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An Embedded Technology Based Automated City Load Shedding Management Scheme

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ABSTRACT: Electrical Power System networks are nowadays heavily facing various disturbances that are significantly affecting their operation. Hence, an Automated Load Shedding phenomenon was proposed as a solution for overloaded infrastructures in cases of load imbalances between generation and demand. However, determining the various parameters that contain a conventional load shedding schemes is not an easy task. In this situation, where the load shedding schemes must be well designed, there is a need to pursue new methodologies that provide fast and optimized solutions whose parameters are appropriate for the specific requirement of each Electrical Power System. Therefore, this paper proposes a new technique to analyse the required parameters in conventional Load Shedding designs. The project "An Embedded Technology Based Automated city load shedding management scheme" is implemented such that the load monitoring and load shedding is controlled from one central location. And also it can cut the power to shed the power supply of a specific zone by a programmed user interface. In this project we will be monitoring the power supply of different zones with the help of ARM processor. We will be making an experimental scale prototype to monitor a distribution point from a central location which will help to monitor a load shedding mechanism in a particular area. The results will demonstrate the load shedding distribution in 24-hour period.

KEYWORDS: Electrical Power System, Automated Load Shedding, ARM processor

I. INTRODUCTION

Load shedding strategy is applied when there is not enough electricity available to meet the increasing demand of consumers, and an electricity supply or utility company stops the energy supply to certain areas. It is a last option to balance electricity supply and demand. Most of the utility companies try to do it on the timely basis of load shedding schedules to enable their customers to be better prepared in the event of load shedding, which is also known as rotational load shedding. Rotational load shedding is more common in developing countries, like India in our case. because the electricity grid is underfunded, outdated or the electrical power system infrastructure is not properly managed. However, it can happen in developed countries as well to balance the load demand. This rotational load shedding may caused due to high demand for the power at the operational times. The blackouts are taken place fairly and rapidly so that no area had to spend more than one hour without power.

To balance the availability and the requirement of electricity the concerned authority has to execute the load shedding process. The process is more prone to human errors as an operator has to manually switch the load ON/OFF. If we can design an efficient and economical solution to perform this operation automatically from a one centralized location, we will be able to replace the manual system with a sophisticated centralized automated system. "An approach to automated city load shedding management using embedded technology" implements the application of the embedded system technology which has covered almost all areas of the world. This helps in reducing the implementation cost and also makes it simpler and easier to install a fully automated system both at the controller and transformer side. An ARM processor is one of the CPUs based on the RISC (Reduced Instruction Set Computer) machine architecture

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developed by Advanced RISC Machines (ARM) itself. The proposed approach for designing this system is to implement microcontroller based control module that receives its instructions and command from an ARM processor and accordingly shed the particular load as per the program. The ARM processor then will carry out the issued commands and transfer the control to relays which will shed the interfaced load accordingly. The load shedding is interpreted by the ARM based module and instruction is given to the hardware i.e. relays which perform the action of turning ON/OFF of the load.

II. RELATED WORK

This section describes the existing power management techniques. The overall work is divided into two sub-sections:

Conventional Load Shedding Techniques
Conventional Load Shedding techniques are still used to meet demand and supply imbalance in many developing countries. Automated under frequency Load Shedding methods are based on the frequency drop or rate of frequency change. This techniques are simple to execute but time delays makes their response considerably slow. Additionally it may result in tripping of distributed generation source. Another advanced PLC based load shedding technique being automated and technologically equipped provides many advantages over under frequency based technique. It provides fast response or increases power consumption. However, it has its own disadvantage including excessive load shedding during transient responses, absence of dual communication ability and predefined or non flexible power limitations.

Modern Load Shedding Techniques
Modern Load Shedding techniques are more progressive towards micro grid or smart grid technology. It shows all the communications and electricity flows connecting each domain and how they are interrelated . Recent research in this field mostly focuses on intelligent load shedding management systems. However, there is very little research is done on load priority based intelligent load shedding systems. It's an efficient technique which can be used in future smart cities. Drawbacks include limited categorization of loads and decision making within defined limits of power are used to shed the load which results into excessive or malicious load shedding.

Since there is no sufficient work done to address the need of future power distribution in the cities, we need to address practical solutions that are not focused to a limited boundary or a specific user. We have to simultaneously address this issues for domestic and commercial end users. Therefore we have to propose a new and more generic approach in the field of power management techniques.

