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IoT Enabled Climate Monitoring System for Vineyard

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Abstract: ***Agriculture is the significant economic activity in India.80% Indians are depending on agriculture and its products directly or indirectly. 16% of total GDP contributes agriculture in India. Agriculture is mostly depending on monsoon. Environmental changes affect on crop field and its productivity. In India, Maharashtra is the well-known state for fruit production. Bananas, Grapes, Papayas, Oranges and many more fruits are produced as well as exports to the other countries. Among them grapes are produced in Maharashtra in large amount. It is the profitable economic activity but the grape crops are very sensitive to the is 10^0C to 40^0C. The grape crops can handle rise in temperature but temperature below 10^0C affect severely on crops. For proper growth of grape crops, the ideal temperature range and high humidity affect on production. In winter below 10^0C temperature, the leaves become blackish, crops tend to stop the growing and affecting the overall production. So, to maintain the temperature is very important task. The farmers can control the temperature by their own traditional strategies like to cover the stems with hey or remaining part of sugarcane and many other methods, if they know the exact temperature of the field. In the present work, the temperature monitoring system developed for grape horticulture by using sensor and IoT technology. In the system, temperature sensor LM35 used for detecting the temperature of the field. The microprocessor PIC16F877A processed the data and sent to the server by using ESP8266 Wi-Fi Module. If the temperature goes down or up of the predefined level which is set to the microcontroller then the SMS goes to the farmer's smartphone. Farmer can take immediate control action for temperature management in the crop field.***

Keywords: LM35 sensor, PIC16F877A microcontroller, ESP 8266 Wi-Fi Module

I. INTRODUCTION

Agriculture is the important economic activity in India. Indian economy is based on agriculture and agricultural products. 80% of the Indian population depends on the agriculture. Agriculture is the biggest employment providing sector. It provides the most of the raw materials to the fastest growing industrial sector. So, it becomes earner of foreign exchange. 16% of total GDP contributes agriculture in India (1). Maharashtra is one of the largest providers of fruits like Grapes, Bananas and Papayas. Among the fruits, Grapes are produced in large amount in Maharashtra. Maharashtra is famous as well as biggest producer of the best quality of grapes and its products. The grapes are also exported to the European countries. Maharashtra has largest area under the different fruit crops like grapes, bananas, mangoes, oranges, cashewnuts etc. In Maharashtra, most of the farmers are depend on the natural environment or monsoon. In winter, most of the times the temperature of the environment becomes very low and the low temperature affects on the development of fruit crops. The temperature range required for growing the grape crops is between 10^0C to 40^0C. Grapes are very sensitive to temperature and humidity. Changes in the temperature badly affect on grape crops. If the temperature decreases below 10^0C then the effiecncy of fruit crops decreases, the leaves of the crops burned and grapes are get cracked and becomes black. It affects on overall production and cost of the grapes. So, it is very important to monitor and manage the environmental changes.

If the farmer knows the exact environmental condition, he can avoid the loss of grapes by adopting the controlling strategies. The farmers can take immediate natural control actions like to cover the stems with hey or remaining part of sugarcane. One can adopt the natural management system for increased and decreased temperature. By adopting the sensor applications and Internet of Things the farmer can get the information about the temperature and he can manage the temperature variations. In winter below 10^0C temperature, the leaves become blackish, crops tend to stop the growing and affecting the overall production. So, to maintain the temperature is very important task. The farmers can control the temperature by their own traditional strategies like to cover the stems with hey or remaining part of sugarcane and many other methods, if they know the exact temperature of the field.

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II. LITERATURE REVIEW

Nikesh Gondchawar and Prof. Dr. R.S. Kawitkar addressed 'IoT based Smart Agriculture'. (2) The authors developed a system using robot and IoT technology. The system performs moisture sensing, bird and animal scaring operations automatically. Also, the system monitors the environmental condition and control the system by intelligent decision making, which is based on real-time monitoring data. Controls the task by remote devices by interfacing sensors, camera, microcontroller, actuators, raspberry pi and Wi-Fi modules.

Dr. N. Suma and et al. addressed 'IoT based Smart Agriculture Monitoring System'. (3) The authors developed a system to remotely monitoring and controlling the various parameters affecting on agriculture. The system monitors temperature, moisture, scaring intruders, irrigation system and leaf wetness continuously. Using WSN, the parameters at different locations in farm field monitored and controlled. Interfacing sensors, Wi-Fi, microcontroller and camera the controlling action performed.

