FAULT SENSING IN A REMOTE TRANSFORMER USING GSM & AUTOMATIC ON/OFF OF STREET LAMPS

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ABSTRACT: Networked embedded systems have become quite important nowadays, especially for monitoring and controlling the devices. Advances in embedded system technologies have led to the development of residential gateway and automation systems. Apart from frequent power cuts, residential areas suffer from a serious problem that people are not aware about the power cuts due to power disconnections in the transformers, also power theft issues and power wastage in the street lamps during day time exists. So this paper presents a lifestyle system using GSM which transmits the status of the transformer.

 Keywords: Networked embedded system, Power theft, Power wastage in street lamps, Status of transformer.

I.INTRODUCTION

Generally Automation in Embedded Systems plays major role in various applications. The main function is to make the system compatible with all devices that can be connected to digital communication networks. Automation reduces human effort and saves lot of time. This paper is based on Automation in Transformers which mainly uses GSM to transmit the status of the transformer via message.

II.PROPOSED MODEL AND ITS MERITS

Most of the residential areas are not aware about the power cuts that are caused due to disconnections in the transformers. The problem can be solved only if a person had noticed and make a call to the EB station and explain where the problem exists also, power theft issues and power wastage in street lamps during day time exists. Mainly the people in the rural areas are affected due to these existing problems.

Frequent power disconnections, power theft, power wastage are the main defects in the existing system. In order to overcome the problems mentioned in the existing system, this system is proposed with GSM based detection and automation. With this system, we are going to detect the power disconnections in the transformer, automatic ON/OFF street lights, detection of power theft. All the limitations are overcome and better service is provided.

III.METHODOLOGY

The power cut issue due to disconnections in the transformer, power theft and a power wastage issue exists in residential areas. In real time these issues can be rectified by the concept we had proposed. Firstly, the disconnection problems for example short circuits can be detected by setting up a breaker circuit in the nearby transformer which is then connected to the PIC microcontroller which senses the status of the transformer i.e., when there is a disconnection in the transformer the breaker will be tripped so this will be sensed by the controller and the information is send to the receiver. Secondly, the power wastage problem due to the glow of street lamps in the area can be rectified as follows. An LDR (Light Dependent Resistor) which is placed on the street lamps which works depending upon the intensity of the surrounding and is compared with the use of comparator and the street lights are automatically ON/OFF and also if any problem exists in the LDR circuit, if the lights are glowing even in the day time, this will be sensed by the controller and the message is sent to the receiver. Thirdly, power theft issues that can be detected by comparing   the voltage value of the current transformer with the reference voltage and the comparator output is given to the controller.

If the controller senses the status of the transformer this message will be transmitted to the receiver side through GSM. The status of the transformer can be displayed either directly in the mobile phone, PC or laptop in EB Station as well as corresponding In-charge person (lineman).

IV. BLOCK DIAGRAM OF TRANSFORMER FAULT DIAGNOSIS SYSTEM AND ITS DESCRIPTION

Fig: Block diagram of transmitter
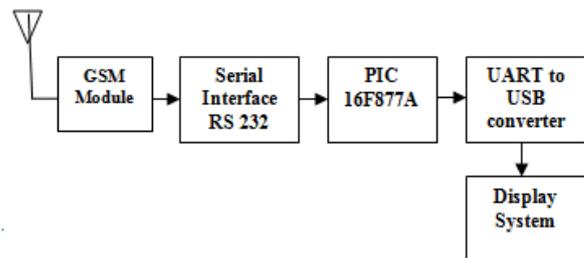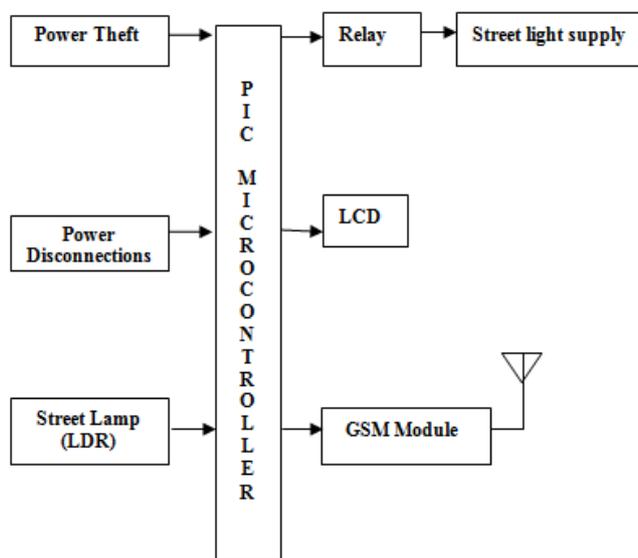
Fig: Block diagram of receiver

