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Implementation of Greenhouse Service Control Protocol using Raspberry-Pi

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Abstract- The term "greenhouse" refers to a controlled atmosphere in which plants are cultivated. To achieve optimal plant development, greenhouse systems must continuously monitor and regulate environmental factors such as temperature, soil moisture, light intensity, humidity, and others. A greenhouse provides a year-round climate for growing plants, even on cold, gloomy days. This project's major goal is to develop a basic, low-cost system that continually updates and controls the value of environmental parameters in order to ensure optimal plant development. Precision agriculture uses a variety of approaches to monitor and regulate the environment for the growth of numerous crops. It is difficult to meet the needs of farmers to manage water evenly due to the unequal distribution of rain water. This necessitates various irrigation methods that are suited for every weather condition, soil type, and diversity of crops. Finding a strategy that provides flawless analysing and regulating in order to build a proper atmosphere is more vital. Agriculture is one of the many areas where ICT technology is frequently used. The majority of equipment and greenhouses in the agriculture industry still rely on outdated serial connection methods. Several technical implementations of communications and information, such as internet and Bluetooth are becoming more widely used, yet they are still incompatible. Korea is working on a set of standards to ensure that various vendors can communicate with one another. For Protocol of Link-Control to be standardized, which is not dependent on infrastructure of network underlying, may be used to offer fundamental interoperability. We created a protocol of controlling the service on basis of protocol of Link-Control and implemented it using Python in this article.

Keywords- Smart greenhouse, protocol, implementation, python.

I. INTRODUCTION

Life of human being is becoming easier in this era of digitalization and automation, since practically everything is automated, replacing old manual processes. Because the internet has become such an important aspect of daily life, all devices must be connected to the network. This is the main goal of the IOT.

The IOT is a cutting-edge technology that has the potential to revolutionize the way we live that may be used to connect, control, and manage intelligent devices that are connected to the Internet via a variety of protocols and ways. The smart greenhouses have sensors that monitor the greenhouse's temperature, humidity, and soil moisture.

IoT is transforming agriculture and allowing farmers to overcome the enormous challenges they confront.

Agriculture is one of the many areas where ICT technology is frequently used. The majority of equipment and greenhouses in the agriculture industry still rely on outdated serial connection methods. Even though several ICT technologies are becoming more extensively utilised, such as Bluetooth, and the Internet, they are still incompatible.

Fundamental interoperability got achievement by Protocol of Link-Control to be standardized, which is not dependent on infrastructure of network underlying. This post, we used Python to develop a protocol of controlling the service on basis of protocol of Link-Control.

Many research; initiatives have been conducted to enhance greenhouse conditions in the area where our project is located. We're utilizing a USB camera to implement image processing for better plant health prediction. The different sensors in our hardware system collect data on temperature, humidity, soil moisture, and light intensity in our greenhouse. This information is constantly monitored and verified in real time.

The Raspberry Pi, which serves as the system's main controller and is tiny in size, is an open source and adaptable platform for experimentation. New IoT applications are tackling these challenges and improving agricultural output quality, quantity, sustainability, and cost efficiency.

II. DESIGNING – AI-BASED SMART GREENHOUSE CONTROL USING IOT

Proposed system image processing is being used to monitor the health of green hose plants and manage the environment. The suggested system uses a sensor to monitor and manage the water spraying operation, while image processing checks the plant's health.

The proposed system employs a wireless data logger to monitor and operate from the remote location the green house through a WIFI connection and a phone APP.

The proposed work aims from the IoT component on the user's end, where the user will be able to manage the light and water levels of indoor plants. The functioning of the water motor and light is based on the sensor readings since the user is in a remote place.

