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Implementation of Web-Based Monitoring and Automatic Control System to Prevent the Faults Occurrence in Power Transformers

[1]Abbas Mahmood Ibrahim and [2]Dr. Öğr. Üyesi Yusuf Erkan Yenice,
[1,2]Electrical, Electronics and Computer Engineering, Aksaray University, Aksaray, Turkey

Abstract: Transformer is essential point in power system and more susceptible to unexpected faults. This project is made to establish a monitoring system to monitor the current consumption, voltage at the terminals, temperature of windings and gas leakage. Due to over current consumption, winding temperature is raising gradually and heats the oil surrounding the windings and hence causing to burn the oil. Due to oil burning, CO_2 emission might be occurred. This paper is proposing efficient solution for continuous monitoring of power systems as well as automotive control to prevent any fault occurrence. PIC microcontroller of 18F4620 is used to provide web service-based monitoring system. The proposed system is outperformed in various working conditions.

Keywords: *- PIC, Transformer, Sensor, Temperature, Fault, Over-load*

I. INTRODUCTION

The current years recalls a set of technologies that becomes a curtail in human daily activities. It is obvious that information systems [1] [2] have griped the attention of large technology provider and hence dominated the market of today's world. The information systems can be seen in every individual life of new days, this is however motivated by the large facilities provided by those systems such as time saving, cost cutting and simply it can be prescribed as life facilitating technologies where people cannot give up of it. big engineering industries are not behind the technology development either. Usually, transformers are making the essential corpus of power systems where energy is transfer from one level to other level. Power transformation involves either transferring the power from the high level into low level which is referred as step-down conversion (transformation) or it can transfer the power from lower side into higher side to form what is so called step up transformation [3]. The classical systems that introduced to support the power systems are termed as protection system and those are initially found by establishment of protection devices such as switches and relays. Those devices are being installed in the site of the power system on the component that being willed to get protection. The new technology involves development of safe and green protection systems that can be used remotely and supports automatic process that secure any component without the need of human hand [4]. New protection system contains of smart monitoring systems that can be accessed remotely and hence any power system can be surveilling all the time. The integration of internet with power system has gained extensive attention in the many research eras. At [5] [6], author mentioned that power system monitoring information can be performed using SMS based microcontroller where updates of temperature is sent to mobile using SMS facility. Unfortunately, this service is limited to the coverage of GSM network and it encountered for service charges. While a research is made at [7] to transmit information of decision of system from microcontroller upon fault occurrence to particular switches to toggle them using a radio frequency antenna. This is also limited by the distance and no remote monitoring can be ensured. Also, many approaches are made in [9] [10] [11] where authors have monitored only couple of parameters such as temperature or current without given any concern about other parameters such as gas or oil overheat or even the voltage. In this paper, PIC microcontroller 18F4620 is used to collect information from sensors such as current sensor, temperature sensor, gas sensor, etc. it is then made to process the readings and then send it across a web network where remote terminal computer unit can receive all the sensing information in form of web page.

II. MICROCONTROLLER

The preceding sections of this chapter are demonstrated the prototype of the control and monitoring units. It however directly relaying on presence of processing unit capable to accommodate all sensors outputs and send it across network reaching the remote terminal unit. in order to complete these important demand, pic type microcontroller is used [12]. Microcontroller from "18F4620" family is shortlisted due to several interested features such as low watt technology and efficient of fly mode, multiple modes of run and on demand idle mode. The device exact model is 18f4620 which can work as webserver to transmit data through network. Looking to the device, forty ports can be seen lying on both sides of the chip. Furthermore, following features are the device big promotors to be used in applications similar to monitoring and controlling systems [11].

