INTELLIGENT PLUG FOR USER AWARENESS AND POWER MANAGEMENT

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ABSTRACT

In today's busy life style we are ignoring about power loss through different appliances in home, and they are working even if no one is in home, so we need a reminder which give status about the working of different home appliances in different plug points. Short circuit or over load causes fire or power failure in building/home, so continuous monitoring of load variations helps to avoid danger. Many of us forget to turn off the appliance after use and sometimes they think about that after leaving the home. So we need a system which give provision for turning on or off the loads remotely. The proposed system, uses GPRS communication for accessing the electrical parameters like voltage, current consumption. From the time the plug began to power the load, it starts to send signals from smart plug to an android device and android application installed in it shows the details. User can set the limits for voltage and current, and the system will give alert message when anything goes beyond the limit. Android application have option to set limit for different parameters and also for On Off time management. When smart Plug is connected to the socket, at the same time it starts to operate with the android device. Android application shows the electrical parameters available through the GPRS communication. GUI available facilitate user to set parameters threshold values, and set timer for On/Off conditions. User can set the over voltage limit, lower voltage limit, current limit, and off time using the application software.

Keyword: - Load monitoring, GPRS communication, threshold values, GUI interface

1. INTRODUCTION

The development in the electrical technology makes our lives more convenient. The demand for power supply is increasing day by day. We have to look on how to save power and also how to meet the need of society for electricity. So as for energy management the proposed intelligent plug realizes to monitor electrical parameters constantly and gives data to the user periodically. [1]

Intelligent electrical plug is an important part of intelligent household system, it can realize the power equipment monitoring easily, control and transmit data, communication technology using the GPRS wireless technology. Intelligent plug concept is for the purpose of security, protection and energy management and here the ordinary plug

has been redesigned to perform more functions, such as its several protection functions against short circuit, overvoltage etc. Unattended power plugs leads to short circuit or overload problems which may result in fire hazards and power failure in houses/buildings.

Now in this paper the proposed system is designed to have these features combined with the circuitry to transmit data wirelessly using GPRS wireless communication. It automatically operates the electrical plug based on the parameters acquired thus makes the system intelligent eventually. And also through the GPRS network the data will be transmitted to the user and this data serves as the basis for the user to make decisions manually.

Intelligent plug can be used for household intelligent functions. Intelligent plugs can open circuit power supply, so as to control the electrical power supply; and setup a base to communicate with user to ensure that it operates normally.

2. EXISTING STRUCTURE

The existing systems is focused on load monitoring, evaluation and optimization. And those systems would disconnect excessive current consumption devices and overload devices, while the other equipment's connected to the circuit breaker will remain unaffected and in operation. In the case of such an event, depending on the system configuration, a notification would be generated, e.g. an email or a text message. This message is generated by the central control unit of the intelligent network.

Wireless solutions for intelligent home systems are most often based on well-known technologies like Bluetooth Low Energy-BLE (IEEE 802.15.1), Zig Bee (IEEE 802.15.4), Wi-Fi (IEEE 802.11) or Z-wave (ITU-T G.9959). These technologies can be evaluated and compared from different aspects [2],[3].Among the most important parameters for home intelligent networks, the communication range, data rate, data security (encryption), power efficiency and compatibility with third part devices are considered.

A lot of external smart plug systems are available on the market [1], while only a very limited number of built-in solutions exist. Moreover, a lot of solutions is Wi-Fi network based that is inherently power inefficient, thus not suitable for large scale installations that aim to control and optimize the households power consumption. Therefore, our motivation is to develop an intelligent energy monitoring system based on a low-power wireless networking technology that would have the minimum installation requirements.

3. PROPOSED SYSTEM

3.1 Basic design

The proposed system consist of a microcontroller, GPRS module, relays, electrical measurement module, voltage conversion circuit, the power input port and the power supply output pin, and supporting circuitry, which is shown in figure 1. The figure represents the connections between the related modules.

