Transmission Line Fault Detection Using Arduino and GSM

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Abstract The power system is divided into three sections: Generation, Distribution and Transmission. Various types of faults occurred in this system that should be isolated. In this module we included the Arduino UNO, to drive the relay, a resistor, LCD display, moving switches to create fault. as per the programming of Arduino UNO when we create the fault across any line LCD displayed the output as," Fault occurred in that particular line (i.e. R, Y, B) at the distance (1, 2, 3, and 4 km)". The output which shows on the LCD display depends on where we create a fault and in which line. In this project, we represent a section of the 11-kV network in Tulkarm Governorate (Irtah Street), with an approximate length of 5 km.

Keywords Transmission line fault deterction · Arduino · GSM

1 Introduction

Power system faults are common, so 80% of the service interruptions of the customer are attributed to network failures. There are several examples of faults, such as over loading, solid faults (single line to ground, double line to ground, line to line, triple

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line to ground, three phase short circuit faults), over-voltage, under-voltage fault and phase failure.

This project offers a solution for these issues to ensure the safety of the lineman. For a safe operation of the power system, the identification type and location of power line faults are very important.

The work is so organized that the electric power supply is ON/OFF by maintenance staff or lineman. Now if there is a malfunction in electricity, the power supply is turned off and the electricity is fixed easily and then power switched on the rare special protection systems to improve accuracy and reliability by using contact schemes. Faults detection and warning in the distribution line significantly reduces resources, saves time and runs effectively without human interference [1].

After studying many projects about three phase fault detection and protection. We found that the projects were limited to identifying the type of common faults and separating the system for protection.

In our project, we modified the above by making the system inclusive of all abnormal cases (under voltage, high voltage, overload, phase failure, single line, double line, and symmetrical fault).

Also, by using the previously mentioned equations and adding (GSM), which in turn sends a message containing the type of fault and its approximate location to the maintenance engineer, which facilitates and speeds up the fault repair process. Also, we added a fire sensor system that sends a message to the civil defense and maintenance engineer.

2 Methodology

In electrical power transmission system there are 3-phase, each phase wires can be copper or aluminum, and the conductor which is mostly aluminum because it's lighter in weight and less expensive and bears higher tension forces than copper, but in our project, we used copper wires as it is an educational model [2].

Copper wires have a specific resistance and conductivity that is determined by its physical properties, we used copper because it has a relatively low specific resistance and high conductivity.

When a voltage is applied to the conductor's, an electrical current pass through it according to the connected load and the value of the voltage according to Ohm's law:

$$V = I * R \tag{1}$$

In our project, we applied a voltage value of 12-V DC at the three phases, whose cross-sectional area and conductivity are known.

When an abnormal condition occurs (overload, fault, phase failure) The voltage and current values on the phases change according to the fault that occurred in it,

Table 1 Fault diagnosis

Event	Result
If $I > 1.25i$	Over load
If $I > 5i$	short circuit
If $v < 9$v	Under voltage
If $v > 12$v	Over voltage
If $t > 35$ s	Fire

based on the sensors placed on the three phases (voltage sensor, current sensor) The sensors sense the change in the voltage and current values.

The microcontroller (Arduino Uno) applies Ohm's law and uses the value of the resulting resistance in the following equation, then we get the length at which the fault occurred.

$$(R = \rho * L/A), \tag{2}$$

12.1 Ω_____1000 m

Rcal_____L_{fault}.

In order to protect the system, we used a relay on each phase, where its input is connected to the microcontroller and the output has a normally closed contact connected to the load and a normally open contact on a buzzer for warning.

Using a bi-directional relay (for source and load protection) When a fault occurs, the microcontroller sends a signal to the relay to isolate the fault and send a signal to the GSM which sends a message to the maintenance engineer containing the type of fault and the distance where it occurred relative to the reference point.

In case of fire near the transmission lines, the sensor sends a signal to the microcontroller which sends a signal to the GSM that sends a message to the civil defense and maintenance engineer, containing the location where the fire occurred approximately (Table 1).

3 Results

The following points summarize the results of the project:

1. The ability to determine the type of malfunction in the system.
2. The ability to locate the fault with an acceptable error rate.
3. The ability to know the percentage of overload on any of the lines.
4. Network protection when faults occur and the ability to fix the error with less time and effort.
5. The ability to detect and control fires close to the system early.

4 Conclusions

In now days there is the huge demand of the electricity because of all the industrial or any other work is depending on electricity. Due to this sometime overloading is occurred which affect the conductor of transmission line and electrical equipment life. Because of this situation and natural calamity fault is occurred. It should be detected early and rectify earlier to provide electricity to the consumer without any longer period interruption of power supply. Using this programmable device fault location can be detected instantly so that fault can be removed in short time period and continue the power supply by removing fault in short time period.

5 Limitations

1. The inability to implement the project on alternating current and using direct current instead.
2. The inability to raise the current used due to the unavailability of some parts with high capacities (more than 2 W), and this forced us to use a relatively small rated current, and this problem was solved by using two separate voltage sources.
3. The sensitivity of the sensor was higher than the value of the current used, so the sensor was reading incorrect values. We raised the current by reducing the resistance.
4. It is not possible to make a short circuit between two phases, because the DC does not have a frequency, so we cannot make a short circuit except between the positive and the negative.
5. The GSM segment needs only a strong signal in order to send messages, and this is not available in all regions.
6. The wires used in the connection have a relatively high loss.
7. The pieces used in this project are educational pieces with little proficiency.

References

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