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Integrating Wireless Sensor Networks, IoT, and Cloud Computing for Real Time Application

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Abstract- This paper presents the design of a model of a wireless moisture and water tank level indicator as a sensor node which monitor based on wireless sensor network (WSN) and information is updated on cloud. The user-controller provided with information from the receiver board (master) that transmitted sensors data (as current parameter of water tank level and soil moisture level through the transmitter board (slave). The receiver board AT89C51 used to receive a real time sensor data from a transmitter to a PC monitor via serial connection and forming a database for future uses. The system uses Arduino nano, moisture sensor, ultrasonic sensor, nodemcu and transceiver RF module.

Keywords- IoT, WSN, Arduino nano, Node mcu,

I. INTRODUCTION

In recent years, extensive research has focused on the applications of Wireless Sensor Networks (WSNs) in various fields, such as monitoring systems. WSN technology involves a self-organized network that provides real-time monitoring by deploying numerous small sensor nodes to collect environmental data. However, WSNs face several challenges, including limited energy resources, restricted computing capacity, long communication distances, and wireless connectivity issues, which can cause network failures. Additionally, sensor nodes, often powered by small batteries, must operate for extended periods without human intervention.

One critical design aspect of WSNs is minimizing energy consumption. This can be achieved by enabling nodes to communicate with each other and the Base Station (BS) through a multi-hop transmission scheme. Multi-hop communication allows nodes to relay data to the BS via intermediate nodes, reducing the power required for long-distance transmissions and thereby extending the network's lifespan. Effective data exchange and transmission are essential for efficient WSN operation.

In WSN architecture, sensor nodes are typically situated far from the sink node and transmit data over multiple hops to conserve energy. Multi-hop communication significantly reduces power consumption and enhances the network's longevity by shortening transmission distances. This paper focuses on maximizing WSN lifespan by strategically placing intermediate nodes between sensor nodes and the BS for remote monitoring systems based on Arduino, utilizing a multi-hop communication model.

Significant research has explored various WSN applications. For instance, Benammar et al. (2017) developed a single-hop indoor air quality monitoring system using a Raspberry Pi 2 gateway and Libelium Waspmote sensor nodes. Tested in a school, this system monitors CO, CO2, ozone, chlorine, temperature, and humidity but does not account for the distance between the BS and sensor nodes. Tijani et al. (2018) proposed a WSN-based building fire system for indoor air quality monitoring, using a fixed Arduino and a mobile sensor drone communicating via Bluetooth to a remote smartphone, with data uploaded to the cloud via WiFi. Durrani et al. (2019) created a smart weather monitoring station combining IoT and deep learning to collect and predict weather parameters. This system utilizes various sensors to gather environmental data, which is then uploaded to the cloud, with machine learning techniques employed for future weather forecasting.

II. PROPOSED SYSTEM

The proposed system architecture shown in fig 1. Consist of sensor node. It can be 1 to many as per the requirement. The master node and the data transfer to cloud platform. The data can be visualizing by using mobile phone or pc. The data is available on cloud for monitoring and analysis purpose. The system consists of nodemcu, Arduino nano, RF trans receiver module.

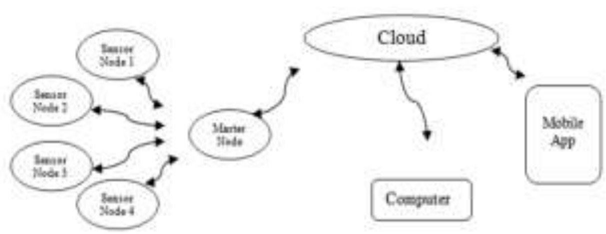

Fig.1 Proposed System architecture

1. Arduino Nano

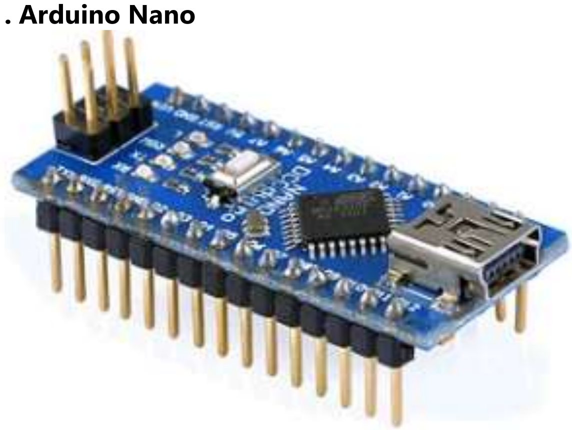

Fig. 2 Arduino Nano

In our agriculture IoT based data acquisition system deployed the Arduino nano. The hardware is pocket size and rugged provides the easy interface with agriculture sensor. It requires a voltage of 5 v. advance technical features gives 14 digital input-output pins. In which 6 generates PWM output. Eight analogue input pins (A0 to A7). It has 32 kb of flash memory which provides the efficient storage of data. ATmega328 AVR core-based microcontroller used in Arduino nano. The advantage of AVR core that processing mathematical and logical operation with high speed with easygoing system programming, which allow user quick prototyping of hardware. Serial communication pins Tx, and Rx provides an easy interface to Wi-Fi chipset. Due to such out of box feature Arduino is widely used as open source hardware and software platform for developing applications particularly inthe area of IoT as well as WSN.

