AGROBOT-IN-Hydroponic Monitoring Ecosystem

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Abstract: **Traditional farming involves many challenges when it comes to growing crops, like maintaining the right amount of water and sunlight, fertile land or coping with drought. Such problems can be overcome by switching to hydroponic indoor farm because hydroponic system use LED lamps instead of sunlight and sensors to monitor temperature, humidity, ph level and more to ensure that the plants are growing in optimal conditions. Not only do the crops require no soil or pesticides but also use less water than traditional systems. The aim is to bring the joys of outdoor gardening indoor with an aesthetically pleasing smart garden that feels good to use. The system is designed to fit seamlessly into any living space in urban cities as people do not have much space and time to continuously monitor the growth of plants. Therefore, the advances in hydroponic system involve a fully automated system using app notification and thus, the user will be freed from the overhead of continuously monitoring the system. With this, anyone can grow the crop of their choice all year round.**

***KEYWORDS*— hydroponic, LED, sensors, ph, smart garden, automated.**

I. INTRODUCTION

Hydroponics means growing plants without soil by using only water, nutrients, and a growing medium. The word hydroponics emerged from the roots where "hydro", meaning water, and "ponos", meaning labor. Hydroponic gardeners use water as solvent and minerals as solute instead of soil. The main idea behind hydroponics is to solve as many problems as possible regarding the growth of plant's roots and the water, oxygen, and nutrients it requires to grow. Hydroponic farmers do not use herbicides or pesticides, and any system with the potential of not using pesticides is very beneficial because plants strife less stress and are nourished optimally, hence they are healthy enough to resist any pests able to enter the greenhouse. Since hydroponics method doesn't need soil to grow so weeds are not an issue with it. The statistics says that 23 percent of food borne diseases deaths and 46 percent of food borne illnesses are due to eating produce, according to the Center for Disease and Prevention. Soil polluted by domestic waste is often pinpointed as the main cause for this because hydroponics systems are germ-free and don't have soil to be polluted and therefore disease outbreaks are less likely to occur, especially in clean, well-run systems.

II. LITERATURE SURVEY

Two more systems which work on similar concepts are:-

- Aquaponic System - Aquaponic refers to integration of hydroponic with aquaculture [1].
  The fishes act as a fertilizer supplement [1].
- Aeroponic System - Aeroponic is the method of cultivating plants inside a conditioned air environment [2]. Grows plants suspended in closed or semi-closed environment [2]. Controlled environment has a strong potential to improve plant's development stages [2].

Hydroponics is classified as soilless culture. In these systems, the medium contributes in a variable rate to the growing of the crops, which can be composed by substances of different origins and characteristics (i.e. organic, inorganic and inert) [4]. Only 50% outcome is obtained with Aeroponic in comparison with hydroponic system [3]. Whereas in Aquaponic change in Lethal and sub lethal temperature can alter various body functions of fishes [1]. Hydroponics allows high quality crops with an efficient use of water and fertilizer [4]. This operation allows shorter culture period and reduction of hydric stress by continuously supplying mineral elements and water [4].

III. SYSTEM ARCHITECTURE

To create an automated device to continuously monitor and manage garden's environment from any web browser or Mobile Application and track progress over time and provide corrective measures to the user. The data will be saved in the database.
There are four modules in this system:

1. Grow Box: Grow box contains all the nutrients solution, plants and the required sensors connected to it.

2. Microcontroller: Arduino Uno and Raspberry pi microcontrollers will collect the information from the sensors and will provide information to the user.
3. Mobile Application: A notification about the plant behavior will be sent to the user on an android app along with the corrective measures.
4. E-Commerce Website: Website registration will provide access to the android app.

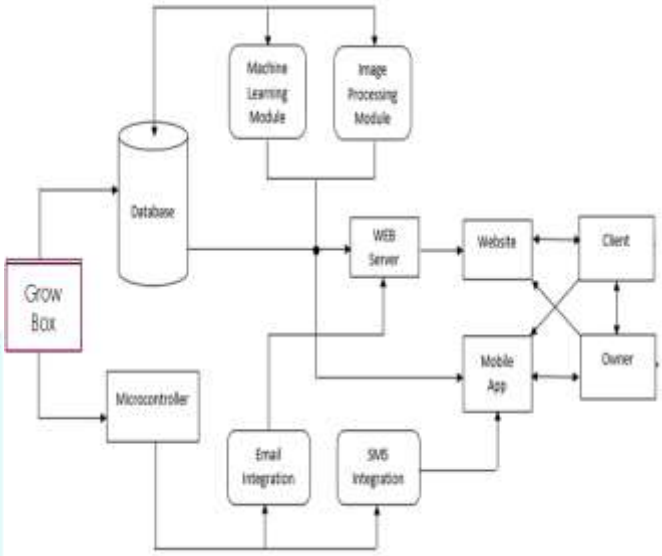

Figure 1 Architecture Design

IV. PROPOSED METHODOLOGY

The proposed system will help in fast and efficient growth of plants by regularly monitoring it for optimum results.

