

# A Hybrid Plant Care System

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## ABSTRACT

The design and implementation of a home plant care system is presented. The system contains an Arduino® microcontroller [1], Xbee® transmitter/receiver [2], a VEX® robot [3] equipped with a water pump and a mini plough machine all of these sub-components work in conjunction with each other to create a hybrid plant care system. The microcontroller is used to obtain the commands from the Internet or inputs from sensors and send control signals to the robot for watering the plant or loosening the soil. The software package has been designed in both autonomous mode and remote control mode, i.e. the robot can automatically work based on commands received from the owner such as water the plant or loosen soil, as well as work autonomously based on inputs via its sensors. The plant owner can also check the ambient environment of the plant through an Internet enabled device.

Figure 1 shows the system organization of the plant care system. The web GUI (graphic user interface) allows a user to observe the measurements from the sensors and send a control signal through the Internet. Through the router, the Arduino® microcontroller sends or receives a signal and the signal is transferred and sent to the logic controller of the VEX® robot via Xbee®. The robot can perform the actions as (1) sending a digital signal to turn on/off the watering pump and/or (2) sending a digital signal to turn on/off the motor connected to the mini plough machine; (3) navigating the robot around the plant based on the measurement from the line tracking sensor. In addition, a temperature sensor, a moisture sensor and a light sensor are directly connected to the microcontroller.

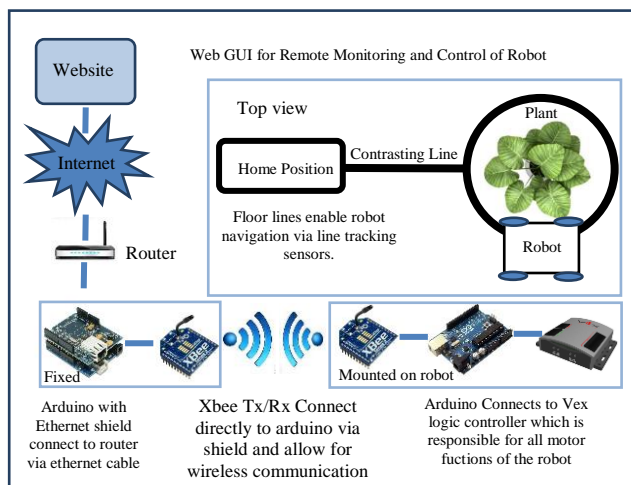


Figure 1: System organization

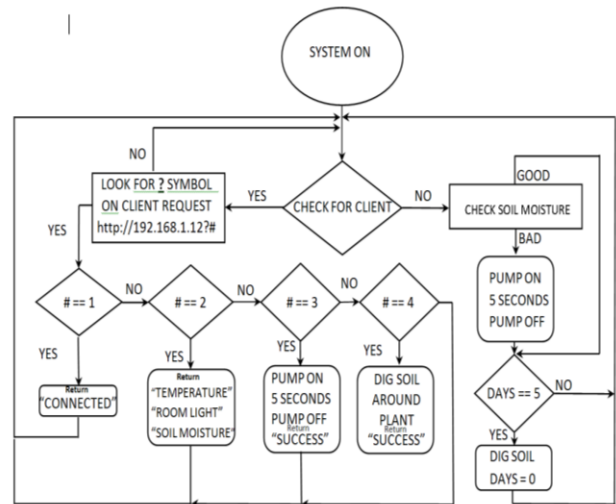


Figure 2: Arduino System Flow Chart

The flow chart of the program running in the Arduino microcontroller is explained in Figure 2. When the system is on, the computer will first check if a client is

coming through wireless communication devices. If not, the plant care system will run under autonomous mode. The autonomous mode is set by checking the moisture sensor and then deciding whether the water pump is on and next checking the on-chip timer. If the time exceeds 120 hours (5 days), the mini plough machine is on to loosen the soil. For either case, the robot will move around the plant for one revolution at the speed of 5 inch/minute. If there is a client request, then the system will run the program by checking the following button signals in order: (1) the connection is alright; (2) the user requests the room temperature and light strength as well as soil moisture information; (3) the user requests to run the water pump; (4) the user requests to run the mini plough machine. According to each of the requests, the Arduino® microcontroller will send the sensors' information to the user or the corresponding action signals to the VEX® robot.

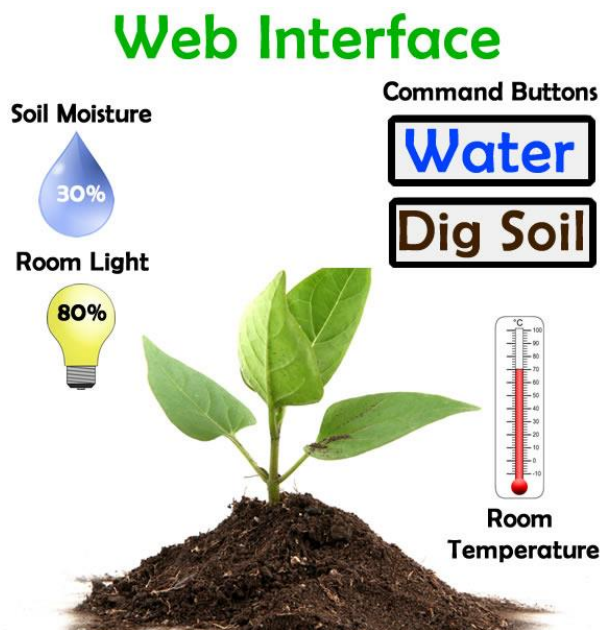


Figure 3: Web Interface

The web interface can be accessed through any internet connected device and acts as a bridge between the plant care system's main components and the user. Through the web interface the user is able to send commands such as water the plant or dig soil. The web interface also displays invaluable live information such as soil moisture, room light and room temperature. To provide secure access to the plant care system, the web interface may implement a secure login phase in order to authenticate the client.

This research has discussed the design of a plant care system which can either run automatically or be

controlled remotely. Experiments have demonstrated the feasibility and effectiveness of the system. The low-cost embedded-internet and mobile devices make the system affordable for common families and individuals.

Indoor plant care systems aren't too common. On a regular house hold plants have to be attended by humans on a daily basis. This Hybrid plant care system can be implemented in houses where owners do not have the time needed to care for their plants or while he (or she) is on a business trip or vacation.

Variations of this system be implemented on a bigger scale such as smart green houses where autonomous robots can constantly monitor and take care of the plants and farms and plantations where man labor can be dramatically decreased. Such system allow for smatter agriculture techniques that put invaluable information and control in a user's fingertips.

## REFERENCES

- [1] <http://arduino.cc/en/Main/Products>
- [2] <http://www.digi.com/xbee/>
- [3] <http://www.vexrobotics.com/>

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