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Monitoring and Detection of Voltage Stress in Underground Cables Using I2C Protocol

A.Balamurugan [1], T. Govindaraj [2], P.Loganathan [3]

Asst. Professor, Department of EEE, VMKV Engineering College, Salem, Tamilnadu, India[1]

P.G. Student, Department of EEE, VMKV Engineering College, Salem, Tamilnadu, India [2]

Asst.Professor, Department of EEE, VMKV Engineering College, Salem, Tamilnadu, India[3]

ABSTRACT: Transmission and distribution of power can be done either by overhead lines or power cables. Although for many years, the overhead lines have been most reliable power transmission medium, the deregulation of the electricity supply markets and growing environmental awareness are creating exciting new markets for power transmission solutions based on underground cable technology. Even though many protection methods for high-voltage cable systems this paper deals with the advanced monitoring and detection of voltage stress in MV or HV Underground cables. This system is implemented with the help of embedded system in which master slave concept.This paper uses a PIC16F877A micro controller as a master and the sensor network acts as slave. Thus the master and slave communication can be implemented using i2c protocol. In case any abnormal voltage stress across the UG cable, the corrective action has done in both input and output side by using step-down transformer step up transformer. So that balanced output is maintained in the UG cables.

KEYWORDS: cable technology; voltage stress in MV or HV ; step-down transformer step up transformer

I. Introduction

A lack of effective power cable monitoring will lead to more frequent disturbance of electrical supply to commercial and domestic customers. Continuous on-line monitoring systems are being installed with the aim of reducing unexpected failures. This study presents work on the analysis and handling of acquired data, from the point of view of asset management and the PD activities observed in an on-line cable monitoring systems. Initially, a review of on-line against off-line cable PD monitoring is presented, in terms of setups and their respective advantages and disadvantages. The study then presents the experience of applying wavelet based denoising techniques [both the discrete wavelet transform (DWT) and the second generation wavelet transform (SGWT)] to PD data de-noising.

Networks of medium-voltage (MV) cables are used to deliver electrical power at a local level in the majority of the world's utility systems. The majority of the MV distribution cables, and the associated plant, in the UK's networks were installed during the 1950s and 1960. As the items, typically, have a design life of 40–70 years they are approaching, or have exceeded, their expected operational life.

Despite reported indications of increasing failure rate in power plant, the operational and cost constraints affecting utilities requires that equipment continues to operate for a considerable time. Utilities in the UK and Holland have reported that half of outages to customers are due to underground cable failure. Private communication with a UK utility indicates that at the current replacement rate of 100 km per annum prior to 2010, it will take hundreds of years to replace the components in its underground cable network. The result of faults in distribution cable is 2-fold, firstly, interruption of electrical supply to customers as a result of the failure and secondly, inconvenience to the public through roads being dug up to carry out repairs.

A lack of effective power cable monitoring will lead to more frequent disruption of electrical supply to commercial and domestic customers. This may have severe economic consequences for electricity suppliers and users, for example in July 2006174,000 New York residents lost power in a single incident. For failing to address pre-existing faults and for poor Maintenance, the company suffered a large financial penalty and the board was severely reprimanded.

A typical MV distribution power circuit consists of multiple cable sections connected by joints which are assembled manually on-site. It has been reported that cable system failures because of the breakdown of electrical insulation between the conductors commonly occur at joints and terminations.