III. LITERATURE SURVEY

Many authors have proposed different ideas and approaches in their books, research papers and articles to improve the load shedding strategy in present scenario. For Example, The books in References [1] and [2], written by C. L. Wadhwa, covers the subject of Electrical Power Systems and Generation, Distribution and Utilization of Electrical Energy with basic and advanced topics. These books cover the fundamentals of power system, Generation, Transmission and Distribution of Electrical Energy, performance of transmission lines, high voltage D.C. transmission, line constant calculations, and capacitance of transmission lines. Topics like Corona, Mechanical Design of Transmission Lines, Insulated Cables, Voltage Control, Overhead Line Insulators, Neutral Grounding, Transients in power systems, symmetrical components and fault calculations, protective relays, Circuit breakers, insulation coordination and overvoltage protection, and power system synchronous stability are also covered in both books.
In the research paper of Reference [18] the detection of initial rate of change of frequency with time intervals to formulate an appropriate load shedding strategy is explained. Meanwhile, to avoid load shedding failures, a modification method is also explained to shed load. The research paper in Reference [19] deals with the problem of using optimal load shedding, fast, spinning reserve, distributed generators (DG), and optimal power generation re-dispatch in order to withstand major sudden generation losses without collapsing by load cascading effects. In the research paper of Reference [20], The author has presented a new methodology for avoiding the high construction and maintenance costs in the existing meter reading technology. The designed system eliminates human intervention in

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Power Management. This paper also addresses advantages of implementing the GSM communication module and design detail and discusses the advanced security of the data communications. In research paper shown in Reference [21], authors have actually developed an Automatic Load Shedding module for teaching and research. The module uses an Arduino Uno microcontroller combined with a switching circuit to implement a load shedding plan in four settlements of a laboratory-scale urban settlement. The developed module is useful as a teaching aid for illustrating power system automation among undergraduates and Researchers.

IV. AN ELECTRICAL POWER SYSTEM

There are three stages involved in an electrical power system to produce electricity: Generation, Transmission and Distribution. Each of these stages involves distinct production processes. Electricity Generation, Transmission and Distribution is a bit complex Engineering process which requires huge investment and skilled manpower.

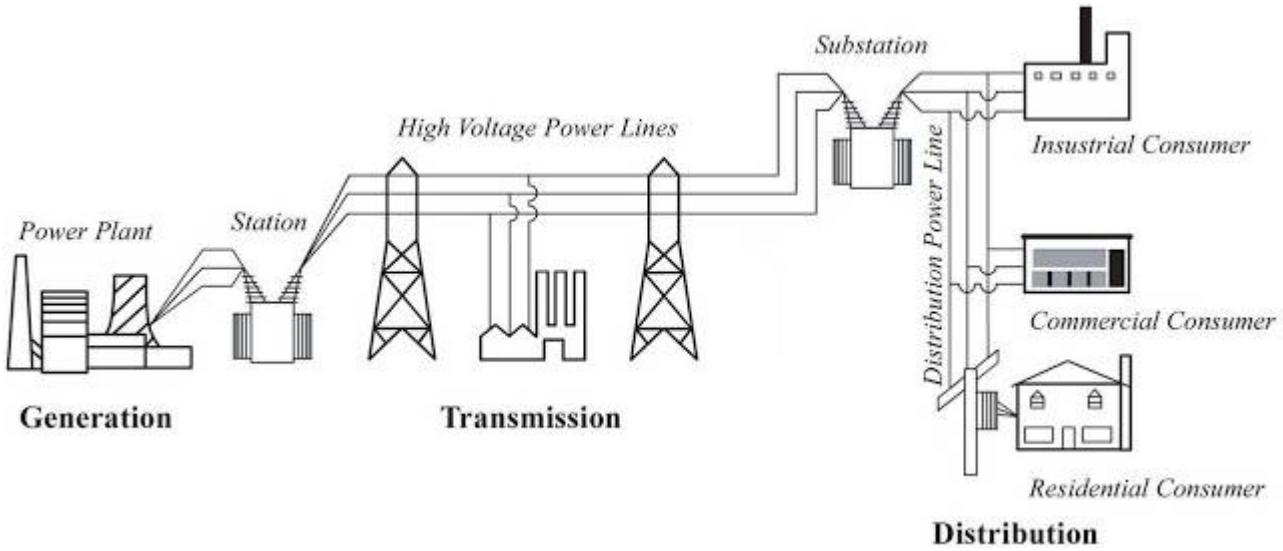

Figure 1: An Electrical Power System

The basic structure of an Electrical Power System Network is shown in Figure 1. It contains an Electric Power Generating Station, a Generator Station Transformer, High Voltage Power Lines, a Transmission Substation Step Down Transformer, Distribution Power Lines and a Consumer Side having Industrial consumer, Commercial consumer and Residential consumer.

The important elements in an electrical power system are:

1. **Generation Station:** Which generates electricity using primary energy sources (includes fossil fuels - coal and natural gas, nuclear, or large hydroelectric dams).
2. **Generation Transformers:** Steps up or step down the voltage level for Transmission and Distribution.
3. **High Voltage Power Lines:** Carries the power from one place to another over long distances.
4. **Transmission Substation Transformers:** Where the voltage is stepped up or down to meet the requirement of load.
5. **Distribution Power lines:** Used for Distribution of power where it's needed.
6. **Consumers:** An Electricity Consumer side uses electricity to perform daily tasks. It has Industrial consumer, Commercial consumer and Residential consumer. These include mainly large industrial, commercial and residential areas.

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This was the basic working of an Electrical Power System. Although, we have not mentioned the in-depth details of each equipment used in an Electrical Power System. In addition to three main stages as Generation, Transmission and Distribution, there are numbers of associated equipments. Some of these equipments are Circuit breaker, Lightning arrestor, Isolator, Current transformer, Voltage transformer, Capacitor voltage transformer, Wave trap, Capacitor bank, Relaying system, Controlling arrangement, the Earthing arrangement of the line and substation equipment etc.

