Divide and Conquer

IPMS: Indoor Plant Maintenance System

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Project Narrative

Many homeowners like to have some sort of plant(s) inside their home. Plants are self sustaining, but they need to be cared for on a consistent basis when they are outside of their native environment. For them to be kept indoors they still need to get adequate sunlight and hydration. This becomes a problem when there is no one at home to care for the plant. For example, if a homeowner is traveling on business or on vacation with a significant other then their plants at home have no way to take care of themselves.

Often people might call someone they know to go to the house and water these plants, because that is a solution to prevent the plants from deteriorating. Another solution would be to try to use a “Do It Yourself” kit (D.I.Y) which would use household items to create a system for watering plants such as using a water bottle with a thin tube placed in the soil. The problem with this solution is that it is not consistent with how the plant might need to be cared for. The plants are often left alone with a DIY kit being constantly fed with water and nutrients without realizing the plant could possibly be over or underfed.

The person who is called to the house might over water the plant as well as the D.I.Y kit described in online videos.This is because different plants have different needs in terms of care. Some plants may require little water every other day and others might need to be watered constantly to be sustained. To solve this problem the proposed solution is to create IPMS, the Indoor Plant Maintenance System. We want to build a system that can properly care for indoor plants once the homeowner is away.

The Indoor Plant Monitoring System would be able to monitor how much water is in the pot of the indoor plant and be able to apply water to the soil accordingly. The IPMS will have an easy to use interface that the user can interact with. The IPMS will water the plant when the moisture in the soil is getting too low through several sensors as well as be able to tell how much light the plant is receiving on a daily basis. This will let the plant stay hydrated and well lit when no one is in the house to provide proper care.

The Homeowner will be able to monitor their plants through an application that will say how much water is in the plant and allow them to disable the watering or add more water manually through the application. This is so that the owner can adjust the water flow to prevent the plant from being over-watered. This would be the only Indoor Plant Monitoring System that allows the user to interact with the plant through software when they are away.

Another competitive system would be a self watering pot by HBServices who have thousands of good reviews online. They use a pot that lowers the plant into a cup of water on hollow legs so that the soil can soak the water up to where the roots are. The problem with this is that it may not reach roots that are not long even and also prevents an even distribution of water throughout the soil. IPMS would apply water to the top of the soil so that the soil will have moisture all throughout as water is pulled down by gravity.

Requirements for Hardware & Software

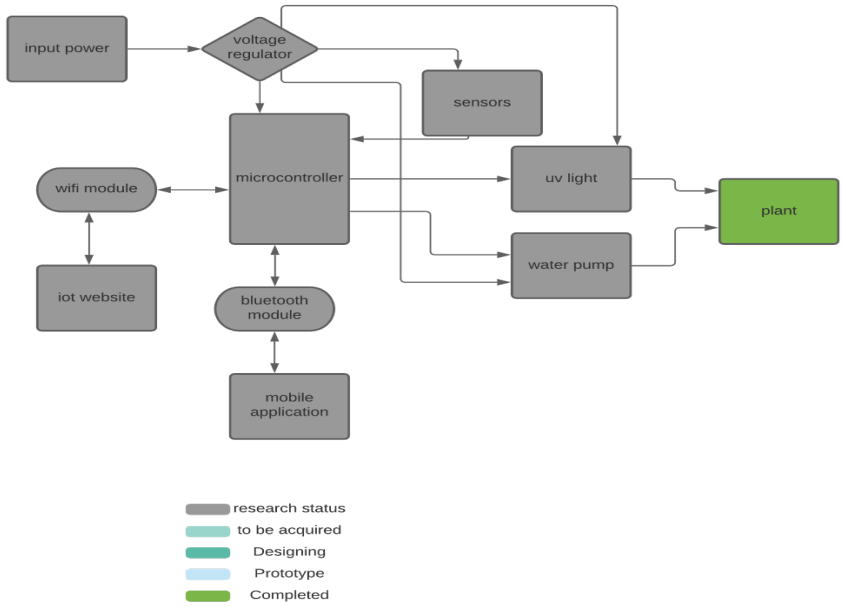
Specifications	Requirements
moisture sensor	The system shall be able to detect the moisture level.
Temperature sensor	The system shall be able to detect the temperature with a minimum accuracy of ±2º Fahrenheit.
Light sensor	The system shall have the ability to sense the light.
PH sensor	The system shall be able to detect the PH level of the soil.
Humidity sensor	The system shall be able to detect the humidity percent with a minimum accuracy of ±1%.
Battery	The system battery shall last TBD amount of hours.
Bluetooth module	The system shall be able to connect with smartphone or a tablet.
WIFI module	The system shall be able to connect to a website.
Water pump	The system shall be able to adjust the water flow.
UV light	The system shall be able to supply the plant with enough light.
Sensors	The system shall read all sensors output and store data.
PCB (voltage regulator)	The circuit board shall be able to supply the system, sensors, water pump, UV light with necessary voltage.

Commented [1]: what do you guys think?