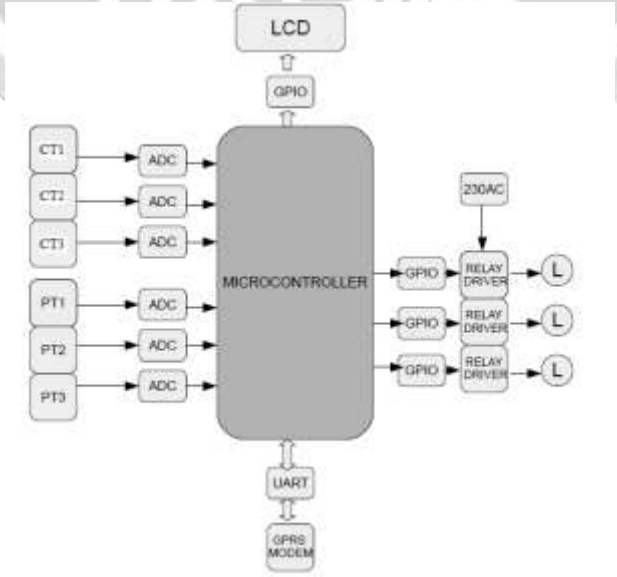

Figure 1: Basic structure for intelligent plug

3.2 Microcontroller Section

Microcontroller PIC16F877A is selected as the key controller of the system, this module is the core of the system, and its functions include data acquisition, dynamic data exchange, data operation, data statistics, data storage etc. The microcontroller part diagram is as shown in figure 2.

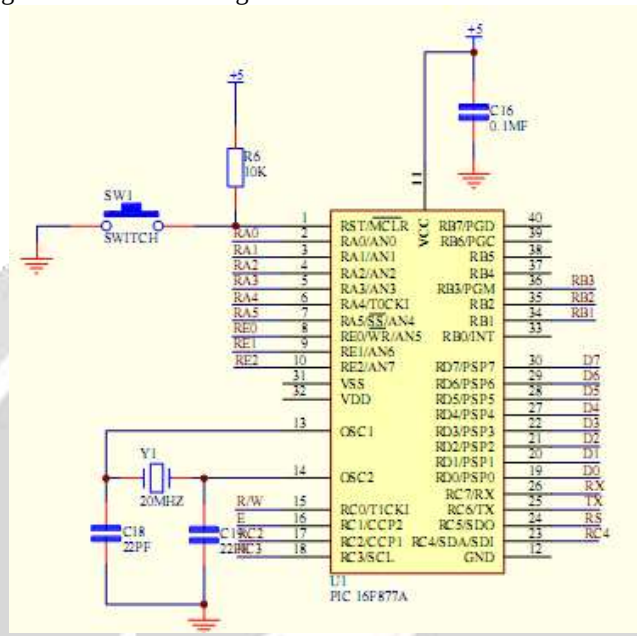

Figure 2: Microcontroller Part

16F877 requires 20MHz frequency. To generate 20MHz frequency we use a high speed crystal having ability to produce the same frequency by connecting two capacitors each of 22pF. 0.1µF at pin 11 is used to ground the ac signal. Voltage spikes below Vss at the MCLR i.e. 1st pin including currents greater than 80mA may cause latch-up. So a 10Kohm resistor is used when applying low-level to the MCLR pin rather than pulling this pin directly to Vss. The power supply part of the circuit diagram is as shown in figure 3.

3.3 GPRS communication section

GSM/GPRS TTL -Modem built with SIMCOM Make SIM900 Quad-band GSM/GPRS engine is used here to obtain connection with microcontroller. The main function is to realize the GPRS communication, to communicate with the MCU on data collection. The circuit diagram to connect the GPRS system with the MCU is shown in the Figure 3 below.

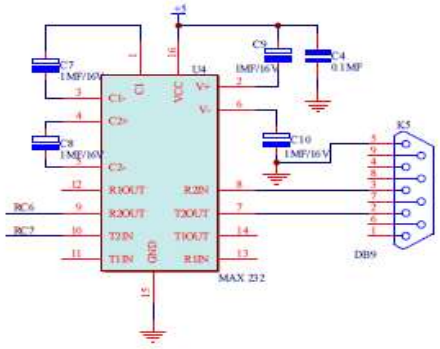

Figure 3:GPRS communication connection circuit

3.4 Relay module

The Relay connects with the MCU's GPIO port. MCU controls relay on or off through the output of the GPIO port, which is shown in Figure 5.

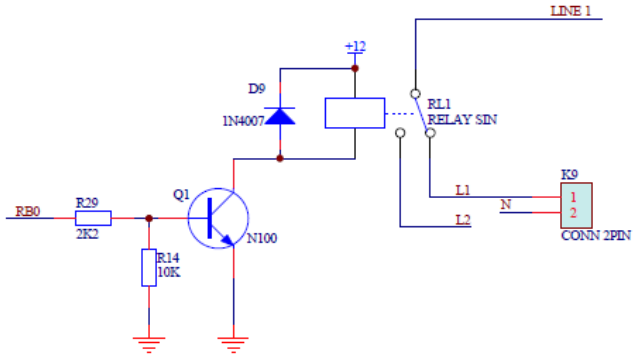

Figure 4: Relay section

3.5 Key

Key's main function is to reset the socket .While the push-button is pressed less than 3 seconds, the system will reset. Resetting the socket will generate a new connecting network name, IP address etc. The socket will generate a network automatically, through the app installed in the android phone of the user it can be connected to the Internet.

