Implementation of Real Time Monitoring in the Field of Agriculture

Muskan Pashine[1], Prasanna Mundhada[2]

[1]Department of Electronics Engineering Shri Ramdeobaba College of Engineering and Management, Nagpur
[2]Department of ECE Engineering Shri Ramdeobaba College of Engineering and Management, Nagpur

---

Abstract: *Technological advancements are being made in the field of agriculture with the sole aim of increasing the yield of crops. The growth of crops highly depends upon the surrounding conditions and hence real time monitoring of these conditions is of utmost importance. Monitoring the parameters will allow us to make the required changes so that optimum conditions for plant growth are met. Temperature, humidity, soil moisture, and vapor pressure deficit are some of the parameters on which the rate of crop growth is highly dependent. Hence, we propose a system for real time monitoring in the field of agriculture to monitor the parameters such as temperature, humidity, moisture, and vapor pressure density. The system comprises of Atmega2560 microcontroller, MQ-2 gas sensor, soil moisture sensor, and DHT11 for measurement of parameters and ESP8266 and 2.8' TFT LCD screen for the display purpose. The parameters measured are displayed on the TFT screen and these parameters are displayed on Thingspeak (IoT platform) as well. The system also comprises of a secure website that allows users to login and gets the idea of the measured parameters dynamically. This website also provides crop information and information about various government schemes useful for the farmers. Thus proposed system helps to get an idea about the parameters essential for the growth of plants at remote locations as well with the help of the website.*

Keywords: *Atmega2560, DHT11 sensor , microcontroller, MQ-2 sensor ,Soil moisture sensor.*

INTRODUCTION

India is an agricultural country (krushi-pradhan-country). Nearly 60-70 percent of the Indian population lives in rural areas. And in rural areas, people mostly do farming or other farm-aided businesses such as animal husbandry, poultry farming, forestry, etc. Be it on a small scale or large scale farming is the most sought-after occupation in rural areas. Agriculture contributes about 15% of India's GDP and employs millions of people. Out of total export in the country, 70% export is of agricultural products. Despite agriculture being prime economic activity, the productivity of the factors of production involved in agriculture is very low as compared to developed nations. Although the traditional methods of agriculture are good they are not enough to get the desired yield of crops. Therefore there is a need for use of science and technology. Science and technology are still used in farming. The example of it being trucks used for transporting crops, use of tractors, use of water pumps for irrigation, etc. This still is not enough for the desired yield of crops as these technologies mentioned focus on a broader dimension but other important things such as measurement of surrounding conditions for better crop yield remain untouched. One primarily focuses on cutting down expenses in farming to yield maximum profit but a monitoring system that monitors the condition essential for plant growth can be considered as a boon to the farmers as this investment can reap maximum crop growth and in turn produce maximum profits for the farmers.

Temperature is an important parameter for plant growth. Photosynthesis is a basic process carried out in plants in which plants use sunlight, water, and CO_2 to produce glucose along with oxygen. Temperature greatly affects the rate of photosynthesis in plants. At low temperatures, the enzymes that carry out the process of photosynthesis do not work efficiently and as a result, there is a decrease in the rate of photosynthesis. Now since the rate of photosynthesis is decreased the production of glucose also decreases which in turn affects the growth of plants negatively. At the optimum temperature range, the photosynthetic enzymes work at their optimum levels, so the rate of photosynthesis is high which increases the glucose levels. As a result of this, there is an increase in the growth rate of plants. At higher temperatures again the photosynthetic enzymes do not work properly and there is a decrease in the rate of photosynthesis which in turn decreases glucose levels. So there is a decrease in the growth quality of plants as well. Pollination which is also an important process in plant growth is greatly affected by temperature. Temperature also affects the temperature of the water levels in the soil and changes in water levels affect the plants in their growth. Considering all the above scenarios there is an immense need to monitor the temperature of the surrounding for optimum growth of the plant.

