ANDROID AND WEB BASED ELECTRICITY MONITORING AND CONTROLLING USING IOT & EMBEDDED SYSTEM

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Abstract—As we know home automation system uses portable device as user interface, monitoring and controlling home appliances will be the demand of new era. In the main objective to developed proposed system is to provide remote level control and monitoring by means of few communication protocols. The aim of this project is approaches the development of a firmware for a smart control, which can control the on & off of the load by using IOT platform and Android mobile app. In this project, we are using the controlling and monitoring in IOT server at anywhere in the world by using Internet. Relay controller will be used to automate the home appliances. If the web affiliation is down or the server isn't up, the embedded system board still will manage and operate the appliances domestically. By this we provide a climbable and price effective Home Automation system.

Keywords—component; Energy meter; Embedded controller; Keil C.

I. INTRODUCTION

In today days electricity is the every one basic need and consumption of energy is increases day by day .and resources energy decrees day by day. Usage of power is also increasing that’s why prevention is better than cure awareness of energy consumption should be brought into every place before resources get extinguished. And in now day’s technology is the most important part human’s life. By using this technology social interaction of peoples growing. Technology are also use for transportation .internment and in medical field it’s also usage for creation of many devices like mobile phones, computers laptops have caused many people’s are connected to technology to communicate with their friends, family access and store the information such as document movie music and picture. The internet has become a common interface that many devices use to simplify the daily life of many peoples. Internet helps us to take immediate solution for many problems and also able to connect from any of the remote places which contributes to overall cost reduction and energy consumption.

The designed system will help in reducing the energy wastage by continuously monitoring and controlling the electrical appliances. Smart Home or home automation introduces technology for home atmosphere which is usage to provide ease and protection to its occupants. By using the technology of the Internet of Things, The internet of things (IoT) is the network of physical devices, vehicles, buildings and other items embed with electronic, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. [1] Smart Home automation is the residential extension of building automation and involves the control and automation of lighting, heating, ventilation, air conditioning (HVAC), appliances, and security. Modern systems generally consist of switches and sensors connected to a central hub sometimes called a "gateway" from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, mobile phone software, tablet computer or a web interface.

Smart Home automation means to connect all electrical devices in the home to a central control system that control those devices according to user inputs. The connected electrical devices are intelligent in a sense. Internet helps us to bring in with immediate solution for many problems and also able to connect from any of the remote places which contributes to overall cost reduction and energy consumption. The Internet might even be utilized in home automation that offers several decisions.
from economical use of energy to additional console, protection and safety. Even over great distances the user can monitor and manage their home gate, various appliances and turn on/off the T.V without any human intervention. [2]

The user domain of the smart grid naturally blends with hybrid system. But the typical proposed approaches the development of a firmware for a smart control, which can control the on & off of the load by using IOT platform and android mobile app. In this project, we are using the controlling and monitoring in IOT server at anywhere in the world by using Internet. The portion of the smart grid on customer premises-embedded controller in an IOT and android platform. In this project the smart energy meter are connected to the opto-coupler. In opto-isolator, also called an opto-coupler is a component that transfers electrical signals to the control signals.

In IOT (Internet of Things) is a secure access point we are using android app in mobile phone or PC. In IOT platform is access on customer and EB admin by using IOT server is not a same password or different password and different user ID in database. In third parties are not accesses but a fully secured. So then only the advanced techniques are used in this project. In order to improve market acceptance and ease of deployment. Now a days the embedded world an advanced & intelligent system by using real time applications. So, thus the system is very cost effective and also it can perform precise operation for saving the power.

II. EXISTING SYSTEM

In the problem of exciting method is domestic energy meter reading systems universally exist many problems such as difficulty in construction, too narrow bandwidth, too low rate, poor real time, not two way communication quickly etc. To solve above problems, this proposed project the main objectives of this research is to design and implement a smart energy meter using android app in IOT platform that is capable of controlling and monitoring in IOT server at anywhere in the world by using Internet. In order to improve market acceptance and ease of deployment. Now a days the embedded world an advanced & intelligent system by using real time applications. So, thus the system is very cost effective and also it can perform precise operation for saving the power.

III. PROPOSED SYSTEM

In this proposed method is approaches the development of a firmware for a smart control, which can control the on & off of the load by using IOT platform and Android mobile app. In this project, we are using the controlling and monitoring in IOT server at anywhere in the world by using Internet. A proposed method provides the communication between the Electricity Board section and the consumer section using Internet of things (IOT) for transmitting the customer’s electricity consumption and bill information.

