HARDWARE IMPLEMENTATION OF EFFECTIVE PROGRAMMABLE LOAD SHEDDING USING MICROCONTROLLER

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Abstract: Load shedding is what electric utilities do when there is a huge demand for electricity that exceeds the supply. Thus in a distribution system it needs to be precisely controlled for specific period of time. Programmable load shedding time management system is a reliable circuit that takes over the manual task of switch ON/OFF the electrical devices with respect to time. It uses real time clock (RTC) interfaced to a microcontroller of 8051 family. While the set time equals to the real time, then microcontroller gives command to the corresponding relay to turn ON the load and then another command to switch OFF as per the program. Multiple ON/OFF times entry is the biggest advantage with this model. The push buttons helps to entering the time. A 7-sement display is interfaced to the microcontroller to display time. This paper presents the model which is designed to operate an electrical load multiple number of times as per the program. It overcomes the difficulties of switching the load ON/OFF manually.

Index Terms - Load shedding, real time clock (RTC), Microcontroller 8051 family.

I. INTRODUCTION

Load shedding in electrical supply networks is a controlled process in which the utility company drops off part of the load in order to balance the demand and the generated capacity. This is often done whenever there is excess load on the system. In standby generators, it involves disconnecting or shedding some circuits to prevent an overload condition. Power companies are required to supply sufficient energy to meet installed capacity. However, the demand may become inconsistent during peak periods. Whenever the power generated is insufficient to support the load, the electrical supply and distribution system becomes unbalanced and unstable. If not controlled, the system can collapse and cause a total blackout. In such a situation, it may take hours or days to restore back the power. The utility monitors their systems and compare the load against the supply. If the difference between the two gets very narrow, some of the sections are disconnected so as to prevent the system from becoming unstable. In power systems, an excess load puts a stress on the generating equipment. It slows down the prime movers, associated generators and other parts of the system as they attempt to cope with the excess load. This leads to a combination of events including power swings and overloads which can cause the system becoming unstable. Some of the parts such as protection systems may interrupt the supply due to the excess current resulting from the overload.

The higher load may also lead to a lower generating and supply frequency. Even though the hydro generating systems can tolerate up to 10% frequency change, the thermal generator's operation will be affected since they are more sensitive. A five percent decrease can reduce the generated power significantly due a decrease in the energy to the turbine generator. The reduced frequency can damage the steam turbines as well as the frequency sensitive load. As such, most generator systems incorporate under-frequency relays to automatically disconnect some of the excess load.

When a power system is stable at normal frequency the total mechanical power input from the prime movers to the generators is equal to the sum of all running load and all real power losses in the power system. The frequency conditions of the overall power system will directly depend on the amount of active power that the generator could deliver to the system. Also, the prime mover's stored energy plays an important role on the system behaviour. For gradual increases in electric load, or sudden but mild overloads, unit governors will sense speed change and therefore increase power input to the generator. Extra load is handled by the unused capacity of all accessible generators functioning and synchronized to the system. If all generators are operating at their maximum capacities and the spinning reserve is zero, then the governors may be powerless to relieve overloads. So it is necessary to shed the load of a particular geographical region. Load shedding is an intentionally engineered electrical power outage where electricity supply is stopped for non-overlapping periods of time over a particular zone. For manually maintaining Load shedding times, some man power may be employed or by using computer it can be controlled efficiently. Detaching of power is done to minimize the consumer load provided through several substations, which are connected to the main power station. The main station instructs the sub-stations to cut some of the feeders for a certain period of time & thus the shedding procedure continues.

