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Wireless Sensor Networks Master Slave based Farm Monitoring

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Abstract: ***There are many tough situations where in it becomes harder to monitor our farm area manually. To check the water supply and wetness of soil, to detect occurrence of a fire accident, internist of light etc. Sometimes manual inspection may not be very precise, humans generally not intentionally do overlook. So instead of checking out manually we use Wireless Sensor Networks (WSN), that monitor our farm and update data on to the server, which can be monitored by sitting at home. This also helps us in continuous monitoring of our farm without any inconvenience. To achieve this, we are using wireless sensor networks Master Slave model. Where in, both master and slave are equipped with the sensors to measure the environment. Each master and slave are equipped with the smoke sensor, soil moisture sensor, LDR, DTH11 to monitor the surrounding environment. Mater node acts as a gate way i.e, (all) the slave nodes communicate to or transfer information to the master node. Mater node transmits the information on to the server. This communication between slave to master is done using ZigBee HC12 modules and Bluetooth module is used for the communication between master and the server. Here we are using a mobile application, Arduino Bluetooth controller to show the received data.***
Keywords: IoT, Wireless Sensor Networks, Master node, Slave node, Zigbee HC12.

I. INTRODUCTION

Wireless sensor networks are infrastructure less distributed sensors nodes, that collect and gather data from their respective environment. Nodes are the building blocks of the WSN. Each node is made up of a sensor unit, a processing unit, a communication unit and a power supply unit aka a battery, in general. Sensor unit is used for sensing the surroundings, generally a sensor unit is analogues to the human sensor organs. A sensor unit may be comprised of single sensor or multiple sensors. Processing unit processes the collected and transmit it with the help of communication module. WSN find their application in various fields. WSN is deployed in numerous fields such as animal tracking, precision agriculture, environmental monitoring, security and surveillance, smart buildings, health care and so on.[1] In this paper we are going to discuss the implementation of WSN in the area of precision agriculture. Agriculture is one of the major contributors to the Indian economy, it holds a share of 19.9 percent in the GDP of India as of the financial year 2020-21. Precision Agriculture is utilized to improve the productivity and efficiency of limited agricultural resources by monitoring the relevant data in the field.[2] this can be done by the usage of wireless sensor networks. An intelligent and smart WSN system can collect and process large amount of data from the beginning of the monitoring and manage air quality, soil conditions, to weather situations.[3]

II. OBJECTIVE

From the previous discussions it is quite evident that the precision agriculture improves the productivity and efficiency of the agriculture. Hence to help and revolutionize the field of agriculture. We are going to implement a master slave based WSN that mounters the farm continuously and updates the acquired data to the mobile application.

III. SYSTEM ARCHITECTURE

In this implementation we are employ a gate-way type architecture based on Master slave model. Where we have a master node that acts as a gate-way. All the slave nodes present in the network communicate to the master. Master performs some sort of processing and pushes the data on to the server, in this case the Arduino Bluetooth Controller application. Here we employ Zigbee HC12 modules, which are basically transceivers, for communication between slave and master.by doing this the traffic at the application side would reduce as only master node is communicating with the server. We can also implement decentralized architecture, where each node transmits information independently to the server or the app. But in the centralized architecture like the master slave the transmitted raw information can be preprocessed, if needed, this would increase the efficiency of the transmission.

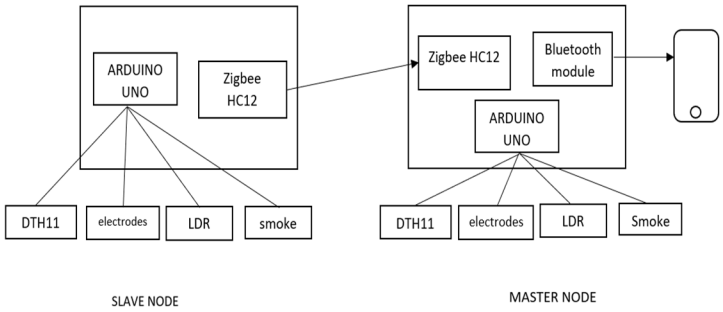

Fig 1 2 node master slave model block diagram

IV. TOOLS AND TECHNOLOGIES

Here in this work, we are using tools and components that are of low cost and small distance range. In this section, we are not going discuss in detail about the sensors.

