Automatic Device Fault Diagnosis Using Artificial Intelligence in IoT

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Abstract -Electric power systems are designed to ensure a reliable supply of energy with highest possible stability. A substation facility is a small building which contains transformers, switches, voltage regulators, and metering equipment that are used to adjust voltages and monitor circuits. Since the power generated at the main stations is transported hundreds of miles using transmission lines before they reach the substations.A huge amount of power loss may occur during the transportation of the generated power which leads to the reduction in the quantity of power received at the substations. Therefore, measurements must be acquired either at sending end stations and user end, to ensure quality of power supply is maintained continuously. The main objective of this project is to overcome the power and distribution transformers are protected against damages due to overloading and faulty conditions like short-circuit, surges etc. Fast determination of fault location is recommended for further fast repairing of the fault to restore the power. Distribution systems being the largest portion of the whole system, diagnosis of faults becomes a challenging task. Faults in distribution systems affect power system reliability, security and quality. Locating a fault in distribution networks represents a sophisticated problem since different locations of a fault can produce the same fault indications. In our project we are solving that problem also and gives a solution for that using current sensor. Accurate fault location minimizes the time needed to repair damage, restore power and reduce costs. In case any problem occurs then it will be intimate to substation through Internet of Things (IoT). The proposed project reduced commercial losses, reduce the equipment damage, and enhanced power quality and reliability.

Keywords – IoT, Artificial Intelligence, Faulty condition.

I. INTRODUCTION

The transmission lines and distribution system plays significant part in current distribution to the consumers without interruption. The review indicates that 80% of the consumer's service interruptions are due to failures in distribution networks. Transmission lines are among the power system components with the maximum fault incidence rate, since they are exposed to the environment. Line faults due to lightning, storms, etc., the balanced faults in transmission line are three phase shunt and three phases to ground circuits. Single line-to ground, line-to-line and double line-to-line faults, overload, overvoltage, short circuit are unbalanced in nature. On a transmission system the protective relaying the protective system is integrated to detect the abnormal signals indicating faults isolate the faulted part from the rest of the system with minimal disturbance and equipment damage. Power transmission and distribution lines are the vital links that achieve the essential continuity of service of electrical power to the end users.

Transmission lines connect the generating stations and load centers. As the generating stations are distant from the load centers they run over hundreds of kilometers. But, the chances of fault occurring in transmission lines are very high. Many electric power transmission companies have primarily relied or circuit indicators to detect faulty sections of their transmission lines.

However there are still challenges in detecting the exact location of these faults.Although fault indicator technology has provided a reliable means to locate permanent faults, the technical crew and patrol teams still has to physically patrol and inspect the devices for longer hours to detect faulty sections of their transmission lines. Fault analysis is very significant problem in power system in order to clear faults quickly with minimum disruption. This system immediately transmits any fault information to electricity board. This concept can be used in isolated urban and rural areas to recognize the faults into load lines. The IoT technology were used in this network for communication purpose.

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II. FAULT DETECTION IN POWER SYSTEM

Identifying and locating fault in power line is very essential for strong operation of power system. In electrical power line fault often occur many times making the power system unreliable. Here using sensor for detecting fault which includes overvoltage, short circuit and mainly overload in power line for better reliable and optimal operation of the system is presented. In the proposed concept power line is divided by WNS (wireless sensor network) that could sense the faulty condition in power line, indicate to operator as through IOT to EB. Parameters calculated in PIC microcontroller transmits data to EB so that immediate action can be done with the help of IoT technology.

III. THEORETICAL BACKGROUND

Transmission line: Transmission line is the long conductor with special design (bundled) to carry bulk

amount of generated power at very high voltage from one station to another as per variation of the voltage level.

Type of transmission Line: In transmission line determination of voltage drop, transmission efficiency, line loss etc. are important things to design. These values are affected by line parameter R, L and C of the transmission line. Length wise transmission lines are three types.

Short Transmission Line

- Length is about 50 km.
- Voltage level is up to 20 kV
- Capacitance effect is negligible
- Only resistance and inductance are taken in calculation capacitance is neglected.

Medium Transmission Line

- Length is about 50km to 150km
- Operational voltage level is from 20 kV to 100 kV
- Capacitance effect is present
- Distributed capacitance form is used for calculation purpose.

Long Transmission Line

- Length is more than 150 km
- Voltage level is above 100 kV
- Line constants are considered as distributed over the length of the line.

