Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7439

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2019) *7*(4), 160-165

Indian Journal of Pure & Applied Biosciences

Research Article

Smart Agriculture Monitoring System using IoT

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Received: 23.04.2019 | Revised: 30.05.2019 | Accepted: 7.06.2019

ABSTRACT

The agricultural growth is enhanced with the increase in the productivity and upgradation of the plantation systems. The application of Internet of Things (IoT) technology in agriculture could have the greatest impact for increase the productivity. The global population is increased every year. So, to feed this much population, the farming industry must use advanced technology like IoT for increased profit. Smart farming based on IoT technologies will enable growers and farmers to reduce waste and enhance productivity ranging from the quantity of fertilizer utilized to the number of journeys the farm vehicles have made. In IoT-based smart farming, a system is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, PIR Sensor) and automating the irrigation system. The farmers can monitor the field conditions from anywhere. IoT-based smart farming is highly efficient when compared with the conventional approach.

Keywords: *IoT, PIR Sensor, Light, Humidity, Temperature*

INTRODUCTION

The agricultural development is accelerated with the increase in the productivity and upgradation of the plantation systems. The Internet of Things (IoT) has the capability to transform the world. However, the application of technology like IoT in agriculture could have the greatest impact. Every year the population is increased. So, to feed this much population, the farming industry must embrace IoT (Jim Chase, 2013). Against the challenges such as extreme weather conditions and rising climate change, and environmental impact resulting from intensive farming practices, the demand for more food has to be met. Advanced automated IoT technologies have to be used in agriculture to meet the demand. This paper described the agriculture sensor and its use in smart agriculture for increase the productivity with reduced human effort and cost. The IoT technology is more efficient due to following reasons such as Global Connectivity through any devices, Minimum human efforts, Faster Access, Time Efficiency and Efficient Communication.

Cite this article: Prema, P., Sivasankari, B., Kalpana, M., & Vasanthi, R. (2019). Smart Agriculture Monitoring System using IoT, *Ind. J. Pure App. Biosci.* *7*(4), 160-165. doi: http://dx.doi.org/10.18782/2320-7051.7439

The key advantages of using IoT in enhancing farming are as follows:

1. Soil management such as PH level, Moisture content etc can be identified easily so that farmer can sow seeds according to soil level.
2. Water management can be efficiently done using IoT with no wastage of water using sensors.
3. Crop monitoring can be easily done to observe the growth of crop. IoT helps to continuous monitor the land so that precautions can be taken at early stage.
4. It increases productivity, reduce manual work, reduce time and makes farming more efficient.
5. Sensors and RFID chips aids to recognize the diseases occurred in plants and crops. RFID tags send the EPC (information) to the reader and are shared across the internet. The farmer or scientist can access this information from a remote place and take necessary actions, Automatically crops can be protected from coming diseases (Lakshmisudha, 2011).

LITERATURE SURVEY

In Agriculture field, the farmers use manual method for checking the checking the soil parameters. The system mainly focuses todeveloping devicesto manage and alert the farmers by the wireless sensor system (Lakshmisudha, 2011). It proposes a low cost and efficient wireless sensor network technique to acquire the soil moisture and temperature from various locations of farm and as per the need of crop controller to take the decision whether the irrigation is requirement (Nandurkar et al., 2014). The author (Chetan, 2015) proposes a novel technique for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology. The atmospheric conditions are monitored and controlled online (Vidya Devi & Meenakumari, 2013). The IoT technologies are used for smart agriculture (Gondchawar & Kawitkar, 2016). The highlighting features are smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, human detection and keeping vigilance. The cloud computing devices that can create a whole computing system from sensors to tools that observe data from agricultural field images and from human actors on the ground and accurately feed the data into the repositories along with the location as GPS coordinates (Gayatri et al., 2015). The author proposes (Joaquín Gutiérrez, 2013) an idea about how automated irrigation system was developed to optimize water use for agricultural crops. In addition, a gateway unit handles sensor information. The IoT based monitoring system (Meonghun Lee, 2013) to analyze crop environment and the method to improve the efficiency of decision making by analyzing harvest statistics. Image processing (Jhuria et al., 2013) is used as a tool to monitor the diseases on fruits during farming, right from plantation to harvesting. The variations are seen in color, texture and morphology. The soil parameters such as soil moisture content and surrounding temperature are crucial factors for the proper plant growth**.** The system provides a real time system which monitors soil temperature and soil moisture efficiently. The system valves are turn ON or OFF automatically depending upon the moisture content. The system provides a real time analysis to the owner to monitor variation in the parameters. Using this system, one can save manpower, water to improve production and ultimately increase profit.