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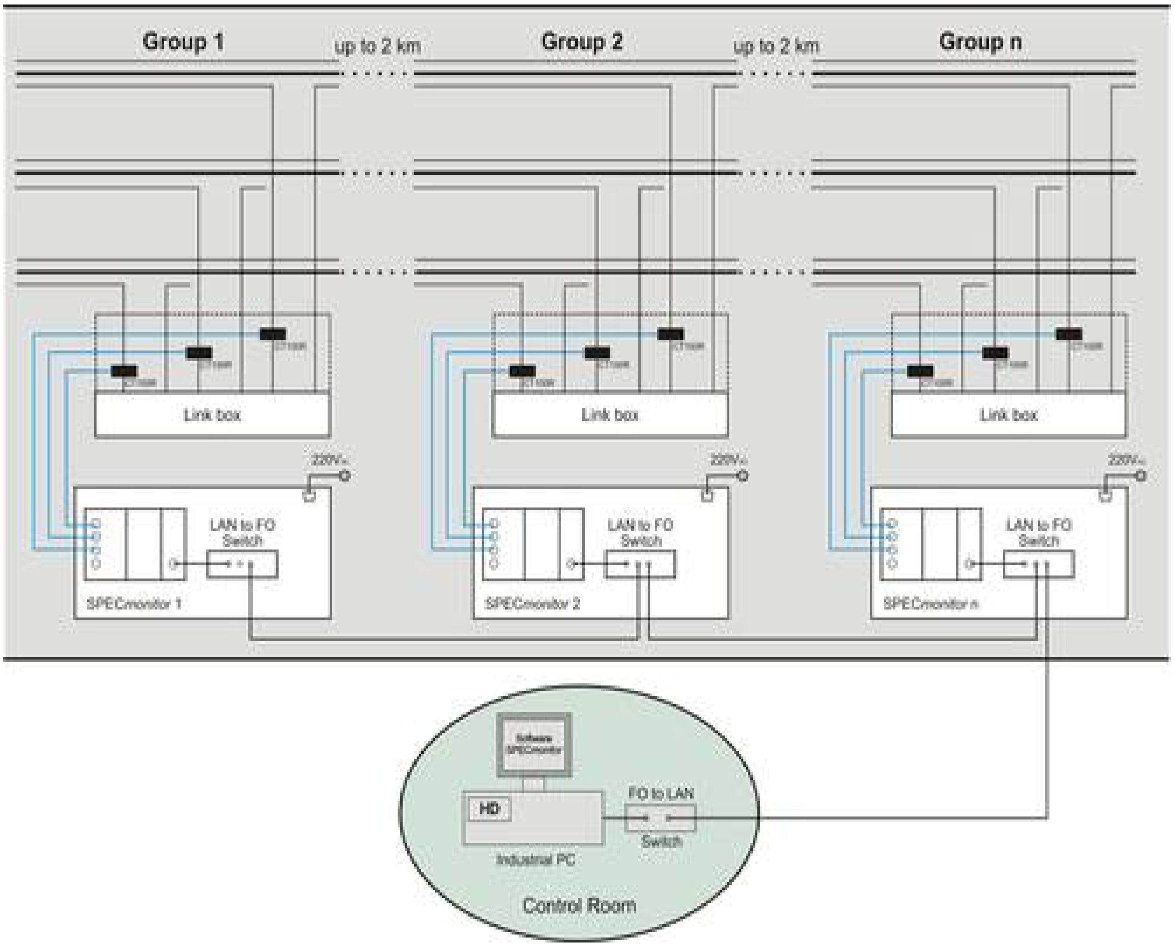
A failure of cable insulation is normally preceded by a period during which material degradation takes place, this may last for months or several years. Identification, characterization and determination of the rate of degradation are fundamental to improving assessment of cable integrity and successful extension of operational life. Industry recognizes that, regardless of initiating mechanisms, deterioration of the insulating materials results in partial discharges at localized degradation site.

II. RELATED WORK

A lack of effective power cable monitoring will lead to more frequent disturbance of electrical supply to commercial and domestic customers. Continuous on-line monitoring systems are being installed with the aim of reducing unexpected failures. This study presents work on the analysis and handling of acquired data, from the point of view of asset management and the PD activities observed in an on-line cable monitoring systems. Initially, a review of on-line against off-line cable PD monitoring is presented, in terms of setups and their respective advantages and disadvantages. The study then presents the experience of applying wavelet based denoising techniques [both the discrete wavelet transform (DWT) and the second generation wavelet transform (SGWT)] to PD data de-noising.

BLOCK DIAGRAM



1.Block Diagram

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OPERATION

Partial discharge (PD) faults in power cables have been identified through I2C protocol. Where ever the fault possibilities identified by the voltage stress sensor and it is immediately sent to the corresponding authority by two wire communication. For current and voltage stress monitoring here Hall sensor is placed with their whole circuit arrangement in every 1Km. From the receiving ID we can locate the exact fault possible location before that will occur.

