# SMART HYDROPONICS WATER MONITORING USING IoT

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***Abstract:*** There has been much research and various attempts to apply new IoT technology to agricultural areas. However, IoT for the agriculture should be considered differently against the same areas such as industrial logistics.This project deals with the IoT-based agricultural production system for monitoring the water conditions and developing the system by using the sensors for the production of crops by gathering its environmental information. This project designs the IoT-based monitoring system for Hydroponic Farming Ecosystem (HFE), and the methods to improve the efficiency of decision making by analyzing harvest statistics with the help of IoT devices. The HFE is made to support non-professional farmers, urban people who have limited knowledge in farming and people who are interested in doing vertical planting in very small areas in the city such as building tops, balconies of small rooms in high-rise buildings, and in small office spaces. To make the system easy to control and easy to use, we have an android application to control IoT devices in the HFE and alarm users when their farm is in an abnormalsituation.

The purpose of this project is to design, install and maintain hydroponics containing different varieties of crops.

## I. INTRODUCTION

In a world like today, with almost all devices getting smarter, there is an urge for automation. This can be done with the help of the currently trending technology, IOT. It enables us to connect objects to the internet for controlling everything remotely. India is an agricultural country and it is also the main occupation of people in the country. There are different forms of agriculture, one among them being Hydroponics.

Hydroponics is the method of growing plants or vegetables without soil, but using mineral nutrient solutions mixed with water. Since this solution will be used as a food source for plants or vegetables, it is necessary to control or manage many factors in this liquid. Some examples of variables we have to control are the pH value or concentration of the nutrient solution. There will be many devices involved and interconnected to create such a system such as IoT devices to monitor humidity, nutrient solution temperature, Level of Turbidityand pH value. It will be used to control and analyze data from all interconnected devices and sensors [ 1].

The Hydroponic Farming Ecosystem consists of three parts. The first part is about the detection sensors which include: air and water temperature, humidity, pH and Turbidity. The second part covers the control system which can be manipulated to regulate the system by monitoring the values from the sensors. The air temperature, humidity and concentration of nutrients can all be controlled so that they are in a specific range or threshold. The last part will look at dynamically changing the application to inform the user of any changes. The user can control the devices in the HFE setup through the android application.

Hydroponic grow located in urban environments can help with maximization of crops per acre. The purpose of this project is to design, install and maintain hydroponic containing different varieties of crops.

## II. SCOPE AND BENEFITS OF IoT

It's the technology of today which is touching and transforming every aspect of our real life. IoT has given a concept of Machine to- Machine (M2M) communication. Companies like Microsoft and SAP are implementing strategy to capitalize on Internet of Things so that you can just stop your business and starts making it thrive. IoT is going to have huge impact on home automation and building automation system where every convenience will be taken care of by the interconnected devices on IoT [ 2]. With the personal

electronic good connected to Internet will enable us to "author" our lives. In medical science field, IoT has given a privilege to devices and system to sense for coming disease and to prevent it, for e.g.: It can make a person healthier with wearable that can predict heart attack and cardio vascular strokes. The IoT will also help to improve efficiency. But, it's only a matter of time before IoT data analysis helps you realize new business functions. Also, this will lead to new revenue opportunities. The IoT may be that special "X factor". Its uniqueness gives many organizations a strategic advantage over the competitors. This advantage will be valuable to companies now and into the next decade. IoT-connected sensors will help us monitor confined and hazardous places and processes, removing humans from danger. Then, by correlating sensor and environmental data over time, new insights can be identified to better understand past events and mitigate future risks.

## III. EXISTING SYSTEM

In the existing system the hydroponics cultivator can only monitor the necessary conditions required for plant growth such as humidity, temperature, water level, light intensity only by using some traditional cultivating methods. The most valuable measurement for your hydroponic system is its pH level. We need to have a top-notch pH meter and monitor the levels at least once a day. The cultivator can know the increase or decrease in necessary parameters and control it only if he is physically present at the sight. This system has a disadvantage because the user can't control these parameters if he is in distance, since the system needs constant monitoring and control. The existing system doesn't satisfy the control of this agriculture completely.

