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BIG DATA BASED POWER SYSTEM

Submitted by

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ABSTRACT

In the current system of electricity, underground cable systems have a lot of advantages over overhead cables which is why it is more preferred nowadays. Recently plans have been made to replace overhead electrical cables with underground cables in the next decade or so. While fault occurrence in the underground cable is rare, it is also very hard to detect. In the past, there have been many research papers suggesting the use of various methods like the Murray loop test, Varley loop test or implementation of ohm's law to find the short circuit fault but they have many confinements associated with them. Thisis where we aim to minimize the confinements and enhance the already existing projects for better performance. Also, we aim to locate the open circuit fault for the three-phase system which is IOT based that has not been previously done. Our objective is to design an electrical power system which will save electricity by minimizing the excessive power

load in-between the transformers and also ifthe power consumed is less than the average load in a particular transformer, then the remaining load is supplied to the other transformers. Our design also helps in alerting people from electrical danger in the pavement using BIG DATA.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

The electricity network is an essential part of the underlying infrastructure of society as Everyone in the society uses electricity. Within 2030, the use of electricity is projected to rise by 6%. Even during the coronavirus epidemic, it also reminds us of the crucial role of electricity in our daily lives. Millions of people are currently restricted to their homes, using telework to do their jobs, e-commerce websites for shopping, online media services to find entertainment, and the crisis has demonstrated how much modern society depends on electricity.

Generally, electricity is generated or produced by turning or rotation of turbines. These turbines can be rotated by any means – coal, steam, nuclear energy, renewable energy such as solar energy etc. In most power plants, turbines are rotated by the pressure of steam. This steam is created by boiling water using burning coal in large boilers. The pressure of steam is such that it turns the turbines, which in turn generates electricity.

After electricity is generated in the power plant, it is time for transmission. This is done by using step-up transformers which increase the voltage. This high voltage electricity is transmitted through a network of electrically conductive wires of aluminum or copper. These lines are called high-voltage transmission lines that can transmit electricity over long distances.

Electric power distribution is the final stage in the delivery of electric power; it carries electricity from the transmission system to individual consumers. Distribution substations connect to the transmission system and lower the transmission voltage to medium voltage. Primary distribution lines carry this medium voltage power to distribution transformers located near the consumer's premises. Distribution transformers again lower the voltage to the utilization voltage used by lighting, industrial equipment and household appliances. Often several consumers are supplied from one transformer through secondary distribution lines. Commercial and residential consumers are connected to the secondary distribution lines through service drops. consumers demanding a much larger amount of power may be connected directly to the primary distribution level or the sub transmission level.

Urban distribution is mainly underground, sometimes in common utility ducts. Rural distribution is mostly above ground with utility poles, and suburbandistribution is a mix. Closer to the consumer, a distribution transformer steps the primary distribution power down to a low-voltage secondary circuit. Electricity is distributed via an electric distribution substation. At the substation, the high voltage electricity from the high-voltage transmission lines is passed through step-down transformers that lower the voltage. The electricity is then transmitted to a network of local electric distribution lines. Before electricity enters a home, the voltage is again lowered using step-down transformers. In a home, electricity is distributed to different outlets by a network of wires throughelectrical wiring.

Our dependence on a reliable supply of electricity continues to grow. Power supply interruptions are undesirable. The role of the electricity distribution network is to deliver electricity to consumers with standard supply quality. Power supply interruptions and weather-related vulnerabilities are profoundly important due to extreme weather events in recent years that affected many consumers.

1.2 TECHNOLOGIES USED

1.2.1 Embedded System

An embedded system is a microprocessor-based computer hardwaresystem with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system. At the core is an integrated circuit designed to carry out computation for real-time operations.

Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks; from no user interface to complex graphical user interfaces. Embedded system applications range from digital watches and microwaves to hybrid vehicles and avionics. As much as 98 percent of all microprocessors manufactured are used in embedded systems.

Embedded systems are managed by microcontrollers or digital signal processors (DSP), application-specific integrated circuits (ASIC), field-programmable gate arrays (FPGA), GPU technology, and gate arrays. These processing systems are integrated with components dedicated to handling electric and/or mechanical interfacing.

1.2.1.1 Structure of embedded systems

The basic structure of an embedded system includes the following components as the sensor measures and converts the physical quantity to an electrical signal, which can then be read by an embedded systems engineer or any electronic instrument as shown in the Fig 1.1. A sensor stores the measured quantity to the memory.

An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal. Processors assess the data to measure the output and store it in the memory. A digital-to-analog converter changes the digital data fed by the processor to analog data. An actuator compares the output given by the D-A Converter to the actual output stored and stores the approved output.

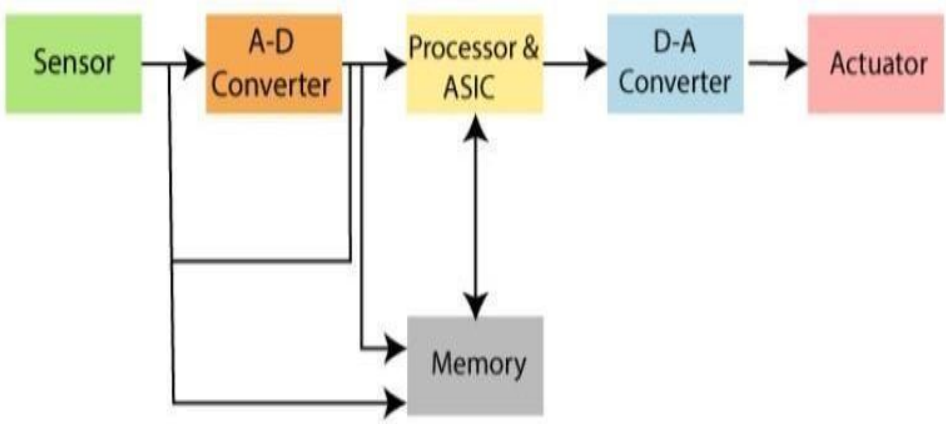


Fig. 1.1: Structure Of Embedded Systems

1.2.2 Big Data

Big Data refers to data sets that are too large or complex to be dealt with by traditional data-processing application software. Data with many fields (rows) offer greater statistical power, while data with higher complexity (more attributes or columns) may lead to a higher false discovery rate. Big data analysis challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy, and data source. Big data was originally associated with three key concepts: volume, variety, and velocity. The analysis of big data presents challenges in sampling, and thus previously only allowed for observations and sampling. Therefore, big data often includes data with sizes that exceed the capacity of traditional software to process within an acceptable time and value.