III. PROPOSED ALGORITHM

The proposed system is used to monitoring and detection of High voltage stress in MV or HV Underground cables. To implement the system we use a Hall sensor, step-up & step down transformer, and PIC micro controller. Every one kilometer sensor (slaves) is placed to measure the voltage stress level. Thus conversely provide the information about the UG cables. The data can be stored in master controller. Here we are using PIC micro controller as a master. In case any abnormal voltage stress across the UG cable, the correction can be done in input side by using step-down transformer. In output side can be controlled by step up transformer. So that balanced output is maintained in the UG cables.

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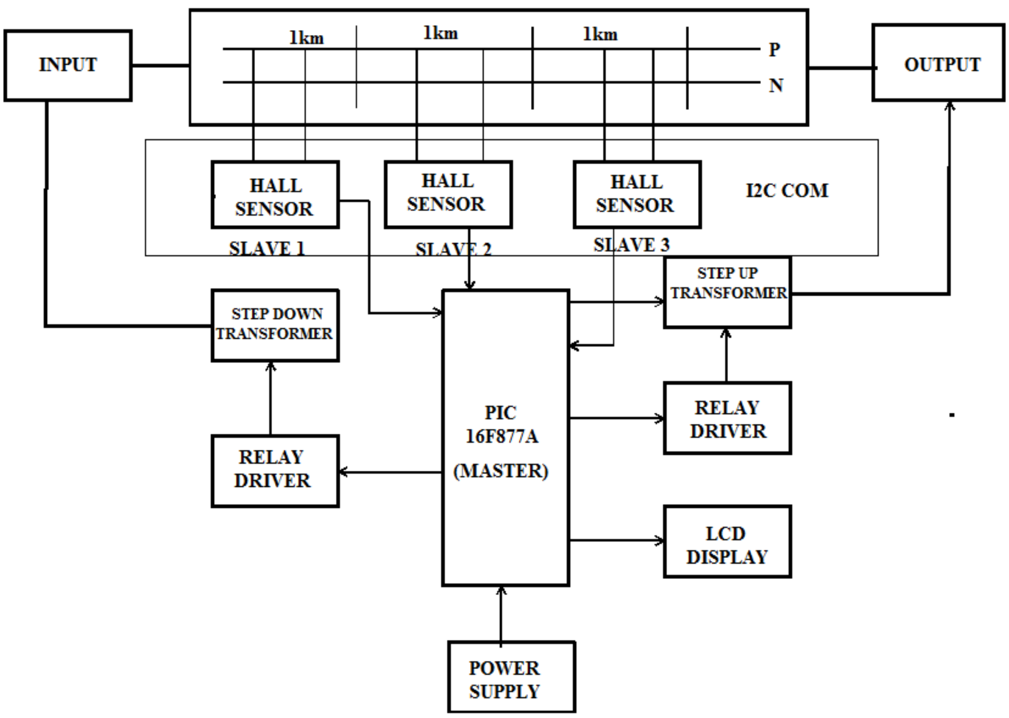

