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Microcontroller based Arduino system for the detection of multiple faults in Three Phase Transmission lines

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Abstract:
The main aim of this paper is to design a Microcontroller based Arduino system for the detection of multiple faults in Three Phase Transmission lines and also it displays the fault type on LCD module. This system detects four types of faults line-line fault, line - ground fault, Over and under voltage fault and open circuit fault.
This proposed model uses the concept of Ohms law to detect the open circuit fault, line-line fault and line -ground fault which is quick, reliable and cost effective. This system consists of ESP832 module which has an inbuilt wi-fi and which is used for sending alert notification to the user mobile using twilio APP. This system consists of POT (potentiometer) is used to change the voltage from LOW to HIGH. If the system detects any fault, it will alert the user through buzzer. This system uses an Arduino microcontroller and a rectified power supply.
Here the current sensing circuits made with a switches combination of resistors are interfaced to Arduino micro controller at ADC port for providing digital data to the microcontroller representing the cable length in kilometers. At all known kilometer fault switches are placed to create faults manually, hence the fault is detecting, a particular fault type name will be display on LCD and activate buzzer for alerts also sending alert notification to the user mobile through twilio mobile application. The fault creation is made by the set of switches. Whenever it will detect the over / under voltage it will trip the circuit through Relay which is indicate as particular phase through Bulb. The main controlling device of the paper is Arduino UNO. To achieve this task microcontroller loaded program written in embedded C language.
Keywords: IOT, Arduino, Microcontroller, detection of faults

INTRODUCTION

The main aim of this paper is to design Microcontroller based Arduino system for the detection of multiple faults in Three Phase Transmission lines and also it displays the fault type on LCD module. This system detects four types of faults line-line fault, line - ground fault, Over and under voltage fault and open circuit fault.
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application. The fault creation is made by the set of switches. Whenever it will detect the over / under voltage it will trip the circuit through Relay which is indicate as particular phase through Bulb. The main controlling device of the paper is Arduino UNO. To achieve this task microcontroller loaded program written in embedded C language.

Objectives:

- Design a three-phase fault detection system.
- It will detect line-line, open circuit, line-ground and over/under voltage faults.
- IOT based fault notification to the user.
- Over/Under voltage protection.
- Alert fault indication using BUZZER.
- Display the fault name on LCD display.

Overview:

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers.

Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

It is an exclusive project that can detect the three-phase faults (L-L, L-G, Over/under voltage &Open circuit) and sending notification to the user mobile using twilio APP and also it can display the fault type and particular phase on LCD. This system capable of detecting the over and under voltage of transmission line and trip the circuit through relay which is connected to the BULB and which is indicated by the particular phase(R,Y,B). Whenever fault is occurred, this system alerts the person through buzzer.

EMBEDDED SYSTEMS

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today.

Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.)

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. For example, handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them, but they allow different applications to be loaded and peripherals to be connected. Moreover, even systems which don't expose programmability as a primary feature generally need to support software updates. On a continuum from "general purpose" to "embedded", large application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a

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few dedicated functions", and is thus appropriate to call "embedded". A modern example of embedded system is shown in fig: 2.1.