IV. BLOCK DIAGRAM

Power supply

Power supply gives supply to all components. It is used to convert AC voltage into DC voltage. Transformer used to convert 230V into 12V AC.12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC components and discharge on ground. LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted AC component

Relay Driver

Relay Driver is used for drive the relay. ULN2003A IC is used as driver. Relays are switching devices.
Switching devices are the heart of industrial electronic systems. When a relay is energized or activated, contacts are made or broken. They are used to control ac or dc power.

**Arduino**

Arduino is an open-source platform used for building electronics projects. It consists of both microcontroller and a piece of software runs on your computer, used to write and upload computer code to the physical board. It is used to control the robot hand movement based on the input from control panel.

**Potential Transformer**

The potential transformer works along the same principle of other transformers. It converts voltages from high to low. It will take the thousands of volts behind power transmission systems and step the voltage down to something that meters can handle. These transformers work for single and three phase systems, and are attached at a point where it is convenient to measure the voltage.

**Voltage measurement**

The load voltage is measured by using a potential transformer. The load voltage is stepped down to a low value by using a potential transformer. The output of the potential transformer is connected to an attenuator. The attenuator circuit reduces the voltage to a required level.

**Current Transformer**

A current transformer (CT) is a measurement device designed to provide a current in its secondary coil proportional to the current flowing in its primary. Current transformers are commonly used in metering and protective relaying in the electrical power industry where they facilitate the safe measurement of large currents, often in the presence of high voltages. The current transformer safely isolates measurement and control circuitry from the high voltages typically present on the circuit being measured.

**Current measuring circuit**

The current drawn by the load is measured by using current transformer. The primary of the current transformer is connected in series with the load. A resistance of suitable value is connected across the secondary of the current transformer. Here the current is converted into voltage. Now the voltage drop across the resistor is applied to an attenuator circuit. The attenuator circuit reduces the voltage to a required level.

**Internet of Things (IOT)**

The Internet of Things (IoT) is a system the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data. That is provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

**MAX 232**

Max 232 is an integrated circuit that converts TTL (Transistor Transistor logic) logic level signal into its equivalent RS-232c level signal and Rs-232c level to its equivalent TTL level signal. This IC is very important in case when we need to make connection and transfer data between devices that work on different signal level wave forms (TTL, Rs232c).

**VI. CIRCUIT DIAGRAM**

![Circuit Diagram](image)

The Circuit Diagram consists of Power supply unit, AT mega 328 p, Max232, Internet of things, relay driver, relay, Load, Alarm and LAN. Power supply gives supply to all components. It is used to convert AC voltage into DC voltage.

Transformer used to convert 230V into 12V AC. 12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC components and discharge on...
ground. LM 7805 regulator is used to maintain voltage as constant.

Then signal will be given to next capacitor, which is used to filter unwanted AC component.

Potential transformer is used to step down the measured voltage level and its output is given to the voltage measuring unit which provides the voltage to the arduino 328.

Current transformer is used to step up the measured current level and its output is given to the current measuring unit which provides the voltage signal according to the measured current value to the arduino 328. Relay Driver is used for drive the relay.

ULN2003A IC is used as driver. In the IC port 14 is a connected to the driver (ULN2003A) port1 (1B). In the IC port 15 is connected to the port2 (2B). In the IC port 16 is connected to the port3 (3B).

A relay is energized or activated, contacts are made or broken. They are used to control ac or dc power. In ‘Port 16’ (1C) is connected to the relay 1. In ‘Port 15’ (2C) is connected to the relay 2. In ‘Port 14’ (3C) is connected to the relay 3. In ‘Port 13’ (4C) is connected to the relay 4.

In ‘COM’ is connected to the common ‘Vcc’ in relay switch. In relay (1, 2, 3&4) are connected to the load. Max232 is used as the interface between Internet of things and arduino328 controller.

Max232 is used to increase the voltage level or increase the signal to transfer the data without oscillation.

The Internet of Things (IoT) is a system the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.

That is provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Relay driver is used to drive the relay.

Relay is an automatic switching device which is used to switch the fan and load according to the output of the AT mega 328 controller.

VIII. HARDWARE DETAILS.

SINGLE POWER SUPPLY

Power supply gives supply to all components. In our project input source used to battery. LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next capacitor, which is used to filter unwanted AC component.

Load will be LED and presenter. LED voltage is 1.75V. If voltage is above level beyond the limit, and then it will be dropped on resistor.

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The Atmega328 is a very popular microcontroller chip produced by Atmel. It is an 8-bit microcontroller that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM.

The Atmega328 has 28 pins. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and 6 analog input pins. These I/O pins account for 20 of the pins.

The Pinout for the Atmega328 is shown below.