Hydroponic gardening is a great way to grow plants to their full potential. Plants are given as much nutrients and water as they can absorb. The system follows the following methodology:

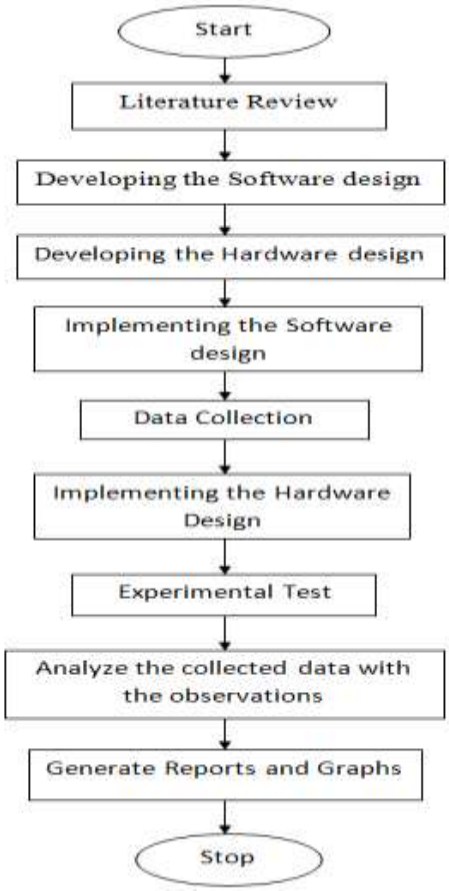

Figure 2 Methodology Flowchart

V. WORKING

The automation device is used to continuously monitor and manage garden's environment from any web browser or mobile application and track progress overtime and provide corrective measures to the user. Here one square meter package is considered for demonstration purpose.

A. Software Development

(i) E-commerce Website

User will register on website to buy the package and will get a username and password on the email ID through which user can log in into the android app.

(ii) Android Application

After logging into app user will select the type of package bought from the website and will select the plant accordingly, to get the information about that plant.

B. Hardware Development

After the request is fed into the database, the microcontroller and all the sensors are setup with the plants environment. The plants environment is divided into two parts:

(i) Hydroponic System

- Stock Solution

Stock solution is prepared with proper concentration in PPM (Parts Per Million) for the particular seed. For experimental purpose spinach seeds are taken and spinach plant requires following solutions which are prepared in separate tanks:
A - Calcium Nitrate
B – Magnesium Sulphate
C – Master Solution

- Fertigation Tank

Solutions from A, B, C tank are added into the fertigation tank using the water from the water tank. The solution in the fertigation tank is checked for EC and ph value via the EC meter and ph level sensor. The water is also monitored using water level sensor. Solution from the fertigation tank is supplied to plants through saline tubes.

(ii) Processors (microcontrollers and sensors)

- Microcontroller

The plants environment is monitored using 2 sensors – LDR sensor and temperature sensor. All the values from the sensors are collected in microcontroller Raspberry pi3 and will be compared with the threshold values and the notification will be sent to the user on android app.

- Sensors

a. EC meter – DFRobot to monitor the strength of solution in fertigation tank.
b. Ph sensor – DFRobot to monitor the ph value of the plant solution.
c. Water level sensor – Ultrasonic sensor used to monitor water level.
d. LED sensor – LDR used to monitor the frequency of light.
e. Temperature sensor – DHT 12 used to monitor the temperature.

VI. ACKNOWLEDGMENT

The authors would like to thank Sponsoror SunAnshul Technologies Private Limited, Bhyander, Thane, and Institute Bharati Vidyapeeth's College of Engineering for Women, Katraj, Pune, Project Guide Prof. M. A. Rane.

VII. CONCLUSION

The desired completion of this project will enable a great ease in growing plants efficiently with negligible human efforts. Also, it is easy to use and operate as the system is fully automated. The module is compact and economical; the various sensors present in the prototype along with the hydroponic system makes it a much enhanced module which is very reliable and helpful.

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