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Design and Construction of an Automatic Load Monitoring System on a Transformer in Power Distribution Networks.

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ABSTRACT

The research aims to design and implement an automatic loading monitoring system on a distrition on a transformer, This research work presents design and the prototype of a single functional model device that can be used to monitor transformer load on a given line and switch off the line in case of detected overloading activity on that very line. This ensures that only the line causing overload is switched off without switching off or shutting down the entire power equipment. The device model shows the load status on each line being monitored and trip the line seen causing the overload using power relays. The trip information notification is then sent to the technical team in form of SMS to alert them that transformer x has open on overload. The trip data is then displayed on the display. Various components have been assembled to ensure that the system work effectiively and reliably. Proper means of protection and communication has been employed to ensure discrimination and timely communication. Distribution companies can easily configure this automatic load monitoring device on a distribution transformer at the time it’s installation.
Keywords: GSM, ATMEGA, AVR, enhanced architecture),active low module and pin pulling.

INTRODUCTION

Distribution transformer is an essential component in the power distribution system [1,2,3,4]. Failure of distribution transformers causes capital loss, customers dissatisfaction and loss of revenue to the nation. With the increasing loads, voltages and short circuit duty of the distribution substation feeders, distribution over current protection has become more important today than it was even 10 years ago [5,6,7,8,9]. The ability of the protective equipment to minimize damage when failures do occur and also to minimize service interruption time is demanded not only for economic reasons but also because the general public just expects "Reliable" service. In distribution transformers, the loading on the secondary side increases sometimes due to increased power consumption, faults on the low voltage distribution networks which goes beyond the designed current provided by the manufacturer as the maximum load of the transformer [10,11,12,13]. Due to this, load draws more current from transformer than its rated value and if proper protection is not provided against this overload current, then it damages the transformer windings insulation, leading to its failure. A series-connected high range current-limiting circuit breaker must be installed to protect the transformer from damages due to overloading by instantaneous tripping [14,15,16,17,18,19]. However, it should withstand the initial magnetizing inrush current and should not trip during that period. Additional devices, such as thermaloverloadalarms/relays and sud den-pressure relays, are also available for protection of transformers. These are typically specified with the transformer itself and can provide very good protection. However, even if these devices are installed the primary and secondary overcurrent devices must be coordinated with the transformer. All the distribution transformers in umeme networks are given location numbers which make each one of them unique in their identification [20,21,22]. The unique identification numbers and the design loading information for each transformer is then send and programmed in the system such that each time the preset value is exceeded the trip signal is triggered to open the circuit from the transformer windings so that the transformer is safe from overload.The trip information notification is then sent to the technical team inform of SMS to alert them that transformer X has open on overload. The trip data will be displayed on the display. Various component has been assembled to ensure that system works effectively and reliably. Proper means of protection and communication has been employed to ensure discrimination and timely communication.

Objective

To design and construct an automatic load monitoring and switching control system on a distribution transformer.

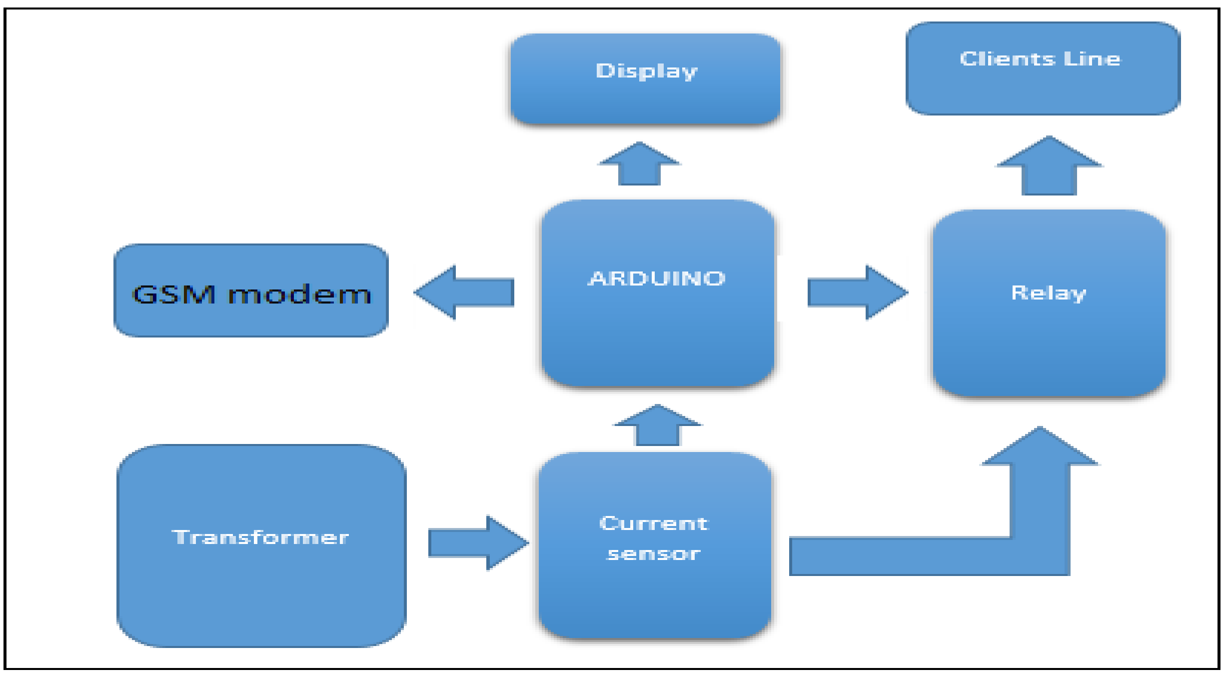
Specific objectives

To study the current methods used in transformer load monitoring and safety switching.

To develop a functional model of an automated load monitoring and switching control system on distribution transformers.

To test the efficacy of the developed system.

Conceptual framework



METHODOLOGY

Study area and population

This project covered design and construction of distribution transformer load monitoring and line switching system concept. The system is meant to ensure that a given line causing the power equipment overload is switched off without shutting down the entire transformer. The system also enhanced safety of the power equipment from disasters like total shutdown/failure due to overloading.

Sample size

A single small transformer will be used to simulate the mode of operation of a distribution transformer. This will be tested with a single developed prototype to verify its response and reliability on monitoring the load and switching on overload.

Research design

The study utilized quantitative and descriptive research design by analyzing themes and sub-themes generated out of the interview questions. It was out of the response data that conclusions and recommendations were made.

Research methods

Observation

I visited places where transformer overloading is rampant. This helped understand how the utility company currently ensure safety of equipment from the overloading common in peak hours.

Interviews

Primary data was obtained using self-administered interview questions with the beneficiaries of the system. Data was collected through interview guides given to the respondents which include utility company technicians and domestic power users with structured questions in relation to the set objectives and research questions. The interview questions helped get statistical information in terms of costs and activity.

System construction

The schematic design was transferred to the breadboard and then tested for functionality. If it meets the performance specifications, then the design thereafter was transferred and firmly soldered onto the copper board.

