

# Power Meter Billing Plus Load Control

Prachi Dukate, Priyanka Gajakosh, Niranjani Kini, Siddhesh Rasam

Electrical Engineering  
Mumbai University

**Abstract-** Electric utilities load shed when there is huge demand for electricity exceeding supply or if power generated is less than the consumers demand, the need to shed load is eminent in order to avoid total breakdown of equipment's used by power distribution companies as a result of overloading effect. Power failure in the power system is mainly due to the overloading. The possible damage to the area is losing a power. The ESP32 based load control system is a device which automatically control overload on supply by controlling power and cut-off supply whenever system exceeds the amount of power supplied for peak period.

**Index Terms-** Automatic Meter Reading, Energy, Global System for Mobile, Microcontroller, Power, Power Controlling.

## I. INTRODUCTION

Power Failure in the power system is mainly due to the overloading. The possible damage to the area is losing a power. The ESP32 based load control system is a device which automatically control overload on supply by controlling power and cut-off supply whenever consumers exceed the amount of power supplied for peak period.

This is achieved by ESP32, which detect overload and simultaneously cut-off the supply for the period of supply overloading. In this project system can be automated into two stages are monitoring function and controlling function. In Monitoring function, it has to record the reading, 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. The project aims 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.

## II. LITERATURE REVIEW

"Islanding Scheme and Auto Load Shedding to Protect Power System" Srinu Naik Ramavathu, Venkata Teja Datla, and Harshitha Pasagadi. This paper presents a technique to develop an auto load shedding and islanding scheme for a power system to prevent blackout and to stabilize the system under any abnormal condition. In this paper, load shedding is

done calculating the rate at which the system frequency is varying during an abnormal condition. The rate of change of frequency technique proposes the sequence and conditions of the applications of different load shedding schemes and islanding strategies.

It is developed based on the international current practices. It is designed, and an auto load-shedding and islanding scheme is developed which is quick and is highly helpful in obtaining system stability.

"GSM based automatic substation load shedding and Sharing using programmable switching control" S.R.BALAN, P.Sivanesan, R.Ramprakash, B.Ananthakannan, K.Mithin Subash This project is designed to control substation load shedding and sharing using a programmable switching control by automatically. In this project he demonstrates the working of this simple operation using a Microcontroller.

The development of this application requires the configuration of the program through GSM module. In substation, there are many tasks like certain loads need to be switched on/off in specific time intervals. In this, the loads can be operated in three modes: Set mode, Auto mode and Manual mode All the modes and status of loads are displayed on an LCD. Finally, GSM modem which sending SMS to the control system we can select the mode and timing remotely.

"SMS based Load Shedding Period Control System" Dwijen Rudrapal, Smita Das Swapan Debbarma Goutam Pal This paper demonstrates the need for a modern load shedding scheme and introduces the idea of developing a SMS based procedure for controlling the load-shedding system where manual work will be minimized by selecting the feeder, substation and duration of shedding time by the user by sending SMS.

### Objectives

The objectives of developing this system are as follows:

- Set maximum load limit as per requirement.
- Automatic load control based on the limit set by user.
- Automatic on/off of devices based on priority.
- Prevent power failures and damage to the system.
- Real Time data monitoring using IoT.

