IoT Based Underground Optical Fiber Cable Fault Detection System

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Abstract - Optical fiber cables are very well tested before burying it underground, but in contrary they are prone to problems as they are quite fragile. This fault detecting system is used find the fault in the optical fiber line across the customer sides. The received power supply in optical fiber is monitored by laser output power using microcontroller. Any instantaneous change in the power of optical line is detected and the fault message is unveiled through Wi-Fi using IoT. The microcontroller is operated in low power mode to save power consumption. Exact location of the fault occurred in the optical fiber line is shown.

Key words: ***Optical fiber line/cable, laser, fault detection, IoT.***

I. INTRODUCTION

Fiber optics communication is developed immensely in the past two decades. It is seen much lower interference and attenuation in optical fibers compared to copper wires. The fiber is a strand of silica based glass protected with a transparent cladding. The information is transmitted through the fiber in the form of monochrome light over great distances at a high data rates. Telecommunication companies are now opting mostly for optical fibers for telephone/internet connections as they are very efficient. Good efficiency comes with unusual faults which are quite rare in optical fiber cables but when they do occur this intelligent fault detection system could be applicable. From this fault detection system, fiber is monitored which is prone to many numbers of parameters including current, temperature, Power supply, transmitted power, received power. In this project optical fiber is monitored by received power supply. To know exact location of the fault is our main aim. Therefore this is developed through IoT where the location of fault is detected.

II. LITERATURE REVIEW

There are many related studies based on optical fiber fault detection. [1] This paper introduced passive optical network based on some issues in wireless fiber to the home building for fault detection. Nowadays optical fiber is used as media to design a network that is short and long network and it supports great bandwidth. The author explained the planning of optical network on basis of wireless fiber to the home building. In Future, it is useful to investigate other parameters of optical network and used to measure other units. [2] This paper introduced Robotic Platform for configuring underground cable systems. The author explained that Robotic sensor has been developed for checking underground, power distribution cable systems. In future it is possible to include signal acquisition, data fusion and signal processing based on sensors information. [3] This paper introduced the model of fault location for underground power cable using microcontroller. In this author detects the exact location of fault in short circuit. [4] This paper introduced Underground Cable fault detecting system using Aurdino. Author examined to identify the distance of underground cable fault from base station in kilometers using Aurdino board. This greatly reduces the time and operates effectively. In this it is possible to detect the location of open circuit fault. Location of the fault is detected from the server unit.

III. CIRCUIT DIAGRAM

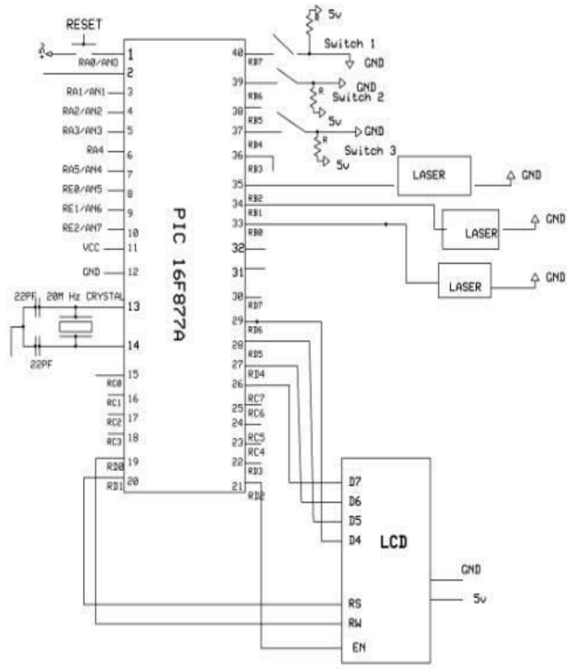

Fig. 1.1: Circuit of PIC16F877A controller board

In our project the PIC (16F877A) controller will act as brain of the controlling device in the set up. It is one of the most advanced microcontrollers from Microchip. One of the major advantages of PIC controller is that the data can be written or erased as many times as possible because it uses FLASH memory technology. It is a 40 pin microcontroller in which 33 pins are for input and output. It has two 8 bit and one 16 Bit timer. It also consists of capture and compares modules, serial ports, parallel ports and five input/output ports. We use the 12V DC adapter for giving power supply to the controller board.