A.MICROCONTROLLER: They are destined to play an increasingly important role in revolutionizing various industries and influencing our day to day life more strongly than one can imagine. The microcontroller has been recognized as a general purpose building block for intelligent digital systems. A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products.

B.MAJOR FEATURES OF MICROCONTROLLER PIC 16F877A: 16 Bit CPU optimized for control applications, Extensive Boolean processing (Single - bit Logic) Capabilities, On - Chip Flash Program Memory, On - Chip Data RAM, Bi-directional and Individually Addressable I/O Lines, Multiple 16-Bit Timer/Counters, Full Duplex UART, Multiple Source / Vector / Priority Interrupt Structure, On - Chip Oscillator and Clock circuitry, On - Chip EEPROM, SPI Serial Bus Interface, Watch Dog Timer.

C.SHORT CIRCUIT BREAKERS: A circuit breaker [3][10] is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and, by interrupting continuity, to immediately discontinue electrical flow. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city.

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D.CONCEPT OF DETECTING SHORT CIRCUIT:
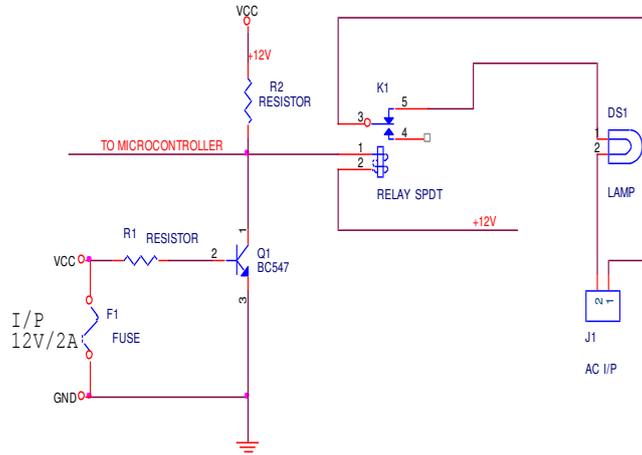
In the above circuit, when there is no short between wires there is a normal flow of power. At this condition the load (40W bulb) will be glowing. When the two wires are shorted the then the load will be off indicating that the two wires are shorted. The collector output of the transistor is given to the controller as input.

E.AUTOTRANSFORMER: An autotransformer [10] (sometimes called auto step down transformer) is an electrical transformer with only one winding. The "auto" (Greek for "self") prefix refers to the single coil acting on itself and not to any kind of automatic mechanism. In an autotransformer portions of the same winding act as both the primary and secondary. The winding has at least three taps where electrical connections are made. Autotransformers have the advantages of often being smaller, lighter, and cheaper than typical dual-winding transformers, but autotransformers have the disadvantage of not providing electrical isolation.

Autotransformers are often used to step up or step down voltages in the 110-117-120 volt range and voltages in the 220-230-240 volt range—for example. Providing 110 or 120V (with taps) from 230V input, allowing equipment designed for 100 or 120 volts to be used with a 230 volt supply (as in using US electrical equipment in with higher European voltages).

