Scientific Journal of Impact Factor (SJIF): 4.72
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 01, January -2018

Fault Detection Robot for Underground Cable

DR. Kaushika Patel[1], Raj Kevadiya[2], Shreya Maheta[3]

[1]*Assistant Professor in Department of Electronics Engineering, Birla Vishvakarma Mahavidyalaya Engineering College*
[2]*U.G. Students, Department of Electronics Engineering, Birla Vishvakarma Mahavidyalaya Engineering College*

Abstract: *Till the last decade the cables where made to lay over the ground surface and currently the scenario is to lay underground cable, which is superior to the earlier method. When the cable breaks due to some reasons it's very difficult to locate that. Currently what is done is they find the approximate location and dig the cables out from the location and check it manually to find the exact point of discontinuity. Currently a robot is developed which can be used to locate the break from an external point. When an underground cable is broken or Short-circuited then our robot will move over it and locate the exact position of discontinuity. Hence it is an advantage for repairing the same.*

Keywords- *Signal injector (Electromagnetic signal), Signal sensor, PIC Microcontroller, Power regulator, Motor driver, Servo motor, Navigation unit, Battery, LCD.*

I. INTRODUCTION

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 [1].

II. BLOCK DIAGRAM

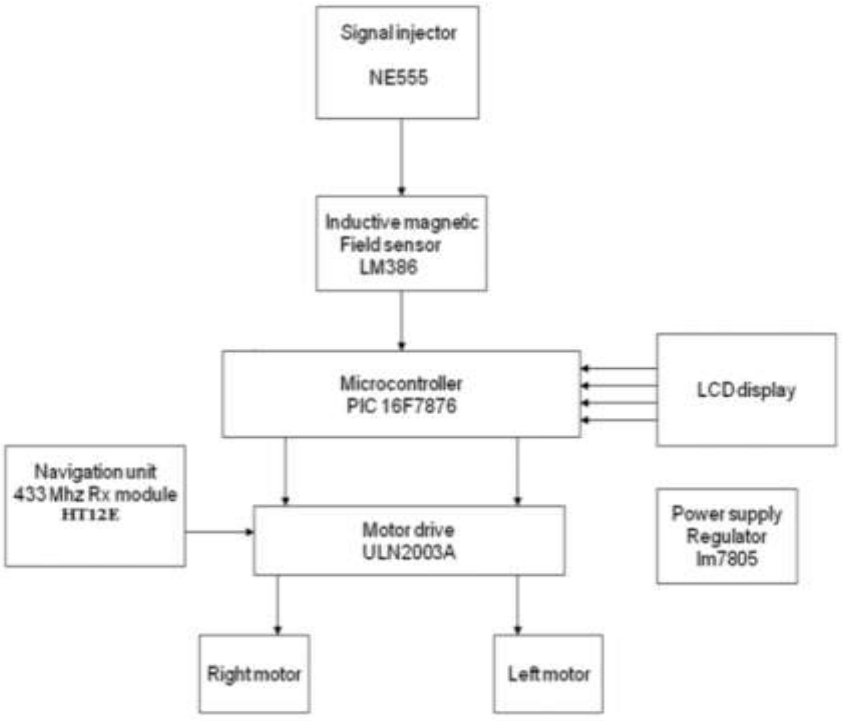

Figure 1. Block diagram of detector

The fault detection robot consists of a signal generator part and robotic part. Short circuit cable is checked for its continuity by passing a 3 KHz low frequency signal. A signal generator can be used to generate this signal. The AC signal passing through wire produces a magnetic field around it. This magnetic field is sensed by the robot using a

inductor circuit. The AC signal sensed by robot is then amplified using a LM386 circuit. This amplified signal is then rectified and converted to DC. DC level is provided to the analog input of microcontroller. Microcontroller converts this analog input to digital signal. Based on the program programmed in the microcontroller the robots movement is controlled. When the robot reaches the point where the discontinuity lies, the magnetic field will be zero. In such case the input signal at the analog input port will be substantially low. When the input signal strength is less than set value the PIC is programmed to display short circuit and distance is displayed on LCD [2][3].

III. COMPONENTS DESCRIPTION

Following components have been used in making of the project.

3.1. PIC MICROCONTROLLER LAUNCHPAD

These devices feature a 14-bit wide code memory, and an improved 8-level deep call stack. The instruction set differs very little from the baseline devices, but the two additional opcode bits allow 128 registers and 2048 words of code to be directly addressed. There are a few additional miscellaneous instructions, and two additional 8-bit literal instructions, add and subtract. The mid-range core is available in the majority of devices labeled PIC12 and PIC16.

