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AGRICULTURE CROP MONITORING FRAMEWORK BASED ON WSN

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ABSTRACT

Agriculture and food security have become a serious issue throughout the world. Pakistan's major source of income is from agriculture sector. There is a pressing need to resolve the issue in the domain so that it can reclaim its vibrancy and resume its upward trajectory. Agriculture farming crops produced in low quality due to deficiency of information of farmers and crops destroyed by insects. Issues concerning agriculture have been always hindering development of country. Various factors are used for crop environment i.e. humidity, temperature and soil moisture. These parameters can be integrated through wireless sensor network to increase the crops productivity in good quality. One of the solution is smart agriculture by revolutionizing existing traditional agriculture methods. Therefore, this paper presented the design and implementation of Wireless Sensor Networks based automation and monitoring system. This WSN based automation and monitoring framework makes use of WSN in order to collect data from various sensors which are installed at different node point and transmit it via wireless protocol communication. The proposed framework results in the reduction of labour cost and crop wastage, and also use water resources in efficient way.

Keywords: Agriculture, Crops, WSN, Monitoring, Automation.

I. INTRODUCTION

The agriculture products as it is one of the best sources of improving the economic status of a state. To monitor the crops efficiently it has a lot of utilities and also it increases the production ratio significantly as it tries to provide optimum amount of water and consumables to the crops [1]. Besides its benefits there are some problems related to crop monitoring such as cost of operation and maintenance due to which most of the farmers cannot be benefited from it. But in Pakistan most of the people are travelling from the rural setup to urban areas due to the classical methods of farming which they cannot tolerate.

A former want to be informed about different attributes and condition of crops anytime. Different attributes may contain environmental temperature, humidity, soil water level, rain condition etc. These attributes help the former to provide the required environment to the crop. For example, if water level become low than required level for a crop, the farmer should get informed and he should water the crop to achieve high quantity and high quality of products [2]. Similarly, if in a greenhouse rain is not suitable and harmful for a specific type of plant or crop, the farmer should get informed, so that he provides a safe shelter from rain to crop. Other attributes also help farmer to maximize his crop yield and improve quality of crop.

Wireless technologies have made a tremendous progress in the modern era. It has reduced the need for wires and harness to a greater extent [3]. Presently, the need of a system that works in real time with a variety of sensors linked to a single gateway is felt more than ever which is later converted into WSN. In WSN there are different nodes [4]. Through SMS, the owner of farm i.e. the farmer will be knowledgeable from the field environment and crop's condition. And by analyzing information transmitted from the sensor, the central node will take decisions accordingly. For example, if the sensor sends data of soil moisture level. By receiving it by main node, the main node will take decision that the watering device may be an irrigating system or tube well should water the crop or not? So it will instruct the actuator node to turn on or off the irrigating system [5].

This paper proposed to design a communication network for monitoring the farm and different type of crops. The communication network will consist of hardware and software. We will design WSN for communication and will design a control system for controlling 10 the different attributes for example water level as shown is figure 1.