Agricultural Sensor

A number of sensing technologies are used in precision agriculture, providing data that helps farmers monitor and optimize crops, as well as adapt to changing environmental factors.

Soil Moisture sensor

A sensor that will sense the moisture level in the sand is called soil moisture sensor.

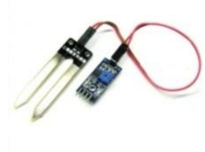

Fig. 1: Soil Moisture Sensor

The Moisture sensor is used to measure the water content (moisture) of soil. When the soil is having water shortage, the module output is at high level, else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening.

Temperature Sensor

Temperature Sensor DHT-22 is used to read current temperature and humidity of the atmosphere. DHT22 capacitive humidity sensing digital temperature and humidity module is one that contains the compound has been calibrated digital signal output of the temperature and humidity sensors. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The sensor includes a capacitive sensor wet components and a high-precision temperature measurement devices, and connected with a high-performance 8-bit microcontroller. The product has excellent quality, fast response, strong anti-jamming capability, and high cost. Standard single-bus interface, system integration quick and easy. Small size, low power consumption, signal transmission distance up to 20 meters, making it the best choice of all kinds of applications and even the most demanding applications. It's Humidity Range is 0-100% and Temperature range is -40 to - 125°C

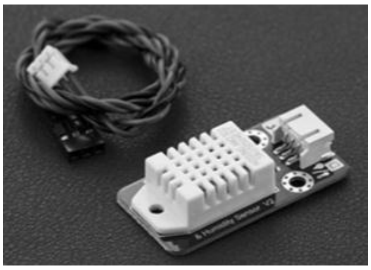

Fig. 2: Temperature sensor

PIR Sensor

A PIR Sensor or a Passive Infrared Sensor is an electronic device that measures the infrared (IR) light emitted by the objects in its observable area. The term ‘Passive’ in the PIR Sensor indicates that the sensor actually doesn’t emit any infrared light but rather passively detects it that is emitted by its surrounding objects. Every object, with its surface temperature greater than absolute zero i.e. -273^{0}C emits heat in the form of infrared radiation. Humans cannot see this radiation as the radiations are in infrared wavelength. But PIR Sensors detect these radiations and change them into appropriate electrical signals. To connect with external devices, it has only three pins namely VCC, Digital OUT (Data) and GND. On the top of sensor board, there is a special type of lens called Fresnal Lens that is covering up the actual Pyroelectric Sensor. The function of the Fresnal Lens is to focus all the infrared radiation onto the pyroelectric sensor.

Fig. 3: PIR Sensor

The brain of the PIR Sensor Module is the BISS0001 PIR Motion Detector IC. Near this IC, we have two potentiometers, one for adjusting the Sensitivity and the other is for adjusting the delay time. Using Sensitivity Adjust, you can control the range of field of view and in our sensor, it is up to 7 meters. Using the Delay Time Adjust, you can control the duration for which the Digital Out will stay HIGH when a moving object is detected.

MATERIALS AND METHODS

Hardware

Arduino Uno-MICROCONTROLLER:

The Arduino Uno is one of the most popular microcontrollers in the industry. It is user convenient and easier to handle. The coding or programming of this controller is also easy. The device has capabilities to be connected the internet and act as a server too, this way the handling of information and data.