R. Nageswara Rao and B. Sridhar introduced 'IoT Based Smart Crop-field Monitoring and Automation Irrigation System'. (4) The authors proposed a system which makes the agriculture smart using IoT technology. It is an automatic irrigation sensor-based technique. The sensor senses the data of temperature and humidity of the soil. Based on the data which is sensed by sensors the base station take decision for the irrigation i.e. water is required for soil or not. If water is required then motors get ON and starts watering the soil. Using Raspberry Pi 3 module, temperature sensor, moisture sensor the system is become automated.

Prosanjeet J. Sarkar and Satyanarayan Changala presented 'A Survey on IoT Based Digital Agriculture Monitoring System and Their Impact on Optimal Utilization of Resources'. The authors addressed the monitoring system which are developed by different researcher by using IoT technology. Monitoring of various parameters like temperature, humidity, moisture, pH value of the soil for maximizing the profit. The paper proposed a system which get data from sensors and processes the data using microcontroller and by using ESP8266 wi-fi module the data shared on internet. Using PDA, Web data can be accessed remotely from anywhere.

Raju Bhowmik and Ajita Pathak introduced 'An Arduino based WSN to Control and Monitor the Greenhouse Parameters'. The authors proposed WSN system based on Arduino for monitoring and controlling the greenhouse parameters like temperature and humidity. For maintain the greenhouse parameters the system is useful.

A. Salleh and et al. addressed 'Development of Greenhouse Monitoring using WSN through Zigbee Technology'. The authors developed a system implementing Wireless Sensor Network to monitor the greenhouse parameters temperature and humidity. The automated system is developed by using zigbee protocol.

III. METHODOLOGY

The overall IoT system architecture is shown in following figure.

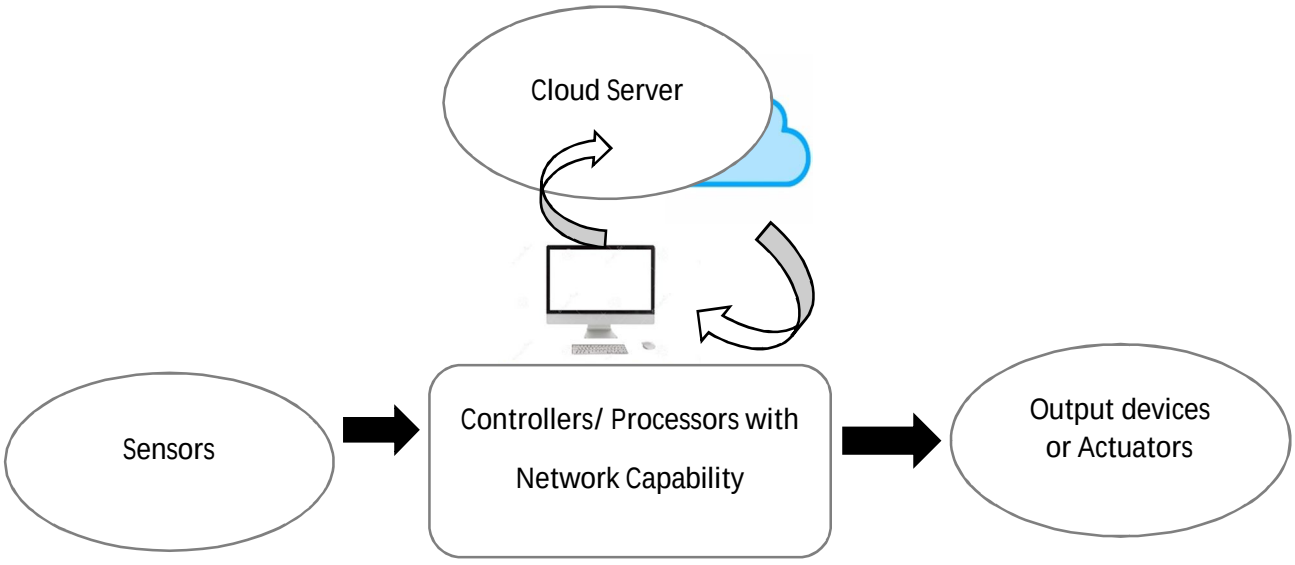


Fig.1 IoT system architecture

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Introducing Internet of Things (IoT) in the grape's horticulture the efforts of the farmer reduced. Even the concept of the Internet of Things is new to farmer and the other persons but the uses of the IoT are endless. The Internet of Things enables the physical objects or 'things' to collect and exchange the data over the Internet. In other words, IoT is the network of objects using sensors, controllers or processors and network connectivity for gathering and exchanging the information or data. IoT enable the physical objects to be sensed, monitored and controlled remotely over the network. The sensors sense the physical parameters and transfers to the microcontroller or processors. The microcontroller or processor process the data and sends over the cloud server using network infrastructure. From Internet one can access the data at remote place.
The block diagram of the system is shown in following figure.

