supergrow: New Way to Grow Plants

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***Abstract*—As we know, almost everything is completely connected to the internet and almost all devices communicate with each other via the internet. Internet became a fundamental need for all human beings. In this project, I aimed to broaden the limits of the internet and tried to extend it also to the plants. With supergrow, plants will live in a much more optimal way since their needs will only get satisfied when they really need them, thanks to the various sensors that supergrow has. For the user end, users are able to monitor the sensor-read values and control the pump and fan motors from the mobile application.**

***Index Terms*—Plant Monitoring; Environmental Factors; IoT; Wi-Fi**

I. Introduction

On a global basis, there has been an explosion in the production and use of IoT technology in the late years. People are increasingly using a variety of "smart devices" in their homes that are connected to the user's phone for added comfort and functionality. With supergrow, monitoring your plant's vital attributes just from your mobile phone is easier than ever before. Thanks to its various sensors, you can't miss any detail about your plant. Also, it is not just limited to monitor the vitals, supergrow system can even feed your plant with its needs to make it grow healthier. For example, instead of watering your plant in the mornings, your plant gets watered anytime it needs water, or fans get turned on if the temperature is higher than it should be while you watch your TV. These will help the plant grow in a more optimal way. If wanted, all motors can be manually triggered and the user can intervene with the system.

II. System Design and Implementation

The whole system can be seen in Fig. 1.

Fig. 1. supergrow System

A. *System Design*

*1) **Hardware**:* Used hardware for this project can be seen in Fig. 2.

- **Arduino UNO:** Arduino UNO is an open-source microcontroller board. I was using this until one of its pins got broken while I was traveling to the USA, so I borrowed another microcontroller from one of my roommates.
- **ESP-WROOM 32D:** The ESP32-WROOM-32D is a versatile Wi-Fi and Bluetooth microcontroller that can be used in a wide range of applications, from low-power sensors networks to the most demanding tasks including voice encoding, audio streaming, and MP3 decoding. I started to use this microcontroller 3 weeks prior to the deadline because of the reason I mentioned above. It almost had the same implementation as Arduino UNO, so it didn't cause any crucial problems to me.
- **Light Sensor:** I used an LM3939 sensor to determine if the area is lit enough.
- **Humidity and Temperature Sensor:** I used a DHT11 sensor to determine if the humidity or temperature of the area is optimal.
- **Moisture Sensor:** I used a YL69 sensor to determine if the soil moisture level is set correctly.
- **Motor Driver:** I used an L298N motor driver to control the direction and speed of motors, which are a fan and a water pump in my project.
- **Fan:** I used a fan to cool the environment if the sensor-read value is too high.
- **Water Pump:** I used a motor submersible water pump to pump water if the moisture level is low.

*2) **Software**:*

- **Arduino IDE:** To write and upload programs to Arduino UNO.
- **Blynk Mobile App:** At the beginning, I was thinking that I might come up with a unique application for my project, supergrow. However, during the semester, I couldn't find time to build an Android app from scratch so I used Blynk to monitor the sensors and to control the motors

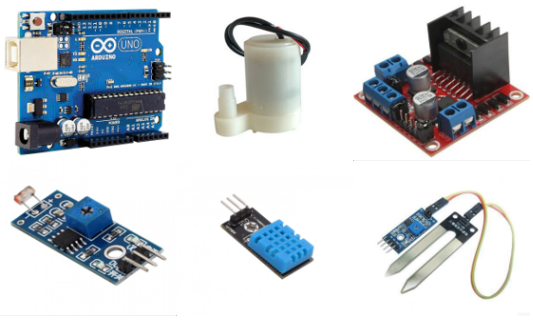

Fig. 2. Hardware used, except a generic fan, to create the supergrow plant monitoring project. (From up left to bottom right: Micro controller, Water Pump, Motor Driver, Light Sensor, Humidity and Temperature Sensor, Moisture Sensor)

when needed. A screenshot of the user interface from the custom build Blynk app can be seen in Fig. 3.

Fig. 3. Blynk Mobile App UI

B. *Data Flow*

The supergrow system provides information to 3 main sensors: Humidity, temperature, and light. Then, respective motors start working if the read values are not in the desired ranges. After the work is done, values get updated on the system. The whole data flow diagram can be seen in Fig. 4.

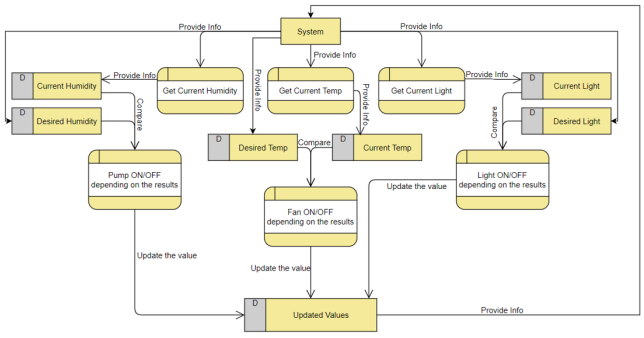

Fig. 4. Data Flow Diagram

C. *Control Flow*

To summarize the control flow, we can think that there are 3 identical operations go in the system: For humidity, temperature, and light. Each operation gets the current values from the sensors and compares them to the desired values. Depending on the results, motors get activated or deactivated. The whole control flow diagram can be seen in Fig. 5.

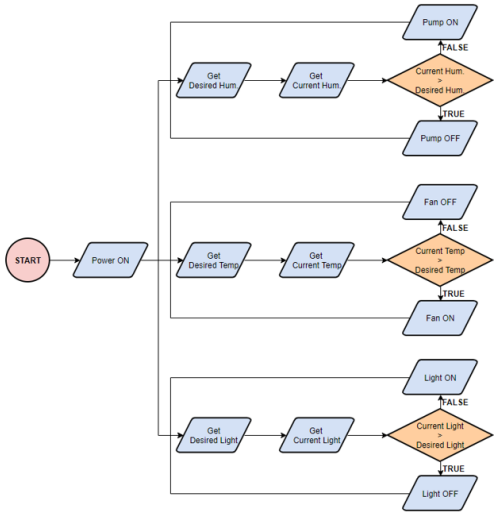

Fig. 5. Control Flow Diagram

EVALUATION

After testing the system in my house for 14 days, I didn't encounter any problems. My plant got "fed" regularly and it seems to be healthy after this period. Sometimes, I raised the temperature of the environment and the connected fan started to run whenever my plant needed it to run. I also disconnected the wires of the water pump for a time to see how my system would act after reconnecting it. After the re-connection, the pump started to work just after it got the reading from the soil moisture sensor.

CONCLUSION

I can clearly conclude that my goal before starting this project was achieved. The system can monitor the environmental values constantly and users can interact with the system without any issues. I also strongly believe that this system can be scaled up for bigger and more complex projects since its implementation is not that costly. For further improvements, I think that some sort of machine learning model can be implemented/trained with numerous plants so that the mobile app would suggest users some tips depending on the type of the plant to grow his/her plant even healthier.

REFERENCES

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