Interactive Plant: An Arduino Project

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Abstract
The main objective of this project was to design and integrate an Interactive plant with the help of electronic components like Arduino and other electronic sensors to make possible interaction with plants. Through various research it is evident that in the modern era people have lost interaction with plant, in-order to bring in more connection between plant and the owner, an interactive system was developed which helps to communicate directly with the plant through output devices connected to plant with the help of Arduino.

Author Keywords
Interactive Plant; Arduino; HCI; Physical Computing.

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): User interfaces—Prototyping.

Introduction
The interactive plant project aims to provoke people to interact with potted plants, by educating people to have more engagement with their everyday life objects such as plants through the help of electronic devices. By extending an interaction between people and their plant, we aim to build an emotional attachment with them. It is more prominent to display emotional aspects of human character to the plant in order to build more connection with the plant and through this project we strive to achieve strong relationship between plant and their owner.

Implementation
The Interactive plant was implemented with certain procedural methodology that we followed throughout the implementation. Started with an initial build testing the light, heat and moisture sensing and ensured that they worked perfectly when connected. Moved on to building a basic 3 sensor circuit with all the sensors working perfectly. Began to program the basic code for Arduino, then placed and connected it with plants and calibrated the sensors. For the intermediate build, added an RGB LED indicator and connected them into the circuit. Reprogrammed the Arduino to display the status of the plant on the RGB LED indicator. For Further advancement connected an LCD Screen to the circuit to display the reading and other information. Wired the LCD properly with the Arduino and reprogrammed to accommodate the new addition.

To expediate more, added a piezo and decorative lights to the circuit. The Piezo from the first plant made a heartbeat sound when the owner held the plant for more duration, while the second plant lit up the entire decorative lights to display the reaction from the care received from the plant owner.

Figure 1: Connected the sensors and calibrated them along with the Arduino and did initial testing, then uploaded the basic programming code to check the proper functioning of system.

Design Exploration

The development started by exploring basic needs of the indoor plants, which included:

- Lights for generating glucose, which is the ultimate source of energy.
- Water for photosynthesis and transferring nutrients from the soil through the plant.
- Adequate temperature to perform photosynthesis.

After identifying the basic needs of the plants, started thinking about scenarios for interaction between plant and the owner, keeping in mind to focus from the plant's perspective and to achieve engagement with plant. These are the scenarios drawn from the research

- First time opening the interactive plant system, there will be a welcome message and few basic instruction for the owner.
- Implementing Tamagotchi concept , plants would portray their emotion to the owner just to obtain some attention for survival.
- The plants would convey their needs, only when the owner gives attention to them.
- Capturing the current reaction of the plant for building an emotional status for the plant.

Next step is to develop different characters for the plants, in this project, we portray two different plant characteristics:

1. A Plant experiencing Loneliness
2. Another plant in a really grumpy mood.

We managed to build these characters to the plant after studying the emotional status that plants would obtain.

Research Exploration Summary

After careful research we decided to implement these features to build more characteristics to the plant.

- Display the emotional status of the plant
- Display messages of plant needs only when the owner touches the plant.
- Funny Reaction to owner: When touching the plant.
- Reacts when owner minds the plant (Ex: adjust the light, watering the plant, adjust room temperature)

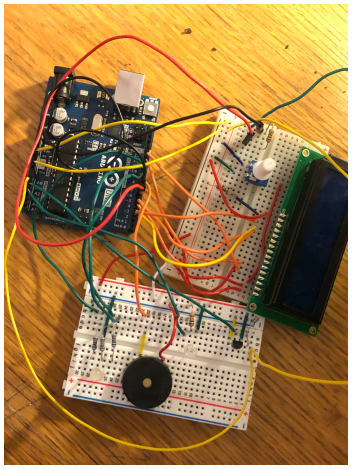

Figure 2: Diagram showing the connection of Arduino with the potted plant.

Materials used for project

These are the various materials used for the building the project:

- Arduino Uno kit
- Potted plants:
- 1. Spathiphyllum Bellini (Peace Lily)
- 2. Poinsettia

Input sensors

- Light sensor
- Temperature sensor
- Moisture sensor
- Capacitive sensor

Output

- LCD screen
- RGB LED Indicators
- Piezo Buzzer
- Decoration lights

Other materials

- 2 Breadboards
- Potentiometer (For LCD)
- Resistors and Wires
- Tin foil and cling Film
- 2 metals conductors

Circuit Diagram for Interactive Plant

The circuit diagram clearly explains all the connections and components present in the system that we developed.

