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Research paper

Intelligent Mushroom Monitoring System

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Abstract

Mushrooms are classified as vegetables in the food world, but they are actually fungi. Although they are not vegetables, mushrooms provide several important nutrients and they have a very important part in the food market. Mushrooms are enriched in nutrients and they possess medical benefits such as decrease the risk of obesity and overall mortality, diabetes, and heart disease. The main barriers for the high yield is the defects in primitive methods that is being used. The research applied the use of Internet of Things with sensors to measure and monitor the temperature, humidity, CO_2 in the mushroom farm. The collected data is checked with the bound values and triggers the actuators accordingly. The intense monitoring eventually leads to increased yield. The system utilizes sensor technology to optimize climate condition for optimum growth.

Keywords—*mushroom; IoT smart farm; sensor technology;*

1. Introduction

Mushrooms are classified as vegetables in the food world, but they are not technically plants. They belong to the fungi kingdom. Although they are not vegetables, mushrooms provide several important nutrients and they have an very important part in the Indian food market. As mushroom is enriched in nutrients they possess medical benefits such as decrease the risk of obesity and overall mortality, diabetes, and heart disease. They also promote a healthy complexion and hair, increased energy, and overall lower weight. In an average the mushroom is cultivated and processed by means of manual methods such as from spawn production to packing, as a result of this the mushroom cultivators need to spend more time and have to maintain hygienic conditions in the cultivation area, which is very difficult and thus chances of occurrence of pests and diseases are much more which sometimes damages mushroom crop to a great extent thereby leading to an severe loss to the cultivator. The mushroom growers are growing mushroom in thatched mud houses, in which maintaining the required temperature and humidity for mushroom cultivation is very difficult. As these kind of structures need refinement by scientific techniques to develop an appropriate low cost farm design. A scientifically designed mushroom farm needs heavy investment and hence is out of reach of small & marginal mushroom growers/farmers. And since mushroom units need to keep their air-conditioning plants running almost round the year, the mushroom farms are charged witha high power tariff.

2. Proposed Solution

With the help of the proposed model the farm environment can adjust itself automatically according to the need of specific type of mushroom. It is an intelligent system that automatically adjusts the vital things like temperature, moisture and carbon dioxide level of the cultivation room. When it is time to spray water or to provide fresh air and remove carbon-dioxide from the cultivation room, the system will notify after taking each action. Farmers don't need manual intervention. The system can maintain proper balance of soil moisture, temperature, and carbon-dioxide that is essential for a good yield of mushrooms. With the help of this system, farmers can easily monitor through mobile phone. As everything today is going digitalized, so this proposed system is digital too with IoT technology.

3. Block Diagram and Its Operation

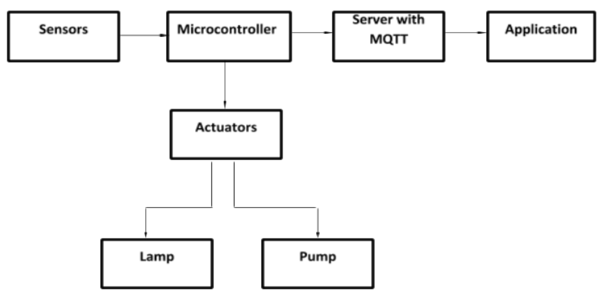


Figure 1": Block Diagram

The proposed system will have sensors that are required to monitor the vital parameters connected to the microcontroller the actuators are attached to the microcontroller. The program is written in such a way to monitor and to automate the farm. The microcontroller will do both the process and will send the data from the sensor and the status of the actuator to the server from the server and dashboard is developed to display the status of the farm.

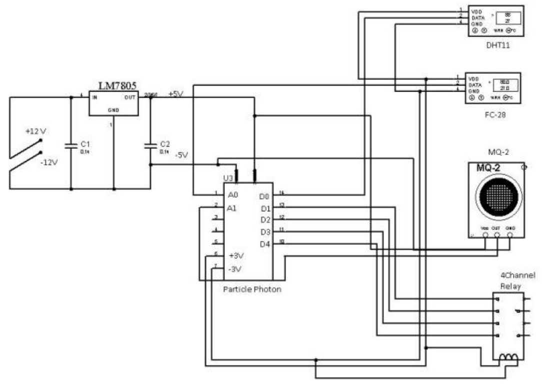


***Figure 2*:** Circuit Diagram

The hardware design starts with a 220V to 12V DC adapter which is connected to an IC LM7805 which is a 12V to 5V regulator. The particle board and the sensor MQ2 is powered with the 5V.The other sensors are powered by the 3v pin that is present in the particle board. The sensors and the pin configurations are explained below.