4. WORKING

The system consists of a microcontroller setup, here PIC 16F877A microcontroller is used for performing the function required for us. Three current transformers are used to obtain the current readings of the current flowing through the circuit. This is calibrated as required and given to ADC to obtain digital signals which is then given to the microcontroller.

Similarly voltage transformers are provided, which are step down transformers which gives step down voltages as output corresponding to the voltage of the circuit. This step downed voltage is given to ADC and the digital signals are given to the microcontroller. The voltage and current values are calibrated with the normal voltages and currents.

The microcontroller is programmed to compare the signals from the current transformer and voltage transformer with those of the values programmed or preset in the IC and operates the corresponding relay circuitry to turn off and turn on the corresponding supply to the 3 circuits.

The same voltage and current measured along with status are displayed in the LCD which is interfaced with the microcontroller unit. In addition, the microcontroller also gives signals for transmitting these data's to the users android phone using GPRS technology.

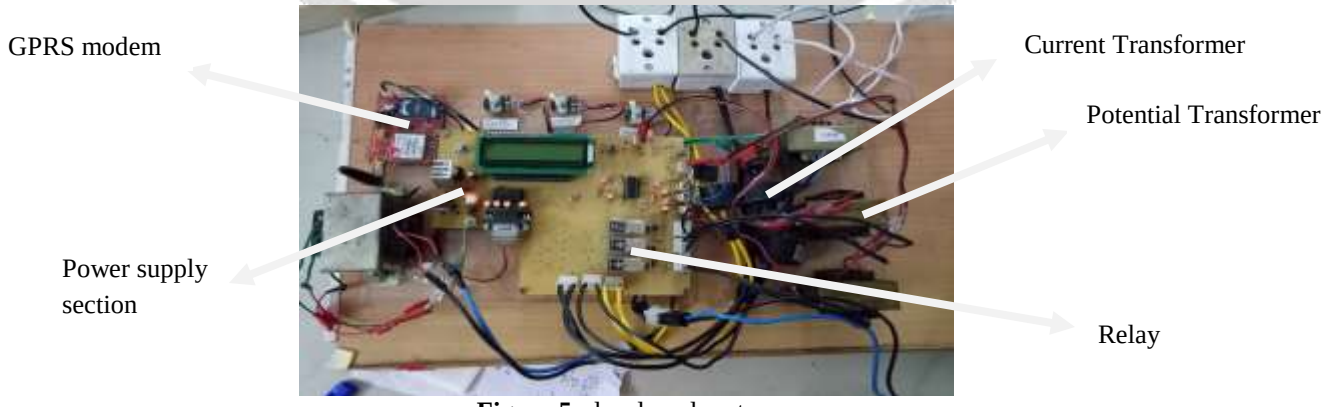

Figure 5: developed system

5. SOFTWARE SECTION

The intelligent plug's concept is to accomplish a smart home system through GPRS communication system. If we have a super smart plug, no matter where we go, we can control the household appliances just only with the phone.

5.1. Main program flow

The purpose of designing of the system software is that for receiving a serial data from the port, according to the parameters obtained from the plug. Initially the user request for connection is processed by connecting with the IP address as provided by the GPRS module. After that it will send the received binary data stream to the user. User's android application then completes the functions such as data receiving displaying and so on.

