A novel IOT based domestic automation system for load monitoring and efficient control

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Abstract. Home and industrial automation are really relevant as it offers flexibility and allows things easy to use. Wireless home automation control is built and deployed using Wi-Fi technologies to monitor specific home appliances with essential protection and also to secure the network. Devices installed in each room have their own work boards attached to the personal computer or mobile devices through the control panel and the user may be aware every day of their energy use by sophisticated tracking methods. The suggested method is also very beneficial for users in managing their electricity consumption and effective load management may also be carried out.

1. Introduction
The Internet of Things (IoT) is an Internet communication that allows the interaction and exchanging of data with the actual items, vehicles, home appliances and those in hardware applications, sensors, activators and networking. Each object is special, yet can fit into the network infrastructure, via its integrated computing unit [1].

The IoT allows artifacts to be detected or remotely controlled through existing internet infrastructure, goals and to make incorporation of the physical world with desktop-based systems [2]. It resulting in enhanced efficiency, accuracy and financial advantages in addition to the reduced human involvement. IoT with Mobile applications are going to gather useful data utilizing numerous current technologies and enabling themselves for data transfer among other devices.

Now days there are variety of services and the system that can aimed to reduce the energy consumption, so we develop IOT based load monitoring and efficient control [3]. In this system we use a separate display unit for monitoring and knowing the energy consumption. Our system can be installed in industries or in apartments, lodges, hotels and highly populated residential buildings.

Automatic monitoring and controlling is the way to reduce the human efforts by using the mobile application and web pages [4-5]. We can control many loads as required by using mobile application, the main purpose of mobile application is to control the loads by customer themselves. So the proposed system is user friendly and the customer can control the load through a simple mobile application and also do monitoring process.

2. Existing System
The new network comprises of stat device Wi-Fi router[6], local computer, rectifier, transmitter, panel, relay drivers and relays, which are included in the latest tracking system by way of an energy meters and a locally-based database[7]. This is not managed over long distances with the present PIC controller as only a load can be attached. We would have to write the coding for further charge and then upload the coding in a pic controller if we were going to attach the additional load reset [8].
However, we use atmega328 to link to this charge anytime as per requirement. That is what the atmega328 has to offer. For converting DC supply to AC supply, the existing system rectifier is used. Nonetheless, we can regulate ac supply directly. Compared to our method, the current framework is quite complex [9]. The Wi-Fi router is found in the new network. We are using the implementation of Wi-Fi modem in our network. Similarly, on the internet, the ios app is really simple for end users to manage load.

**Figure 1.** Block diagram of existing system

Figure 1 shows the block diagram of existing system which is typically used to learn our current Process Block diagrams, with less comprehensive explanations at a higher degree, and are meant to explain basic principles without reference to implementation specifics. It provides information on the design and physical layout of electrical components [8].

Typically an AC power supply transfers the voltage from a wall outlet (main supply) to the desired voltage. There may also be some filtering [10]. AC power supplies can be broken into one-phase and three-phase devices for standard applications. The key disparity between single phase and three phase AC capacity is the transmission constancy at 230v, 50 Hz.

An electronic part is a voltage regulator device that helps to preserve a constant degree of voltage control. A Potential regulator can provide constructive feedback and can use a clear feedback system. Feedback voltage regulation feature contrasts the present output voltage with a certain specified reference voltage. The controlling factor is usually regulated if the output potential is too high to achieve lower output potential [9].

Using PIC16F57, the memory of the system and data is isolated [11]. Data is 8-bit, 16-bit memory, and 32-bit width in new versions. The software directions may be 12, 14, 16 or 24 bits in bit counting per PIC unit. The device's hardware features vary from SMD 6-pin, 8-pin Drop, up to 142-pin IC with dedicated O/I connectors [10]. The guidance can even be extended for more efficient chips that include instructions for automated signal processing functions. The developer offers machine tools with many forms of applications. It offers reduced-cost or costless software resources and the re-programming of series programed machines; low-cost production programmers and high-processing programmers are supported [12]. A relay is a circuit powered electrically. Many relays are fitted with an electromagnet, although certain practical concepts such as solid phase relays are often included. Relaxation is used when a specific low-power signal may be operated on a circuit or when several circuits can be controlled by a single signal. The first reliefs were used as amplifiers in long range
telegraph circuits: they reproduced and conveyed the signal through one circuit again. Relays have been commonly used for logical operations of phone lines and early computers. ATMEGA328, MCU (Wi-Fi module), ACS712 (30A, Existing sensor) etc. are the framework that is suggested. With the aid of block diagram and circuit diagrams we are now learning about it in depth.