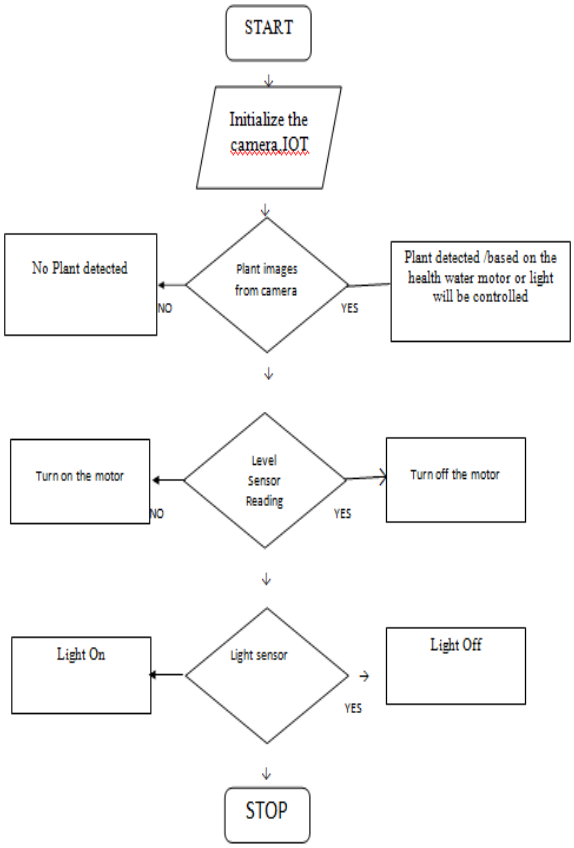

Fig 1. Flow Chart.

- Initialization of the system on startup, the LCD and an introductory message are shown.
- IOT is used to set up the camera.
- The camera detects the live view to check for plant pictures, and a choice is made based on the images in the frame.
- Determine if the IoT control is activated by the user, and then perform the appropriate control actions.

1. Implentation of greenhouse servic control protocol using Raspberry-pi:

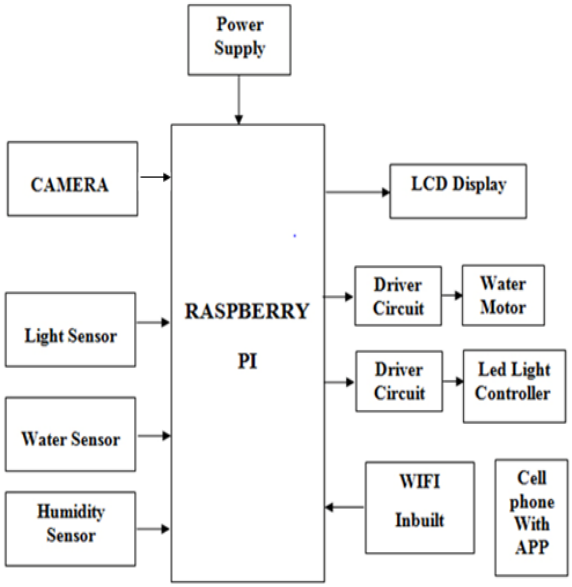

Fig 2. Block Diagram.

The proposed work aims from the IoT component on the user's end, where the user will be able to manage the light and water levels of indoor plants. The functioning of the water motor and light is based on the sensor readings since the user is in a remote place. The figure 2 shows block diagram of the proposed system.

As certain plants require particular attention, such as more light and water, and are reliant on human involvement, the camera will collect photos of the plants and the Raspberry Pi will determine whether the plants require more light or water depending on their health. This process makes use of LED lights and a water pump. Sensors that sense light and water are connected to the Raspberry PI through ADC.

2. Artificial Intelligence usage:

The industry is turning to Artificial Intelligence technologies to help yield healthier crops, control pests, monitor soil, and growing conditions, organize data for farmers, help with the workload, and improve a wide range of agriculture-related tasks in the entire food supply chain.

2.1 Soil and crop health monitoring system: The type of soil and nutrition of soil plays an important factor in the type of crop is grown and the quality of the crop. Due to increasing, deforestation soil quality is degrading and it's hard to determine the quality of the soil.

2.2 Precision Farming and Predictive Analytics: AI applications in agriculture have developed applications and tools which help farmers inaccurate

and controlled farming by providing them proper guidance to farmers about water management, crop rotation, timely harvesting, type of crop to be grown, optimum planting, pest attacks, nutrition management.

