

Condition Monitoring of Distribution Transformer with Prepaid Energy Meter through IOT

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Abstract

Transformers plays consequent role in power system. Large numbers of transformers are distributed world widely in energy transmission and distribution system, its problem to monitor the performance of one and all transformer manually. So it's decisive to monitor the working and ascertain data automatically. This paper represents the embedded system to monitor short circuit, oil level over voltage and temperature as well as energy meter system. The implementation of online monitoring system fused IOT (Wi-Fi) Module with PIC Microcontroller and sensors. By the output of sensor, check the abnormalities of synchronized model, system are programmed with predefined instructions. If the results are affirmative, Wi-Fi module alters the substation. This helps in stations to best possible practicality transformers and distinguishes problems before any failure and fatal. The project also aims at proposing a system that will reduce the power losses and tariff due to power thefts and other illegal activities and get the efficient billing system. The main advantages of this project are better energy management, energy conservation and hassle free billing. Automatic billing will keep a track on real time energy consumption.

Keywords: PIC microcontroller, current, temperature, oil level, online monitoring, Wi-Fi, IOT, energy meter.

1. Introduction

Now a day's, our life is totally depend on electricity. Transformers capital investment is bit high when compare to other equipment, thus the operation takes place under precised rated values, this rated values will be depending on name plate rating of transformer while manufacturing. So, life of that equipment is good and sometime extendable. Factors which effect the operation of transformer are, Overload, oil level, temperature, load current and over voltage. The failure may occurs due to internal or external fault, or due to some damages, or due to exceeding the standard rating of the transformer, hence care to be taken towards such deficits. Prepaid energy meter is used to measure the electricity. As name indicted amount will paid before the electricity usage. By interfacing energy meter we can reduce losses, wastage and theft of electric power, which also solve the problem of due billing. Use of smart meter technology, will helps to overcome the technical and non-technical losses. This will result in energy conservation and will also indirectly increase the economy of our country. Smart meter is a pre-programmed electronic measuring device which interface between distribution station and

the end user equipment, which helps to generate bill as per the user consumption and will also notifies the user accordingly. These both applications are purely based on PIC microcontroller and IOT, this is technology is non-reliable, always monitors the data and update. TCP/IP protocols are also used for managing the network traffic since they are simple and robust.

2. Block diagram

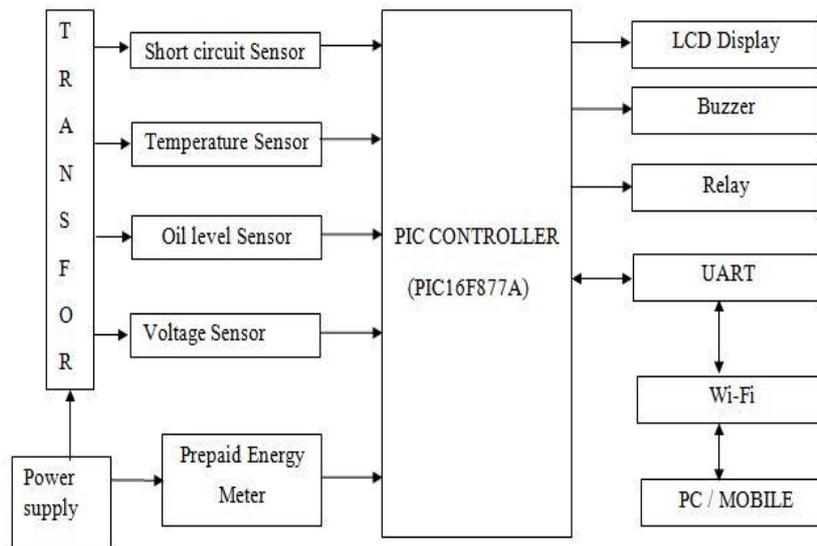


Fig1:block diagram of health of the transformer monitoring with prepaid energy

The project is purely based on PIC controller program. The program of PIC controller is Embedded C language. MP lab IDE software is used for written program and CCS compile will help to debug the code. After successfully program burning microcontroller become ready for use.

In testing, after successfully program burning microcontroller is mounted on its bars and kit become ready for testing. Here, two applications are design and implementation such as, transformer health monitoring and prepaid energy meter. Both are together based on the conditions by controller general purpose input output pin connected supply and ground respectively. For testing in program kit has provided with fallows parameter of transformer and also billing status:

1. Voltage fault $1.8 > V > 4.2$,
2. Temperature fault > 2.7 ,
3. Oil level $< 10\text{ml}$,
4. Short circuit of winding,
5. Giving amount is less than 30 Rs.