The size and number of available data sets have grown rapidly as data is collected by devices such as mobile devices, cheap and numerous information-sensing Internet of things devices, aerial (remote sensing), software logs, cameras, microphones, radio-frequency identification (RFID) readers and wireless sensor networks. The world's technological per-capita capacity to store information has roughly doubled every 40 months.

Relational database management systems and desktop statistical softwarepackages used to visualize data often have difficulty processing and analyzing big data. The processing and analysis of big data may require "massivelyparallel software running on tens, hundreds, or even thousands of servers". What qualifies as "big data" varies depending on the capabilities of those analyzing it and their tools. Furthermore, expanding capabilities make big data a moving target. For some organizations, facing hundreds of gigabytes of data for the first time may trigger a need to reconsider data management options. For others, it may take tens or hundreds of terabytes before data size becomes a significant consideration.

1.3 OBJECTIVES

- To identify underground problems effortlessly.
- To limit the electricity wastage.
- To caution the pedestrians if there are broken wires.
- To estimate open and short circuit fault distances in theunderground transmission cable.
- To ensure facile maintenance of the system

- To develop and implement an effective system compared to conventionaldetection approaches.

The introduction chapter gives a brief introduction to the technologies used in the proposed model. It helps in understanding the concepts behind the working of the system which is explained in the following chapter.

1.4 ORGANIZATION OF REPORT

The report is summarized as follows:

- Chapter 1 describes an introduction and the purpose of the project.
- Chapter 2 deals with the literature survey.
- Chapter 3 deals with existing methods and proposed methods.
- Chapter 4 explains in depth the actual working of the project.
- Chapter 5 ends with the conclusion and future enhancement ideas.

CHAPTER 2 LITERATURE REVIEW

2.1 LITERATURE REVIEW

[1] Author: Chen, Z., Liang, K., Ding, S.X., Yang, C., Peng, T. and Yuan, X.

Year: 2008

Title: A Comparative Study of Deep Neural Network-Aided Canonical Correlation Analysis-Based Process Monitoring and Fault Detection Method

Description: Multivariate analysis is an important kind of method in process monitoring and fault detection, in which the canonical correlation analysis (CCA) makes use of the correlation change between two groups of variables todistinguish the system status and has been greatly studied and applied. For the monitoring of nonlinear dynamic systems, the deep neural network-aided CCA (DNN-CCA) has received much attention recently, but it lacks a general definition and comparative study of different network structures. Therefore, this article first introduces four deep neural network (DNN) models that are suitableto combine with CCA, and the general form of DNN-CCA is given in detail. Then, the experimental comparison of these methods is conducted through three cases, so as to analyze the characteristics and distinctions of

CCA aided by each DNN model. Finally, some suggestions on method selection are summarized,and the existing open issues.

[2] Author: Chunlong, J., Hui, H., Yun, L., Hongjing, L. and Kuan, Y.

Year: 2004

Title: Research on Transmission Line Vibration Condition Monitoring Systemand Energy Management Scheme Based on Micro Energy Harvesting

Description: In view of the problem that the current transformer is mainly used in the existing transmission line vibration condition monitoring system, which iseasily affected by the line load and has the problem of missing reports, this paper proposes a new design scheme of transmission line vibration condition monitoring system based on micro energy collection. In this scheme, the vibration energy of the transmission line is collected to obtain electric energy, and then a micro energy management circuit based on a logic device is used to control the accumulation of weak energy and the power supply to the load. Finally, the sensor node can start to work when the line vibrates, so as to avoid the influence of line load on the condition monitoring system, avoid the omission of vibration data, and improve the system reliability. The experimentalresults show that the system can realize the condition monitoring of the transmission line when the vibration frequency is 100Hz and the vibration intensity is 0.5g, 0.8g and 1g. The sampling interval is 21s, 17s and continuous sampling respectively.

[3] Author: Devireddy, Y., Sanke, M., Ragi, Maganti, H. and Thorlikonda, A.

Year: 2018

Title: Real-Time Energy Monitoring and Controlling System using IoT **Description:** As the cost of energy consumption is increasing, energy savinghas become a demanding and challenging issue. This research work proposes a novel system to monitor energy consumption based on wireless sensors. Energy monitoring systems are becoming crucial in providing the consumers withuseful metrics to evaluate their consumption patterns. Furthermore, with the rapid advancement of information technology, particularly the Internet of Things, a better energy monitoring system may be established by delivering consumption data in real-time. Sensing and transferring electricity data can be done with wireless sensors. Users can utilize the cloud platform to monitor and

operate their home appliances remotely. In this way, by continuously monitoring their household appliance's electricity usage and controlling them through the cloud, users can save electricity using our model.

[4] Author: Hatakeyama, K.

Year: 2013

Title: An Energy Efficient Processor Applicable to Continuous SPO2 Monitoring

Description: This paper proposes an energy efficient processor, which enables portable health monitoring devices to continuously work with limited battery capacity. The proposed processor realizes a single stage operation by asynchronously reading data from the data memory. Experimental results on a FPGA board show that estimated energy consumption to complete the Dhrystone benchmark test suite by the proposed processor is 6.4% compared to a five-stage pipelined MicroBlaze processor. Implementation of the proposed processor for human tissue oxygen saturation measurement demonstrates thatthe system substantially lasts over two days with a AA NiMH rechargeable battery. IEEE Draft Guide to Using IEEE Std 1547(TM) for "Interconnection ofEnergy Storage Distributed Energy Resources with Electric Power Systems". Application of IEEE Std 1547-2018 to the interconnection of energy storage distributed energy resources (ES DER) to electric power systems (EPSs) is described in this guide. Along with examples of such interconnection, guidance on prudent and technically sound approaches to these interconnections is also given. The guide's scope includes ES DERs that are capable of exporting active power to an EPS. The guide also considers energy storage-related topics that arenot currently addressed or fully covered in IEEE Std 1547-2018 and sets a basis for future development of industry best practices for ES DER-specific

interconnection requirements that could be considered in future revisions of IEEE Std 1547.

