IoT Based Mushroom Monitoring System – A Survey

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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. This project mainly focuses of the monitoring of the mushroom farms. The sensors are placed at specific regions of the farm, which will monitor the status. The control unit is setup with some basic parameters such as temperature, humidity and gas content that is required for the cultivation when the threshold varies the control unit will trigger the actuators. An intelligent app is designed to check the status of the farm by the user which will be connected with the control unit through a server, The app will be a used by the cultivator, where in the app, the status of the farm will be displayed. Once the actuators are triggered the users will be notified with the help of SMS.**

Keywords—mushroom; IoT smart farm; sensor technology;

I. 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. The Internet of things (IoT) is that the network of physical devices embedded with physics, software, sensors, actuators, and property that allow these objects to attach and exchange knowledge. Every factor is unambiguously recognizable through its embedded automatic data processing system however is ready to inter-operate at intervals the present web infrastructure. The farming and agricultural business depends on innovative concepts and technological advancements to assist increase yields and higher portion resources. The late nineteenth century and therefore the twentieth century brought variety of mechanical innovations, like tractors and harvesters. Today, an actuation behind enlarged agricultural production at a lower value is that the web of Things (IoT), that leaves the door wide open for engineers wanting to bring a wise farming answer or IoT agricultural detector to plug. The basic plan of the ton is that nearly each physical factor during this world may also become a laptop that's connected to the web. These efforts handle variety of things like ecological footprint, product safety, labor welfare, nutritionary responsibility, plants' and animals' health and welfare, economic responsibility and native market presence. The efforts cowl most steps within the production chain regarding the daily agricultural tasks, the transactional activities for all concerned stakeholders and therefore the support of knowledge transparency within the organic phenomenon.

II. LITERATURE SURVEY

2.1 IOT for Smart Farm:

Lingzhi Mushroom Farm at Maejo University Oran Chieochan et al.,(2017) applied the use of IoT with a sensor to measure and monitors the humidity in the Lingzhi mushroom farm. The research aims to develop a prototype of a smart farm using technology IoT, NET and LINE API to measure and monitor the humidity of the Lingzhi mushroom farm and control the sprinkler and fog pumps automatically. The Thai government would like to promote Thailand 4.0 to use a new technology for Thai agriculture. Therefore, Maejo University Chiangmai, has a concept to develop a prototype of a smart lingzhi mushroom farm by using current information technology to control the environment. The reason for developing the smart Lingzhi mushroom farm is to promote a new modern agriculture to Thai farmers. 'Controlling the environment of mushroom temperature needed.' Previous research was applied using IoT with RFID to find the best practice of logistic management [1]. The developed IoT system was considered stable. Humidity data was considered reliable and accurate (if compared to the information done manually). The functional status of sprinkler and fog pumps were done correctly. The project leaders of smart Lingzhi mushroom farm from Maejo University, ChiangMai were satisfied.

2.2 Environmental Monitoring and Controlling System For Mushroom Farm With Online Interface

Arjuna Marzuki and Soh Yan Ying (2017) contributed to the research in Malaysia. As most of the mushroom farms in Malaysia are smallscaled, their production capability is limited by inadequate environmental control system and the lack of financial resources to upgrade the systems. This paper presents an environmental monitoring and controlling system to monitor and control the environmental conditions in a mushroom farm. It enables user to monitor temperature, humidity, carbon dioxide concentration and light intensity in a mushroom farm on an android device by using ThingSpeak online platform. The control algorithm is able to control devices in a mushroom farm automatically based on feedback from the sensors to maintain the environment in an optimum condition for mushroom growth. The percentage error of temperature, humidity, carbon dioxide and the light was measured using the developed system [2]. The control system was able to control ac-powered humidifier, light and fan based on the feedback of the sensors to maintain temperature, humidity, carbon dioxide concentration and light intensity at optimum growth condition in an actual mushroom farm.