2. Proposed Algorithm

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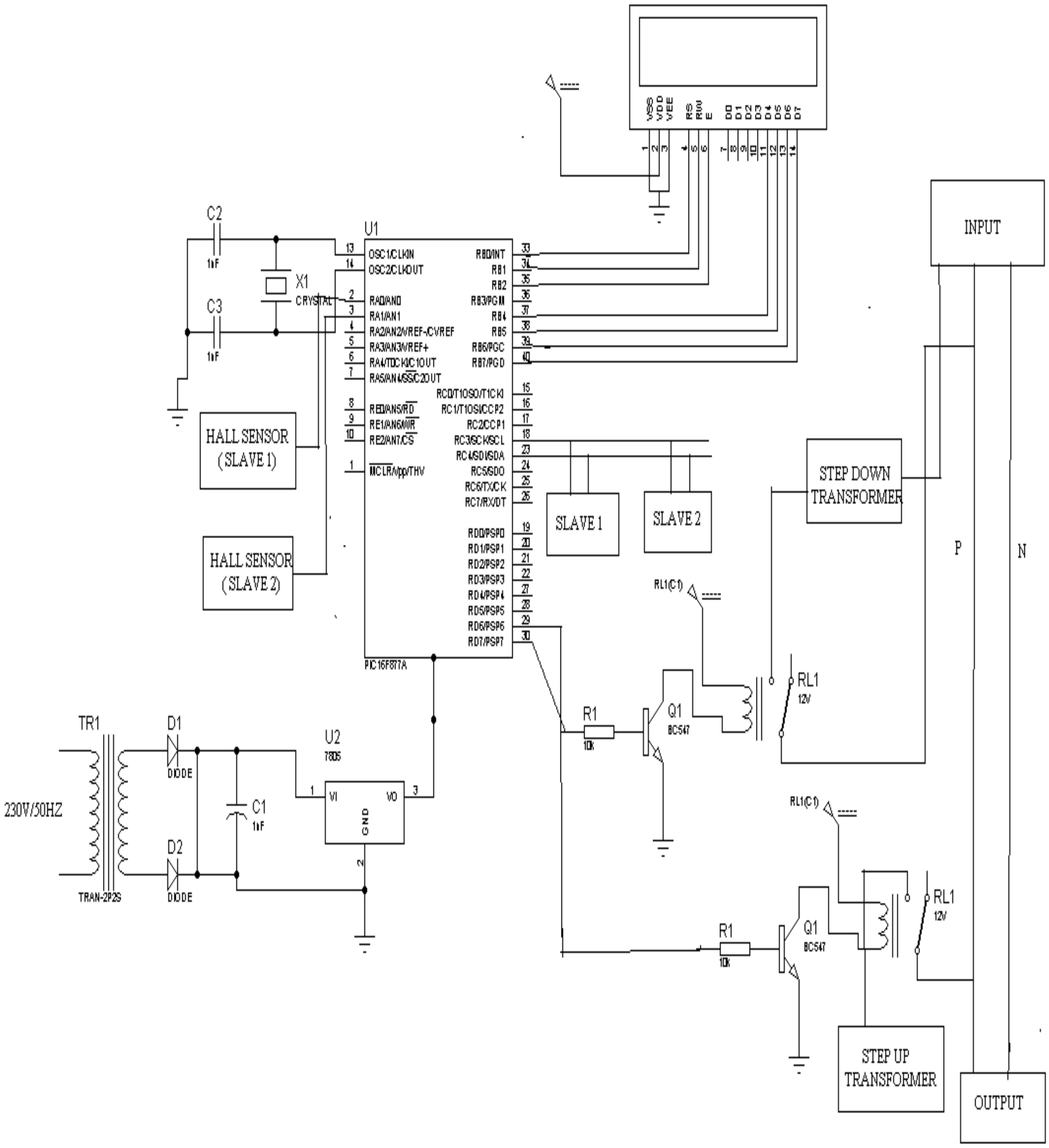
CIRCUIT DIAGRAM



