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# IOT BASED FAULT DETECTION IN OVERHEAD TRANSMISSION LINE

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***Abstract:*** The project's main objective is to design and implement automatic problem detection and location identification in transmission lines, as well as monitoring using the internet of things. Two single phase 230V transmission lines are being built for demonstration purposes, with continuous monitoring of the microcontroller's fault sensing. A sophisticated GSM-based defect detection and localization system was deployed to quickly and accurately pinpoint the precise spot where the problem had developed. The system provides precise fault location information, significantly cutting down on the time required to locate a flaw.

***Index Terms* - Location Identification, Continues Monitoring, Transmission Lines, Precise, Location, Line, Fault Detection, GSM.**

## I. INTRODUCTION

When a power line is cut, the sensor will notice an outage and notify the wi-fi module that a power line has been unplugged. The aws cloud will receive data from the WIFI, and the cloud module will alert the nearby electrical board of the power failure. At the same time, a buzzer begins to ring to alert neighbouring humans and animals to the danger. The energy board now turns off the area's main power source when a power line is damaged in the majority of rural areas until the system is back up and running. In this project, a planned and constructed mobile embedded system is used to monitor and record key aspects of a distribution transformer fault status. The idea of an online monitoring system combines a freestanding single chip microcontroller and a wi-fi modem. The embedded system's analogue to digital converter (adc) is utilized to record the aforementioned properties at the position of the distribution transformer. Edited parameters are kept in the cloud memory after being acquired. The system sends short message service (sms) messages to the mobile phones conveying information about any anomaly or emergency event, as per the programmed instructions encoded in the microcontroller. With the help of this portable device, the transformers will be able to operate more effectively and identify problems earlier. The components that are used fluidly interact with one another. Making connections is done by connecting cables. A distributed power supply is employed, which is practical and economical, to provide each component with the right amount of power because the system uses two sensors and each one consumes a certain amount of power.

## 2. SYSTEM CONFIGURATION

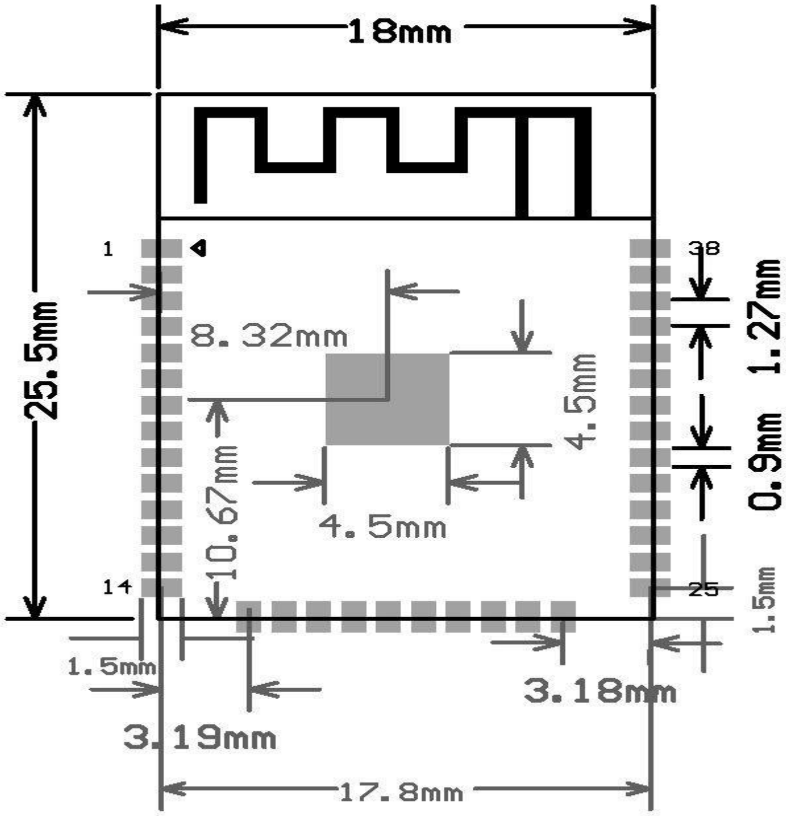


Figure 1. Top view of ESP-32S

### 2.1 PIN DESCRIPTION

A 38-pin ESP-32S is used. See Table 1 for definitions of pins.