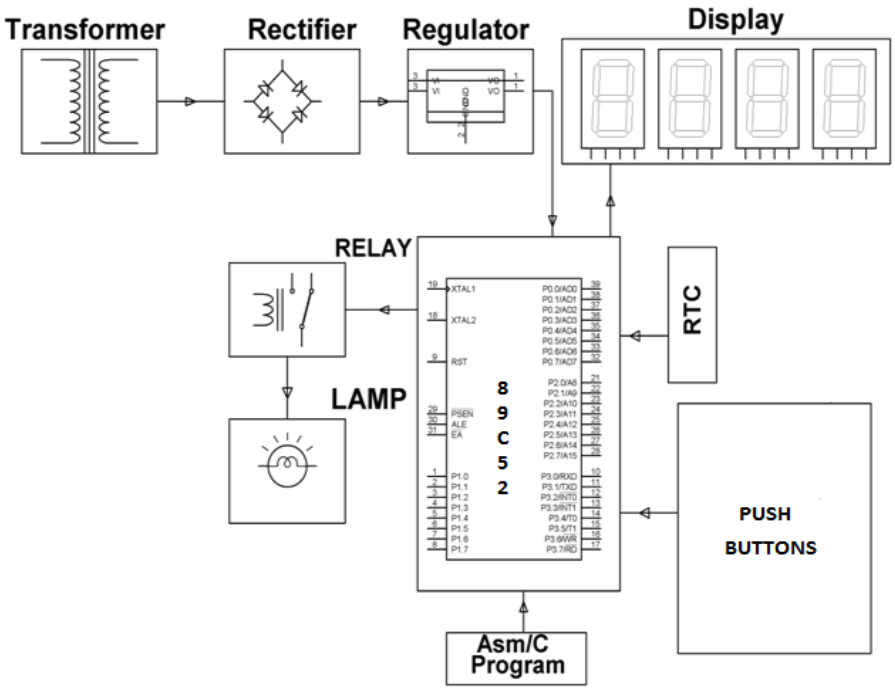

Figure-1 Block diagram

Programmable load shedding time management system is a reliable circuit that takes over the manual task of switch ON/OFF the electrical devices with respect to time. It uses real time clock (RTC) interfaced to a microcontroller of 8051 family. While the set time equals to the real time, then microcontroller gives command to the corresponding relay to turn ON the load and then another command to switch OFF as per the program. Multiple ON/OFF times entry is the biggest advantage with this model. The push buttons helps to entering the time. A 7-sement display is interfaced to the microcontroller to display time.