## IV. PROPOSED SYSTEM

In our project we have proposed an idea that would monitor the parameters of the hydroponic system continuously. Also, the cultivators can know the conditions of the plant growth remotely using IoT technology with the help of an application. We will get notified if there is any change to the proposed threshold values for the system.

Advantages of Proposed System

- Continuous Monitoring of theSystem.
- Simple Application is used to monitor thesystem.
- Flexible User Interface which is easy tounderstand.
- Helps in detecting AlgalBlooms.

## V. SYSTEM DESIGN

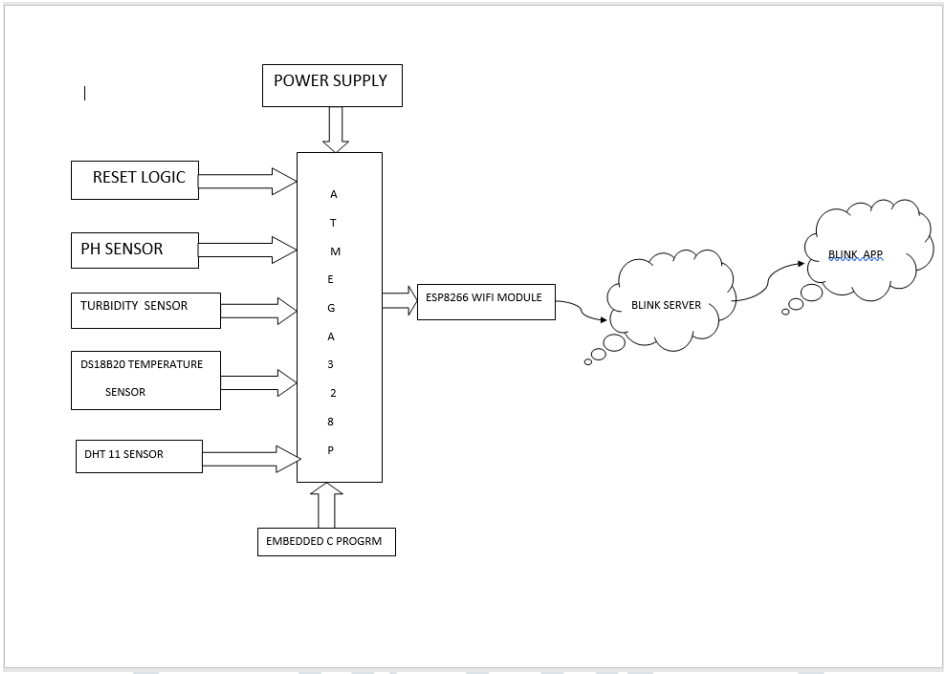


Figure 1. Block Diagram and its Working

Figure 1 clearly depicts that the system consists of four sensors namely pH sensor, Turbidity sensor, DS18B20 sensor and DHT11 sensor to monitor the pH value, Level of Impurity in water, Temperature in water and the humidity around theplant.

The Power Supply is initially given to the Microcontroller 'ATMEGA328P' and reset logic is set for it to provide flaw less readings in our system. An Embedded C Program is loaded in ATMEGA328P to program the IC thus giving the necessary conditions to monitor the system. A wireless fidelity(wi-fi) module named ESP8266 is connected to send the notifications to 'BLYNK' Application. Whenever the sensors read the values other than the threshold values, the LED turns RED in the BLYNK app, else the GREEN LED is turned on. The Blynk server acts as an interface between the Wi-Fi Module and the BLYNKApplication.