[5] Author: Mante, S., Muppala, R., Niteesh, D. and Hussain, A.M.

Year: 2017

Title: LoRaWAN-based Smart Meters and one M2M Platform

Description: The Internet of Things (IoT) plays a key role in real-time monitoring at different stages of the power generation system, assisting to achieve better efficiency, minimize load on the grids by analyzing usage patterns, provide faster resolutions to power outages, and so on. In this paper,we present a novel energy monitoring approach employing LoRaWAN-enabled smart energy meters and a oneM2M-based platform for collecting and analyzing the data. The energy meters transmit data at 15-minutes intervals, i.e., 96 data points per day. This results in a high-resolution dataset containing more than 10,000 instances per meter, accumulated over the last four months. The data can be visualized in a live dashboard enabling the signal parameters such as Received Signal Strength Index (RSSI) and Signal to Noise Ratio (SNR) to be monitored in addition to the electrical parameters, to ensure proper data transmission. Finally, the trends in power and energy consumption of the load have been analyzed, which can result in improved efficiency of building management, and early detection of electrical faults and failures.

[6] Author: Myachin, V., Efanov, D., Osadchy, Aganov, I. and Khoroshev, V.

Year:201

Title: Architecture of a Universal Monitoring System for Transport Infrastructure Facilities

Description: Based on many years of experience in the development and implementation of systems of continuous monitoring of transport infrastructure facilities, the authors have designed an architecture that allows the most efficient and rational arrangement of such systems. The paper notes the need for and importance of universalizing the development, design and implementation of technical diagnostics and monitoring systems of transport infrastructure facilities. It also gives a detailed description of universal monitoring system architecture, as well as a roadmap for the development of universal hardware and software platforms for this system. Main components of monitoring systems are defined. Recommendations are given to be followed when developing the monitoring systems. It is emphasized that a monitoring system can and should be built to make “energy management” possible through minimization of both energy consumption for implementation of operating procedures and reduction of the carbon footprint from the transport infrastructure facilities. Monitoring systems should be a means that help to build highly immune and energy efficient “green” transport infrastructure facilities.

[7] Author: Nabavi, S.A., Motlagh, N.H., Zaidan, M., Aslani, A. and Zakeri, B.

Year: 2014

Title: Application in Smart Buildings With Distributed Energy Generation **Description:** In this project buildings are responsible for 33% of final energyconsumption, and 40% of direct and indirect CO2 emissions globally. Whileenergy consumption is steadily rising globally, managing building energyutilization by on-site renewable energy generation can help respond to thisdemand. This paper proposes a deep learning method based on a discretewavelet transformation and long short-term memory method (DWT-LSTM) and

a scheduling framework for the integrated modeling and management of energy demand and supply for buildings. This method analyzes several factors including electricity price, uncertainty in climatic factors, availability of renewable energy sources (wind and solar), energy consumption patterns in buildings, and the non-linear relationships between these parameters on hourly, daily, weekly and monthly intervals. The method enables monitoring and controlling renewable energy generation, the share of energy imports from the grid, employment of saving strategies based on the user priority list, and energy storage management to minimize the reliance on the grid and electricity cost, especially during the peak hours. The results demonstrate that the proposed method can forecast building energy demand and energy supply with a high level of accuracy, showing a 3.63-8.57% error range in hourly data prediction for one month ahead. The combination of the deep learning forecasting, energy storage, and scheduling algorithm enables reducing annual energy import from the grid by 84%, which offers electricity cost savings by 87%. Finally, two smart active buildings configurations are financially analyzed for the next thirty years. Based on the results, the proposed smart building with solar Photo-Voltaic (PV), wind turbine, inverter, and 40.5 kWh energy storage has a financial breakeven point after 9 years with the wind turbine and 8 yearswithout it. This implies that implementing wind turbines in the proposed building is not financially beneficial.

[8] Author: Raiker, G.A. and Slamet, L.

Year: 2016

Title: Energy Disaggregation Using Energy Demand Model and IoT-BasedControl

Description: In this paper, Energy Management Systems involve monitoring of loads, control, and providing recommendations to reduce demand or energycosts. Energy Disaggregation works on monitoring loads non intrusively, by having a single-smart meter at the entry point to perform the task with machine learning techniques. Training of the machine learning model is an important step and may require historical sub metered data of the appliances. In this article, an energy demand model is used to generate the training data and alleviate the need for historical data of the appliance. The model is optimized for the Indian scenario based on the representation of appliances and active occupancy. The other important contribution of this work is the use of Internet of Things (IoT) devices to feed observable states to the disaggregation model to improve efficiency.

[9] Author: Sharone, M. and Muhtaroglu, A.

Year: 2010

Title: Autonomous Health Monitoring Energy System Tool for Design of Self-Sustained

Description: Wearable body area networks (WBANs) are used to improve the quality of life in many ways. Health-monitoring WBANs have traditionally been powered using batteries that pose various sustainability problems. Batteries are not suitable for quasi-perpetual health monitoring, whereas energy harvesting from ambient nondepletable energy sources can be the gateway to true autonomy in sustainable WBAN s with unlimited capabilities. In this paper,a Health-Monitoring Energy System (HeMeS) tool is presented for unified electrical modeling to accurately analyze full energy flow in an autonomous WBAN node with a thermal-vibrational hybrid energy harvester. Analytical power generation, conversion and delivery models, environmental conditions, geometry, and load requirements are simultaneously incorporated to explore system design space for a variety of health-monitoring WBAN applications. Theholistic system approach in HeMeS opens up opportunities in applying

creativity to identify a new set of biomedical aids that are also sustainable by design. The tool capabilities have been successfully demonstrated using a personal health monitoring system that incorporates pressure, acceleration, ECG sensing, and smart RFID features with a realistic activity model.

[10] Author: Tao, Y., Qiu, S., Lai, Y., Wang and Sun, X.