Testing and validation

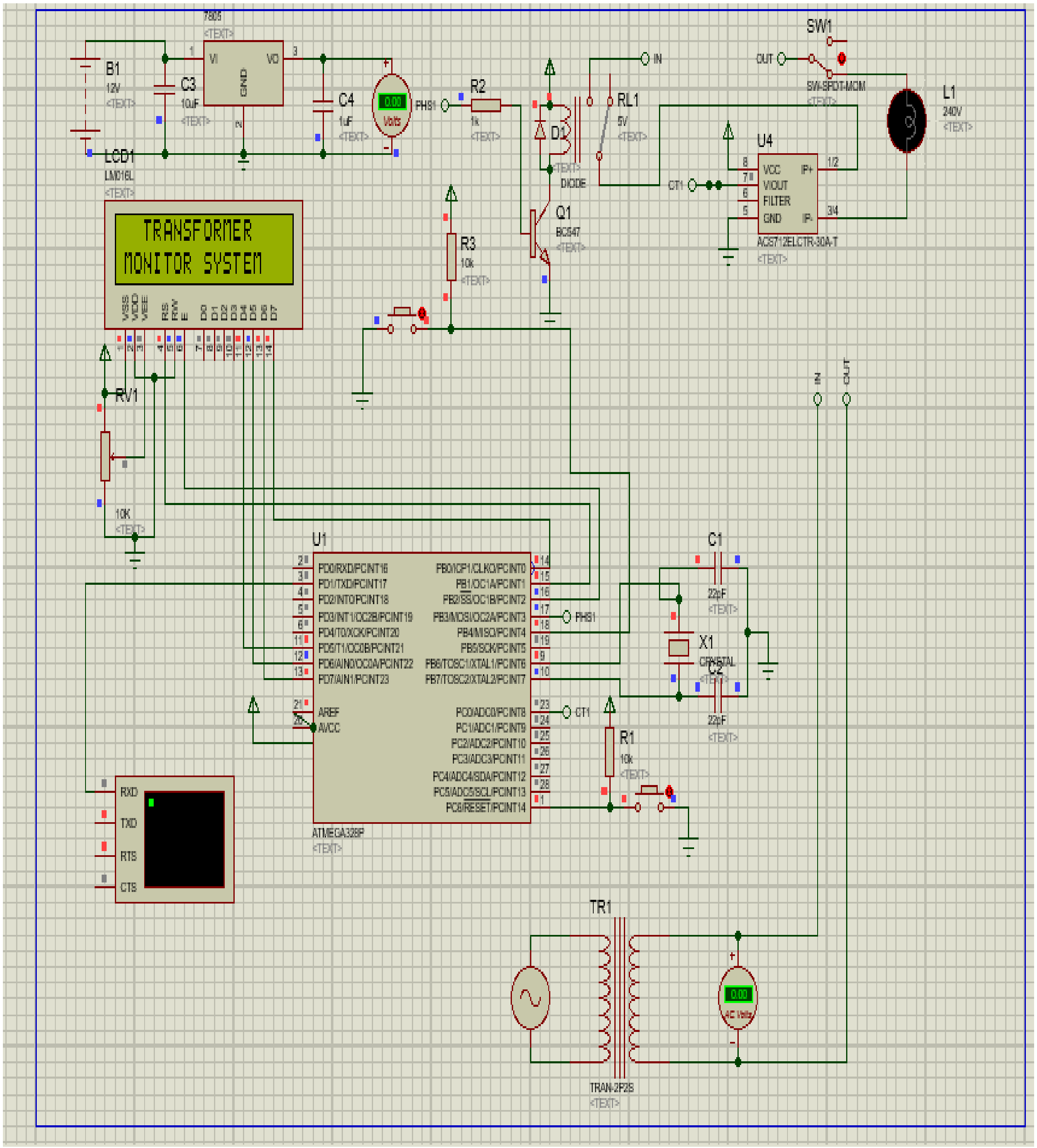
The system was tested immediately after construction to ensure that the functionality of the entire system was as per the objectives of the study defined.

Expected result

A single functional model of a device that can be used to monitor transformer load on a given line and switch off the line in case of detected overloading activity on that very line was obtained. This ensured that only the line causing overload is switched off without switching off or shutting down the entire power equipment. The device model showed the load status on each line being monitored and trip the lines seen causing the overload using power relays.

IMPLEMENTATION AND DESIGN

Project circuit



DESIGN

Components used:

SIM800l GSM modem:

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world.

Figure 1: SIM900 GSM modem

At the heart of the module is a SIM800L GSM cellular chip from SimCom. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LiPo battery supply. This makes it a good choice for embedding into projects without a lot of space. All the necessary data pins of SIM800L GSM chip are broken out to a 0.1″ pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 1200bps to 115200bps with Auto-Baud detection. The module needs an external antenna to connect to a network. The module usually comes with a Helical Antenna and solders directly to NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board. There's a SIM socket on the back! Any activated, 2G micro SIM card would work perfectly. Correct direction for inserting SIM card is normally engraved on the surface of the SIM socket.

LED Status Indicators

There is an LED on the top right side of the SIM800L Cellular Module which indicates the status of your cellular network. It'll blink at various rates to show what state it's in:

Blink every 1s: The module is running but hasn't made connection to the cellular network yet.

Blink every 2s: The GPRS data connection you requested is active.

Blink every 3s: The module has made contact with the cellular network & can send/receive voice and SMS.

Selecting Antenna

An antenna is required to use the module for any kind of voice or data communications as well as some SIM commands. So, selecting an antenna could be a crucial thing. There are two ways you can add an antenna to your SIM800L module. The first one is a Helical GSM antenna which usually comes with the module and solders directly to NET pin on PCB. This antenna is very useful for projects that need to save space but struggles in getting connectivity especially if your project is indoors.

Figure 2: SIM800L selecting Antenna

The second one is any 3dBi GSM antenna along with a U.FL to SMA adapter which can be obtained online for less than $3. You can snap-fit this antenna to small u.fl connector located on the top-left corner of the module. This type of antenna has a better performance and allows putting your module inside a metal case – as long the antenna is outside.

Figure 3 Selecting Antenna

Supplying Power for SIM800L module

One of the most important parts of getting the SIM800L module working is supplying it with enough power. Depending on which state it's in, the SIM800L can be a relatively power-hungry device. The maximum current draw of the module is around 2A during transmission burst. It usually won't pull that much, but may require around 216mA during phone calls or 80mA during network transmissions. Since SIM800L module doesn't come with onboard voltage regulator, an external power supply adjusted to voltage between 3.4V to 4.4V (Ideal 4.1V) is required. The power supply should also be able to source 2A of surge current, otherwise the module will keep shutting down. Here are some options you can consider to correctly power your GSM module.

