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IOT Based Wireless Communication of Transmission Line Parameters

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Abstract - *The modernization of power transmission systems is essential for ensuring reliable and efficient distribution of electricity. In this context, the integration of Internet of Things (IoT) technologies into transmission line monitoring has emerged as a promising approach. This report presents a study on IoT-based wireless communication of transmission line parameters, aimed at enhancing the monitoring and management of power grids. The primary focus of this research is to design and implement a robust IoT framework for real-time monitoring of transmission line parameters. The proposed system employs wireless sensor nodes strategically placed along the transmission lines to collect crucial parameters such as voltage, current, temperature, and line sag. These sensors are equipped with IoT capabilities, enabling them to communicate wirelessly with a central monitoring station.*

***Key Words*: Internet of Things(IOT),Transmission line, Transmitter and receiver , Arduino, NRF Transceiver**

1.INTRODUCTION

1.1 INTRODUCTION

The Internet of Things (IoT) has revolutionized various industries by enabling seamless connectivity and data exchange between physical devices. In the realm of power transmission and distribution, IoT technologies offer immense potential for enhancing monitoring, management, and overall efficiency of the electrical grid. This project focuses on leveraging IoT for the wireless communication of transmission line parameters, employing Nordic Semiconductor's NRF series as a cornerstone for connectivity. Transmission lines form the backbone of the electrical grid, carrying high- voltage electricity over long distances from power generation plants to distribution substations. Monitoring the parameters of these transmission lines is critical for ensuring grid reliability, preventing outages, and optimizing power flow. Traditionally, this monitoring has been conducted through manual inspections or wired communication systems, which are often labor-intensive, costly, and limited in scalability. By integrating NRF modules with sensors capable of measuring parameters such as voltage, current, temperature, and line sag, this project aims to develop a comprehensive IoT framework for transmission line monitoring. These sensors, strategically deployed along the transmission lines, wirelessly communicate with a central monitoring station using NRF modules, thereby eliminating the need for wired connections and enabling seamless data transmission over long distances. By leveraging the capabilities of the NRF series, this project seeks to overcome the limitations of traditional wired communication systems and empower utilities with real-time insights into the operational status of transmission lines.

2. PROJECT DESCRIPTION

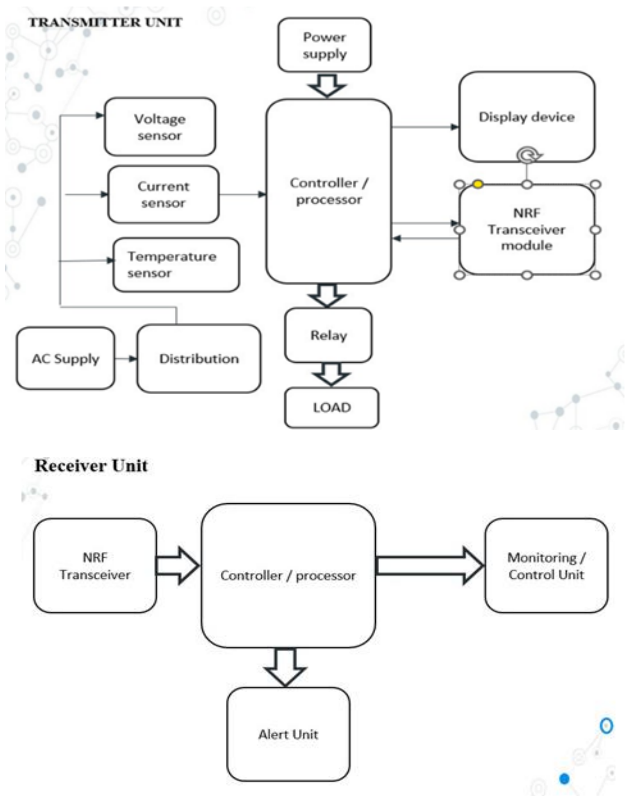

Fig 1.Block Diagram

2.1 NRF TRANSCEIVER:

The NRF24L01 is a wireless transceiver RF module, where each module can send and receive data. Since it operates on the 2.4 GHz ISM band, thetechnology is approved for engineering applications in almost all countries. This module can cover 100 meters (200 feet) when operated efficiently, making it suitable for wireless remote control projects.The NRF24L01 module is powered by 3.3 Volts, so it can be easily used in both 3.2 Volts and 5 Volts systems. Each module has an address range of 125 to communicate with the other 6 modules and also allows several wireless units to communicate with each other in a specified location.

Therefore, mesh and other types of networks use this module.