II CIRCUIT DESCRIPTION

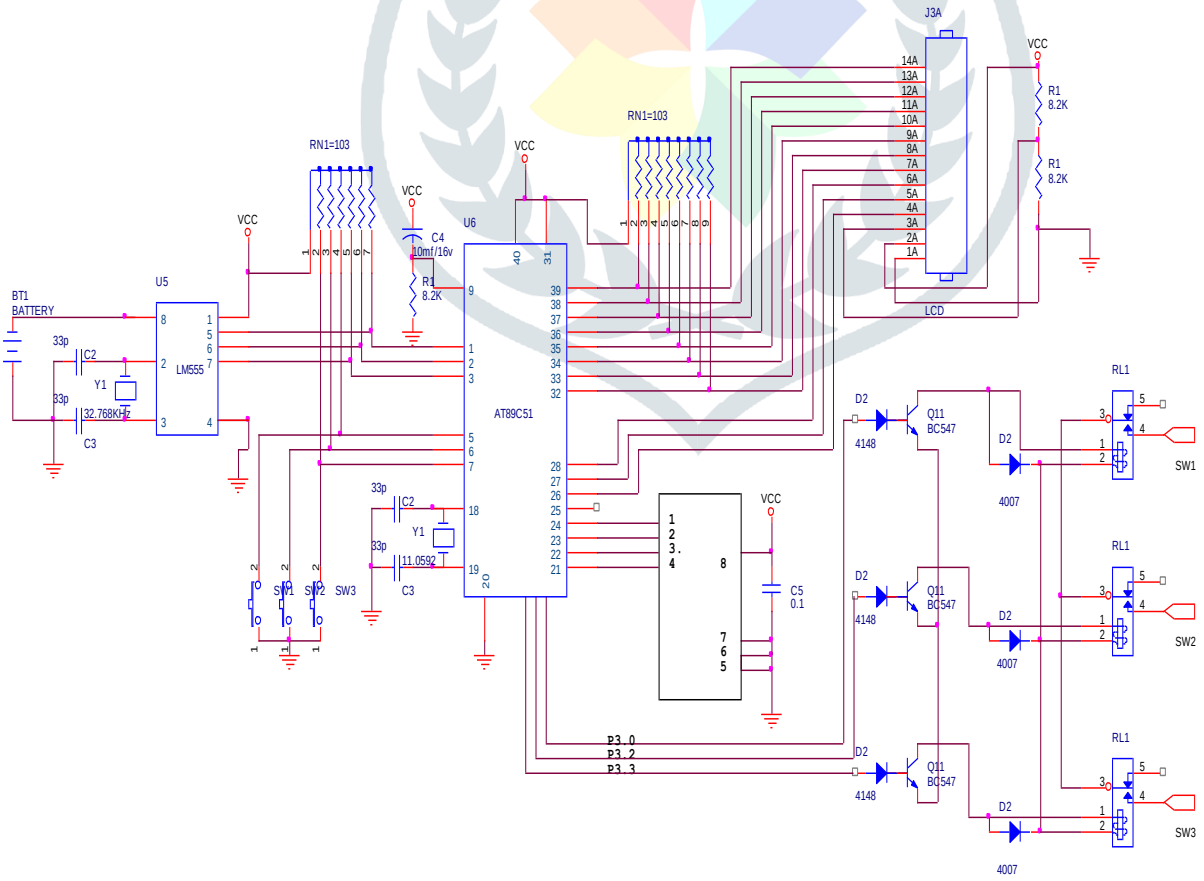

Figure2: circuit diagram

III OPERATION EXPLANATION

DC power supply circuit:

It comprises of a step down transformer (230v-12v AC), bridge rectifier circuit, a voltage regulator with filter capacitors and a power indicating LED. The step down transformer directly converts 230v AC to 12v AC supply. The output is still AC and it fluctuates around 12v. This 12v AC is given as input to a bridge rectifier circuit which converts it to 12v pulsating DC. The pulsating DC obtained as output from the rectifier is given to voltage regulator through a filter capacitor. The main function of voltage regulator is to provide a constant voltage of 5v. In other words, if there is any fluctuation in the input of regulator, but the output will be a constant 5v DC. The capacitor1 (470microf) filters out the pulsating DC to ripple less DC. The second capacitor eliminates any other ripples in the output. Thus, we get a steady supply of pure 5v DC. This is indicated by the LED which is present in the power supply circuit.

Circuit Operation:

The programmable load shedding time management for utility department circuit consists of an 8592 microcontroller IC,16*2 LCD module,7805 voltage regulator ic, push buttons, DS12887 RTC IC, relay, a Crystal oscillator. The 7805 voltage regulator converts the input voltage to 5V and is given to the Vcc (pin:40) of the 8952 microcontroller. This voltage is necessary to enable the microcontroller .A DS12887 RTC interfaces with port0 of the microcontroller i.e, from pins 32 to 39.The RTC shows the real time at every instant. Once the RTC is programme, it will work continuously even though the power goes off in between. The push buttons are interfaced with port2 of the microcontroller i.e. from pins21 to28.The push buttons are used to set the real time, the time for load shedding time and the time duration. The 16*2 LCD is interfaced to port1of the microcontroller ie from pins 1 to 8.The crystal oscillator helps to provide the working frequency 11.059MHz for the microcontroller. The microcontroller programmed in such a way that we can set the actual time and load shedding time. Using the program we can monitor both real time and load shedding time. Program always checks the equality and whenever it get matched output relay turn off. Whenever the target time matched with the relay time the corresponding loads will be OFF position otherwise they will be in ON position

Load shedding procedures

Utility companies use scheduled load shedding so that the available electricity is fairly shared by the consumers. This involves switching off some parts of the electricity supply network in a planned and controlled process. They alternate between different parts and time schedules to ensure that at least everyone gets power at a specific time. By dropping off the excess load, the power system remains stable.

Some smaller generators such as those used in domestic applications have inbuilt load shedding capabilities. This becomes necessary when these are used as standby generators, in the event of a utility power outage, the emergency supply boosts in. Since all the circuits and appliances are connected, the load demand may exceed the generator capacity. When the load becomes too much, the generator sheds some of the smaller non-critical circuits automatically in an attempt to reduce the load.

Advantages of load shedding:

i. Prevents overloading and damage of the power generators
ii. Prevents instability and system collapse of the electrical generation and distribution systems
iii. The planned schedules ensure that available capacity is shared fairly and each consumer gets power at one time or another.
iv. It serves as a warning to the utility hence forcing them to increase capacity, and efficiency so as to meet the demand.