**table 1 pin descriptions**

| NO. | Pin Name | Function |
|---|---|---|
| 1 | GND | Ground |
| 2 | 3V3 | Power supply |
| 3 | EN | Chip-enable signal. Active high |
| 4 | SENSOR_VP | GPI36, SENSOR_VP, ADC_H, ADC1_CH0, RTC_GPIO0 |
| 5 | SENSOR_VN | GPI39, SENSOR_VN, ADC1_CH3, ADC_H, RTC_GPIO3 |
| 6 | IO34 | GPI34, ADC1_CH6, RTC_GPIO4 |
| 7 | IO35 | GPI35, ADC1_CH7, RTC_GPIO5 |
| 8 | IO32 | GPIO32, XTAL_32K_P (32.768 kHz crystal oscillator input),ADC1_CH4, TOUCH9, RTC_GPIO9 |
| 9 | IO33 | GPIO33, XTAL_32K_N (32.768 kHz crystal oscillator output),ADC1_CH5, TOUCH8, RTC_GPIO8 |
| 10 | IO25 | GPIO25, DAC_1, ADC2_CH8, RTC_GPIO6, EMAC_RXD0 |
| 11 | IO26 | GPIO26, DAC_2, ADC2_CH9, RTC_GPIO7, EMAC_RXD1 |
| 12 | IO27 | GPIO27, ADC2_CH7, TOUCH7, RTC_GPIO17, EMAC_RX_DV |
| 13 | IO14 | GPIO14, ADC2_CH6, TOUCH6, RTC_GPIO16, MTMS, HSPICLK,HS2_CLK, SD_CLK, EMAC_TXD2 |
| 14 | IO12 | GPIO12, ADC2_CH5, TOUCH5, RTC_GPIO15, MTDI, HSPIQ,HS2_DATA2, SD_DATA2, EMAC_TXD3 |
| 15 | GND | Ground |

| | | |
|---|---|---|
| 16 | IO13 | GPIO13, ADC2_CH4, TOUCH4, RTC_GPIO14, MTCK, HSPID,HS2_DATA3, SD_DATA3, EMAC_RX_ER |
| 17 | SHD/SD2 | GPIO9, SD_DATA2, SPIHD, HS1_DATA2, U1RXD |
| 18 | SHD/SD3 | GPIO10, SD_DATA3, SPIWP, HS1_DATA3, U1TXD |
| 19 | SCS/CMD | GPIO11, SD_CMD, SPICS0, HS1_CMD, U1RTS |
| 20 | SCK/CLK | GPIO6, SD_CLK, SPICLK, HS1_CLK, U1CTS |
| 21 | SDO/SD0 | GPIO7, SD_DATA0, SPIQ, HS1_DATA0, U2RTS |
| 22 | SDI/SD1 | GPIO8, SD_DATA1, SPID, HS1_DATA1, U2CTS |
| 23 | IO15 | GPIO15, ADC2_CH3, TOUCH3, MTDO, HSPICS0, RTC_GPIO13,HS2_CMD, SD_CMD, EMAC_RXD3 |
| 24 | IO2 | GPIO2, ADC2_CH2, TOUCH2, RTC_GPIO12, HSPIWP, HS2_DATA0, SD_DATA0 |
| 25 | IO0 | GPIO0, ADC2_CH1, TOUCH1, RTC_GPIO11, CLK_OUT1,EMAC_TX_CLK |
| 26 | IO4 | GPIO4, ADC2_CH0, TOUCH0, RTC_GPIO10, HSPIHD, HS2_DATA1, SD_DATA1, EMAC_TX_ER |
| 27 | IO16 | GPIO16, HS1_DATA4, U2RXD, EMAC_CLK_OUT |
| 28 | IO17 | GPIO17, HS1_DATA5, U2TXD, EMAC_CLK_OUT_180 |
| 29 | IO5 | GPIO5, VSPICS0, HS1_DATA6, EMAC_RX_CLK |
| 30 | IO18 | GPIO18, VSPICLK, HS1_DATA7 |
| 31 | IO19 | GPIO19, VSPIQ, U0CTS, EMAC_TXD0 |
| 32 | NC | - |
| 33 | IO21 | GPIO21, VSPIHD, EMAC_TX_EN |
| 34 | RXD0 | GPIO3, U0RXD, CLK_OUT2 |
| 35 | TXDO | GPIO1, U0TXD, CLK_OUT3, EMAC_RXD2 |
| 36 | IO22 | GPIO22, VSPIWP, U0RTS, EMAC_TXD1 |
| 37 | IO23 | GPIO23, VSPID, HS1_STROBE |
| 38 | GND | Ground |

