

REMOTE ALERT SYSTEM FOR ELECTRICITY IN PLUG MAINS

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Abstract: The research was made to achieve an alert system for electricity status in mains. The status is sent through a wireless medium, and is done when voltage is Low, High or power goes off. The system uses a GSM module to send alert via Short Message Service (SMS), other devices like Arduino, measures the voltage from mains, and controls the electric status sent at a particular time by controlling the GSM module (M590); the relay, for selecting voltage source for the system; Mosfet for digital switching of the Arduino and GSM module, the DC battery for source when mains goes off; keypads to input MSISDN (Mobile Station International Subscriber Directory Number), Liquid crystal display to see numbers input, condition of the module and when number is saved. The alert is sent to a phone which has the saved MSISDN. The aim of the research is to design a Remote alert system for monitoring when electricity is in mains or not from any distance around the globe, which sends measured voltage from the mains too. It can be used anywhere we have electric power, but mostly where it is unstable.

Keywords: GSM module, relay, keypad, MSISDN, Remote alert, Arduino, AT Command.

1 Introduction

There has been a growing demand for electricity on the part of industries, commercial establishments and residential dwellings. Electric remote alert systems are needed in situations where power is unstable, user is far away from the environment and needs to monitor when power is on or off. It notifies the user immediately power is in mains or not. This can be in an environment where power is needed to control production, for home gadgets or to know when to switch devices to avoid damage through electric surge. Remote alert can be restricted by distance depending on the method used in the system.

Modern equipment requires a continuous supply of electricity. Power failure may be caused by different factors but whatever the reason you will be notified immediately power goes off and also when it comes on. Take the case of a microwave cooker, the microwave cooker is used to boil or warm foods in container and needs a stable power to complete the process or else the food will spoil. Also imagine if you have an automated system in an industry for production which needs power from the national grid and is costly using a personal power source, you see the need to monitor when power is on and when it goes off. Remote Alert for electricity plug in mains could be achieved by various techniques as follows: Transmission Control Protocol/internet Control Protocol (TCP/IP) as an alert system when power comes in mains, GSM (Global System for Mobile Communication) Module for alert notification when power on in mains, Sound Alarm Alert on Electricity plugged in mains, Alert system Using Bluetooth notification with sound. A Top- down design is used for developing the system and a bottom-up approach for components integration.

2 Overview of the Remote alert system

The GSM Module (M590) is a communication module is an ultra-compact GSM industrial wireless module, optional dual-band or Quad-band, is used in sending notification to the user mobile phone. It uses the Attention command (AT commands) as extended command set, with a point to point cell broadcast. The Module is controlled by the microcontroller, in this case Arduino Uno. The microcontroller executes the code uploaded, and operates depending on external devices control connected to it.

The performance of the intended device is all dependent on the telephone network under use. However, the SMS is sent to the MSISDN (Mobile Station International Subscriber Directory Number) provided by the user and can be changed if need be. An alert is sent at any point voltage varies by 50V. When sent to the SMS center, the message is further stored until the service center can gain connectivity to the destination. There is a validity period attached to each message sent from the device, if this period should elapse before the network is available, the message will be deleted from the message center buffer.