## VI. SYSTEM IMPLEMENTATION

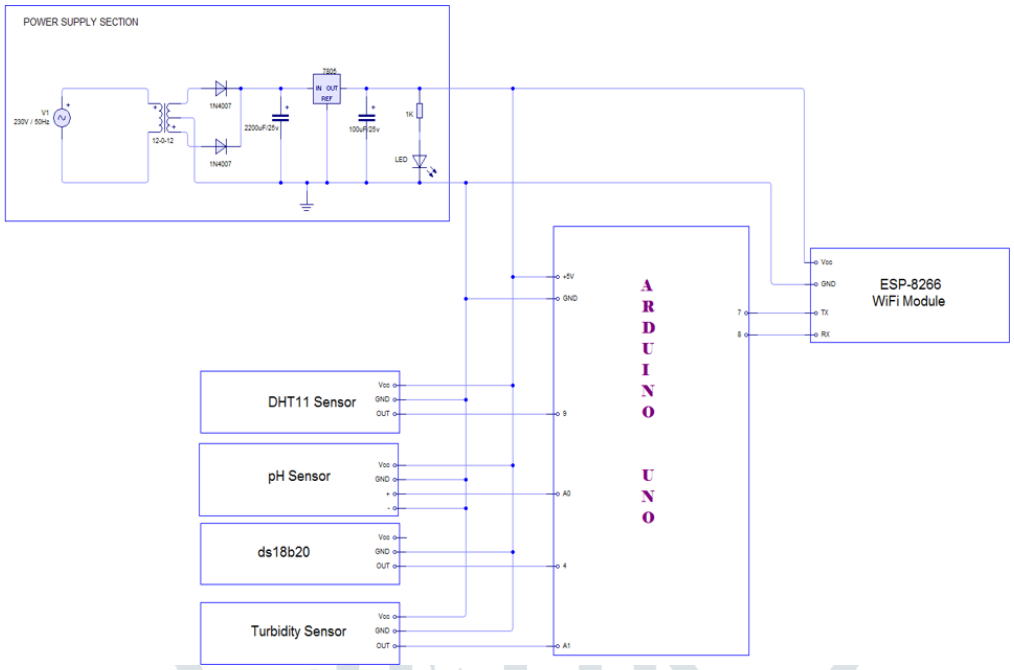


Figure 2. Input Design of the System

The Input Design clearly shows how the circuit is exactly connected containing each and every detail of how the pins in the Arduino Uno Board are connected to the different modules used in the circuit like ESP8266 Wi-Fi Module and all the different Sensors. The power supply section shows how the rectifiers are connected to ensure by converting the AC power supply to DC power supply.

## VII. SYSTEM SPECIFICATIONS

Arduino Uno Board

The Arduino Uno is a microcontroller board based on the ATmega328. Arduino Uno in our project is used a board which has ATMEGA328P Microcontroller [ 3]. When the power supply is given to the board, the Arduino Uno gets activated and helps the micro controller to take the readings from the sensors used in the system. Arduino app via a 'blynk' server regarding the changes in the Uno here is connected to Wi-Fi Module which is used to send the notifications to the 'blynk' hydroponic nutrient solution to theuser.

DS18B20Sensor

The DS18B20 digital thermometer provides 9-bit to12-bit Celsius temperature measurements and communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor [ 4]. The DS18B20 Sensor in our Hydroponic System is used to continuously monitor the Temperature of the nutrient solution which helps in reflecting the changes in blynk application. The nutrient solution has to maintain a temperature of 15-30 degrees Celsius for growing spinach. Although, different plants have different watertemperature.

DHT11 Sensor

It is complex with a calibrated digital signal output. By using the exclusive digital- signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability [ 5]. DHT11 Sensor in our project is used to continuously monitor the Humidity Level near the hydroponic plant which helps in reflecting the changes in blynk application. Also, the humidity level of atmosphere plays an important role in noticing the plant health. The plant is safe when the humidity value ranges between 50-80 RH for growing spinach. Although, different plants have different values of Humidity.

pH Sensor

A pH (potential of Hydrogen) probe measures the hydrogen ion activity in a liquid. At the tip of a pH probe is a glass membrane. This glass membrane permits hydrogen ions from the liquid being measured to defuse into the outer layer of the glass, while larger ions remain in the solution [ 6]. pH Sensor in our project is used to monitor the potential of hydrogen in the nutrient solution. With the help of pH, we can notice the level of hydrogen activity in the nutrient solution. The nutrient solution has to maintain a pH value of 5.8-7.0 for growing spinach. Although, different plants have different values of pH.

