Original Research Article

Smart Greenhouse Monitoring System using Blynk IoT app

Abstract—

A smart greenhouse system that utilizes the Blynk IoT app is an innovative technology designed to automate greenhouse operations, thereby reducing labor and resource costs and optimizing plant growth. Multiple environmental sensors, including temperature, humidity, soil moisture, light intensity, continuously collect data. This data is then transmitted to the Blynk IoT application, which enables cultivators to remotely monitor and regulate the greenhouse. It also has a fire sensor to create an alarm for possible fire occurrence. Farmers can set up customized alerts to notify them of any changes in environmental conditions, such as irrigation or heating, that require their attention. Additionally, they can remotely and manually control fans, lights and humidifiers. The system can automatically turn on fans, lights, humidifier if the temperature, light intensity or humidity goes below a certain level. The system also features a water pump that turns automatically on based on the soil moisture level and can also be controlled remotely, ensuring the plants receive the proper amount of water.

Keywords— Smart greenhouse system, Blynk IoT app, environmental sensors, soil moisture, humidity, fire sensor

I. INTRODUCTION

The agriculture industry in Bangladesh is in a perpetual state of change, and growers are always seeking ways to increase production efficiency and yield [1-5]. One area of emphasis is greenhouse cultivation, where a controlled environment permits year-round cultivation and provides crop protection from external environmental elements. However, maintaining optimal growing conditions in a greenhouse can be difficult and requires constant monitoring of various environmental parameters. Intelligent greenhouse systems have been developed to automate this process, ensuring optimal growing conditions for crops, increasing yield, and decreasing labor and resource costs [6-12].

Monitoring and regulating greenhouse environmental parameters manually are a time-consuming and labor-intensive process. Utilizing a smart greenhouse system to automate this procedure can substantially reduce labor costs and increase crop yield. Additionally, a smart greenhouse system utilizing the Blynk IoT app provides the ability to remotely monitor and regulate the greenhouse, allowing producers to manage multiple greenhouses simultaneously [13-16]. Therefore, the purpose of this study is to investigate the potential advantages of a smart greenhouse system utilizing the Blynk IoT app and evaluate its efficacy in optimizing plant growth, reducing labor costs, and mitigating environmental hazards in greenhouse cultivation.

The goal of this study is to evaluate the potential benefits of a smart greenhouse system that integrates the Blynk IoT app in greenhouse agriculture. Specifically, this study aims to:

1. Investigate the impact of a smart greenhouse system on agricultural productivity and plant growth optimization.

2. Examine the effectiveness of a smart greenhouse system in reducing labor expenses and improving resource efficiency.

3. Evaluate the feasibility and functionality of using the Blynk IoT app to remotely monitor and regulate greenhouse environmental factors.

4. Assess the efficacy of a smart greenhouse system that utilizes the Blynk IoT app in mitigating environmental risks, such as fire threats.

5. Provide recommendations for stakeholders and producers on how to implement and operate a smart greenhouse system that integrates the Blynk IoT app in greenhouse agriculture.

II. LITERATURE REVIEW

Greenhouse agriculture offers a controlled environment that permits crop production with minimal interference from external factors such as climate, parasites, and diseases. Nonetheless, obtaining optimal growing conditions in a Greenhouse is a difficult task that requires constant monitoring and adjustment of environmental factors. This can be a laborious and time-consuming task, resulting in a reduction in crop quantity and quality.

To eradicate these problems, Khandelwal [17] proposed a greenhouse automation and remote monitoring system that utilized a GSM modem. For greenhouse environment data collection, the system included a variety of temperature, humidity, leaf temperature, leaf humidity, and rain sensors. Anisha *et al.* [18] present a framework for evaluating nurseries that includes the collection of environmental data using a variety of sensors and Arduino Uno. The system enables Arduino to control the ventilation fan and modify the light source based on the changing characteristics of the sensors. Hoque *et al.* [19] propose a system for monitoring and controlling a greenhouse that collects environmental parameters such as temperature, humidity, light, and soil moisture using a variety of sensors. Arduino Uno R3 is used to process and store the acquired data, and a GSM module transmits the measured values of these parameters to the user's mobile phone via SMS. Sahu and Mazumdar [20] introduced an easy-to-install microcontroller-based circuit that can monitor and record temperature, humidity, soil moisture, and radiation levels in the surrounding environment. These values can be continuously altered and regulated to promote optimal plant growth and enhance production.