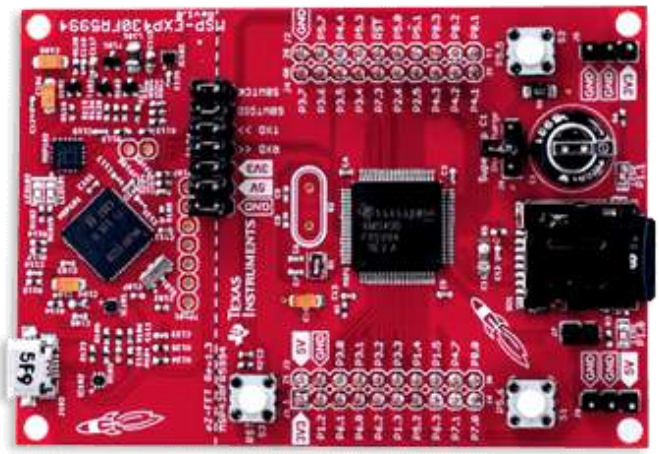

Figure 5. PIC Microcontroller Launchpad

The first 32 bytes of the register space are allocated to special-purpose registers; the remaining 96 bytes are used for general-purpose RAM. If banked RAM is used, the high 16 registers (0x70–0x7F) are global, as are a few of the most important special-purpose registers, including the STATUS register which holds the RAM bank select bits. (The other global registers are FSR and INDF, the low 8 bits of the program counter PCL, the PC high preload register PCLATH, and the master interrupt control register INTCON).

The PCLATH register supplies high-order instruction address bits when the 8 bits supplied by a write to the PCL register, or the 11 bits supplied by a GOTO or CALL instruction, is not sufficient to address the available ROM space. [4][5][6].

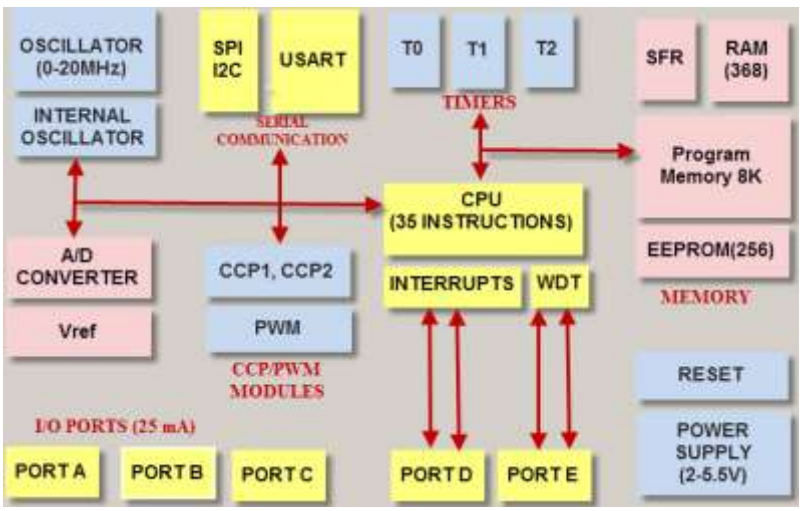

Figure 2. PIC Microcontroller Architecture

3.2. SIGNAL INJECTOR

Signal injector is use for generate the signal of desire frequency and we can inject the desire signal from the external point in this project.

Figure 3. Signal injector

It having Size: 31mm * 22mm and Input Voltage: 5V-15VDC. when power supply is 5V , the output current can be 15MA around;when 12V power supply, the output current can 35MA around. Input current is greater or equal to100MA and Output amplitude is 4.2V V-PP to 11.4V V-PP. The output duty cycle can fine-tune and duty cycle and frequency is not separately adjustable also adjusting the duty cycle will change the frequency.[7]

3.3. INDUCTIVE MAGNETIC FIELD SENSOR

As the name suggest this sensor sense the magnetic field which passes through the cable in our case. This sensor basically used inductive load to sense the magnetic field. Detail description of sensor is given further.