SIM800L GSM Module Pinout

The SIM800L module has total 12 pins that interface it to the outside world. The connections are as follows:

Figure 4: SIM800L GSM Module Pinout

NET is a pin where you can solder Helical Antenna provided along with the module.
VCC supplies power for the module. This can be anywhere from 3.4V to 4.4 volts. Remember connecting it to 5V pin will likely destroy your module! It doesn't even run on 3.3 V! An external power source like Li-Po battery or DC-DC buck converters rated 3.7V 2A would work.
RST (Reset) is a hard reset pin. If you absolutely got the module in a bad space, pull this pin low for 100ms to perform a hard reset.
RxD (Receiver) pin is used for serial communication.
TxD (Transmitter) pin is used for serial communication.
GND is the Ground Pin and needs to be connected to GND pin on the Arduino.
RING pin acts as a Ring Indicator. It is basically the 'interrupt' out pin from the module. It is by default high and will pulse low for 120ms when a call is received. It can also be configured to pulse when an SMS is received.
DTR pin activates/deactivates sleep mode. Pulling it HIGH will put module in sleep mode, disabling serial communication. Pulling it LOW will wake the module up.
MIC± is a differential microphone input. The two microphone pins can be connected directly to these pins.
SPK± is a differential speaker interface. The two pins of a speaker can be tied directly to these two pins.

DC Buck Converter

Any 2A-rated DC-DC buck converter like LM2596 would work. These are much more efficient than a liner voltage regulator like LM317 or LM338.

Figure 5: DC Buck Converter

Warning: You should be very careful to not to disconnect the GND before the VCC and always connect GND before VCC. Otherwise the module can use the low voltage serial pins as ground and can get destroyed instantly.

ATMEGA328P-PU MCU:

The ATmega328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the Atmega328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

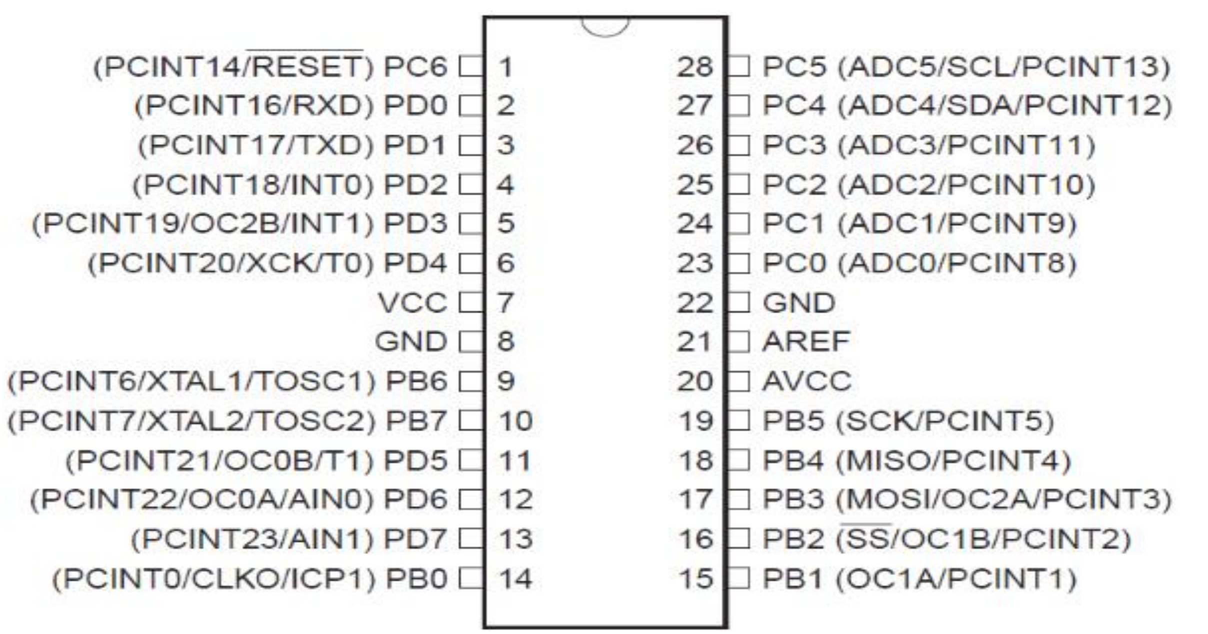


Figure 6: ATMEGA328P 28-DIP Top-view

The Atmega328P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption[12].

AVR reset

The AVR RESET mode is an active low module on RESET pin. Pulling the RESET pin HIGH disables the unwanted system resets. Pull-up resistors on the dW/(RESET) line must not be smaller than 10k (datasheet page 256). The pull-up resistor is not required for debug WIRE functionality. However, connecting the RESET pin directly to VCC will not work in disabling the reset mode.

Clock Sources

The device has the following clock source options, selectable by Flash Fuse bits as shown below. The clock from the selected source is input to the AVR clock generator, and routed to the appropriate modules.

Table 1: Device Clocking Options Select. Source: device datasheet

Device Clocking Option	CKSEL3...0
Low Power Crystal Oscillator	1111 - 1000
Full Swing Crystal Oscillator	0111 - 0110
Low Frequency Crystal Oscillator	0101 - 0100
Internal 128kHz RC Oscillator	0011
Calibrated Internal RC Oscillator	0010
External Clock	0000
Reserved	0001

Note: 1. For all fuses "1" means unprogrammed while "0" means programmed.

The device is shipped with internal RC oscillator at 8.0MHz and with the fuse CKDIV8 programmed, resulting in 1.0MHz system clock. The startup time is set to maximum and time-out period enabled. (CKSEL = "0010", SUT= "10", CKDIV8 = "0"). The default setting ensures that all users can make their desired clock source setting using any available programming interface.

Low Power Crystal Oscillator

Pins XTAL1 and XTAL2 are input and output, respectively, of an inverting amplifier which can be configured for use as an On-chip Oscillator.

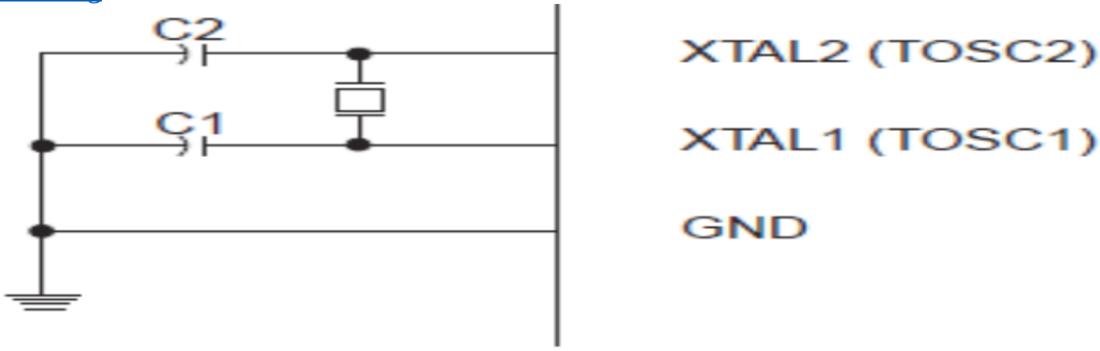


Figure 7: Crystal Oscillator Connections:

Either a quartz crystal or a ceramic resonator may be used. This Crystal Oscillator is a low power oscillator, with reduced voltage swing on the XTAL2 output. It gives the lowest power consumption, but is not capable of driving other clock inputs, and may be more susceptible to noise in noisy environments. C1 and C2 should always be equal for both crystals and resonators. The optimal value of the capacitors depends on the crystal or resonator in use, the amount of stray capacitance, and the electromagnetic noise of the environment. Some initial guidelines for choosing capacitors for use with crystals are given below:

Table 2: Low Power Crystal Oscillator Operating Modes. Source: Table 9-3 on Page 30 of device datasheet.