Researchers are also developing systems with Blynk IoT app to regulate and monitor greenhouses. Aafreen *et al.* [13] present an IoT-based system designed for greenhouse telemetry and environmental control. The system is wireless and employs sensors for data collection, with the capacity to analyze and process data via the ThingSpeak cloud and GSM infrastructure. The mobile software for this system is powered by the Blynk IoT platform, which is renowned for its light weight and speedy performance. The application allows users to remotely communicate and control the greenhouse's environment, as well as receive notifications regarding any imminent irrigation needs. In their study, Khan and Karna [14] recommend employing an automated system that replaces manual control with an Arduino UNO microcontroller, environmental sensors and actuators, the ESP01 IOT module for communication, and the Blynk Application. The objective is to enhance water services to vegetation and attain optimal climatic conditions for the growth of specific plants by analyzing system-collected data with IoT. In addition, the Blynk application displays real-time system values on mobile devices for effective monitoring.

After reviewing relevant literature and conducting background research, it is apparent that implementing an automated greenhouse monitoring system can significantly improve crop productivity and quality while reducing associated costs. In this paper, we present an innovative and automated monitoring and control system for greenhouses.

III. METHODOLOY AND MODELING

3.1. Process of Work

The system is equipped with a wide variety of sensors that will assist farmers in automating a greenhouse to more effectively monitor and control conditions as required. It features sensors for both temperature and humidity so that farmers can keep track of the conditions within the greenhouse. It is equipped with a soil moisture sensor that can determine the level of moisture in the soil. A buzzer will go out if there is a fire in the greenhouse because it is equipped with a flame sensor that will alert farmers to the situation. It comes with an LDR module, which can measure the amount of light intensity in the greenhouse. All of the sensor data may be viewed on a 16x2 LD display or through the Blynk IoT mobile app. In addition, there is a fan, a light, a humidifier, and a motor contained within the system. These components may be manually activated using a switch, or they may be activated remotely using the Blynk mobile app by selecting the Manual option. Therefore, farmers are able to easily control these devices remotely based on the current weather conditions in order to better maintain their plants. Additionally, they have the option to set the Blynk app to Auto mode. In the event that the sensor data falls below the value that has been set up, this will activate the fan, humidifier, or light automatically.

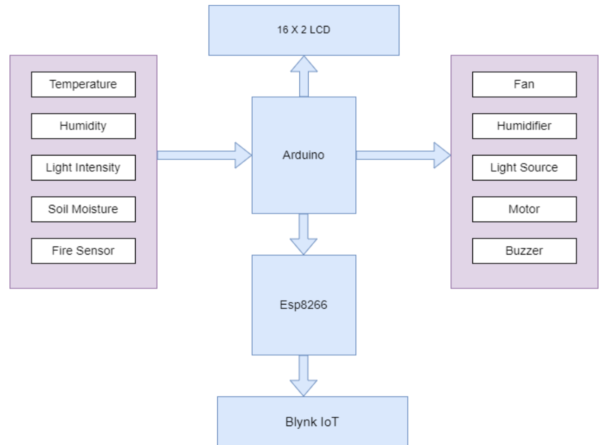

Fig.1 Block Diagram of proposed system.

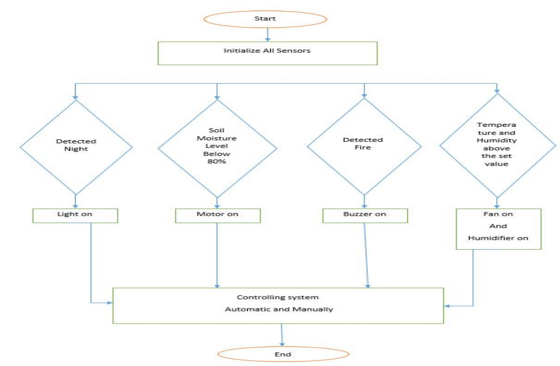

Fig.2 Flowchart of proposed system.

3.2. Used Components and Cost Analysis

Here are all the components that has been used in the system as well as the price is represented in the table.

