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Remote Monitoring of Earthing System

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Abstract: As we know the industries consisting of inductive loads especially high wattage machine and all the machines are connected to the earthing system. It is very important to monitor the earthing system. Mostly earthing are pipe type earthing and plate type earthing so, in a substation or any installation the pipe earthing are mostly used.
If the leakage current increases and the person get in contact with the machine, it may get a severe shock. Hence, it is very important to continue monitoring the earthing system.
In our project, we deals with the continuous monitoring of the earthing system. In this project we continuously monitoring the leakage current on the LCD, if the leakage current is more than permissible limit then there will an alarm and similarly if the moisture of the earth gets decreases, the earth resistance increases. This will be also displayed on the LCD that will especially monitor for the leakage current magnitude in order to maintain in the permissible limit. If the permissible Limits get increases there will be an alarm signal or there will be a message to the observer through GSM device. We are mostly using GSM technology to transfer the data from one place to another so, overall our project deals with the remote monitoring of the earthing system.

Keywords: Pipe Earthing, Microcontroller Pic16f886, Leakage Current, Earth Resistance, Moisture Level.

I. INTRODUCTION

The Earthing was probably discovered by the German scientist Carl August Steinheil in the year of 1836–1837, that the ground could be used as the return path to complete the circuit, making the return wire unnecessary. For the most part, however, leakage current specifications are rarely observed and are never a cause for concern by electrical design engineers. The reason for this is that the leakage current is usually very low, usually in either the low µA (micro-amps, or 10-6 amps) range or even the nA (nano amps, or 10-9 amps) range In.
Leakage current is the natural phenomenon in electrical circuits of current flow from the circuit's live electrical components to the frame of the device or to ground. This is due to the intrinsic physics law that energy flows from higher to lower potential; when a conductor has a potential difference with respect to the earth (in other words, a voltage above 0 V), some current will flow from the conductor to the earth. Leakage current typically flows through the earth connection but may also flow through live or neutral wires.

Earthing plays a very important role in the electric power system. Earthing is a process of transferring the immediate discharge of electrical energy directly to the earth with the help of low resistance wire. Resistance to an earth connection varies due to the structure of the earth, chemical content, moisture, temperature, the season of the year, depth and diameter of the rod, and other reasons. This is done by connecting the non-current carrying part of the equipment to the neutral part of the supply system with the ground. Earthing must have the least resistance so that the leakage current has the least resistance path to flow current. Resistivity increases when soil moisture decreases. The person coming into contact with the machine can even cause a fatal accident. If there is moisture in the soil, the leakage current is properly grounded and the resistivity decreases.

II. OBJECTIVES

1. The system measure the earthing resistance of earthing pit.
2. System should measure moisture.
3. System should have a small display for showing values.(resistance, leakage current, moisture of soil, pump ON/OFF)
4. System should store a real time data (Date, Time, Earth Open Or Close, Resistance, Earth Leakage Current) in computer through USB connector/cable
5. System should be able to give warning in case value is above permissible resistance. (Buzzer and red light)
6. System should send the message to observer through GSM.

