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Wireless Transformer Monitoring System

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ABSTRACT: This project is about design and implementation of a mobile embedded system to monitor and record key parameters of a distribution transformer like load currents, oil level and ambient temperature. The idea of on-line monitoring system integrates a global service mobile (GSM) Modem, with a standalone single chip microcontroller and different sensors. It is installed at the distribution transformer site and the above parameters are recorded using the analog to digital converter (ADC) of the embedded system. The obtained parameters are processed and recorded in the system memory. If any abnormality or an emergency situation occurs the system sends SMS (short message service) messages to the mobile phones containing information about the abnormality according to some predefined instructions programmed in the microcontroller. This mobile system will help the transformers to operate smoothly and identify problems before any catastrophic failure. In case of any malfunction, the transformer automatically issues a warning and trips the primary and secondary lines.

KEYWORDS: efficient monitoring, faster information sharing, implementing technology, fuzzy logic and dramatic efficiency, easy installation.

I. INTRODUCTION

In power systems, distribution transformer is electrical equipment which distributes power to the low-voltage users directly, and its operation condition is an important component of the entire distribution network operation. Operation of distribution transformer under rated condition(as per specification in their nameplate) guarantees their long life.However, their life is significantly reduced if they are subjected to overloading, resulting in unexpected failures and loss of supply to a large number of customers thus effecting system reliability. Overloading and ineffective cooling of transformers are the major causes of failure in distribution transformers.

We need a distribution transformer real-time monitoring system to detect all operating parameters operation, and send to the monitoring centre in time. It leads to online monitoring of key operational parameters of distribution transformers which can provide useful information about the health of transformers which will help the utilities to optimally use their transformers and keep the asset in operation for a longer period. This will help to identify problems before any serious failure which leads to a significant cost savings and greater reliability. Widespread use of mobile networks and GSM devices such GSM modems and their decreasing costs have made them an attractive option not only for voice media but for other wide area network applications.

II. PROBLEM STATEMENT

Ordinary transformer measurement system generally detects a single transformer parameter, such as power, current, voltage, and phase. While some ways could detect multi-parameter, the time of acquisition and operation parameters is too long, and testing speed is not fast enough. Detection system itself is not reliable. The main performance is the device itself monitoring system should is no effect. Timely detection data will not be sent to monitoring centers in time, which cannot judge distribution transformers three-phase equilibrium. A monitoring system can only monitor the operation state or guard against steal the power, and is not able to monitor all useful data of distribution transformers to reduce costs. Many monitoring systems use power carrier communication to send data, but the power carrier communication has some disadvantages: serious frequency interference, with the increase in distance the signal attenuation serious, load changes brought about large electrical instability, poor anti-jamming capability, low

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measurement accuracy of the data, or even state noise. So if use power carrier communication to send data, the real-time data transmission, reliability cannot be guaranteed.

III. SURVEY

Small survey was done on domestic transformer in and around our city. When we went on examining every domestic transformer, we found that the E.B workers facing various difficulties while identifying the fault ,as they have to search every possible fault occurs in the transformer for a single fault. It also consumes more manpower work and time consumption. This analysis helped us to come out with designing a monitoring machine for analyzing the fault quickly

IV. HARDWARE COMPONENTS

In our project, wireless tansformermonitering system, we have developed a mechanical setup for continuous and efficient process. The following are the hardware components used,

- Arduino
- GSM Module
- Temperature sensor
- Oil level sensor
- Buzzer
- Display board
- Light-emitting diode
- Relay

V. MAIN FUNCTION UNIT

Arduino is an open-source hardware and software company, project and user community that designs single-board microcontrollers for building digital devices. It is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz 24 crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig 1: ARDUINO model

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Arduino gets the data from each sensor and evaluates the sensor data with the perdefined value set in the program. Then the arduino sends the measured value from the sensor to the display. If the sensor data exceeds the predefined value arduino signals the gsm module to send a alert message. These messages are also predefined in the arduino program.

VI. GSM MODULE

A GSM module is a circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem is a critical part here.