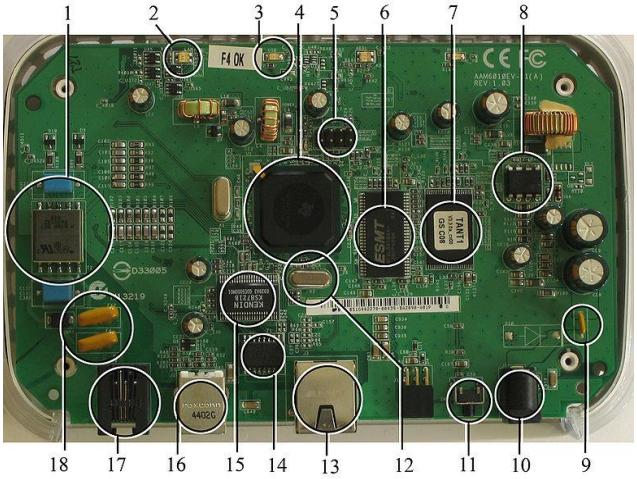

Fig 1:A modern example of embedded system

Labeled parts include microprocessor (4), RAM (6), flash memory (7).Embedded systems programming is not like normal PC programming. In many ways, programming for an embedded system is like programming PC 15 years ago. The hardware for the system is usually chosen to make the device as cheap as possible. Spending an extra dollar a unit in order to make things easier to program can cost millions. Hiring a programmer for an extra month is cheap in comparison. This means the programmer must make do with slow processors and low memory, while at the same time battling a need for efficiency not seen in most PC applications. Below is a list of issues specific to the embedded field.

HARDWARE COMPONENTS

In this chapter the block diagram of the paper and design aspect of independent modules are considered. Block diagram is shown in fig: 2:

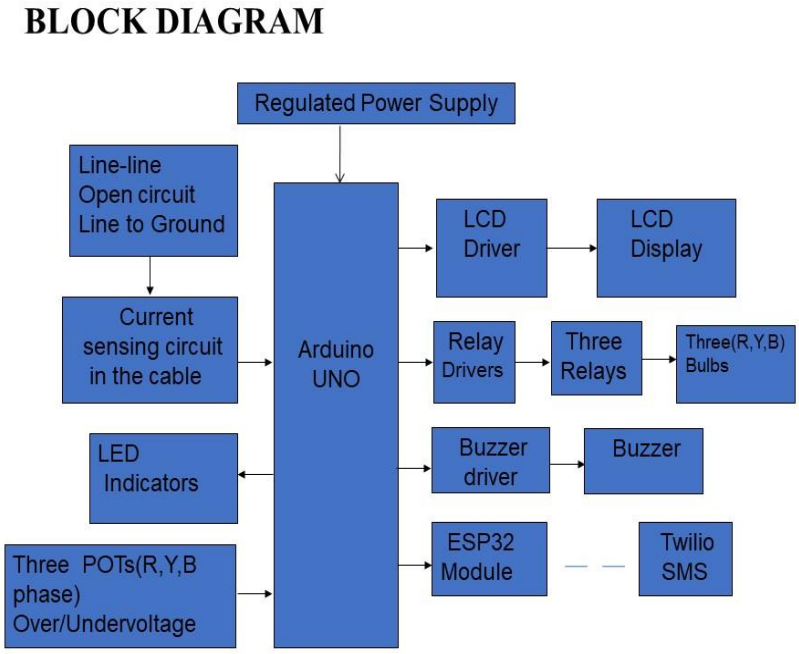

FIG 2: Block diagram of Microcontroller based Arduino system for the detection of multiple faults in Three Phase Transmission lines

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The main blocks of this paper are:

- Adapter power supply.
- Arduino UNO Microcontroller.
- Fault switches.
- Resistor.
- Relay.
- LCD with driver.
- Esp32 module.
- Buzzer
- Three phase supply.
- POT (potentiometer).

ARDUINO:

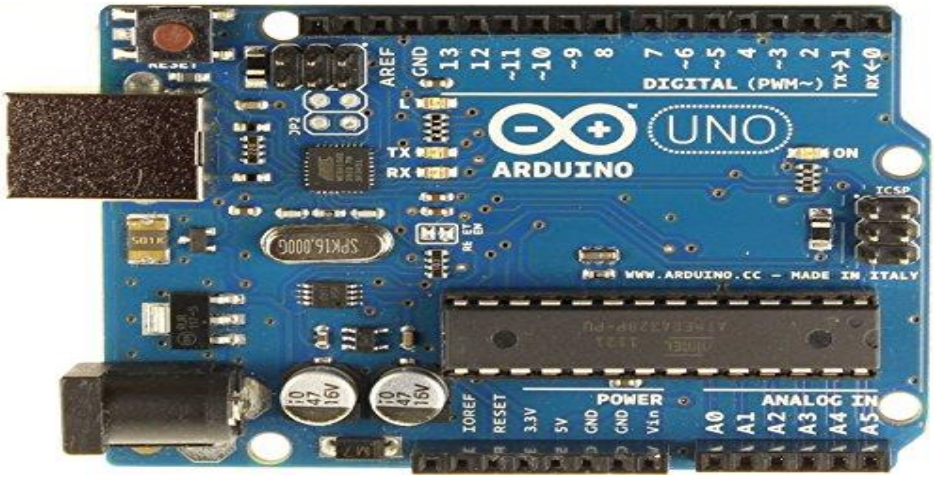

Fig 3: Arduino Block Diagram

The Arduino Uno is a microcontroller board which has ATmega328 from the AVR family. There are 14 digital input/output pins, 6 Analog pins and 16MHz ceramic resonator.
USB connection, power jack and also a reset button is used. Its software is supported by a number of libraries that makes the programming easier.

LED:

A light-emitting diode (LED) is a semiconductor light source. LED's are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LED's emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown in figures 4(a) and 4(b) respectively.

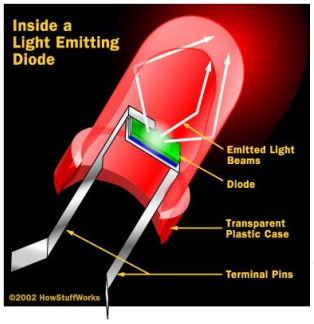

Fig 4(a): Inside a LED

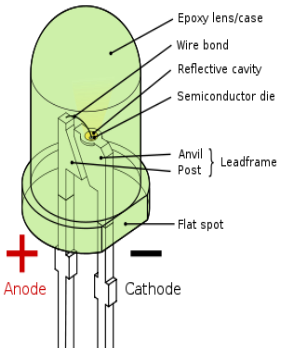

Fig 4(b): Parts of a LED

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Relay:

A **relay** is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".

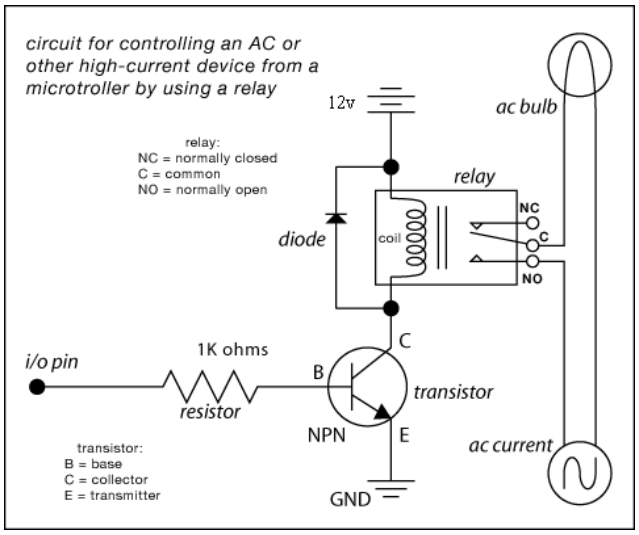

Fig 5: Relay Board

LCD display:

LCD Background:

One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the many microcontrollers are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

Basic 16x 2 Characters LCD

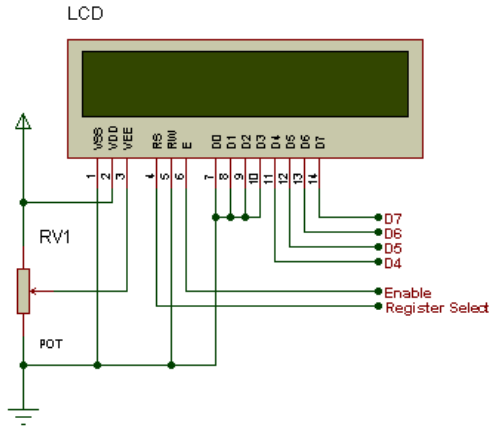

Fig 6: LCD Pin diagram

ESP32:

ESP32-WROOM-32 is a powerful, generic Wi-Fi+BT+BLE MCU module that targets a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding.