### 2.2 Block Diagram

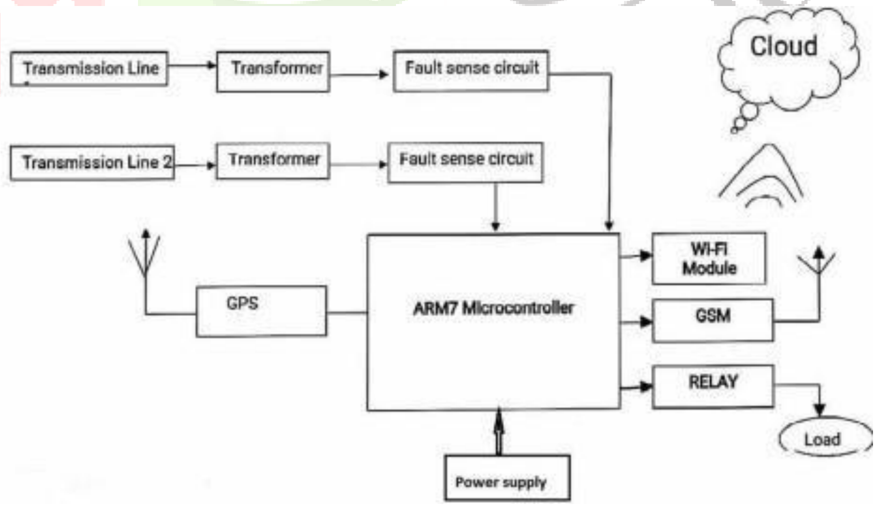


Figure 2. block diagram of arm7 microcontroller

**Transmission Line:** Transmission lines are specially designed cables or devices used to transport radio frequency alternating current or currents with a high frequency. They can be used to connect computer networks, distribute cable television signals, route calls, and carry high-speed computer data. Transmission lines use specialized construction methods and impedance matching to transmit electromagnetic signals with the least amount of reflection and power loss. They have a constant impedance along their whole length due to a property called characteristic impedance. Waveguides are used at microwave frequencies and higher due to their excessive power losses, while optical techniques are used to focus electromagnetic waves at much higher frequencies. Acoustic transmission lines are built using techniques from transmission line theory.

**Transformer:** Transform electrical energy between electrical circuits or between a number of circuits using a transformer, a passive electrical device. Faraday's law of induction is the result of a fluctuating magnetic flux around the core of the transformer. In electric power applications, transformers are used to connect stages of signal processing circuits, raise low AC voltages at high current, and drop high AC voltages at low current. Transformers can alter the frequency of the supply and the amount of power that travels from one winding to another without altering the supply's voltage or current levels.

**Fault Sensing Circuit:** Faults are abnormal electric currents in an electric power system, such as short circuits, open-circuit faults, and ground faults. Protective devices can detect fault conditions and trigger circuit breakers to minimize service loss.

i}A polyphase system may experience a "symmetrical defect," which has an equal impact on all of the phases. If just some phases are affected, the resulting "asymmetrical fault" is more difficult to evaluate. In many cases, the diagnosis of these defects can be made simpler by using methods like symmetrical components.

ii}A number of power transmission problems could cause power outages if they are not properly regulated. These stand out among the rest: - Defects in infrastructure used to generate electricity Power transmission lines that have been damaged (trees falling on wires) - Lightning - Faults at substations or other parts of the distribution subsystem Types of faults in transmission lines The two categories of power system flaws are shunt faults and series faults.

**Wi-Fi Module:** The ESP32 Wi-Fi Module is a self-contained SOC with an integrated TCP/IP protocol stack. It can be connected to sensors and other application-specific devices through its GPIOs with a minimum of upfront development and runtime loading. It has powerful on-board processing and storage capabilities, and is designed to take up little room on the PCB. It also has built-in self-calibrated RF, APSD for VoIP applications, and Bluetooth co-existence interfaces. The strong community support has enabled the ESP32 to have access to a virtually limitless pool of information. The Documents section below provides numerous tools to make use of the ESP32, including instructions on how to make this module an IoT.

**GSM:** The GSM (Global System for Mobile communication) digital mobile network is a variant of time division multiple access (TDMA). It transforms data into an electronic format, compresses it, and sends it along with two other streams of user data through a channel. It is made up of four main parts: the mobile device itself, the base station subsystem (BSS), the network switching subsystem (NSS), and the operation and support subsystem (OSS). The SIM card transmits identification information about the mobile user to the network, while the BSS regulates the flow of traffic between mobile devices and the NSS. The NSS tracks callers' whereabouts to make it easier to supply cellular services.