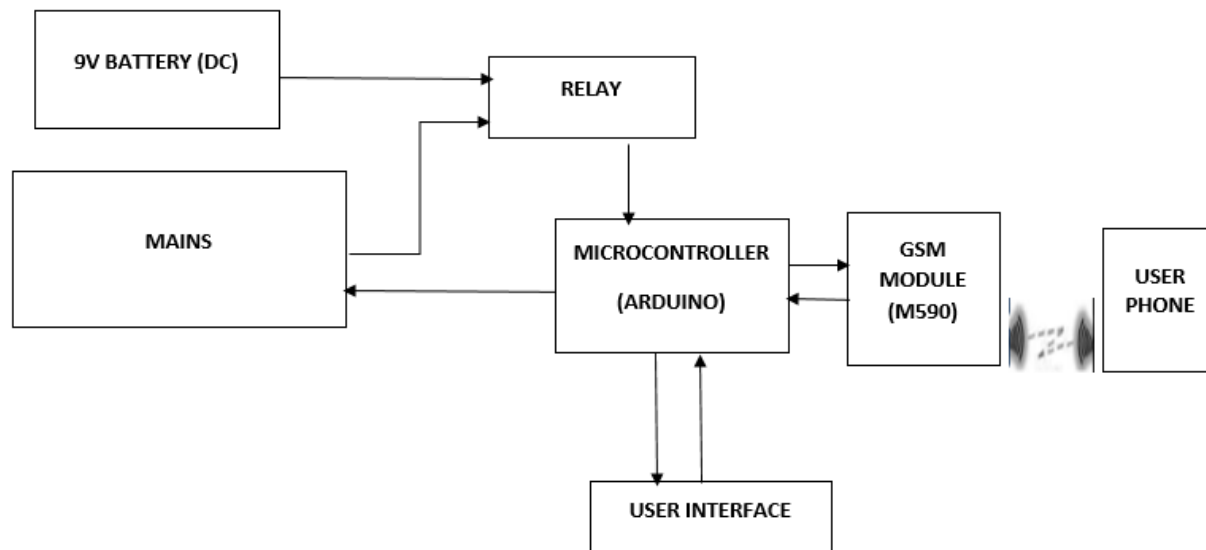
The message contains the electricity on mains status, and if electricity is on mains it measures the voltage on mains and sends the measured voltage to the MSISDN number in a phone.

The user can receive the message anywhere under the globe. It helps in monitoring devices at home or in a factory without physical observation. The project can be modified to achieve a complete automation system which will create an interface between user and monitored environment. The System uses two different sources; the mains, which is monitored; the DC battery which is used immediately the mains cuts off. The user communicates with the system through the keypad and is visible on the LCD

3 Design and Implementation

The block diagram in figure 1 shows, the remote alarm system consists of two subsystems: Alert system and the User phone. The alert system contains five different blocks;

- ❖ Source (DC battery and mains).
- ❖ Arduino Microcontroller.
- ❖ User interface.
- ❖ Relay.
- ❖ GSM Module.

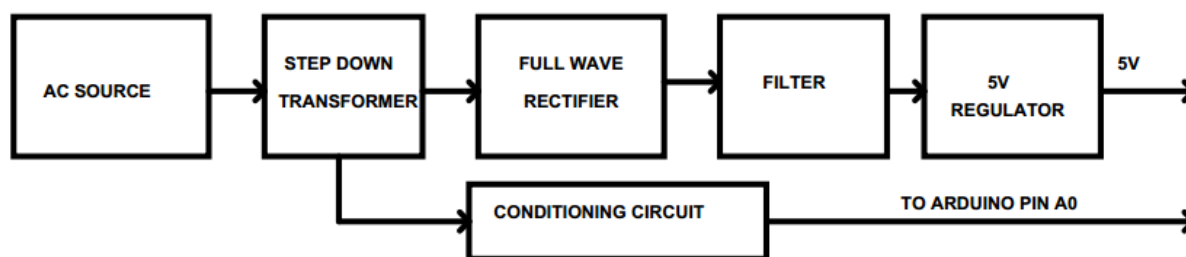


Block diagram of the Remote alert system for electricity in plug mains.

3.1 AC Source

This is the main power source. It is responsible for providing electrical power to the system. The system source is from AC outlet, which is stepped down to 12volts, then rectified, filter and regulate it to 5volts

which is used to power the system (GSM modem and Arduino uno). At the same time, the unfiltered full wave rectified signal is conditioned and applied to the analog pin A0 of the Arduino uno for voltage measurement.



Block diagram of the power supply

The AC voltage source is 240v, the transformer a center tapped transformer rated 12v 1000mA.

In designing the power supply, we should consider the different ratings for different electronic components. According to the M590 GSM module hardware design manual, power supply design and good circuit layout are crucial for ideal performance of the module. The power source not only powers the digital and analog circuit, but also the RF power amplifier which draws high peak currents. It is necessary to include low ESR electrolytic capacitors or tantalum capacitors, close to the VBAT supply

inputs. Furthermore, filtering capacitor in the range of 0.1µf, 100pf and 33pf should also be included for higher frequency interference reduction.