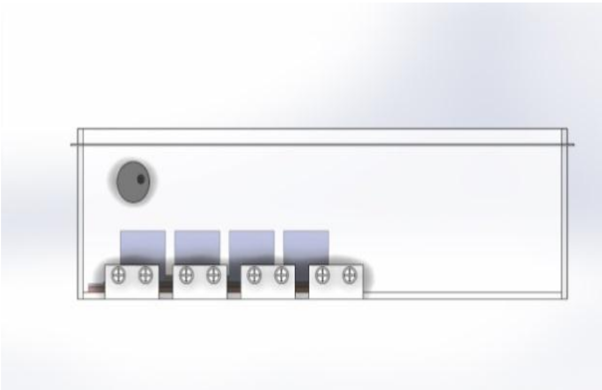


Figure 3: Proposed Hardware Design

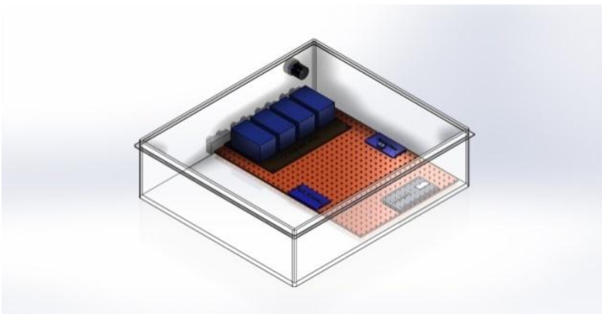


Figure 4: Proposed Hardware Design

4. Interfacing and Working

4.1Working:

The flowchart for intelligent mushroom monitoring system is given below,

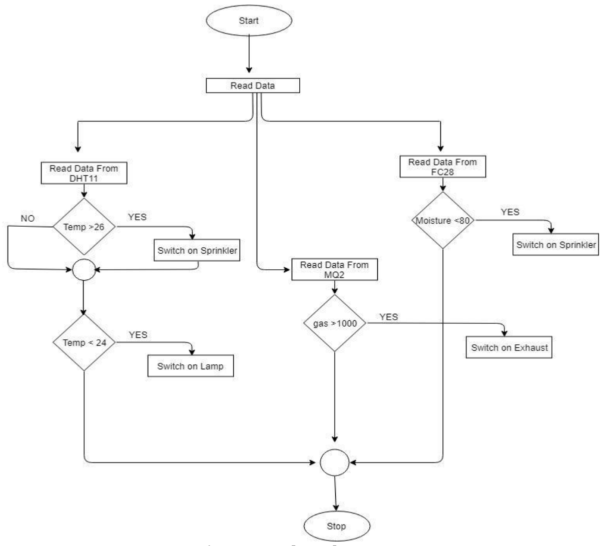


Figure 5: Flowchart

A unique algorithm is designed in-order to monitor and automate the farm. The program is written using C++ language and it is flashed to the particle board with the help of Particle Dev.

The vital parameters are set with a threshold value and each of the sensors is made to monitor these parameters if there occurs a variation in the threshold the actuations will be turned on and the notification will be sent through sms.

The following table explains the actions taken by the actuator when the threshold value changes.

Table 1: Actuator Triggering

Threshold	**Actuator**
Temperature	
>26	Turn on Sprinkler Pump
<26	Turn on Lamp
=26	Turn off Lamp & Pump
Soil Moisture	
<75	Turn on Fogger Pump
>95	Turn off Fogger Pump
=75	Turn off Fogger Pump
Carbon Di Oxide	
>1100	Turn on Exhaust Fan
<500	Turn on Fan

4.2 Implementation:

The sensors are fixed at the appropriate place in the farm. The system is powered on and the microcontroller automatically starts to collect the values from the sensors and will start to transmit the values with the help of a topic. While sending the messages the values are being compared and the local server is setup to receive the message by subscribing to the topic that is being transmitted to by the microcontroller.

In order to check the message is being received by the local server the terminal is opened and the following command is executed “mosquitto_sub -t "#" –v” and all the incoming messages with the topic will be displayed.

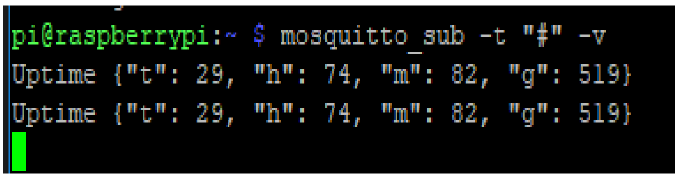


Figure 6: MQTT Message at Server

In the above figure we can see that the server is able to receive the topic Uptime which is sent by the photon. The message is received to the server in terms of string. This string is further processed to create an dashboard or to trigger an SMS.