2.3 Architecture Design of Internet of Things in Logistics Management for Emergency Response

Ran Xu et al., (2013) researched on the title 'Architecture Design of Internet of Things in Logistics Management for Emergency Response was —The Internet of Things (IoT)' that aims to connect individual smart "network enabled" objects to the Internet using wireless/wired technologies for secure and efficient deployment of services using these objects. Since the concept of the IoT was put forward in 2005, we see the deployment of a new generation of networked objects with communication, with sensory and action capabilities for numerous applications, mainly in global supply chain management, environment monitoring and mobile target tracking. One of the scientific and technical challenges in the design of the IoT is the architecture design, which enables the interconnection of trillions of smart objects. This paper employs radio frequency identification (RFID) sensor networks as smart "network enabled" objects and proposes a service-oriented IoT architecture for logistics management [4]. The core components of this system are Domain Sensor Name Server, Sensor Service Publisher, Historical Database and RFID sensor networks. Using emergency response operation as a case study, this paper demonstrates the possible implementation and strategic values of the IoT architecture in logistics management.

2.4 Mushrooms - a fungi as edible

Mushrooms are macro fungi with distinctive fruiting bodies which are either epigenous or hypogenous and sufficiently conspicuous to the naked eye to be hand-picked (Chang and Miles, 1982). The appraisal of mushrooms as highly nutritive foodstuff is well founded. Many kinds of mushrooms are edible, and at the same time possess tonic and medical attributes (Chang, 1999). Human use mushrooms since early to 5000 BC. About 2000 species of edible mushrooms are known all over the world. One of the most delicious and excellently edible mushrooms is the European button mushroom. The total production of edible mushrooms is about 3.75 million tones. Extensive clinical studies, conducted primarily in China and Japan, have explicitly illustrated that a number of mushroom species have medicinal and therapeutic value in the prevention /treatment of cancer, viral disease, hypercholesterolemia, blood platelet aggregation, and hypertension (Jong et al., 1991). Mushrooms have been important in human history as food, as medicine, as legends, and in folk lore and religion [5]. Mushrooms are lively in folklore as ‚witches egg and fairy egg' (Molitoris, 2001). Mushrooms are basically consumed for their texture and flavor. They have recently become attractive as health - beneficent food and as sources for the development of drugs. Many higher Basidomycetes mushrooms are known to contain a number of biologically active components that show promising antitumor and immunomodulation, cardiovascular, hepato protective, hypocholesterolemic, antiviral, antibacterial, ant parasitic and anti-diabetic effects (Didukh, 2001).

2.5 History of Mushroom Cultivation based on Europe culture

Hippocrates first mentioned mushrooms medicinal value in 400 B.C. The first mention of mushroom cultivation, distinct from a chance of appearance in the field was in l652. The first record of year-round commercial production was in l780. When a French gardener began to cultivate mushrooms in the underground quarries near Paris, gardeners introduced mushroom growing to North America by using dark areas underneath greenhouse benches to grow mushrooms. In 1894 the first structure specifically designed to grow mushroom was built in Chester County, Pennsylvania, which is usually referred to as the mushroom capital of the world (Lo and Wasser 2011). Since ancient times, mushrooms have been regarded as the 'Food of the Gods' [6]. The Pharaohs of ancient Egypt believed they had magical powers, while the Chinese used them for their health-giving properties (Chu et al. 2002).

2.6 History of Mushroom Cultivation based on Indian culture

Department of Agriculture, Solan, Himachal Pradesh, started the work on a small scale to grow mushrooms [7]. In India, commercial cultivation of mushrooms had been with the joint effort of scientists and farmers (Chang and Miles 2004). Annual mushroom production has increased to 80,000 ton in 2006 from a mere 1,000 ton in 1981. Fifty percent of this is produced by marginal and small production units and the rest by industrial establishments. Mushroom husbandary is now one of the major sources of income for farmers of many states like Haryana, Uttar Pradesh, Punjab, Uttarakhand , Himanchal Pradesh and Tamilnadu (Ekonem and Ubengama 2002).