Fig 2: GSM Module

VII. SENSOR UNIT

Sensors are installed on transformer site which reads and measures the physical quantity from the distribution transformer and then it converts it into the analog signal. Sensor are used for sensing load current, ambient temperature, winding temperature, oil temperature and oil level. A sensor is a device which receives and responds to a signal when touched. A multitude of different measurable variables can be collected for on-line monitoring. However, it is very rarely useful to use the entire spectrum. Therefore, sensor technology must be adjusted to the specific requirements of a particular transformer depending on their age and condition. Following general set-up of sensors for example is proposed for the use at a Distribution transformer: • PT100 to measure top oiltemperature • PT100 to measure ambient temperature • C.T to measure load current (single phase) • Determination of voltage at measurement tap of bushing (three phase) transformer on-site the oil can be contaminated with water. Breathing of the transformer can cause absorption of moisture by the oil in the conservator. Due to the fact that water is a result and also an origin of paper degradation the water-in-oil content is an important indicator for the condition of winding insulation. The voltage applied to the transformer is acquired at the measuring tape of the capacitor bushing by means of a voltage sensor. It acts with the capacity of the bushing as a voltage divider. This enables not only the measurement of the operational voltage but also the detection of overvoltage, because due to its design the voltage sensor has a bandwidth up to some MHz. The output of the voltage sensor is connected to a peak sampler to detect the amplitude of overvoltage by the monitoring system

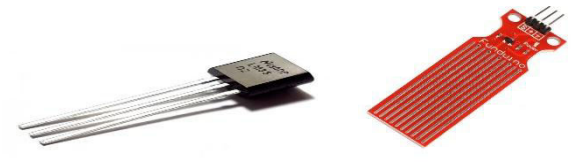

Fig 3: Tmperature and Oil Level sensor

A capacitive thin film sensor is used for the detection of moisture in oil. There are several causes for an increase of water-in-oil content. After improper shipping and erection of the transformer on-site the oil can be contaminated with water. Breathing of the transformer can cause absorption of moisture by the oil in the conservator. Due to the cause absorption of moisture by the oil in the conservator. Due to the fact that water is a result and also an origin of paper degradation the water-in-oil content is an important indicator for the condition of winding insulation. The voltage applied to the transformer is acquired at the measuring tap of the capacitor bushing by means of a voltage sensor. It acts

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VIII. RELAY

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

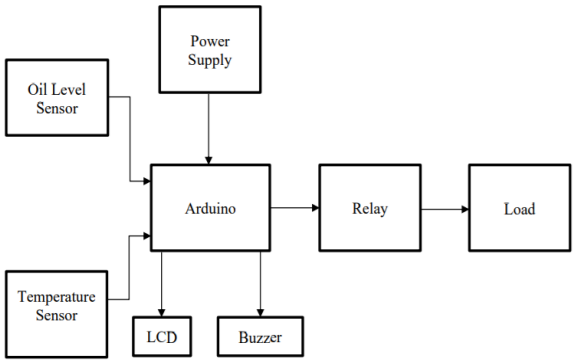

Fig 4: Block Diagram

IX. MONITORING UNIT

The display used is 16x2 LCD (Liquid Crystal Display); which means 16 characters per line by 2 lines. The standard is referred as HD44780U, which refers to the controller chip which receives data from an external source (Here Atmega16) and communicates directly with the LCD. Here 8-bit mode of LCD is used, i.e., using 8-bit data bus. The three control lines are EN, RS, and RW. The EN line is called "Enable." This control line is used for telling the LCD that we are sending data. For sending data to the LCD, the program should make sure that the line is low (0) and then set the other two control lines or put data on the data bus. When the other lines are ready completely, bring EN high (1) and should wait for the minimum time required by the LCD datasheet and end by bringing it low (0).