The web GUI dashboard created using the Node-RED and is made to establish a connection with the server. Once the connection is established between the MQTT Node and the server we can navigate our web browser to “http://local-server-IP:1880/ui” to view the dashboard.

Figure 7*:* Web Dashboard

The page actually displays the live status of the farm. This is designed in such a way to display the user the actual status of the farm.

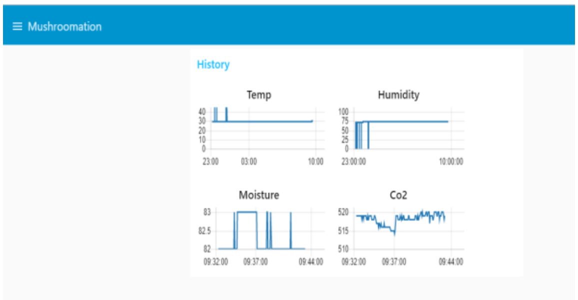


Figure 8: Web Ui Histogram

This is the page that will display the status of the farm at every time interval.

The android application is designed in the same way as the web dashboard was built but here we do not use NodeRED instead the app itself will directly connect with the local server and will start to receive the data from it. The android app will show its status of connectivity with the network and the MQTT Server, Once the connection is established the dashboard tab of the app will display the status of the farm.

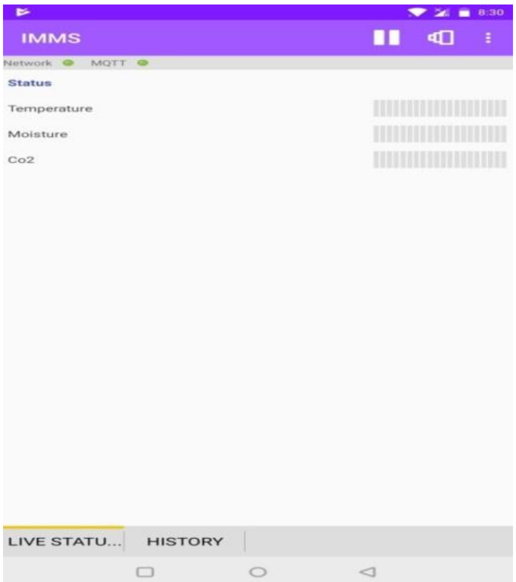


Figure 9:Android App Dashboard

Figure 10: Android App histogram

Users were notified about the status of actuators. Whenever there is a change in the state of actuator, the SMS were triggered.

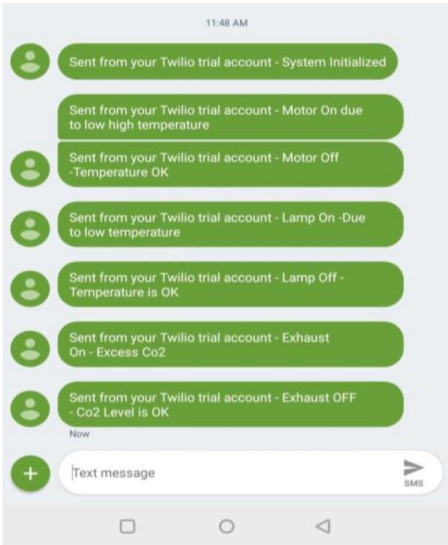


Figure 11: SMS

5. Testing

IMMS was actually tested in farm for a period of 30days.The farm was 10 ft X 20ft in dimension and the sensors was placed in the appropriate positions.The actuators were directly connected to the actuator modules.

The entire project was tested under two phases namely

1. Monitoring Session
2. Automation Session

In both the Sessions there were no flaws and the expected result came.

5.1 *Monitoring Session*

In this Session, temperature, humidity, moisture and the Carbon-di-oxide content of the farm was collected with the help of the hardware that was designed. On the analysis we were able to find that the vital parameters were not maintained at the correct level but still the farmer were able to get yield out of it.

5.2 Automation Session

In this Session of testing the sensors were made to monitor the conditions and the modules such as the sprinkler pump, halogen lamp and the exhaust fan were interfaced with the device and when the vital parametric condition changes the corresponding action was performed as per the algorithm we have put in the microcontroller. We were able to notice that whenever the threshold values varies the corresponding action was taking place and an notification was sent to the user through SMS.