Year: 2005

Title: Energy Management Strategy of Micro-grids in Joint Energy, Reserve and Regulation Markets based on Non-intrusive Load Monitoring

Description: The heating, ventilation, and air-conditioning (HVAC) units are regarded as major demand response (DR) resources in micro-grids. However, due to privacy protection, it is difficult for the system operator to obtain complete information of each individual appliance. In this paper, we present a non-intrusive load monitoring (NILM)-based framework for the operation strategy of the micro-grid in the joint energy, reserve, and regulation markets. The NILM technologies enable the operator to disaggregate the power of the HVAC units from the reading of the smart meters. Hence, the operation state of the appliances and the behavior of consumers can be studied without obtaining detailed data of each individual appliance. Based on the NILM result, a novel method to evaluate the upward and downward reserve capacity of the HVAC units is formulated. The evaluated reserve capacity can help the operator better bid in the joint market based on the proposed optimization model. The proposed framework and methodology are verified through case studies. The simulation result reveals that with NILM, the market operator can save more energy consumption costs and load curtailment costs and earn more revenues in the joint market through selling excessive energy and providing ancillary services.

[11] Author: Zheng, J., Han, G., Yang, S. and Tan, S.

Year: 2009

Title: Research on optimization of energy consumption monitoring point layout on the user side

Description: In industrial production, the consumption of electric energy is very large. Most enterprises have the problem of repeated monitoring of energy consumption, so the optimization of energy consumption monitoring points has its significance. Firstly, the monitoring points were selected according to the energy efficiency fluctuation coefficient. Then, according to the electrical wiring mode, the proposed monitoring points were optimized for the second time by using the Quantum-behaved Particle Swarm Optimization (QPSO). Finally, the concept of maximum redundancy is put forward to screen and optimize the proposed monitoring points, and the experiment is carried out in anenterprise. The results show that after the first two steps of optimization, the number of monitoring points can be significantly decreased. After the third step of optimization, a more reasonable scheme can be selected under the condition of the same number of monitoring points.

2.2 SUMMARY OF LITERATURE REVIEW

With this, based on the above literature surveys, we have made a new method for locating faults in underground cable lines with the help of microcontrollers. The details are elaborated in forthcoming chapters.

CHAPTER 3 SYSTEM

ANALYSIS

3.1 EXISTING SYSTEM

In the existing system manual labor is employed for every problem like power fluctuations, power cuts, damages in electrical components. Every communication is done manually through mobiles, etc. An alert from the meteorological department is expected to cut the power supply in areas where natural disasters are active.

In the underground system, cables are generally directly buried or in ducts. So, there is very little chance for the cable to be damaged. But nevertheless, there is always a chance for the cables to get damaged due to various reasons such as insulation failure due to chemical reaction with atmospheric agents, Mechanical damage during transportation or installation. Since the cable is buried underneath the ground, visual inspection for locating the fault is not practical. The faults in cables can be classified into threecategories-

- Open circuit fault
- Short circuit fault
- Earth fault

Digging of the roads to find out the area of fault occurred in theunderground cable.

3.1.1 Disadvantages of Existing System

- Time consuming
- Increased traffic due to digging of roads
- Lack of timely intervention

3.2 PROPOSED DESIGN

This all-round system will enable real time monitoring which can be seen through an app named blynk. By using weather sensors, real time values are updated and when the values reach a threshold value, the power supply is cut off automatically. By employing ohm's law, the precise area of short circuit that has occurred underground is acquired. This can be implemented using an Msp430 to accurately find the type and location of the fault and transmit the data using an IOT module. During broken wires due to natural disasters, caution the pedestrians about the same through the LCD display. To make the system energy efficient, a buck booster is used to distribute the unused power and provide the extra power when power consumption is excess.

3.2.1 Advantages

- Energy Efficient
- Automation.
- Improved safety.
- Saves electricity.

3.2.2 Applications

- In areas of high voltage fluctuations
- In areas of extreme weather conditions
- Urbanized settlements prone to natural disasters
- Roadways and community management
- Incorporated in environment conservation