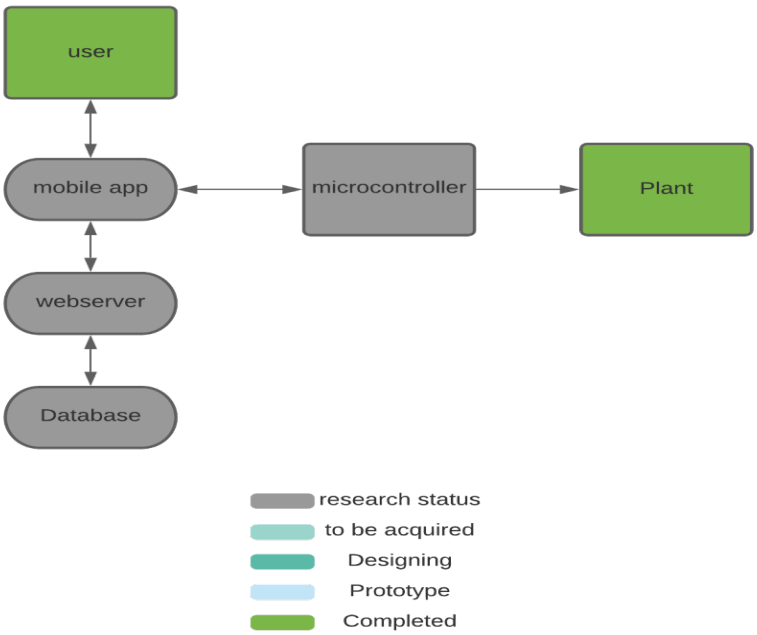
Microcontroller	The microcontroller shall be able to read the sensors output, communicate with the (mobile application/website), control the water pump and the UV light

*May vary

Hardware block diagram



Software block diagram



Estimated Project Budgeting

Device/Part	Approximate Price
SENSORS:	
Moisture Sensor	$7.00-$40.00
Temperature Sensor	$15-$40.00
Light Sensor	$6.00-$20.00
PH Sensor	$6.00-$30.00
Humidity Sensor	$4.00-$20.00
Electronics:	
CPU	$10.00-$40.00
PCB	$20.00-$60.00
Microcontroller	$1.00-$15.00
Bluetooth module	$2.00-$20.00
Development Kit	$30.00-$50.00
MISC:	
Batteries	$10.00-$20.00
Container	$30.00-$50.00
CircuitElements(resistors,capacitors,etc)	$5.00-$15.00

LED Lights	$20.00-$60.00
Unplanned Components	
Approximate Total Price Range:	$166.00-$480.00

With the cost split among the four members of the project, the price it will take to complete this project is approximately between the range of $41.50 - $120.00 for each member of this project.

Initial Project Milestones

Spring 2021 Schedule

Week	Milestone (Tasks)	Start Date	Deadline
1	Form Group/Brainstorm ideas	January 11, 2021	January 15, 2021
2 to 3	Choose a project and discuss features	January 15, 2021	January 29, 2021
3	Finish Divide and Conquer V1		January 29, 2021
3 to 5	Research and Discuss the details of the project amongst group and Professor.	January 29, 2021	February 12,2021
5	Finish Divide and Conquer V2		February 12, 2021
6 to 9	Study and implement various possible designs for the project	February 12, 2021	March 12, 2021
9	Submit New Assignment on Standards		March 12, 2021
12	Submit 60-page Draft		April 02, 2021
13 to 14	Review Documentation and Finalize both Design and documentation (Spring Break)	April 03, 2021	April 16, 2021
14	100-page Report		April 16, 2021
15	Organize all documents for final submittal and begin purchasing components needed for prototype	April 16, 2021	April 27, 2021
16	Submit Final Documentation		April 27, 2021

Summer 2021 Schedule

Week	Milestone (Tasks)	Start Date	Deadline
0-1	Acquire Purchased Components & Test them	April 27, 2021	May 17, 2021
1 to 2	Build Prototype	May 21, 2021	May 28, 2021
3	Adjust components and documentation based on prototype results and purchase revised components	May 28, 2021	June 05, 2021
4	Build final product	June 06, 2021	June 12, 2021
5 to 6	Troubleshoot Hardware and Software issues	June 13, 2021	June 25, 2021
6 to 7	Tweak issues based on troubleshoot	June 26, 2021	July 03, 2021
8	Troubleshoot/Test product	July 04, 2021	July 10, 2021
9	Finalize Product	July 11, 2021	July 17, 2021
10 to 11	Complete Documentation	July 18, 2021	July 31, 2021
11	Present Product		August 07, 2021

Projects under Consideration

Delivery Alert System. A device would monitor the front door area and alert the resident when a package is delivered.

Increasing numbers of people are ordering online and getting deliveries. Some of these are food items that may be perishable or attract animals. There is also an increasing number of thefts. The device would use a scanner like a garage door safety system, with one or more mirrors positioned to effectively cover the front porch area where a package might be left. The system would include a timer to determine that an object had been delivered, and alert the resident. It could be entirely self-contained if battery powered and the alert was wireless. It might also generate a text/audio message if it had access to a telephone connection.