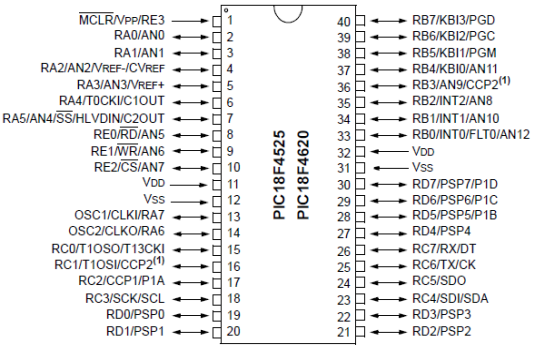

Figure 1:18F4620 Pin-out, figure depicts the input and output ports also the direction of installation of PCB board.

The device is supported by thirteen channels analogue to digital convertors with capacity of ten bits. The analogue-to-digital-ports are capable to detect the signals (inputs) automatically and can perform that even while device on sleep mode. It is capable for dual comparison of analogue inputs and automatic multiplexing of the input as well. Availability of sixteen levels low voltage and high voltage detectors which can work using programmable interrupts. Compatibility with high clock operations as device works on up to Sixteen-

Megahertz crystal clock frequency. Around 4000 bytes of memory to store applications data and 32768 bytes for code instructions and samples storage and 65536 for program random access memory. Compatibility of several network interfaces and controllers such as Ethernet ports and serial port. The input operation voltage is solely five DC volts; the device is depicted over Figure 1.

III. TEMPERATURE SENSOR

In order to detect the temperature variation in transformer's windings as temperature of windings are keep on increasing soon after current is consumed in large quantities. LM 35 is popular integrate circuit that able to detect temperature variation in centigrade without needing of external calibration. It can detect temperature with accuracy of (±) 0.25 and (±) 0.75 at indoor environments and outdoor environments respectively. The mentioned accuracy of the sensor at outdoor environment is however meant as sustainability within acceptable error range under very low to very high temperatures more likely in range of -55 through +150 centigrade [13] [14]. The features of this device are listed as below.

1. Tiny size unit which make it to utilize the space efficiently. It is small plastic outlined piece and can be installed on surface to detect the temperature at the surrounding environment.
2. Wafer level fabrication make it cost efficient for many applications.
3. Small power supply (five volts) requirement and guaranteed stability (linear output).
4. Device accuracy is high, several models of this devices are folded under LM family such as LM35CA, LM35C, LM35D and LM35E are available in market.

The LM35 temperature sensor is well depicted in Figure 2.

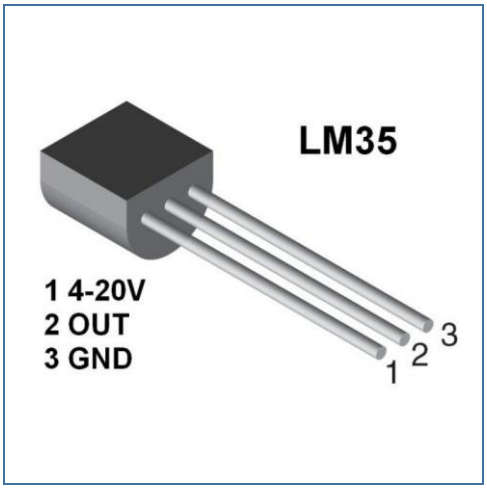

Figure 2: Temperature sensor LM35, a demonstration of pin-out.

A. Current sensor

The current flowing in power cables due to potential difference can be measured using current sensors. In this project, ACS712 is used as current sensor. It is developed by "Allegro" and available in market. This type of sensors is perfect for communications applications, electric motor current management and many other industrial applications. The device is featured by its ease of use to detect DC or AC current [16]. This sensor is operating by DC voltage of five volts and provide linear indication of the current flow in scale of zero to five volts. This integrate circuit provide accurate detection of current due to its stabilized chopper material and low offset current. Furthermore, power losses in this device is relatively low because of small resistance of internal circuit of this device around (1.2 Ohm) as well as small thickness of the wafer [17].