Frequency Range (MHz)	Recommended Range for Capacitors C1 and C2 (pF)	CKSEL3...1[1]
0.4 - 0.9	–	100[2]
0.9 - 3.0	12 - 22	101
3.0 - 8.0	12 - 22	110
8.0 - 16.0	12 - 22	111

For ceramic resonators, the capacitor values given by the manufacturer should be used.

Power supply design:

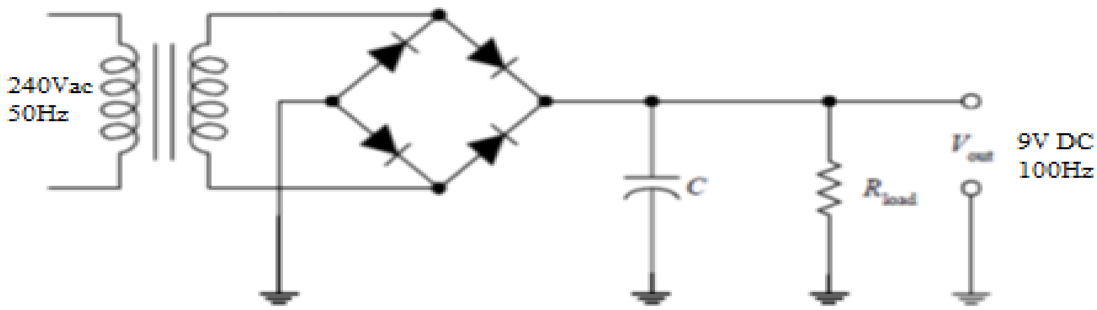


Figure 8: 240Vac to 9Vdc circuit

By using a transformer and a full-wave bridge rectifier, a simple ac-to-dc power supply has been constructed. The transformer acts to step down the voltage, and the bridge rectifier acts to convert the ac input into a pulsed dc output. A filter capacitor is then used to delay the discharge time and hence “smooth” out the pulses. If the above circuit is used in a power supply application, the capacitor must be large enough to store a sufficient amount of energy to provide a steady supply of current to the load. If the capacitor is not large enough or is not being charged fast enough, the voltage will drop as the load demands more current. A general rule for choosing C is to use the following relation:

RloadC >> 1/f

where f is the rectified signal’s frequency (120 Hz). The ripple voltage (deviation from dc) is approximated by

Vripple = Iload/fC

One explanation of 'smoothing' is that the capacitor provides a low impedance path to the AC component of the output, reducing the AC voltage across, and AC current through, the resistive load. In less technical terms, any drop in the output voltage and current of the bridge tends to be canceled by loss of charge in the capacitor. This charge flows out as additional current through the load. Thus the change of load current and voltage is reduced relative to what would occur without the capacitor. Increases of voltage correspondingly store excess charge in the capacitor, thus moderating the change in output voltage / current.The capacitor and the load resistance have a typical time constant $\tau = RC$, where C and R are the capacitance and load resistance respectively. As long as the load resistor is large enough so that this time constant is much longer than the time of one ripple cycle, the above configuration will produce a smoothed DC voltage across the load.

7805 Voltage regulator (12 DC power supply)

The L7805 series of three-terminal positive regulators is available in TO-220 TO-220FP TO-3 and D2PAK packages and 5V fixed output voltage, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. This regulator type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. The device outputs a stable 5V for any input in range of 7V to 18V DC.

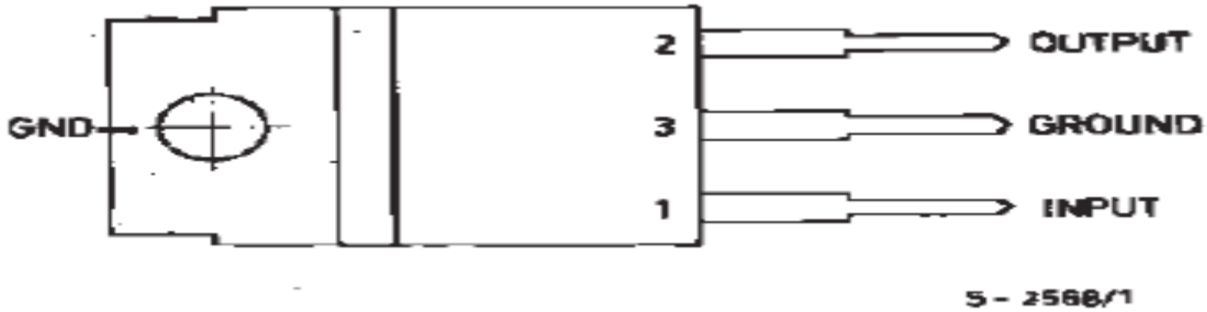


Figure 9: 7805 TOP VIEW

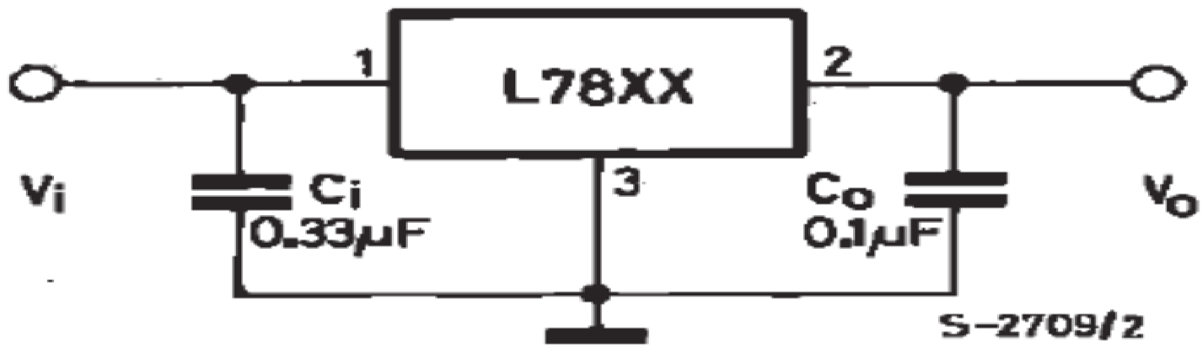


Figure 10: 7805 typical application circuit

Zener Diodes

A zener diode is a device that acts as a typical pn-junction diode when it comes to forward biasing, but it also has the ability to conduct in the reverse-biased direction when a specific breakdown voltage (VB) is reached. Zener diodes typically have breakdown voltages in the range of a few volts to a few hundred volts (although larger effective breakdown voltages can be reached by placing zener diodes in series).

