ARM Cortex Based Underground Cable Fault Detection

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***Abstract*: The project is intended to detect the location of fault in underground cable lines from the base station in kilometers using an ARM cortex microcontroller. This project uses the standard concept of Ohms law i.e., when a low DC voltage is applied at the feeder end through a series resistor to the Cable lines, then current would vary depending upon the location of fault in the short circuited cable. In the urban areas, the electrical cables run in undergrounds instead of overhead lines. Whenever the fault occurs in underground cable it is difficult to detect the exact location of the fault for process of repairing that particular cable. The proposed system finds the exact location of the fault. Here the current sensing circuits made with combination of resistors are interfaced to ARM cortex microcontroller with help of the internal ADC device for providing digital data to the microcontroller representing the cable length in KM's. The fault creation is made by the set of switches. In case of short circuit (Line to Ground), the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed ARM cortex microprocessor that further displays fault location in kilometers.**

Keywords— ARM cortex,coocox,

INTRODUCTION

Underground cables have been widely applied in power distribution networks due to the benefits of underground connection, involving more secure than overhead lines in bad weather, less liable to damage by storms or lightning, no susceptible to trees, less expensive for shorter distance, environment-friendly and low maintenance. Every cable has its own resistance. As the length of the cable increases, so does the resistance value of the particular cable increase.

The only disadvantages of utilizing underground cables is that, it is 8 to 15 times more expensive than equivalent overhead lines, more liable to permanent damage following a flash-over, and difficult to locate fault.

Faults in underground cables can be normally classified as two categories: incipient faults and permanent faults. Usually, incipient faults in power cables are gradually resulted from the aging process, where the localized deterioration in insulations exists. Electrical overstress in conjunction with mechanical deficiency, unfavorable environmental condition and chemical pollution, can cause the irreparable and irreversible damages in insulations. Eventually, incipient faults would fail into permanent faults sooner or later.

The detection of incipient faults can provide an early warning for the breakdown of the defective cable, even trip the suspected feeder to limit the repetitive voltage transients. The location of permanent faults in cables is essential for electric power distribution networks to improve network reliability, ensure customer power quality, speed up restoration process, minimize outage time, reduce repairing cost, dispatch crews more efficiently and maintain network reliability. The state estimation (SE) is an auxiliary tool to provide the necessary information for the proposed location algorithms. The related methods published in journals and proceedings are reviewed, summarized and compared in the next subsections.

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the proposed location algorithms. The related methods published in journals and proceedings are reviewed, summarized and compared in the next subsections.

LITERATURE SURVEY:

[1] M. Hartebrodt and K. Kabitzsch, “Fault detection in field buses with time domain reflectometry,” in Proc. 7th AFRICON, Sep. 2004, vol. 1, pp. 391–396. In the Time Domain reflectometry (TDR) method, a low energy signal is sent through the cable where the perfect cable with the uniform characteristic impedance returns the signal within a known time and with a known profile.This time and profile of the signal is altered once the cable has impedance variation due to any fault. The impedance variation causes a portion of the signal reflected back to source. The reflected signal fortifies the original signal when there is an increase in characteristic impedance at the fault location, while it opposes the original signal when there is a decrease in characteristic impedance. Graphical representation on the Time Domain Reflectometry (TDR) screen gives the user the distance to the fault in time units.

[2] E.C. Bascom and D.W. Von Dollen, “Computerized underground cable fault location expertise,” in IEEE Power Engineering Society Transmission and Distribution Conference, pp. 376–382, 10–15April 1994,.Power Technologies, Inc. (PTI) developed an expert system and on-line advisor for the Electric Power Research Institute (EPRI). The system, FAULT, provides guidance for field crews to diagnose a cable failure, recommend applicable fault location techniques, and trouble-shoot resulting difficulties which occur during the process of locating underground cable faults on transmission and distribution cable systems. The fault location methods which were identified during development of the expert system are presented in this paper, along with utility statistics from a survey on underground cable fault location

[3] Proceedings of the International Multi-conference of engineers and computer scientists 2010 Vol II,IMECS 2010,march 17-19,2010,Hong Kong. A. Ngaopitakkul and C. Pothisarn, “Discrete Wavelet Transform and Back-propagation Neural Networks algorithm for fault location on Single-circuit transmission line,” In Proceedings of 2004 International Conference on Robotics and Biomimetics (ROBIO2008), Thailand, February 2009, pp. 365-371. This paper proposes a technique for locating the distance of fault occurring in underground cable using combination of discrete wavelet transform and traveling wave. Positive sequence current signals are used in fault detection algorithm. It is found that this algorithm can detect fault with the accuracy of 100% using scale 1 only. Various case studies have been carried out including the variation of fault inception angles and fault types. As a result, the application of the discrete wavelet transform (DWT) based on traveling wave is a good choice in power system.

