HY-FAH: An Indoor Hydroponic System with Remote Monitoring and Regulation Using Convolutional Neural Network Application for Crop Status and Plant Growth

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I. Introduction

With the population continuously expanding, pushing further the tendency of more urbanization projects in the future, it is necessary to develop innovative ways of producing enough food to accommodate the basic needs of the people. Hydroponics is a type of horticulture that has become beneficial recently with its highly efficient use of resources. In this technique, plants are grown in an environment without soil. Instead, they are submerged in a nutrient-rich water solution. Compared to soil-grown plants, hydroponic plants can grow more quickly and yield greater quantities [1]. The reason for this is that plants can grow more effectively since they have access to a precise balance of water and nutrients.

Plants produced from dirt have lower quality due to pollutants and illnesses. As soil includes pollutants and diseases, the plants grown in systems using nutrient-rich solutions are free from these factors. Controlled Environment Agriculture (CEA) is a high-tech hydroponic method of optimizing horticultural operations. Hydroponics and other dynamically controlled environment agriculture, combined with emerging agriculture technology interventions, offer practitioners and scientists opportunities to ask new questions and develop novel solutions that maximize food production while minimizing economic costs and environmental externalities.

II. Background of the Problem

The Philippines is one of the 63 countries with the largest number of undernourished people. In the years 2019 to 2021, FAO reported that 5.3 million Filipinos were severely food insecure, while 48 million fell under the category of moderate or severe food insecurity. According to FAO, the factors at play in food insecurity are the triple crises of climate, long-standing conflicts, and the COVID-19 pandemic [2]. The geographical features and location of the country heightened its vulnerability to the impacts of climate change and weather events in general. With an average of 20 typhoons a year, the agricultural sector is adversely impacted, affecting the availability, affordability, and accessibility of nutritious food. However, apart from the economic and environmental factors that contribute to food insecurity and malnutrition in the country, they are also driven by the technological aspect of the country's agriculture with its antiquated farming methods and the negative effects of urbanization in the form of land conversion. FAO director-general QU Dongyu stated that we need the transformation of agri-food systems for better production, nutrition, the environment, and a better life for all [3]

To contribute to food security and improved nutrition, the researchers present an innovative system allowing urban residents to produce hands-free leafy vegetables with optimized yield inside their houses. With the use of hydroponics, an efficient soilless farming method, leafy vegetables can be grown in a system that consumes minimal space suitable for indoor use. The growing, monitoring, and harvesting processes are automated to minimize

manual labor and to ensure the good quality of its yield. Implementing a rechargeable battery will provide an uninterruptible power supply which is crucial for the continuous control of the nutrient-rich solution.

III. Objectives

The general objective of the study is to design an Indoor Hydroponics System with Regulation using Convolutional Neural Network Application for Crop Status and Plant Growth, which allows a sustainable and energy-efficient environment and hands-free farming of high-quality leafy vegetables.

This research journal aims to develop a monitoring system for the crop status using Raspberry Pi with cameras and Yolov5 model to determine when the plants are already good for harvest.

It also aims to develop a notification system that will enable the user to remotely monitor the environmental parameters (pH level, Total Dissolved Solid (TDS), and air temperature) and the crop status with the use of mobile application and Internet of Things.

IV. References

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