2.7 Applications of Wireless Sensor Networks in Shiitake Mushroom

Cultivation Mohamed Rawidean Mohd Kassim et al., applied wireless sensors network(WSN) to build decision support systems to solve real time problems. Based on the WSN and mobile computing, a greenhouse environment for mushroom cultivation was developed for shiitake mushrooms which ranks next to button mushroom in the edible world. The shiitake mushroom is consumed raw, cooked or dried, making them a versatile food. It offers largest number of health benefits. With ever increasing demand the output has to be increased. Most mushrooms are grown indoor. Environmental factors such as humidity, temperature and carbon dioxide (CO_2) in the farm has to precisely maintain for the optimized growth. Manually controlling these parameters would be difficult and hence automated control systems were developed. The mushroom farm requires day-to-day changes during its different growth stages. They believed that these requirements could be achieved through an automated solution. WSN offers a powerful combination of distributed sensing, computing and communication [8]. WSN integrates the knowledge of sensors, control, digital network, information storage and processing. The shiitake mushroom monitoring system developed in this project called Smart Shiitake Mushroom System (SSMS) would monitor temperature, humidity and CO_2 inside the mushroom greenhouse. Furthermore, the system would also collect real-time image/video data through CCTV cameras and store the data into a database through a web server (Cloud). The application layer provides user requests and display module for the retrieved values of environmental parameters.

2.8 Environment Control for Smart Mushroom House

Ibrahim Mat et al., built a Smart Mushroom House (SMH) for the shiitake mushroom which is considered to be on demand in Malaysia. The system utilizes sensor technology with feedback system to optimize climate condition for optimum growth. There are many issues and challenges faced by this industry. Challenges for Malaysian mushrooms growers are low quality seeds and high production cost. This paper highlights the solutions to increase the yield of mushroom cultivation. The famous mushrooms in market are Oyster and Shiitake mushrooms. The most crucial parameters for mushrooms cultivation environment are Carbon Dioxide (CO2), humidity, temperature and light. Most important component that is the controller to handle monitoring and control of the overall system functions. Smart Mushroom House system monitor parameters and control the devices in order to utilize resources as optimum as possible. The sensing parameters are Carbon Dioxide (CO2), humidity and temperature. The parameters read by the sensors will be sent wirelessly using XBEE technology to control panel and gateway. The control devices such as humidifier exhaust fan and circulation fan is to increase the humidity, to remove exceed CO2, move the air inside [9]. Factors of growth are controlled automatically based on data from sensors to follow an optimal growth climate for the mushrooms at their different stages of development. Humidity, temperature and CO2 are tracked in real time via sensors placed into the mushroom growing system at key intervals.

2.9 Based on Open Access Scientific Reports

The fruiting of mushroom requires the casing soil, the room temperature is maintained around 25oC, ample ventilation is provided to reduce the CO2 level preferably below 1000ppm, and relative humidity of the room is maintained between 85 and 90% all the time [10].

III. 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.

BLOCK DIAGRAM AND ITS OPERATION

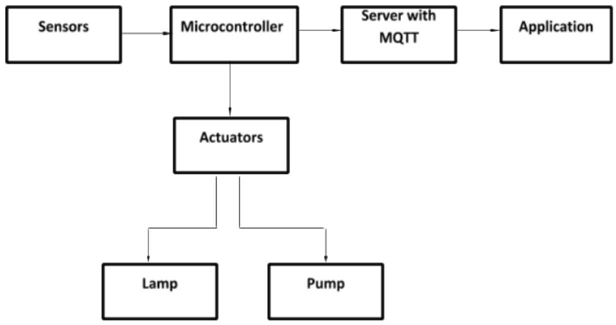

Figure 1 : Block Diagram

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.