[4] International Journal of Electrical and Computer Engineering (IJECE) Vol. 3, No. 2, April 2013, pp. 145~151 ISSN: 2088-8708 .Present trend of laying cables for various purposes is to lay underground. Companies prefer laying the cables underground because the climatic adversities don’t affect this. With advantages come challenges. There are many difficulties in laying the cables and once laid in case of any complaints, it is difficult and costly to fix it. This paper is about the robot that is designed by us which is capable of finding where the complaint lies, so the engineer can directly get the hole dug at that point and fix the issue. The basic principle of Electromagnetic Theory is employed to detect the discontinuity in the cable. Using a signal injector, a low frequency signal is passed through the wire and the induced magnetic field is used to detect the fault.

Abbreviations:ARM-advanced risc machine , LCD-liquid crystal display , TDR-Time Domain Reflectometry ,SE-State estimation

METHODOLOGY:

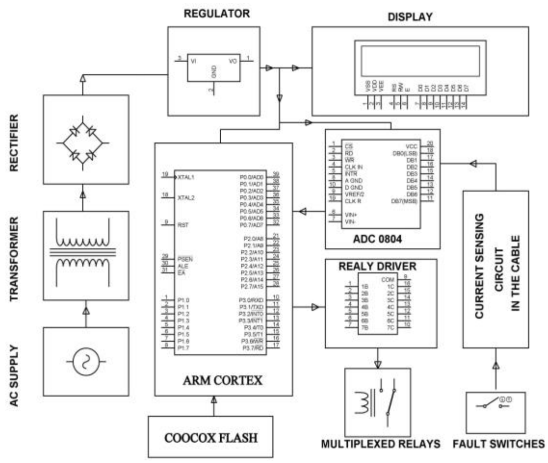

Fig.a Design diagram of the proposed system

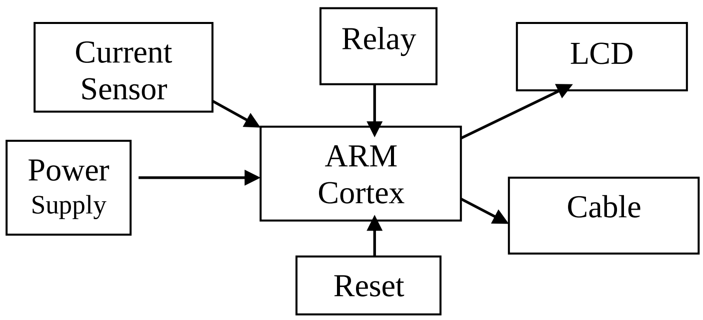

Fig.b Schematic structure of the system

Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design concept is adopted and the system is mainly composed of a single microprocessor, current sensor, relay, power supply unit, and resistance circuit.

The ARM cortex processor is programmed so that it keeps on inspecting the resistance of the cable whenever an damage occurs in the cable the resistance value of the cable varies and the current sensor keeps on measuring the resistance of the network and keeps on updating the processor and the processor is loaded with the default value of resistance and hence the processor keeps on comparing the resistance value sent by the current sensor and when this value changes with the default value the processor calculates the distance of damage occurred from the reference point is calculated and the relay is used to stop the flow of current to prevent the damages due to leakage of current.

HARDWARE REQUIREMENTS:

- ARM cortex microprocessor.
- LCD.
- Relay.
- Power supply unit.
- Resistant circuit (in place of cable).
- Current sensor.

SOFTWARE REQUIREMENTS:

- Coocox IDE Tool
- Coocox Flash

ADVANTAGES:

- Installation and maintenance cost is less.
- Economically viable.
- Times spent for searching damaged point in cables are reduced.

DISADVANTAGES:

- Cost differential decreasing with time.
- Fault ,location instantaneous ,can have longer repair time.
- Undergrounding all of the lines would increase the cost of electricity by 16%.

FUTURE SCOPE:

With the ongoing changes taking place in today's technology the entire unit can be made into a simple and compact device.

REFERENCES:

1] M. Hartebrodt and K. Kabitzsch, "Fault detection in field buses with time domain reflectometry," in Proc. 7th AFRICON, Sep. 2004, vol. 1, pp. 391–396.

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