

**AUTOMATIC LOAD SHARING BY PARALLEL TFRANSFORMER**

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**ABSTRACT**

Transformer is basically a static device which transfers the electrical power from one circuit to another circuit with desired change in voltage and current at constant frequency. It is only one device which operates at highest efficiency at full load condition. But abnormal condition occurs at overloading condition which may result in severe problem in future.

To avoid such condition we are using other standby transformer which supplies the load when overloading occurs on main transformer unit, which switch on automatically by Arduino. This will result in efficient loading of both transformers. Also when load is normal both transformers can be switched on to supply the load alternately. This will avoid the thermal overloading of transformer. Also this arrangement will provide proper maintenance facility for both transformers.

**Keywords:** *load sharing, overloading, transformer*

**INTRODUCTION**

Transformer is a static device which transfers the electrical power from one circuit to another circuit with desired change in voltage and current at constant frequency. Transformer is only one device which operates at higher efficiency at full load condition. But some abnormal conditions occur at overloading conditions. Also transformer efficiency gets reduced due to increased heating and increased losses. So it is very essential to share this load other transformer or replace the transformer of higher rating. Later technique is not feasible economically so the first technique is practically employed to supply load efficiently.

We are employing the first technique to supply the load efficiently and reliably. To accomplish this requirement there is one method of manual approach. In this other transformer is connected manually during heavy loading condition. But practically manual approach is not efficient. So we are employing Arduino to make the switching of transformer automatically. Arduino is an automation based microcontroller device which will automatically switch the transformer into circuit when overloading condition occur for transformer one. Thus this will result in efficient working of both transformers. Also when load is constant both transformers are switched on into the circuit alternately. This will avoid continuous heating of only one transformer. This arrangement offers proper maintenance facility for both transformers. All this advantages will make this system very efficient.

**OBJECTIVE**

The main aim of the project is to protect the Transformer under overload condition by sharing load with a Standby transformer and to provide uninterrupted power Supply to the consumers

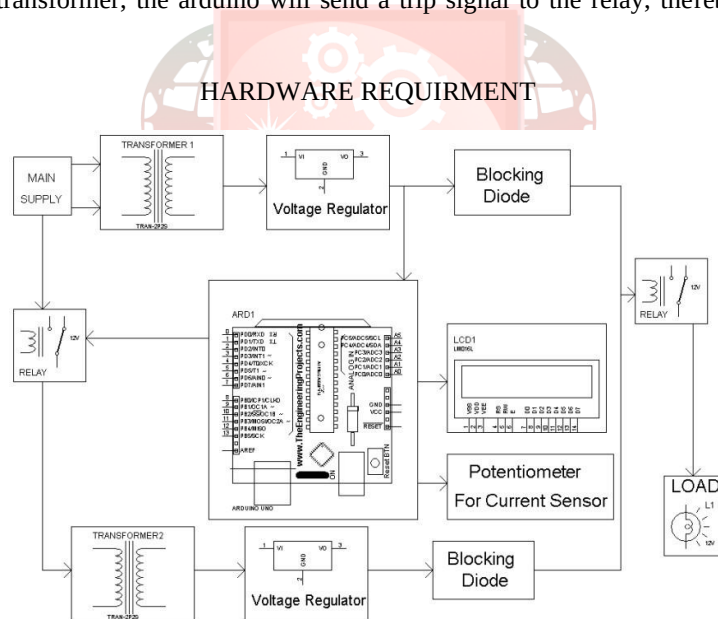
**LITERATURE REVIEW**

Rekha. T, Bindu Prakash, Asna. S, Dinesh. Sand Nandana. S.Prasad (2015), Distribution transformers are an important part of power system which distributes power to the low- voltage users directly, and its operation condition is important for the entire distribution network operation. However, their life is significantly reduced if they are subjected to overloading and over temperature resulting in unexpected failures and loss of supply to a large number of customers thus effecting system reliability. Protection against fault in power systems is very essential and vital for its reliable performance. This project is a