Hazardous Stove Mitigation. This device would automatically turn down the heat on a stove heating element that had inadvertently been left on "high" and forgotten.

The device would be designed as an add-on to be inserted in the heating element circuit between the existing controls and the electric burner. It would use time and/or a heat sensor to determine when a burner had been left on "high" too long, and was now getting too hot. This often occurs when no pot is on the burner, or the contents of the pot have evaporated. The temperature will get very hot, to the point of melting the pot and/or igniting the contents. When

an unsafe condition occurs, the device would limit the current, effectively turning down the heat on the burner.

This would be especially valuable in homes with seniors living alone, but useful in most homes. A similar device might be created for gas stoves, but would require external power and gas-tight controls.

360 Degree Car Surveillance. This idea is to protect the vehicle on all sides from collision.

Cameras would be positioned to provide 360 degrees of surveillance. When an object came within range and appeared to be approaching, it would cause a warning/alert so that the driver/owner could do something to mitigate damage.

Automatic Plant Caretaker. An advanced system to care for plants when left unattended for lengthy periods of time.

Rather than rely on a passive system that delivered a relatively constant low level of water, a moisture detector would be used to sense soil moisture and deliver an appropriate amount of water. This could also be managed by time and light level, to provide the water at the optimum time. It might also be enhanced with sensors to detect heat and humidity, and add a mister and/or pot rotator.

Though intended to use when the owner is away, it might also be used for routine maintenance.

Facial Recognition Security System. A secure entrance would use facial recognition to admit authorized persons.

The entrance would have a camera and a database containing images of authorized persons. When someone arrived at the entrance, they would stand in front of the camera to be scanned. The system would then compare key features in the image to determine if the person was authorized. If so, it would automatically unlock the entrance.

Parking lot management. Create a device similar to the Sunpass or EZpass that someone like UCF could use to manage parking privileges in their parking lots and garages.

Instead of a sticker, each parking permit would actually be a transponder that has the driver/vehicle information. When the driver enters the parking area, the driver will receive a text message instructing them where to park, within a time limit (like 5 minutes). If they didn't park in the designated parking spot, the system would assign the parking spot to someone else, and if someone else parked in an area that was not given to them by the network, they would get a violation ticket.

This would provide additional convenience for the driver by telling them where the open space is, and save UCF money by eliminating the need to patrol the parking lot. Additionally, the transponder could be updated electronically to extend the dates rather than issuing new parking permits, also saving resources.

Remote entrance security system. Whereas many apartments and large offices have a system of wired doorbells, intercoms, and electrically controlled door locks, we would create a wireless system using WiFi.

These days, nearly everyone has a smartphone. The doorbell at the entrance would notify the resident of a visitor by sending a text message that included an generated image of a QRC code. If they wished to admit the visitor, they would forward the generated image to the visitor. The visitor would then hold up the image to a scanner on the doorbell that read the image and confirmed that it matched the QRC code it had generated and unlocked the entrance door.

The table below summarizes the pros and cons of the project ideas. The green background indicates something considered positive, while red indicates a negative. Based on these assessments, we chose the automatic plant caretaker for having the most positives and fewest negatives.

	Motivation	Feasibility	Appropriateness	Risk	Cost
Delivery Alert System	Increasing use of online shopping and home delivery.	Can stand alone without connection to power and communications	Combines electronics for detection, software, and communicaitons.	Might be difficult to make certain a package was left in the right area.	Low for electric eye, micro computer, and alert
Hazardous Stove Mitigation	High risk of damage by forgetful people	Hazardous working with high power in hot environment.	Combines electronics for detection and control, software to implement logic.	Would require a connection to a high power circuit in a hot location	Costly for High power components and difficult to test
360 Degree Car Surveillance	Costly car repairs reulting from collision damage	Unclear how to mount on car. Competing with car manufacturers	Combines electronics for cameras and display, plus software	Not certain what a person could do even if the hazard were detectred	Moderate for cameras, micro computer, and alert
Automatic Plant Caretaker	Common problem for people on vacation	Competing with passive systems that rarely work well	Combines electronics for detection and control, software to implement logic.	Passive systems exist but require guessing needs in advance	Low for moisture sensor, micro computer, and water control
Facial Recognition Security System	A convenience for people needing secure admittance	Facial recognition software is commercially available	Combines electronics for cameras and lock, plus software processing	Changes in appearance would render system inoperative	Moderate for cameras, micro computer, and lock
Parking Lot Management	Helpful for drivers and security in busy parking lots	System relies on communication with driver on phones that shouldn't be used	Combines electronics for cameras, plus software for logic and communications	System could not prevent drivers from parking in wrong spaces.	Moderate for cameras, micro computer, and transmitter
Remote Entrance Security System	Replaced expensive wired systems	Most people have smartphones and can send images	Combines electronics for cameras, plus software for logic and communications	If someone doesn't have a phone, they must go in person	Moderate for scanner and micro computer and lock