3.3 SYSTEM DESIGN

3.3.1 Architectural Diagram

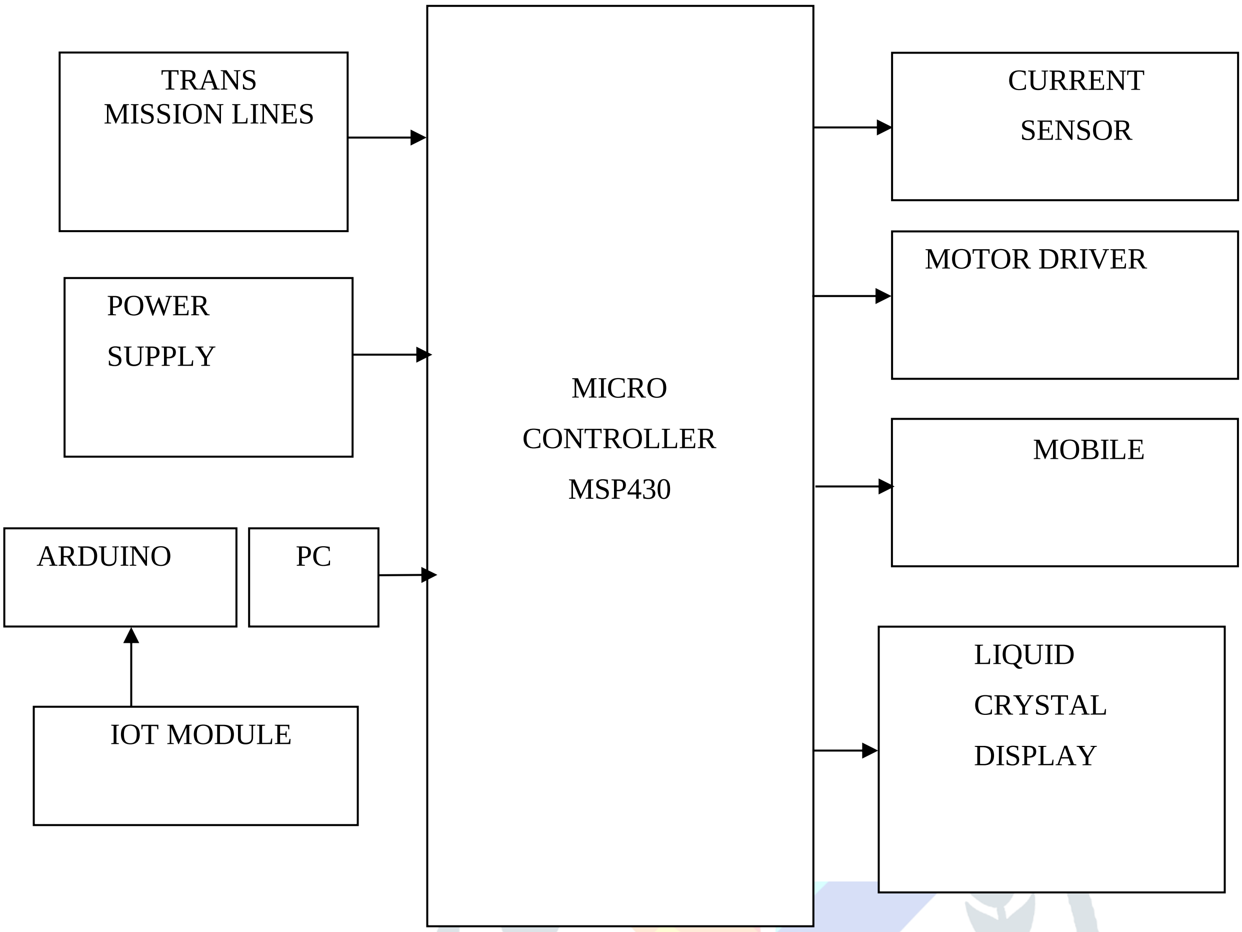


Fig 3.1: Architectural Diagram

3.4 WORKING

A method for locating faults in underground cable lines with the help of microcontrollers. The outcome of this method is the determination of the distance (In kilometers) of the fault from the base station using the theory of the commonly known Ohm's law. The approach is an occurrence of a fault in cable lines that adversely affects resistance and voltage in the lines, followed by a variation in current in the lines as well. The cable is represented by resistors,

while DC voltage is supplied at one end. Afterward, an analog to voltage converter and a microcontroller performs relevant calculations to detect variations in voltage, which indicate fault. The fault distance is sent via email.

Our project uses the basic concept of OHM'S law meaning when the dc voltage is applied at the feeder end of the system through a series of cable lines the current will vary when a fault is generated depending upon the location of the fault. When the current changes the voltage will change proportionally since the length of the cable is known when a fault occurs at any section of the cable, we can find the distance where the fault has occurred according to the voltage drop across that segment of the cable. This data is fed to the ADC pin of a microcontroller which is pre-programmed to process the data and find the fault and sends a message through the IOT module and the exact location through GPS and also which sends an email as an alert.

3.5 MODULE DESCRIPTION

- Power supply Module
- Processing Module
- Current Sensor Module
- Pulse Width Modulation
- Node MCU Module

3.5.1 Power Supply Module

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. The power supply circuit consists of a step-down

transformer which is 230v step down to 12v. In this circuit 4 diodes are used to form a bridge rectifier which delivers pulsating dc voltage & then fed to the capacitor filter the output voltage from the rectifier is fed to the filter to eliminate any A.C components present even after rectification.

The filtered DC voltage is given to the regulator to produce 12v constant DC voltage. 230V AC power is converted into 12V AC (12V RMS value wherein the peak value is around 17V), but the required power is 5V DC; for this purpose, 17V AC power must be primarily converted into DC power then it can be stepped down to the 5V DC. AC power can be converted into DC using one of the power electronic converters using Rectifiers.

There are different types of rectifiers, such as half-wave rectifiers, full-wave rectifiers and bridge rectifiers as shown in Fig 3.2. Due to the advantages of the bridge rectifier over the half and full wave rectifier, the bridge rectifier is frequently used for converting AC to DC.

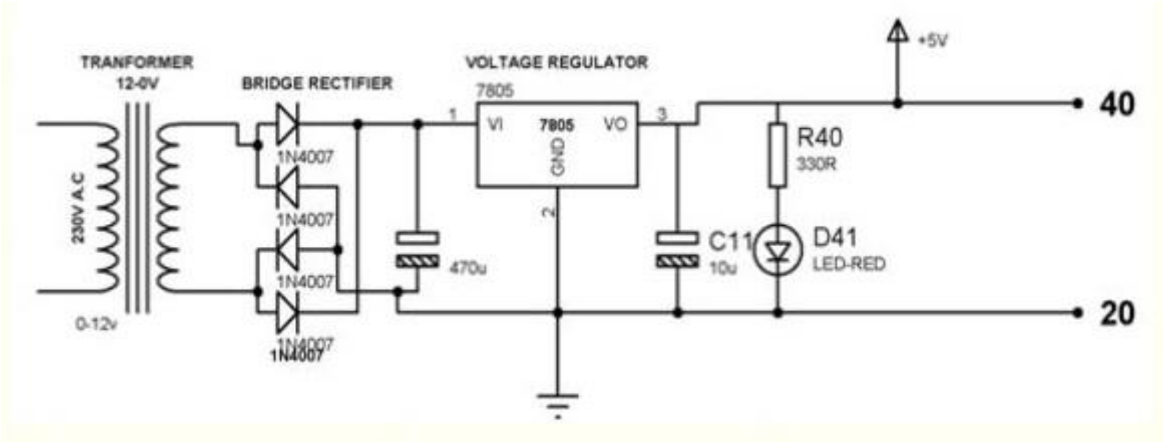


Fig 3.2: Power supply

3.5.2 Processing Module

The MSP430 is a 16-bit microcontroller that has a number of special features not commonly available with other microcontrollers as shown in Fig 3.2. The MSP430 can be used for low powered embedded devices. The current drawn in idle mode can be less than 1 µA. The top CPU speed is 25 MHz. It can be throttled back for lower power consumption. The MSP430 also uses six different low-power modes, which can disable unneeded clocks and CPU. Further, the MSP430 can wake-up in times under 1 microsecond, allowing the controller to stay in sleep mode longer, minimizing average current use. The device comes in a variety of configurations featuring the usual peripherals: internal oscillator, timer including pulse-width modulation (PWM), watchdog timer (watchdog), USART, Serial Peripheral Interface (SPI) bus, Inter-Integrated Circuit (I²C), 10/12/14/16/24-bit analog-to-digital converters (ADC), and brownout reset circuitry. Some less usual peripheral options include comparators (that can be used with the timers to do simple ADC), on-chip operational amplifiers (op-amp) for signal conditioning, 12-bit digital-to-analog converter (DAC), liquid crystal display (LCD) driver, hardware multiplier, USB, and direct memory access (DMA) for ADC results. Apart from someolder erasable programmable read-only memory (EPROM, such as MSP430E3xx) and high volume mask ROM (MSP430Cxxx) versions, all of the devices are in-system programming enabled via Joint Test Action

Group (JTAG), full four-wire or Spy-Bi-Wire), a built in bootstrapping loader (BSL) using UART such as RS232, or USB on devices with USB support.