5.2. Flowchart

The basic flowchart for the system is shown in figure 6

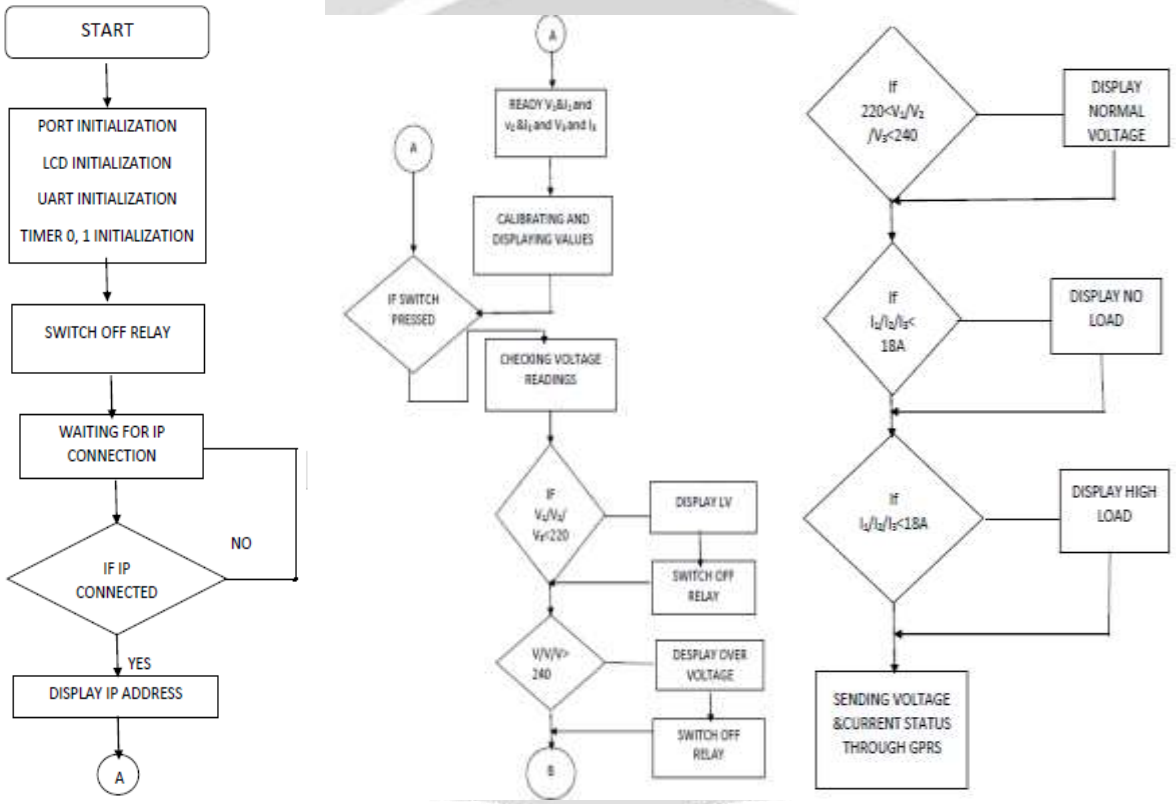

Figure 6: Basic flowchart

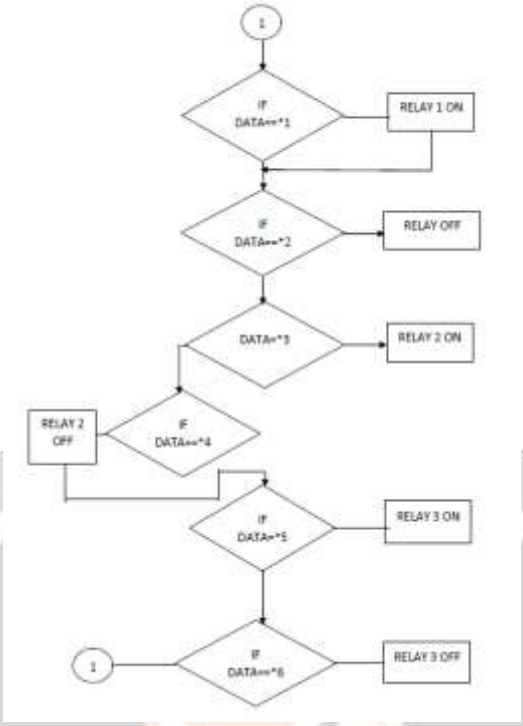

Figure 7: Interrupt section flowchart

The flowchart representing the interrupt program is as shown in figure 7.

5.3 Design of android application software

Figure 8: Android application window

The android application software window designed for the purpose of controlling and monitoring the system is as shown in figure.

Before being activated, the software read the information of interface elements, graphical user interface (GUI) designed will open up after connecting with the IP address. The socket's equipment interface can add or delete a socket for users, and it also can control the state of the socket whether open or not. The electricity information will be displayed in the window as shown in figure8.

6. CONCLUSION

In our paper, we presented a way to overcome a daily life problem which results in the saving of power, which is especially needed in today's fast growing world. Our project detects the fault and no load, overload, and normal load conditions in the circuit and automatically operates the relay without our intervention. That is it had got an intelligence of operating on its own by looking at the conditions present at that time. Moreover an added feature for user friendly operation using android app was also developed, which include transmission of the signals obtained and its condition through GPRS communication to the android app present in the users device.
Hence our project suitably overcame the faced problem of power management through load monitoring, and future innovations can be done using this.

7. REFERENCES

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