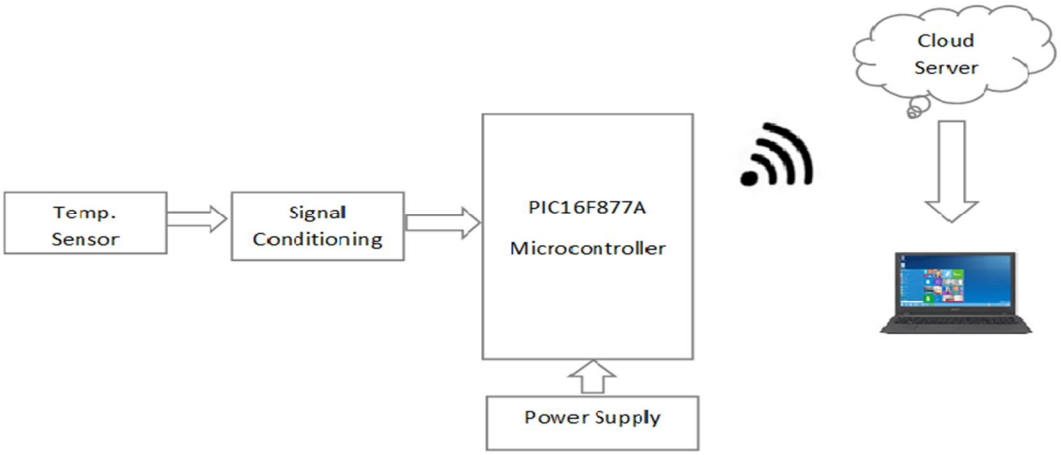


Fig. 2 The block diagram of the system.

For monitoring the temperature of the crop-field the temperature sensor LM35A used. Temperature sensor LM35A is a semiconductor. The temperature range of LM35A is $+2^0$C to $+150^0$C. LM35A sensor has zero offset voltage that means the sensor output is 0 volt at 0^0C. Voltage range of the LM35A sensor is from 10mV to 1.5V. The output of the sensor is in analog form. In signal conditioning process the output from sensor was converted in appropriate form. Therefore, the temperature can be realized in degree Celsius by using the equation

Temp. = [5* (analog read *100)/ 1024]

The microcontroller PIC16F877A used for the further processing the temperature sensor's output. PIC16F877A microcontroller is 10-bit and 8 channel ADC. The PIC16F877A microcontroller compared the sensor output with predefined temperature range. If the temperature was exceedingly above and below the range then the microcontroller sent the data to the cloud server by Wi-Fi ESP8266 module. ESP 8266 Wi-Fi module is a SOC having TCP/IP protocol. It gives microcontroller access to the Wi-Fi network. A communication link was developed between the PIC16F877A microcontroller and the Wi-Fi module by using USART module in the PIC microcontroller. The data from microcontroller was stored on the cloud server. By accessing the Internet, the data was transferred to the remote places. As well as the data or temperature of the crop-field was displayed at the field location by interfacing the LCD to PIC16F877A microcontroller.
The farmer gets the messages on the smartphone about temperature variations in the atmosphere. By knowing the current temperature farmer can implement the controlling actions of temperature. The temperature parameter is the most important parameter for the crop's growth. There are many remedial actions for the manage the temperature in the crop-field. Most of the crops get damaged because of various pests. Crop productivity affected by temperature variations.

IV. RESULT AND DISCUSSION

The temperature sensor and the Internet of Things (IoT) makes the farmers work and efforts easy. Implementing the system in the crop-field the farmers aware about the atmospheric variations. The system implemented in the grapes horticulture. In winter, the temperature below the 10^0C the fruits get severely affected. The current system is sensing the temperature in the crop-field and sends the data to the farmer using Internet of Things very effectively. The farmer received the notification about temperature at regular interval.