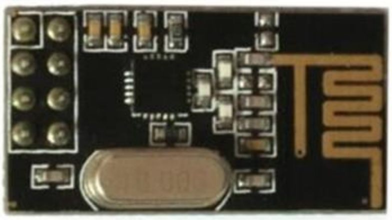

Fig 2. NRF Module

2.2 TRANSFORMER:

The transformer, in a simple way, can be described as a device that steps up or steps down voltage. In a step-up transformer, the output voltage is increased, and in a step-down transformer, the output voltage is decreased. The step-up transformer will decrease the output current, and the step-down transformer will increase the output current to keep the input and output power of the system equal.

Fig 3. Transformer

2.3 ARDUINO UNO CONTROLLER:

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

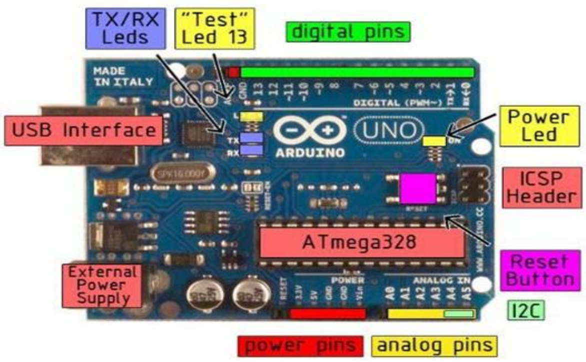

Fig.4. Arduino Uno Controller

2.4 MICROPROCESSOR AND MICRO CONTROLLER:

Microprocessor:

A microprocessor is a central processing unit (CPU) that serves as the brain of a computer or electronic device. It is a programmable integrated circuit (IC) that executes instructions to perform arithmetic, logic, control, and input/output (I/O) operations.

Microcontroller:

A microcontroller is a compact integrated circuit (IC) that combines a microprocessor core with memory, input/output (I/O) peripherals, and other functional blocks on a single chip.

2.5 RELAY:

A relay is an electrically operated switch that uses an electromagnet to mechanically control the opening or closing of one or more electrical contacts. It is commonly used in electrical circuits to control the flow of current based on the activation of an external signal or input. Relays consist of a coil, an armature, one or more stationary contacts, and one or more movable contacts.

Fig 5.Relay

2.6 TEMPERATURE SENSOR:

DHT11 Sensor and Its Working Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. DHT11 is a digital temperature and humidity sensor

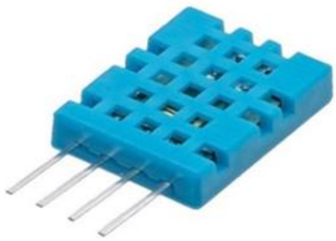

Fig.6. Temperature Sensor

2.7ACS712 (CURRENT SENSOR):

The ACS712 is a fully integrated, hall effect-based linear current sensor with 2.1kVRMS voltage isolation and a integrated low-resistance current conductor. Technical terms aside, it's simply put forth as a current sensor that uses its conductor to calculate and measure the amount of current applied.

Fig. 7. Current sensor

2.8 BYEPASS CAPACITOR:

A bypass capacitor, also known as a decoupling capacitor, is an electronic component used in electrical circuits to shunt unwanted high-frequency noise to ground and stabilize the voltage levels at specific points in the circuit. Bypass capacitors are typically placed in parallel with the power supply lines or signal lines of integrated circuits (ICs) or other active components. They provide a low-impedance path for high- frequency noise currents to flow to ground, preventing them from affecting the performance of the circuit.

Fig 8. Bye pass Capacitor

2.9 FILTER CAPACITOR:

A filter capacitor, also known as a smoothing capacitor or reservoir capacitor, is an electronic component used in electrical circuits to filter or smooth variations in voltage or current. In alternating current (AC) circuits, filter capacitors are often connected in parallel with a load or power supply to reduce or eliminate fluctuations in voltage caused by variations in the input power source or by switching components. They store electrical charge during periods of high voltage and release it during periods of low voltage, effectively smoothing out the waveform. In direct current (DC) circuits, filter capacitors are commonly used in power supplies to remove ripple voltage or noise caused by the rectification process.

Fig.9. Filter Capacitor

2.10 TTL CONVERTER:

A TTL (Transistor-Transistor Logic) converter is a device or circuit that is used to convert signals between TTL logic levels and other logic standards, such as CMOS (Complementary Metal-Oxide-Semiconductor) or RS-232 (Recommended Standard 232).