TABLE 1. Component Cost Analysis

Components	**Price**
Arduino Uno R3	950
Power Supply	350
Buck Converter (2)	70x2 = 140
Esp8266	300
4-c Relay	320
LCD 16*2 + I2C driver	350
DHT11	160
LDR Module	50
Bread Board	40
Soil Moisture	90
Flame Sensor	50
Water Pump	100
Humidifier	100
Fan	50
Light	100

Wire	250
Decoration	300
Total	**3700**

3.3. Experimental Setup

A power supply of 12 volts and 2 amps was what we utilized for the system's primary power source. This device has an input voltage of 220 volts and an output voltage of 12 volts DC. We were using a total of two buck converters. The first one reduces current from 5 amps to a maximum of 1.5 amps while the second one reduces voltage from 12 volts to 5 volts. The 5-volt supply powers both the system's primary circuit as well as the sensors. The 1.5-amp current is used by both the fan and the water motor. The screen resolution of the LCD is 16 by 2. We employed an I2C display driver in this LCD in order to cut down on the number of wires, which brought the total number of wires to a minimum of 4. The Arduino Uno R3 serves as the primary functioning circuit in this system. The Blynk IoT app receives both the sensor data and the control signals via the Esp8266 microcontroller. In order to automate the switches and make them responsive to control via the Blynk IoT app, a 4-c relay is applied.

Fig.3 Proposed experimental setup.

Sensor data can be monitored by both LCD and Blynk IoT app.

Fig.4 Monitor Sensor data via LCD

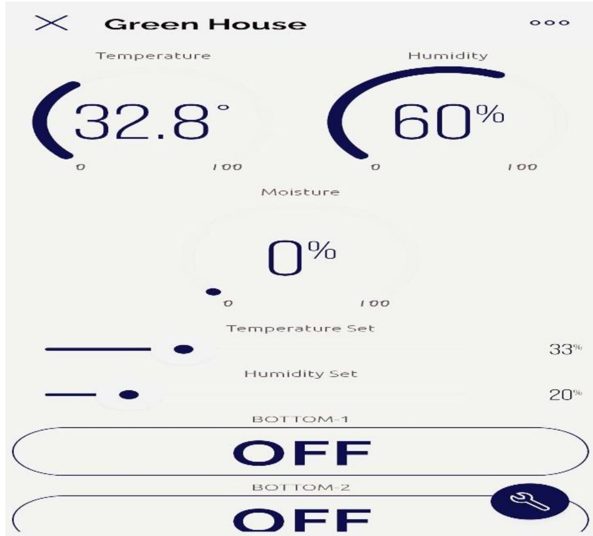

Fig.5 Monitor Sensor data via Blynk IoT app.

Soil Moisture level can be monitored by both LCD and Blynk IoT app.

Fig.6 Increasing moisture level.

Fig.7 Monitor moisture Sensor data via Blynk IoT app.

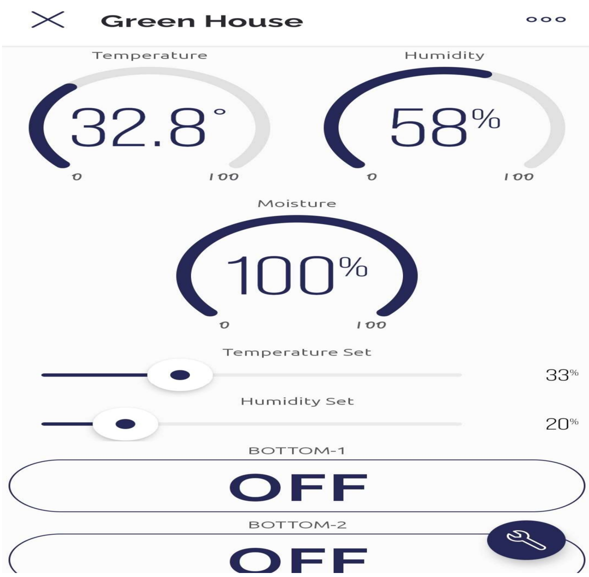

Fig.8 Monitor moisture Sensor data via Blynk IoT app.

Water pump turns on when the moisture level goes below a certain range.