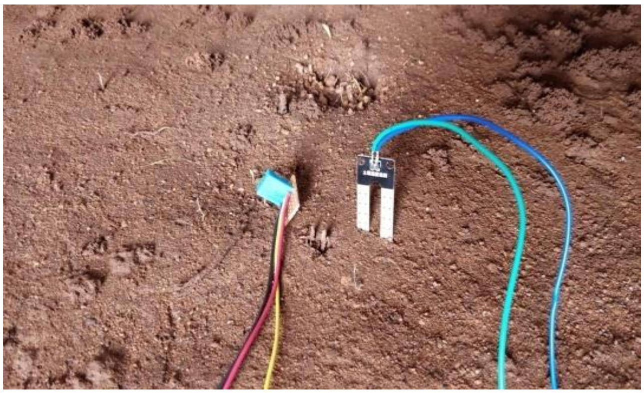


Figure 12: Fixing the Sensors

Figure 13: Sensors near the bag

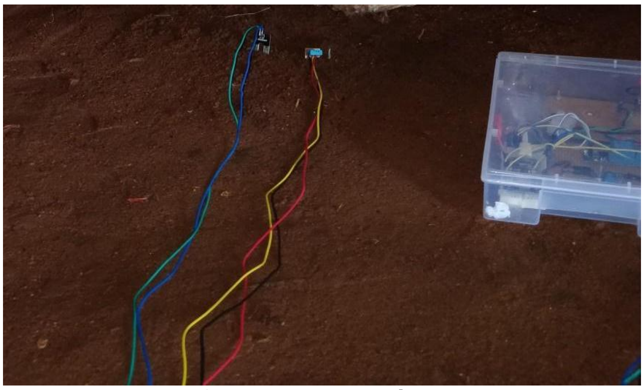


Figure 14: IIMS Control Unit

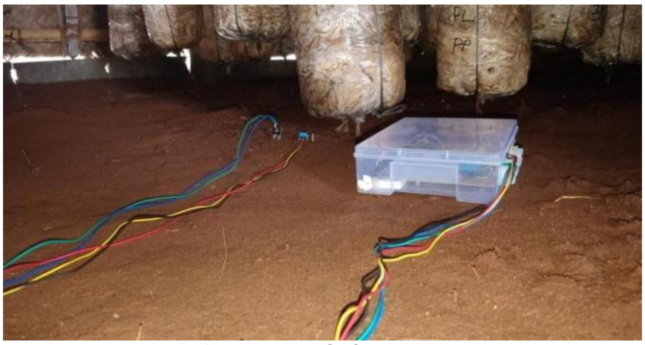


Figure 15: Inside the Farm

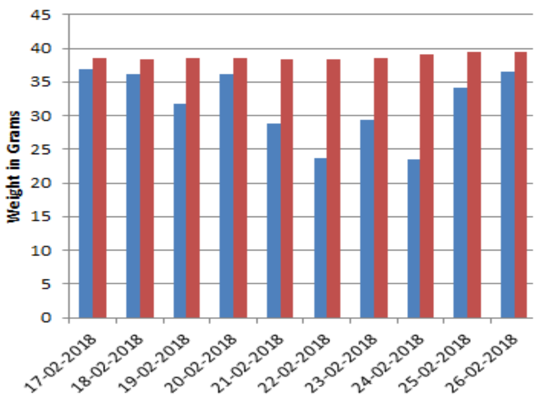
Figure 16: Fogger

5.1 *Result Analysis*

The farm where the IMMS was tested had nearly around 100 mushroom bags in it, the IMMS was tested on a single bag for a period of 30Days and the growth of mushrooms were monitored, on comparing it with the traditional method we were able to find that our system was able to give an increase in the production. The results can be analyzed by the help of the following comparisons.

5.2 *Growth per Day*

When IMMS was deployed, the results were found interesting.On daily basis the results were taken and the bag that had IMMS installed on it gave around 5-10 grams increase in the yield on daily basis.



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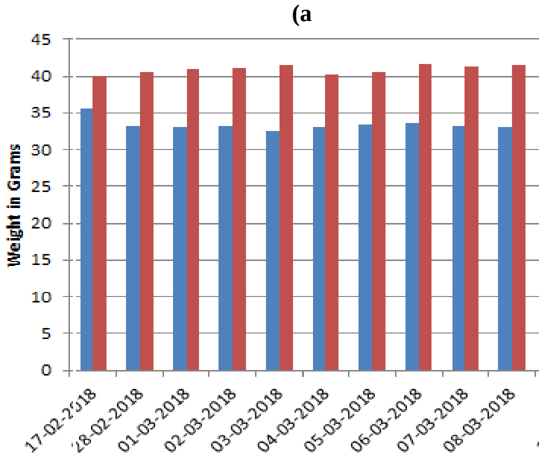