Electric power transmission:

Electric power transmission is the bulk movement of electrical energy from a generating site, such as a power plant, to an electrical substation. The interconnected lines which facilitate this movement are known as a transmission network. This is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution. The combined transmission and distribution network is known as the "power grid".

IV. SYSTEM:

Most transmission lines are high-voltage three-phase alternating current (AC), although single phase AC is sometimes used in railway electrification systems. High-voltage direct-current (HVDC) technology is used for greater efficiency over very long distances (typically hundreds of miles). HVDC technology is also used in submarine power cables (typically longer than 30 miles (50 km)), and in the interchange of power between grids that are not mutually synchronized. HVDC links are used to stabilize large power distribution networks where sudden new loads, or blackouts, in one part of a network can result in synchronization problems and cascading failures.

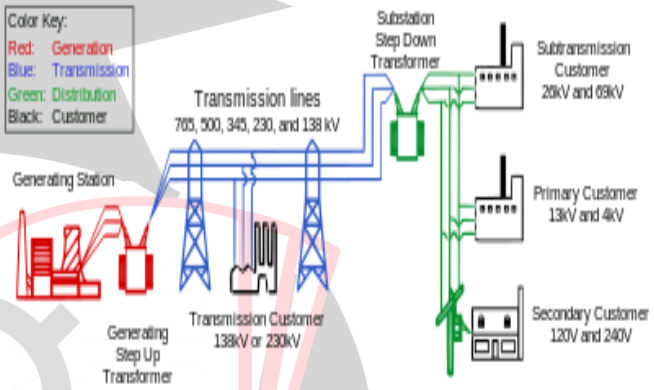

Diagram of an electric power system, transmission system is in blue

Electricity is transmitted at high voltages (115 kV or above) to reduce the energy loss which occurs in long-distance transmission. Power is usually transmitted through overhead power lines. Underground power transmission has a significantly higher installation cost and greater operational limitations, but reduced maintenance costs. Underground transmission is sometimes used in urban areas or environmentally sensitive locations.

A lack of electrical energy storage facilities in transmission systems leads to a key limitation. Electrical energy must be generated at the same rate at which it is consumed. A sophisticated control system is required to ensure that the power generation very closely matches the demand. If the demand for power exceeds supply, the imbalance can cause generation plant(s) and transmission equipment to automatically disconnect and/or shut down to prevent damage. In the worst case, this may lead to a cascading series of shut downs and a major regional blackout.

Electric transmission networks are interconnected into regional, national, and even continent wide networks to reduce the risk of such a failure by providing multiple redundant, alternative routes for power to flow should such shut downs occur. Transmission companies

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determine the maximum reliable capacity of each line (ordinarily less than its physical or thermal limit) to ensure that spare capacity is available in the event of a failure in another part of the network.

TYPES OF FAULTS:

The design of systems to detect and interrupt power system faults is the main objective of power system protection.

They are shown below.

a. Transient fault

b. Symmetric fault

c. Asymmetric fault

(a).Transient fault:A transient fault is a fault that is no longer present if power is disconnected for a short time and then restored; or an insulation fault which only temporarily affects a device's dielectric properties which are restored after a short time. Many faults in overhead power lines are transient in nature. When a fault occurs, equipment used for power system protection operate to isolate the area of the fault.

(b).Symmetric Fault: A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric. This is in contrast to an asymmetrical fault, where the three phases are not affected equally.

(c). Asymmetric Fault: An asymmetric or unbalanced fault does not affect each of the three phases equally. Common types of asymmetric faults, and their causes:

Line-to-Line:-

A short circuit between lines, caused by ionization of air, or when lines come into physical contact, for example due to a broken insulator.

2. Line-to-Ground:-

A short circuit between one line and ground, very often caused by physical contact, for example due to lightning or other storm damage.

3. Double Line-to-Ground:-

Two lines come into contact with the ground (and each other), also commonly due to storm damage.

Internet of things:

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications.

The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities."Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters,[16]automobiles with built-in sensors,DNAanalysis devices for environmental/food/pathogen monitoring or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest to look at "Things" as an "inextricable mixture of hardware, software, data and service". These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens or refrigerators/freezers that use Wi-Fi for remote monitoring.

V. SYSTEM ANALYSIS

Existing method:

In existing method, when a fault occurs in transmission line, it is difficult to detect. But slowly these minor faults can lead to damage of transformer and can turn destruction to human life. It may also burn the whole part. Present day in India, we do not have a system in hand so it is more problematic in real time once a fault occurs. Problem of concern is that since we do not have a real time system, this leads to damage of the essential equipment's connected and turns out to be a risk to human around.