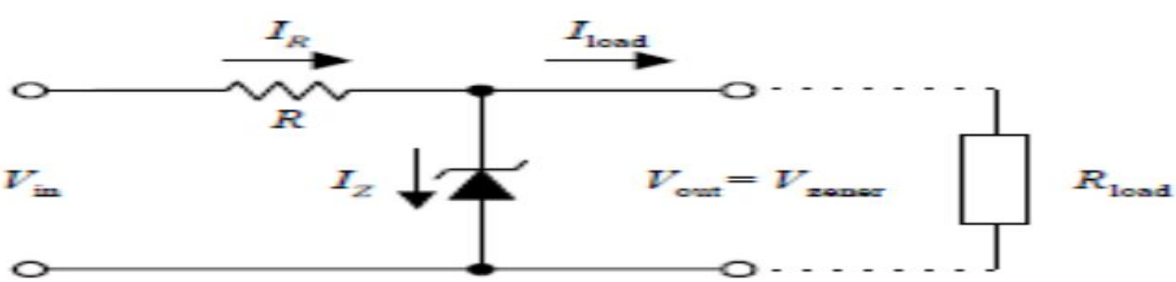


Figure 11: Zener diode as a voltage regulator

In this project design, a 5V zener diode is used to regulate the voltage supplied to a load. When Vin attempts to push Vout above the zener diode's breakdown voltage (Vzener), the zener diode draws as much current through itself in the reverse-biased direction as is necessary to keep Vout at Vzener, even if the input voltage Vin varies considerably.

Indicators LEDs:

This allows current to flow in only one direction. By convention, current can only flow from the anode (positive) to the cathode (negative). Current is what determines how bright a LED is. More current means more light. LED current should typically be between 10 to 20mA.Therefore a current limiting resistor is used to keep the bias current in the above range. When current flows through the LED; a forward voltage drop of about 1.6V will develop between its pins, depending on the current. So this of this resistor as a valve - reduce it to increase LED brightness, or increase it to limit wasted power in the circuit. Consider an LED at maximum brightness. To achieve this, a typical LED current required. Now we need to calculate the forward voltage drop across this diode with this current. Forward voltage drop is not just a function of current, but also LED color and temperature (because of the different LED chemistries) as shown in the table below.

Table 1: LED color PD definition

LED color	Potential difference/V
Infrared	1.6 V
Red	1.8 V to 2.1
Orange	2.2 V
Yellow	2.4 V
Green	2.6 V
Blue	3.0 V to 3.5 V
White	3.0 V to 3.5 V
Ultraviolet	3.5 V

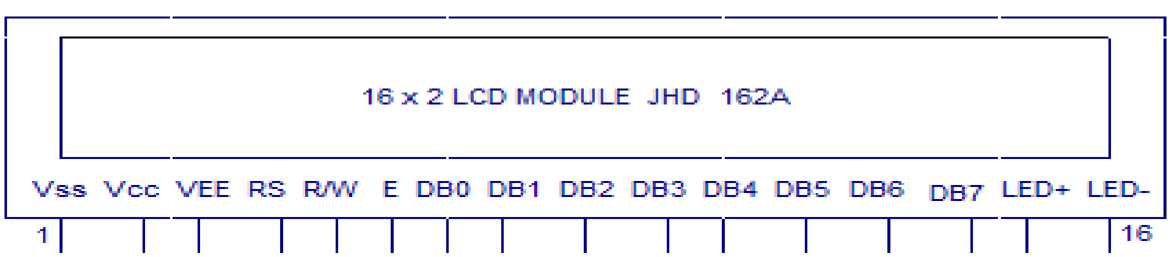
To keep the bias current in between 10 and 20mA, the following applies.
5V Supply generated by LM7805 chip has been used in this system.

Using Ohm's Law (V=IR)

(Voltage applied - Forward voltage drop) / Forward current = Resistor value (5V - vdV) / idA = Rd ohms . Where 5V is the applied voltage and idA is the forward bias current in amperes of the LED, vdV is the drop across the LED dependent on color and Rd is the current limiting resistor of the diode

LCD (JHD162A)

JHD162A is a 16×2 LCD module based on the HD44780 driver from Hitachi. The JHD162A LCD module has 16 pins and can be operated in 4-bit mode or 8-bit mode. Here we are using the LCD module in 4-bit mode. Before going in to the details of the project, let's have a look at the JHD162A LCD module. The schematic of a JHD162A LCD pin diagram is given below.



The name and functions of each pin of the 16×2 LCD module is given below.
Pin1(Vss):Ground pin of the LCD module.
Pin2(Vcc): Power to LCD module (+5V supply is given to this pin)
Pin3(VEE):Contrast adjustment pin. This is done by connecting the ends of a 10K potentimeter to +5V and ground and then connecting the slider pin to the VEE pin. The voltage at the VEE pin defines the

contrast. The normal setting is between 0.4 and 0.9V.

Pin4(RS):Register select pin.The JHD162A has two registers namely command registerand data register. Logic HIGH at RS pin selects data register and logic LOW at RS pin selects command register. If we make the RS pin HIGH and feed an input to the data lines (DB0 to DB7), this input will be treated as data to display on LCD screen. If we make the RS pin LOW and feed an input to the data lines, then this will be treated as a command (a command to be written to LCD controller – like positioning cursor or clear screen or scroll).

Pin5(R/W): Read/Write modes. This pin is used for selecting between read and write modes. Logic HIGH at this pin activates read mode and logic LOW at this pin activates write mode.

Pin6(E): This pin is meant for enabling the LCD module. A HIGH to LOW signal at this pin will enable the module.Pin7(DB0) to Pin14(DB7): These are data pins. The commands and data are fed to the LCD module though these pins. Pin15(LED+): Anode of the back light LED. When operated on 5V, a 560 ohm resistor should be connected in series to this pin. In arduino based projects the back light LED can be powered from the 3.3V source on the arduino board.Pin16(LED-): Cathode of the back light LED. RS pin of the LCD module is connected to PB1. R/W pin of the LCD is grounded. Enable pin of the LCD module is connected to PB2. In this project, the LCD module and AVR controller are interfaced in the 4-bit mode. This means only four of the digital input lines(DB4 to DB7) of the LCD are used. This method is very simple, requires less connections and you can almost utilize the full potential of the LCD module. Digital lines DB4, DB5, DB6 and DB7 are interfaced to digital pins PD5, PD6, PD7, and PB0. The 10K potentiometer is used for adjusting the contrast of the display.