simplified approach to protect the transformers from unusual conditions. For this purpose two similar types of distribution transformers are used so that, if any one transformer fails, then immediately another transformer is brought into the circuit during over loading, over temperatures, input voltage variations and provides conventional 230V supply to the consumers without burning of transformers. Most of the loads (e.g. Induction motors, arc lamps) are inductive in nature and hence have low lagging power factor. The low power factor is highly undesirable as it causes an increase in current, resulting in additional losses of active power in all the elements of power system from power station generator down to the utilization devices. So in this paper an automatic power factor correction circuit is also incorporated with the load sharing module.

## METHODOLOGY

Transformer-T1 is a main transformer we called it a master transformer and transformer-T2 Each transformer has its own load handling capacity. In case of a normal operation the master transformer shares the load but as the load is beyond the rated capacity of main transformer the slave transformer is connected in parallel automatically and shares the load. A sensor circuit containing microcontroller, current transformer etc. is designed to log the data from master transformer and if it is found to be in overload condition, immediately the slave transformers will be connected in the parallel to the master transformer and the load is shared. Whenever loads are added to the secondary side of the transformer, the current at the secondary side rise. As the load current exceeds the rated current rating of the transformer, the arduino will send a trip signal to the relay, thereby turning on the slave transformers



## ARDUINO

1. LCD DISPLAY
2. RELAY

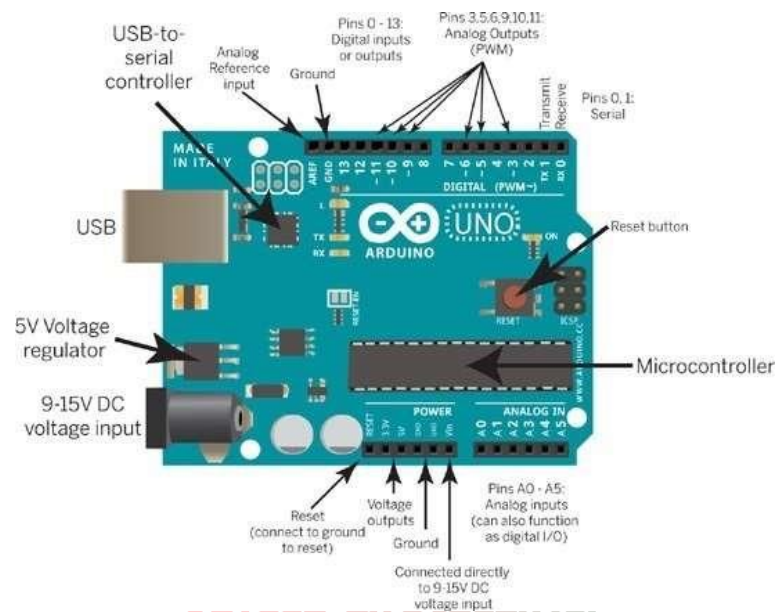
## ARDUINO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible pack

The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. We'll talk about what's on it and what it can do later in the tutorial.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.



Arduino Pin Diagram

A typical example of Arduino board is Arduino Uno. It consists of ATmega328- a 28 pin microcontroller.