V. CURRENT APPROACH FOR LOAD SHEDDING AND ADDRESSING THE ISSUES

A constant power supply is generally straight forward to produce electricity from a typical coal, gas or nuclear power generating stations. However the demand for this supply is not constant as it varies from time to time. There is a more demand during hot afternoon hours when air conditioners are functioning. A utility company must be able to supply power at all times regardless of demands. So we are motivated to shift large electrical load from high demand peak hours to low demand peak hours with the help of scheduled load shedding.
Electrical energy is a type of energy that cannot be stored for a longer duration. It must be generated, distributed, utilized or consumed immediately as soon as possible for its proper usage. When the load in a particular system approaches its maximum generation capacity, the operators must either find an additional supply of energy or find ways to shed the load. Hence proper load management is necessary. If the shedding mechanism is unsuccessful then system may become unstable and blackouts or brownouts can occur. Automated load shedding management is the process of balancing the supply of electricity on power system network with an electrical load by adjusting or controlling the load shedding automatically with the help of embedded systems rather than power station output. Because of poor energy management in the conventional load shedding systems, there is tremendous energy loss may occur. So for improving the stability of the system and improving the load shedding management the latest technology of priority based automated load shedding management using embedded technology is introduced in this project.

VI. OBJECTIVES

The objectives for designing this automated load shedding scheme are:

1. Designing an efficient and cost effective solution for replacing the manual process of load shedding.
2. All problem related to effective power distribution should be controlled by controlling the load shedding from a centralized location for a 24-hour period.
3. To efficiently control the ON/OFF of relays via program.
4. Minimize power and time wastage.
5. Elimination of the requirement of being physically present on the location for tasks involving the operation.

VII. SYSTEM OVERVIEW

The work shown in this project is related to monitoring load shedding of electrical loads by using ARM processor based embedded technology. Design of the main or centralized control system and management of load shedding automatically for various loads are the main concern of this work. The input load shedding scheme can be controlled through computer or laptop. Once the load shedding scheme is started, it will work for 24-hour without any interruption. When the load shedding scheme is started, the ARM processor gives command to the relay to shed the particular load from the system and finally the entire operation is observed on computer display which has GUI (Graphical User Interface).
An ARM based laboratory scale automated load shedding management module is being developed. The development of this module involves: Developing an arrangement to show a load shedding effect for an urban cities which requires 5 bulbs as a load, developing an ARM processor-based circuit and programming of the automated load shedding management scheme. A GUI (Graphical User Interface) to control and monitor the automated load shedding scheme. The entire arrangement is connected to computer or a laptop through USB to UART bridge. The control and monitoring of automated load shedding parameters for different cities is done using a PC through GUI. The PC loaded with program and GUI is considered as a central location from where the automated load shedding management scheme is controlled and monitored.

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VIII. SYSTEM BLOCK DIAGRAM

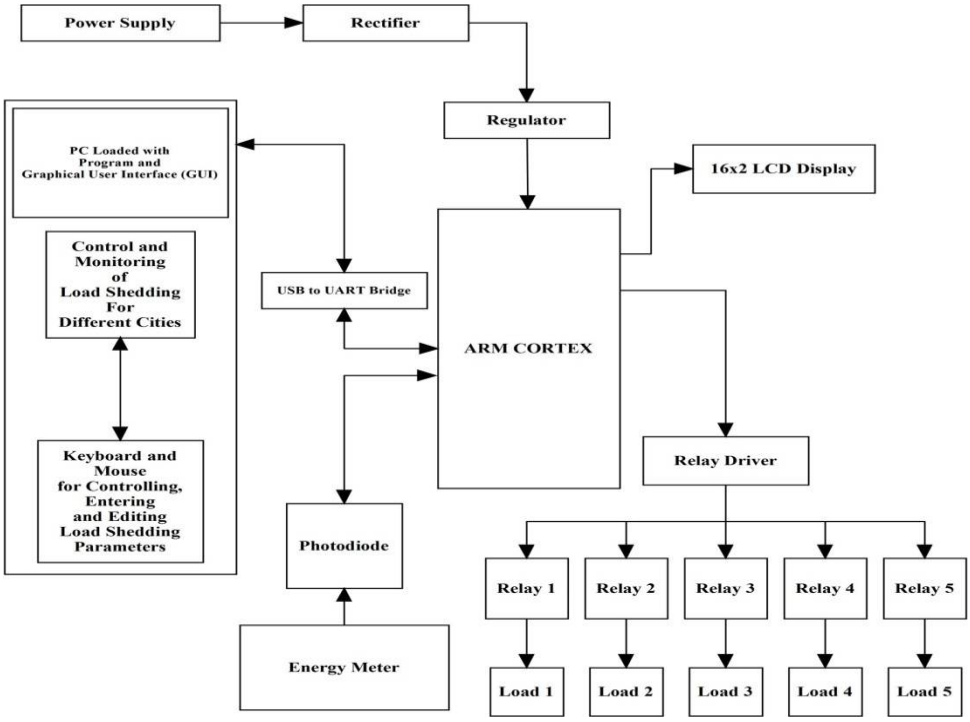

Figure 2: System Block Diagram

IX. SYSTEM REQUIREMENTS

HARDWARE REQUIREMENTS:

Arduino Due ARM CORTEX M3 processor board

The Arduino Due is a microprocessor board based on the Atmel AT91SAM3X8E ARM Cortex-M3 CPU. It's a first board based on a 32-bit ARM core microprocessor. The Arduino Due processor board runs at 3.3V. The maximum voltage that the I/O pins can handle is 3.3V. It has two ports, namely Native USB port and Programming USB port. Either of the USB ports can be used for programming the board, though it is recommended to use the Programming port due to the way the erasing of the chip is handled. The programming software Arduino IDE is used for uploading the program into processor memory with the help of external USB connection. The Native USB port can also act as a USB host for connected peripherals such as mice, keyboards, and Smartphones. It is also possible to erase the Flash memory of the ARM processor with the onboard Erase button.

Energy Meter

Watt hour meter or energy meter is an instrument which measures amount of electrical energy used by the consumers. Utility companies install these instruments at every place like homes, industries, organizations to charge bills for the electricity consumption by loads such as lights, fans and other appliances. Most interesting type are used as prepaid electricity meters. Basic unit of power is watts. One thousand watts is one kilowatt. If we use one kilowatt in one hour, it is considered as one unit of energy consumed. These meters measure the instantaneous voltage and currents, calculate its product and gives instantaneous power. This power is integrated over a period which gives the energy utilized over that time period.

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LCD

A 16x2 LCD display is a basic module and it is very commonly used in various devices and circuits. 16×2 LCD is named because it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most commonly used one is the 16x2 LCD .These modules are preferred over seven segments display and other multi segment LEDs. The reasons are 16x2 LCDs are economical, easily programmable, have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

Photodiode

A photodiode is a p-n junction or pin semiconductor device or diode that consumes light to generate an electric current. It is also sometimes known as photo-detector, photo-sensor, or light detector. Photodiodes are specially designed to operate in reverse bias conditions. Reverse bias means that the p-side of the photodiode is connected to the negative terminal and n-side is connected to the positive terminal of the supply. Photodiodes are very sensitive to light so when light or photons falls on the photodiode, it easily converts light into electric current. In a normal p-n junction diode, voltage is used as the energy source to generate an electric current whereas in photodiodes, both voltage and light are used as energy source to generate an electric current.

Transistor Relay Driver

A Relay Driver circuit is a circuit which can drive, or operate a relay so that it can function appropriately in a circuit. An electronic circuit normally needs a relay driver using a transistor circuit stage in order to convert its low power DC switching output into a high power mains AC switching output. The driven relay can then operate as a switch in the circuit which can open or close, according to the need of the circuit and its operation. PNP, NPN, or MOS transistors are used to make a relay driver circuit. Single channel relay driver using BC547 NPN Bipolar Junction Transistor (BJT) is a simple and convenient way to interface a relay for switching application in any microcontroller based project.

SPDT Single Pole Double Throw Relay

They are high quality Single Pole - Double Throw (SPDT) packaged relays. They are used to switch high voltage, and/or high current devices. This relay's coil is rated up to 12Volts, and its minimum switching voltage is 5Volts. The contacts are rated up to 5Aamperes (At 250Volts AC, 30Volts DC).

CP2102 Single Chip USB-To-UART Bridge

The CP2102 is an upgrade from RS232 to USB by providing a complete solution with royalty-free drivers that eliminate the need for additional software. The highly-integrated single chip USB to UART bridge reduces board space, simplifies system design and reduces development time. The CP2102 includes a USB 2.0 full-speed function controller, USB transceiver, oscillator, EEPROM, and asynchronous serial data bus (UART) with full modem control signals in a compact 5 x 5 mm MLP-28 package. No other external USB components are required for CP2102 USB-To-UART Bridge.

SOFTWARE REQUIREMENTS:

Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Most of the Arduino Boards, Including Due, requires Arduino IDE to upload the programs, also known as 'Sketches'. The programs are based on C++ without 80% of the instructions. Sketches need two functions: void setup( ) and void loop( ). setup( ) runs first and once. loop( ) runs over and over, until power is lost or a new sketch is loaded.

Visual basic 6.0

Visual Basic is a third-generation event-driven programming language first released by Microsoft in 1991. It evolved from the earlier DOS version called BASIC. BASIC means Beginners Allpurpose Symbolic Instruction Code. Visual

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Basic is engineered for building safe and object-oriented applications. Like the BASIC programming language, Visual Basic was designed to accommodate a steep learning curve. Programmers can create both simple and complex GUI applications. Programming in Visual Basic is a combination of visually arranging components or controls on a form, specifying attributes and actions for those components, and writing additional lines of code for more functionality Visual Basic enables developers to target Windows, Web, and mobile devices.

