Intelligent Circuit Breaker To Prevent The Transformer From Lightening By Using Solid State Devices For Opto Coupler

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Abstract *— This project about rainy season problems in electric board. Intelligent circuit breaker to prevent transformer from lightning by using solid state devices is a new project to face the problems during lightning when rainy season. The project is mainly developed to reduce the transformer blasting or power cut during the lightning period. Normally high voltage discharger and buckolz relay was used to prevent the transformer blasting from lightning. But in this project we have used the solid-state controllers to protect the transformers. And the GPS and GSM is used to locate which transformer is affected by lightning. The mainly used solid-state devices are has high speed of response then the older methods, the solid state devices are made on semi conductive devices and the mixture of optical elements. So it will be a good solution for the transformer protection. The devices are usually used for high performance electronic switches to prevent from surge voltage in PLC and other sensible equipment's. This will be good solution for surge voltage from lightning.*

Index Terms *— Buckolzrelay,GPS, GSM, Solid-State Controllers.*

I. INTRODUCTION

A. Basic of Transformer Protection

The electrical equipment and circuits in a substation must be protected in order to limit the damages due to abnormal currents and over voltages. All equipment installed in a power electrical system have standardized ratings for short-time withstand current and short duration power frequency voltage. The role of the protections is to ensure that these withstand limits can never be exceeded, therefore clearing the faults as fast as possible. In addition to this first requirement a system of protection must be selective. Selectivity means that any fault must be cleared by the device of current interruption (circuit breaker or fuses) being the nearest to the fault, even if the fault is detected by other protections associated with other interruption devices. As an example for a short circuit occurring on the secondary side of a power transformer, only the circuit breaker installed on the secondary must trip. The circuit breaker installed on the primary side must remain closed. For a transformer protected with MV fuses, the fuses must not blow. They are typically two main devices able to interrupt fault currents, circuit breakers and fuses.

Depending of the application, protection against these two types of voltage surges may be necessary and are often ensured by means of ZnO surge arrestors preferably connected on the MV bushing of the transformer. Stresses due to the loadA transformer overload is always due to an increase of the apparent power demand (kVA) of the installation. This increase of the demand can be the consequence of either a progressive adjunction of loads or an extension of the installation itself. The effect of any overload is an increase of the temperature of oil and windings of the transformer with a reduction of its life time. The protection of a transformer against the overloads is performed by a dedicated protection usually called thermal overload relay. This type of protection simulates the temperature of the transformer's windings. The simulation is based on the measure of the current and on the thermal time constant of the transformer. Some relays are able to take into account the effect of harmonics of the current due to non-linear loads such as rectifiers, computers, variable speed drives etc. This type of relay is also able to evaluate the remaining time before the emission of the tripping order and the time delay before re-energizing the transformer. In addition, oil-filled transformers are equipped with thermostats controlling the temperature of the oil. Dry-type transformers use heat sensors embedded in the hottest part of the windings insulation.

B. Transformer Protection Related Work

A preventive maintenance schedule consists of regular inspections and component replacements according to the product specific maintenance schedule. Maintenance schedules are based on transformer's decade's long experience of manufacturing and maintaining its products. Regular preventive maintenance helps facilitate forward budget planning.
The main point of concern in ageing and the life expectancy of transformers is the condition of the insulation system, which is typically based on organic products.
The organic products in a transformer degrade over time and finally they lose the capability to withstand the stresses a transformer might see in daily life (short circuits, energizing, vibration, etc.). It is possible to reverse the ageing of mineral oil through oil reclamation that can restore the material properties close to the values when new. Ageing of paper insulation however is an irreversible process and is considered one of the life-limiting processes of a transformer.
The lifetime of this combination of mineral oil and paper in a transformer is very much dependent on the operating temperature, oxygen content, acidity of the oil and the moisture content in the insulation. Temperature is mainly dependent on the transformer design, the loading, the cooling facilities, and the ambient temperature. Changing these parameters is not easy and normally involves large investments. Moisture is accumulated within the paper insulation of the transformer and has different sources.