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.

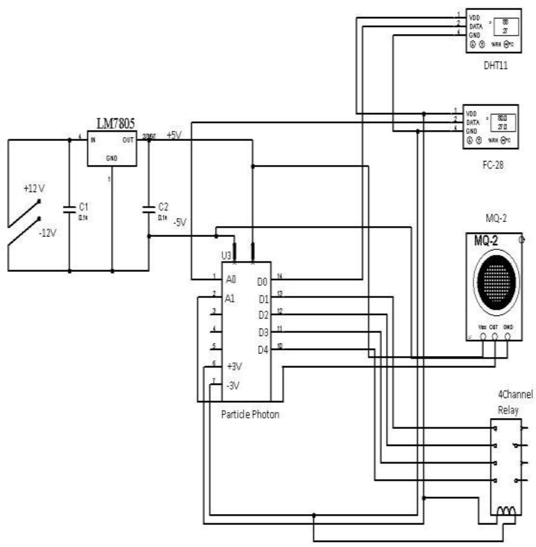

Figure 2: Circuit Diagram

HARDWARE DESIGN

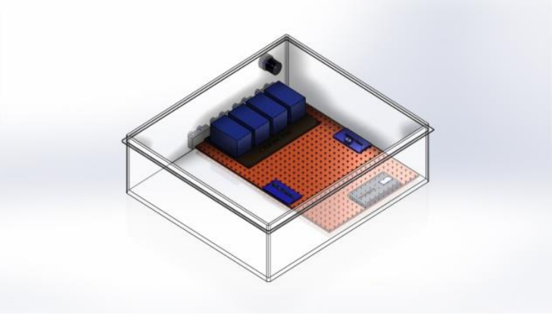

Figure 3: Proposed Hardware Design

(isometric view)

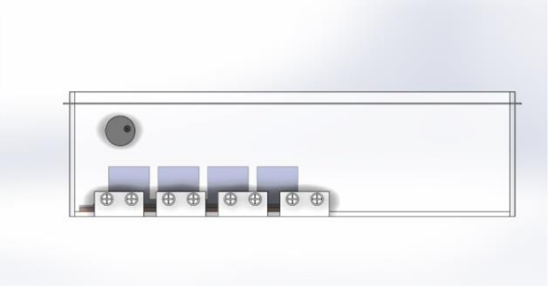

Figure 4: Proposed Hardware Design

(side view)

IV. INTERFACING AND WORKING

A. WORKING:

The flowchart for intelligent mushroom monitoring system is given below,

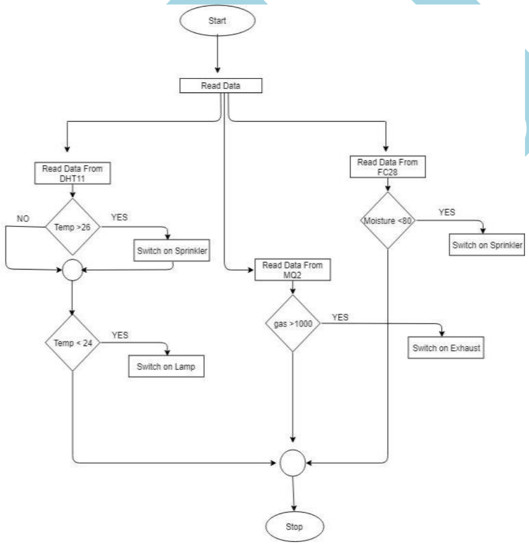

Figure 5: Flowchart

V. SUMMARY

The literature survey has been made and observed that for mushroom cultivation controlling the environment of mushroom temperature is needed. Hence IoT based smart mushroom monitoring system has developed. There is a need to convert manual monitoring process to automated system hence, it ultimately reduce the human cost, increase net profit etc.

VI. CONCLUSION AND FUTURE WORK

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). 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.

VII. REFERENCES

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