ExpressPCB and ExpressSCH

ExpressPCB is free Schematics and PCB design software. ExpressPCB lets design a PCB circuit using different components from the library and also user definable components. So a designer can design components for any number of pins and shape. The circuit diagram and PCB schematic for hardware is designed by using ExpressPCB Design Software. The ExpressPCB designs PCB Schematic while the bundled software ExpressSCH designs hardware circuits with components. After finishing setup, the connection was tested for the proper functioning of the system.

X. SYSTEM PERFORMANCE

Performance Description:

1. The designed system consists of Arduino Due ARM Cortex-M3 processor, which is the main part which controls and drives all peripherals. The timings to the individual areas can be set by user using RTC (Real-time clock) on GUI (Graphical User Interface). The GUI starts load shedding operation after selecting the proper USB port. Once the operation is initiated the ARM processor will start sending the data on to the UART of the ARM processor through PC USB port. The data from the GUI contains current local time, customer electricity usage amount, total electricity units consumed and information on whether to turn ON/OFF the supply to each individual areas.

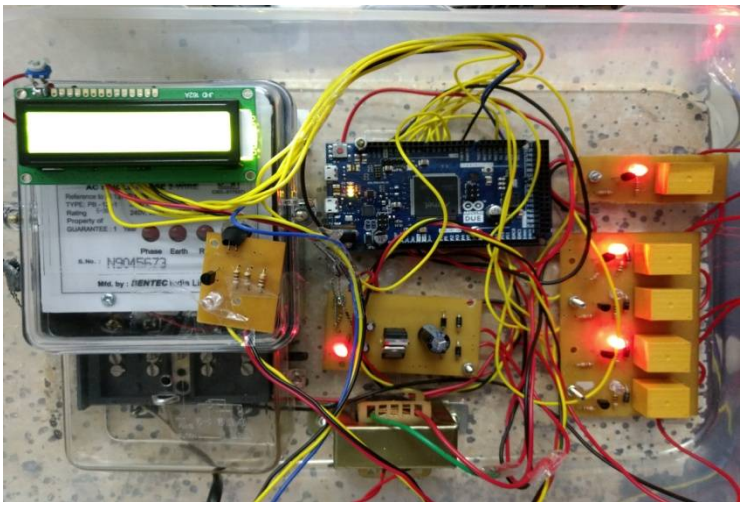

Figure 3: The Hardware module

2. The system requires a supply voltage of 240V, AC supply, which is then converted to a 12V, AC by using a combination of A step-down transformer, Rectifier and a regulator circuitry. The operating voltage range for Arduino Due is from 5V-12V. The Supply will be provided using following power supply circuit:

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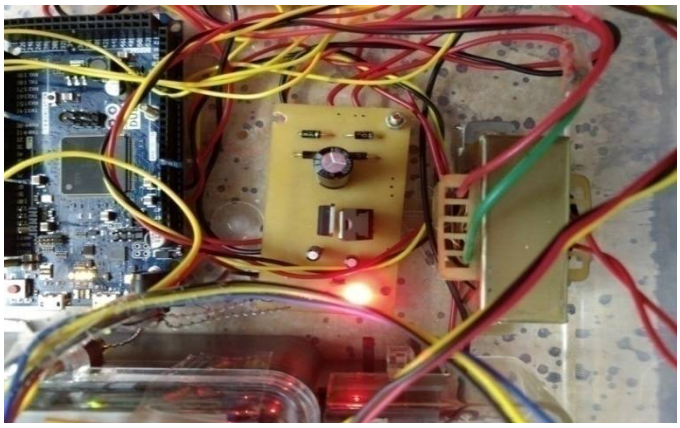

Figure 4: The Power Supply Circuitry

3. The processor receives start command and uses this command to control the ON/OFF mechanism for each of the SPDT Relays, and to display the current local time and Status of the System on the GUI (Graphical User Interface), and also to show the notification about the load shedding.

4. In the designed system, the generation of electricity usage amount is made automated by reading the Watt Hour pulses using Photodiode and ARM Processor. The Photodiode Senses the pulse count, when each time the LED on AC energy meter flashes. the overall count is then sent to the GUI. When the pulses are counted, the graphical representation is displayed on GUI. It also calculates the total amount for used electricity units by the consumer. After the defined time interval, the ARM processor cut off the power by triggering a relay which acts as a switch between power supply from the energy meter power input. Thereby it removes the manual work to cut off the power supply and to provide power supply back to turn on another relay.

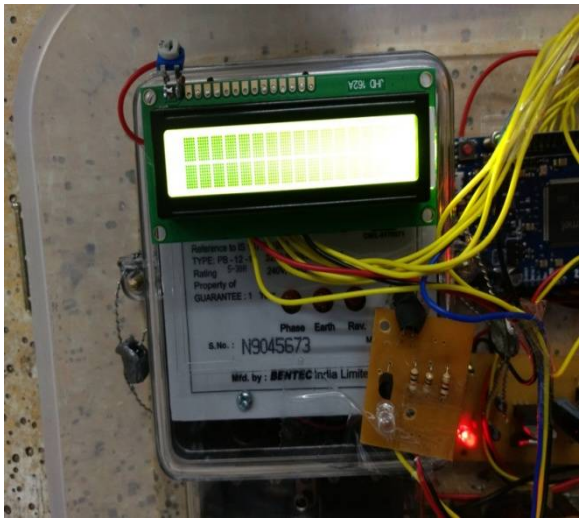

Figure 5: The Energy meter and a Photodiode Circuit reading Watt Hour Pulses

5. This system can also works as automated load management system. The energy meter is connected to the system reads the electrical energy consumed by the load which are considered as individual cities and sends

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that entire data to the central location or control centre which will control the load shedding schemes for more than one cities.