Deice V_{cc} input ports as well as the output and ground ports. The features of this device can be listed herein: Big bandwidth of eighty Megahertz which is achievable by using capacitors (filter on the input ports), the filters are connected at the input to eliminate the noise effect of this device, small response time to the current changes. Variation is detectable within five microseconds only, small dimensional design which make is suitable for monitoring applications and control system. It is also can guarantee good accuracy level of 1.5 percent at moderated temperature, low magnetic hysteresis which means low magnetic losses and accurate output, tiny internal resistance and single supply to empower the circuit make it power efficient device, low noise output with 55 millivolts for every one ampere, the ratio of output is direct proportional to the input current in both DC and AC cases, compacted size for the model of thirty amperes capacity make it suitable for control application and other industrial applications which concern about space utilizing.

B. ENC 24J60

In order to interface the microcontroller unit with the network world, network adapter is seemed to be must. Microchip has developed an Ethernet controller called as ENC24J60 which stands for Ethernet board with network adapter. RJ 45 is the method of network interface that is used link the Ethernet board with other network devices like switches, hubs or routers. The output payload of this controller is often megabit resolution. Figure 3 demonstrates the physical Ethernet board [17].

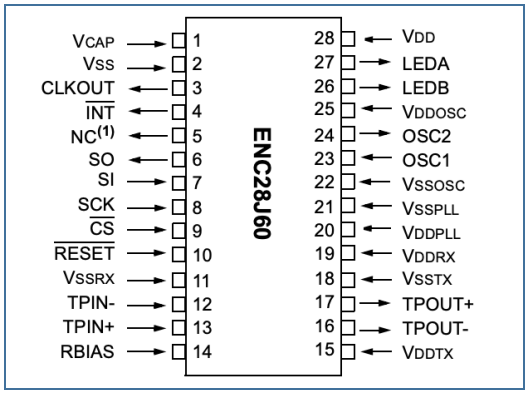

Figure 3: ENC24J60 Ethernet controller pinout diagram

The significant of this device is recognized by the following features: This device paved the way to apply Ethernet connection for any technology supports universal extension technology (UEXT), it include LAN interface capability because of RJ 45 support, ENC board involves couple of light emitting diodes to indicated the status of communications, supports Serial Peripheral Interface which means it can be easily integrated with microcontroller through SPI ports, it is compatible with Ethernet previous versions such as ENC28J60-H, good pin spacing which make it easy to adopt PCB boards.

C. Model fabrication

After gathering and understand every part of the model, parts are fabricated together as deemed in Figure 4.11. model can be tested by firstly accessing the microcontroller unit by typing the IP address of it in the remote terminal web browser.

As soon as web page is displayed on the computer, all the readings from every sensor are displayed. In order to examine the parts and find if every unit is working properly, current sensor, temperature sensors are readjusted. Test might be commenced by manually adjusting the temperature and checking if the same reflects at the remote terminal page. At same time, of temperature set to fifty-five centigrade, first fan has to be started and similarly if temperature set to sixty-six, second fan should start automatically as well. in order to test the emergency alarm, temperature is set to 100 and alarm is observed. Hereinafter, current circuit is to be tested using the software defined buttons. Buttons to be clicked sequentially and that might lead to increase the current and display the reading at the remote terminal web page.

System remote shutdown facility can be examined by pressing the particular button and observe the system current (on web paper) which should be indicate zero ampere. Voltage terminal is also connected to microcontroller and it detect constant terminal voltage of 220 volts unless system is shut down so the terminal (secondary voltage might go to zero). Gas sensor is to be adjusted using the rheostat resistance and same will reflect the level of leakage at the remote terminal unit web page.