A TTL converter may be necessary when interfacing between systems or components that operate with different logic standards. For example:

- TTL to CMOS Conversion: CMOS devices operate with logic levels typically ranging from 0 to the supply voltage (Vcc). A TTL to CMOS converter may be used to adapt signals from TTL logic levels to CMOS logic levels.

Fig.10 TTL Converter

2.11 BRIDGE RECTIFIER

A bridge rectifier is an electrical component or circuit configuration used to convert alternating current (AC) into direct current (DC). It is commonly used in power supply circuits to provide a constant DC output from an AC input source. A bridge rectifier typically consists of four diodes arranged in a bridge configuration, hence the name "bridge." The diodes are connected in such a way that they form a loop or bridge, with two diodes conducting during each half-cycle of the input AC waveform. This arrangement allows the bridge rectifier to rectify both the positive and negative halves of the AC waveform, resulting in a full-wave rectified output.During the positive half- cycle of the AC input voltage, two diodes conduct current, allowing it to flow through the load in one direction. During the negative half-cycle, the other two diodes conduct, allowing current to flow through the load in the opposite direction. As a result, the output voltage across the load is always positive with respect to the common terminal, providing a continuous DC output.

Fig.11.Bridge Rectifier

2.12 LIQUID CRYSTAL DISPLAY (LCD):

LCD is essentially used for expose the information. Here we are using 2x16 LCD. It is used to display numbers, texts and graphics. This is in contrast to LEDs, which are limited to numbers and characters. The LCDs are fragile with only a few millimeter thickness. Since the LCDs utilize less power, the y are efficient with low power electronic circuits, and can be charged for long terms. The LCDs don't provoke light and so light is needed to read the display. The LCDs have long lasting life and a wide operating temperature range

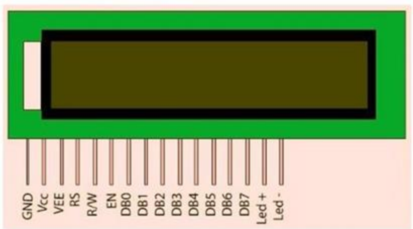

Fig.12 .Pin diagram of LCD

3. RESULTS:

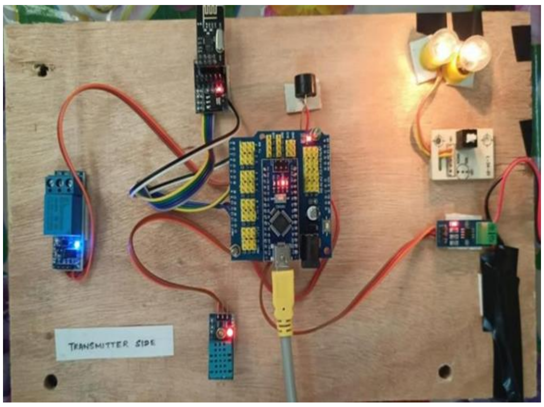

Fig 13.Transmitter side

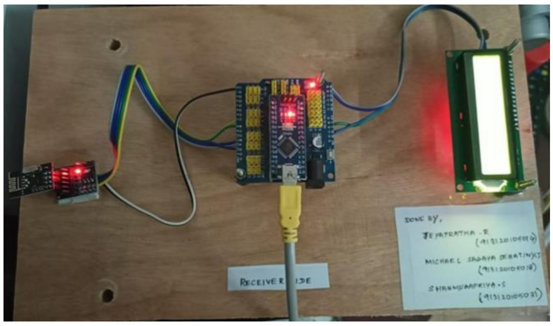

Fig 14. Receiver side

When the receiver side connected with the supply or when it connected with the Arduino receiver code it gives the out as

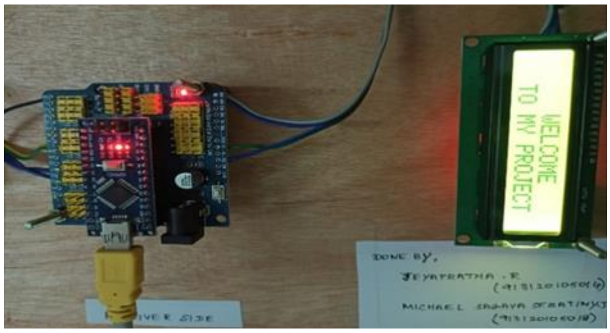

Fig 15:Initial output of the receiver side

When the current(in mA) in the load is within the give range which is set using the code written in Arduino software, the resultant output will be **"Normal current"**

Fig:16 Normal current

When the temperature of the load is exceeds the give range which is set using the code written in Arduino software, the resultant output will be **"Over temperature".**

Fig 17: Over Temperature

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