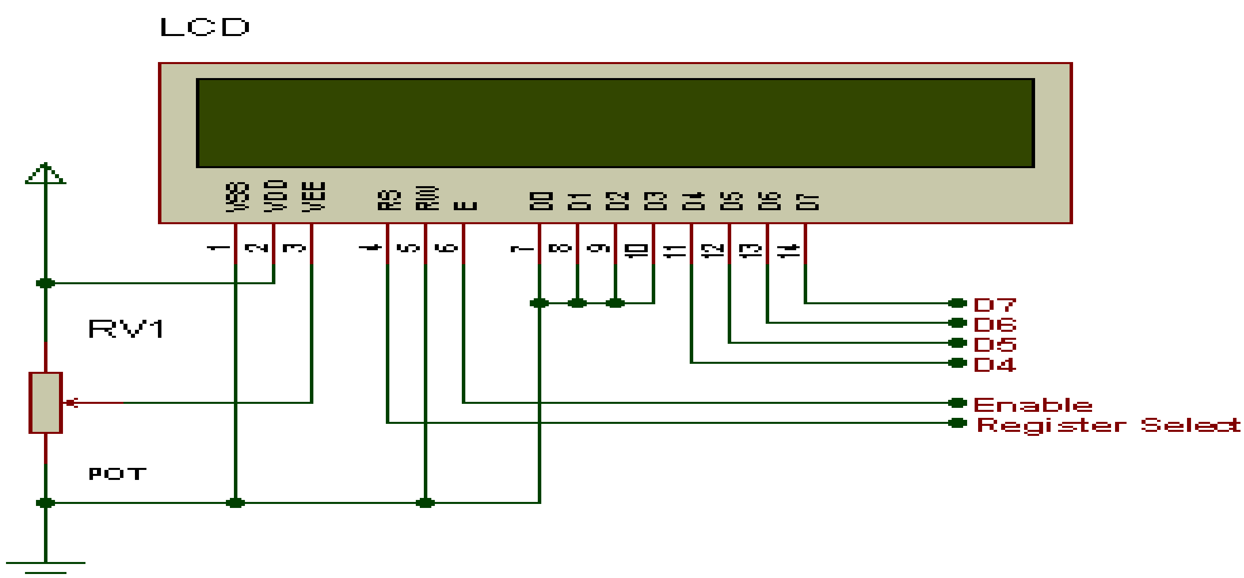


Figure 12: LCD interface circuit

ACS712 Current sensor

The cool thing about an ACS712 is that current is measured is measured in two directions. What this means is that if we sample fast enough and long enough, we sure to find the peak in one direction and the peak in another direction.

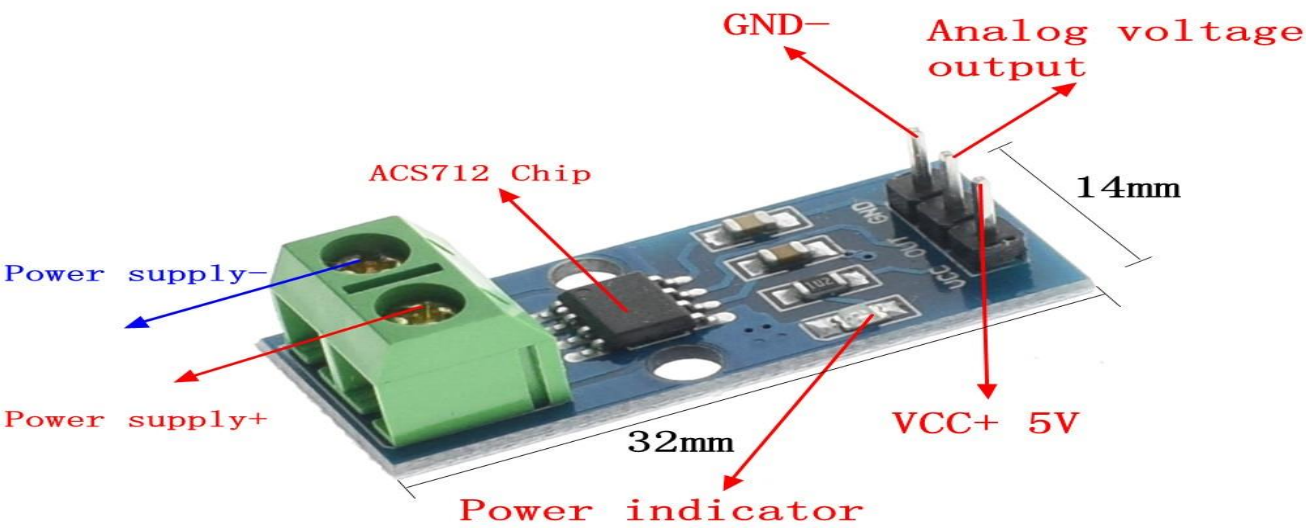
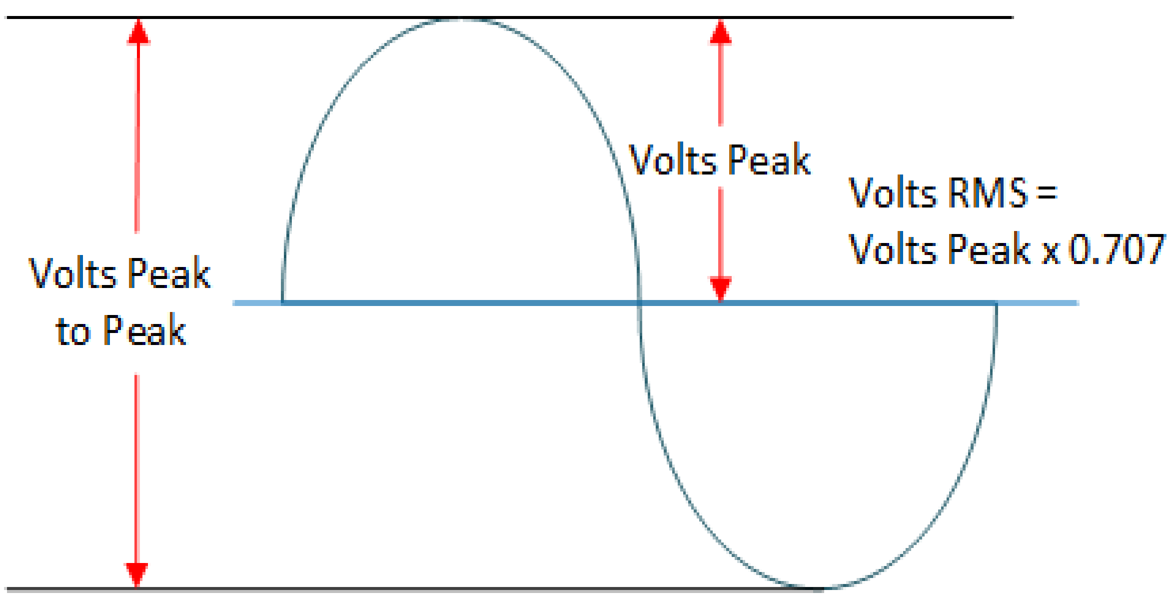