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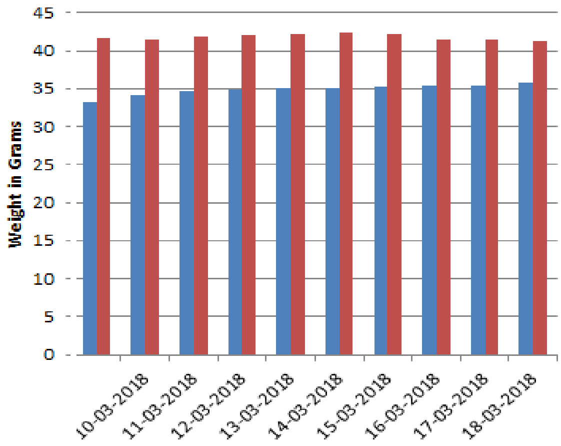

(c)

Figure 17(a b c): Daily Growth

5.3 *Production per Month*

When IMMS was deployed for 30 days the traditionally grown mushroom bag produced only 1.012 Grams of mushroom, but whereas on using IMMS it gave around 1.214Grams. Finally when the comparison was made between the monthly growths it was found that using this method there was a raise in growth.

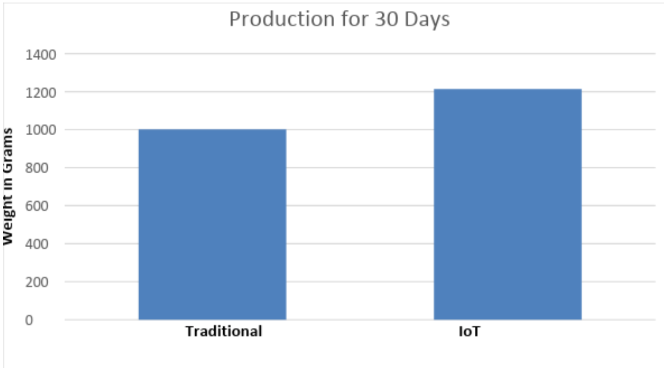

Figure 18*:* Production

5.4 Revenue

IMMS was tested with only one bag which earlier produced 1.012Kg of mushrooms but on using our IMMS it gave about 1.214Kgs of mushroom. These mushrooms are sold at a price of Rs.450 Per Kg so on calculating an farmer can get a profit on Rs.93.6 Per Kg.

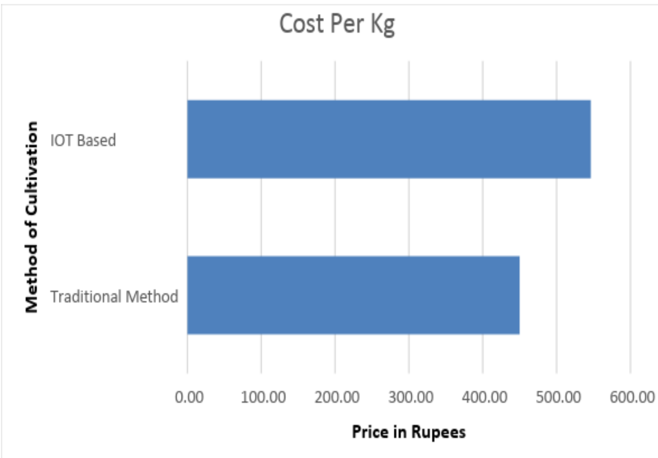

Figure 19: Revenue

6. Conclusion and Future Work

6.1 Conclusion

IoT Technology was applied for the mushroom farm. The developed system was tested for a period of 30 days. The developed IoT system was considered stable. Humidity,temperature,moisture and Carbon di oxide data was considered reliable and accurate (if compared to the information done manually). The functional status of sprinkler and fog pumps were done correctly. Threshold values for climatic conditions like humidity, temperature, moisture can be fixed based on the environmental conditions of that particular region. Moreover, this system can be installed by any individual type of farm, who doesn't have knowledge about mushroom farming. It reduces effort and time of farmer and makes farming efficient and profitable activity. The advantage of this system over traditional methods is that we were able to produce good yield of mushrooms and create a climate for the proper growth of them and even provide increase in the revenue.

6.2 Future Work

This method can also be extended to cultivations that are made in closed areas. Weather data from the meteorological department can be used along with the sensed data to predict more information about the future which can help farmer plan accordingly and improve his livelihood. Integration of farming with IoT can make it much more efficient and profitable activity. Smart Greenhouse has a bright scope of future in agriculture field and it will create a revolution in the way the agriculture is carried out in India.

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