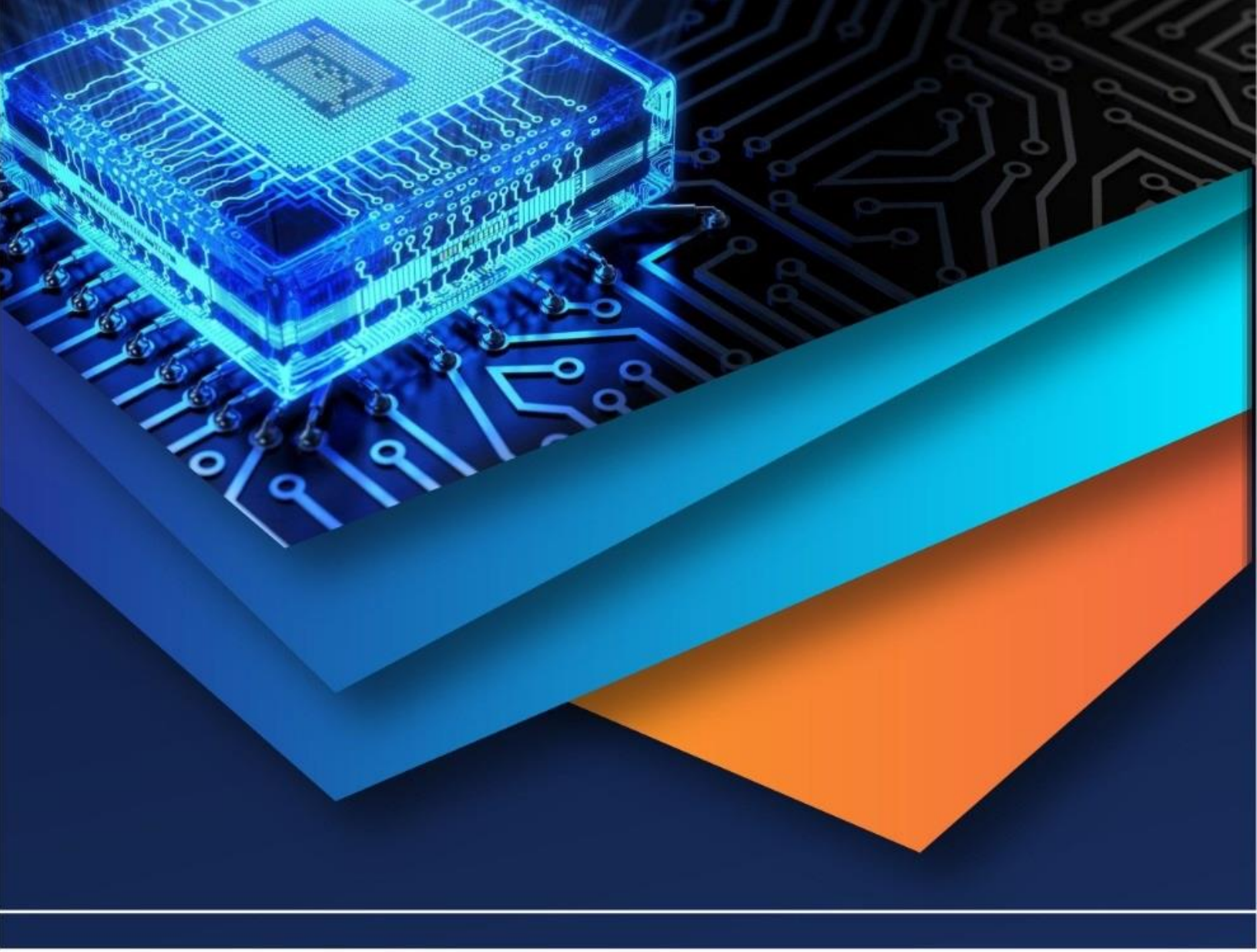
The system is useful for farmers for protecting their crop fields from environmental changes. The sensor and IoT technology switch the traditional agriculture to smart agriculture. The IoT technology improves the efficiency of crops as well as the farmers. Thereby productivity and profit also increase.

V. CONCLUSION

For monitoring the temperature in the grapes horticulture, the system is developed. The temperature sensor LM35A sensed the temperature and the output of the sensor sent to the microcontroller PIC16F877A through signal conditioning. The temperature sensor, Wi-Fi module ESP8266 and LCD display successfully interfaced with PIC16F877A microcontroller and communication link developed between microcontroller and wi-fi module. The data regarding temperature stored successfully on the cloud storage.
The system is the solution to the variations in temperature for the grapes horticulture. The system is free from human interference. The automated system saves the efforts and time of the farmer. The system can definitely improve the crops and overall, the grapes production.

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