Humidity is defined as the measure of the amount of water vapor in the air. Generally, humidity is measured in terms of relative humidity which is defined as the amount of water vapor present in the air expressed as a percentage of the maximum amount of water vapor the air can hold at the same temperature. There is a noticeable effect of humidity on crop quality. Changes in humidity levels can contribute to problems in crops such as foliar and root diseases, loss of yield quality, etc. Transpiration is a process in which a plant releases

water in the form of water vapor from its aerial parts such as leaves, stems, and flowers. If the humidity level is too high, it signifies that the air is saturated. If the air is saturated, the evaporation of water that happens through stomata is not carried out properly. Even if stomata is completely open the transpiration process that happens in plants is highly affected. As there is a lack of air circulation the plant cannot carry out the process of transpiration or draw nutrients from the soil. If this condition of high humidity prevails for a longer time the plant eventually rots due to this abnormality in the process of transpiration. This overall results in the stunted growth of plants as the above-mentioned basic process of plants is not carried out normally in case of higher humidity. If the humidity levels are low, it can cause the stomata to close to conserve water and if this condition is combined with cold air can cause many plants to stunt their growth as a defense mechanism. This effect can also be seen in winter where most plants lose their leaves. Thus temperature and humidity correlate them and both of them need to be monitored for the good overall growth of plants.

Soil moisture can be defined as water held in between the spaces of soil particles. Soil moisture can be categorized into two broad categories. First is surface soil moisture which is the content of water present in the upper 10 cm of the soil. While the second category is root zone soil moisture. It is defined as water present in the upper 200 cm of the soil. Appropriate soil moisture content is very important as it is of prime importance to many biogeochemical, biological and hydrological processes in plants. Soil moisture helps in controlling the exchange of water and heat energy between the land surfaces and atmosphere through evaporation and plant transpiration. Soil moisture acts as a solvent and carrier of food nutrients for plants. It also regulates the soil temperature and heat capacity. As water binds the soil particles it also helps the soil from weathering. Also one must know that all the water present in the soil cannot be used by plants. Some amount of the water remains in the soil as a thin film. Soil water dissolves salts and makes up the soil solution which acts as a medium for the supply of nutrients to growing plants. Considering the above-mentioned importance of soil moisture on plants it is of utmost importance to monitor this parameter.

Vapor pressure deficit is defined as the difference or deficit between the moisture or water content in the air and how much water or moisture the air can hold in saturated conditions. The change in vapor pressure deficit leads to a change in the rate of the transpiration process in plants. Because as vapor pressure deficit increases there is an increase in demand for water in the atmosphere. As there is greater demand for water in the atmosphere there is generally an increase in the rate of transpiration. This analogy can be understood from the effect of variation in humidity as explained above since vapor pressure deficit and humidity are related closely. The plant is under stress if vapor pressure deficit increases since more force acts on it from leaves to the roots since transpiration rate is increased. So we can see that all of the above four parameters mentioned above have an effect on the growth of plants as these parameters change. Also, these parameters are interrelated and they need to be monitored for the proper and fast growth of plants. Hence the aim of this project is to :

1. Measurement of parameters such as temperature, humidity, soil moisture, gas quality, and vapor pressure deficit is important for plant growth.

2. Display these measured values on a 2.8 inch TFT LCD screen.

3. Building a secure website for the comfort of the user so that the user can log in and get the dynamic values of the parameters at any remote location.

Related work

The proposed system comprises a TFT screen for on-site display and there is wireless communication via ESP8266 to a website so that the remote communication can be done[7]. Our system provides not only the status of the farm but also the governmental schemes and other parameters for a progressive farmer. The system provides a much more accessible way for the user we updated GSM to a website with a more easy and understandable graphical user interface[1]. The requirement would be constant internet connectivity. The system is updated to a TFT screen with a much suitable interface. There are many pages and options to view the parameter values on site[5]. With a TFT screen interfaced the system also automates the water pump for irrigation, ventilation for a greenhouse, and temperature maintenance.