### III. SCHEMATIC (BLOCK) DIAGRAM AND WORKING

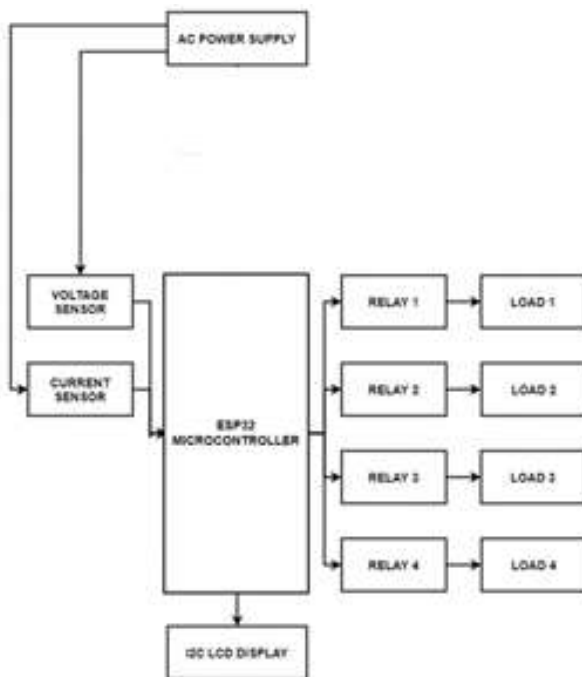


Figure 1: Block Diagram

- The system comprises of ESP32 as the microcontroller.
- A custom made android app is used to set maximum load wattage which is displayed using I2C LCD connected to the system.
- It is also used for activating relays connected in the system to which load is connected.
- A current sensor and a voltage sensor is used for measuring current and voltage respectively which is then reported to the microcontroller based on which current wattage is calculated.
- When the loads are switched on the wattage changes. The user can switch on loads only up to the maximum wattage set after which the system will automatically cut off supply to the loads based on the priority set in order to keep the wattage within specified limit.
- Current status of the system can also be viewed on Android App designed using Kodular.

### Circuit Diagram

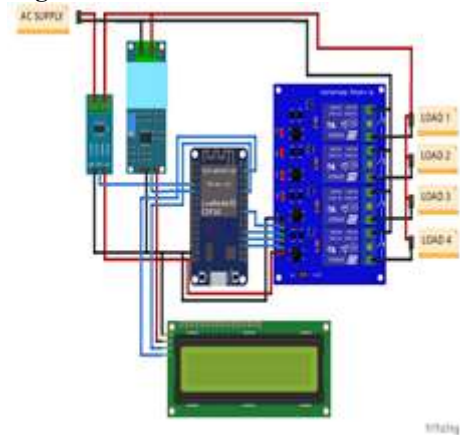


Figure 2: Circuit Diagram

### IV. MAIN COMPONENT INTRODUCTION (EQUIPMENT DETAILS)

#### 1. ESP32 Microcontroller



Figure 2: ESP32 Microcontroller

ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC. ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

#### 2. 4 Channel Relay Module



Figure 3: Channel Relay Module

The 4 Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc. The relays terminal (COM, NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay.

### 3. I2C LCD Display



Figure 4: I2C LCD Display

This is a 16x2 LCD display screen with I2C interface. It is able to display 16x2 characters on 2 lines, white characters on blue background. Usually, LCD display projects will run out of pin resources easily. Hence I2C LCD is used as it requires less number of pins.

### 4. Voltage Sensor



Figure 5: Voltage Sensor

ZMPT101B AC Voltage Sensor is the best for the purpose of the DIY project, where we need to measure the accurate AC voltage with a voltage transformer. This is an ideal choice to measure the AC voltage using Arduino/ESP8266/Raspberry Pi like an opensource platform.

In many electrical projects, engineer directly deals with measurements with few basic requirements like High galvanic isolation, Wide Range, High accuracy, Good Consistency.

### 5. Current Sensor



Figure 6: Current Sensor

The ACS712 Module uses the famous ACS712 IC to measure current using the Hall Effect principle. These ACS712 module can measure current AC or DC current ranging from +5A to -5A, +20A to -20A and +30A to -30A. You have to select the right range for your project since you have to trade off accuracy for higher range modules. This modules outputs Analog voltage (0-5V) based on the current flowing through the wire; hence it is very easy to interface this module with any microcontroller.

### 6. Zero PCB

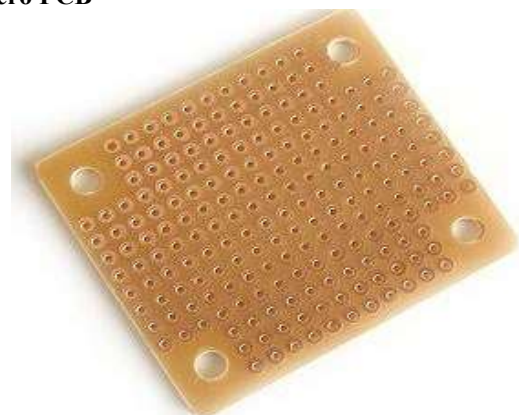


Figure 7: Zero PCB

Zero PCB or Perfboard is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made of paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminate (FR-4).