6. The program was written using the Arduino Sketch language in Arduino IDE to implement the load shedding schedule. The program was uploaded to the Arduino Due processor installed in the laboratory scale module from the PC or laptop using a USB to UART bridge connection. Even after the PC or laptop is disconnected, the Arduino Due continues to perform switching operations in the different time intervals with the load shedding plans as described in the next points.

7. In this project, the full programming simulation is done using the hardware and software specifications required for automated load shedding scheme. Below is the snapshot given for sample output after implementation of load shedding with its graphical pattern. The project GUI on computer which controls the load shedding scheme also acts as a simulator:

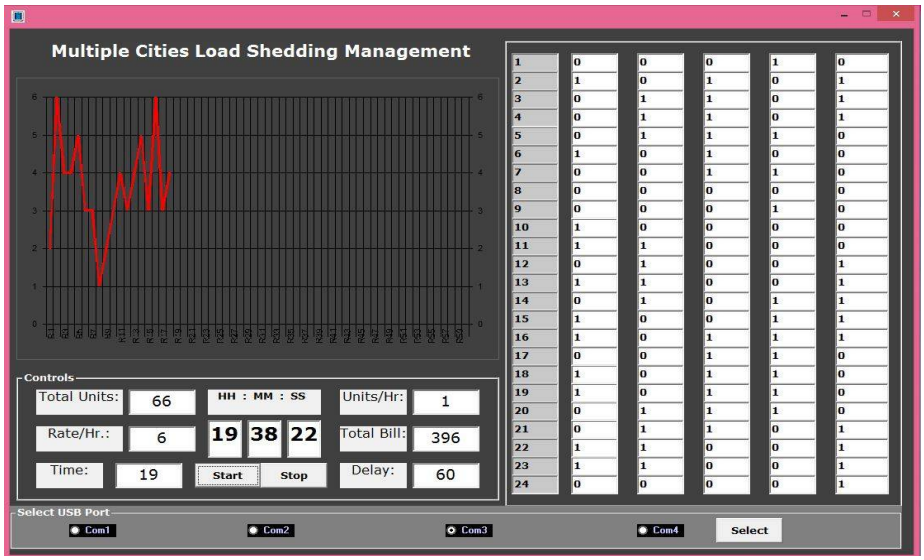

Figure 6: The sample output on GUI after 19-hours of operation

8. LED's are used to represent electric loads. As shown in the hardware module in Figure 3, consisting Arduino Due processor and the switching relay circuit. The Arduino Due is connected to relay through a resistor transistor pair. The transistors are used to switch the LED's on or off depending on signal received from the output pins of Arduino Due. The program is implemented such that LED's will turn on or off for showing load shedding scheme of a particular area.

9. As the entire process of load shedding is automated, the scheme works for 24-hours without any interruption. The process stops automatically once the 24-hour period is completed. The manual interruption is also possible by clicking on 'Stop' Button of controls on GUI. Once the process is stopped, the load shedding for the given loads is discontinued. To continue once again from beginning, the process can be restarted by pressing 'Reset' button on Arduino Due board and then again selecting proper USB port and clicking on 'Start' Button on GUI.

10. The relays are connected to a set of loads which are thereby turned ON or OFF depending on 1's and 0's in the table of load distribution on GUI. LED's show which relay is ON or OFF and in turn, which load is going under load shedding.

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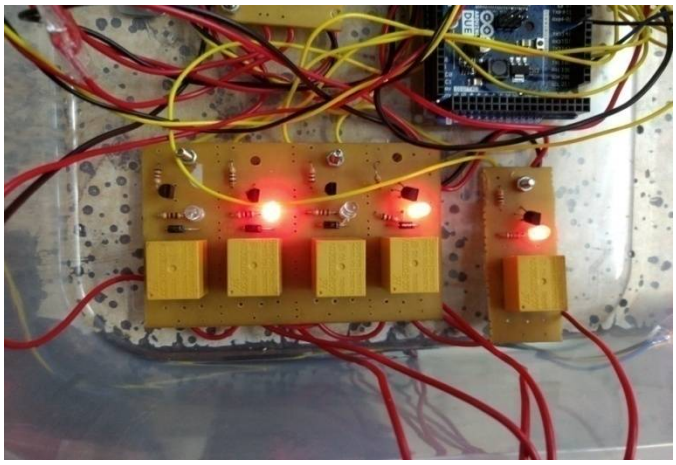

Figure 7: The Relay Circuit with LED indication

XI. RESULTS AND DISCUSSION

1. A consideration is made on the basis of power distribution for 4 different areas depending on the load. This 4 areas are Residential, Industrial, Commercial and Hospital and Healthcare. This all 4 areas where the load shedding scheme is to be applied in a 24-hours are connected to one central location from where the controlling and managing of load shedding is done. The entire operation is controlled on PC via GUI. The GUI has included with a feature which is total bill generation on the basis of time interval and total units consumed in each hour of operation and load shedding amongst the loads. The same system setup can also used to manage the load shedding amongst a home based automated load management scheme as well.