Fig.9 Monitor Sensor data via LCD

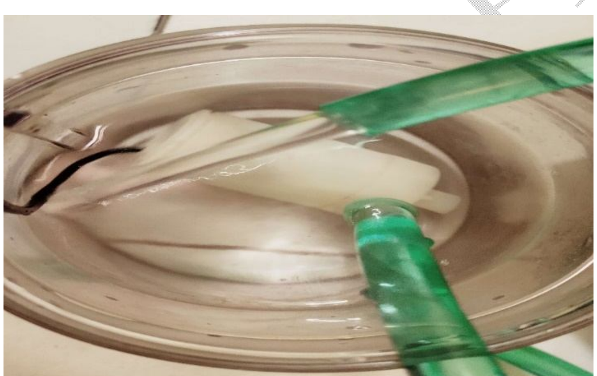

Fig.10 Working of water motor.

The buzzer notifies any fire occurrence using fire sensor.

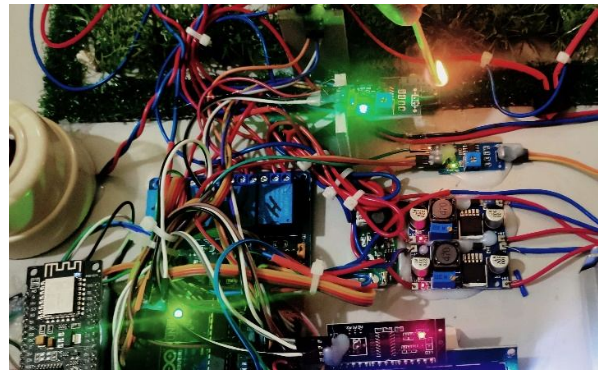

Fig.11 Working of fire sensor.

Fan, light, water motor, humidifier can be controlled via switch and remotely from anywhere through Blynk IoT app by toggling to manual mode.

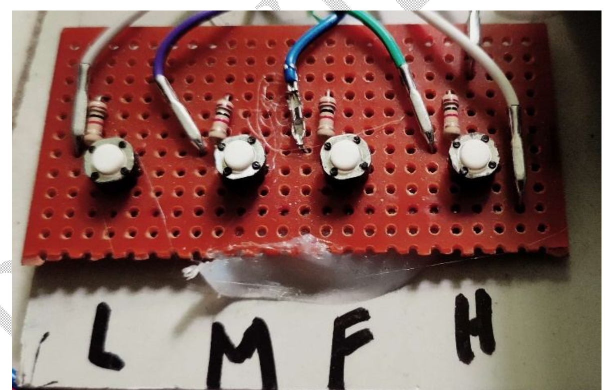

Fig.12 Manual switches.

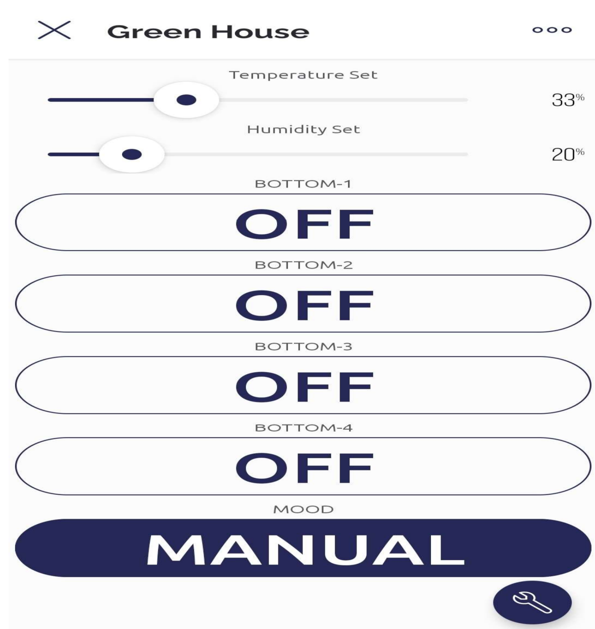

Fig.13 Manual mode of Blynk IoT app.

Through the use of the Blynk IoT app, the system may also be switched into the Auto mode. On that scenario, the fan, the light, and the humidifier will turn on and off automatically based on the data collected by the sensors and the value that the farmers have set on the Blynk app.