The microcontroller MSP430 can be programmed with the Arduino software. It comes pre-burned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The MSP430 also uses six different low-power modes, which can disable unneeded clocks and CPU. Further, the MSP430 can wake-up in times under 1 microsecond, allowing the controller to stay in sleep mode longer, minimizing average current use. The device comes in a variety of configurations featuring the usual peripherals as shown in Fig 3.3.

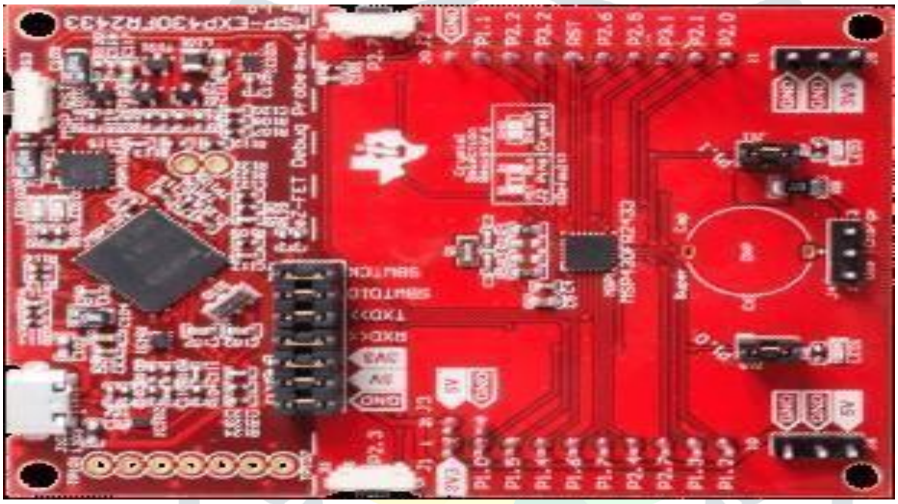


Fig 3.3: Microcontroller MSP430

3.5.3 Current Sensor

A current sensor is a device that detects electric current (AC or DC) in a wire, and generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output. It can be then utilized to displaythe measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be utilized for control purposes. The module is shown below in Fig 3.4.

Fig 3.4: Current Sensor Module

The sensed current and the output signal can be:

- Analog output, which duplicates the wave shape of the sensed current
- Bipolar output, which duplicates the wave shape of the sensed current
- Unipolar output, which is proportional to the average or RMS value ofthe sensed current
- Unipolar with a Unipolar output, which duplicates the wave shape of thesensed current
- Digital output which switches when the sensed current exceeds a certainthreshold

Features: Small size and low cost. Easy to integrate. Factory calibrated in awide temperature range.

3.5.4 Pulse Width Modulation (PWM)

Pulse width modulation reduces the average power delivered by an electrical signal by converting the signal into discrete parts. In the PWM technique, the signal's energy is distributed through a series of pulses rather than a continuously varying (analog) signal. In power electronics, pulse width modulation is a proven effective technique that is used to control semiconductordevices. Pulse width modulation or PWM is a commonly used control techniquethat generates analog signals from digital devices such as microcontrollers. The signal thus produced will have a train of pulses, and these pulses will be in the form of square waves. Thus, at any given time, the wave will either be high or low as shown in Fig 3.5.

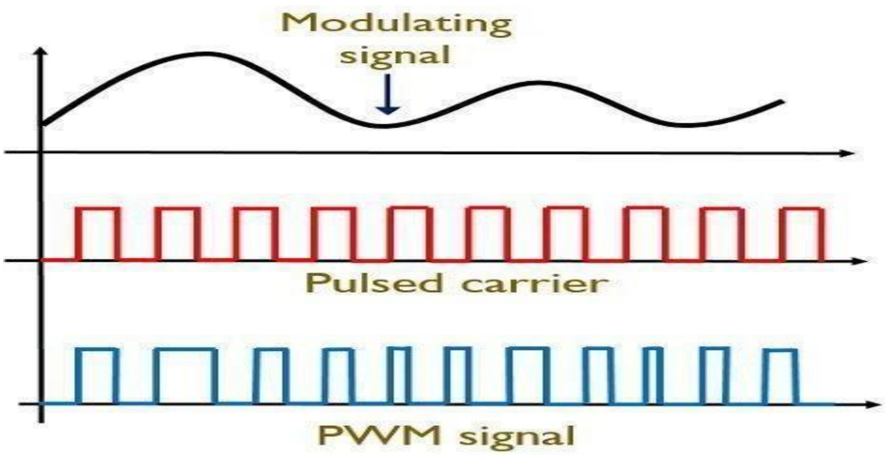


Fig 3.5: Pulse Width Modulation Signal

A pulse width modulating signal is generated using a comparator. The modulating signal forms one part of the input to the comparator, while the non-sinusoidal wave or sawtooth wave forms the other part of the input. The comparator compares two signals and generates a PWM signal as its output waveform.

3.5.5 Node MCU Module

Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware, which is based on the ESP-12 module. The term “Node MCU” by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. It uses many open-source projects, such as Lua-cjson and spiffs. LUA based interactive firmware for Express if ESP8622 Wi-Fi SoC, as well as an open-source hardware board for programming and debugging, is breadboard-friendly, and can simply be powered via its micro-USB port as shown in Fig 3.6.

