Smart Planting

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Abstract

The main idea of the project is to control and monitor plants' growth in the greenhouse automatically under the effect of LED lights and with the help of different types of sensors such as DHT11, PH, soil moisture, LDR and NDIR. We propose a system that uses video cameras to capture each growth stage of the plant. By using image processing techniques, we will be able to detect the needed LED light to be switched on, also detecting some diseases of our plants. The LED lights has multiple needed colors which are Green, Blue for increasing the growth and forming strong roots and leaves, Red for making tomato plants' more flowery; these LED lights work according to the growth stages of the plant from seed to harvest time. The system notifies the landowner if a disease is detected and when the plant fruit are ready to harvest. Our system experiment will be made on tomatoes.

1 Introduction

1.1 Background

Tomatoes are one of the most important vegetables in Egypt[1]; Meanwhile it's percentage of being affected by diseases is very high, such as: leaf curl virus, early and late blight[1]. Thus increasing the growth of tomatoes based on Computer Technology is our main aim in this project. With the help of images from the greenhouse , a data-set for different shapes of tomatoes in different stages , sensors[2][3][4] and Cameras. According to these attributes, the system will be able to take the suitable action for our environment such as providing the needed LED light. [2][3][5][6]

1.2 Motivation

1.2.1 Market Motivation

During the Ceremonial hangover of the Food and Agriculture Organization of the united nations (FAO), The FAO Representative in Egypt Hussein Gadain said that "Egypt is considered as one of the largest tomatoes' producers in the

world; but unfortunately during the production, harvesting and retail, more than 50% of the tomatoes are being wasted. So both the production and the quality of the tomatoes decrease".[7]
According to the FAO website, there is a huge tomatoes loss because of tomatoes' diseases such as leaf curl virus, early and late blight.[1]

1.2.2 Academic Motivation

Landowners started to face an extreme problem in tomatoes being effected by many number of disease that some of them couldn't be cured until now. So, this could be improved by providing a smart greenhouse to increase in the productivity of the tomato. According to our system, landowners will be provided by:

1. Automated greenhouse planting.
2. Detection of abnormality in tomatoes.
3. A complete controlled greenhouse by the help of technology for tomatoes growth.

Our work is motivated by the previous work of Pirapong Limprasitwong and Chaiyapon Thongchaisuratkrul [3] They included that sensors played an important role in greenhouses. Jadwiga Treder, Anna Borkowska, Waldemar Treder, Krzysztof Klamkowski [8] They provided that LED lights is prefared compared to HPS lamps. Richard T. Watson1 , Marie-Claude Boudreau1 and Marc W. van Iersel2 [9] Admitted that food must increase to full fill the user needs.

1.3 Problem Definitions

The agricultural sector in Egypt faces major challenges. Farmers and landowners wait for the crop to be harvested so it takes too much time, thus the production of the plants decrease, the economy of the country will be affected negatively. Our project will be responsible for automatic monitoring and controlling the plant in the greenhouse under the effect of LED lights using video cameras and different types of sensors. Our challenge is to increase the production of the plants in a shorter period of time, so the economy of the country will increase.

2 Project Description

Automated monitoring and controlling the tomatoes in the greenhouse under the effect of LED lights and with the help of different types of sensors.

2.1 Objective

The project main objective is to increase the production of tomatoes which will decrease the cost in the market, also it helps with early detection of any abnormal behavior of the tomatoes.

2.2 Scope

The system will cover several things:

1. System will switch between the LED lights according to the growth stages of the tomatoes from seed to harvest time.
2. Alert to the landowner if there is any disease of the tomatoes.
3. Notify the landowner when the tomatoes are ready to harvest.