F.CONCEPT OF THEFT POWER DETECTION:
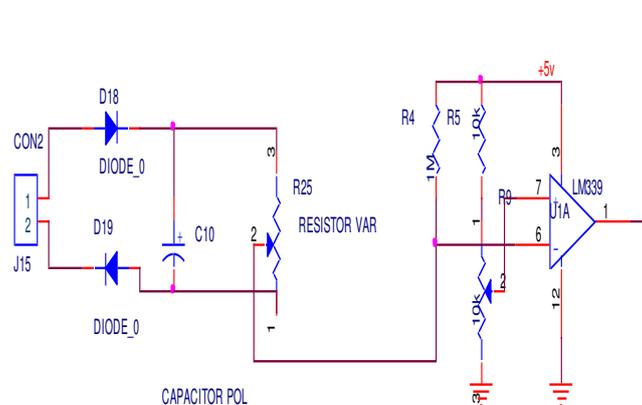
Figure: Circuit for Power Theft Detection

In the above circuit current transformer is used because the input from auto transformer is maximum that the circuit can't bear the high voltage. The current transformer will measure the current from the auto transformer and the high voltage will be converted to a voltage below 5V which is the operating voltage of the controller. When the auto transformer is varied the load (40W bulb) is made on which indicates there is a power theft. This is done by using a comparator with reference voltage as 3.5V. When the input voltage is more than the reference voltage there will be theft.

Reference voltage	Input voltage	Output
3.5V	<3.5V	No theft
3.5V	>3.5V	Theft

Table: Comparison of input voltage with reference voltage to Detect Power Theft

G.CURRENT TRANSFORMER: Instrument transformers means current transformer &voltage transformer are used in electrical power system for stepping down currents and voltages of the system for metering and protection purpose. Actually relays and meters used for protection and metering, are not designed for high currents and voltages.

High currents or voltages [10] of electrical power system cannot be directly fed to relays and meters. CT steps down rated system current to 1 Amp or 5 Amp similarly voltage transformer steps down system voltages to 110V. The relays and meters are generally designed for 1 Amp, 5 Amp and 110V

H.LDR [Light Dependent Resistor]:
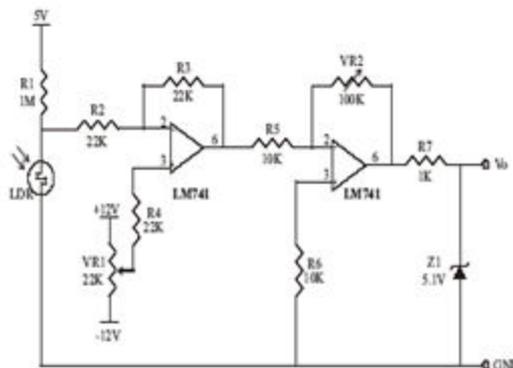
Figure: Circuit Diagram of LDR

A photo resistor is an electronic component whose resistance decreases with increasing incident light intensity. It can also be referred to as a light-dependent resistor (LDR), or photoconductor.A photo resistor [4] is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. In intrinsic devices, the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities added, which have a ground state energy closer to the conduction band since the electrons don't have as far to jump, lower energy photons (i.e. longer wavelengths and lower frequencies) are sufficient to trigger the device.

I.AUTOMATION OF STREET LAMPS: For automation in the street lamps LDR is used. Using the LDR (Light Dependent Resistor) sensor whose resistance is varied manually the street lights are glow automatically.
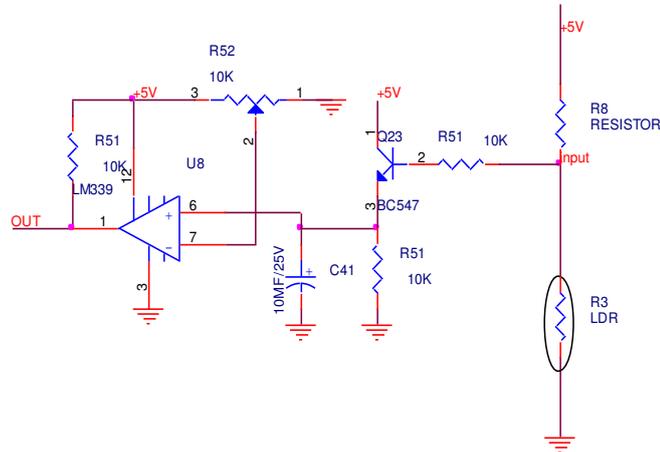
Figure: Circuit for Street Lamp Automation