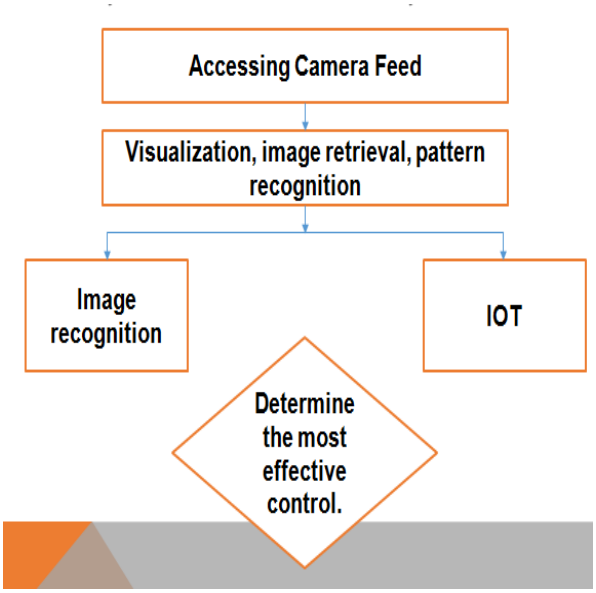

Fig 3. Description of work.

The project begins with an IoT component on the user's end, in which the user will be able to manage the light and water levels of indoor plants. The water motor and light operate depending on sensor data since the user is in a faraway place.

Because certain plants require particular attention, such as more light and water, and because they are reliant on human involvement, the camera will capture pictures of the plants and the Raspberry Pi will determine whether the plants require more light or water depending on their health. LEDs for lighting and a water pump are employed in these activities. Sensors linked to the Raspberry PI through ADC are used to detect light and water.

III. IMPLEMENTATION

Ac supply from the main power outlet get converted to DC by using bridge rectifier and regulated to a voltage of 5v. Raspberry pi is powered by using the same DC voltage in order for the light and motor to work we are using BLYNK server for the IOT control and Image processing for the better health of the plant in order to achieve this we are using USB camera which takes series of images and PI makes the necessary action to control the device.

In the project we have also make use of the sensor which will take the control part of the water motor and light based on the parameter of the sensor values. Sensor is interfaced with the ADC IC which is MCP3208/3008 which converts Analog to Digital where our Raspberry Pi make the control decision based on the sensor values.

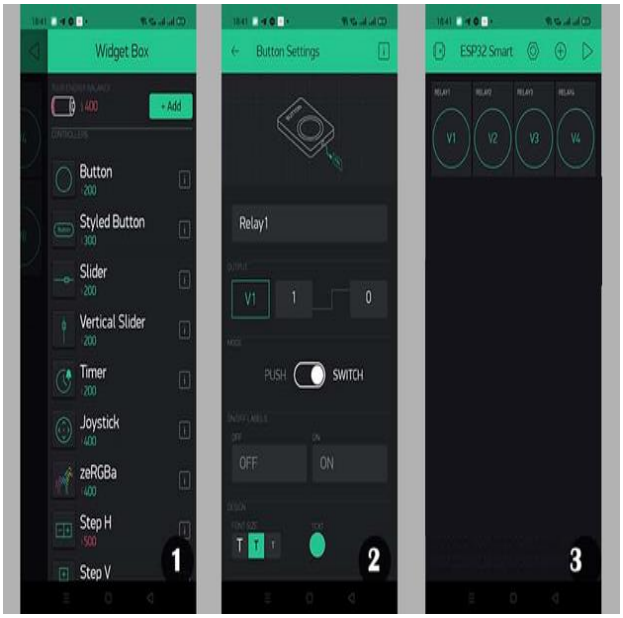

Fig 4. BLYNK Server usage.