Soil Moisture Monitoring

Soil moisture is the water held within the soil pores. Soil moisture is one of the main factors deciding crop yield, as it affects the water uptake of the plant. So measuring soil moisture always plays an important role in successful farm management. The conventional method to evaluate soil moisture content of 'look and feel' can be highly inaccurate. The use of moisture sensors helps to evaluate soil moisture helps to make relevant irrigation decisions.

The hardware is consists of an Arduino microcontroller (here an Arduino Uno) and a pre-wired soil moisture sensor module. The soil moisture sensor module, built around the LM393 comparator, gives an active-low (L) level output when the soil is dry (determined by a pre-setted threshold value). This digital output (wet soil → L / dry soil → H) is routed to one I/O terminal (D2) of the Arduino microcontroller. Based on this input (at D2) arduino gives an active-high (H) output through D13 when soil is dry, and an active-low (L) output when soil is wet.

Table 1: Soil Condition and output

Soil Condition	**Output**
Wet	Low /Off
Dry	High / On

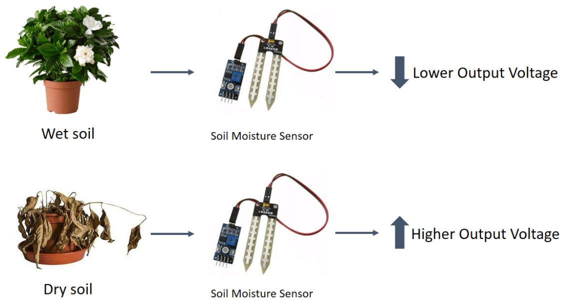

Fig. 4: Soil moisture sensor module

Temperature Sensor

The figure shows the connectivity diagram of Humidity sensor.

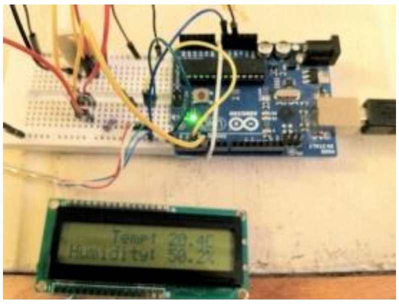

Fig. 5: Temperature Sensor

The sensor read the temperature and humidity and displays the reading in the LCD. It can measure the environment temperature and humidity to meet the high demand.

Experimentation and Results

The hardware is interfaced with all the sensors in the board. The hardware components include the microcontroller, a water pump, relay,12 V battery, Wi-fi sensor and the soil moisture sensor is interfaced and power supply has provided. The system has been tested for watering a plant in a garden. In the field section, sensors are deployed in the field like soil moisture. The data collected from these sensors are sent to the Database via the android application. In control section, the system is turned on using the application, this is done using the on or off buttons in the application. Also, this system is turned on automatically when the moisture of the soil is low, the pump is turned on and depending on the moisture content. The application has a future feature of taking the time from the user and irrigates the field when the time comes. In manual mode, there is a manual switch in the field to make sure that if the system fails, one can turn off the water supply manually.

Future Work

For further enhancement, this system is used for large acres of land. Also, the system can be integrated to check the soil nutrient and crop growth in each soil. Also, the system can be further improved by adding machine learning algorithms, which are able to learn and understand the requirements of the crop, this would help the field be an automatic system.

CONCLUSION

Internet of Things will help to enhance smart farming. Using IoT we can predict the soil moisture level and humidity. Irrigation system can be monitored and controlled by IoT technology. The crop damage using predators is reduced. IoT works in different domains of farming to improve time efficiency, water management, crop monitoring, soil management, control of insecticides and pesticides. It also minimizes human efforts, simplifies techniques of farming and helps to gain smart farming. Along with these features smart farming can help to grow the market for farmer with single touch and minimum efforts.

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