II. EXISTING METHOD

The system provides a protection for transformer from high voltage and lightning power while using power transformer if any slow-developing faults (insulation failure of windings, core heating, fall of oil level due to leakage etc) arise, the oil present in the transformer is decomposed due to heat. This decomposition of oil produces gases in which more than 70% is hydrogen gas. Due to lightweight, the hydrogen gas tries to go into the conservatory which in result activates the floating element. The hydrogen gas exerts some pressure on the mercury type switch, the element tilts to connect to the alarm which produces alarming sound. Whenever a transformer is using a huge power and if some serious internal faults occur and if very enormous in amount, the oil inside in the transformer produces a huge amount of gas. But due to overheating the oil tends to rushes into the conservator in between the lower element mercury type switch is tilt and which flaps the contacts the trip circuit.

III. PROPOSAL METHOD

Thisproject about day-to-day problems in agricultural surrounding. Wireless Sensing Technology is extensively used future and extensive in the current systematic globe. As Wireless Sensing Network (WSN) helps to enhancement the knowledge. In the make inquiries field of wireless sensor networks the power resourceful time is a major issue. This problem can be overcome by using the IOT technology. The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types.
The manufacturer supplies computer software for development known as MPLAB X, assemblers and C/C++ compilers, and programmer/debugger hardware under the MPLAB and PICKit series. Third party and some open-source tools are also available. Some parts have in-circuit programming capability; low-cost development programmers are available as well as high-production programmers.
PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, serial programming, and re-programmable Flash-memory capability. The main idea of this is to recognize how data movements through a wireless medium transmission using wireless sensornetwork and monitoring system. This paper design an irrigation system which is computerized by using controllable constraint such as temperature, soil moisture and air humidity because they are the important factors to be restricted in exactness Agricultures.

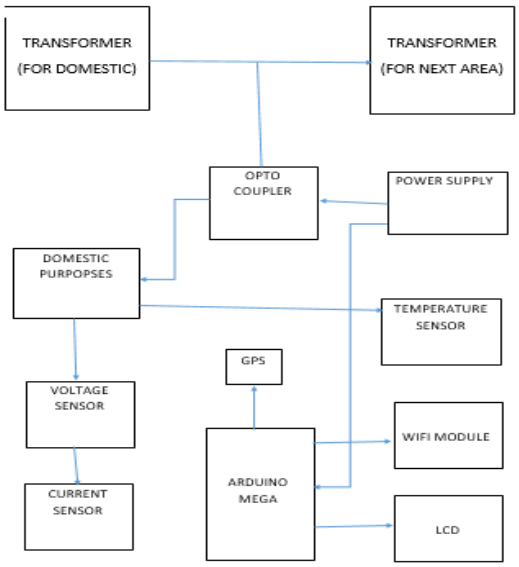

Fig.1 Architecture of Proposal Method

IV. SYSTEM DESIGN

The planned system proposes progression is divided into two methods one is top –down and other is Bottom- Up method. The design process of the projected system is divided into five levels.

Description of Design Level

The five design sequence for the proposed system.

- Requirement Level
- Specification level
- Architecture level
- Component level
- Protection level
- Application level

A. Requirement Level

It is a first level of the design process of proposed an automatic irrigation system it is divided into two types and they are as follows

B. Specification Level

Specification is a detailed assessment of requirements of devices. The table gives a specification of devices used.

S.NO	DESCRIPTION	SPECIFICATION
1	Arduino mega	Inbuilt ADC ,maximum i/o ports, output current -20ma
2	Opto coupler	Operating range-230v
3	Voltage sensor	(4-20ma) or (0-10v)
4	Temperature sensor	(0-200celisius), voltage output
5	Transformer	230-12v
6	GPS	1560 MHz and 1590 MHz
7	GSM	Gsm-900

C. Architecture Level

It consists of the specified hardware device partition, performance and trouble shooting. The proposed system consists of two nodes. Node 1 called as sensing node and Node 2 called as receiver node. The receiver node plays an important role in an automatic transformer protection system. In Node 1 the address of the destination is set on receiver node. Node 1 sensed the information by using sensor this sensing information transmitted to ADC. An ADC converts it from analog to digital then transmitted the digital data to UART for serial communication. This is inbuilt in Arduinomega(2560). IOT is used for wireless transmission of data. IOT transmits data of Node 1 to the receiver node of IOT This Receiver node sends the data toarduinomicrocontroller and information display on the LCD of receiver node as well as mobile.