A. Arduino UNO

The Arduino UNO is a microcontroller board with a programmable logic controller. It has an embedded Microchip ATmega328p microcontroller. Arduino.cc created the board, which is open source. The board has 14 Digital I/O pins (6 of which can be used for PWM output), 6 analogue I/O pins, and is programmable Using a USB cable, connect to an open-source IDE called Arduino IDE. It also SPI (Serial Peripheral Interface) and other interfaces are supported. MOSI – D11, MISO – D12, and SCK – D13 interfaces; UART There is serial communication on Pins D0 and D1, as well as to replicate the functionality of software communication Rx and Tx lines are hardwired.

All the logic is present in the Arduino itself. Hence, we program Arduino board using c language. We have a separate IDE to program the Arduino, it is called the Arduino IDE. Language used for this is quite similar to the c language and it is rich in libraries.

B. Zigbee HC12

It is a transceiver, it can both act as a receiver and a transmitter. It acts as a transmitter when data is given to its Rx port and acts as a receiver when data is given to the Tx port. For example, When Tx port of Arduino is connected to the Rx port of the HC12 module it acts as a transmitter and transmits the received data on the Rx port. This module uses ZigBee communication technology.

Fig 3 HC12

C. Bluetooth Module (HM-10)

Bluetooth module HM-10 uses the latest Bluetooth version 4.0, this the currently used protocol for wireless devices. HM-10 is more advanced and low power consuming and large range than the HM-05, the range of this HM-10 is around 100 meters. We can transmit the data from the Arduino to the Bluetooth supported application where the data can be displayed. Here we are using Arduino Bluetooth controller application that is available on the play-store. We can connect to any application which are present out there, every HM-10 has a password and name, these are required to login and stream the data.

Here the application is non graphical one the data is not displayed in the form of graphs. Rather the parapets are displayed in the form of text, like key value pairs, where the key is the parameter like temperature or humidity and value is the observed value.

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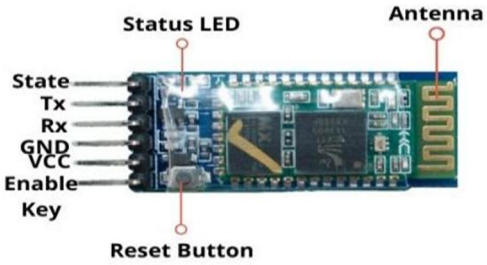

Fig 4 HM-10 Bluetooth module

D. Soil-Moisture Sensor (Electrodes)

It is used to test the wetness of the soil. It is based on a very simple and basic principle of BJT. When base and emitter are shot, whatever voltage is supplied appears across the collector. Based on this principal soil-moisture sensor is designed.

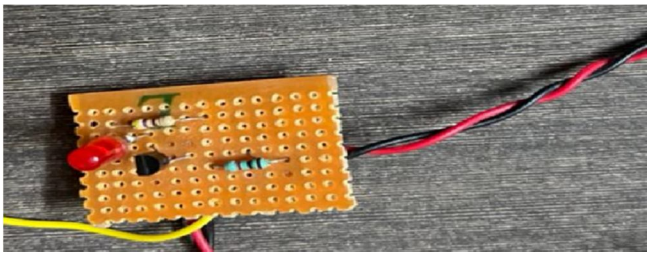

Fig 5 Electrode

E. Smoke Sensor

In this sensor we have a oxygen level setter, a white screw mounted on blue base as shown in fig 6, we adjust this at the threshold level of the environment we are monitoring. When ever there is a sudden change in the oxygen concentrations in the surrounding environment the sensor is active. We can detect smoke harmful gases and even alcohol using this sensor. There is a comparator to compare the threshold and detected value.

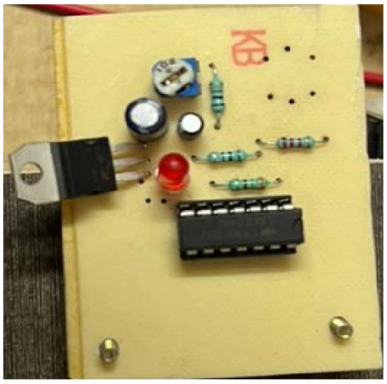

Fig 6 smoke and chemical sensor

Along with this we are also using DTH11, LDR to mounter temperature, humidity and lite intensity respectively. We are not describing about these sensors as they are the common ones (assuming reader knows about them).