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Fig 7:ESP32 Board

At the core of this module is the ESP32-D0WDQ6 chip*. The chip embedded is designed to be scalable and adaptive. There are two CPU cores that can be individually controlled, and the CPU clock frequency is adjustable from 80 MHz to 240 MHz. The user may also power off the CPU and make use of the low-power co-processor to constantly monitor the peripherals for changes or crossing of thresholds. ESP32 integrates a rich set of peripherals, ranging from capacitive touch sensors, Hall sensors, SD card interface, Ethernet, high-speed SPI, UART, I2S and I2C.
The integration of Bluetooth, Bluetooth LE and Wi-Fi ensures that a wide range of applications can be targeted, and that the module is future proof: using Wi-Fi allows a large physical range and direct connection to the internet through a Wi-Fi router, while using Bluetooth allows the user to conveniently connect to the phone or broadcast low energy beacons for its detection. The sleep current of the ESP32 chip is less than 5 μA, making it suitable for battery powered and wearable electronics applications. ESP32 supports a data rate of up to 150 Mbps, and 20.5 dBm output power at the antenna to ensure the widest physical range. As such the chip does offer industry-leading specifications and the best performance for electronic integration, range, power consumption, and connectivity. The operating system chosen for ESP32 is freeRTOS with LwIP; TLS 1.2 with hardware acceleration is built in as well. Secure (encrypted) over the air (OTA) upgrade is also supported, so that developers can continually upgrade their products even after their release.

RESULTS

The application was designed a Microcontroller based Arduino system for the detection of multiple faults in Three Phase Transmission lines. This system able to detects four types of faults open circuit fault, line-line fault, over/under voltage and line to ground fault will be display on LCD and it will send the notification to the user mobile through twilio APP also activating the buzzer for alert. This system will detect the Over/Under voltage of three phase transmission line and automatically it will trip the appropriate circuit through relay. Here relay works as a switch to ON/OFF the circuit.

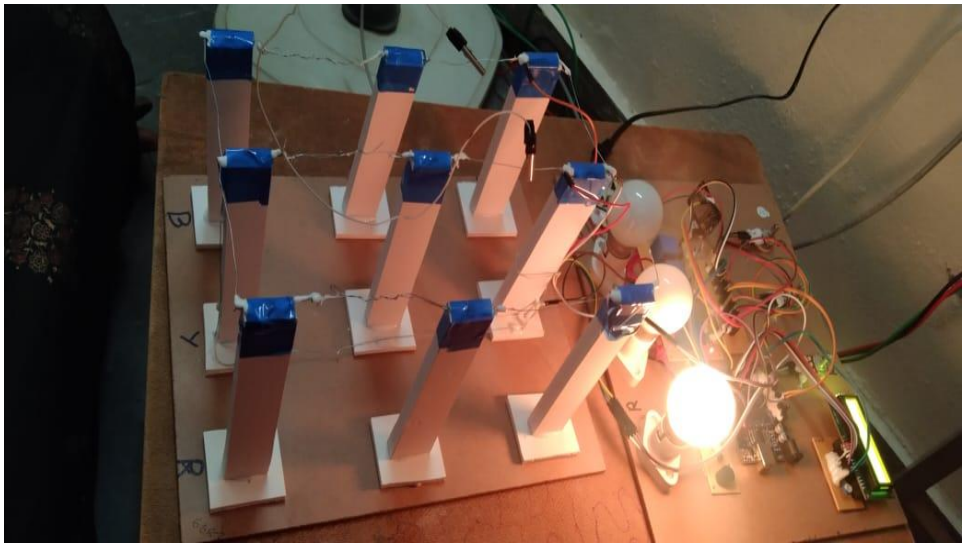

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Fig 8: Results

CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the paper has been successfully implemented. Thus the paper has been successfully designed and tested.