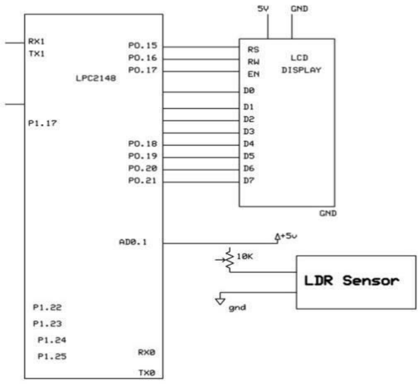

Fig. 1.2: Circuit of ARM Controller board

ARM is known as advanced Risk machine Microcontroller. It is a 32 bit controller. Its operating voltage is 3.3V.it has frequency of 60 Hz. when this is compared to 8051 microcontroller this has internal peripherals like 10bit and 2 ADC. It consists of 64 pins. It consists of 2 UART. ARM is an architecture used in many processors and microcontrollers. ARM is also known as LPC that is low power consumption controller. It can be used as general purpose and for Bi-directional output. When compare to other Microcontroller this has more storage which is advantage for project.

IV. BLOCK DIAGRAM

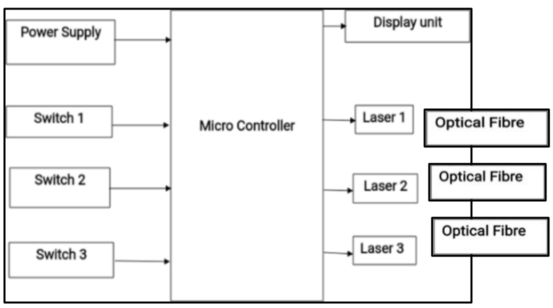

Fig. 2.1: Transmission unit

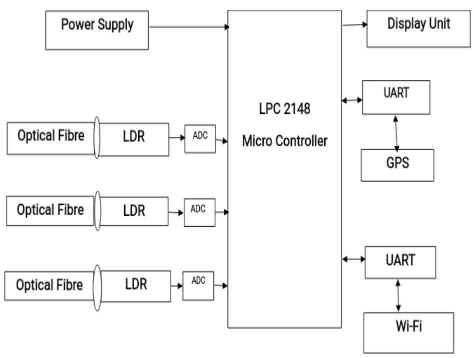

Fig. 2.2: Receiver unit

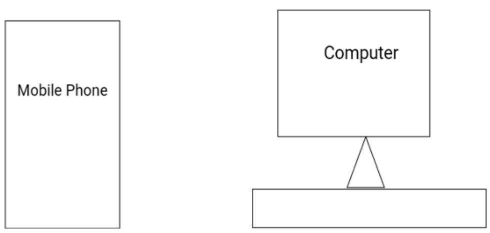

Fig. 2.3: Server unit

The block diagram consists of three units namely:

1. Transmission unit
2. Receiver unit
3. Server unit

1. Transmission unit

In transmission unit (Fig. 2.1) switches are connected as line 1, line 2, and line 3. Adapter is used to activate PIC16F877A microcontroller and hence switches, laser, LCD gets activated through Microcontroller. LCD displays the title of project. Laser transmits monochromatic light in order to transmit data to optical fiber. Optical fiber carries light signals.

2. Receiver unit

In receiver unit (Fig. 2.2) adapter is used to activate LPC2148 Microcontroller and hence optical fiber, LDR sensor, ADC gets activated through microcontroller. Optical fiber is given as input to another Microcontroller unit. Optical fiber is connected to LDR sensor. LDR sensor is connected to analog digital converter. LCD connected displays the fault occurred.

3. Server unit

In server unit (Fig. 2.3) if fault occurs in Line 1, Line 2, Line 3. GPS determines the exact location and this message are automatically sent to mobile phone and laptop through TCP client app.

V. FAULT DETECTION AND RECTIFICATION PROCESS

Optical fiber fault recognition and adaptation involves of two stages: I) Fault Recognition Phase and II) Fault Adaptation Phase.

