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EECS 1021

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MAJOR PROJECT

AUTOMATED FILTRATION SYSTEM

INTRODUCTION

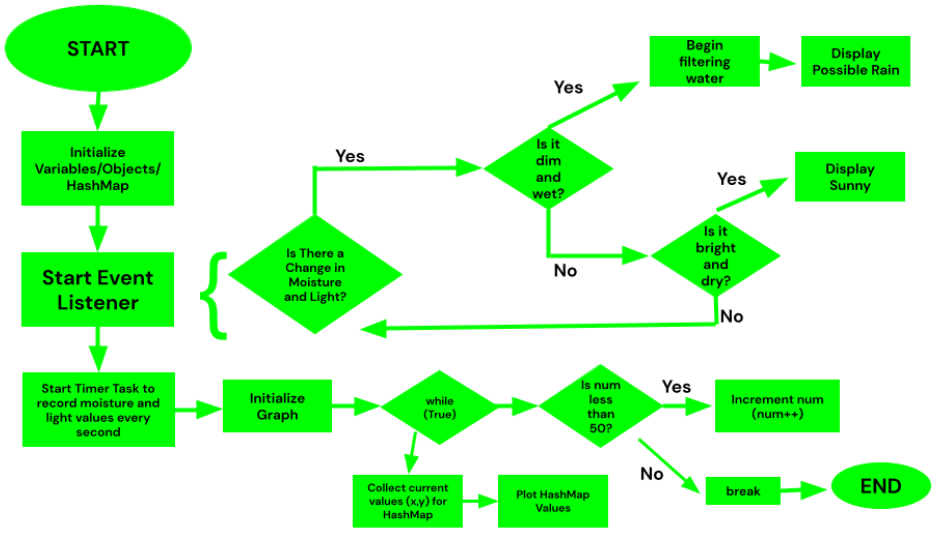
Water is essential for human survival. To put this into perspective, water makes up 60% of one's body weight according to a Healthline article on water and the human body. In addition to this, the article also states that the human body would simply give up after 21 days without food or water. Despite this, the government of Canada stresses that over 40% of the world lacks clean drinking water. With that being said, providing access to clean water is the challenge that will be approached in this project.

CONTEXT

The plan to approach this big issue will be to create an automated filtration system by utilizing existing sensors on the Arduino board. The machine will collect rainwater and sense that weather conditions have changed as a result of rain. Once the machine realizes this change, it will respond by filtering the water; this will create clean water for drinking, bathing, and more. With this system, we will be one step closer towards helping the entire world have access to clean water.

TECHNICAL REQUIREMENTS/SPECIFICATIONS

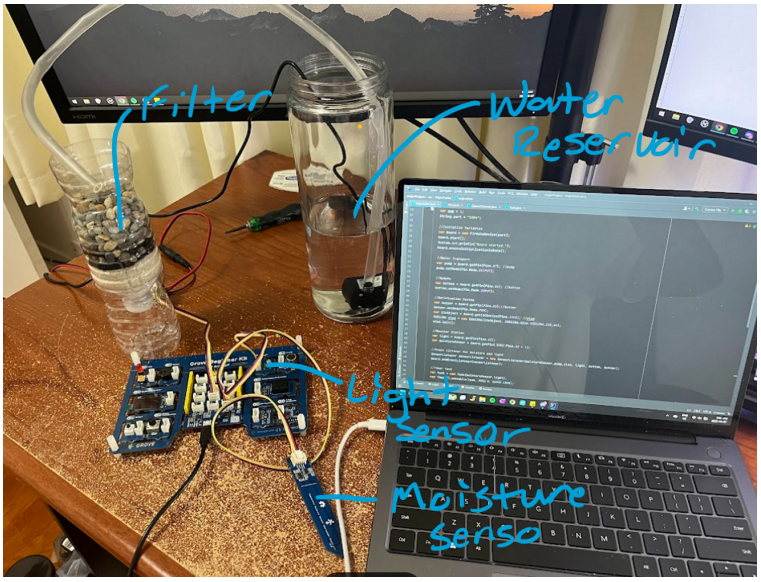
Requirements needed for this project include the light and moisture sensor to detect weather conditions. These will be accessed in an event listener to actively monitor changes. More requirements contain the filter and buzzer notification system. StdLib and Firmata4j are crucial for this project. For instance, Firmata4j allows the program to connect with the Arduino board and its' components such as the light sensor, moisture sensor, and buzzer. Methods like getValue() and setValue() enable the process of monitoring the weather and beginning the filtering process. In addition to this, StdLib is used to collect and graph data so users can have a better understanding of how the state



machine responds to specific states. In this case, bright and dry conditions will be responded to with “Sunny Pump OFF” on the OLED display. On the other hand, if conditions are dim and moist, the system will respond by displaying “Possible Rain Pump ON” on the OLED display and proceed to pump water through the filtration process. These conditional statements are within the event listener which actively updates and looks for changes to respond to. After this process, two HashMaps are initialized. Light and moisture are collected throughout the process into these HashMaps and plotted with respect to time.

