Arduino Based Smart Load control

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Abstract: *Power Failure in the power system is mainly due to the overloading. The possible damage to the area is losing a power. The Arduino Uno based load control system is a device which automatically control overload on generator by controlling power and cut-off supply whenever consumers exceeds the amount of power supplied for peak period. This is achieved by Arduino Uno, which detect overload and simultaneously cut-off the supply for the period of generator overloading. In this paper system can be automated into two stages are monitoring function and controlling function. In Monitoring function it has to record the meter reading at different location in the system, for normal as well as overload condition which is required for system planning. Distribution Supervisory control and Data Acquisition System (DSCADA) performs some of these monitoring function and controlling function about switching operation that is controlling of relay circuit breaker. The function Impacts on Consumer as well as reliability. The research work to be aimed at developing local full scale distribution automation system which can be control from secondary distribution substation to the consumer end. Power distribution automation expected for the broad areas. The project aimed at uninterrupted power supply for loyal energy consumer by implementation of this the problem of interruption off power supply due to energy misusing consumer can be avoided. This system provides the reliable operation at consumer end.*
Keywords: Generator; Arduino Uno; Load control.

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I. Introduction

In the power system the load is increased rapidly but the generation is constant so it can't be fulfill the consumer needs in future, for this reason researchers give attentions towards distributed power generation which is used in remote and rural areas. One major problem facing the generator is overloading by generator which affects on quality of power and efficiency of power system. [1]

Monitoring the feeder, substation, distribution transformer and distribution points from one central location it is hard to achieved. For the purpose of monitoring the system at consumer end from central unit, if any problem occur related to overloading the indication will be sent to the central unit. Also the theft is quite common at distribution points it is difficult to monitor that 24hrs. When there is overloading on the generator occur, the complete power of to the concern area will be cut-off [2]

Disconnection of the power connected to the load of the society through a various substation which are supplied by a power station for minimizing the load connected to the main power station. For that purpose the main station instructs the substation to cut-off the power the some of the feeders for certain time period. [3]

Inadequacy in the protection monitoring and control of the power system the system become unstable. The problem of overloading , voltage variation and heating effect are common which takes lots of time to repair and also the cost related to repairing is high .this is all about the protection purpose of generator for overloading condition that's why the monitoring system has to automatic detected monitor and classify existing limitation of generator . the system helps to protect the generator against the overload by different consumers at peak time who excides the maximum power demand and automatically disconnect that consumer's supply and also informs him by messaging .[1]

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India has a scarcity of electric power during peak-use periods. Most Indian utilities resort to load shedding (LS) to manage the peak demand. A review of US experience with direct load control and interruptible or time-of-use (TOU) tariffs shows successful programs. Direct load control of agricultural pumps, commercial air conditioners and interruptible or TOU tariffs in the industrial sector are identified as useful options for India. Implementation strategies for these are suggested. Load management (LM) by Indian utilities may provide a better solution to the current peak power shortage than mandatory LS.[5]

To provide continuous power in rural areas smart DG by using CPD based DSTATCOM indirect current control scheme is created for the utilization of more renewable energy and contributes for solving the load shedding problem which increases efficiency and decreased the cost of two level three phase DSTATCOM based WE DG system.[7]

II.   Literature Survey

2.1 Rekha.T, Bindu Prakash, Asna.S.Dinesh.Sand Nandana. S.Prasad (2015)

Distribution Transformer 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 system is very essentials and vital for its reliable performance. Thus project is a simplified approach to protect the transformer for unusual conditions. For the purpose two similar types of distribution transformer are used to that, if any one transformer is fails, then immediately another transformer is brought into the circuit during overloading over temperature, input voltage variations and provides conventional 230V supply to the consumers without burning transformers. Most of the loads are inductive in nature and hence low lagging power factor. The low power factor is highly undesirable as it cause 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.

2.2 Ashish R. Ambalkar, Nitesh M. Bhoyar Vivek V. Badarkhe and Vivek B. Bathe (2015)

The transformer is very costly and bulky equipment of power system. It operates for 24 hours of a day and feeds the load. Sometimes the situation may occur when the load on the transformer is suddenly increased above its rated capacity. When this situations occurs, the transformer will be overloaded and overheated and damage the insulation of transformer resulting in interruption of supply. The best solution to avoid the overloading is to operate the number of transformer in parallel. In this work, a slave transformer share the load of master transformer in case of overload and over temperature. A sensor circuit is design to log the data from master transformer and if it is found to be in overload condition, immediately the slave transformer will be connected in parallel to the master transformer and the load is shared. Initially when we switch ON the load that load will be shared by the first transformer. Once load has been increased on first transformer above its rated capacity then the stand by transformer will shared the load automatically. In this we are used a relay and comparator IC's for automatic load sharing between three transformer. The number of transformer to be operated in parallel can also be increased according to demand of a particular area.

III. Proposed Plan

In this system, we have to design the system which protects the generator from overloading by detecting the consumers who exceeds the maximum power demand in the peak time or the generation overloading condition and disconnect the power of that consumer. Also the system is fully automated. In this system we are using Arduino Uno for the controlling the load shedding action. It improves overall system performance.