### Atmega168 Pin Mapping

| Arduino function    | ATmega168 Pin            | ATmega168 Pin | Arduino function       |
|---------------------|--------------------------|---------------|------------------------|
| reset               | (PCINT14/RESET) PC6      | 28            | PC5 (ADC5/SCL/PCINT13) |
| digital pin 0 (RX)  | (PCINT16/RXD) PD0        | 27            | PC4 (ADC4/SDA/PCINT12) |
| digital pin 1 (TX)  | (PCINT17/TXD) PD1        | 26            | PC3 (ADC3/PCINT11)     |
| digital pin 2       | (PCINT18/INT0) PD2       | 25            | PC2 (ADC2/PCINT10)     |
| digital pin 3 (PWM) | (PCINT19/OC2B/INT1) PD3  | 24            | PC1 (ADC1/PCINT9)      |
| digital pin 4       | (PCINT20/XCK/T0) PD4     | 23            | PC0 (ADC0/PCINT8)      |
| VCC                 | VCC                      | 22            | GND                    |
| GND                 | GND                      | 21            | AREF                   |
| crystal             | (PCINT6/XTAL1/TOSC1) PB6 | 20            | AVCC                   |
| crystal             | (PCINT7/XTAL2/TOSC2) PB7 | 19            | PB5 (SCK/PCINT5)       |
| digital pin 5 (PWM) | (PCINT21/OC0B/T1) PD5    | 18            | PB4 (MISO/PCINT4)      |
| digital pin 6 (PWM) | (PCINT22/OC0A/AIN0) PD6  | 17            | PB3 (MOSI/OC2A/PCINT3) |
| digital pin 7       | (PCINT23/AIN1) PD7       | 16            | PB2 (SS/OC1B/PCINT2)   |
| digital pin 8       | (PCINT0/CLKO/ICP1) PB0   | 15            | PB1 (OC1A/PCINT1)      |
|                     |                          |               | digital pin 9 (PWM)    |
|                     |                          |               | digital pin 10 (PWM)   |
|                     |                          |               | digital pin 11 (PWM)   |
|                     |                          |               | digital pin 12         |
|                     |                          |               | digital pin 13         |
|                     |                          |               | VCC                    |
|                     |                          |               | analog reference       |
|                     |                          |               | GND                    |
|                     |                          |               | analog input 0         |
|                     |                          |               | analog input 1         |
|                     |                          |               | analog input 2         |
|                     |                          |               | analog input 3         |
|                     |                          |               | analog input 4         |
|                     |                          |               | analog input 5         |

Digital Pins 11, 12 & 13 are used by the ICSP header for MOSI, MISO, SCK connections (Atmega168 pins 17, 18 & 19). Avoid low-impedance loads on these pins when using the ICSP header.

Arduino Uno consists of 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button

**Power Jack:** Arduino can be power either from the pc through a USB or through external source like adaptor or a battery. It can operate on a external supply of 7 to 12V. Power can be applied externally through the pin Vin or by giving voltage reference through the IOREf pin.

**Digital Inputs:** It consists of 14 digital inputs/output pins, each of which provide or take up 40mA current. Some of them have special functions like pins 0 and 1, which act as Rx and Tx respectively, for serial communication, pins 2 and 3-which are external interrupts, pins 3,5,6,9,11 which provides pwm output and pin 13 where LED is connected.

**Analog inputs:** It has 6 analog input/output pins, each providing a resolution of 10 bits.

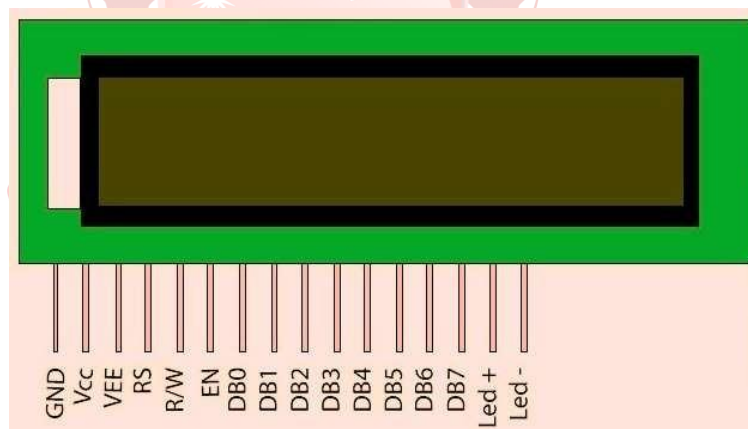
**ARef:** It provides reference to the analog inputs