The method of error recognition and adaption involves of two stages: I) Fault Recognition Stage: This stage is to pinpoint the place where optical fiber cable has been cut due to some reason like structure of road. The device which is recycled for this is called Optical Time Domain Reflectometer. II) Fault Adaptation Phase: This stage is to make OFC joint with slight spice damage. The device used for linking is called mixture splicer. To understand this concept considers a example. Adopt there are two telephone connections A and B which are located at a distance of D from each other. Both the telephone connections are connected through 0ptical fiber cable. Due to some reason the Optical fiber cable which link A and B is cut. After the Optical fiber cable breakdowns between A &B, the optical fiber diffusion equipment‘s installed at A&B start exhibiting visual alarms. After observing the visual alarms it is supposed that the OFC break between A’&B’. To prove this statement or to know the real place of Optical fiber cable break, Optical Time Domain Reflectometer is connected to fiber at A or B or both and the distance of fiber is measured. There can be only two possibilities

1. The distance of fiber (Y) = D which suggest there is no Optical fiber cable break.
2. The distance of fiber (Y) < D which suggest optical fiber cable broke has been broken.

When the distance of fiber Y is recognized this is a lesser amount of than D because the Optical fiber cable has been cracked. Currently to repair the Optical fiber fault breakdown, the distance X is equal to Y from A is slow along the Optical fiber cable way on the road through space meter or any car.

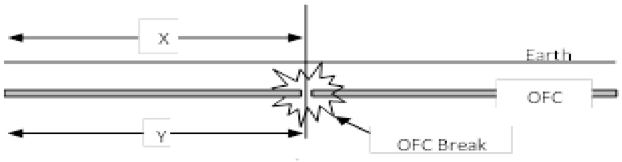

Fig. 3.1: OFC Break

Fig 3.1: Two digs are made on both the sides once the optical fiber cable reaches Distance X, at distance of 1020 meters. The length between crack and the cut should not be big if so it is hard to detect fault.

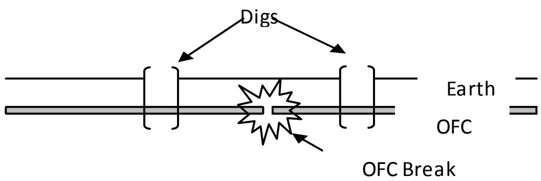

Fig. 3.2: OFC break

It is to pull breakdown cable from both the sides once after making two digs. The digs and placed a new cable between both the digs.

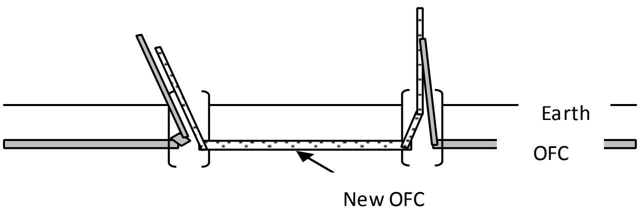

Fig. 3.3: Adding new cable

Both the trimmings of the original cable are connected with the cracked ends of old cable. The device which is used to make optical fiber cable joint is called mixture splicer or splicing mechanism. The optical fiber cable joints are cover by mutual shutting box. Then the combined shutting boxes are located below the digs and digs are occupied with earth.

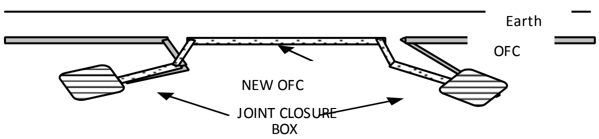

Fig. 3.4: New OFC and Joint closure.

The communication between A and B starts again as the Optical fiber cable. Error is corrected. Currently the space between A and B = D + the length of the new fiber.

VI. METHODOLOGY

The main idea of this paper is to perform real time monitoring on underground optical fiber and to detect if there is any breakage in optical fiber cable. In IoT based Underground optical fiber cable fault detecting system is an effective method to analyze various faults in optical fiber cable and automatic message will be sent to the monitoring person. In Transmission unit, PIC 16F877A Microcontroller gets activated through adapter via 5V supply. Switches connected to Microcontroller are taken as Line 1, Line 2, and Line 3. LCD is initialized along with the display of the project title. Laser gets activated in order to transmit data on optical cable. Optical cable carries light signals from laser.

