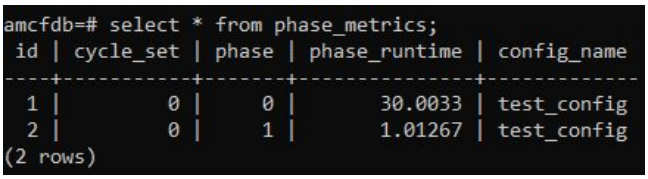
The reports will show “growth chamber” metrics from the beaglebone. As of now the hardware where the application will pull from is currently disassembled in a box. We needed to transport what we could salvage from the HSDC and these parts do not transport well in a breadboard configuration. The reports will show:

- Cycle Set
- System uptime
- Total Phase uptime
- Actuator phase uptime
- Sensor phase uptime
- Sensor readings

As shown on the beaglebone:



```
amcfdb=# select * from device_metrics;
 id | metric_id |   uptime    |      name
----+-----------+-------------+----------------
  1 |         1 |     10.0044 | Light
  2 |         1 |           0 | WaterPump
  3 |         1 |     1.34812 | HeightSensor
  4 |         1 |     16.5502 | MoistureSensor
  5 |         2 | 0.00141835 | Light
  6 |         2 |     1.01188 | WaterPump
  7 |         2 |           0 | HeightSensor
  8 |         2 |           0 | MoistureSensor
(8 rows)
```



```
amcfdb=# select * from phase_metrics;
 id | cycle_set | phase | phase_runtime | config_name
----+-----------+-------+---------------+-------------
  1 |         0 |     0 |       30.0033 | test_config
  2 |         0 |     1 |       1.01267 | test_config
(2 rows)
```

Task 4

The user manual will consist of details on how to set up, operate, and maintain both the growth chamber and the application. It will be divided into two sections for hardware and software. The software subsection will include guides for astronauts, administrators, and documentation for developers. The astronaut section will explain how to use the application and how to tweak the configuration file. The administrator section will provide information on how to set up the software and database on the microcontroller. The developer section will detail the operation of the driver and task manager along with how to develop subclasses for actuators and sensors.

Task 5

A final poster for the project will be designed to include information regarding the features of the growth chamber, it’s software, and the application. Mostly focusing on its ability to operate in microgravity.

Poster notes:

- Focus on key features of working in microgravity
- Not three levels, only 2
- Use subsections, possibly with different color schemes
- Get mechanical involvement
- Show only final photo of device, not the design
- Name the module running the device and name the application
- Use those names as headers
- Don't try to put everything on the poster

GUI notes:

- Separate buttons based on what can be used during run and what can't
- Different colored device icons
- Talking point notes:
- Switch order of points 5 and 6
- User manual notes:
- Separate into two sections
- Focus on software
- Software subsections: astronauts, botanists, sysadmin, developer

Task 6

The hardware demo was hurt by the closing of HSDC. TBD

Date(s) of meeting(s) with Client during the current milestone 5:

Every two weeks starting 9/13/19

Project Logs			
Action	Date	Time spent in hours	Comments
Met with Dr Chan regarding poster design, GUI feedback, and user manual design.	2/28/2020	2	Notes shown in task 5 above.
Milestone 5 review/evaluation		1.5	Client/sponsor comments below

"See Faculty Sponsor Feedback below"

Faculty Sponsor feedback on each task for the current Milestone:

Task 1

Make sure you can read, change, and save config files.
User-friendly slider for numerical values.

Task 2

Task 3

Task 4

Task 5

Task 6

Live status diagram if we have time. Show phases in graphical sense and what the sensor values are. Reference the circle diagram from last semester + extra graphics. Tooltips on hover of device on dashboard.

Faculty Sponsor Signature: _____ Date: _____

Faculty Sponsor Evaluation:

1. Faculty Sponsor: detach and return this page to Dr. Chan (HC 322)
2. Score (0-10) for each member: circle a score (or circle two adjacent scores for .25 or write down a real number between 0 and 10)

Christopher Millsap	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Giampiero Corsbie	0	1	2	3	4	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10

Faculty Sponsor Signature: _____ Date: _____