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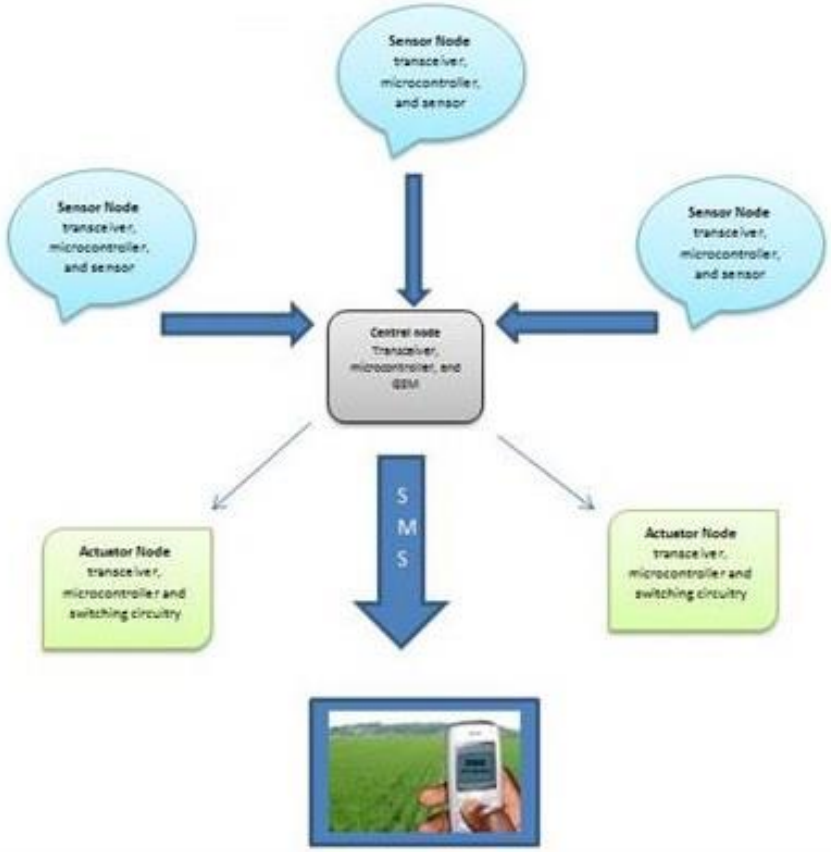

Figure 1: System Architecture

II. LITERATURE REVIEW

Authors in this paper examined the creation of a suggested wireless plant network in order to accomplish scientific cultivation and the low administrative expenses associated with environmental monitoring [6]. An efficient and cost-effective system based on WSN technology was created to handle important environmental elements such as temperature, humidity, and illumination based on an analysis of greenhouse environmental characteristics. This paper investigates and evaluates the possibility of employing WSNs and communication algorithms in data management for the aim of managing the production environment directly. In [7], the authors presented a long-term agricultural solution that is sustainable. The main aim of this paper is to collect environmental information and control irrigation with a smart phone. The WSN purpose communication method is used [8]. The Automated Irrigation system reports things to the farmer via portable SMS, website or voicemail alert. The authors used the advanced innovation to work on agrarian exercises [9]. One of these undertakings is to control the measure of water in the developed fields, this interaction relies straightforwardly upon the planting and creation of the plants, as they can annihilate the plants. Propose a framework called Equalized Cluster Head Election Routing Protocol (ECHERP) in view of the mix of a coordinated framework for programmed water system the executives with cutting edge WSNs conventions (remote sensor organizations. Computerized framework [10] [11]. There are a few advantages to utilizing WSNs and computerized horticultural dynamic frameworks:

- Improved rate and field water system arranging relies upon accessible water accessibility.
- Reduction of HR required, time and exertion in farming creation.
- Better cooperation between various working gatherings, specifically Farmers and specialized colleagues because of a reasonable division of work.

III. METHODOLOGY

The proposed methodology is design in three main sections, such as the sensor node, the central node and the actuator node. Every node consists of microcontroller and transceiver. Inter node communication is wirelessly using Bluetooth technology. The proposed framework is as shown in figure 2.