D. Component Level

It is an important and independent part of system which performs the function in the architecture. It is the most important level for the design of the system. It consists of hardware and software component

E. Protection level

System integration consisting of connecting all the components together and building a proper structure. It also consists of troubleshooting tasks in order to run the system smoothly. It is a difficult stage as we have to find why the system is not working properly. The proposed system consists of a sensor which gives a signal to the microcontroller. There are three channels respectively, for temperature sensor, voltage sensor and current sensor. Sensory information is converted into digitized with the help of ADC and it is transmitted to LCD to display. Then this information is transmitted to IOT.

IOT also compares the sensor output with the set values and gives output to the driver. The data are transmitted to IOT to the master node. It collects information from node1 there are four which can be used to select sets values of a particular crop. Switches are interfaces to Port E Using resister. There are three relays are used for Buzzer, Fan, Pump Motor. This relay is interfaced to Pin RA0, RA1, RA2, BC547 is used to control more power create by a coil of the relay and it amplifies the signal of arduino microcontroller. The information displays from Master Node LCD 16*2 and mobile.

F. Application Level
The proposed system is applied in electric board to detect the temperature, voltage and lightning, which will improve the safety of the transformer.

V. PROJECT DESCRIPTION

A. Microcontroller (ARDUINO MEGA 2560)
The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, 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 aACto-DC adapter or battery to get started. The Mega is compatible with most shields designed for the ArduinoDuemilanove or Diecimila.

B. High Performance RISC CPU
PIC has only 35 single word instructions. All are single cycle instructions except for program branches, which uses two-cycle. The Operating speed of PIC in DC is 20 MHz and clock input in DC is 200 ns instruction cycle. The PIC has 8K x 14 words of flash Program Memory, 368 x 8 bytes of Data Memory (RAM).

C. Peripheral Features

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

D. Cmos Technology
PIC has a Low power, high speed CMOS FLASH technology with a fully static design. It provides a wide operating voltage range of 2.0V to 5.5V. It has Low power consumption and used in commercial and industrial temperature ranges.

E. Pin Diagram

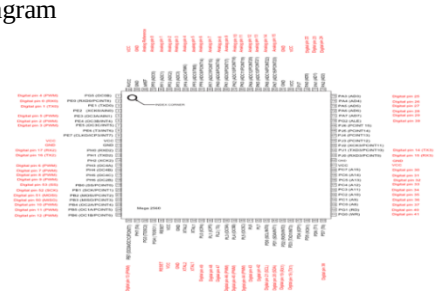

Fig.2 Pin Diagram of Arduinomega (2560)

F. LCD Display
A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCDs do not emit light directly. Liquid crystal displays (LCDs) are a passive display technology.

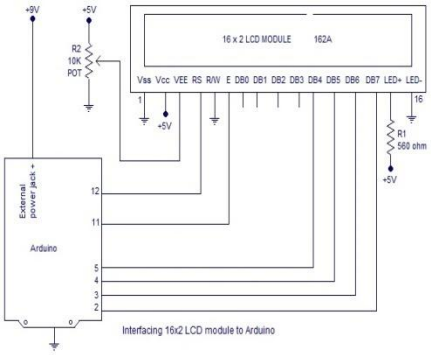

Fig.3 Interfacing 16×2 LCD with Arduino mega (2560) Circuit Diagram.

G.OPTO Coupler
Design with transistor opto-isolators requires generous allowances for wide fluctuations of parameters found in commercially available devices. Such fluctuations may be destructive, for example, when an opto-isolator in the feedback loop of a DC-to-DC converter changes its transfer function and causes spurious oscillations, or when unexpected delays in opto-isolators cause a short circuit through one side of an H-bridge. Manufacturers' datasheets typically list only worst-case values for critical parameters; actual devices surpass these worst-case estimates in an unpredictable fashion. Bob Pease observed that current transfer ratio in a batch of 4N28's can vary from 15% to more than 100%; the datasheet specified only a minimum of 10%.

VII. SYSTEM ANALYSIS

PROTEUS MODELS AND RESULTS

A. Proteus Module
The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products include an auto router and basic mixed mode SPICE simulation capabilities.

B. Schematic Capture
Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design

phase of a PCB layout project. It is therefore a core component and is included with all product configurations.