Prepaid energy meter is used to reduce the unnecessary use of supply, delay for paying billing, and also theft, and if recharge amount is goes low alert message is come to supply point to end user via communication module.

Status of transformer as well as billing statement are updated in LCD, buzzer to local area, and same time update the result to nearest electrical company or substation via communication model.

2.1 PIC microcontroller

PIC controllers are commonly used by developers due to less cost and huge available in market; developing tools are free and reprogramming with flash memory capability.

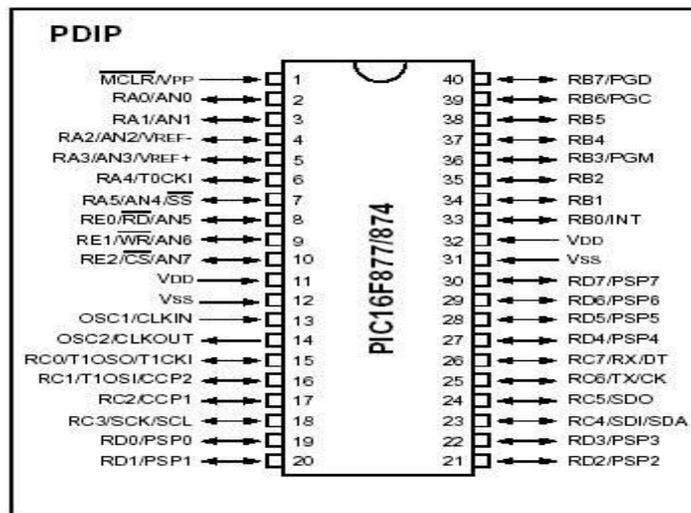


Fig2: pin configuration of pic microcontroller

2.2 Temperature Sensor

Various types of temperature sensor are available in the market but LM35 is the frequently used for measuring the temperature with output of electrical signal is relatively to the temperature in degree Celsius ($^{\circ}\text{C}$). The LM35 operated range from -55° to $+150^{\circ}$ C and this is low self heating.

2.3 Voltage Sensor

Voltage sensors are fact that determining the supply of voltage is to be measured and monitored. It can be measures both AC as well as DC voltage It can measure Ac level or/ and DC voltage level.

2.4 Short circuit Sensor

An electrical circuit normally faces the problem is short circuit. Short circuit is occurs when terminals or any of the two wire are contact with each other's. Thus high current flows via circuit, a short circuit also happens when there is a bypass of electrical current.

2.5 Oil Level sensor

Oil monitoring sensors measure the content of oil. Purpose of this sensor is to sense the oil level and determine oil is present through-out the sensor. Purpose of oil is cooling and insulation.

2.6 Prepaid Energy meter

Digital meter have replace instead of conventional metering system this digital meter gives a more accurate readings, but have a problem in taking false reading and also paying additional bill for required more power than usually consumed power.

LCD is an electronic display module. 16*2 LCD module commonly used in various applications. A buzzer is a device which is used for indication or notification purpose by producing the audio signals.

2.7 Wi-Fi module

The ESP8266 is a cost-effective Wi-Fi module with full TCP/IP stack and microcontroller capability produced by manufacture. This device is capable of either offloading all function of Wi-Fi network or hosting an application from other application processor.