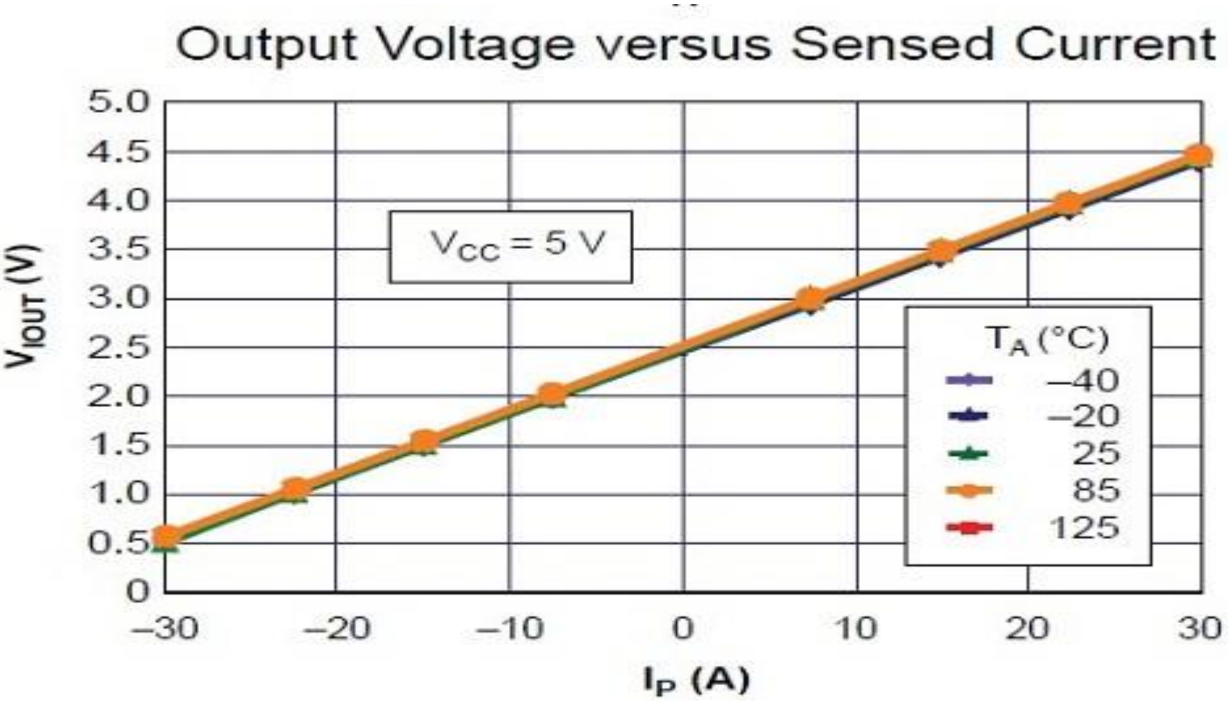
Figure 13: ACS712 Current sensor

With both peaks known, it is a matter of knowing the shape of the waveform to calculate the current. In the case of line or mains power, we know that waveform to be a SINE wave. Knowing that allows us to apply a basic electronic formula to yield a decent result.

In most cases, an expression of AC current will be in a value known as RMS. In order to use the ACS712 current sensor to measure AC current, it is important to understand how to calculate an RMS current value from the device readings.



With an ACS712, current measurements are reported with a voltage output. In this tutorial, we calculated the RMS volts and applied the ACS712 scale factor.



Conversion for a sine wave with a zero volt offset (like your mains or line power) is performed as follows

1) Find the peak to peak voltage (Volts Peak to Peak)
2) Divide the peak to peak voltage by two to get peak voltage (Volts Peak)
3) Multiply the peak voltage by 0.707 to yield rms volts (Volts RMS)

Having Calculated RMS voltage, is simply a matter of multiplying by the scale factor of the particular ACS712 to yield the RMS value of the current being measured. The values out of the ACS712 are constantly changing when measuring AC Current. In order ensure that you have come very close to finding the peaks, you need to sample fast enough and long enough. Because mains or line power is at a frequency of 50 to 60 Hz, the Arduino will be fast enough provided it takes consecutive samples with little or no interruption. For ASC712 VCC - 5V, when there is no current flowing through the IP+ and IP- terminals, the output voltage at VIOUT of ACS712 is 2.5V (Offset). Now, in order to calculate the current, divide this value with the sensitivity of the sensor (185mV/A for 5A Sensor, 100mV/A for 20A Sensor and 66 mV/A for 30A Sensor).

A dc Value = analog Read (current Pin);
A dc Voltage = (a dc Value / 1024.0) * 5000;
Current Value = ((a dc Voltage – offset Voltage) / sensitivity);

Loading of transformer

Load modelling of a transformer is an integral part of many studies in power engineering. Load profiles are among some of the most challenging models to develop. This is due to the ever-changing nature and unpredictability in end-use behaviour. To develop accurate demand curves, load forecasts employing decades of data as well as economic and sociological trends have to be undertaken. Statistical methods may then be employed to probabilistically predict variations in demand curves.

Transformer rating and maximum design loading for different transformer sizes in amperes(a).

Formulae.