The maximum instantaneous current input to the GSM module is 2A, maximum current will occur during the process of calling or data transmission in weak signal environment.

Hence the current requirement for the signal is described as follows.

$$I_s = I_{GSM} + I_{Arduino} + I_{LCD}$$

I_{GSM} is the maximum supply current for the GSM module and $I_{Arduino}$ is the maximum supply current for the Arduino board while LCD is for the LCD module.

$$I_{Gsm} = 2A$$

$$I_{Arduino} = 200mA,$$

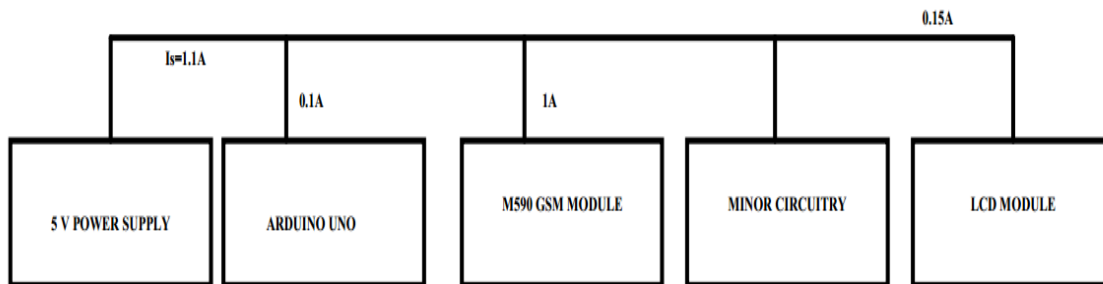
$$I_{LCD} = 150mA$$

$$\text{So, } I_s = 2 + 0.2 + 0.15 = 2.35A$$

This is the absolute maximum supply current.

We choose to operate the Arduino at 100mA and the GSM modem at 1A. so that the required supply current will be

$$I_s = 1 + 0.1 + 0.15 = 1.25A$$



Current distribution Model

The minor circuitry draws negligible amount of current. So, it is ignored and only the Arduino GSM modem and the LCD supply current will be considered.

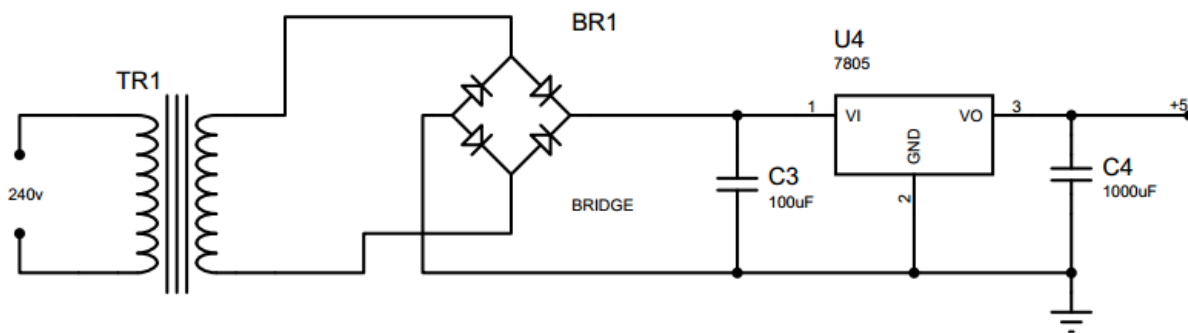
$$V_{ARDUINO} = 5V$$

$$V_{GSM} = 5\text{volts}$$

$$V_{LCD} = 5\text{volts}$$

3.2 Voltage Consideration

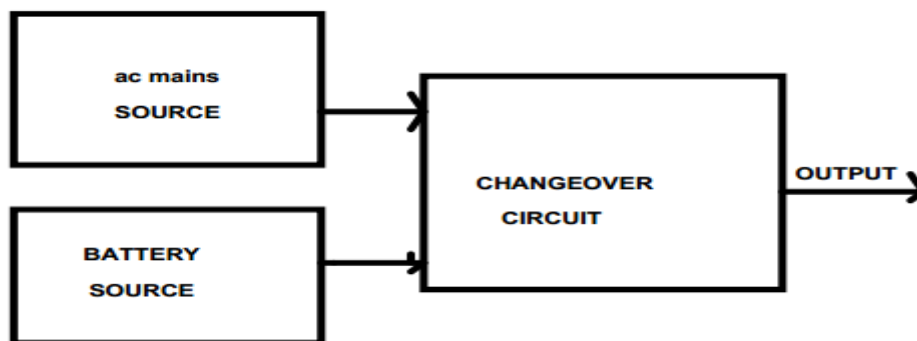
The Arduino uno and the M590 GSM/GPRS module will be powered with 5volts