Turbidity Sensor SKU:SEN0189

The turbidity sensor detects water quality by measuring the levels of turbidity. It uses light to detect suspended particles in water by measuring the light transmittance and scattering rate, which changes with the amount of total suspended solids (TSS) in water [ 7]. Turbidity sensor in our project in used to measure the level of impurities thereby providing the real time monitoring of impurities in hydroponic system and also helps in detecting algal blooms.

## VIII. RESULTS AND DISCUSSIONS

Experimental Result 1

The following values are obtained under the specific conditions when the temperature of water is 28 degrees Celsius, the humidity level noticed is 62 RH, the pH of water is observed as 8.66. This implies that the water has basicity which shows that there are greater number of nutrient salts which are more when compared to the required amount of salts. Also, the Impurity level is observed as 1.251 V.

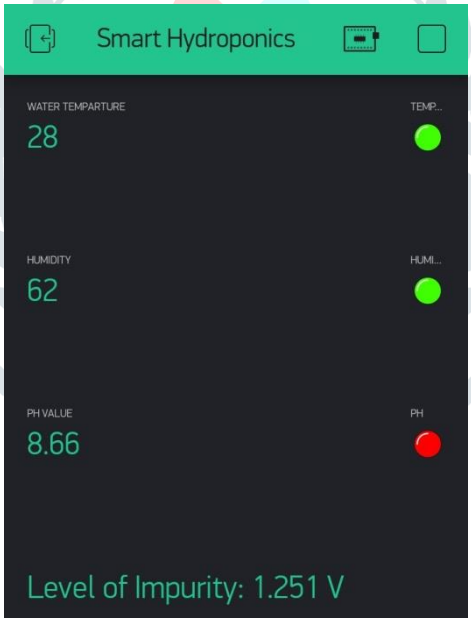


Figure 3.Display of different Parameters used for monitoring the system

The following values are obtained under the specific conditions when the temperature of water is 28 degrees Celsius, the humidity level noticed is 62 RH, the pH of water is observed as 8.66. This implies that the water has basicity which shows that there are greater number of nutrient salts which are more when compared to the required amount of salts. Also, the Impurity level in the nutrient solution is observed as 1.251 V.

Experimental Result 2

The following values are obtained under the specific conditions when the temperature of water is set to 23 degrees Celsius, the humidity level noticed is 60 RH, the pH of water is observed as 7.01. This implies that the water is almost neutral but still out of the range. Also, the Impurity level in the nutrient solution is observed as 3.739 V. This shows that when the water is changed, the impurity levels in water may change.

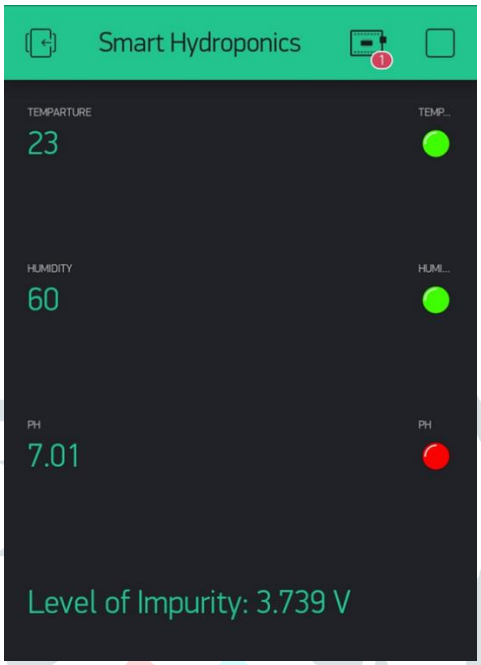


Figure 4. Output in Blynk Application

## IX. EXPERIMENTAL SETUP

This is the experimental setup of our project which we have implemented entitled “Smart Hydroponics Water Monitoring using IoT”. The circuit shows the Arduino Uno board and all the different sensors we used to monitor the values continuously.