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V. IMPLEMENTATION

We implemented the WSN master slave model where in we have a master or the gate way node and a slave node. Both the nodes are equipped with the similar kind of sensing unit. This sensing units are composed of a LDR, DTH11, Smoke sensor, and Soil moisture sensor. All the sensors are connected to the Arduino UNO board.

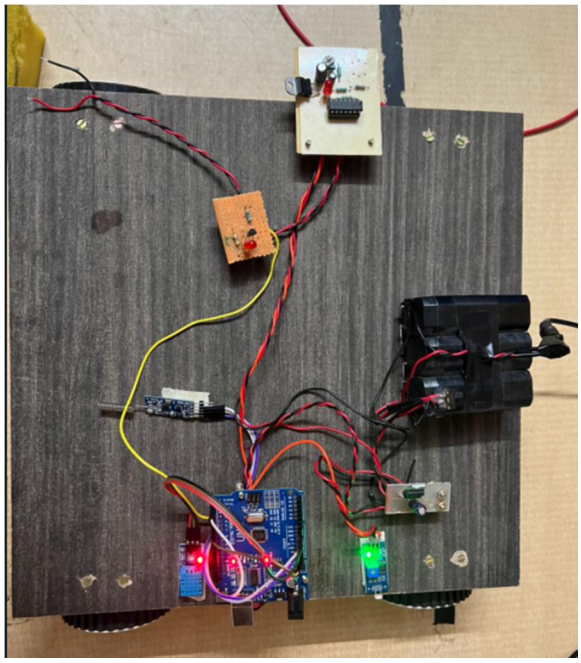

Fig 7 Slave Node

For the purpose of communication, we used the ZigBee HC-12 module. At the master node this module acts like the receiver whereas at the slave node it acts as a transmitter.

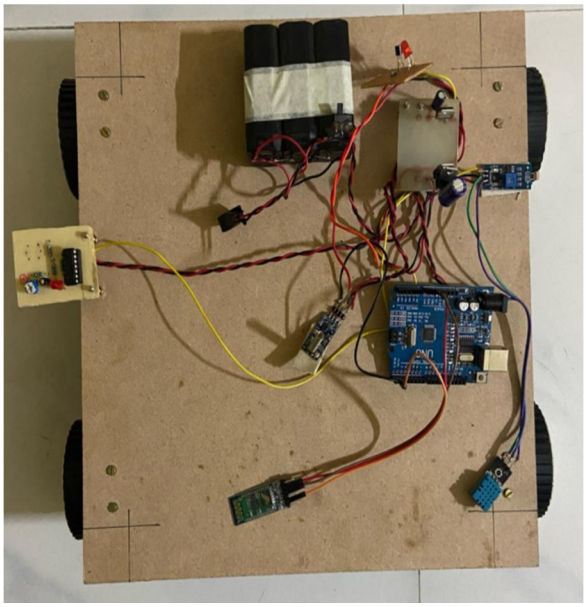

Fig 8 Master Node

Here, master node acts as a gate way for the data transmission. Slave node gathers data and transmits it to the master node, instead of transmitting it to the server or application directly. Master node is equipped with a Bluetooth module HM-10. We can connect to this Bluetooth from the above-mentioned application and view our data and observe any occurring changes.

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VI. RESULTS

Nodes continuously mounters the farm with out any break, at the programmed frequency and update the results on to the app. If there is significant change in the readings then it's a matter of concern. These are the resulted we got when we tested the functionality.

Fig 9 output in the Arduino Bluetooth controller app

Here location 1 is the location of node and the location 2 is the location of the slave node. Similarly, result is obtained for other parameters as well.

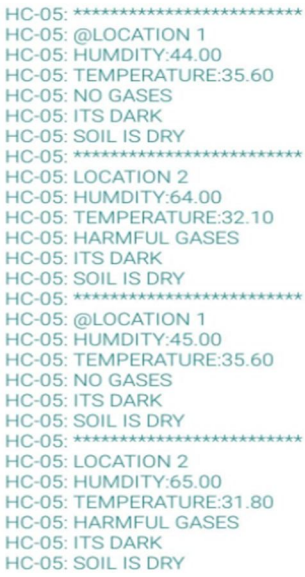

Fig 10 detection of harmful gas at slave node

VII. CONCLUSION

The WSN will be an important technological advancement which will take the IoT and network in every domain like as animal tracking, precision agriculture, environmental monitoring, security and surveillance, smart buildings, health care and so on. So, we are using this technology for Farm monitoring and precision agriculture. Thus, it is seen in our paper that, we had set up a wireless sensor network using ZigBee HC12 transceiver module where the slave sensor node sends the data to the base receiver module aka the master node and, master node acts as a gateway to connect this wireless sensor network to Bluetooth module. So, as itis seen in result, the parameters are displayed on the Arduino Bluetooth controller app.