Figure 4. Inductive magnetic field sensor

The UTC LM386 is a power amplifier, designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor

between pin 1 and pin 8 will increase the gain to any value up from 20 to 200. The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 miliwatt when operating from a 6 voltage supply, making the LM386 ideal for battery operation. Operated on battery. It having minimum external parts. Also there is wide voltage range about 5v-18v and 4ma current drain which is very low. It having 20 to 200 voltage gain. Its Input refers to the ground where as output is self-centered quiescent voltage and Distortion is very low.[8]

3.4. MOTOR DRIVER

This circuitry is basically give direction to the robot as it given left or right movement to the stepper motor. It is connected to the microcontroller which maintain the operations.

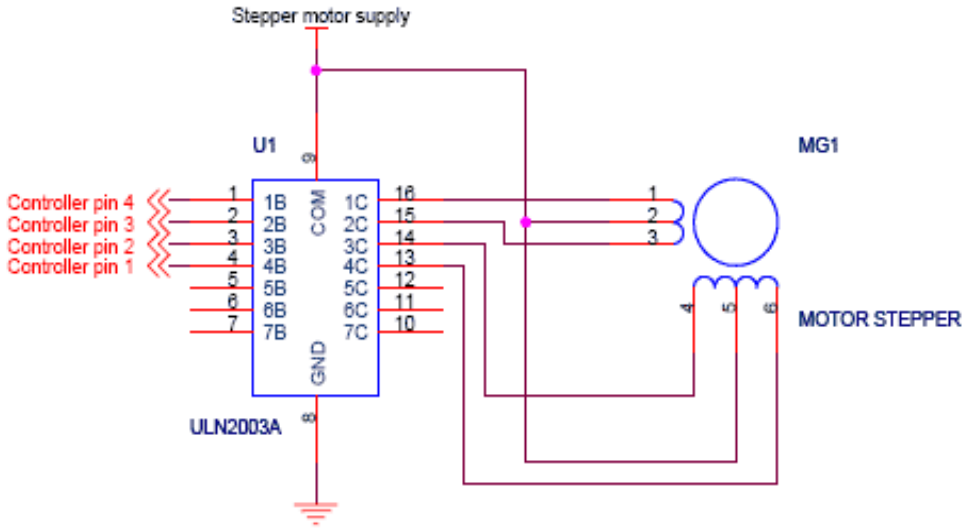

Figure 5. Motor driver

The ULN2003 is known for its high-current, high-voltage capacity. The drivers can be paralleled for even higher current output. Even further, stacking one chip on top of another, both electrically and physically, has been done. Generally it can also be used for interfacing with a stepper motor, where the motor requires high ratings which cannot be provided by other interfacing devices. It having 500 mA rated collector current (single output) and 50 V output (there is a version that supports 100 V output) also includes output fly back diodes. It having Inputs compatible with TTL and 5-V CMOS logic. Typical usage of the ULN2003A is in driver circuits for relays, lamp and LED displays, stepper motors, logic buffers and line drivers [9].

3.5. NAVIGATION AND SWITCHING UNIT

This unit consist one transmitter and one receiver which is responsible for send or receive data from the microcontroller. Basically this unit use for the manual control of the robot. Detail description of both sender and receiver is given further.

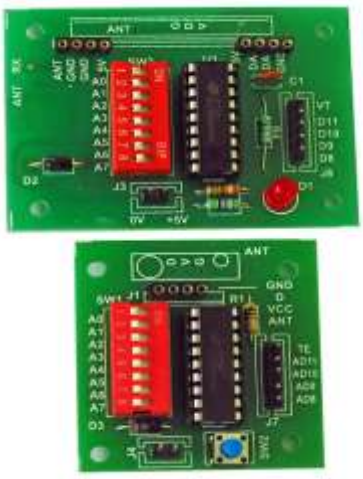

Figure 6. HT12E and HT12D

HT12E is an encoder integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format.

HT12D is a 212 series decoder IC (Integrated Circuit) for remote control applications manufactured by Holtek. It is commonly used for radio frequency (RF) wireless applications. By using the paired HT12E encoder and HT12D decoder we can transmit 12 bits of parallel data serially [10][11].

3.6. POWER REGULATOR

As we know that all circuitry of a huge system is not working on single power supply. So, there is need of control of power supply for this power regulator is must require. Detail features of power supply regulator is given below.