The Home Location Register and Mobile Switching Center (MSC) are two NSS components that carry out SMS and call routing, SIM card-based caller account authentication and storage, and other functions. Due to roaming agreements, users can use their phones when travelling abroad without experiencing any service interruptions.

**Relay:** Relays are switches that electrical circuits can use to open and close. They regulate one electrical circuit by actuating contacts in a different circuit. Relays are used to switch minor currents in a control circuit, but they can also control bigger voltages and amperes. Protective relays can prevent equipment damage by spotting electrical anomalies like reverse currents, overloads, and over- and undercurrents. Additionally, heating components, pilot lights, starting coils, and alarms are routinely switched using relays.

**Cloud Computing:** Cloud computing is the on-demand provision of computing resources, such as data storage and processing power, without direct active supervision by the user. It is popular due to the availability of huge networks, affordable computers, and storage devices, as well as the widespread application of hardware virtualization, service-oriented architecture, and autonomous and utility computing. By 2019, Linux will be the most widely used operating system, and the cloud service provider will screen, watch, and gather data from the firewalls, intrusion detection systems, and information stream within the network (CSP). This creates privacy concerns because the service provider has access to all data stored there at any time.

## 3 HARDWARE USED

**The Internet of Things (IoT):** The Internet of Things (IoT) is a network of physical items connected to the internet and actively gathering and exchanging data. It is possible due to the emergence of inexpensive computer processors and the widespread use of wireless networks. By linking these devices and giving them sensors, digital intelligence is given to previously dumb technology, enabling it to communicate real-time data without the assistance of a person. IoT aims to connect any device with an ON/OFF switch to the internet and generate the necessary data.

**The GSM Modem:** A modem, also known as a modulator-demodulator, demodulates an analogue carrier signal after it has been modulated to encode digital information in order to decode the data that has been sent.

**GPS:** A satellite-based navigation system called GPS employs two extra signals to determine exactly where the receiver is on the planet. Using satellites, a receiver, and algorithms, the Global Positioning System (GPS) is a navigation system that synchronizes location, velocity, and time data for travel by air, sea, and land.

**ESP32:** The ESP32 is a low-cost, low-power SoC microcontroller created by Espressif Systems for IoT projects. It has Wi-Fi and Bluetooth connectivity, a dual-core processor, and input/output connectors. It is popular due to its low power consumption, adaptability, and simplicity of use. It is used in robotics, sensor networks, smart agriculture, and home automation.

**LCD 16*2:** The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

## 4 SOFTWARE USED:

**EMBEDDED C:** A wide range of keywords, data types, variables, constants, etc. were used to build the C programming language. A C programming language that is linked to a particular hardware architecture is referred to as embedded C. The C language extension known as embedded C comes with certain extra header files.

**Ubidots:** It is a website and platform that provides resources for gathering, displaying, and evaluating data from linked devices and sensors. It provides a number of functions, including data ingestion, storage, visualization, analysis, and interaction with other services and devices. Users can generate unique data visualizations and keep an eye on their gadgets in real-time using Ubidots' user-friendly dashboard. It is easy to connect a variety of devices and sensors to the platform and provides APIs and SDKs for integrating with different platforms and services. It is user-friendly and accessible to both novice and advanced users.

## RESULT AND DISCUSSION

The three terminals linked to the switch provide an output when one switch is on and the other two are closed, indicating that terminals Y and B are broken (Supposed terminal is R, Y, B and terminal R is connected to supply i.e., switch is ON and another switch which is connected between terminal Y and B is OFF hence its shows the fault). The method for locating and detecting faults on the transmission line is being examined. if there is any form of problem that can be identified and located. After that LCD 16*2 shows the fault in which phase it occurs and simultaneously we can monitor the fault and in which phase it occurs using Ubidots website anywhere around the globe.

## CONCLUSION

The model is designed to address the problems that transmission line users encounter. It is straightforward to identify the problem and resolve it using this method.

Furthermore, it would make it possible for operators like GRIDco to precisely locate and diagnose faulty transmission line segments, reducing power outages at distribution substations and maintaining expensive transformers.

It also allows for data storage now that a low-cost, incredibly accurate method to identify flaws in three-phase transmission lines has been proposed. Therefore, this method can be applied at any time to find flaws and gather essential information.

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➢ Transmission Line Fault Detection Using Android Application Via Bluetooth by MD AsaduzzamanNur, Jahidul Islam, Md. Golam Mostofa & Moshiul AlamChowdhury.