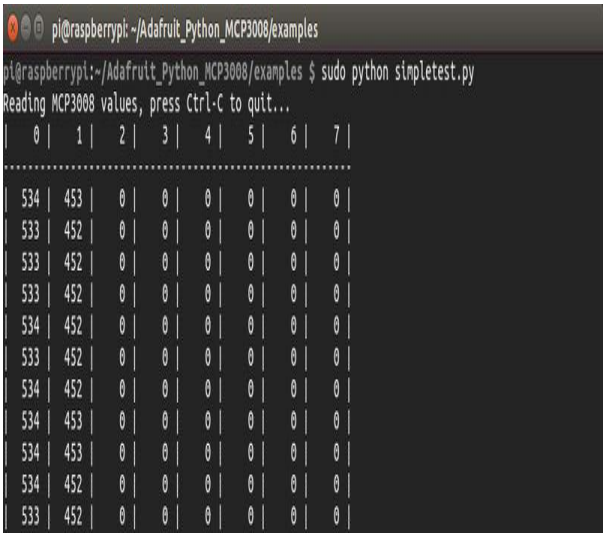

Fig 5. Sensor Values Command

In order for the raspberry pi to communicated with the IOT and get the control instructions over the internet to has to be connected to the WIFI or through the Ethernet cable.

All the control instructions are received through the internet and based on the sensor value the operation of the devices are controlled and operated. For the system to store the sensor data over a long period of time we are using think speak MQTT server for the sensor values to be monitored over a long period of time.

Sensors, often known as objects, are devices that detect data and act on it on a local level. ThingSpeak permits websites, instruments, and sensors in order to send information to the cloud; it might be stored on a public or private channel.

Fig 6. ThinkSpeak Channel.

In private channels the data is stored by ThinkSpeak by default; however public channels can be utilised to exchange information. You are able to examine and display information in a channel of ThinkSpeak, fresh data to compute and interact with social media, other devices and services through online method once the data is in channel.

1. OpenCV:
It's a major library of unwrap-resources in favour of vision of computer, processing of image and many more, that be now used in real-time operations. It can recognise objects, people, and even human handwriting in photos and videos.

1.1 IMAGE Detection using OpenCV:

- In this part, we'll use OpenCV to recognise images in real time from a live webcam feed.
- As you may know, movies are made up of frames, or still pictures. Every frame in a video is subjected to facial detection. So there's not much of a difference between detecting a face image in video path and recognising a face image in a still-image.
- To detect faces, we will use the Haar Cascade method, commonly known as the Viola-Jones algorithm. It's a machine learning object detection method that detects things in images or videos. Many cascaded Haar's models which are trained stored as the files of XML in OpenCV. We utilise this file instead of starting from scratch when constructing and training the model. In this project, we will utilise the "haarcascade frontalface alt2.xml" file.

1.2 Create a model to recognise plant health:
In this part, we will create a classifier that can distinguish between healthy and unhealthy plants. We'll need data in the form of images to make this classifier. We have a dataset with plant pictures. We can't train a neural network from start since these photos are so few. Instead, we fine-tune MobileNetV2, a pre-trained network that was built on the ImageNet dataset.

2. How to do Real-time image plant detection:
After our model has been trained, we can change the code in the first part to make it identify plant health.Plant pictures are required for our model to function. To do so, we'll use the methods described in the first part to recognise frames containing several plants, then pre-process them before passing them to our model. Let's start by importing all of the essential libraries.

We can even utilise the faces varying to acquire a plant's frame and after it pre-process that plant's frame in order for it to be put it for prediction into model, because it provides the rectangle's height, width, and top-left corner coordinates enclosing the face images of plant. The pre-processing procedures are the same as those used in the second part while training the model. This is how we detected plants in real-time and created a model to recognise plants. We had succeeded to change plant recogniser to plant health recogniser by using this approach.

IV. DEPLOYMENT ON RASPBERRY-PI USING PYTHON WITH AI

We've finally made it to our objective. We must put the hardware in place because we have all of the necessary equipment.

In the project we have also make use of the sensor which will take the control part of the water motor and light based on the parameter of the sensor values. Sensor is interfaced with the ADC IC which is MCP3208/3008 which converts Analog to Digital where our Raspberry Pi make the control decision based on the sensor values.