In Receiver unit, the optical fiber is given as input to another microcontroller unit i.e. LPC 2148. The optical fiber carries data in the form of light. The received data will be sensed by LDR sensor. LDR sensor converts light signals to electrical signals. LDR output is fed to ADC. ADC converts an Analog signal into digital signal. The digital values will be displayed on LCD. If the digital values are equal to threshold value then it is displayed as" LINE 1 OK". If the digital values are less than threshold value then the fault is detected and is displayed as "LINE 2 FAULT OCCURRED".

VII. FLOW CHART

The flow chart of IoT based Underground Optical fiber fault detecting system is as shown in Fig. 4

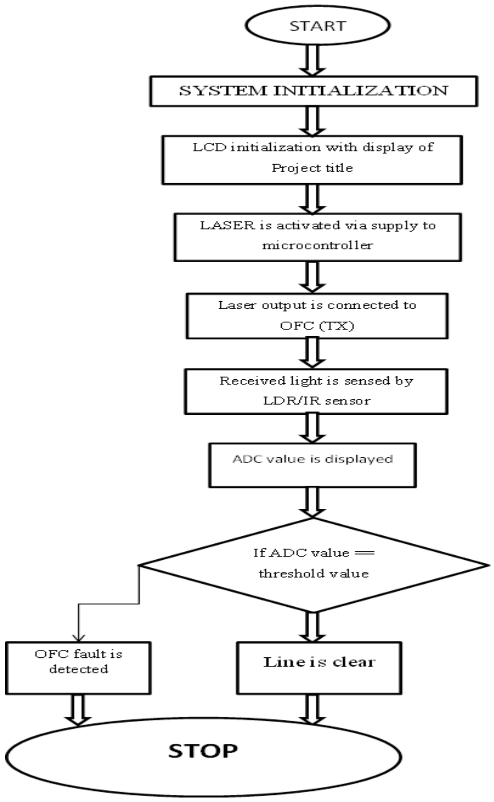

Fig. 4: Flowchart of IoT based Underground optical fiber fault detecting system.

VIII. HARDWARE RESULT

In the project IoT based underground optical fiber cable fault detecting system there are two modules namely transmission module and receiver module.

In transmission module the source of the supply is micro controller. This micro controller controls all the components which are present in transmission side. In the side there is a display unit which displays the title of the project. When switches are activated, the laser light signals are transmitted by the principle of Total Internal Reflection through an optical fiber and it reaches the receiver side.

In the receiver side, LDR sensor senses laser light signals which are coming out from the optical fiber. Depending upon the intensity of light, the fault is calculated and the amounts of faults are displayed in the receiver part. The basic faults here are bending loss, alignment loss, and design loss. The faults which are occurring can be seen in a phone as well as in a system. If the optical fiber has a fault or the fiber is ok, it displays in the display unit, systemas well as in the phones.

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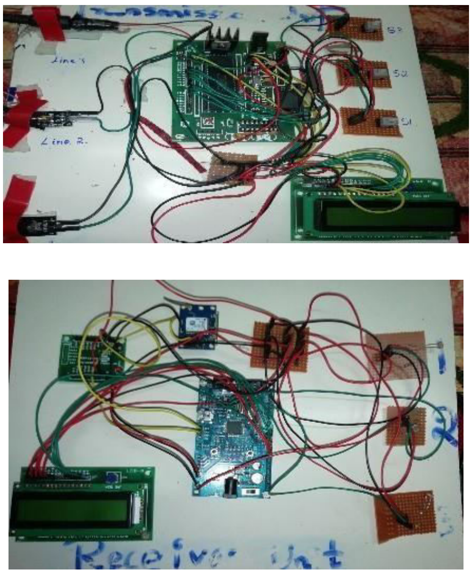

Fig. 5: Hardware kit

IX. CONCLUSION

From this project it is possible to simplify the actual problem of detecting faults and find where the actual fault has occurred by finding the exact position or locations in latitude longitude form and also find the accurate distance of breaker points. By using software's can encrypt the land transfer at controlling section and actual action will be working out.

X. FUTURE SCOPE

In future, this list must be better to investigate other parameters of the optical line and able to extent other units. Locating fiber fault within the network becomes more important due to the growing demand for consistent service distribution.

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