The table below gives a description for each of the pins, along with their function.
As stated before, 20 of the pins function as I/O ports. This means they can function as an input to the circuit or as output. Whether they are input or output is set in the software. 14 of the pins are digital pins, of which 6 can function to give PWM output. 6 of the pins are for analog input/output.

2 of the pins are for the crystal oscillator. This is to provide a clock pulse for the Atmega chip. A clock pulse is needed for synchronization so that communication can occur in synchrony between the Atmega chip and a device that it is connected to. The chip needs power so 2 of the pins, Vcc and GND, provide it power so that it can operate. The Atmega328 is a low-power chip, so it only needs between 1.8-5.5V of power to operate.

The Atmega328 chip has an analog-to-digital converter (ADC) inside of it. This must be or else the Atmega328 wouldn’t be capable of interpreting analog signals. Because there is an ADC, the chip can interpret analog input, which is why the chip has 6 pins for analog input.

The ADC has 3 pins set aside for it to function- AVCC, AREF, and GND. AVCC is the power supply, positive voltage, that for the ADC. The ADC needs its own power supply in order to work.

GND is the power supply ground.

AREF is the reference voltage that the ADC uses to convert an analog signal to its corresponding digital value.

Analog voltages higher than the reference voltage will be assigned to a digital value of 1, while analog voltages below the reference voltage will be assigned the digital value of 0.

Since the ADC for the Atmega328 is a 10-bit ADC, meaning it produces a 10-bit digital value, it converts an analog signal to its digital value, with the AREF value being a reference for which digital values are high or low. Thus, a portrait of an analog signal is shown by this digital value; thus, it is its digital correspondent value.

The last pin is the RESET pin. This allows a program to be rerun and start over.

And this sums up the Pinout of an Atmega328 chip.

**RELAY DRIVER**

**ULN2003** is a high voltage and high current Darlington array IC. It contains seven open collector darlington pairs with common emitters. A darlington pair is an arrangement of two bipolar transistors.

ULN2003 is for 5V TTL, CMOS logic devices. These ICs are used when driving a wide range of loads and are used as relay drivers, display drivers, line drivers etc. ULN2003 is also commonly used while driving Stepper Motors.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PC6</td>
<td>Reset</td>
</tr>
<tr>
<td>2</td>
<td>PD0</td>
<td>Digital Pin (RX)</td>
</tr>
<tr>
<td>3</td>
<td>PD1</td>
<td>Digital Pin (TX)</td>
</tr>
<tr>
<td>4</td>
<td>PD2</td>
<td>Digital Pin</td>
</tr>
<tr>
<td>5</td>
<td>PD3</td>
<td>Digital Pin (PWM)</td>
</tr>
<tr>
<td>6</td>
<td>PD4</td>
<td>Digital Pin</td>
</tr>
<tr>
<td>7</td>
<td>Vcc</td>
<td>Positive Voltage (Power)</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>9</td>
<td>XTAL 1</td>
<td>Crystal Oscillator</td>
</tr>
<tr>
<td>10</td>
<td>XTAL 2</td>
<td>Crystal Oscillator</td>
</tr>
<tr>
<td>11</td>
<td>PD5</td>
<td>Digital Pin (PWM)</td>
</tr>
<tr>
<td>12</td>
<td>PD6</td>
<td>Digital Pin (PWM)</td>
</tr>
<tr>
<td>13</td>
<td>PD7</td>
<td>Digital Pin</td>
</tr>
<tr>
<td>14</td>
<td>PB0</td>
<td>Digital Pin</td>
</tr>
<tr>
<td>15</td>
<td>PB1</td>
<td>Digital Pin (PWM)</td>
</tr>
<tr>
<td>16</td>
<td>PB2</td>
<td>Digital Pin (PWM)</td>
</tr>
<tr>
<td>17</td>
<td>PB3</td>
<td>Digital Pin (PWM)</td>
</tr>
<tr>
<td>18</td>
<td>PB4</td>
<td>Digital Pin</td>
</tr>
<tr>
<td>19</td>
<td>PB5</td>
<td>Digital Pin</td>
</tr>
<tr>
<td>20</td>
<td>AVCC</td>
<td>Positive voltage for ADC (power)</td>
</tr>
<tr>
<td>21</td>
<td>AREF</td>
<td>Reference Voltage</td>
</tr>
<tr>
<td>22</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>23</td>
<td>PC0</td>
<td>Analog Input</td>
</tr>
<tr>
<td>24</td>
<td>PC1</td>
<td>Analog Input</td>
</tr>
<tr>
<td>25</td>
<td>PC2</td>
<td>Analog Input</td>
</tr>
<tr>
<td>26</td>
<td>PC3</td>
<td>Analog Input</td>
</tr>
<tr>
<td>27</td>
<td>PC4</td>
<td>Analog Input</td>
</tr>
<tr>
<td>28</td>
<td>PC5</td>
<td>Analog Input</td>
</tr>
</tbody>
</table>
Each channel or darlington pair in ULN2003 is rated at 500mA and can withstand peak current of 600mA.