Also we are using a GSM module for communication purpose in which we are communicate with the customer who exceeds the maximum power demand at the time of load control.

The proposed system reduces the human efforts thus it reduces human errors it also includes the messaging system which informs the customer about the exceeding maximum power demand. This system is designed to monitor the load connected
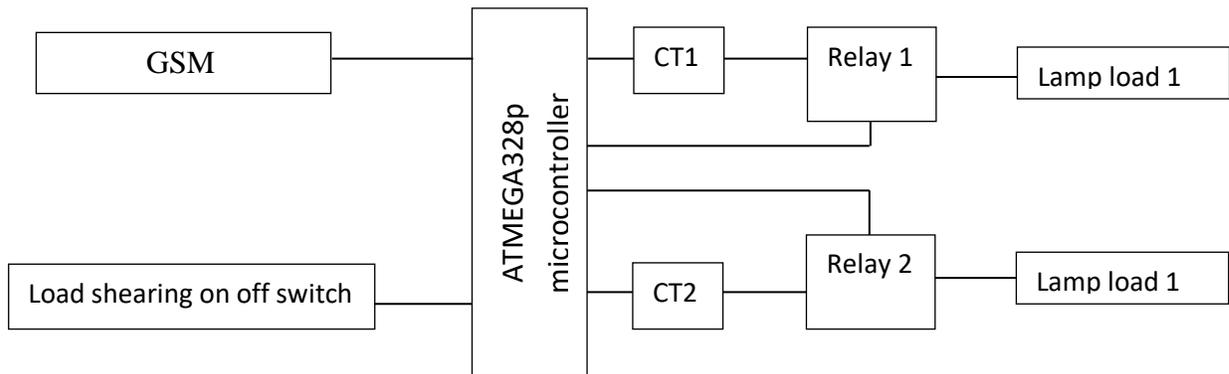
IV. Working Methodology

Fig. 1 Block Diagram

4.1 Hardware Required:

➢ Arduino Uno:

The Arduino Uno is the microcontroller based on the ATmega328. It has 14 digital input/output pins. It contains everything needed to support the microcontroller Simply connect to it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started. Uno means one in Italian. The Uno is the latest in series of USB Arduino boards, and the reference model for the Arduino platform.

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontroller

➢ Relay:

Relay is an electrically operated switch. It consists of sort of input terminals for single or multiple control signal and set of operating contact terminal. Relay are used where it is necessary to control a circuit by an independent low power signal, or where several circuits must be control by one signal

In proposed system relay receives command from the microcontroller which calculates the signal from the CT which are already prioritized with predefined current value which CT exceeds that value relay has to cut-off the supply of that load.

➢ Current Transformer:

A current transformer (CT) is the type of transformer that is used to reduce or multiplies an alternating current. It produces a current in its secondary which is proportional to current in primary.

In the proposed system CT is used sense the current in the system connected to particular l.oad. As we know current is proportional to the load connected so as the load connected changes the current also changes. So to get an idea about the load connected we measures the current through the CT which is gives to the microcontroller for particular CT fixed current rating is decided.

➢ GSM:

The global system for the mobile communication is uses by the mobile devices such as mobile phones and tablets. In proposed system it is used to communicate with the customer as well as utility system

➢ Load shearing switch:
   This load shearing switch is used for deciding a peak load conditions this may be online when we used this with programmable logic controller (PLC)

Fig 2. Circuit Diagram of load control using Arduino(ATMEGA328p microcontroller)

4.2 Working:

Our main motive is to prevent the overloading for that we have to follow the following methodology. Firstly we have to consider that one consumer from the above Fig no 3.1 is sanctioned with the 400 W while the another is sanctioned with the 800W .

Here we have to note that the load is decides the current through the incoming cable or feeder . So if we want to note the changing load then we have to pay attention towards the changing current through the incoming cable .

Now for that purpose we have to use the couple of CTs each one is for either consumer . Which are rated with the full load current through the cable.

So if current exceeds that limit then current through the CTs also exceeds. This is noticed by the Aurdino (ATMEGA328P) & it takes decision to cut off the supply of that consumer who exceeds the current limit and at the same time we want to send the SMS alert to consumer that they are exceeding the load limit .

But the point is we want this operation only for the peak load time because for remaining time we already have the excess power in the system for the off peak load time so if the consumer uses this then it is beneficial for the system only , for financial way and also the way to keep the system balance .

Now to decide the peak load we are using load switch which can be operated automatically or manually. For the automatic operations we can be use the PLC input . Where PLC keeps continues on connected load graph (daily load curve) .

So the Aurdino operations to cut off the supply is only done whenever the load switch is closed , but the GSM sends the SMS every time when consumer exceeds the current limit or load limit .

While the continuous information about the connected load can be watched from the substation and also the load control of individual consumer is also achieved through the proposed method

V.Conclusion

The proposed work provides an efficient way for load control at real time. The Arduino Uno based load sharing and control system designed specially to monitor overload on generator. The design scheme consists of dual load system. This was achieved by the used of some solid state components like Arduino Uno and Relays. The method used in the project provides necessary stages from overload detection to switching and cutting of supply. Then it was fairly successful and their liability level expected commendable.

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