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III. PROJECT METHODOLOGY

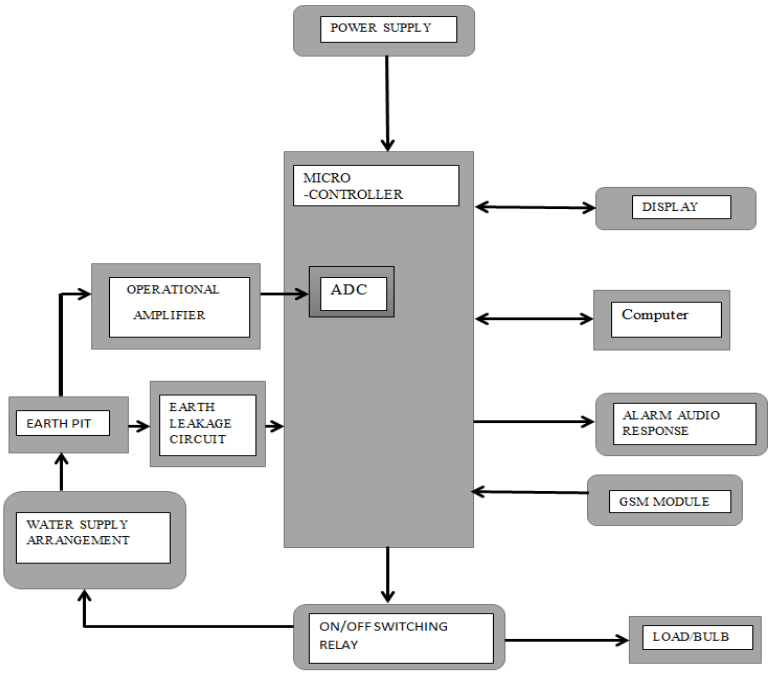

Fig.1 Block diagram of remote monitoring of earthing

In this project actually based on variation of resistance with respect to leakage current. The System is design for decreasing the resistivity and increases the moisture level of the soil and easily distribute the leakage current.
Now in industries have using typical method, manually start and stop the water supply of earthing or it construction nearer to water reservoir locations like river, lake, artificial water tank etc. it also away from main station near (25km).
In some industries does not have any kind of provision of water reservoir system near to their plants. i.e. they are using continues water supply arrangement for earthing.
In our project power supply is 12V which is converting to 5V DC supply.
The GSM module, water supply arrangement, buzzer, red light for indicating danger zone, computer to shows and stored the real time reading data, a small display which is for showing value of measurement.
The GSM, display TTL logic data logger is run on 5v dc supply and buzzer, relays are operate in 12V DC supply.

IV. WORKING OPERATION

In our project, we require a continuous supply of 5 volts DC for microcontroller PIC16F886. The central tap (12-0-12) stepdown the transformer supplied with 220 volts AC, which stepdown to 12 volts AC. Besides, it is converted to pulsating DC. Using a full-wave rectifier with central bypass and this pulsating DC is converted to pure DC using a capacitor (C1). We are using an IC7805 voltage regulator to regulate the 5v supply voltage. After regulation, some transient pulses are present, to eliminate these pulses we are using a capacitor (C2). Then it is connected in series with the voltage source to reduce the resistance since we only needed a 5v supply for the operation.
To reset the microcontroller, we initially need 0V. For this purpose, we are using a capacitor in the resistor (R1). When capacitor C3 discharges its function as a short circuit, PIN 1 is provided to reset the voltage of 0 volt. After while, the capacitor is charged and acts as an open circuit and is given a 5v supply PIN 1. Then the microcontroller begins its execution.
For the proper functioning of the microcontrollers, these three basic requirements must be met.
1) Adequate and continuous nominal supply
2) Reset the microcontroller to start the execution
3) Continuous clock pulses using a crystal oscillator
In a microcontroller, each storage and deletion operation is performed in a flip-flop. Your main requirement is the clock pulses. Clock pulses generated by an oscillator.

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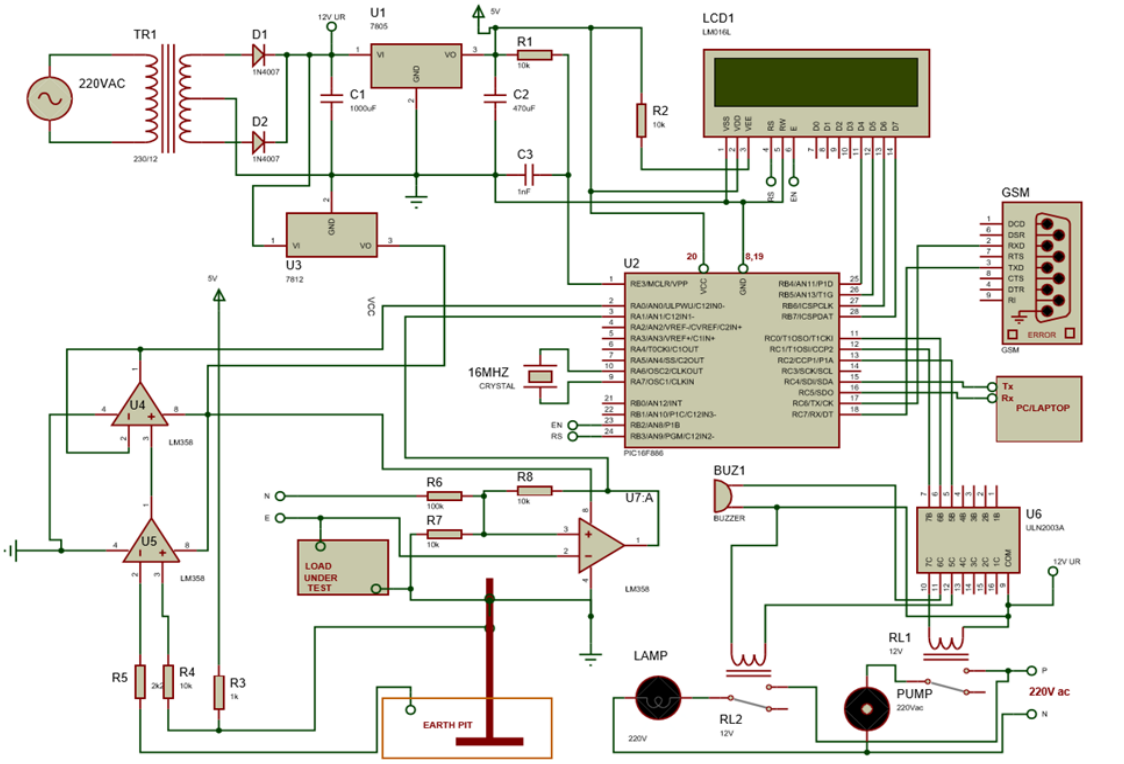