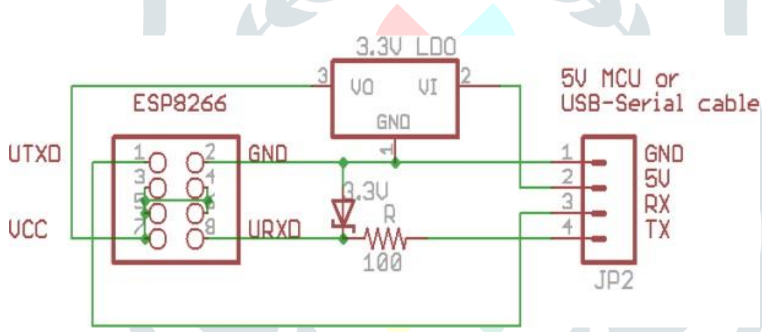


Fig 3.6: Circuit Diagram Of ESP8266

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Espresso. The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer,

AIThinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands.

However, at the time there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

The successor to these microcontroller chips is the ESP32. ESP8266 (presently ESP8266EX) is a chip with which manufacturers are making wirelessly networkable micro-controller modules. More specifically, ESP8266is a system-on-a-chip (SoC) with capabilities for 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2), general-purpose input/output (16 GPIO), Inter- 28 Integrated Circuit (I²C), analog-to-digital conversion (10-bit ADC), UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and pulse-width modulation (PWM). The processor core, called "L106" by Espressif, is based on Tensilica's Diamond Standard 106Micro 32-bit processor controller core and runs at 80 MHz (or overclocked to 160 MHz). It has a 64KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

CHAPTER 4 RESULT AND DISCUSSION

The result description of our project consists of both hardware and software. The experimental results obtained in this project work are discussed here. The results are analyzed at various levels. The detailed description is givenbelow.

4.1 REAL TIME MONITORING

The real time monitoring system module in the device constantly records and updates the values of Temperature, Humidity, Voltage and Current as shownbelow in Fig 4.1.

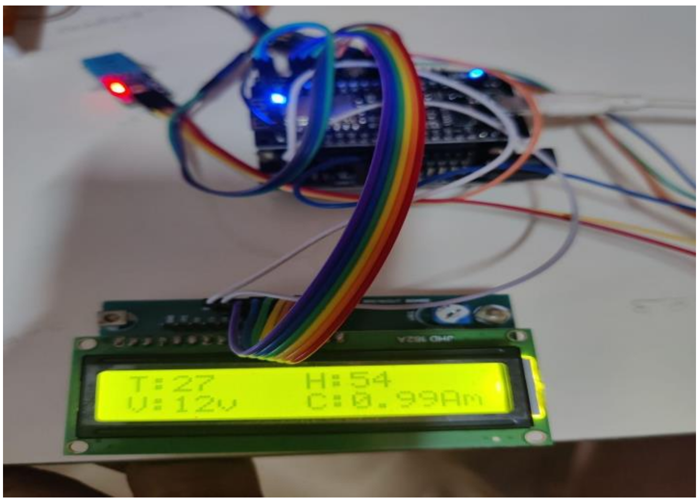


Fig 4.1: Real Time Monitoring

4.2 UNDERGROUND CABLE FAULT DETECTION

- The short circuit problem that occurs in the underground cable is detectedusing Ohm's Law theory.
- The problem is alerted via notification in the mobile application as shownbelow in Fig 4.2.

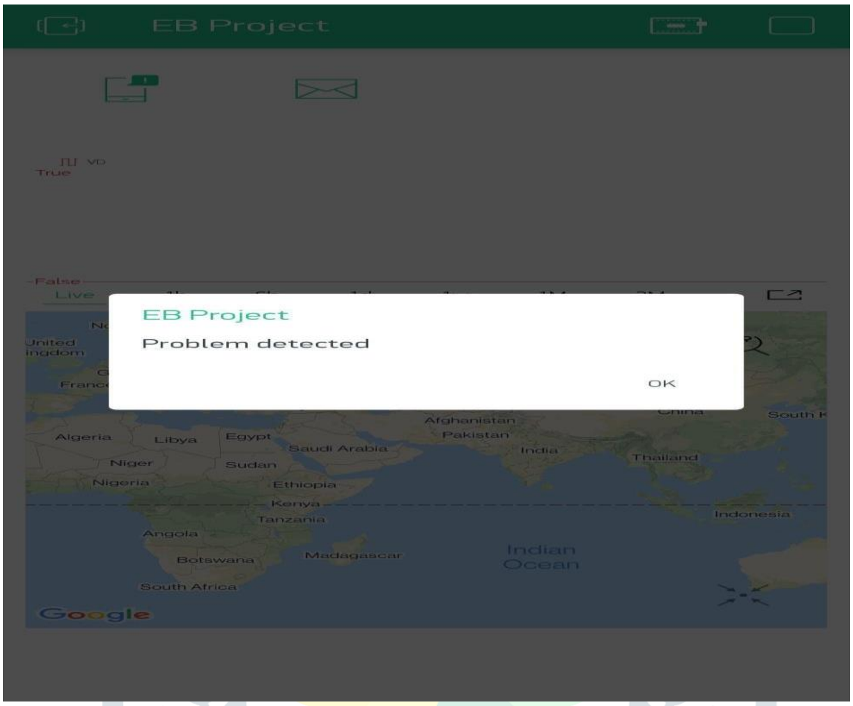


Fig 4.2: Problem Alert Via Mobile

- Here, after determination, the distance (In kilometers) of the fault isshared via email as shown below in Fig 4.3.