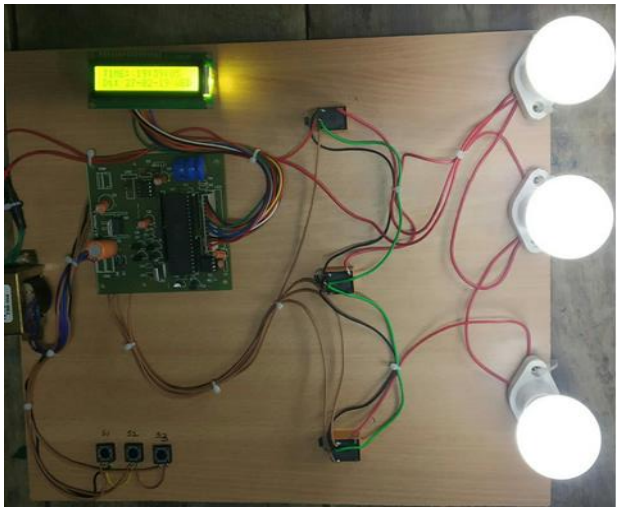

Figure 3: When all loads are ON

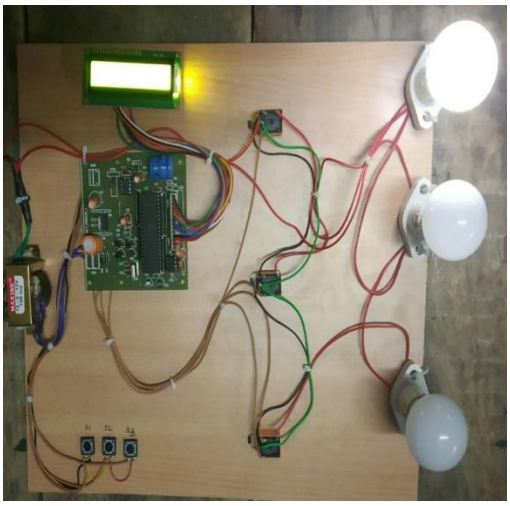

Figure 4:When Load 1 is ON

The proposed circuit is developed with 895c2 microcontroller and different configurations are tested by entering the time when the loads has to be shed.Figure 3 shows when all the loads are in ON condition and figure 4 shows when only the load 1 is in ON condition.For matching the generation and demand, we are shedding the load 2 and load 3 by giving the input as 01(binary code 001) by using push buttons.

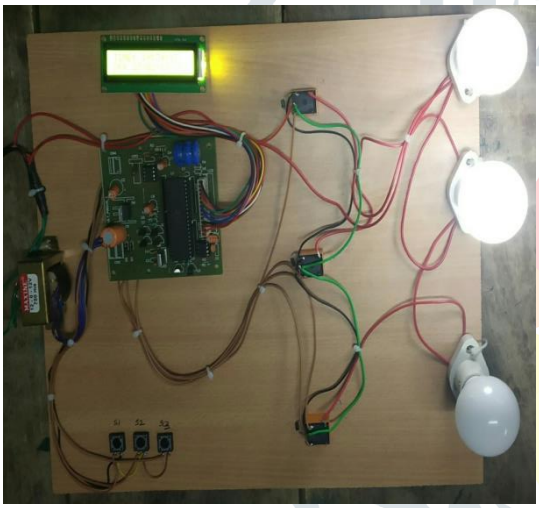

Figure5: **When Load 1 and Load 2 are ON**

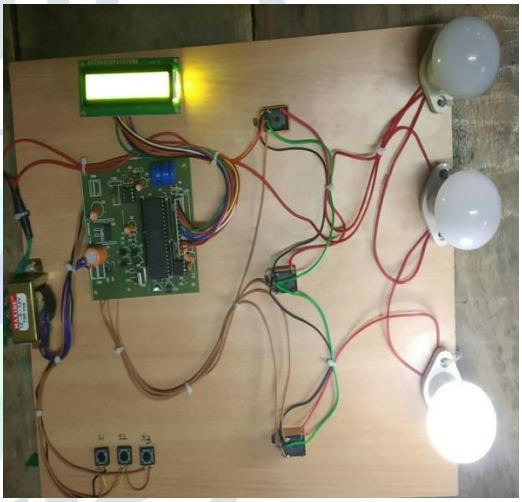

Figure 6: **When Load 3 is ON**

Figure 5 shows that when load 1 and load 2 are ON. For matching the generation and demand, we are shedding the load 3 by giving the input as 03(binary code 011) by using push buttons. Figure 6 shows that when load 3 is ON. For matching the generation and demand, we are shedding the load 1 and load 2 by giving the input as 04(binary code 100) by using push buttons.