**Reset:** It resets the microcontroller when low.

## LCD DISPLAY

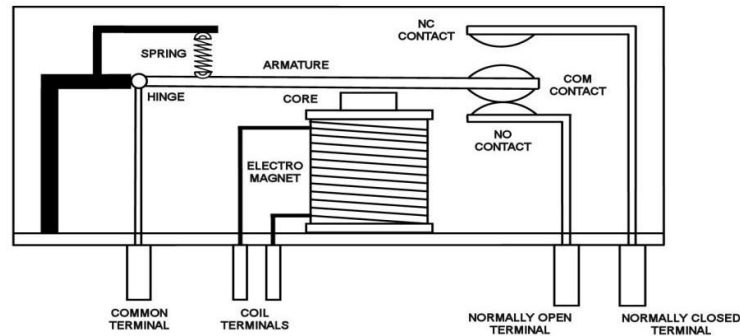
LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given



to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

## RELAY



A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB.

## TRANSFORMER

One of the main reasons that we use alternating AC voltages and currents in our homes and workplace's is that AC supplies can be easily generated at a convenient voltage, transformed (hence the name transformer) into much higher voltages and then distributed

The reason for transforming the voltage to a much higher level is that higher distribution voltages implies lower currents for the same power and therefore lower  $I^2R$  losses along the networked grid of cables. These higher AC transmission voltages and currents can then be reduced to a much lower, safer and usable voltage level where it can be used to supply electrical equipment in our homes and workplaces, and all this is possible thanks to the basic



## ADVANTAGES

1. The sharing of load in Transformer is automatically.
2. There are no manual error in operation.
3. It helps to be protected or be safe to the main transformer when load is high.
4. Continuously not disturbed supply is provided to the consumers.

## APPLICATIONS

1. This system can be used in Hostels and Hotels.
2. This system can be used in Offices
3. This technique is often utilized in industrial applications.
4. This system can be used in Electrical Substations.
5. This system can be used in power grids.
6. Un-interrupted power supply to the consumers is supplied.

## FUTURE SCOPE

1. The describes about how to use power force intelligently under peak loads. The design automatically connects and disconnects the motor therefore guarding motor from load. Seeing unit
2. Current motor plays an important part by seeing the current through the cargo and transferring feedback signal to the microcontroller
3. The switching process occurs in the Relay which automatically connects the motor in parallel in agreement to the cargo tasted by the CT. The unborn compass of our design is particularly in Substation.
4. In substations particularly during the peak hours there's a need for the operation of fresh motor to supply the fresh cargo demand. Our design automatically connects the motor under critical loads. Therefore there's no need to operate both mills under normal loads, particularly during off peak hours. Therefore power is participated intelligently with the mills in parallel.

## RESULTS

| SR. NO | LOAD IN %       | OUTPUT                        |
|--------|-----------------|-------------------------------|
| 1      | Load below 50%  | Transformer 1 is ON and 2 OFF |
| 2      | Load above 50%  | Both Transformer 1 And 2 ON   |
| 3      | Load Above 100% | Both Transformer are OFF      |

## CONCLUSION

In this project we observed that if load on one transformer is increases then the relay will sense the change in current & arduino operates & slave transformers comes automatically in operation to share the load. The work on “Automatic load sharing of transformers” is successfully designed, tested and a demo unit is fabricated for operating three transformers in parallel to share the load automatically with the help of change over relay and relay driver circuit and also to protect the transformers from overloading and thus providing an uninterrupted power supply to the customers.

By designing an Automatic load sharing transformer using arduino we have concluded that as we all know the transformer is the most important equipment in the power system, so its safety is very important. This project is about the importance of transformer load sharing so that the power that can be transferred is uninterrupted.

We observed that if the load on one transformer is increased then the relay will sense the change in current and the microcontroller operates and other transformers come automatically in operation to share the load and when the load decreases then again the relay will sense the change in current and the load distribute and share back to the single main transformer.



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