REFERENCES

[1] T. A. Short, Electric power distribution handbook: CRC press, 2014.

[2] Saravanababu, K., P. Balakrishnan, and K. Sathiyasekar. "Transmission line faults detection, classification, and location using discrete wavelet transform." IEEE International Conference on Power, Energy and Control (ICPEC), 2013, pp. 233-238

[3] Han, Jun, Won-Ki Kim, Jae-Won Lee, and Chul-Hwan Kim. "Fault type classification in transmission line using STFT." 2012, pp. 85-85.

[4] Reddy, B. Ravindranath, M. Vijaya Kumar, M. Suryakalavathi, and Ch Prasanth Babu. "Fault detection, classification and location on transmission lines using wavelet transform." IEEE Conference on Electrical Insulation and Dielectric Phenomena, 2009, pp. 409-411.

[5] "IEEE Guide for Determining Fault Location on AC Transmission and Distribution Lines," IEEE Std C37.114-2014 (Revision of IEEE Std C37.114-2004), 2015, pp. 1-76.

[6] Bagchi, S., S. Goswami, B. Ghosh, M. Dutta, and R. Bhaduri. "Symmetrical and Asymmetrical Fault Analysis of Transmission Line with Circuit Breaker Operation." IEEE International Conference on Advanced Technologies in Intelligent Control, Environment, Computing & Communication Engineering (ICATIECE), 2019, pp. 343-347.

[7] Banerjee, Ms Devjani, and Mrs NR Kulkarni. "Three phase Parameter data logging and fault detection using GSM Technology." International Journal of Scientific and Research Publications 3, no. 2, 2013, p.1.

[8] Gulbhile, Priya A., Jitendra R. Rana, and Bapu T. Deshmukh. "Overhead line fault detection using GSM technology." IEEE International Conference on Innovative Mechanisms for Industry

Applications (ICIMIA), 2017, pp. 46-49.

[9] Li, Yajie, Xiaohui Song, Shanshan Zhao, and Fei Gao. "Summary and adaptability analysis of implementation schemes about Single-Phaseto-Ground fault diagnosis in distribution system." IEEE 5th Asia Conference on Power and Electrical Engineering (ACPEE), 2020, pp. 1311-1315.

[10] Mohani, Syed Sheraz-ul-Hasan, Muhammad Shoaib Ameer, and Atif Jabbar. "Design and development of fault detection and location system for electrical distribution network." IEEE 3rd International Conference on Emerging Trends in Engineering, Sciences and Technology (ICEEST), 2018, pp. 1-4.

DOI:10.46647/ijetms.2024.v08i03.048 ISSN: 2581-4621

[11] Gururajapathy, Sophi Shilpa, Hazlie Mokhlis, and Hazlee Azil Illias. "Fault location and detection techniques in power distribution systems with distributed generation: A review." Renewable and sustainable energy reviews 2017, Vol. 74, pp. 949-958.

[12] Chen, Yann Qi, Olga Fink, and Giovanni Sansavini. "Combined fault location and classification for power transmission lines fault diagnosis with integrated feature extraction." IEEE Transactions on Industrial Electronics, 2017, Vol. 65, no. 1, pp. 561-569.

[13] Swetapadma, Aleena, and Anamika Yadav. "A novel decision tree regression-based fault distance estimation scheme for transmission lines." IEEE transactions on power delivery, 2016, Vol. 32, no. 1, pp. 234-245.

[14] Khawaja, Arsalan Habib, Qi Huang, Jian Li, and Zhenyuan Zhang. "Estimation of current and sag in overhead power transmission lines with optimized magnetic field sensor array placement." IEEE Transactions on Magnetics, 2017, Vol. 53, no. 5, pp. 1-10.

[15] Chen, Yafeng, Qi Huang, and Arsalan Habib Khawaja. "Interference- rejecting current measurement method with tunnel magnetoresistive magnetic sensor array." IET Science, Measurement & Technology, 2018, Vol. 12, no. 6, pp. 733-738.