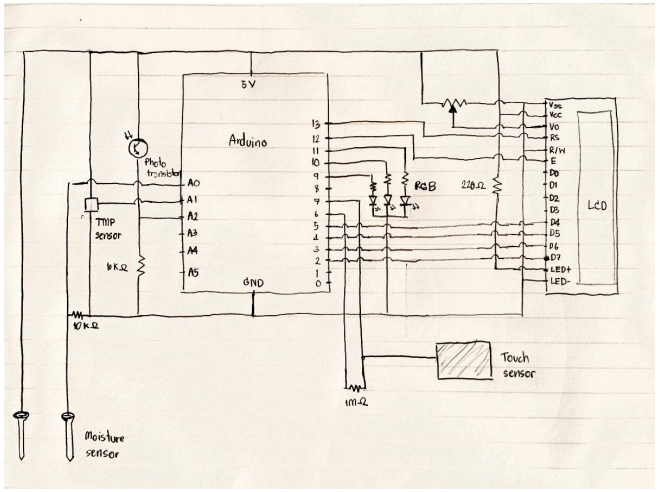

Figure 3: The Circuit Diagram shows all the connections made with the Arduino and the various sensors and components connected with the plant

The mentioned components are connected in the above illustrated manner.

Building and Executing the Project

In the project building process, we started connecting four different sensors which acts as inputs for the system. We connected each of them with an Arduino and wrote basic code to test the sensors.

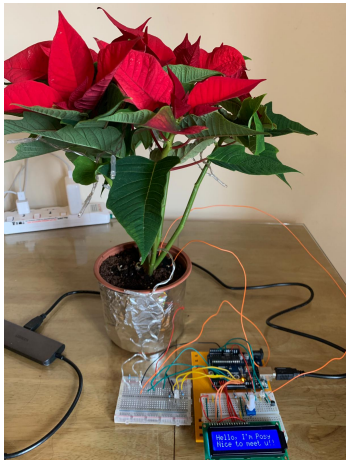

Figure 4: Diagram showing the connection of Arduino with the potted plant.

- Built a Moisture sensor, using two pieces of metal and wire, connected the sensor to Arduino.
- Connected Phototransistor sensor with Arduino.
- Connected Temperature sensor with Arduino.
- Build a Capacitive sensor, with the help of an aluminium foil and cling film.
- Developed the monitoring function for all basic needs of the plants (Light monitoring, Moisture monitoring and Temperature monitoring).
- Calibrating the proper baseline value of each sensor, based on the needs of the indoor plant.
- Created monitoring function for attention of the owner towards the plant, making use of capacitive sensor to detect the touch.

Moving ahead to build outputs:

According to the research done for requirements, there were two mandatory outputs that are required for the system. The First being an RGB LED to illustrate the plant's emotional status, and the second one being an LCD screen, to show the plant's emotional status. The LCD also displayed the messages that the plant wants to covey with the owner.

- Connected RGB Light indicator with the circuit.
- Connected LCD screen to the circuit.
- Developed the initial greeting message to display on the LCD screen.
- Developed the RGB display function of a plant displaying the emotion, by collecting the result of light monitoring, moisture monitoring, room temperature monitoring and attention. Generated different level of emotional colour based on those results.
- Green when the plant is extremely happy, Blue for basic needs getting fulfilled but lack of attention from owner, Yellow for some basic needs getting fulfilled and some attention from the owner and finally Red when the plant is extremely angry (when there is no attention nor some basic needs getting fulfilled.)
- In the same function, it would return the emotional level to display different reaction messages depending on the plant's emotion.
- Developed the display life status function. In this function, the messages would be shown on the LCD screen depending on what plant needed at that moment of time (Light, Water or comfortable room temperature).
- Additionally, the script of messages would return differently regarding the plant's character and plant's emotion. This function would be called only when the owner touches the plant.
- Developed the reaction message function, responding to the owner's action. This function would compare a latest state of the light, moisture, temperature and attention monitoring with the current status. If the state has changed from abnormal state to the normal state, thank you messages from the plant will display on the LCD screen.

Additional features for each plant's character:

Each character would be created with a slightly different concept. So there are three additional features for characters.

For loneliness character (Posy)

She's lonely and demands attention.

- Calculate total waiting time since the last time that the owner touched the plant, and display messages differently depending on how long the plant has waited for attention.
- Display a decorative blinking LED lights, when the owner holds the plant long enough.

Figure 5: Diagram showing the plant lighting up when adequate care and attention is given to the plant.

For grumpy character (Lily)

- Used Piezo to create heartbeat sounds when the owner touches the plant.