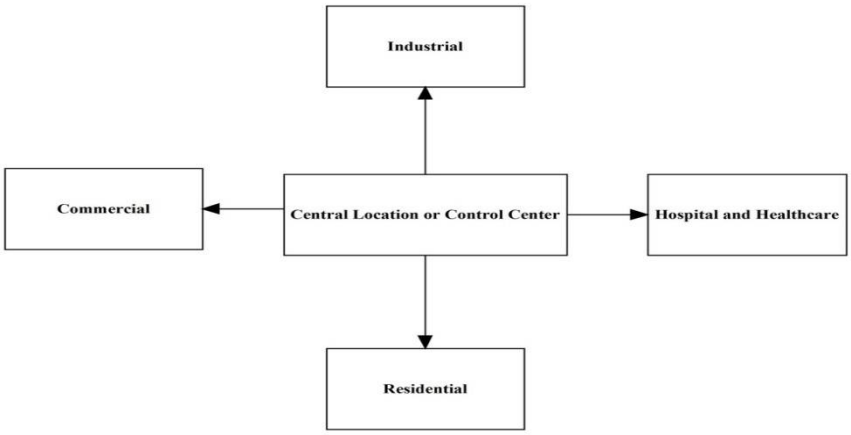

Figure 8: The 4 Areas of load shedding under consideration

2. For the same setup, it can also be concluded that this automated load shedding management scheme was made to run for 24-hours representing and covering the eight time zones. The table is drawn on the basis of

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consideration of load shedding in 4 different areas where the scheme can be applied. The Following table describes the power consumption for 24-hour period for a given set of loads.

Table 1 : Power distribution table for different Time zones under consideration

Time zones	Residential	Industrial	Commercial	Hospital and Healthcare
12.00am - 3.00am	1	1	0	1
3.00am - 6.00am	1	0	0	1
6.00am - 9.00am	1	0	0	1
9.00am - 12.00pm	1	1	1	1
12.00pm - 3.00pm	1	1	1	1
3.00pm - 6.00pm	1	1	1	1
6.00pm - 9.00pm	1	1	1	1
9.00pm - 12.00am	1	1	0	1

Note: 1 = Load is ON, 0 = Load is OFF

3. From the above power distribution table, it is clearly seen that the Residential and Hospital and Healthcare areas require almost 24-hours of uninterrupted power supply while the Industrial and Commercial areas requires power supply during their operational hours.

4. The Table 1 is describing a tentative load shedding analysis of power consumed for different time zones. For a 24-hour period, the time zones are divided into a 3-hour periods. The approximate power consumed by all these areas in the defined time periods is a tentative analysis made for applying an automated load shedding scheme in that particular time zone. From the above tables, it is concluded that in the 24-hours period, the residential and the hospital and healthcare areas are consuming more power than industrial and commercial areas, whereas the industrial and commercial areas are consuming power than residential and hospital and healthcare areas during their operational hours only. For the given experimental setup, the approximate total units consumed are also given. The maximum consumption of power is noted for 24-hours period is from 9.00am to 9.00pm for all the areas. So depending on results made in the above analysis, an automated load shedding scheme can be applied in the particular time zone.

5. In the development of such a strategy, the future work may include addition of remote and real-time sensors with wireless transfer of electricity. The electrical energy loss in the transmission may be reduced to some extent and the maintenance cost may also be reduced to some extent.

XII. CONCLUSION AND FUTURE SCOPE

In this paper, an automated load shedding management module was developed and used to demonstrate the use of embedded systems concept in the field of Power System Automation. This is for the purpose of creation and development of an eco-friendly automated load shedding scheme using low cost and locally available materials. A

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programmed ARM processor is used to automatically perform switching operations in various stages of the lab-scale model of the given circuit arrangement and to distribute the available power with the automated load shedding plan. This was done without human intervention as against the practice in many parts of India. Since the scheme was automated, human error was completely eliminated. Future work would include the incorporation of remote and real-time power monitoring and control capabilities in a single unit. This would make it suitable for teaching and research of modern power system concepts such as the micro grid, and the smart grid.

The proposed system can also work on wireless module for real time data and the efficiency could be very high because every process from taking Watt Hour readings from meter and sending it to the service provider for generating electricity usage bills, sending bills to the consumer via SMS or e-mail and recharging amount in the meter at any time for either prepaid meters or post-paid meters through android or iOS apps, updating electricity related data in database of service provider remotely, everything can be automated.