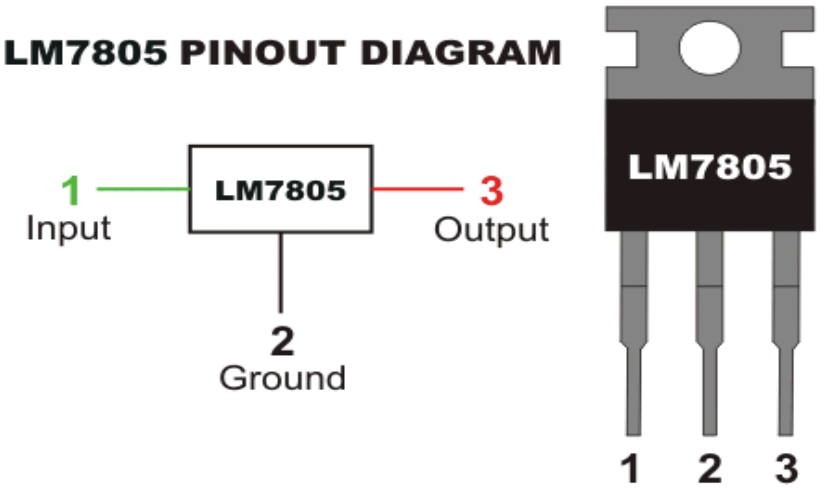

Figure 7. LM7805 Power regulator

7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels [12].

3.7. STEPPER MOTOR

The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft rotation. Using four stepper motor we are making robot (car) which having whole system on it. Construction of the stepper motor is given in below figure.

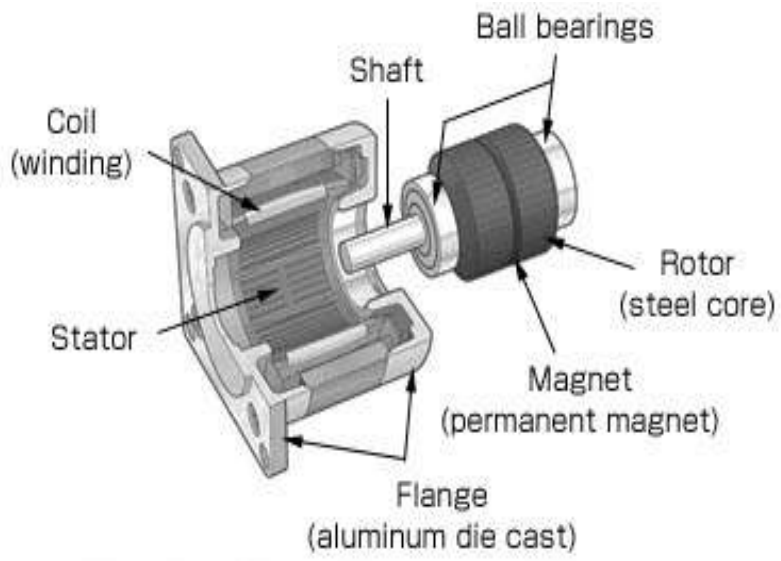

Figure 8. Stepper motor

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. Advantages of step motors are low cost, high reliability, high torque at low speeds and a simple, rugged construction that operates in almost any environment. The main disadvantages in using a stepper motor is the resonance effect often exhibited at low speeds and decreasing torque with increasing speed [13].

3.8. LCD

Common device to display data is LCD. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications.

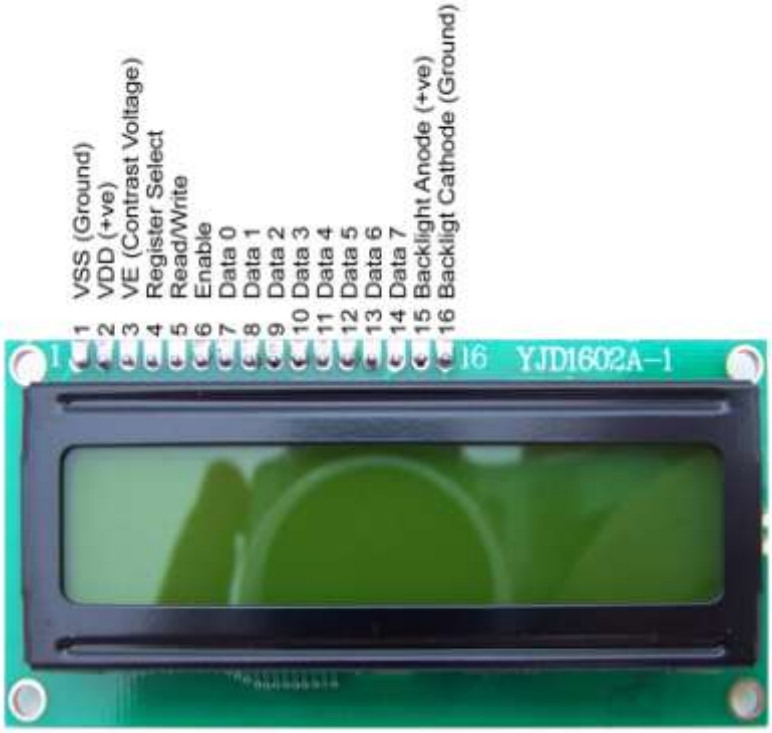

Figure 9. LCD Display

A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD [14].