Proposed methodology:

Many parameters can be monitored for example temperature, humidity, soil moisture, vapor pressure deficit, gas detector, etc. Reading these values is the primary thing but how we use this data for understanding the status of the farm for the normal farmer is the key point. To overcome these points our proposed system is as follows:

1) To get the parameters to value using microcontroller Atmega2560 [8], temperature sensor, humidity sensor (DHT11), vapor pressure deficit, gas sensor (MQ-2), and soil moisture sensor.

2) Using Esp8266 as a wireless communication device with the website created for the remote access of the real-time data updated by the

sensors[4]. The website consists of applications that can be very useful for farmers.

3) Providing on-site TFT display screen for easy access of the farm status with an automated controlling system for the water pump for irrigation, ventilation for a greenhouse, and temperature maintenance.

Microcontroller Atemga2560 is very cheap and the interfacing of sensors to it is very user friendly as shown in figure 1. Also, the TFT screen can be easily mounted on it and works much better with ESP8266.

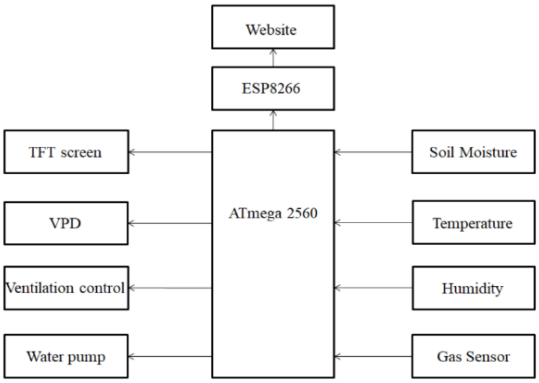

Figure 1:Block Diagram

System Implementation:

Interface the sensors to the microcontroller along with the ESP8266. The communication of ESP8266 is done with the Thingspeak website but the actual website for the presentation of all forms of data is different. First, the sensors send the data to Atmega2560 then it is wirelessly transmitted via ESP8266 using AT commands. This data is then written to the Thingspeak website [9] which is connected to the main website having the flow chart as shown in figure 2. We have a separate website which contains all the extra applications like follows:

1) Display of sensor readings.

2) Having a user ID and password system for every user.

3) Notification center for any triggering of threshold values.

4) Governmental schemes for the farmers.

5) Quick search option for different crop information.

There are different threshold limits set for each sensor value that we are getting so that the load can be triggered. For example, as soil moisture value goes beyond 100 then the water pump gets triggered till the values come below 50. Similarly, the humidity and temperature readings threshold in OR logic triggers the ventilation system.