## 7. Connecting Wires



Figure 8: Connecting Wires

Since stranded wire is more flexible than solid core wire of equal size, it can be used when the wire needs to move around frequently.

## 8. Jumper Wires



Figure 9: Jumper Wires

Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into.

## 9. Male Headers (Burg Strips)



Figure 10: Male Headers (Burg Strips)

Pin headers are stiff metallic connectors that are soldered to a circuit board and stick up to receive a connection from a female socket. While pin headers (often called PH, or headers) are male by definition, female equivalents are also quite common, and we refer to them as female headers (FH) or header connectors.

## 10. Female Headers (Burg Strips)



Figure 11: Female Headers (Burg Strips)

The female connector is generally a receptacle that receives and holds the male connector.

## 11. USB



Figure 12: USB

USB stands for Universal Serial Bus. It is used as a data cable for programming as well as for supplying power.

## Software Used

### Arduino IDE



Figure 13: Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board. The source code for the IDE is released under the GNU General Public License, version. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are

compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. In our project, it is used for uploading code to NodeMCU ESP12-E Board.

### Fritzing



Figure 14: Fritzing

Fritzing is an open-source hardware initiative that makes electronics accessible as a creative material for anyone. We offer a software tool, a community website and services in the spirit of Processing and Arduino, fostering a creative ecosystem that allows users to document their prototypes, share them with others, teach electronics in a classroom, and layout and manufacture professional pcb.

### Kodular

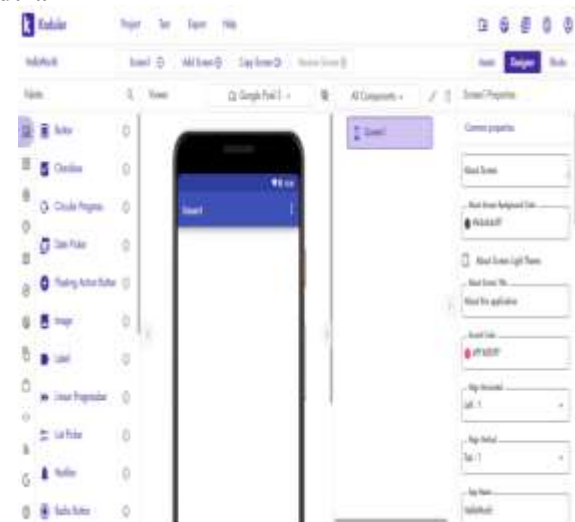


Figure 15: Kodular

Kodular (formerly Makeroid) is an open-source online suite for mobile app development. It has an innovative component

and block design which provides a free drag-and-drop Android app creator without coding, based on MIT App Inventor.

### Advantage

- Real time monitoring and controlling of the system.
- Requires less time for switching.
- Automatic and manual control of loads.
- Easy to implement and scale.
- Modular and inexpensive.

### Application

- Automatic Load Control.
- Automation of Devices.
- Smart Energy Meters etc.

## V. CONCLUSION & FUTURE WORK

The proposed work provides an efficient way for load control at real time. The ESP32 based load sharing and control system designed specially to monitor overload. The design scheme consists of dual load system. This was achieved by the used of some solid-state components like relays. The method used in the project provides necessary stages from overload detection to switching and cutting of supply. Future work may include adding dashboard to the system with auditing and consumption calculators.

## REFERENCES

1. "Islanding Scheme and Auto Load Shedding to Protect Power System" Srinu Naik Ramavathu, Venkata Teja Datla, and Harshitha Pasagadi.
2. "GSM based automatic substation load shedding and Sharing using programmable switching control" S.R.Balan, P.Sivanesan, R.Ramprakash, B.Ananthakannan, K.Mithin Subash
3. "SMS based Load Shedding Period Control System" Dwijen Rudrapal, Smita Das Swapan Debbarma Goutam Pal