The circuit diagram of the main power supply.

3.3 Changeover Module

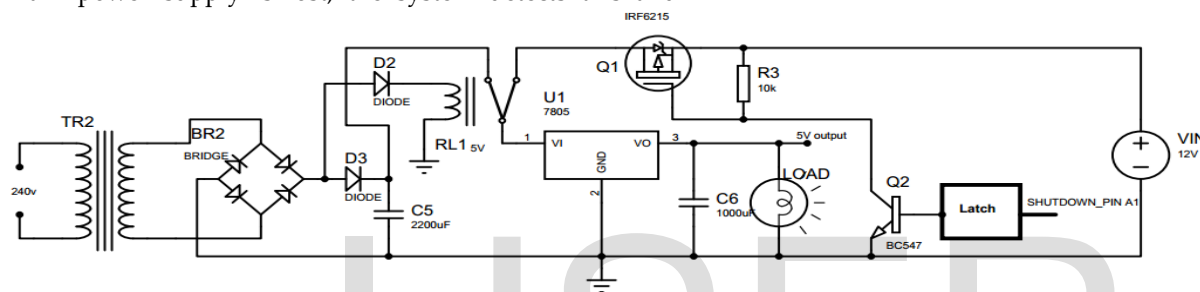
The changeover module is responsible for switching smoothly from the main power supply to the battery power source (DC) when power from mains is lost.



The block diagram of the Changeover Module

When power comes on the main power source selected by default and is used to power the system. However, if the main power supply is lost, the system detects this and

make a quick switch to battery power source. Which is used to send a "power off" SMS alert to remote user.



Circuit Diagram of the Power Source Selector

3.4 CONTROLLER MODULE

This subsystem co-ordinate and sequences the operation of the entire system. It forms an interface with the GSM module through RS232 port and communicates to it through that port. This module is loaded with instructions to execute and these instructions include the following:

1. Display information
2. Read and write to data memory (EEPROM)
3. Measure main source voltage
4. Send SMS to remote user whenever the main power source comes on and when it is lost

The algorithm / pseudocode describing the program flow is shown in figure below.

The Source supplies electrical energy to the system, it consists of the mains which is monitored and the DC battery which acts as a standby source to notify the user when power goes off from the mains. The DC battery can be replaced with a rechargeable battery source. The Arduino microcontroller acts as the brain of the system, it detects the state of the mains, and