IV. INTERFACING OF COMPONENTS

For a system to work the above described components need to be interfaced with each other. Following is the explanation of how a component runs while the project is in its running state.

4.1. Cable sensor with microcontroller

The signal generate by the signal generator can be detected using field sensor. A LM 386 amplifier amplifies the signal produced by signal generator. It can be rectified & input to the microcontroller.

4.2. Navigation circuit & motor driver with microcontroller

Relays are used for triggering the motor circuit. The output from the microcontroller is passed through the ULN driver circuit which is connected to left and right motor. The signal strength which is set at the microcontroller is programmed to control the movement of the motor. When the inductor circuit moves away from the cable, the field strength decreased

& when it moves near the cable field strength increases. The change in field strength is passed on to PIC, which controls the direction of movement of robot.

V. MERITS & DEMERITS

5.1. Merits

1. Use for short circuit detection in underground cables from an external point.
2. Reduce manual labour.
3. Cost effective.

5.2. Demerits

1. Not self-reliable.
2. Difficult to replace a component in the robot if it fails.

VI. CONCLUSION

Current scenario of digging along the cable laid and then pulling the cable out and checking whether the fault exists in the cables is a tedious work. This is not only is wastage of manpower and money for the companies, but this also causes a lot of inconvenience to the normal public. Proposed cable fault detection robot will solve this issue to a great extent and will be really helpful for such application. The robot designed is very much user-friendly and can be easily controlled. Also, the robot is cost effective.

VII. FUTURE SCOPE

In this paper we detect the exact location of short circuit fault in the underground cable from external point in km by using PIC microcontroller can be detected. This method is not use for open circuit fault. So, in future this project can be extended to calculate the impedance by using a capacitor for an AC circuit and so can detect the open circuit fault.

REFERENCES

[1] Abhay Sharma, Akash Mathur, Rajat Gupta, Ranjeet Singh, Er.Mansi Singh, "Underground cable fault distance locator", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 6, Issue 4, April 2017
[2] Jitendra Pal Singh, Narendra Singh Pal, Sanjana Singh, Toshika Singh, Mohd. Shahrukh, "Underground Cable Fault Distance Locator", International Journal of Scientific Research and Management Studies, Vol. Issue 1, pp. 21-26
[3] Gaurav Ojha, Abhilash Guha Roy, Rahul Verma, Vishal Kumar, "Underground Cable Fault Distance Locator", International Journal Of Advanced Research, Idea And Innovation In Technology, Vol. Issue 2
[4] Dhekale P.M., Bhise S.S., Deokate N.R. Guide-Prof.Suryawanshi R.R, "Underground Cable Fault Distance Locator" , International Journal Of Innovations In Engineering Research And Technology, Vol. 2, issue 4, april 2015
[5] Technical research paper, "Microcontroller Based Fault Detector" International Journal Of Advancements In Research & Technology, Vol. 1, Issue 5, October-2012
[6] Meenu Rani Garg, Anu Tonk, "A Study of Different Types of Voltage & Current Sense Amplifiers used in SRAM", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 4, Issue 5, May 2015
[7] Dheepak Mohanraj, "Microcontroller Based An Autonomous Wireless Line Tracking Robot", International Journal of Advanced Engineering Research and Studies, Int. J. Adv. Engg. Res. Studies/III/III/April-June,2014/102-105
[8] https://en.wikipedia.org/wiki/LM386
[9] https://en.wikipedia.org/wiki/ULN2003A
[10] https://www.engineersgarage.com/electronic-components/ht12e
[11] https://www.engineersgarage.com/electronic-components/ht12d
[12] https://www.engineersgarage.com/electronic-components/7805-voltage-regulator-ic
[13] https://en.wikipedia.org/wiki/Stepper_motor
[14] https://en.wikipedia.org/wiki/Liquid-crystal_display