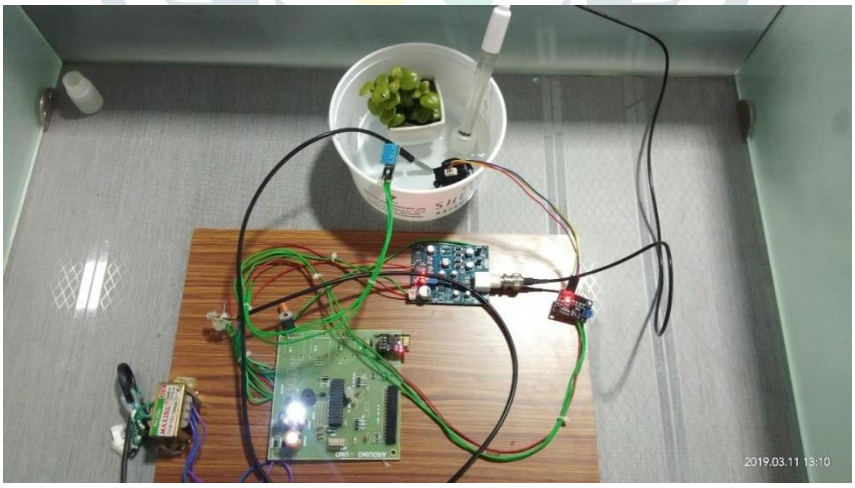

Figure 5. Experimental Setup

## X. CONCLUSION

The aim of this project is to show the details of hydroponics that is implemented using electronic circuit, water and nutrient solution i.e. soilless. The system automatically monitors the nutrient solution and the level of impurities of plant. Once the monitoring is done corrections can be done i.e. it can be controlled manually. This system saves water and fertilizers, gives better yields as compared to soil system. As IoT is a booming technology and hydroponics is a smart way to yield better crops and high productivity, both of them when combined, provides a solution to eradicate the food scarcity problem in the countries like India where the population is growing enormously. This method of

hydroponics with the real time monitoring of the parameters arouses one's interest to grow crops even without the farming knowledge as all the required parameters threshold and the nutrient solution concentration are readily available in the internet. The notification can also be sent through SMS alert in case if the person in-charge doesn't have a smart phone to access the blynk application or is unable to check the mail regularly. We have not implemented this SMS module in our project which is alimitation.

## XI. FUTURE SCOPE

Sensor networks are considered as the key enablers for the IoT paradigm. Hydroponics with IoT gives better results not only when the nutrient solution monitoring is done but also its management has to be implemented. So, the automatic water cleaning i.e., draining out the water using relays when impurities are more, asking the user whether to auto clean the system if he is physically not available etc. and notifying the user of hydroponic system whenever needed.

However, with constant innovation and adoption of newer techniques of growing, the cost differential is reducing. So, we will see progressive farmers adopting the technologies faster in coming years. So, in future, hydroponics adoption will increase in big cities and even more when combined with Internet of Things.

## REFERENCES

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## ACKNOWLEDGEMENT

We have great pleasure in expressing our gratitude to Sri K.V.V.Satyanarayana Raju, Founder & Chairman, Chaitanya Group of Institutions, Sri K. Sasi Kiran Varma, Vice Chairman, GIET Group of Institutions, Smt. Lakshmi Raju Executive Director, GIET, for their kind support in providing us an opportunity to do research in this college.