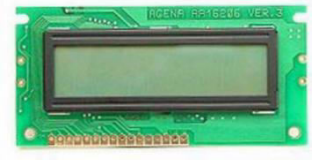

Fig 4:LCD Display Model

The RS line is "Register Select" line. When RS is low (0), the data is treated as a command or special instruction (such as clear screen, position cursor, etc.). When the RS is high (1), the data sent is text data which is displayed on the screen. For example, to display the letter "B" on the screen you would set RS high. The RW line is "Read/Write" control line. When RW is low (0), the information on the data bus is written to the LCD. When RW is high (1), the program is effectively questioning (or reading) the LCD. Only one instruction ("Get LCD status") is read command. All the others are write commands--so RW will always be low. In case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

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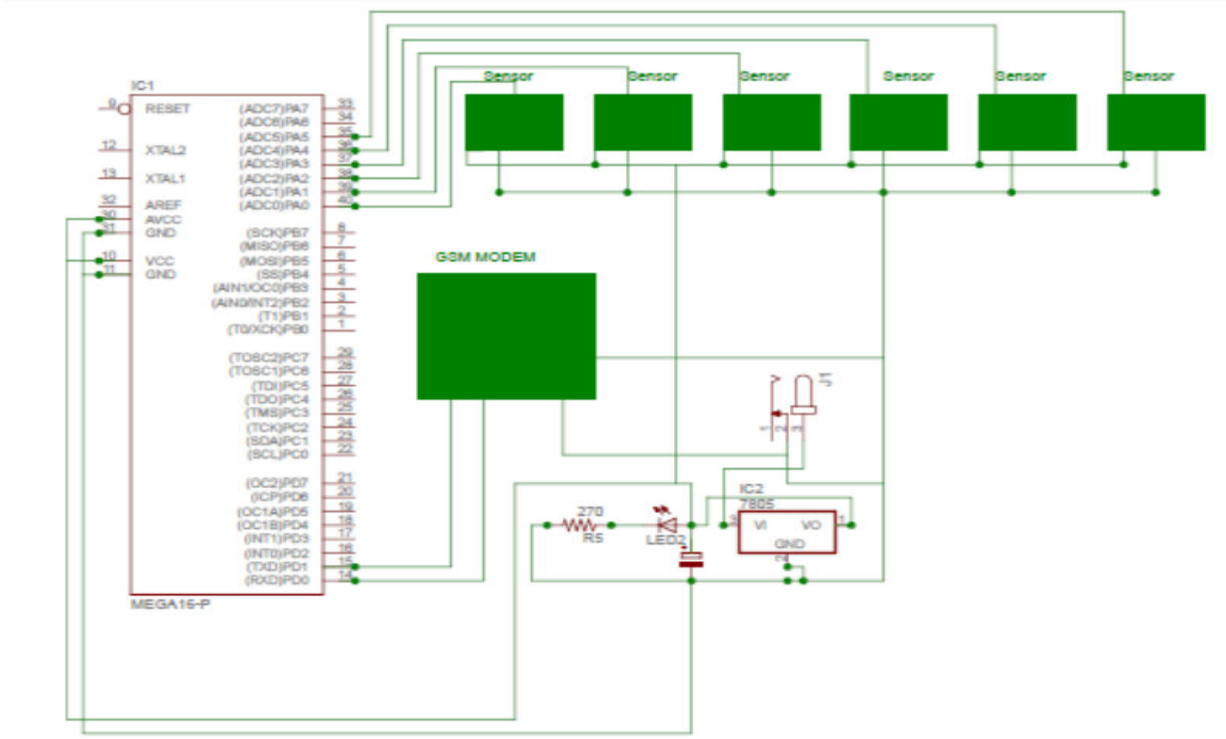

Fig 5: Connection diagram

X. COUNTER UNIT

The counter unit act as a alerting device. This device will be embedded on the transformer .There a buzzer and a LED is used.
If the fault is identified, the buzzer will start to give sound and LED light will glow.

Fig 6: Buzzer

XI. FAULT AND IDENTIFICATION UNIT

The fault is identified from the results of output data of sensors to the Arduino. If any sudden fault occurs in the sensor unit or in relay unit the Arduino will indicate through monitor or sends message through GSM module.

XII. CONCLUSION

The following results can be achieved from this project The gsm based monitoring of distribution transformer is quite useful as compared to manual monitoring and also it is reliable as it is not possible to monitor always the oil level ,oil temperature rise, ambient temperature rise ,load current manually. After receiving of message of any

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abnormality we can take action immediately to prevent any catastrophic failures of distribution transformers. In a distribution network there are many distribution transformers and associating each transformer with such system, we can easily figure out that which transformer is undergoing fault from the message sent to mobile. We need not have to check all transformers and corresponding phase currents and voltages and thus we can recover the system in less time. The time for receiving messages may vary due to the public GSM network traffic but still then it is effective than the manual monitoring.