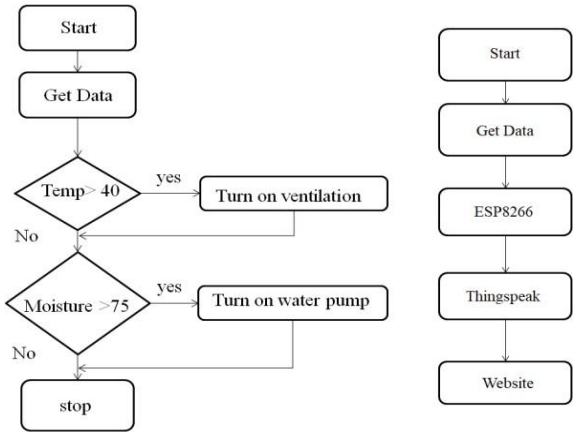

Figure 2: Flow Chart

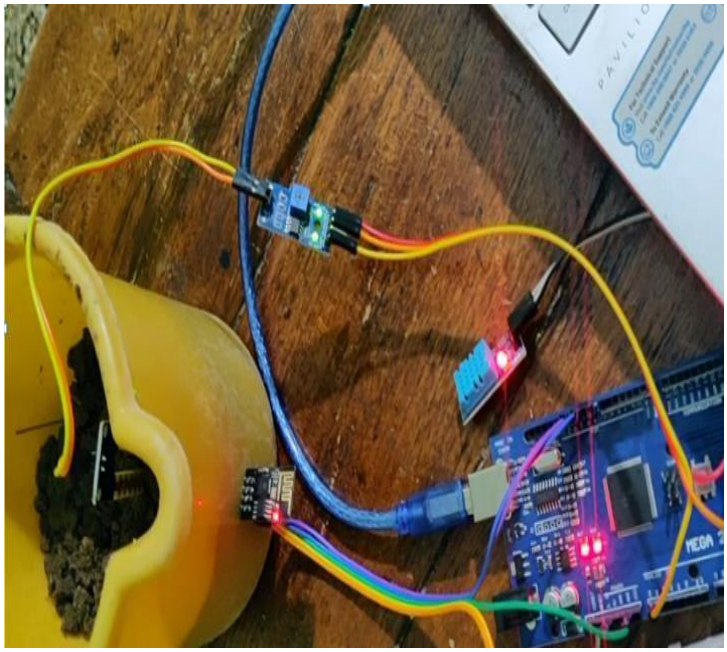

Figure 3: Experimental setup

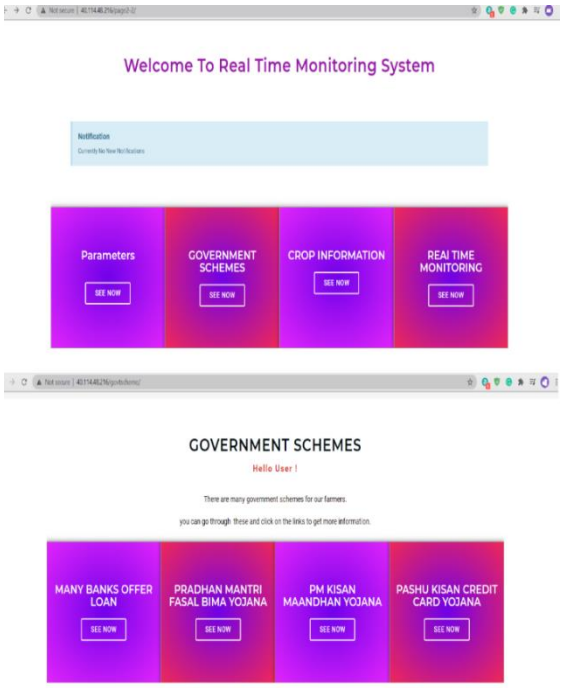

Figure 4.1: Website View

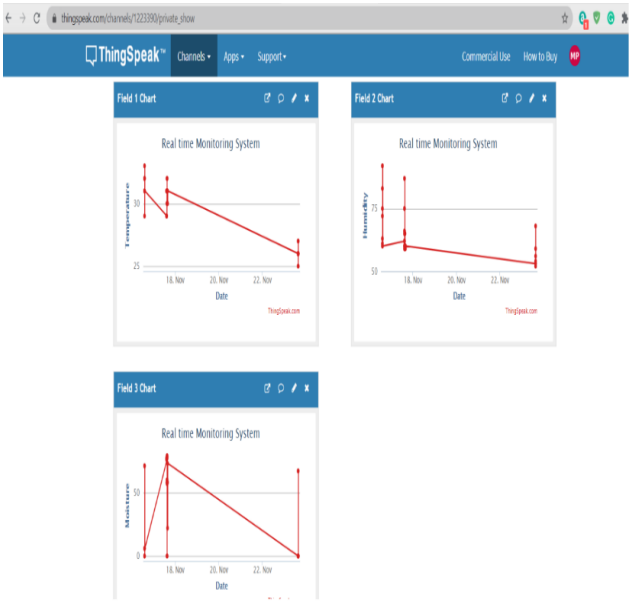

Figure 4.1: Website view

RESULT AND ANALYSIS

Sample tests were taken for searching the accuracy and the time delay estimation. The test proved that the data reading is proper with a bit of delay while sending the data via ESP8266. The data is sent to the cloud server of the Thingspeak which is then used by the main website for display as shown in figure 4. The website shows correct values with some time interval gaps in the graphical view. Each functionality provided in the site gives ease in finding the solution for many problems like scheme-related, crop-related, disease, and fertilizer-related information.