$$P=\sqrt{3}I_LV_L.$$

$$I_L= P/\sqrt{3}V_L.$$

Where VL=433V

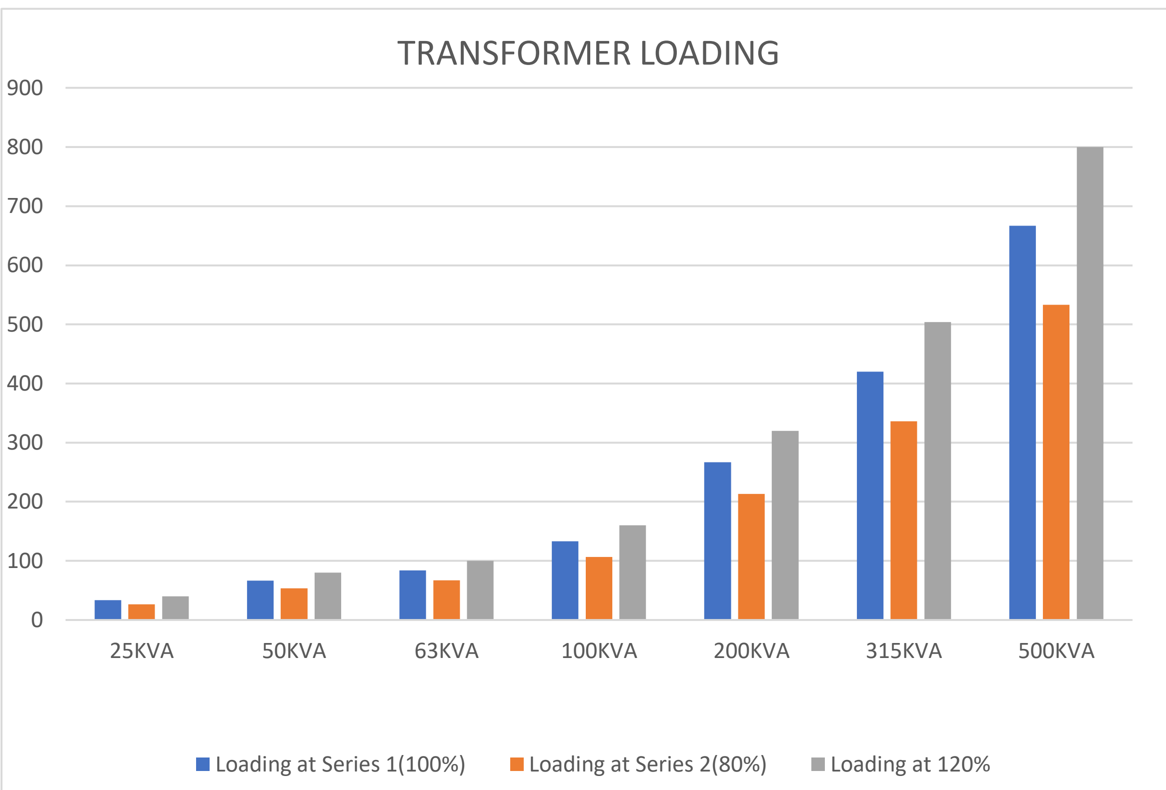
$$\sqrt{3}=1.7321$$

For 25kva transformer.

IL= P/√3VL.
25*10^3/ (1.7321*433) =33.33A
For 50kva transformer.
IL=P/√3VL.
50*10^3/ (1.7321*433) =66.67A
For 63kva transformer.
IL=P/√3VL.
63*10^3/ (1.7321*433) =84a
For 100kva transformer.
IL= P/√3VL.
100*10^3/ (1.7321*433) =133.33A
For 200kva transformer.
IL= P/√3VL.
200*10^3/ (1.7321*433) =266.67A
For 315kva transformer.
IL= P/√3VL.
315*10^3/ (1.7321*433) =420A
For 500kva transformer.
IL= P/√3VL.
500*10^3/ (1.7321*433) =666.67A

Table of transfomer rating and maximum for different tx sizes.

	Tx rating	Maximum Loading in (Amp) at 100%	Loading in (Amp) at 80%
1	25KVA	33.33A	26.664A
2	50KVA	66.67A	53.336A
3	63KVA	84A	67.2A
4	100KVA	133.33A	106.664
5	200KVA	266.67A	213.336A
6	315KVA	420A	336A
7	500KVA	666.67A	533.336A



DISCUSSION

This project presents the overall design and implement an automatic loading monitoring system on a distrition on a transformer, This work presents design and the prototype of a single functional model device that can be used to monitor transformer load on a given line and switch off the line in case of detected overloading activity on that very line. This ensures that only the line causing overload is switched off without switching off or shutting down the entire power equipment. The device model shows the load status on each line being monitored and trip the line seen causing the overload using power relays. The trip information notification is then sent to the technical team in form of SMS to alert them that transformer x has open on overload. The trip data is then displayed on the display.

RECOMMEDATIONS

Training of all people expected to use and instal the device on the transformers The system need internet connectivity in orderto be acessible anywhere, any time. The user companies can as well have dedicated control rooms for controlling the system for safety reasons

CONCLUSION

The prime objective of this project is to monitor an over load in the system. By of current sensors , Then cut off the overloaded line leaving the other lines safe and supplying electricity to their locationssthis project uses current sensors, Arduino and relays to cut off overloaded line. In this way ,automation process is carried out. This is a simple prototype. Using this as areference further it can be expended to many otherprograms.

REFERENCES

1) ABB user's manual, (2007) Readings are very different from the ones obtained in normal conditions, it is necessary to perform a careful revision
2) Alessandro Ferrero, (2008) the design of an automation system based on microcontroller which continuously monitors the transformer and be able to determine the cause of the fault if any from the above mentioned fault parameters
3) Antonio Ginart (2012) ultimate link between high voltage transmission systems and consumer services
4) Argonne National Laboratory, (2006). Power starts from the transmission grid at distribution substations where the voltage is stepped-down (typically to less than 10kV) and carried by smaller distribution lines to supply commercial, residential, and industrial users
5) Carreras, B. A. (2003) protection relays usually operate to isolate the faults from the power system. Overload, by contrast, is current drawn by load, a load current in excess of the transformer name-plate rating
6) Cross, F. L., and Hesketh, H. E. (1975). The key to any monitoring program is establishing an adequate baseline of acceptable ranges that is used as a reference point.
7) Electricity Regulation Authority. Sharing electricity sector achievements and challenges with Uganda energy Journalists Association. http://www.era.or.ug/Pdf/UEJAWorkshop201708-2012-20CEO27s.pdf.
8) Pudlo, G. (2002). Introgration of Power transformer monitoring and overload calaculation into the power system control sufrace"
9) Gohn, B. Strategic deployment document of the European smart grid technology platform. .http://setis.ec.europa.eu/newsroomitemsfolder/ smartgrids-strategic-deployment-document-finalised.
10) Humberto, J. (2006) the power is distributed to different customers from the distribution system through feeders, distributors and service mains
11) International Energy. Agency. Smart technology roadmap smart grids.

http://www.iea.org/papers2011/smartgridsroadmap.pdf
12) Jyotishman Pathak, (2006). Novel electric power systems encompassing of power transmission and distribution grids consist of copious number of distributed, autonomously managed, capital-intensive assets
13) Daponte, P. (2004). It necessitates a monitoring system that is able to automatically detect, monitor, typify and classify the existing constraints on electrical lines
14) Regulation Authority. Developments and investment opportunities in renewable energy resources in Uganda. http:// www.era.or.ug.
15) Sen Ouyang and Jianhua Wang, (2007). inadequacy in the protection, monitoring and control of a power system, the system might become unstable
16) Soma, S. S., Depuru, R., Wang, L. and Devabhaktuni, V. (2011). Smart meters for power grid: Challenges, issues, advantages and status. Renewable and Sustainable Energy Reviews.
17) [18] Study of electricity tariffs used in Africa. http://www.updeaafrica.org/updea/docword/tarifang2 010.pdf.
18) Vadirajachar, K. (2016). Stated that "if oil level decreases beyond required level, it affects cooling and insulation of a transformer"
19) Zhi, H. (2002). Current increases the hottest-spot and thereby decreases the insulation life span.
20) Masisani William Mufana and Adabara Ibrahim (2022). Overview of Smart Grid: A Review. *IDOSR Journal Of Computer and Applied Sciences* 7(1):33-44.
21) Masisani William Mufana and Adabara Ibrahim (2022). Monitoring with Communication Technologies of the Smart Grid. *IDOSR Journal Of Applied Sciences* 7(1) 102-112.
22) Nabiryo Patience and Itodo Anthony Ejeh (2022). Design and Implementation of Base Station Temperature Monitoring System Using Raspberry Pi. *IDOSR Journal of Science and Technology* 7(1):53-66.