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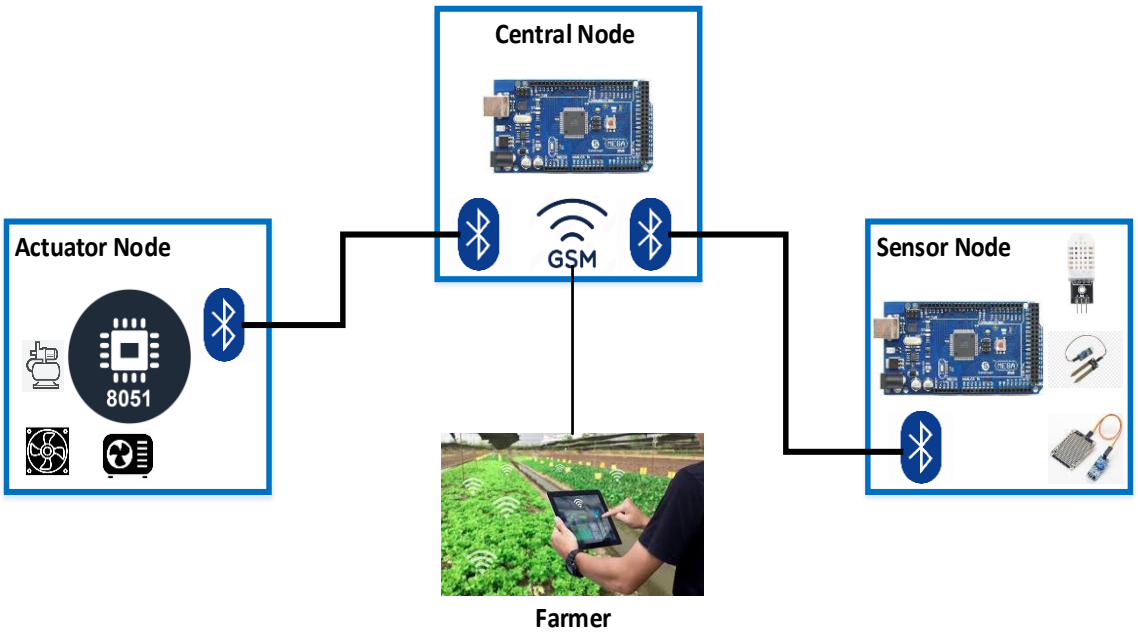

Figure 2: Proposed framework

Sensor node is consisting of Bluetooth, Arduino, transceiver and the sensors. Actuator node is composed of 8051 microcontrollers, Bluetooth transceiver and power relays. The central node is composed of GSM module, Arduino and the Bluetooth transceiver. The hardware used are as follow:

Arduino Mega2560:

It is used for analog reading from sensors and is placed in the sensor node. It is used for sharing processed values of sensors with the main node through Bluetooth.

GSM SIM900:

GSM SIM900 is used in main node for sending SMS. When any change occurs in environment, main node will receive information from sensor node. The central node analyzes the whole process and informed farmer by SMS. The GSM is interfaced with the Arduino. It is done by connecting Rx of GSM to Tx of Arduino and Tx of GSM to Rx of Arduino. Also ground of GSM and Arduino are connected.

BLUETOOTH HC-05:

Bluetooth is used in each node. It is used for internode communication. Bluetooth is low cost that why it is selected as transceiver although its range is low i.e. 10 meter.

SOIL HYGROMETER SENSOR:

It is simple soil moisture sensor. It is used in plant module water devices, for protecting plants in agriculture field. Its sensitivity can be attuned through digital potentiometer. It is dual output module such as analog output and digital output. It is small in size.

RAIN SENSOR:

This sensor uses the high density 2-dimensional material FR-04. The compiler LM393 is used. The output is based on digital and analog mode of 15mA TTL. The module has a flexible sensitivity, which can be adjusted with an adjustable digital potentiometer. If there is no rain the digital output is HIGH. It has two indicators, one for power and one for output. It is less expensive and easier to use.

TEMPERATURE SENSOR DHT11:

DHT11 sensor has temperature and humidity sensors with the output of a standard digital signal. By using a special process of obtaining digital signals and heat and humidity technology, it ensures high reliability and good long-term durability. This sensor links to 8 bit microcontroller and integrates part of the humidity-type humidity measurement and NTC temperature measurement, giving great quality, fast response and cost effectiveness.

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IV. IMPLEMENTATION AND RESULTS

The proposed framework is implemented and designed hardware prototype. It consists of three modules, i.e. sensor node, central node and actuator node. Each node has a microcontroller and a transceiver.

SENSOR NODE:

This node consists of soil moisture sensor, temperature and humidity sensor, rain sensor, arduino mega2560 board and a Bluetooth. This node has its own 9V power supply. Arduino reads sensors value using analog pin. Temperature and humidity sensor is DHT11 for which arduino has a built in library and arduino reads it by sending instructions.

Working: Arduino reads sensors and then compare these readings with the predefined required values. Arduino sends this information through HC-05 Bluetooth to main node, where this information is processed. The sensor node is as shown in figure 3.