The hardware is compact with all sensors and Wi-Fi modules interfaced with it as we can observe in figure 3. The main part to understand is the wireless communication is there with very little error and with a wide range of application attached to it. The GSM and other wireless techniques have a hard time proposing such applications with that ease.

CONCLUSION AND FUTURE SCOPE

The system proposed is capable of finding some feasible solutions in domestic agriculture. Having all the status of the field visible remotely helps in keeping an eye on the farm. The website is very useful for other farm-related knowledge such as governmental schemes, crop information, etc. Automation and manual controlling help in maintaining the farm loads. Wireless communication is the major advantage of such an application. The field of work in this proposed system has many strings which can be very helpful in increasing the yield of the agricultural sector in India.

The proposed system can be implemented in the greenhouse. With proper implementations of the watering system, the greenhouse can be made automated. The proper arrangement of greenhouse covering material can also help in the atmosphere controlling inside the structure. The actual state of the farm can be shown animatedly so that situation can be made very clear for understanding.

REFERENCES

1] Saleemmaleekh Attar1, Sudhakar K N2 “Real-Time Monitoring Of Agricultural Activities Using Wireless Sensor Network” (IJSR) Volume 4 Issue No. 5 ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14. pp 2843-2844

2] Yuan Alfinsyah Sihombing, Sustia Listiari, " Detection of Air Temperature, Humidity and Soil pH by using DHT22 and pH Sensor Based Arduino Nano Microcontroller", 31 March 2020.

3] Vitthal S Saptasagare, Basappa B Kodada ,"Real-Time Implementation and Analysis of Crop-Field for Agriculture Management System based on Microcontroller with GPRS (M-GPRS) and SMS", International Journal of Computer Applications (0975 – 8887) Volume 98 Issue No.5, July 2014.

4] N. M. Z. Hashim*, S. R. Mazlan, M. Z. A. Abd Aziz, A. Salleh, A. S. Ja’afar, N. R. Mohamad “Agriculture monitoring system: a study” 1 October 2015 Jurnal Teknologi. pp 54-59

5] Apurva C. Pusatkar, Vijay S. Gulhane "Implementation of Wireless Sensor Network for Real Time Monitoring of Agriculture" IRJET, volume: 03 issue: 05, may-2016. pp 997-1003

6] Xiaoxiao Shen, Lijing Zhang, "Research and Development of Real-time Monitoring System Based on WebSocket Technology" (MEC) Dec 20-22, 2013, Shenyang, China

7] Balakrishna.K1, Nethravathi.S.N2, Harshitha Krishna," Real-Time Soil Monitoring System for the Application of Agriculture" Volume 6 Issue No. 5 ISSN 2321 3361 © 2016 IJESC. Pp 5326-5330

8] Prachi Patil1, Akshay Narkhede2, Ajita Chalke3, Harshali Kalaskar4, Manita Rajput "Real Time Automation of Agricultural Environment " IEEE 2014. pp 1-4

9] Nikhil R, Prof. Anisha B S, Dr. Ramakanth Kumar P "Real-Time Monitoring of Agricultural Land with Crop Prediction and Animal Intrusion Prevention using Internet of Things and Machine Learning at Edge" October 13,2020, IEEE.

10] Mohanraj I, Kirthika Ashokumar, Naren J," Field Monitoring and Automation Domain", 6th International Conference On Advances in Computing & Communications, ICACC 2016, 6-8 September 2016, Cochin, India. pp 931-93