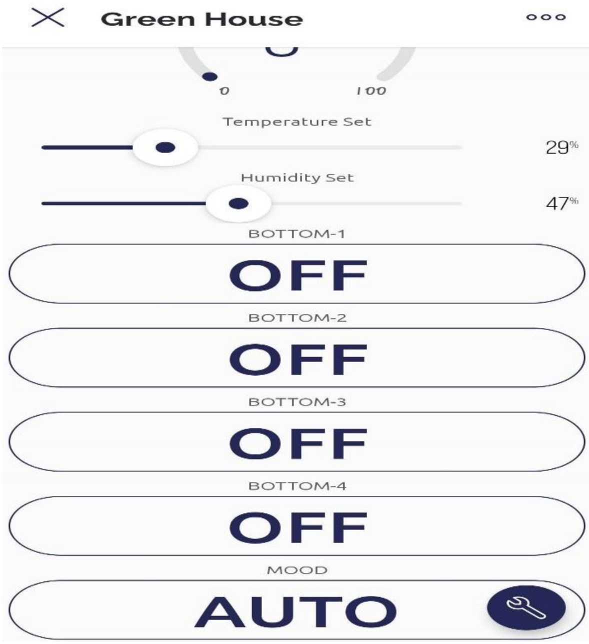

Fig.14 Auto mode of Blynk IoT app.

Light turns on when the light intensity level is below to the set value.

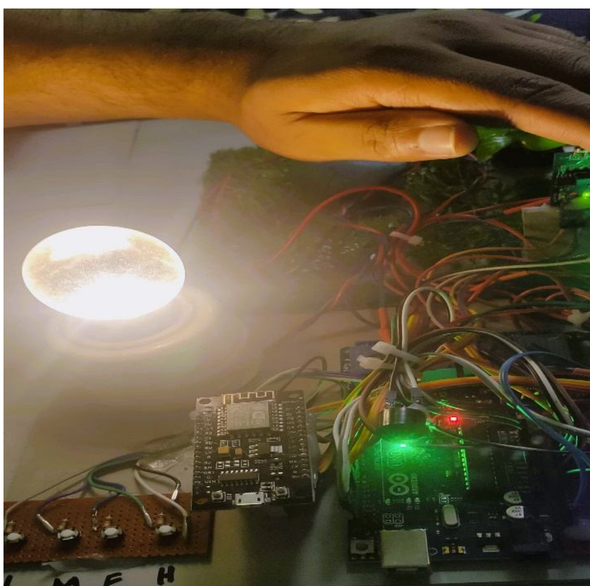
Fig.15 Automatic working of light.

Fan and humidifier turn on when the sensor data is below to the set value.


Fig.16 Automatic working of fan.

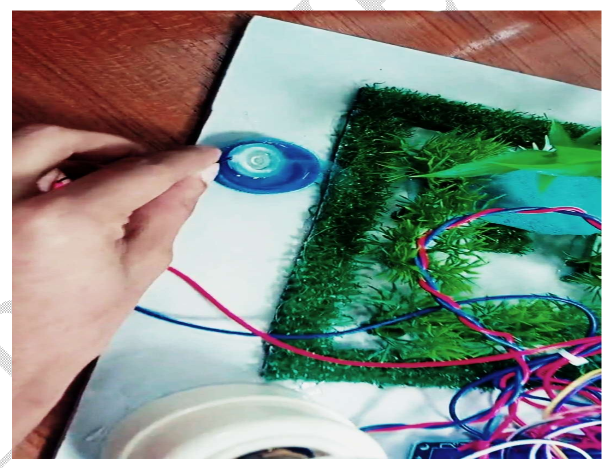
Fig.17 Automatic working of humidifier.

The code of this setup can be found here, https://github.com/shakib-sadat/Smart-Greenhouse-Monitoring-System-using-Blynk-app.

IV. CONCLUSION

In this study, we have developed a strategy for a smart and automated greenhouse system. The proposed approach can be of use to a significant number of farmers in Bangladesh. The system is cost-effective, simple to implement, and adaptable to greenhouses of varying sizes. It will also help the farmers in conveniently monitoring the greenhouse, and it will assist the plants in growing in an atmosphere that is better, healthier, and more suited according to their requirements.

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