**RELAY**

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which connect or disconnect mechanically.

In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, DPDT etc, which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about structure of a relay switch.

**IX. ANDROID AND WEB MODULES**

1. **LOAD FORECASTING**

   Electricity load is one of the major factors in home control. The usage of Electricity varies from home to home. Some may look to minimize the use of Electricity for them this Application would be useful because this module would provide the real time update of how much electricity is used now and as a result the user would be able to minimize the use of electricity and save a lot amount of electricity usage. This module would be highly useful for the families who are poor or for families who like to minimize their expenses. The Real time forecast would be send by the IOT and as a result the user gets real time update and act according to it. Load forecasting would be done on how much power is used in units and in watts.

2. **PRICING INTELLIGENCE**

   With just Load Forecasting it is of no use we would need to make use of Price per usage. In many parts of India there is a vary in pricing for bill. For example up to 500 units there would be a less tariff to pay bills and once if more than 500 units is used the tariff would change. So based on the electricity usage the bill amount may vary so a pricing intelligence is added here to say to you about the current amount wage you need to pay according to the electricity usage. The price is calculated here based on the electricity usage and finally the price and units would reset in the beginning of every month.

3. **BILL PAYMENT**

   When the price and load is calculated in the end of the month the important factor here would be the bill payment so the modules present here would be used for paying the bill amount online with the help of the payment gateway though SSL(Secure Socket Layer). We are aimed here to provide the users with high amount of security and better user interface

4. **ALARM BASED ON THRESHOLD**

   All of us are not a good judge about how much the electricity is used. We may forget to check how much electricity is used in that case we are using here an alarm which would be activated based on the threshold. We can set the unit threshold like 300 units then an alarm would be run when 300 units have been used and as a result the user would get alerted and start to save the electricity and minimizes the bill this module would be of very much useful to all the users.

5. **SMS BASED ALERT SYSTEM**

   Another great feature of our Android Application is the usage of the SMS based alert system in this case the user would be notified about the payment and if the threshold is set up once the threshold is reached then the user would get an SMS from the server and as a result with the help of this an non Android user would also get benefited with this feature

6. **REPORT GENERATION**

   Reports play a major role in all aspects of our concept here a report would be generated on how much electricity is used based on month
and year and also the price associated with it. This module would give a better idea to the user and to the electricity board about the amount of electricity used by an user on day week and monthly basis.

7. REMOTE CONTROL OVER ELECTRICITY

Electricity board used to cut off the electricity if we don’t pay the bill. Even the user might wish to cut the electricity when they are not at home. In such a case the user can cut the electricity usage from outside very much easily. This is done with the help of using the Relay or soft switch so that the electricity wastage would be prevented here. When the Module is opened the button would be available and clicked as a result the IOT device would be activated and the electricity would be cut off here.

8. HOME AUTOMATION

Controlling the devices at home is an important part we have certain devices which we can control from outside. Here we are using smart switch in certain devices or all devices which we can off from outside. This would be off great use where the user moves out of home forgetting to switch off the electric Appliances at home. Then the user could switch off the electric Appliances at home so that the large amount of electricity usage could be saved at the home.

9. LOGIN FEATURE

In our project we give a separate Login ID for the user and EB admin as a result. So that the user and admin can login separately. The user would be provided with the above features and EB admin would be given the control of monitoring all the EB users and given the option to cut off the electricity at a correct time when the bill is not paid at the right time

X. CONCLUSION

In this proposed system, a prototype low cost home appliances control and monitoring system based on wireless embedded gateway is proposed and implemented. The home automation using Internet of Things has been experimentally proven to work adequately by connecting simple equipment to it and the appliances were successfully controlled remotely through internet. In this proposed method is approaches the development of a firmware for a smart control, which can control the on & off of the load by using IOT platform and Android mobile app. In this project we are using the controlling and monitoring in IOT server at anywhere in the world by using Internet. A proposed method provides the communication between the Electricity Board section and the consumer section using Internet of things (IOT) for transmitting the customer’s electricity consumption and bill information.

Future works can be done on increase this protocol model by including all home equipment and services that provide notifications, energy saving ,automation, telecommunication ,security ,entertainment and computers etc and thus make a more intelligent home automation system. It also stores the sensor parameters in the database (webpage) in a timely manner. This will help the user to observe the condition of various parameters in the home anywhere anytime.

XI. REFERENCES