Disadvantages:

- Difficult to find the fault
- Maintenance cost is high
- More time consumption

Proposed Method:

Distribution line multiple faults detection and indication to substation deals with the problem of identifying the fault in the distribution lines and the automatic indication to substation. The electric distribution network the microcontroller interact with the power lines and sends message what kind of fault held in the line through the Internet of Thins (Iot). In this the man power is decreases

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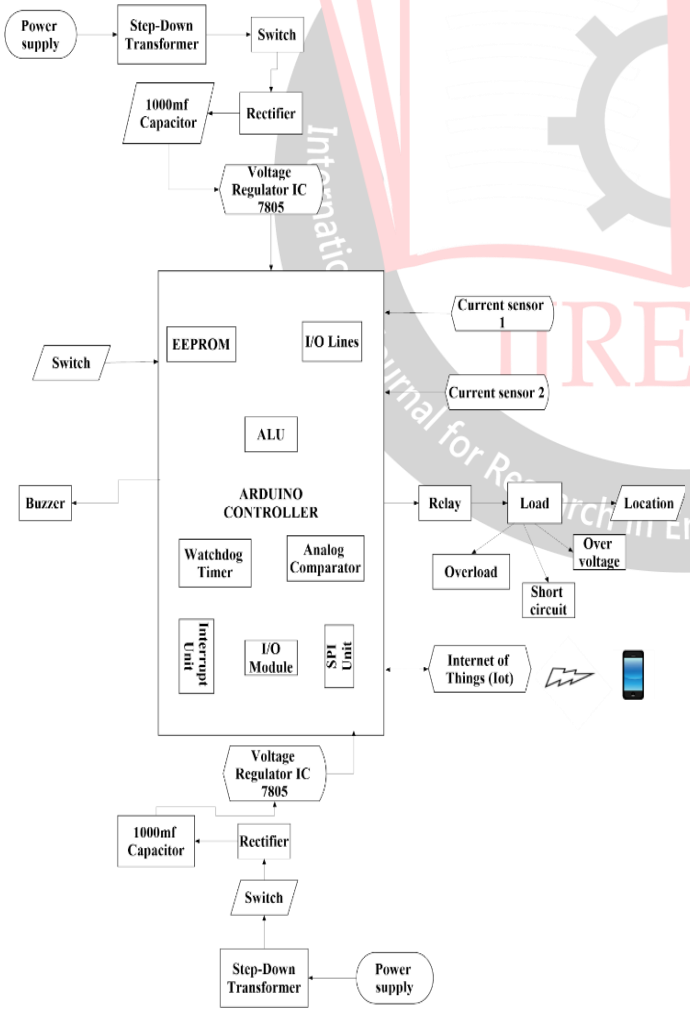
from finding the fault where it is. The objective is to monitor the distribution line continuously and hence to safeguard the fault of distribution line due to the limitations such as overvoltage, overload, and short circuit. Here current sensor is used to detect the overload, short circuit and overvoltage. If any of these does occurs then this information will be sent to the substation through Internet of Things (Iot) and alarm also rings to indicate us. Detecting the area where the fault is occurred is difficult. Using current sensor is reliable to detect and intimate the fault. In the short time we can able know the fault and rectify immediately. Our proposed method shows the correct location of the fault occurred through Current sensor.

Advantages:

- No manual work
- Here we are designing a cost effective and fast response system helping in improving safety.
- The proposed method is efficient method to detecting and intimating the faults
- Detecting the area where the fault is occurred is easy.

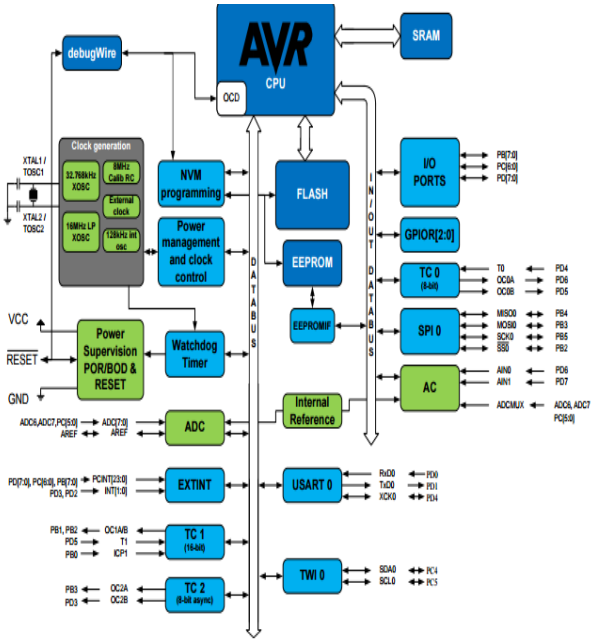
BLOCK DIAGRAM:



HARDWARE REQUIREMENTS:

- Power supply
- Step-Down Transformer
- Rectifier
- 1000mf Capacitor
- Voltage Regulator IC 7805
- Arduino controller
- Buzzer
- Current sensor
- Relay
- Load

BLOCK DIAGRAM:



SOFTWARE REQUIREMENTS

Keil C51 C Compilers

- Direct C51 to generate a listing file
- Define manifest constants on the command line
- Control the amount of information included in the object file
- Specify the level of optimization to use
- Specify the memory models
- Specify the memory space for variables the Keil C541 C Compiler for the 8051 microcontroller is the most popular 8051 C Compiler in the world.
- It provides more features than any other 8051 C compiler available today.

The C51 Compiler allows you to write 8051 microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Language extensions in the C51 Compiler give you full access to all resources of the 8051. The C51 Compiler translates C source files into relocatable object modules which contain full symbolic information for debugging with the uVision Debugger or an in-circuit emulator. In addition to the object file, the compiler generates a listing file which may

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optionally include symbol table and cross reference information.

VI. FEATURES

Nine basic data types, including 32-bit IEEE floating-point.

Interrupt functions may be written in C.

Full use of the 8051 registers banks.

- Complete symbol and type information for source-level debugging.
- Use of AJMP and ACALL instructions.
- Bit-addressable data objects.
- Built-in interface for the RTX51 Real-Time Kernel.
- Support for dual data pointers on Atmel, Cypress, Dallas semiconductor, and Infineon, Philips, and Triscend microcontrollers.
- Support for the Philips 8XC750, 8XC751, and 8XC752 limited instruction

Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors. I.E the programs written in one of the HLL like 'C' will compile the code to run on the system for a particular processor like x86 (underlying microprocessor in the computer). Compiler is a program that translates source code into object code. The compiler derives its name from the way it works, looking at the entire piece of source code and collecting and reorganizing the instruction. See there is a bit little difference between compiler and an interpreter. Interpreter just interprets whole program at a time while compiler analyzes and execute each line of source code in succession, without looking at the entire program.

The advantage of interpreters is that they can execute a program immediately. Secondly programs produced by compilers run much faster than the same programs executed by an interpreter. However compilers require some time before an executable program emerges.

Concept of cross compiler:

A cross compiler is similar to the compilers but we write a program for the target processor (like 8051 and its derivatives) on the host processors (like computer of x86). It means being in one environment you are writing a code for another environment is called cross development. And the compiler used for cross development is called cross compiler. So the definition of cross compiler is a compiler that runs on one computer but produces object code for a different type of computer.

Cross compilers are used to generate software that can run on computers with a new architecture or on special-purpose devices that cannot host their own compilers.

Cross compilers are very popular for embedded development, where the target probably couldn't run a compiler. Typically an embedded platform has restricted RAM, no hard disk, and limited I/O capability. Code can be edited and compiled on a fast host machine (such as a PC or Unix workstation) and the resulting executable code can then be downloaded to the target to be tested. Cross compilers are beneficial whenever the host machine has more resources (memory, disk, I/O etc) than the target. Keil C Compiler is one such compiler that supports a huge number of host and target combinations. It supports as a target to 8 bit microcontrollers like Atmel and Motorola etc.

Why do we need cross compiler?

There are several advantages of using cross compiler. Some of them are described as follows. By using this compilers not only can development of complex embedded systems be completed in a fraction of the time, but reliability is improved, and maintenance is easy.

Register allocation and addressing mode details are managed by the compiler.

- The ability to combine variable selection with specific operations improves program readability.
- Keywords and operational functions that more nearly resemble the human thought process can be used.
- Program development and debugging times are dramatically reduced when compared to assembly language programming.
- The library files that are supplied provide many standard routines (such as formatted output, data conversions, and floating-point arithmetic) that may be incorporated into your application.
- Existing routine can be reused in new programs by utilizing the modular programming techniques available with C.

The C language is very portable and very popular. C compilers are available for almost all target systems. Existing software investments can be quickly and easily converted from or adapted to other processors or environments.

Proteus Software: Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. It is developed by Lab center Electronics. The X Game Station Micro Edition was designed using Lab center's Proteus schematic entry and PCB layout tools.

