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Smart Plug IoT Device with its applications

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Abstract - *In this paper, we propose an advanced method in solving electrical power monitoring and managing problems. A smart plug is a power receptacle that plugs into a traditional electrical outlet and integrates it into your smart home network, allowing you to control whatever you plug into it from an app on your smartphone or with your voice through a virtual assistant. A smart plug transforms even the oldest and non-advanced devices into a part of your smart home network, giving you greater control and customizable options just by plugging the device in. Table lamps, the clothes iron, and even the coffee maker get an IQ upgrade with smart plugs. For the most features and best reliability, stick with smart plugs that connect to Wi-Fi either directly or using a bridge or dongle that plugs into your router*

Key Words: Internet of Things, NodeMCU, DxDesigner, BJT, NB-IOT

1. INTRODUCTION

The smart plugs apart form replacing the traditional sockets were related to some of the basic IoT devices which have a huge potential in the market. The futuristic vision of the latest smart plug devices has a lot of features such as Wi-Fi connectivity which allows you to remotely control devices plugged into smart plugs with your smartphone. With the growing popularity of voice assist, control options like Alexa, Siri, or Google Assistant allow you to control devices plugged into the smart plug unit (some models of smart plug might require a bridge or dongle for this capability). The plug not only fulfils the basic requirement of switching but it was required to do so at scheduled times to increase its efficiency. Therefore set timers were used to do so. With that the track information about energy use and cost of use for a device using the plug in real time is the next important feature to be incorporated. Through this project, we are addressing a variety of considerable problems which we hope to find a suitable solution for. These problems are basically related to electrical power consumption and electrical power grids. First, one of the problems that we wish to solve is the increased power consumption trends. This could be the most important problem that the whole world is looking forward to solve it. People, nowadays, are increasing their electrical power consumption significantly. Second, through this project we wanted to solve the lack of electrical power consumption awareness technologies. Right now, there are many campaigns that are interested in reducing electrical power consumption and encouraging people to do so; however, these campaigns lack the required technology which will help them aware the public toward their power consumption as words are never enough to aware the public. The third problem we are addressing is the increased environmental issues that are related to the increased power consumption, and the fourth problem we are after is the need of power consumption patterns by the various power companies around the globe. Power companies would like to have the enough knowledge about how people consume their electrical energy. Many devices have been designed so far to address these problems. However, the several drawbacks presented in them rose the importance to designing an advanced smart plug system. Smart Plug Outlet MZ701 is one of the devises that are related to power measurement technologies. MZ701/702 smart plug outlet is an AC power outlet with relay control and over current protection device designed to apply 2.4GHz bend wireless remote control. The power circuit is of a free design with the advantage of being remote able via the proprietary network interface. MZ701/702 applies to receive RF command from the remote controller or advance remote management by PC application software.MZ701/702 is power saving by its idle current detection which breaks AC output when the plugged electrical appliance staying no operation [1]. Another of the related projects that have been published in the markets is called the Plug-In Power and Energy Monitor. This device is capable of power measurement of the loads connected to it. It can measure the voltage, the current, and the power of the load connected to it. Consequently, we may say that this device is really that mush advance form the measurement point of view; however, it cannot send theses data that it measures elsewhere. In other words, it only measures and monitors the power readings without providing any kind of control features.

1.1 Energy Metering

The current sensor facilitates this feature as it helps in fetching the required current values. The next area of interest was set in smart plugs to restrict and prevent latent energy consumption by devices while they're turned off. This gives rise to the IoT platforms. One of this is NB-IoT which is the commercially viable method of transmission. Smart plug strips work much like a multi-plug surge protector and can send you notifications if a power surge occurs or alert you when the number of devices connected to the strip poses a safety hazard. For this all the components are placed such

that there peak to peak surge voltage is checked according to the input voltage power.

2. DEVICE LAYOUT

Smart plugs operate on AC with different voltage required by appliances. In this paper we have highlighted the fundamental elements of the design circuitry and our individual prototype of the device at DC current for illustration.

2.1 Hardware

- Relay Switch
- Microcontroller
- Resistors
- Capacitors
- Modem with SIM slots
- Current and temperature sensors
- Power Metering Unit (PMU)
- BJT

All these components have been arranged according to the below figure. The Relay switch is positioned between the socket(main supply) and the Appliance to ensure the switch on and off of the device. The Modem which connects the device to the internet through the SIM slot in it. This enables the commands given to the microcontroller to execute the features.

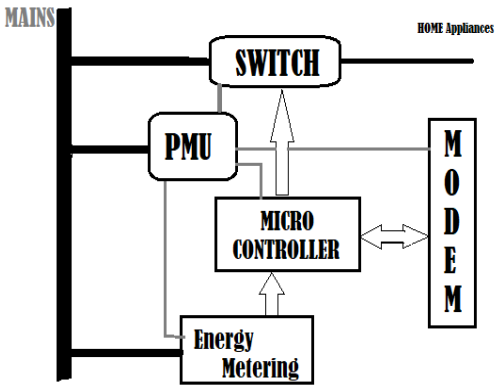

Fig: Block Diagram of Circuit

2.2 Software

- **DxDesigner:**

With a powerful schematic design environment like DxDesigner, you can:

- Reduce product cost and improve performance by ensuring proper component selection
- Reduce time to market and increase quality through efficient design reuse
- Set connectivity for high pin-count devices like FPGAs and connectors in an easy-to-use table
- Improve personal productivity and design performance through tight integration with simulation, analysis and layout.
- Reduce costs and library management overhead by tying your CAD library to your company's MRP/ERP systems
- Avoid costly rework and shorten time-to-market through effective definition and variant management.