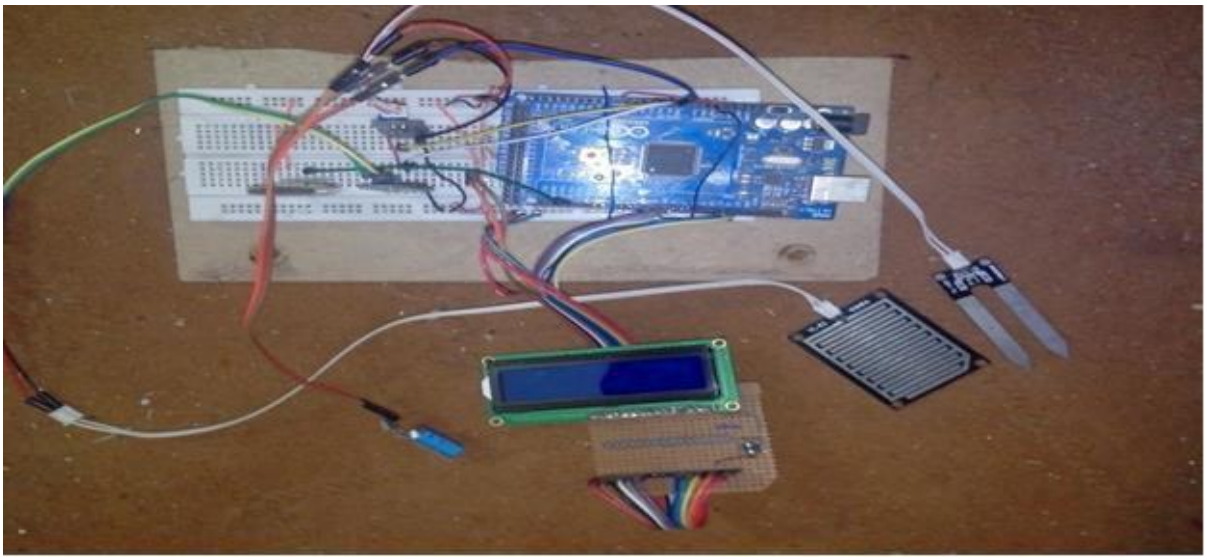

Figure 3: Sensor node

This node also has a 16x2 LCD. This displays the current condition of sensors. Arduino has a built-in library for LCD. Its programming and interfacing with Arduino is easy

CENTRAL NODE:

This node contains an Arduino board, a Bluetooth and a GSM kit. It has also its own power supply. Arduino board needs power of 9V.

Working: Through Bluetooth it receives the data from sensor node. This node processes that data and gets information from that and informs the farmer by SMS through GSM SIM900. Also it sends commands to actuator node for action required. For example, if main node receives data and it finds that water level is low then it sends command to actuator node for switch on the irrigation system which may be a water motor. The SMS contain the current conditions environment and also the command sent to actuator node as shown in figure 4.

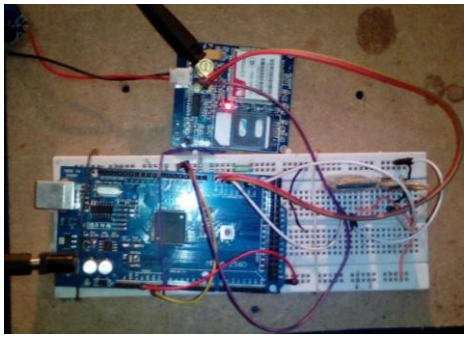

Figure 4: Central node

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ACTUATOR NODE:

This node contains an 8051 microcontroller, a Bluetooth and relays for switching purpose. Relays are used for switching on/off 220V to 240V AC voltage for water motor (irrigation system) and heater, also for switching 12V DC exhaust fan and DC motor for shelter closing and opening. This node has its own power supply.

Working: This node receives commands through Bluetooth from main node and does that action. Actions are on/off switching of DC motor, exhaust, heater and water motor as shown in figure 5.