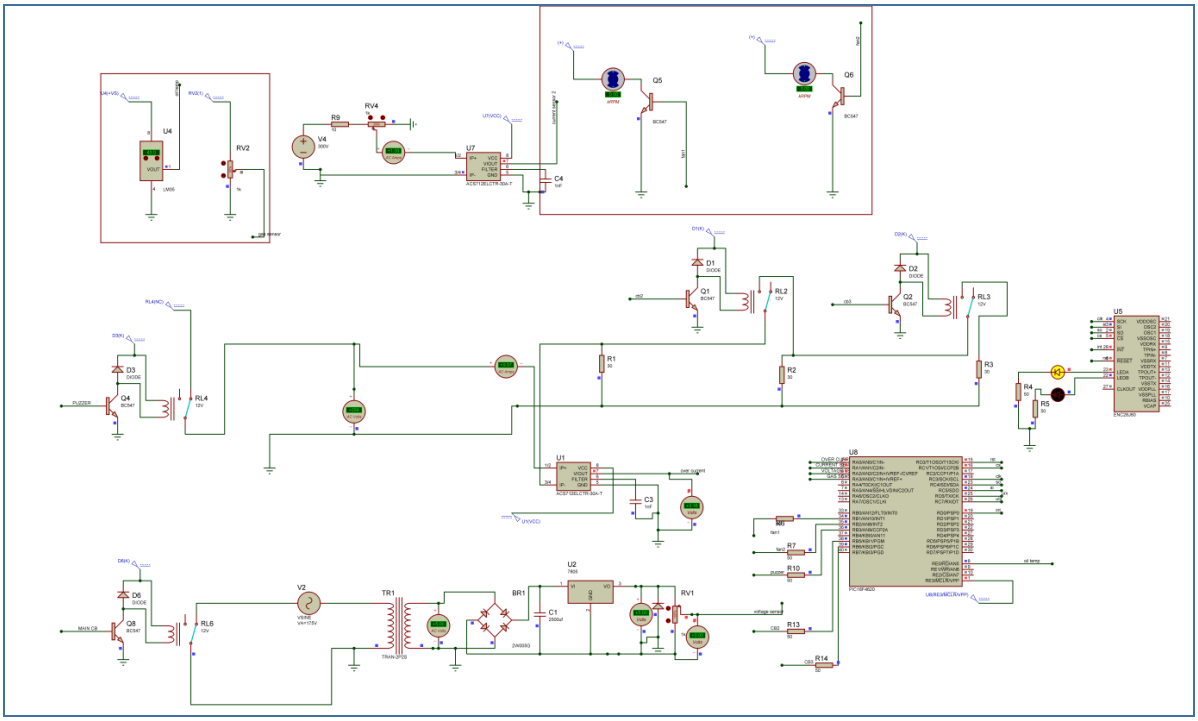

Figure 4. Model fabrication, figure demonstrates entire model's components.

CONCLUSION

Protection system is vital for economical constrains and design worthiness. Power systems are more susceptible to environmental conditions such as rains, winds and floods. Transmission line are the most environmentally influenced part of the power system because of their direct touch with rains and other nature conditions. Faults are the popular performance degradation parameters in power system. It can cause a hefty loss in the cost of power generation also degradation of the power quality from the consumer point of view. Remote control of power system is important for power system effectiveness and safety. In some event alike faults, power system may require to shutdown instantly and automatically. Remote terminal unit is made in this project to keep track of power system status at all times. Terminal voltage, current, temperature and gas leakage are monitored using microcontroller with web service capabilities. These parameters more likely current and temperature are keep changing depends on the load amount and time (peak load, winter and summer loads) so they vary every frequently and so they are consciously monitored in this study. Current is controlled remotely in such way over current status is prevented. This was done by insertion of resistive loads load clearing until the current is stabilized. From the other hand, temperature is detected and displayed on remote web terminal. Upon increment of temperature, supplementary cooling system is to be commenced automatically as an attempt to reduce the temperature hike. This project makes it possible to fully control f power transformer through web network. This study tackled the obstacles of coverage problem and cost of GSM based monitoring system. It is also supporting the flexible monitoring and mobility as well if the network is liked to a WIFI router where mobile devices can be used to access the network (monitor and control the system).

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