Fig.2 Circuit diagram of remote monitoring of grounding

The LCD screen classification is 16 characters / 2 lines, it is an alphanumeric screen. In this circuit we are using 4 data pins, enable and register selection pins.
The LCD also works with 8 data pins, but there is a problem that we need 4 additional pins, that is, we are using only 4 data pins.
VSS - see supply or land
VDD + 5V DC Supply
VEE: this is a contrast adjustment pin, you can control the brightness.
RS: Register a selection pin that is used to select the character, the numerical value and the place of the special character.
R / W pin (5) - Read / write pin. This pin is permanently frozen (this means that the only purpose of the pin is to write data to the controller).
Enable (EN) (6): the function of the activation pin is to decide whether it works or not. I like. If the tenth position is selected and a command is given where character A is present, but the microcontroller is not directly aware. Because the microcontroller works only with digital data (through the numerical value of the digital value)

PIN D0 to D7: this is an input-output pin.
ASCII - Understand human anthropology, Convert the numerical value to a numerical value and this numerical value is in 8 bits.
If the user sends the A 'for display and the ASCII value is 65, then D 122 is present on the screen and sends all the data in the ASCII format.
Why is ASCII anthropology used? Some disadvantages are given below
This is the only 8-bit character with the upper and lower case alphabet, minus nine.
We know in microcontrollers to print A on the screen. The ASCII value is 65
Where in
6 is converted to binary form 0110
5 is converted to binary form 0101
This means that this microcontroller can convert the ASCII value into a binary form.
That is, the microcontrollers send binary values to the screen.
In 8 bit mode
D0 to D3 - LSB: least critical bit
D4 to D7 - MSB - The most important bit

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In the 8-bit microcontroller operation, we can send characters at the same time, But here we only save 4 bits due to some pins to connect other modules. When 8-bit data exchange is enabled on the pin screen enabled. But only 4-bit data is taken at a time in the LCD. This means that it checks the enable mode that they are stored MSB then checks again to activate the pin or not. If it is active then the LSB accumulates. The combination of LSB and MSB is checked and decided to print and it will display and to save the same pin we are using a 4-bit data pin to display the character. But we know that the display works on a 4-bit operation, so when we send 65, where 6 is 4 bit of operation, then when we send where 5 is also 4 bit, finally we send 6 means After which 4-bit data is enabled, the pin is active for 50 msec. 50 msec has been deactivated after the enable pin, but the LCD already receives 4 bits when the pin is activated when enabled, but it disables the data from that pin. When the MSB is then stored in the display, the PIN is activated again and the LSB is stored for 50msec and after that, the display character shows the number. We know that the number of operations is high and the time is assumed to be the same for 8-bit and 4-bit operations.
The LCD gets a total of 10mSec to display any character. Here 50mecec 4bit and 50msec for others to erase the data required for it 3mecec and pin 50mecec to activate the stored data 3nSec.
This operation requires only 9nsec. This is a very short time compared to 1msec.
1000nsec = 1msec
Therefore it is a negligible time.
In our project we get the value of resistance using the calculation it will decide the on / off function of the water pump. Furthermore, it gives the buzzer when the value must be above the permissible limit (soil resistivity is decreasing).
The pump used in our project required a 230v AC supply. For the buzzer, we need a 12 volt DC supply; both of these operations can be controlled by the microcontroller. But our microcontroller operated on 5v DC supply is the basic requirement of this microcontroller.
But the 12v buzzer and 220v pump do not operate on the 5v supply. For this, we connect the 220v pump using the relay. This relay is operated on a 12 volt DC supply in our project. The O / P of the microcontroller is 5 volts and is amplified to 12 V using a 12 V amplifier, we are using the driver LLN 2003A.
In this driver IC, it has a total of 7 input and 7 output pins and all I / P pins have 7 subordinate O / P.
The function of the relay is to provide electrical isolation between the contacts (HV and LV).
Our project aims to measure soil resistance.
Earth pit - means electrode reference to soil means measuring the resistance between electrode and soil. (About 1 to 1.5 feet)
The 5 volt resistor R2 fill is injected into the earth wire through the soil, which has some resistance between the earth wire and the metal probe. This completes the loop through resistor R1 which is connected to the inverted input of the operational amplifier.
Case 1
If some leakage voltage flows through the resistor, it will give the value of leakage current
Case 2-
If there is high resistance in the earth pit, the leakage current will not be distributed i.e. the circuit is open. In that case, the only return path is through the R3 resistor to the non-inverted terminal of an operational amplifier. In that case, the inverted terminals have zero capacitance
Case 3-
If the resistor is connected to the conductor through the earth pit, then, in this case, the voltage flows from R2 to R7 to R7 and then into R1 and then it is connected to an inverted terminal. This means that due to the division of the same voltage as R7, the voltage of the R2 terminals decreases. Less than 5volt is now flowing through R3 and the value of a Non-inverted terminal is decreased and an inverted terminal increased with some voltage value.
Output voltage is less than 5 volt
For example:

Non inverted terminal (+ve)	Inverted terminal (-ve)
4.6V	0.4

Calculation: - 4.6V - 0.4V=4.2V

In Online Leakage Current Circuit Provision is given below.

Case I: - Neutral and Earthing is intrinsically small, we believe everything is working in proper condition. The ground negative terminal of the 12v DC supply is also connected to the earth electrode through the load. Hence there is zero voltage / potential difference in the negative terminal of the DC supply. It flows through a zero voltage resistor R7 that is connected to the non-inverted terminal of an operational amplifier, and also a zero potential difference in a neutral conductor that is connected to the non-inverted terminal of the operational amplifier LM358 through R6 it happens.

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The resistance ratio of R6 and R7 is 10:1.
Simultaneously, the earth conductor which is connected to the body of the load, which we consider as a zero voltage, is directly connected to the pin no. 2 operational amplifier (inverted terminal).
Now pin no. 2 and pin no. 3 has zero voltage. Which means that the output of the OpAmp is zero voltage.

Case 2:-
So if the negative terminal has more voltage than the positive terminal and the output voltage is higher
The positive terminal gets the feedback resistance associated with the output.
If any voltage on the system increases, each time it flows through the negative terminal/pin no. 2.
It is connected to the internal ADC and output of the microcontroller for output control. If the output current is more than 2.5 mA
At that time it will get alarmed and the relay will be on and red light flashes and water pump will be on / start.
Why do we consider 2.5mA?
If a neutral current passes through the accidental terminal, in that case, pin no. 3 has some voltage and so the output of OpAmp decreases and it does not detect the value by the microcontroller.

V. RESULTS AND DISCUSSION

The result is obtained, measurement of resistance of soil, leakage current(mA), humidity/moisture of soil, display real time data and checking all the other component are in working conditions i.e. Display, Buzzer, relay, pump, GSM module for sending mwssage to observer.

Table of testing

Condition	Earth Resistance	Pump ON/OFF	Relay Operation	GSM Operation	Light ON/OFF	Load ON/OFF	Moisture (%)
(1) Dry	Above 4.8 Ω	ON	Relay will trip the load circuit	Message send to receiver through GSM	ON	OFF	36-39 %
(2) Wet	Below 4.8 Ω	OFF	Relay will make the load circuit	Message send to receiver through GSM	OFF	ON	40-100%

* (Note- Set default value of earth resistance is 4.8 Ω)

Observation table

Earth Resistance Reading	Pump ON/OFF	Moisture (%)
(1) 8.9 Ω (2) 19.7 Ω (3) 28.1 Ω	ON	27%
(1) 0.1 Ω	OFF	100%

VI. CONCLUSION

After the implementation of the system, it fulfils all the objectives of the system which is more economical than any other system. Also if the leakage current goes beyond the permissible value, then ELCB break the circuit to remove the fault or to avoid the shock.

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