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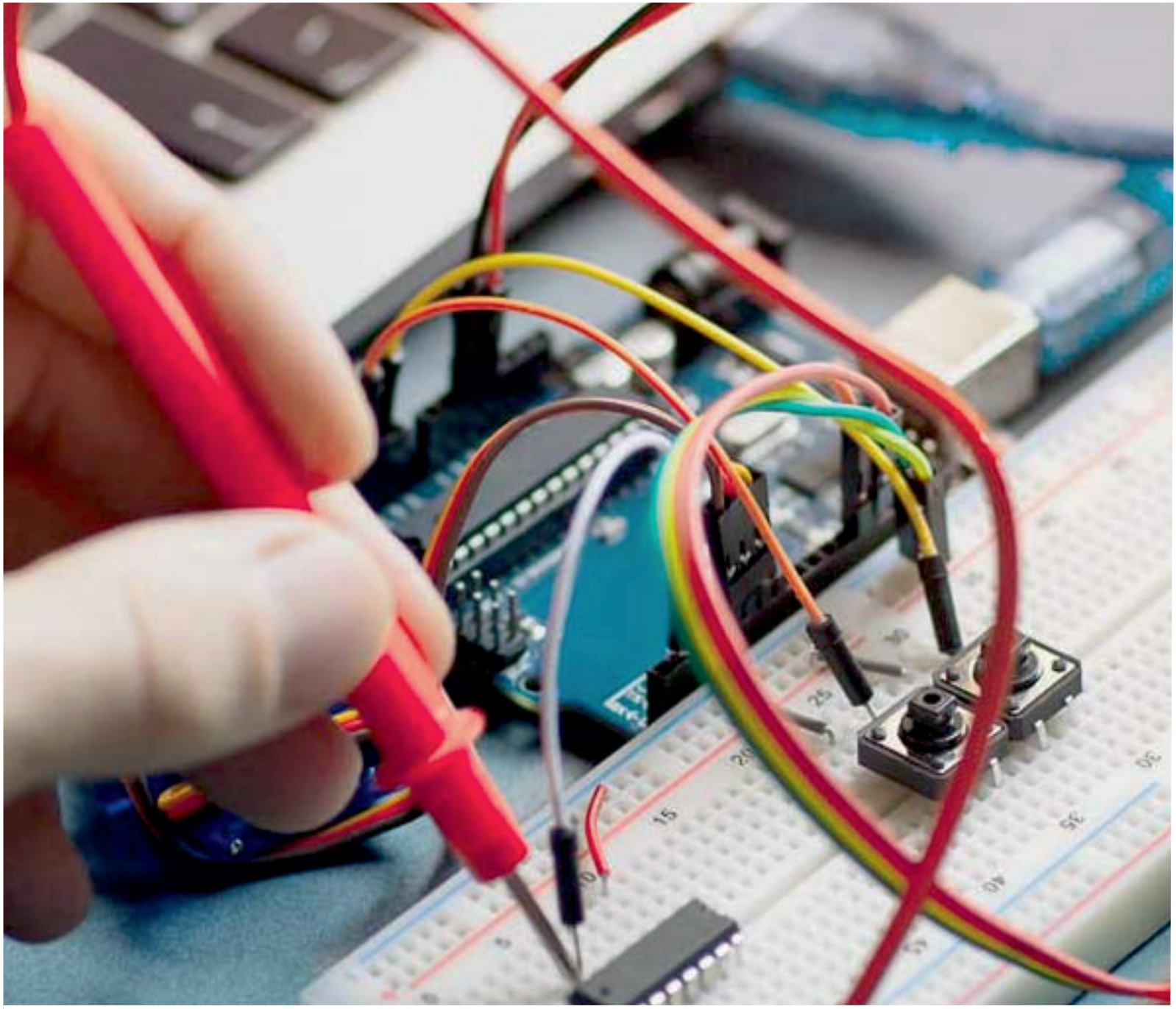

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