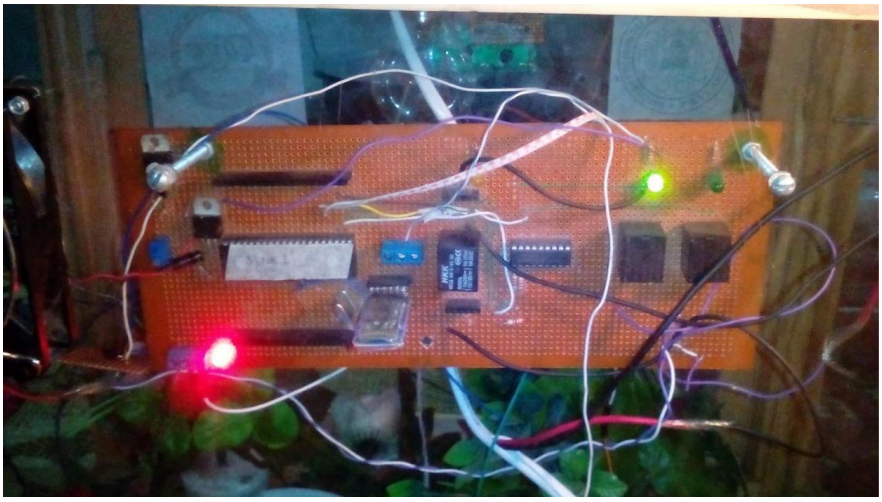

Figure 5: Actuator node

SENSOR DATA:

All sensor nodes have been deployed in agriculture field. The various sensors i.e. temperature and humidity, soil moisture and rain sensor continuously measured the data and transmits this data to the central database server. The temperature data is illustrated in figure 6 and the humidity is illustrated in figure 7.