3. Circuit diagram

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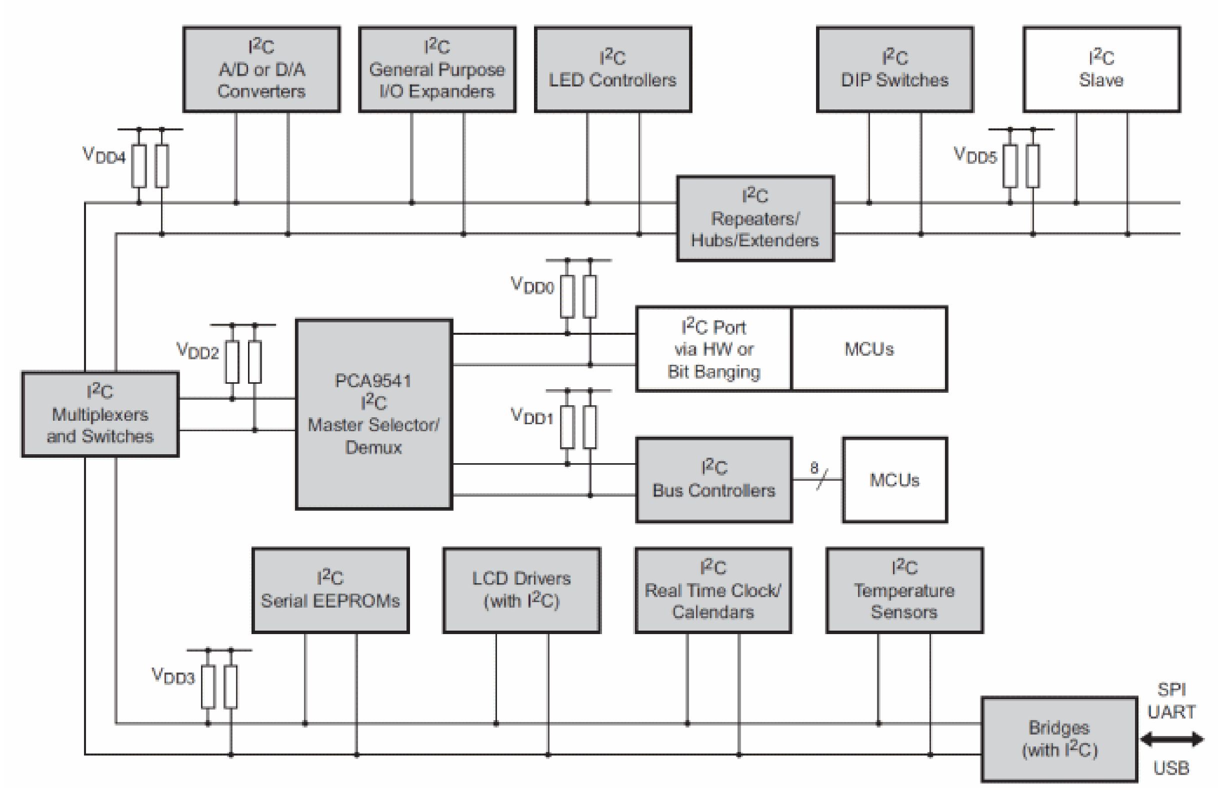
FLOW CHART