2.3 Project Overview

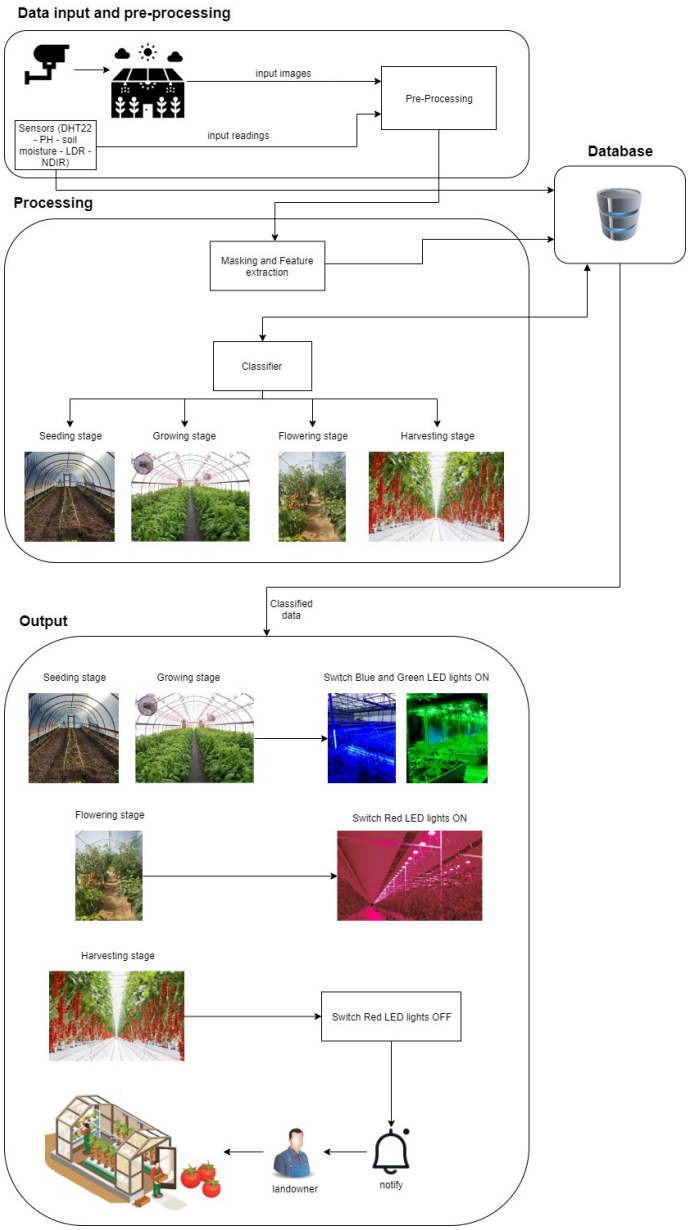


Figure 1: System Overview

In our system, a green house is supplied by video cameras and sensors. The cameras are used to monitor tomato's growth, these films are converted into

picture frames which needs some enhancements to remove the image's noise. While sensors as DHT11 for measuring temperature and humidity inside the greenhouse , PH sensor for measuring the value of PH in the soil, soil moisture for measuring the water level inside the soil, LDR for measuring the light intensity inside the greenhouse and NDIR for measuring the CO2. These sensors readings are saved in our database.
Using masking and feature extraction(ORB) on these frames helped in detecting the accurate state of tomatoes in the greenhouse. These images are classified by the usage of a classifier. Tomatoes are classified into different stages which are: 1-Seeding stage means there are no tomatoes and leaves produced. 2-Growing stage means that tomatoes are still not blossomed while leaves and roots are blossomed and in good health. 3-Flowering stage tomatoes are blossomed but still young (their color is a mix between light red and green). 4-Harvesting stage where all of the tomatoes are blossomed. As for the data generated from the sensors helped in proving the plant a good health to avoid some diseases the tomato could be effected by.
After the images being classified, the LED lights start to work, if the output percentage of system is less than the threshold value generated from the masking stage, the Blue and the Green LED lights will work which means that we are in the Growing stage or still in the seeding stage, these two LED lights are responsible for making the tomato roots and leaves more stronger than natural light. And if the output percentage of system is more than the threshold value, the Red LED light will work to offer the plant to be more floral and new tomatoes will be blossomed which means that we are in the Flowering stage. Finally when all the tomatoes are ready to be harvested, the owner will be notified and all the LED lights will be switched off.

3 Similar System Information

Vimal and Shivaprakasha[2] proposed a system that controls and monitors the main environmental factors for the plant growth in the greenhouse using SMS service. They used Arduino micro-controller which can receive readings from the needed sensors, also it can control used motors and the artificial lights. The used sensors are DHT11 to measure the temperature and humidity, LDR for the light intensity, Soil moisture measures the water amount in the soil and pH sensor. Also cooling fan, exhaust fan, water pump, artificial light and motor pump are connected to the Arduino. A GSM modem and Ethernet are used to send SMS to an android phone whether offline or online so it eliminates the SMS cost and it's stored in a database. When temperature exceeds a certain level, the user receives an SMS from the system so he/she switch the cooling fan on by sending another SMS to the system, Similar for the other conditions.This paper showed the importance of the LED lights, temperature, humidity and soil moisture in the plant to grow strong in the greenhouse.

Limprasitwong and Thongchaisuratkrul[3] presented an experiment that

intended to an efficient way of light for plant growth. There are different types of light which are natural, grow light and LED. The experiment was made in a greenhouse under specific conditions. The system was controlled by some different sensors.The greenhouse was divided into two rooms for natural light and LED testing. The system was tested on a specific time to watering the plant and switch lights on the plant. The result shows that the environment under LED and grow light was controlled but under the natural light was not controlled due to the temperature and humidity. At the end the experiment admitted that the plant grows faster under artificial lights.

Wei Choon et. al.[5] presented an experiment that want to make an environment which is controlled by Artificial lights and also the user can control the other attributes that can affect the plant.The project depends on different sensors such as DHT11 and ultrasonic then all the calculations are done by python by retrieving these data from My-SQL database. The experiment is done on Apple mints using LED lights and using sun lights ,the comparison is held on height , area of the leaf, the green color of the leaves and finally the number of the leaves . By doing this experiment the LED lights show higher record in all of the points except for the height.As a conclusion the Experiment proved that LED lights is more efficient by using a friendly use program to monitor the selected environment.