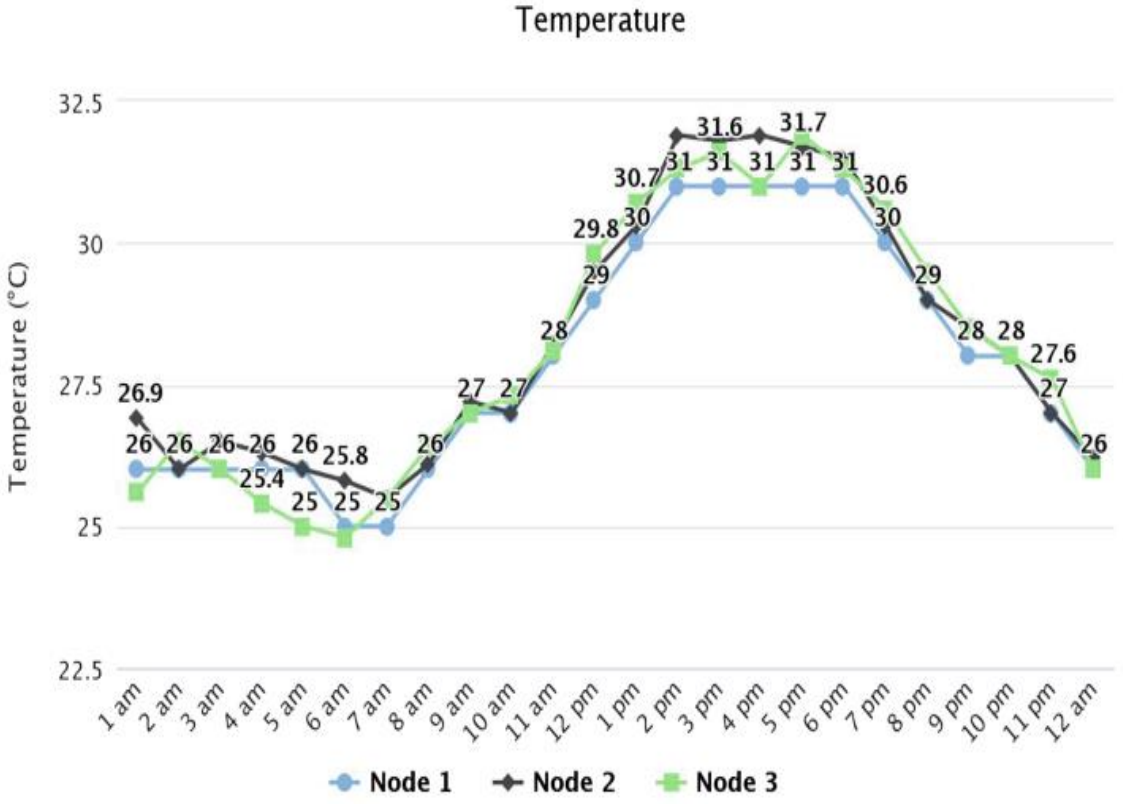

Figure 6: Temperature data

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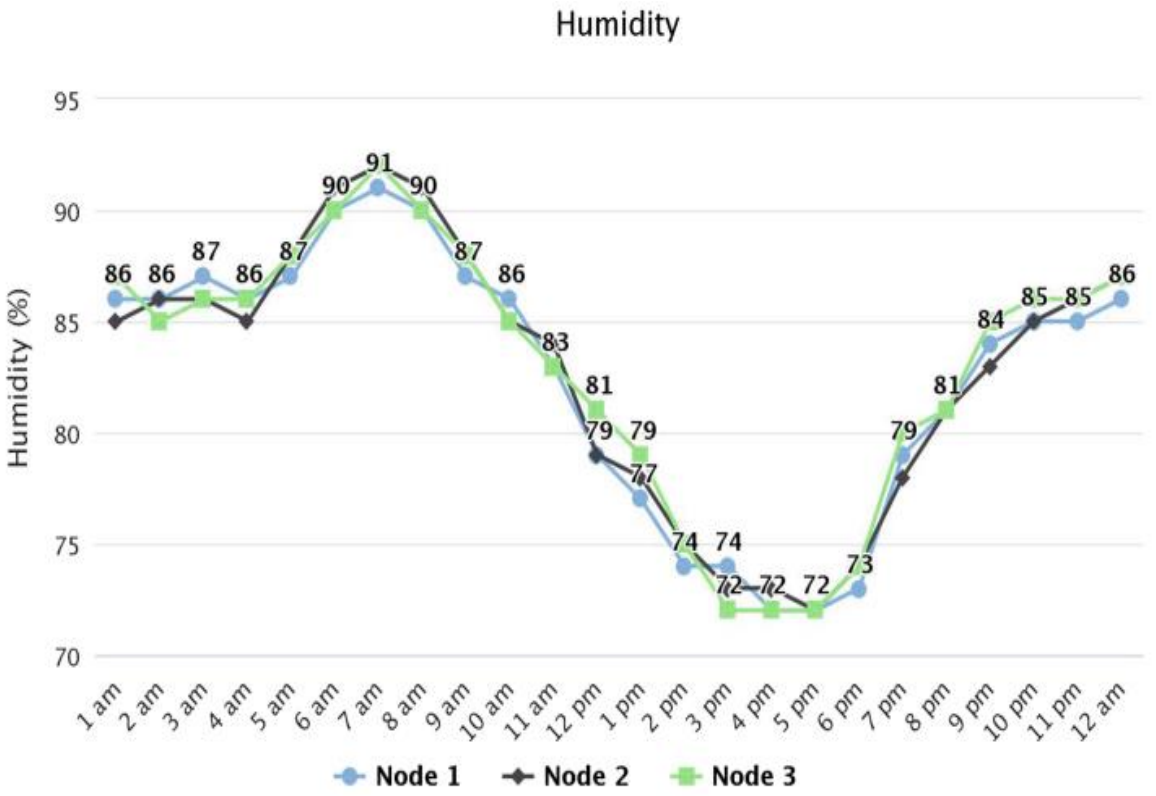

Figure 7: Humidity data

V. CONCLUSION

In this paper, the WSN based automation and monitoring system was developed and designed in order to keep track of present situation in field of agriculture in real time analysis. The proposed architecture consists of sensor node, central node and actuator node, database server and a smart phone. The sensor node made up of microcontroller, GSM module Bluetooth module and consists of various sensors for collecting data from field and by sending these data to the database server. In future, the ZigBee and Wi-Fi will be used for better range of communication and it will cover large area.

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