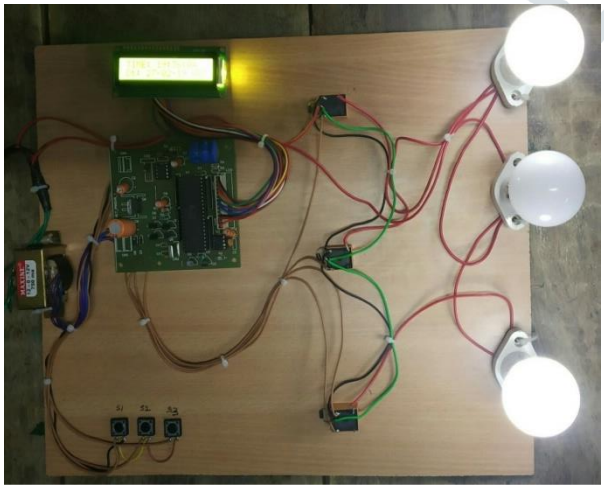

Figure 7: **When Load 1 and Load 3 are ON**

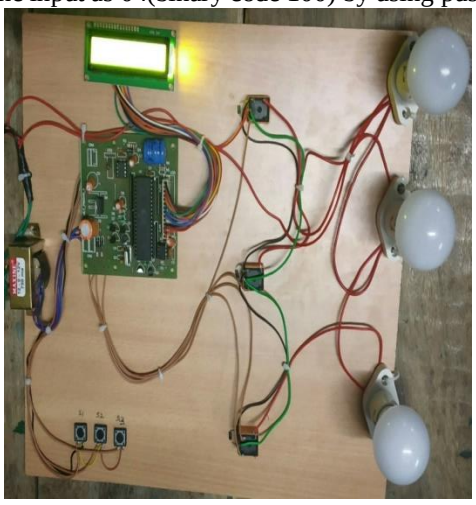

Figure 8: **When ALL loads are OFF**

Figure7 shows that when load 1 and load 3 are ON. For matching the generation and demand, we are shedding the load 2 by giving the input as 05(binary code 101) by using push buttons.Figure 8 shows that when all the loads are OFF. For matching the generation and demand, we are shedding all loads by giving the input as 00(binary code 000) by using push buttons.With the help of push buttons we can control ON and OFF of the loads.

IV ADVANTAGES and APLLICATION

Advantages:

- Low losses.
- Require little maintenance.

Applications:

- Industrial Applications
- Domestic Applications

V CONCLUSION

Electrical load shedding is a method of reducing the demand on the electricity generation and achieved by switching off some loads or energy supply to some geographical areas. This is usually a last measure by the utilities, and often implemented to prevent overloading the generating systems and eventual collapse of the entire power system. Load shedding is one of the last things that a utility company should look at. It leads to frustrated customers and loss of revenue for the consumers as production drops. In addition, it may cause equipment damage. Electricity companies should ensure that they have enough capacity to meet normal and peak demands. This can be achieved by planning for future electricity demand and progressively upgrading the generating equipment, maintain existing systems, reducing transmission losses and increasing efficiency in the entire system.

The proposed model "Programmable Load Shedding "has been successfully completed and tested. Presence of every block has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, the hardware setup was finished using very simple and low cost components making it lightweight and portable. Finally we conclude that programmable load shedding will automatically sheds the loads and balances the power generation with the demand which in turn reduces the spinning reserve requirements when the demand increases.

REFERENCES

[1] V. K. Mehta and Rohit Mehta, "Principles of Power System", 4th ed, S. Chand publication, 2008.

[2] Ashfaq Husain, "Electrical Power System", 5th ed, CBS Publishers and Distributors Pvt. Ltd., 2007.

[3] M.A.O liveira and C.C. Barioni, "Technical loss calculation by distribution system segment with corrections from measurements", Proc.20th international Conference and Exhibition on Electricity Distribution, Prague, Czech Republic, June 2009, pp. 1–4.

[4] Sunil S. Rao, "Switchgear Protection and Power Systems", 9th ed, Khanna Publishers, 2012.

[5] C.L.Wadhwa, "Electrical Power Systems", 4th ed, New Age International Publishers, 2005.

[6] C. J. Bandim, E. R. Alves ., A. V. Pinto, F. C. Souza, M. R. B. Loureiro, C. A. Magalhges and F. Galvez-Durand, "Identification of Energy Theft band Tampered Meters Using a Central Observer Meter: A Mathematical Approach", Transmission and distribution conference and exposition, 2003 IEEE PES, vol. 1, pp. 163-168,2003.