2.10 Flow chart

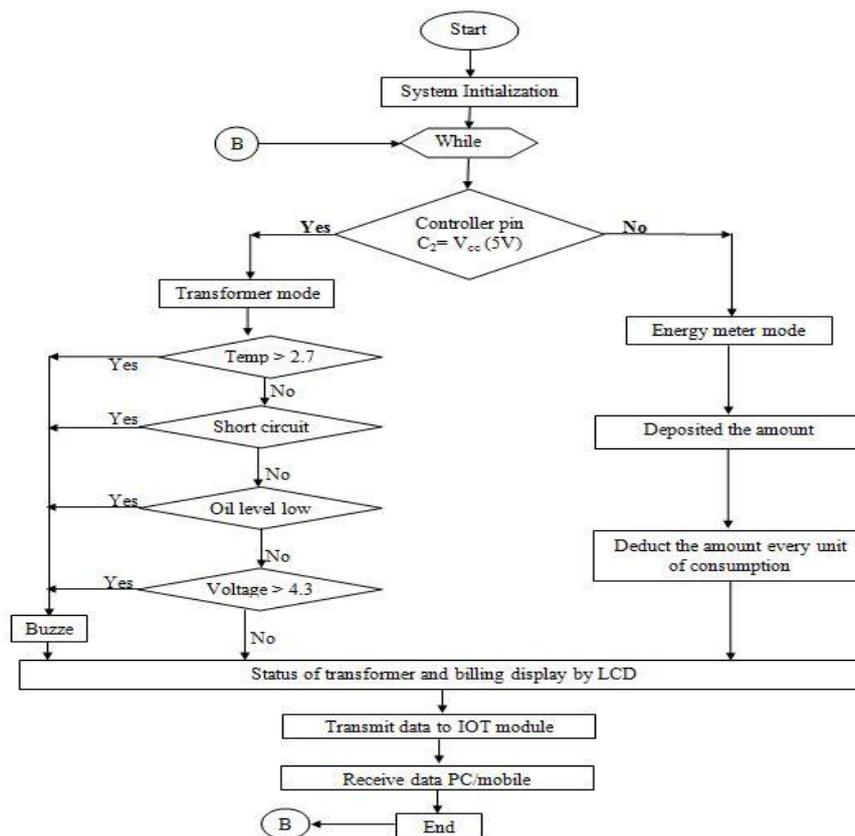


Fig3: Flow chart for health of the transformer and prepaid energy meter

3. Result and discussion

This projected is mainly designed to detect the fault and failure occurs in the transformer and to get hassles free energy billing system. Both applications are operated together based on the conditions; if it's true operated in transformer mode else it is in energy meter mode by controller pin of GPIO. This is operated like N/C and N/O switch.

3.1 Transformer parameter monitoring

Sl. No	Sensor Name	Status of transformer	Result
1	Temperature sensor	< threshold value (2.7 ⁰ C)	Normal temperature
		> threshold value (2.7 ⁰ C)	High temperature
2	Short circuit sensor	When terminal are open	Normal condition
		When terminals are shorted ($I_f > 25\%$ voltage)	Short circuited
3	Oil level sensor	Low (10ml)	Oil level is low
		Normal	Oil level is ok
4	Voltage sensor	Less than threshold value (1.8V)	Low voltage
		Greater than threshold value(4.3V)	High voltage
		between threshold value (1.8-4.3V)	Operated in normal voltage

Table1: Transformer parameter monitoring

3.2 Prepaid energy meter

In PEM, first we initially deposit amount which will be detected as per the energy consumption. If the deposited amount reaches the minimum amount an alter message is sent to the customer which also interface with substation via IOT.

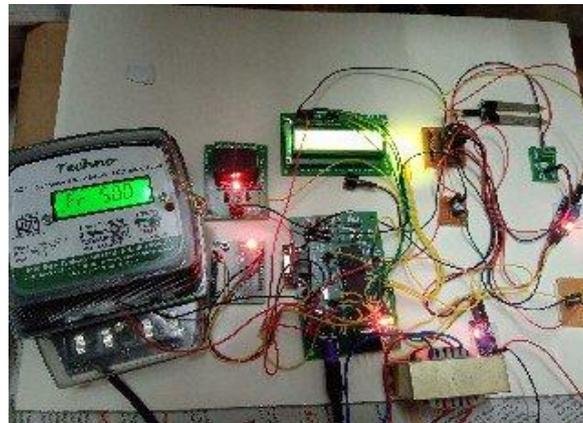


Fig4:prototype of transformer monitoring with prepaid energy meter

4. Conclusion

As per the above discussion, transformers are very important in transmission and distribution system. Regular monitoring of operation of a transformer not only is economical and reliable. Manual maintenance of transformers is time consuming and less effective. With advanced technology of communication now it is possible to detect the fault with in no time and will be more accurate by synchronizing it with IOT technology. Depending upon fault analysis a prototype model of microcontroller based transformer health monitoring and prepaid energy meter developed in laboratory. By implementation of this project in real time system it not only increases the life of transformer but also increases mean down time of transformer which increases reliability and decreased cost of power system operations and getting hassles free energy billing system. This will result in energy conservation and will also indirectly increase the economy of our country.

5. Acknowledgement

I take this opportunity to express my gratitude and profound thanks to our principal, guide, HOD and all faculty of the department of Electrical and Electronic Engineering UBDT Collage of Engineering Davangere, India. For all advice and guidance accorded during the preparation of my project with constant support and encouragement.

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