Through Image processing the USB camera captures the normal image of the plant (object detection) which is a healthy plant/normal plant which is being trained in several positions also in terms of colour,shape,size of the plant(health of the plant) to figure out its normal or an abnormal plant.

Fig 7. Normal plant.

Fig 8. Abnormal plant.

After capturing the image of the plant (object detection) if there is any abnormality in the plant in terms of colour, size, shape of the plant (health of the plant) and if the image does not fits on which its being trained in those several positions which were being captured for normal plant which leads to abnormality then the AI sorts the plant requirement needed automatically.

In Real Time Visualization of Sensor Data at Remote Location:

ThingSpeak plots the data you provide it automatically, allowing user to keep track of devices or equipment from afar. You may access your information from any computer browser or mobile device. You may give clients and coworkers read-only access to your data if you want to.

Fig 9. Water Sensor Report.

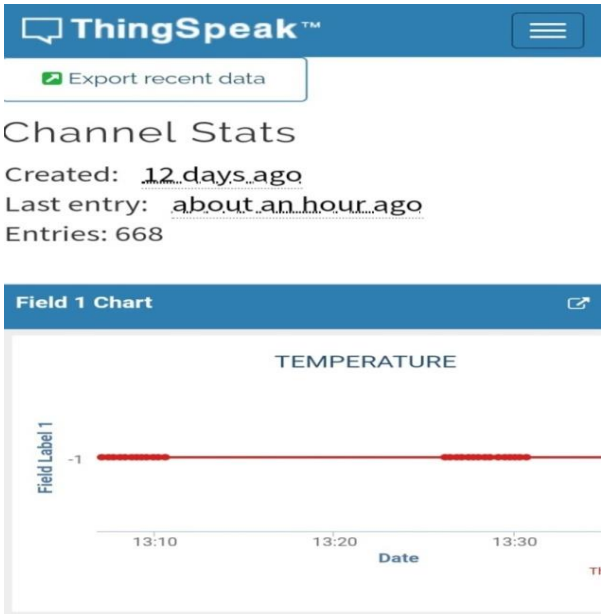

Fig 10. Temperature sensor report.

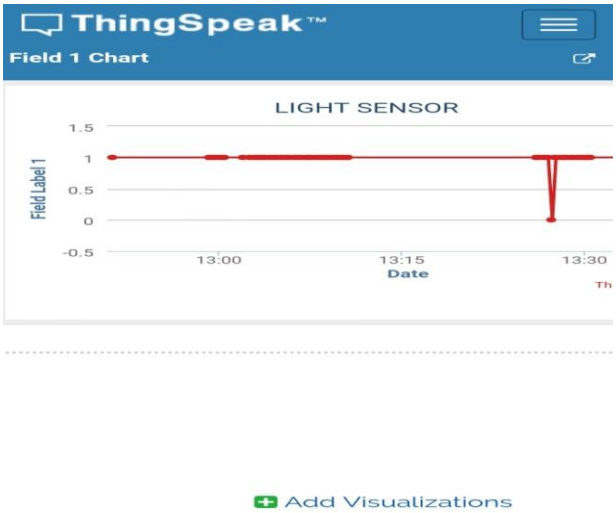

Fig 11. Light sensor report.

V. CONCLUSION

In this paper, Implementation of Greenhouse Service Control Protocol Using Raspberry-Pi has been hardened and produced satisfactorily. It had been formed by combining the all features of hardware apparatus used. Each unit's occurrence had been cautiously measured and positioned, consequentially in the finest achievable procedure of each unit. Subsequently, concept had successfully accomplished employment of sophisticated integrated circuits and rising technologies.

Agriculture networking technology is not only a requirement of contemporary agricultural development, but it is also a significant symbol of agricultural growth's future level; it will be the agricultural development's future

path. Following the construction of water irrigation scheme for farming, hardware analysis, research of characteristics of network hierarchy, functionality, and associated software structural design of accuracy of cultivation water irrigation method, essentially applying IOT to extremely valuable and protected farming invention has an important shock on ensuring reclaimed stream usage efficiently.

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