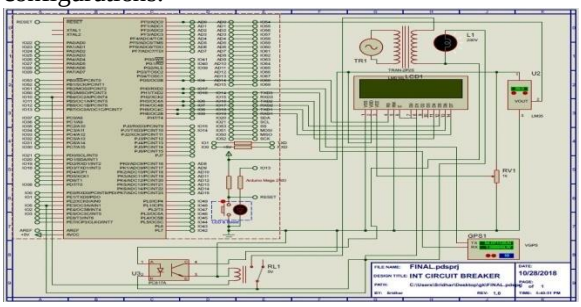

Fig.4 Schematic capture of the transformer protection circuit

C. Microcontroller Simulation

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design.

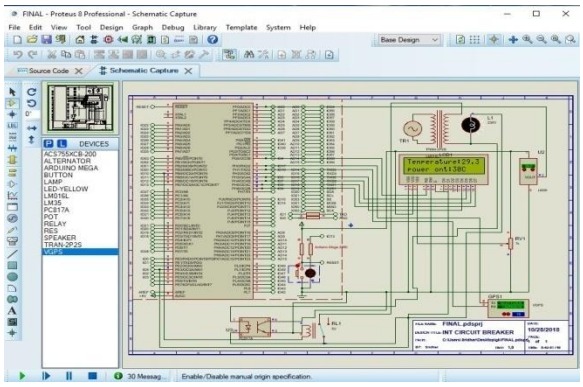

Fig.5 Microcontroller simulation output

D. Circuit Diagram

A circuit diagram is a graphical representation of an electrical circuit. A pictorial circuit diagram uses simple images of components, while a schematic diagram shows the components and interconnections of the circuit using standardized symbolic representations. The presentation of the interconnections between circuit components in the schematic diagram does not necessarily correspond to the physical arrangements in the finished device. In this circuit diagram the Arduino and LCD display and Optocouplers, transformer, GPS are inter connected with each other for the requirement fulfill of the project simulation.

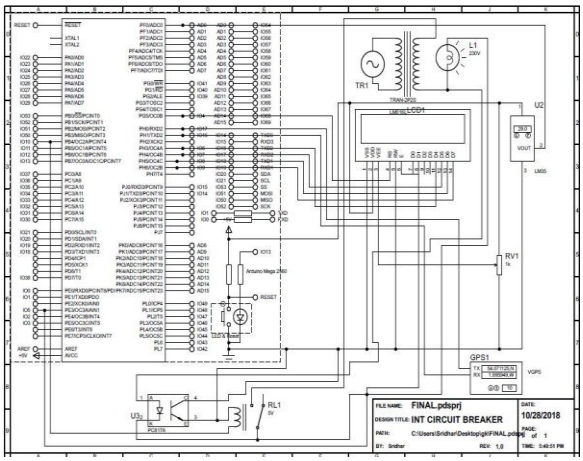

Fig.6 Circuit diagram

VIII. RESULTS&CONCLUSION

A. Simulation Output

When the temperature and the voltage gets increased the optocouplers circuit will open due to the over load and the temperature sensor get the information whether the normal power cut by station or lightning surge and the location of the transformer are send by the GPS module to the electric board or local station.

When the temperature rate crossed the threshold rate of the transformer, then signal gets ON and displays on master node LCD and mobile phone.When Temperature rate crosses the threshold rate of the crop, then enthusiast get ON and displays on master node LCD and mobile.When transformer temperature rate crosses the threshold rate of the transformer then circuit will open and displays on master node LCD and mobile.

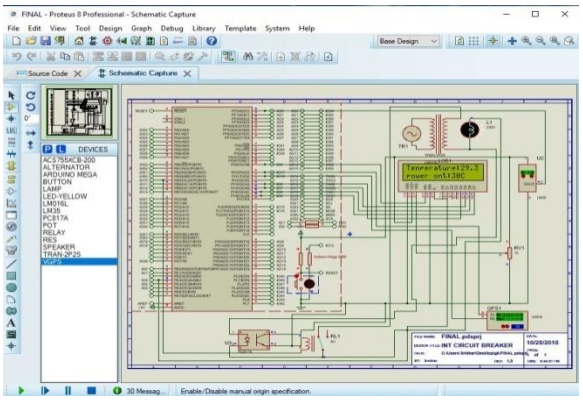

Fig.7 Simulation Output

B. Conclusion

Finally, it will protect the transformer from the lightening and surge it will locate the transformer in

which place the transformer is affected by the lightening are surge and it send the message about location and in which temperature when transformer is affected is there and it will give the information transformer is turn off by manual mode in station or it affected by the lightening or surge.