Both load management and effective regulation are seen in the device block diagram suggested. However, only load control is required in the current framework. And for the control and tracking, we use ATMEGA328 and Node MCU primarily. We use the current sensor to display how often current is actually being used. And also for the same operation, the voltage sensor is used. We may track the watt-hour with this sensor. It implies that in a hour or one day we know what more power we used. This control program would allow end users to realize how much electricity they used for an hour. This control device allows the end consumer rising energy use. They use a pic device in this current framework. It is very challenging to attach new load to the pic unit [13]. However, we use ATMEGA328 in the proposed framework rather than in the pic unit. We can load this ATMEGA328 anytime we want. In contrast with the pic unit, it is easy to install load in ATMEGA328. In our method, Ac supply is included in our planned single step 230v. And to transform the stock, we use a Bridge Corrector. Throughout our plan we should incorporate protection load regulation as the voltage level rises or the load should immediately decrease OFF. Figure 2 shows the Proposed System Block diagram for higher level and less comprehensive definitions are usually used to explain basic principles without concern for execution specifics. It displays the output power and information regarding the design of the electrical and physical elements [14].

The AC power supply usually takes the voltage from the Electrical outlet (main source) and reduces it to the required voltage some filtering may often take place. In current implementations, AC power supplies can be split into single phase and three phase networks. The main distinction between single phase and three phase AC control is the constancy of transmission. We use 230v, 50 Hz in the current model. A relay is a circuit powered electrically. While some design ideas like stable-state relays frequently are used, other relays use an electromagnet to physically control a switch. Relays come into action when a new low-power signal is needed for the communication, or where a single signal is sufficient to monitor multiple circuits. For long distance telegraph systems, the whole first devices were used as transducers: they repeated the signal from one trunk and retrieved the signal to another. Switching devices are used extensively for rational processes of telephone exchanges and energy conserved and utilized efficiently [15].

A relay device that can manage the power required to monitor an electric motor or other freight directly is called a contactor. Rather of utilizing the semiconductor devices for shifting, solid-state relays monitor power circuits with no moving parts. Electric circuits defend against over challenge or loss by utilizing relays with optimized electrical characteristics and often several working coils; such tasks are done by automated instruments often regarded as “protective relays” in current electric power systems. Magnetic relays allow one pulse of inductive power in one direction and a diverted pulse in another to reverse the contacts in one direction. There is no response of repetitive pulses from the same signal. For systems where lost control is not to pass contacts magnetic latching relays are helpful. Both single and dual spindles are necessary for magnetic locks relays. The switch runs in one direction on a single rotating system while the control is applied with a particular polarity and resets when the polarity is inverted. It is necessary to determine the If polarized voltage is added to a reset spin on a dual spinning unit, the contacts are modified [16].

Magnetic lock relays operated by AC have single coils that are used to vary between running and restarting instructions by steering diodes. This has been used in long-distance telegraph systems, storing and sending a signal from one circuit to another. It has A / D (8-can in TQFP and QFN / MLF packages), internal oscillator programmable control signal and five power saving device modes. The system operates from 1.8 to 5.5 volts. The system will reach an output of 1 MIPS per MHz, manage power usage, and work speed by executing high-performance instructions in a single clock cycle. At first, though, the device and the instructions that it approved were almost without English-language records.
The extremely low price and the very small number of external components on the board, which suggested a very cheap amount, attracted many hackers to investigate and convert the processor, chip and software on this project.

3. Software calculation
A cross-platform code written in the computer language Java is Arduino's advanced production framework. The GNU General Public Authorization, version 2 is the root code of the IDE. Use special application layout laws, the Arduino IDE will support the languages C and C++. The Arduino IDE provides the Wiring project program library with various can inlet and outlet procedures. The user-written code contains only two simple functions that are compiled and connected to the software stub main) (for beginning the sketch and the program code loop [17]. The GNU series of software used with the IDE release in an interactive cyclic executive system. The Arduino IDE uses the avrdude program to transform program file into a hexadecimal text format, which has been fed onto the controller board by a feeding function in the relevant software of the component.