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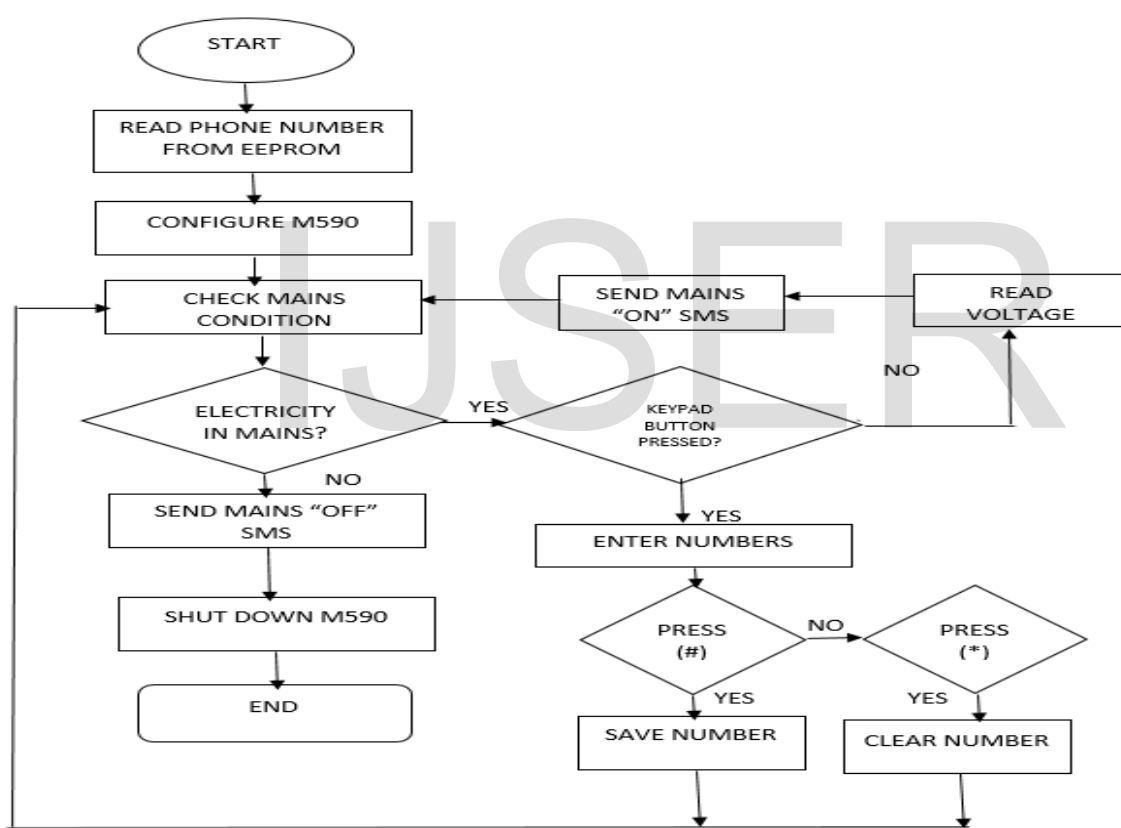
>> Read stored MSISDN
>>Configure M590
>>Check for mains condition
>>electricity is in mains?
    Yes==Keypad pressed?
        Yes==Enter Number (press * to clear and
        #to save)
        No==Read Voltage
            >>Send Mains ON SMS
            No==Send OFF SMS
            >>Shut down M590.
    controls when the module is to notify the phone, it
    saves the MSISDN anytime it is changed by the user.
    The Relay selects sources automatically and is sensed
    by the Microcontroller which sends mains off status
    when source is from the battery. The MSISDN can be
    changed by the user with a keypad and can be seen
    
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through the LCD. The LCD and keypad consists the user interface block diagram.

The user phone can performance is determined by the network under use, but is added to the block diagram for complete notification to be achieved.

The flowchart below shows how the Remote alert system works. The system is plugged in a mains outlet socket, the Arduino reads the MSISDN from the EEPROM (Electrical Erasable Programmable Memory) and configures the GSM module. The microcontroller detects when electricity is on mains and checks if the

user changed the MSISDN by pressing the reset keypad button connected to the microcontroller. The "On" electricity status contains the voltage measured voltage and indicates when Low or High, it continues check to detect when voltage level changes and notifies the user again. The (*) button is used to clear number if a mistake is made while the user inputs number, while (#) is used to command the microcontroller to save. Here a 4 X 3 keypad is used (with 0-9,*, # keys).



Flowchart showing the system process flow

Arduino programming code is used to program the system. Codes are programmed in subsections and can be recalled depending on the systems state. AT commands are also created as a subsection for configuring the GSM module by the Arduino Uno

4 Recommendation

- More projects like this should be encouraged among students, because such a project helps students to integrate their knowledge in other parts of electrical engineering into their electronic design.
- A rechargeable standby source can be used in place of a DC battery, this helps in energy conservation and will not need to be changed with time unlike the common DC battery.

- An automation system can be added to the system to alert the user and also to control devices from anywhere through the user phone.

The remote alert System for electricity in plug mains, is a system which alerts an electricity user the mains status at any change. The system also reads supplied voltage to the mains and tells the user when voltage is High or Low. Notifications can be received from anywhere around the globe, while its performance depends on the network under use.

5 Conclusion

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