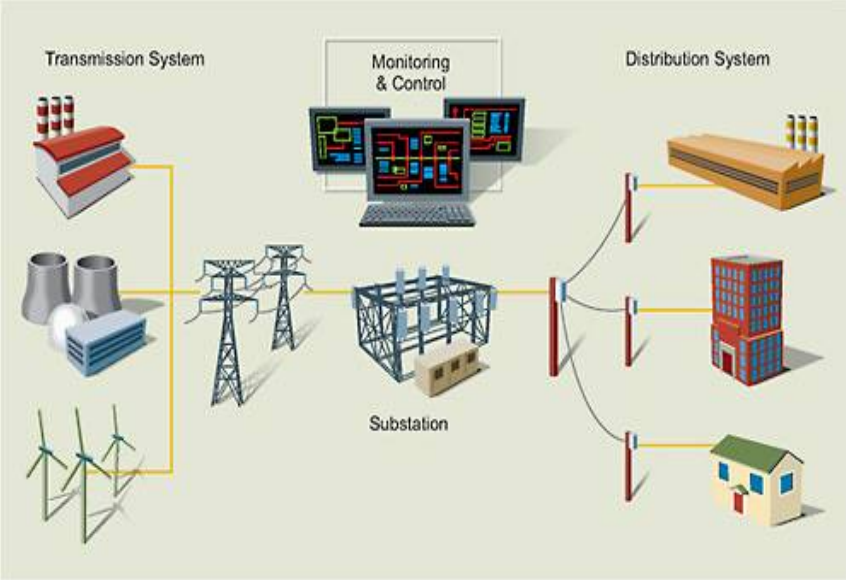

Figure 9: The Future of Electrical Power System Network (Source:www.geartechnology.com)

REFERENCES

[1] C.L.Wadhwa "Generation, Distribution, and Utilization of Electrical Energy "New Age International Publishers, India, ISBN-978-81-224-3853-6
[2] C.L.Wadhwa "Electrical Power Systems" New Age International Publishers, India, ISBN-978-93-86070-19-7
[3] Prabha Kundur, "Power system stability and control", McGraw Hill Publications, 1994. ISBN-978-00-70635-159
[4] Leibfried, T, “Online monitors keep transformers in service”, Computer Applications in Power, IEEE, Volume:11 Issue: 3 , July 1998
[5] O. Moya, “Power system computer controlled load shedding, "Electric Power System Research, pp. 165-171, April 1996.
[6] "Load Shedding , Load Restoration And Generator Protection Using Solid – State And Electromechanical Under - Frequency Relays ", General Electric Co. Get 6449, General Electric Company, Philadelphia, PA
[7] MVP Rao - A Research in Real Time Scheduling Policy for Embedded system-2009 the paper is available at: www.clei.org/cleiej/papers/v12i2p4.pdf
[8] Load Shedding – An Application Guide, John Berdy, General Electric Company Electric Utility Engineering Operation,Schenectady, N.Y.
[9] D. Rudrapalet. al. “Automated Load Shedding Period Control Systems”, International Journal on Computer Sc. & Engineering, Vol 3, Issue 5, pp. 1159 - 1168, May 2011.
[10] Rangan Banerjee ”Load Management in the Indian power sector using US experience” Energy Vol. 23, No. 11, pp. 961–972, 1998.
[11] Introduction to ARM Cortex M3[Online] https://www.arm.com/files/pdf/CortexM3_Uni_Intro.pdf
[12] Data Sheet - ARM Cortex M3 Reference Manual[Online]http://infocenter.arm.com/help/topic/com.arm.doc ddi0337e/DDI0337E_cortex_m3_r1p1_trm.pdf

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Vol. 6, Issue 10, October 2018

[13] Single Pole Double Throw SPDT Relay[Online] https://www.electroDS1307 - Part Number Search- Maximdatasheets.maximintegrated.com/en/ds/DS1307.pdf
[14] Data Sheet - CP2102 Single-Chip USB to UART Bridge https://www.silabs.com/documents/public/datasheets/CP2 102- 9.pdf
[15] Visual Basic 6 tutorial[Online] https://www.vbtutor.net/vbtutor.html
[16] Demand for electricity changes through the days - www.eia.gov
[17] Electricity Demand: http://www.mpoweruk.com/electricity_demand.html
[18] S. J. Huang, and C. -C. Huang, "An adaptive load shedding method with time-based design for isolated power systems," International Journal of Electrical Power & Energy Systems, vol. 22, no. 1, January 2000, pp. 51-58.
[19] A. A. Abou, A. Zein El-Din, S. R. Spea, S.R., "Optimal load shedding in power systems", Eleventh International Middle East Power Systems Conference, Volume 2, 2006, pp. 568 – 575.
[20] O.Homa Kesav and B. Abdul Rahim, "Automated Wireless Meter Reading System for Monitoring and Controlling Power Consumption" International Journal of Recent Technology and Engineering Volume-1, Issue- 2, June 2012.
[21] Olugbenga K. Ogidan, MNSE, Kehinde O. Temikotan, FNSE and Keneth C. Chike ," Development of an Arduino microcontroller-based Automatic Load Shedding Module for Teaching and Research",IEEE 3rd International Conference on Electro Technology for National Development (NIGERCON), November 2017, pp. 1130-1134.