I2C Bus Specification

A typical embedded system consists of one or more microcontrollers and peripheral devices like memories, converters, I/O expanders, LCD drivers, sensors, matrix switches, etc. The complexity and the cost of connecting all those devices together must be kept to a minimum. The system must be designed in such a way that slower devices can communicate with the system without slowing down faster ones.

To satisfy these requirements a serial bus is needed. A bus means specification for the connections, protocol, formats, addresses and procedures that define the rules on the bus. This is exactly what I2C bus specifications define.

The I2C bus uses two wires: serial data (SDA) and serial clock (SCL). All I2C master and slave devices are connected with only those two wires. Each device can be a transmitter, a receiver or both. Some devices are masters – they generate bus clock and initiate communication on the bus, other devices are slaves and respond to the commands on the bus. In order to communicate with specific device, each slave device must have an address which is unique on the bus. I2C master devices (usually microcontrollers) don't need an address since no other (slave) device sends commands to the master.



VOLTAGE REGULATOR

The LM78XX is three terminal regulators available with several fixed output voltages making them useful in a wide range of applications. IC7805 is a fixed voltage regulators used in this circuit. Circuit diagram of such power supply is as shown

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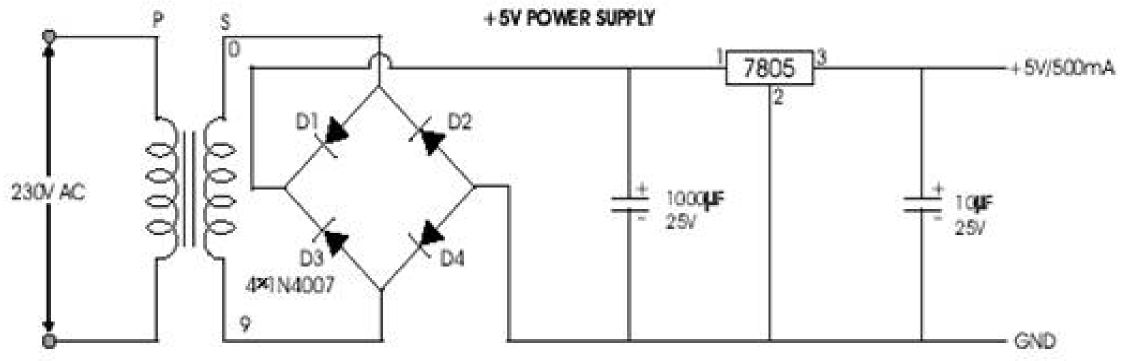
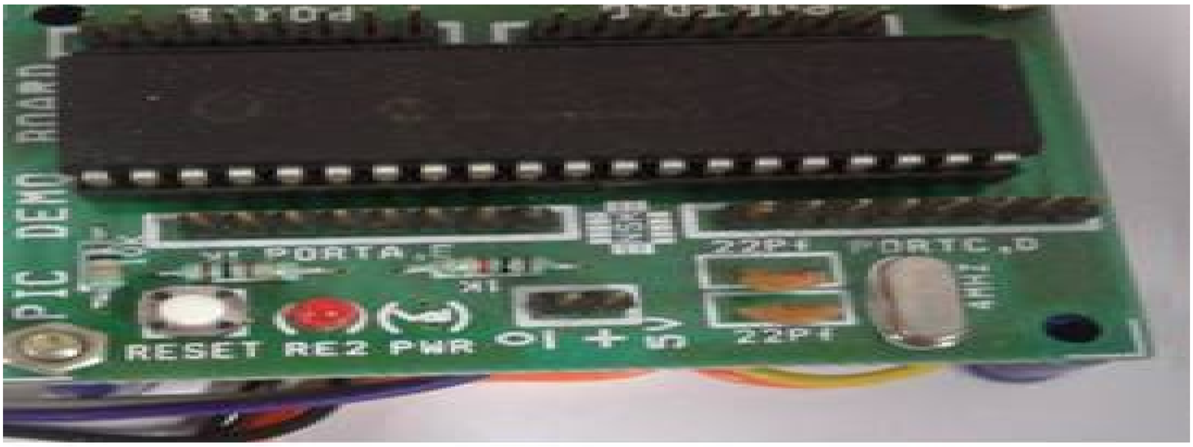


MICRO CONTROLLER



PIC microcontrollers (Programmable Interface Controllers), are electronic circuits that can be programmed to carry out a vast range of tasks. They can be programmed to be timers or to control a production line and much more. They are found in most electronic devices such as alarm systems, computer control systems, phones, in fact almost any electronic device. Many types of PIC microcontrollers exist, although the best are probably found in the GENIE range of programmable microcontrollers. These are programmed and simulated by Circuit Wizard software. PIC Microcontrollers are relatively cheap and can be bought as pre-built circuits or as kits that can be assembled by the user

We will need a computer to run software, such as Circuit Wizard, allowing you to program a PIC microcontroller circuit. A fairly cheap, low specification computer should run the software with ease. The computer will need a serial port or a USB port. This is used to connect the computer to the microcontroller circuit. Software such as, Genie Design Studio can be downloaded for free. It can be used to program microcontroller circuits. It allows the programmer to simulate the program, Simulating the program on screen, allows the programmer to correct faults and to change the program. The software is quite easy to learn, as it is flow chart based. Each 'box' of a flow chart has a purpose and replaces numerous lines of text programming code.

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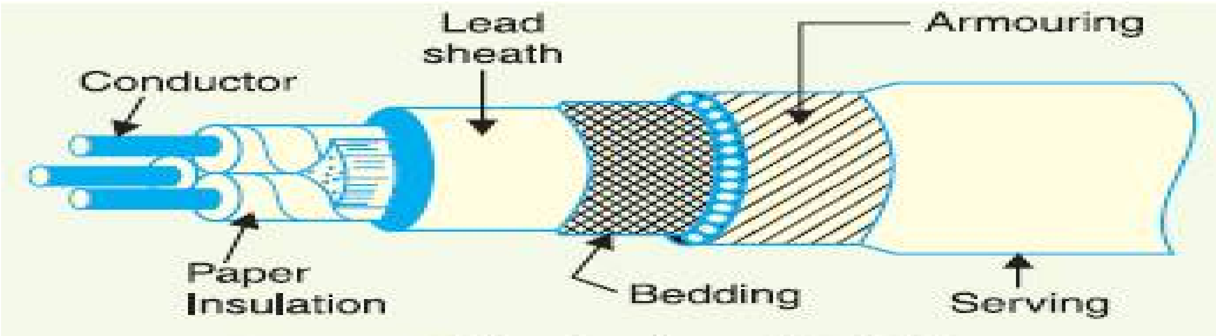
. UG CABLE PROPERTIES AND ITS TYPES