- **PADS Logic 2007**:

PADS Logic is an easy-to-use schematic entry tool used by designers around the world. However, if you need the capability to do more than just draw a schematic, you need a tool that enables complete PCB design creation. The device proposed is made on two separate layers of circuits as shown in the figures below:

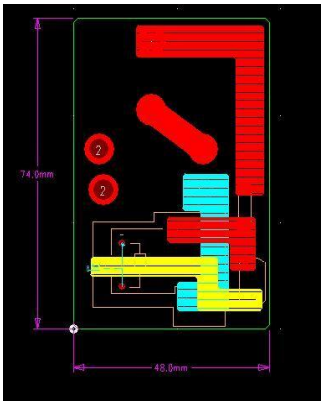

Fig: Both layers together

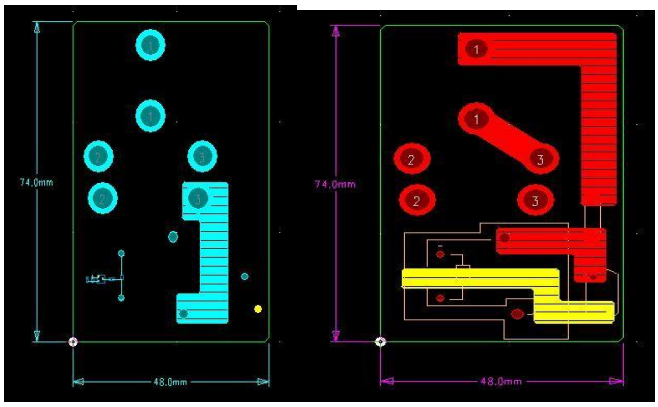

Fig: (a) bottom & (b) top view

- Hyperlink

There are various softwares used for the schematic, fabrication and testing of the devices.

3. COMPONENT SPECIFICATIONS

As the prototype made was in DC current with hosting the device data and processing it was done on the online platform called cayenne, this project in itself is not that robust but rather for a better understanding of the basic implementation and utility of this project.

A.Cayenne

Cayenne is the world's first drag and drop IoT project builder that empowers developers, designers and engineers to quickly prototype and share their connected device projects. Cayenne was designed to help users create Internet of Things prototypes and then bring them to production.

Table -1: Prototype Components

Sr no.	Components used for Circuit		
	Element	**Function**	**Specifications**
1	Node mcu	open source IoT platform	ESP-12 module
9	Current sensor	Power measure ment	ASC172)
10	Temperature sensor	Checks on the sudden voltage surges	BS170
11	Resistors		

3. TESTING

Boards are brought in in a phased process whereby an electronics system, inclusive of assembly, hardware, firmware, and software elements, is successively tested, validated and debugged, iteratively, in order to achieve readiness for manufacture. Quality check under various strenuous conditions ensures the safety of the appliances connect to the plug.

***Population Check*:** In this step the fabricated board and the board received is compared.

***Digital Multimeter*:** The test points are checked if they are carrying all the input and output operations.

DC power generator: As different parts of the board has different voltage requirements such as 1.8V,3.6V,12V etc.

***CRO**:* A cathode ray oscilloscope is used to send various signals to the board and also detect the ones coming at the output.

***Quantum Software**:* This is used for current optimisation i.e. it keeps a tab at the current consumed by the device in the Active and Sleep modes & represents it in a graphical form.

***DC Load**:* This device draws DC power from the battery of a device to check the potential battery life of it.

***AC Load**:* This device works as an appliance and draws current from the board.

So under the AC load there are a variety of applications with different current requirements and consuming technique. It is categorised in to resistive load or inductive load.

The resistive loads such as Television, Air Condition, Fridge, etc which draw a constant current throughout consumption. They have Power factor as 1.00 as resistive power is equal to apparent power.

The inductive loads are the motors used which have sudden large inrush current and then stabilize to draw constant current. They have a power factor in decimals like 0.5 (for e.g). So the smart plug has to be tested for such high levels of inrush current. Even though the 15 Amps relay supports upto 20Amps of inrush current but the fuse used here is a time lagging fuse which can support even higher levels of inrush current for a few seconds. By this we satisfy both of the components.

Fig -1: Name of the figure

4. CONCLUSIONS

This project will be the bridging gap between the traditional electrical devices and the future IoT devices. As this method is also economically viable as why will the customers buy a whole lot of a new device but rather make any of their existing device to a IoT device with this Smart Plug. For the user benefit the energy monitoring is also an additional great feature. From this project we see all the challenges in implementing such an idea in the form of fabrication and live wiring. The Cayenne platforms helps us integrate all our

components and data is then assessed and recorder to be sent to the server which intern displays in it the app for future reference. Thus this project has a huge potential due to the rising market of the IoT devices. Many companies like Reliance have started manufacturing such devices.

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REFERENCES

[1]Ahmed S. Musleh , Mahdi Debouza1 , Mohamed Farook Department of Electrical and Computer Engineering, Khalifa University of Science and Technology 2 Ministry of Foreign Affairs and International Cooperation Abu Dhabi, United Arab Emirates J. Breckling, Ed., The Analysis of Directional Time Series: Applications to Wind Speed and Direction, ser. Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 61.

[2] Nikola Lukac,Roman Pavlovic,Violeta Vukobrat,Nikola Teslic RT-RK Institute for Computer Based Systems, Novi Sad, Serbia

[3] "A postmortem on India's blackout in Spectrum. "[Online].
Available:http://spectrum.ieee.org/energywise/energy/thes marter-grid/a-postmortem-on-indias-blackout

[4] http://www.google.com/powermeter/about/

https://www.gsma.com/newsroom/wp-content/uploads/CLP.28v1.0.pdf (for the eDRX and then PSM modes)

Texas Instruments Application Report:" Current-Transformer Phase Shift Compensation and Calibration".