References

[1] M. Darveniza, D. R. Mercer, "*Service Performance of Distribution Lightning Arresters and Transformers*", Elect Eng Trans. InstEngAust, vol. EE2, pp. 97-112, Sep 1966.

[2] M. Darveniza, T. M. Parnell, D. R. Mercer, "*Service Testing of Distribution Lightning Arresters*", IEEE Rural Elect conf, 1966.

[3] M. Darveniza, T. M. Parnell, D. R. Mercer, "*The Lightning Protection of Distribution Transformers*", Elect Eng Trans. InstEngAust, vol. EE4, pp. 193-204, Sep 1968.

[4] T. M. Parnell, M. Darveniza, S. G. Fraser, "*Impulse Testing of Transformers with Special Reference to Testing Techniques*", Elect Eng Trans. InstEngAust, vol. EE4, pp. 159-167.

[5] J. F. Carter, M. Darveniza, N. Logothetis, T. M. parnell, "*investigations of selected High Voltage Tests on the Windings of 11 kv Transformers*", Elect Eng Trans. InstEngAust, vol. EE12, pp. 89-97, 1976.

[6] R. O. Caldwell, M. Darveniza, "*Experimental and analytical studies of the Effect of Non-standard Wave shapes on the Impulse strength of External Insulation*", IEEE Trans Pwr App and Systs, vol. PAS-92, pp. 1420-1428, Jul-Aug 1973.

[7] I. K. Vosper, T. M. Parnell, M. Darveniza, "*Investigations of the Performance of Distribution Surge Diverters for Steep-Fronted Impulse Voltages*", Proc Elect EngConfInstEngAust, pp. 290-298, 1985-Oct.

[8] C. Dang, T. M. Parnell, P. J. Price, "*The Response of Metal-Oxide Surge Arresters to Steep-Fronted Current Impulses*", IEEE Trans on Pwr Del, vol. PWRD-1, pp. 157-163, Jan 1986.

[9] M. Darveniza, M. A. uman, "*Research into Lightning Protection of Distribution Systems - II Results from Florida Field work*", IEEE Trans Pwr App and Syst, vol. PAS-103, pp. 673-683, 1984.

[10] H. J. Songster, "*Electric Power-Related Lightning Research in the United States*", IEE Conf 1984.

[11] surge characteristics and Protection of Distribution Transformers, Ja

[12] J. Huse, "*Lightning Overvoltages and Overvoltage Protection of Distribution Transformers*", CIRED, pp. 110-113, 1981-June.

[13] J. Huse, Int Conf Lightning and Power Systems, 1984-June.

[14] R. F. Fonseka, M. Darveniza, "*Cost-Benefit Analysis of Improved Lightning Protection to Distribution Transformers*", Proc Elect EngConfInstEngAust, pp. 211-216, 1986.

[15] M. Darveniza, "*Electrical properties of Wood and Line Design*", University of Queensland Press, 1980.

[16] M. J. Master, M. A. Uman, N. Beasley, M. Darveniza, "*Lightning Induced Voltages on Power Lines: Experiment*", IEEE Trans Pwr App &Syst, vol. PAS-103, pp. 2519-2529, 1984.

[17] W.E. Glassbum, R.L. Sharp. "*A Transformer Differential Relay with Second Harmonic Restraint*", AIEE Transactions, vo1.77, pZhe Zhang, Yufeng Hu, Virtual third harmonic restrained transformer differential protection- principle and practice, The Proceeding of the CSEE, V01.21, No.8, pp.19-23,2001. (In Chinese)

[18] R. H. Harner and J. Rodriguez, "*Transient recovery voltages associated with power-system, three phase transformer secondary faults*," S&C Electric Co., Jan. 1972.

[19] R. E. Owen, "*Switching surges,"* Basic Lines. Canonsburg, PA: McCraw Edison, 1979.

[20] Westinghouse Electric Corp., Electrical Transmission and Distribution Reference Book, 1964.