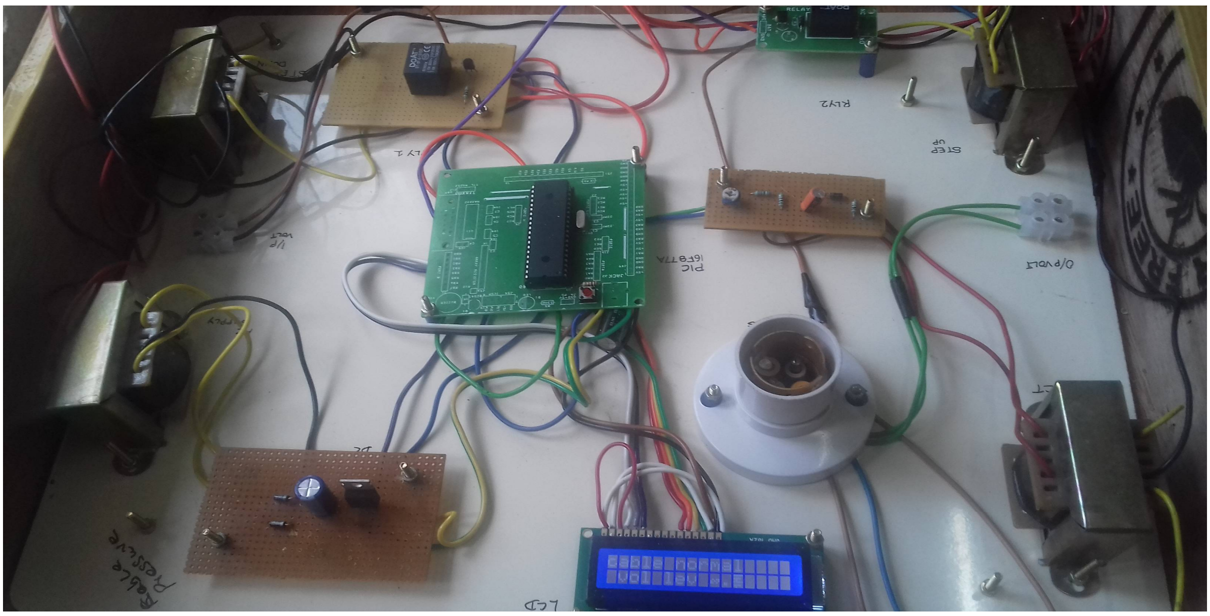
An underground cable consists of one or more conductors covered with some suitable insulating material and surrounded by a protecting cover. The cable is laid underground to transmit electric power.

The underground system of electrical distribution of power in large cities in increasingly being adopted, even though it is costly system of distribution as compared to overhead system. It ensures the continuity of supply apart from the following advantages:



Construction of a Cable

HARDWARE KIT



CIRCUIT DIAGRAM EXPLANATION

This circuit is used to monitoring and detection of High voltage stress in MV or HV Underground cables. To implement the system we use a Hall sensor, step-up & step down transformer, and PIC micro controller. Every one kilometer sensor (slaves) is placed to measure the voltage stress level. Thus conversely provide the information about the UG cables. The data can be stored in master controller. Here we are using PIC micro controller as a master. In case any abnormal voltage stress across the UG cable, the correction can be done in input side by using step-down

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transformer. In output side can be controlled by step up transformer. So that we get the balanced output in the UG cables.

RESULTS AND DISCUSSION

Sno	OPERATION	INPUT VOLTAGE	OUTPUT VOLTAGE (V)	VOLTAGE IN UG CABLE (V)
1	WITH RATED LOAD	230.5	230.5	230.5
2	WITH EXCESS LOAD	228.2	212.4	228.2

IV. REMARKS

In this condition the system efficiency is increased, after implementing the proposed system. The voltage level increased up to 7% then the voltage in UG cable sending end and receiving end are corrected.

By employing this scheme, we can control both input and output voltage with the help of step up and step down transformers, so that voltage stress in UG cable can be normalized as fast as possible.

V. CONCLUSION

Monitoring and detection of voltage stress in MV or HV Underground cables can be done by embedded technology. I2C protocol was implemented successfully in this system. Master and slave operation controlled by PIC 16f877a microcontroller. Abnormal voltage stress across the UG cable has be corrected by using step up and step down transformer

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