. The intensity of surrounding is measured and set to a value say reference voltage is 2.5V and if the intensity is below 2.5V the lights are made ON automatically and if the LDR senses the voltage above 2.5V the lights are made OFF automatically. And also if there is any problem in LDR say like if street lamps are kept glowing even in the day time the status will be send to the receiver side so that they can view in which location the fault occurred and clear the problem. And this status will also be seen by the public on the transmitter side.

Reference voltage	Input voltage	Output
2.5V	>2.5V	Lights off
2.5V	<2.5V	Lights on

Table: Comparison of reference value with Intensity of surrounding

J.GSM MODULE: GSM is global system [3] for mobile communication which is a wireless technology it uses SIM card which is the key feature of GSM.

AT+CMGD	Delete message
AT+CNMI	SMS alert
AT+CMGL	Read message

Table: AT Commands

V. RESULT AND DISCUSSION

This SIM card [9] allows GSM network to quickly move information from one GSM to another. With this GSM technology the speed of communication is improved. The Global System for Mobile (GSM) communication is the Second Generation of mobile technology. Although the world is moving towards Third and Fourth generation but GSM has been the most successful and widespread technology in the communication sector. GSM technology paved a new way for mobile communication.

COMMANDS	MEANING
AT+CMGS	Send message
AT+CMSS	Send message from storage
AT+CMGW	Write message to memory
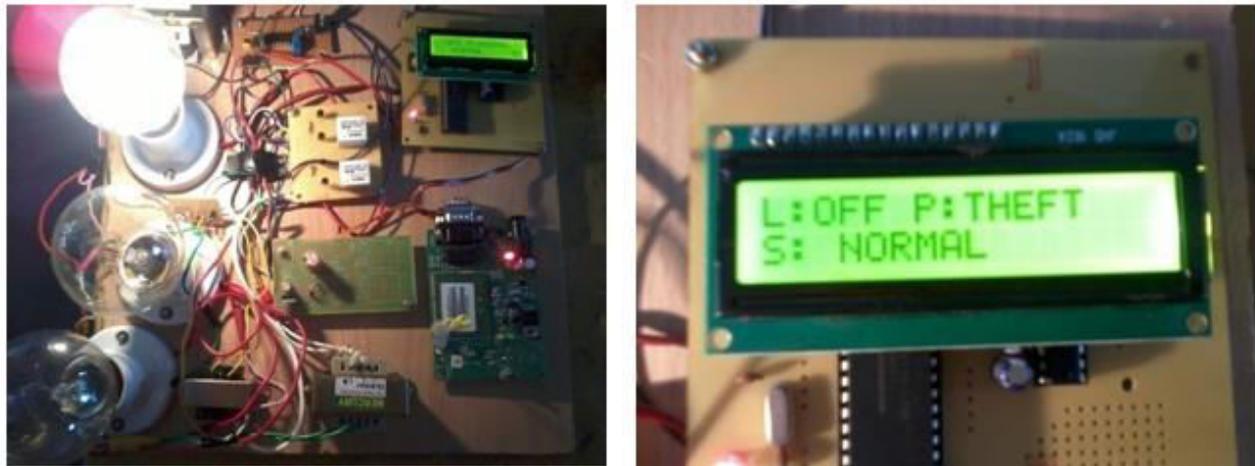
Figure: Hardware Model of Transmitter and its display

This project is based on microcontroller programming. The program is written in Embedded C language and is converted into Hex file which is loaded into the microcontroller through Win PIC flash programmer. After compiling program in µcontroller flash compiler, it is loaded into PIC 16F877A microcontroller with the help of universal program burner kit FP8903 programmer which is connected to computer. After successful program burning, microcontroller becomes ready for use. In testing, after successful program loading, microcontroller is mounted on its base and hardware becomes ready for testing. If there is any short circuit in the transformers, if any theft occurred, if lights are kept glowing in day time all these faults are displayed in the LCD as shown above. The above snapshot of transmitter shows the message in the LCD as **L: OFF P: THEFT S: NORMAL**.