System Components:

- ISIS Schematic Capture - a tool for entering designs.
- PROSPICE Mixed mode SPICE simulation - industry standard SPICE3F5 simulator combined with a digital simulator.

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- ARES PCB Layout - PCB design system with automatic component placer, rip-up and retry auto-router and interactive design rule checking.
- VSM - Virtual System Modeling lets co simulate embedded software for popular micro-controllers alongside hardware design.

System Benefits Integrated package with common user interface and fully context sensitive help.

VII. LANGUAGE FEATURES

At first sight, Proteus may appear similar to Basic because of its straight syntax, but similarities are limited to the surface:

Proteus has a fully functional, procedural approach; variables are untyped, do not need to be declared, can be local or public and can be passed by value or by reference;

All the typical control structures are available (if-then-else; for-next; while-loop; repeat-until; switch-case); New functions can be defined and used as native functions.

Data types supported by Proteus are only three:integer numbers, floating point numbers and strings. Access to advanced data structures (files, arrays, queues, stacks, AVL trees, sets and so on) takes place by using handles, i.e. integer numbers returned by item creation functions.

Type declaration is unnecessary: variable type is determined by the function applied – Proteus converts on the fly every variable when needed and holds previous data renderings, to avoid performance degradation caused by repeated conversions.

The main features of this language are:

Fully functional, procedural language;

Multi-language support: Proteus is available in several languages (keywords and messages);

No data types:all variables can be used as integer numbers, floating point numbers or strings; variables are interpreted according to the functions being applied – Proteus keeps different representations of their values between calls, to decrease execution time in case of frequent conversions between one type and the other;

No pre-allocated structures: all data used by Proteus are dynamically allocated at execution time; there are no limits on: recursion, maximum data size, number of variables, etc.

No operators: Proteus is a completely functional language – there are no operators; thus, there is no ambiguity when evaluating expressions and parentheses are not needed;

Large library of predefined functions: Proteus is not a toy-language, it comes with hundreds of library functions ready to be used for working on strings, dates, numbers, for sorting, searching and so on.

VIII. CONCLUSION

Detecting the area where the fault is happened is difficult. Using microcontroller and Iot based method is reliable to detect and intimate the fault. In the short time we can able know the fault and rectify instantly. The man work is reduced and don't need to walk along through the power line to know the location of the fault. The Iot can sends message quickly to the Electricity board. The microcontroller is cheaper in cost and working efficiency is high. The proposed method is efficient method to detecting and intimating the faults immediately.

REFERENCES

[1] P. L. Ostermann, Editor, Underground Transmission Systems Reference Book, New York: Electric Power Research Institute, 1992 Edition, p. 9.

[2] IEEE Guide for Application of Sheath-Bonding Methods for Single-Conductor Cables and the Calculation of Induced Voltages and Currentsin Cable Sheaths, IEEE Standard 575-1988, March 1986.

[3] Electrical Transmission and Distribution Re ference Book, Westinghouse Electric Corporation, 1964, pp. 64–95.

[4] J. H. Neher, "The Phase Sequence Impedance of Pipe-Type Cables," IEEE Trans. on Power Apparatus and Systems, Vol. 83, pp. 795–804, Aug. 1964.

[5] G. Liu, "Computation of Zero-Sequence Impedance of Underground Three-Phase Pipe-Type Cable," Ph.D. dissertation, Dept. Electr. Eng., Clemson Univ., Clemson, 2000.

[6] Working Group D12 of the Line Protection Subcommittee, PSRC, "Protective Relaying Considerations for Transmission Lines With High Voltage AC Cables," IEEE Trans. Power Delivery, Vol. 12, No. 1, pp. 83–96, Jan. 1997. [7] J. Roberts, E. O. Schweitzer, III, R. Arora, and E. Poggi, "Limits to the Sensitivity of Ground Directional and Distance Protection," in 1996 50th Annual Georgia Tech Protective Relaying Conference.

[8] J. Vargas, A. Guzmán, and J. Robles, "Underground/Submarine Cable Protection Using a Negative-Sequence Directional Comparison Scheme," in 1999 26th Annual Western Protective Relay Conference Proceedings.

[9] V. Leitloff, X. Bourgeat, and G. Duboc, "Setting Constraints for Distance Protection on Underground Cables," in Proc. 2001 7th IEE International Conference on Developments in Power System Protection.

[10] E. O. Schweitzer, III, K. Behrendt, and T. Lee, "Digital Communications for Power System Protection: Security, Availability, and Speed," 1998 25th Annual Western Protective Relay Conference Proceedings.

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