COMPONENTS LIST:

- Simple filter (contains ordered layers of pebbles, charcoal, sand, and cotton)
- Water reservoir (collect rainwater)
- Moisture and light sensor (monitor weather conditions, weather station)
- Pump (transfer water from reservoir to filter)
- MOSFET switch (communicate between the weather station and pump)
- 9V battery
- USB cable

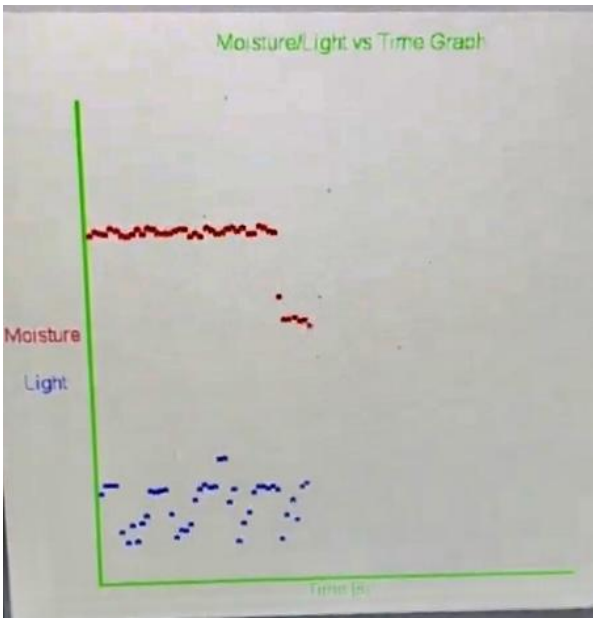


I began the project with the weather station consisting of only the moisture sensor. This was a fatal error as I realized that I required another object sensor as moisture is not the the only indication of rain. So, I removed this error by implementing the light sensor which has changed the program tremendously as it now depends on two factors which indicate rain making the system far more effective.

TEST

The system relies on the functionality of the weather station. I confirmed that this part of the process worked correctly by getting values of the sensors in a while loop or HashMap graph and changing their conditions to observe how they would respond. For instance, shine a light against

the light sensor. After taking note of these values, I can use them to proceed with the program's success.



LEARNING OUTCOMES

This automated filtration system addresses all learning of the learning outcomes:

CLO 1 (verify that the machine works correctly): I have verified that the machine works through solving the issue of unknown sensor values and changes by graphing and observing responses to conditions like light.

CLO 2 (Importance of StdLib and Firmata4j): Firmata4j was utilized to communicate between the program and the Arduino board and its' components.StdLib was used to graph light and moisture values to understand the system.

CLO 3 (The use of HashMap): Moisture and light data is stored in a HashMap which is later graphed with respect to time using a TimerTask.

CLO 4 (The use of state machine): The state machine responds to certain conditions. In this case, the conditional statements say that if it is dim and wet, then water will begin to filter. When it is bright and dry, then water will stop filtering.

CLO 5 (Refined Solution): Started off with one sensor to determine weather conditions, however, moisture is not the only determinant of rain. I then added the light sensor to improve efficiency.

CONTINGENCY

Initially, I wanted to utilize 3 different sensors (light, humidity/temperature, and air pressure). However, I was unable to connect the humidity sensor on the Arduino to java. Secondly, air pressure was not utilized because I realized that air pressure does not perform well as an indicator of rain. Lastly, I realized later on that connecting too many sensors causes the Arduino to overheat and shut down. Knowing this, what I would try to do differently is prepare much earlier in the semester. This will give me the ability to visit tutorials or professors and ask questions on sensors, connections, and other inquiries that were not taught in class specifically. I

would not only like to apply this knowledge to ENG 4000 but also the solution ideation and problem-solving skills that were gained.

ADDITIONAL MATERIAL

As read earlier in this report, over 40% of the world does not have access to clean water. Political groups often aim for large water projects which, in some cases, can be too large of a goal. But this automated filtration system proves that this process can be simplified and provided to those in need. Additionally, this major project contains an environmental aspect. It promotes the use of the environment with the filter containing rocks, sand, and charcoal. Following this, it also encourages the recycling of plastic water bottles to filter water which is often overlooked. Overall, this project exceeds expectations through simplicity and environmental benefits.

CONCLUSION

In the end, this project is an extremely effective method for automating the collection and filtration of water. It exceeds in terms of simplicity making it easily implementable and has environmental benefits. With this small but significant step in the issue, we can bring the issue of 40% struggling with water down to 39%. Ultimately, with enough small steps, the problem of having access to water will be no more.

ACKNOWLEDGMENTS

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Libraries: Princeton StdLib, Firmata4j, JSSC, JCL

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