The purpose of displaying this message is that the public can also view the status of the transformer.
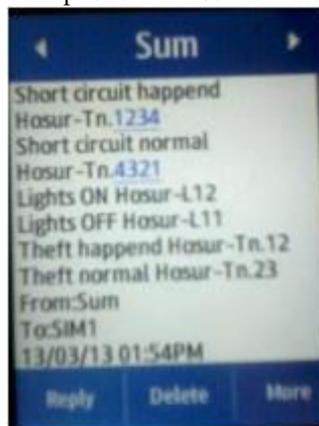
Figure: Mobile Phone as Receiver

The receiver side snapshot is shown in the mobile phone. The received information will contain the location and ID number of the transformer in which the fault is happened.

VI.CONCLUSION

In rural areas people suffer due to existing problem because they are not aware of power cut problems and also power thefts are in practice which the government does not know. By implementing our system these problems are automatically detected using GSM. Power wastage is more when street lights are kept on glowing even in the morning. So this can be minimized by our system by automatic ON/OFF of street lights using LDR concept. With our proposed system we can provide better service and customer satisfaction to the public.

In our proposed system we had used GSM technology to transmit the status of the transformer. The status of the transformer can be transmitted using 3G and 4G technology as a future enhancement along with the detection of additional parameters like temperature and oil level of the transformer.

REFERENCES

[1] Jong-Wook Kim, Byung Koo Park, SeungCheolJeong, SW.Kim, Poo Gyeon Park, "Fault Diagnosis of a Power Transformer Using an Improved Frequency-Response Analysis," IEEE Trans. Power Del., vol. 20, no. 1, Jan. 2005.

[2] W. J. McNutt, W. M. Johnson, R. A. Nelson, R. E. Ayers, "Power Transformer Short-Circuit Strength-Requirements, Design, and Demonstration," Power Apparatus and Systems, IEEE Transactions on, vol. PAS-89, pp. 1955-1969, 1970.

[3] Vadirajacharya.K, Ashish Kharche, Harish Kulakarni, Vivek Landage, ''Transformer Health Condition Monitoring Through GSM Technology'' International Journal of Scientific & Engineering Research Volume 3, Issue 12, December-2012.

[4] Denardin, Gustavo.W ''An intelligent system for street lighting monitoring and control'' Power Electronics Conference, 2009. COBEP '09. Brazilian.

[5] M. Florkowski, J. Furgal, "Identification of winding faults in electric machines using a high frequency method," 2007 IEEE International Coneference on Electric Machines & Drives, IEMDC '07, pp. 590-595.

[6] M. Wang, A. J. Vandermaar,K. D. Srivastava, "Improved detection of power transformer winding movement by extending the FRA high frequency range," IEEE Trans. Power Del., vol. 20, pp. 1930-1938, 2005.

[7] M. Wang, A. J. Vandermaar. K.D.Srivastava, "Transformer winding movement monitoring in service-key factors affecting FRA measurements," IEEE Electrical Insulation Magazine, vol. 20, pp. 5-12. 2004.

[8] AT Commands GSM Reference Guide, Revision A. 2003.

[9] Bajjuri Praneeth Kumar & Boda Vamsee Krishna Babu, "SMS Remote Controller" paper presented in Embedded System –Fall 2005.

[10] Ali Kazemi & Casper Labuschagne ,"Protecting Power Transformers from Common Adverse Conditions", paper presented at the Ga-Tech and the Western Protective Relay Conferences, New Berlin" in 2005.