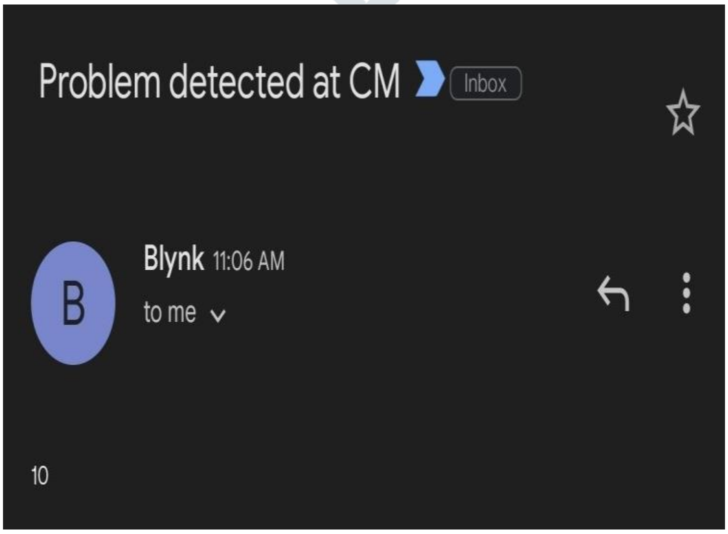


Fig 4.3 Underground Cable Fault Distance

4.3 BROKEN WIRE ALERT

The broken wire in the pavement which are generally caused by naturalhazards is determined and the pedestrians are alerted about the problem via LCD display as shown below in Fig 4.4.

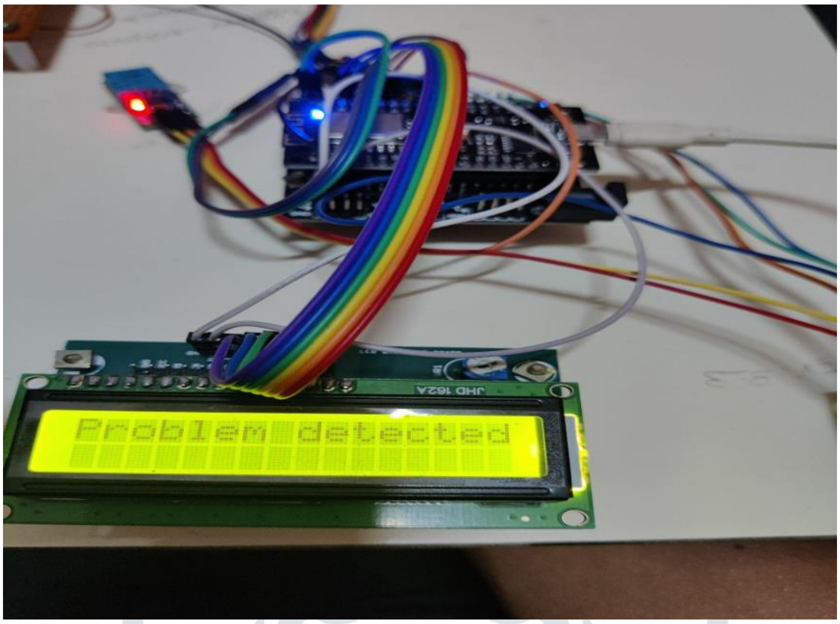
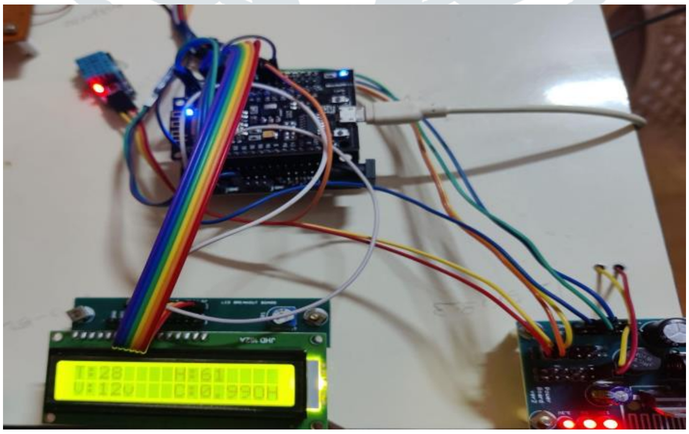


Fig 4.4: Broken Wire Alert

4.4 HUMIDITY

When the humidity value is normal and lesser compared to the giventhreshold value, the humidity is signified as OH(Over Humidity) as shownbelow in Fig 4.5.

Fig 4.5: Humidity Level Alert



When the humidity value is greater than the given threshold value (the value above which the power supply from the base station to the consumers becomes dangerous), the power supply is cut off in the place where the humidityvalue exceeds the given threshold as shown in Fig 4.6.

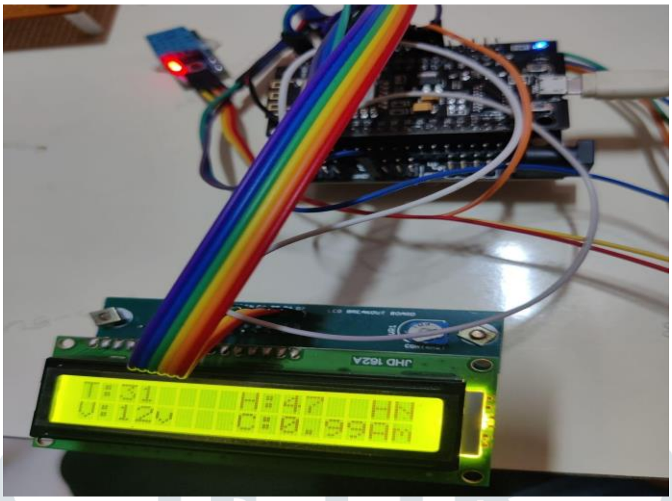


Fig 4.6: Humidity Level Alert

CHAPTER 5 CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The main goal of our project was to develop an Msp430 and IOT-based prototype to detect distances of the open and short circuit faults in the underground transmission cables, using a fairly convenient procedure. Our project proposes a possibility of isolating fault locations in the cable lines underground that are not visible to the bare eye otherwise. This will help to deal with hazardous situations like chemical damaging of underground cables due to chemical reaction with atmospheric reagents, or mechanical damage while installing the cables and so on. By using the Ohm's Law and three phase scanning system we used to display the fault in an LCD screen, sending a notification through IOT via Email. Pedestrians are also alerted about the broken wire via LCD display. By using weather sensors, real time values are updated and when the values reach a threshold value, the power supply is cut off automatically.

5.2 FUTURE SCOPE

In future, this project can be implemented in various places like towns, cities, industrial areas and special economic zones. We are also planning to detect earth faults as well and implement an open circuit fault detection in the hardware version. Further this project can be enhanced by adding the feature of notifications to the respective consumers.

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