Snowden[6] presented an experiment that see's the effect of Blue and Green lights on Tomatoes and cucumber. After leaving both plants under Green and Blue lights, it's acknowledged that Green light doesn't have a great effect on plant density and length, as for the Blue light it's acknowledged to see some difference in the density and length of the plant to be stronger and increase in the leaf area. By adding pure Red light and 15 percent Blue light it appears to be more floral and having a strong roots in the plant. This experiment shows that these three lights have a huge impact in the growth of both tomatoes and cucumber.

Treder et. al.[8] presented an experiment that compared between the effect of different artificial lights such as LED and HPS on two different types of vegetables such as tomatoes and cucumbers in the green house. As for the tomatoes, the seedlings are highly reacted with the HPS on the other hand the LED lights affect its coloration and gives highest leaf area.At the end of the experiment it was proved that LED lights are better than HPS.

Watson et. al.[9] presented an experiment that aims to the highly effect of greenhouse agriculture on food production using LED lights. The system can be controlled automatically, also it reduces lighting cost around 60%. The paper clarifies the plant's physiology which is converting photons such as water, co2 and the three main lights into sugars and oxygen. At the end, The solution has been implemented through a system and sensors in a greenhouse and produces savings of 64 percent with LED lights.

Khamis et. al.[10] proposed a system which a greenhouse is controlled remotely and their goal is to enhance the plant growth by using the artificial lights. Their objective is to use LED as the artificial light, to develop an automated system to control the greenhouse and to improve the sensors reliability by using the Internet. They used temperature, humidity, oxygen sensors with the help of water value and micro-controller. Their software is implemented using Python. Their data are stored in SQL database, then it's processed to be displayed in CHartJS and PHP graphs. This paper aimed to enhance the plant growth using the LED lights and automate the whole system so the farmer won't need to go to the greenhouse, he can track the plant's growth remotely.

Danila et. al.[11] proposed a system that measures the effect of different color of LED lights in an restrictive conditions for a greenhouse construction. By the usage of LED Spectra dedication software.Their objective is to find the suitable lighting and spectrum color for plant growth. It was obtained by the usage of dedication software; that Red and Blue lights are proven to be the most effective on plants, as for the lights, LED is the best compared with fluorescent, metal halide and natural light. Their system shows that the production of plants in greenhouses can be obtained faster by the help of artificial lighting system than outdoors planting.

Gonzalez-amarillo et. al.[12] proposed a system that tracking the stages of plants growth. The agricultural product's quality and safety are the most important things in planting, to avoid the transmission of diseases to people when they eat it. The system was made to improve and fasten the plant growth with high quality. The paper talks about the ideal temperature for tomato's growth which is between 20 and 25 degree Celsius by mornings while 15 and 18 degree Celsius by night. High degree of humidity can attack the plant by fungi and bacteria.

3.1 Similar System Description

3.2 Comparison with Proposed Project

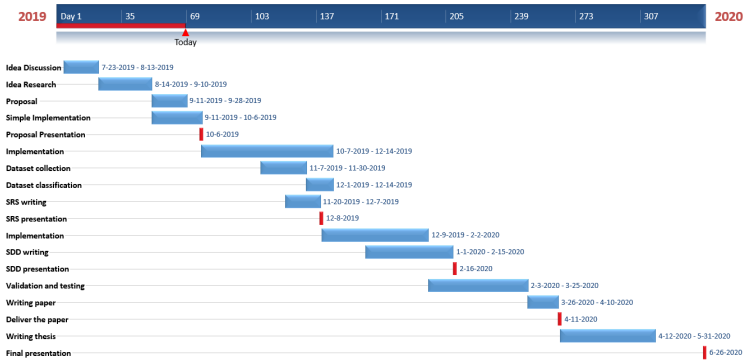
Points of Comparison	Used language	User Interface	Sensors	Type of plant	System used for
Design of Multicolor LED with Control and Monitoring System for Plant Growth	python	GUI in pc , mobile application	DHT11,soil moisture, ultrasonic	apple mint	soil
IOT Based Greenhouse Environment Monitoring and Controlling System using Arduino Platform	Java	Android mobile application	DHT11,LDR,PH sensor, soil moisture	Not mentioned	Green house
LED lighting with remote monitoring and controlling system for indoor greenhouse	Python, HTML ,JS,CSS,PHP	Web-based gui	DHT11, ultrasonic, soil moisture	Cuban oregano	Green house
Plant Growth Using Automatic Control System under LED, Grow, and Natural Light	Not mentioned	Automatic system	DHT11,RTC	Shallot	Plantroom
An IoT-Based Traceability System for Greenhouse Seedling Crops	Not mentioned	Mobile application	DHT11, soil moisture	Fruits	Green house
Our proposed system	Python	Web based gui	DHT11, PH, soil moisture, NDIR, LDR	Tomatoes	Green house

Figure 2: System comparison

3.3 Screen Shots from previous systems (if needed)

4 Project Management and Deliverables

4.1 Tasks and Time Plan



timeline.png

Figure 3: Project Timeline

4.2 Budget and Resource Costs

- Traveling to farms in order to collect data.
- Greenhouse
- Tomatoes crop
- Sensors (DHT11, PH, soil moisture, LDR and NDIR)
- LED lights

4.3 Supportive Documents

5 References

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