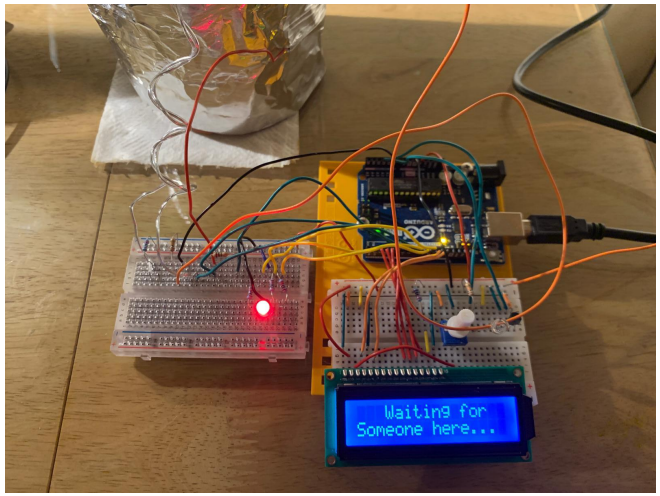

Figure 6: The LED showing up in Red and the LCD screen shows the emotion of the plant. The plant is waiting for some attention and care from the owner.

Academic Research and Existing work

While working on the interactive plant project we came up with some interesting material that gave us insights to think about the project in more personified manner. The terms Tamagotchi and Post Optimal objects began to make more sense. One of the best book that drew more attention on the topic was Hertzian Tales by Anthony Dunne, that covered the post optimal theory for considering the in animate or electronic materials to provide more sense in treating them as a day to day life object in real life.

Hertzian Tales explores the way critical responses to the ideological nature of design can inform the development of aesthetic possibilities for electronic products. It focuses on the role they play in shaping our experience of inhabiting the electrosphere, looking beyond the quality of our relationship with objects themselves to the aesthetics of the social, psychological, and cultural experiences they mediate.

The primary purpose of this book is to set the scene for relocating the electronic product beyond a culture of relentless innovation for its own sake, based simply on what is technologically possible and semiologically consumable, to a broader context of critical thinking about its aesthetic role in everyday life.

The project proposes an approach that uses the design of conceptual electronic products as a way of provoking complex and meaningful reflection on the ubiquitous, dematerializing, and intelligent artificial environment we inhabit. Their strong emphasis on aesthetics and ecological concerns is a powerful ex- ample of design research carried out by practicing designers within an intellectual context.

As new technical developments alter the object and make it "intelligent," they also set the object on a plane with no prior cultural references, although the physical aspects of these objects are still within the world of materials, their operation and their very state of being is well beyond the manipulation of matter and has more to do with information exchange than with form - E. Manzini, The Material of Invention.

These Reading make you think that the if these objects where real they could have a personified approach to the interactions that they could have with human beings. A Research question aroused from the various theoretical papers, What if we could make the plant talk? If they could, How will they respond to human?

The "Tamagotchi Effect" emerged as a term to describe how owners developed emotional attachments to their virtual pets. A new kind of bond between human and machine was created. Journalist Nagao Takeshi linked the heightened emotional response to the Tamagotchi to the contemporary lifestyle of the Japanese, who were described as being isolated, busy, and in high-pressure environments.

The Tamagotchi represented a perspective of technology where it was "embedded within a humans everyday routines" and in lives where many decidedly turned off their devices or left them in designated places; it became a person's constant companion almost more than anything outside the body itself, offering distraction from, the intricacies and intimacies of daily existence. However, in the mid-1990s, the Tamagotchi was first to execute a form of mobile technology designed specifically to elicit an emotional response from the user. Through the Tamagotchi's ability to persuade its users into viewing it as 'alive,' it's portability, and sociability, it technologized play in an unprecedented way.

If our belief systems and ideas don't change, then reality won't change either. It is our hope that speculating through design will allow us to develop alternative social imaginaries that open new perspectives on the challenges facing us. Although these proposals draw from rigorous analysis and thorough research, it's important they do not lose their imaginative, improbable, and provocative qualities. They are closer to literature than social science, emphasize imagination over practicality, and ask questions rather than provide answers.

A similar work that came into notice was from Sungjae Hwang, Kibeom Lee, Woonseung Yeo My Green Pet: A Current-based Interactive Plant for Children. They proposed an interface with voice and visual feedback with a purpose to help children perceive plants as alive. In order to react differently to stroking, hitting, and tickling gestures, we sent a weak electric current through the skin and evaluated the incoming values. They also noticed various behaviours, such as children attempting to have a conversation with the interactive plant, and blaming others when the interactive plant was hurt.

Conclusion

In this study we integrated Arduino and sensors with a potted plant and made it interact with humans. The plant having a personified character and emotional attachment based on the Tamagotchi concept and post optimal concept was something we got to explore. We were able to achieve a clear idea about the functioning and working of Arduino and explored a lot in the programming side in order to achieve the best result, thus obtaining fruitful wisdom for our module: Physical computing.

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