2. Node MCU

Fig,3 Node mcu

The NodeMCU (Node MicroController Unit) is an open-source platform for software and hardware development, built around the cost-effective ESP8266 System-on-a-Chip (SoC). Developed by Espressif Systems, the ESP8266 includes essential computer components such as a CPU, RAM, WiFi networking, and a contemporary operating system with a Software Development Kit (SDK). This makes it ideal for a variety of Internet of Things (IoT) projects. Despite its capabilities, the ESP8266 chip is challenging to use directly. Tasks as basic as powering it on or sending a keystroke require soldering wires with the correct analog voltage to its pins. Additionally, programming the chip involves writing low-level machine instructions compatible with its hardware. While this complexity is manageable when the ESP8266 is used as an embedded controller in mass-produced devices, it poses significant difficulties for hobbyists, hackers, and students aiming to use it in their personal IoT projects.

3. RF Module

RF module operates at Radio Frequency. This frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This types of modulation is an Amplitude Shift Keying (ASK). This RF module is a combination of RF Transmitter and RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 433 MHz. The RF transmitter receives serial data and transmits it wirelessly through through its RF antenna. The transmission occurs at the rate of 1 Kbps – 10 Kbps. RF receiver receives the transmitted data and it is operating at the same frequency as that of the transmitter.

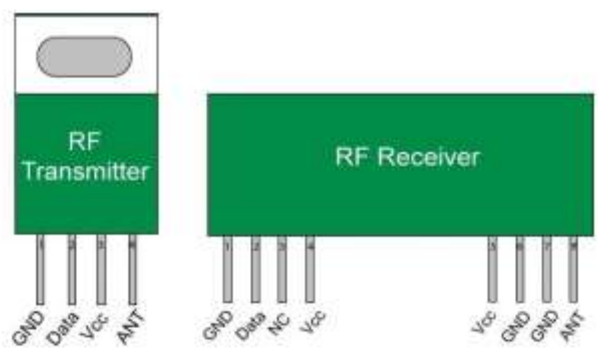

Fig.4: RF Transmitter

4. Soil Moisture Sensor

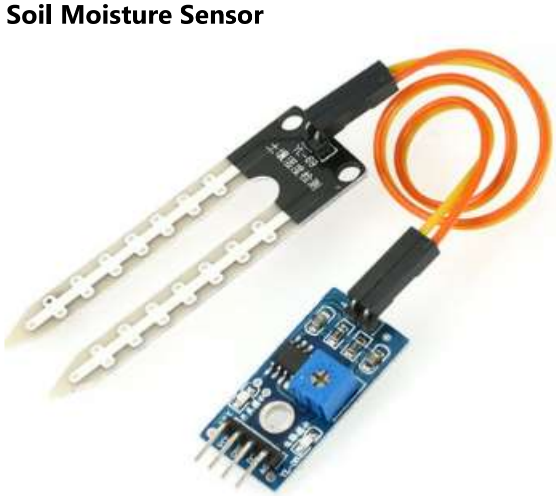

Fig.5: Soil Moisture Sensor

A soil moisture sensor measures the moisture content in the soil around it, making it ideal for monitoring the water levels in gardens or houseplants. This tool is essential for maintaining a connected garden. The sensor operates by using two probes that pass an electrical current through the soil and measure the resistance. Wet soil conducts electricity better, resulting in lower resistance, while dry soil has higher resistance. This device can remind you to water your indoor plants or help you keep track of soil moisture in your garden. To connect this sensor to an Arduino, the IO Expansion Shield is a suitable option. The latest version of the soil moisture sensor features Immersion Gold, which protects the nickel from oxidation.

III. RESULT

The real time status of wsn node where the live status of soil moisture is shown. If the value is display1 then it represents the moisture is dry and if the value is 0 it represents the moisture is wet. Similarly, the water level is high or low can be determine by the field 2. The low level is represent by value 0 and high level by the value 1.

Fig 6: Screenshot of Cloud storage

V. CONCLUSION

Wireless sensor network with cloud technology is designed by use of rf module ,Arduino nano and node mcu. The sensor node provides information to the master node. Master node sends information to the cloud. The utilization of such circuit provide efficient network where internet is not possible. The communication between two Arduino nano is takes place by RF module.The master node communicate by getting the data via Arduino and send it to the cloud.

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