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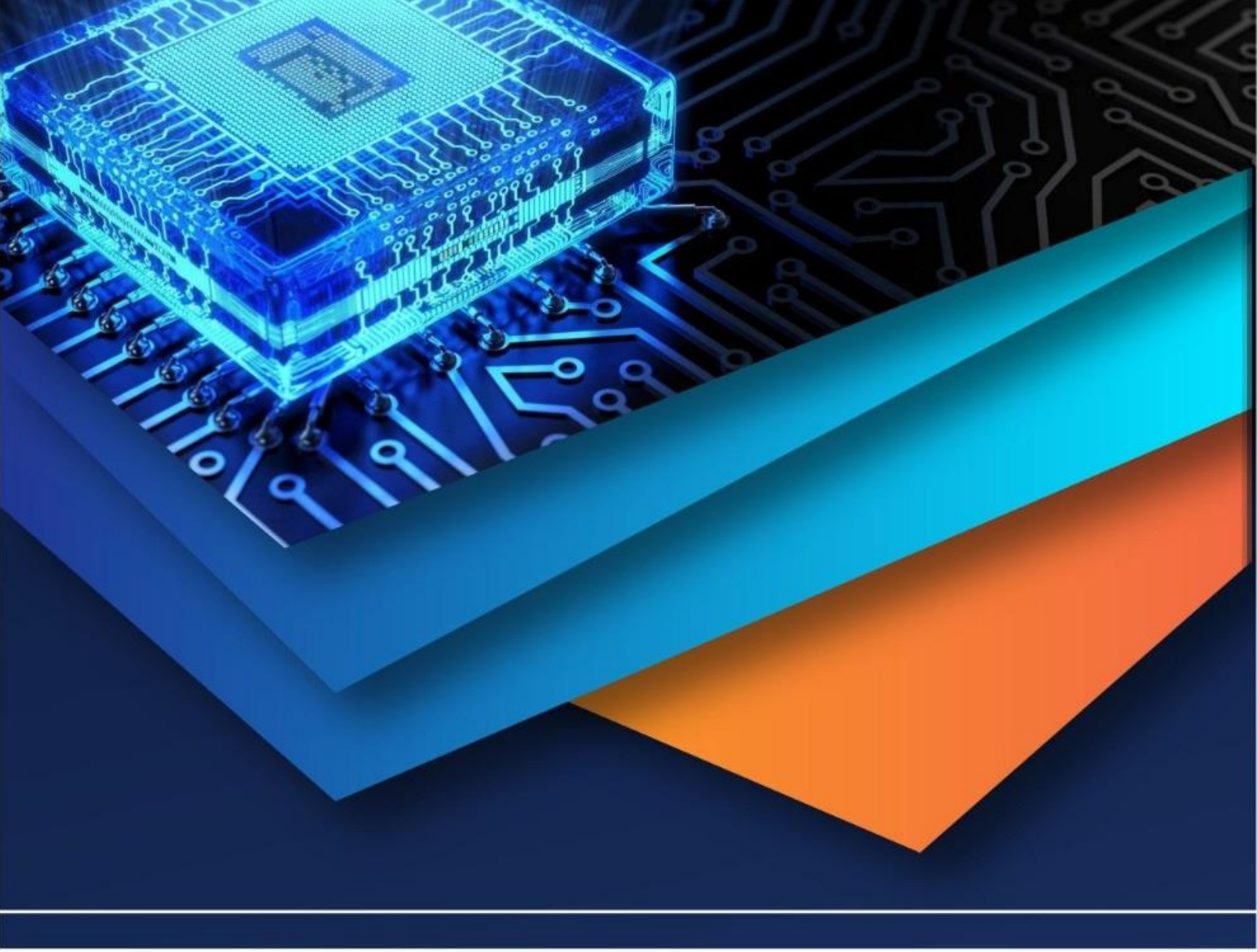

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