3.1. Voltage Measurement
VolrVoltage_Value1 = Voltage_Value * (5.0/1023.0) *67

3.2. Current Measurement
DoubleRMSCurrent = (((maxCurrent - 516)*0.707)/11.8337)

3.3. Power Measurement
Power= voltage * current

3.4. Energy Measurement
Kilo = kilo + (RMS Power * (2.05/60/60/1000))

3.5. Consumption bill amount
Bill amount = kilowatt*3.5(Tariff can be changes based on requirement)
4. Hardware arrangement
This scheme is based strictly on load handling in our program. We use various devices including a resistor bridge and a voltage control device. The performance will be shown on the LCD monitor utilizing Arduino IDE tools. The entire system is connected to a rough board. Both load management and effective regulation are seen in the device block diagram suggested. However, only load control is required in the current framework. And for the control and tracking, we use ATMEGA328 and Node MCU primarily. We use the current sensor to display how much current is actually being used. And also for the same operation, the voltage sensor is used [18-19].

![Figure 3. Hardware setup of proposed system](image)

Figure 3 shows the hardware setup of the proposed system with a motor load. A relay is a circuit powered electrically. Many relays are fitted with an electromagnet, although certain practical concepts such as solid state relays are often included. Relaxation is used when a specific low-power signal may be operated on a circuit or when several circuits can be controlled by a single signal. A current sensor is a system which senses the electric coil of wire and produces a corresponding signal. This signal is used to show the calculated current, or to store and use it in a device for future study. The voltage sensor may calculate the existence of a voltage, i.e. on insulating wires, without having a metal touch. A voltage monitor is made up of a voltage resistive divider. Included in a casted resin (for voltages from 1-72kV), the combined resistors display a weak inductance rating [20].

5. Simulations of the Proposed System
The circuits meant for simulating the proposed system are as follows,

5.1. Simulation circuit for Voltage Measurement
The potential measurement device consists of AC-DC Converter IC, Zener diode, condenser, transformer and variable resistance. The conversation device goes down to 12V ac, and moves into the correction unit and receives 12V dc. 230V AC. This is pushed via the filter device and three volts dc supply is received. The programming is now in micro C. The code could also be written using the Java language. The system generates and creates the code. The main benefit of using Arduino is that the
software can be modified without flickering the controllers except in the runtime. This makes writing code simpler and more versatile. The simulation circuit for calculating voltage is shown in Figure 4. Drawing and simulating in Proteus is even simpler.

![Figure 4. Measuring Voltage in Proteus](image)

5.2. **Simulation circuit for Measuring current**

The sensor used to measure current ACS712 is being used in the segment. The current calculation approximation as seen in Figure 5.

![Figure 5. Simulation circuit of current measurement.](image)

5.3. **Complete Proteus Simulation**

Figure 6 shows the complete simulation diagram of the proposed system with a load which appears to be a simple lamp load for simulation purpose.
6. Hardware Results

Hardware result for under voltage, normal voltage and over voltage diagram given below. Table 1 shows the reference voltage parameters taken for handling loads. The reference voltages are based on the nature of the load selected and as per IEEE norms.

| Description      | Range      | Condition     |
|------------------|------------|---------------|
| Under voltage    | Below 180v | Relay is ON, Load is OFF |
| Normal voltage   | 180v to 230v | Relay is OFF Load is ON |
| Over voltage     | Above 250v | Relay is ON Load is OFF |

6.1. During Under Voltage condition

If the measured voltage value is less than that of the reference value of 180V, then the relay is turned ON to protect the load and the Load will get OFF. The LCD display under this condition is shown in the figure 7. In the figure the LCD display interfaced to the Arduino controller shows the active or inactive behavior of the Relay and the load.
6.2. **During Over Voltage Condition**

If the measured voltage value is greater than that of the reference value of 250V, then the relay is turned ON to protect the load from over voltage and the Load will get OFF. The LCD display under this condition is shown in the figure 8. In the figure the LCD display interfaced to the Arduino controller shows the active or inactive behavior of the Relay and the load. This overvoltage if not prevented then it will definitely damage the load.

6.3 **During Normal Operating Condition**

If the measured voltage value is well within the normal values, i.e. 180V to 230V, then the relay is turned OFF and the Load will be turned ON. The LCD display under this condition is shown in the figure 9. In the figure the LCD display interfaced to the Arduino controller shows the active or inactive behavior of the Relay and the load.

7. **Conclusion**

This work implies a good plant efficiency and demand management principles includes an awareness of service levels and consumption calculation added to clear knowledge of the operation and the load which is managed. The paper also proposed a modified smart monitoring and management system with the function of manipulating data at high speed by profibus technology and digital meter current era. The customized system proposed is designed as an automatic system for demand tracking and load control with exact management of different load during peak period based on system requirements and actual time control of system output. Power quality could also be evaluated and recorded in a control module by multiplying the voltage and current.

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