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Security and Control System for IoT-Based Electrical Devices

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Abstract*: With the rapid proliferation of Internet of Things (IoT) devices, modern homes and industries are becoming increasingly security and control problems of electrical systems. As devices become interconnected, we find that traditional ways of managing electrical devices are no longer sufficient to address vulnerabilities. An IoT based device security and control system is proposed in this paper to enhance both the security and functionality of electrical infrastructures. With a combination of sensors, real time monitoring and secure communication protocols; the system allows the users to remotely manage and secure their electrical devices.*

Keywords*: IoT, electrical device security, remote control, anomaly detection, encryption, cloud computing, energy efficiency.*

I. Introduction

The power of the lighting would be brought down to electrical devices like lights, mobiles and HVAC systems that would be connected to the cloud based services through a central IoT platform which would end with. Remote control Device through mobile app as well as through web interface, scheduling of device as well as real time monitoring of device status. Furthermore, the system has included the wherewithal of advances in the security of the cyber attacks or unprivileged access in the shape of encryption, multi factor authentication and anomaly detection. Finally, the integrated solution delivers real time alerts for abnormal conditions of device malfunction, loading, odd electrical fault etc. The alerts are sent to the users who can act on the alerts immediately without any damage or hazard. It also employs machine learning algorithms to detect and predict the failure of the maximum device functionality and least cost of maintenance.

In addition to enhancing the user experience by increasing control and convenience, as well as contributing to energy efficiency and overall system reliability, the proposed IoT based security and control system shows that the development of alternate architectures enables architecture performance beyond present capabilities. This solution addresses both security and functionality, resulting a great step forward in managing modern electrical devices safely and efficiently in this increasingly connected world.

II. Proposed System

An IoT based device security and control system is designed for safe, far remote, and extremely efficient electrical devices management in both residential and industrial environments. Connecting electrical devices with a central control platform, usually via a mobile app or web interface, the system uses the Internet of Things (IoT) to bring devices to a central source. Through this approach, users are able to monitor, control and secure electrical devices in real time for better convenience as well as improved safety.

IoT-Enabled Electrical Devices: There are various IoT sensors and smart controllers fitted with devices like fan, lights, air conditioners, Security system etc. which are and can be monitored and controlled remotely over internet.

Centralized Control Platform: All devices connected send data thru a cloud based or local server platform and the users have a single unified interface to manage all devices. The users can control the devices from remote, set controls or automation of the devices.

Security Features: It has security updates to secure the system's security and prevent someone from seeking unauthorized access or cyber attack. Real-Time Monitoring and Alerts: The system continuously monitors the operational status of devices and sends alerts in case of anomalies, such as device malfunctions, overloads, or security breaches. This allows for immediate action to prevent damage or hazards.

Energy Efficiency and Optimization: It features an energy management system that tracks usage and can optimize device operation to reduce energy use, and lower cost.

Predictive Maintenance: This is useful to the system, which can use these machine learning algorithms to predict possible failures by characteristics such as usage patterns and other environmental conditions. Proactive maintenance is made possible to reduce downtime, repair costs.

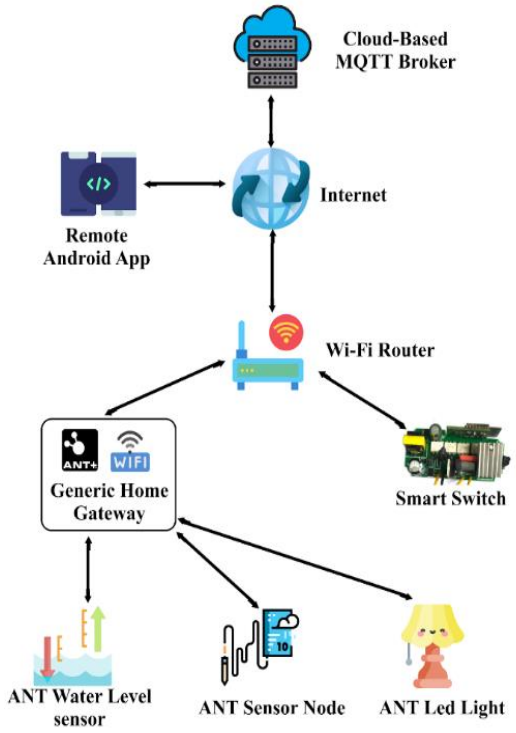

Figure 1: IoT Proposed System

III. Relay and Processor

Relays are switches that are powered by electricity. It is made up of a set of operating contact terminals and a set of input terminals for one or more control inputs. The switch can have as many contacts as it wants in any of the several types of contacts, such as break contacts, make contacts, or both. It is employed when a circuit needs to be controlled by a separate, low-power signal or when a single signal needs to control many circuits. Originally employed as signal repeaters in long-distance telegraph circuits, relays send a signal and receive it on a different circuit, which refreshes the signal entering from the first circuit. During the day's early computer sessions and phone conversations, relays were employed to carry out various processes, including logical ones.

Figure 2: Relay Module

ESP8266: ost popular is modules built with ESP8266 by third party AI-Thinker, although these remain a little more rare. And they're all the 'ESP-xx modules' ecosystem put together. They need additional components to form a workable development system, including a serial TTL to USB adapter (also known as a USB to UART bridge), and an external 3.3 volt power supply. For novice ESP8266 developers, a larger ESP8266 Wi-Fi development board such as the NodeMCU, which includes the USB-to-UART Bridge, as well as the Micro-USB connector and a built in 3.3 volt power regulator on the board, will be worth considering. Outside of the project development, we don't need these components and those cheaper ESP-xx modules are purely a smaller and lower power version for production runs.

Figure 3: Processor ESP8266

IV. Operation

Utilities use smart meters as an electronic measurement device to communicate information on how much the customer is using (for the bill) and record that customer's use, and operate the utility's electric system. If we have smart meters, we can send the meter data straight back to the electricity supplier automatically so the meter doesn't have to be mounted outside the customer's premises. The meters could live inside a garage or other room, giving them a far safer place to sit and provide some much needed security for the smart grid. That would mean you'd need to either move or stretch the power line terminus away from its normal location to the interior, which would be quite costly, if not altogether prohibitive, for any large scale smart grid projects. In fact, this could be a handy thing to consider when building any new homes in places that already have smart meter infrastructure. You can send the data wirelessly to an access point at the power pole or communicate the data over the low voltage power lines.

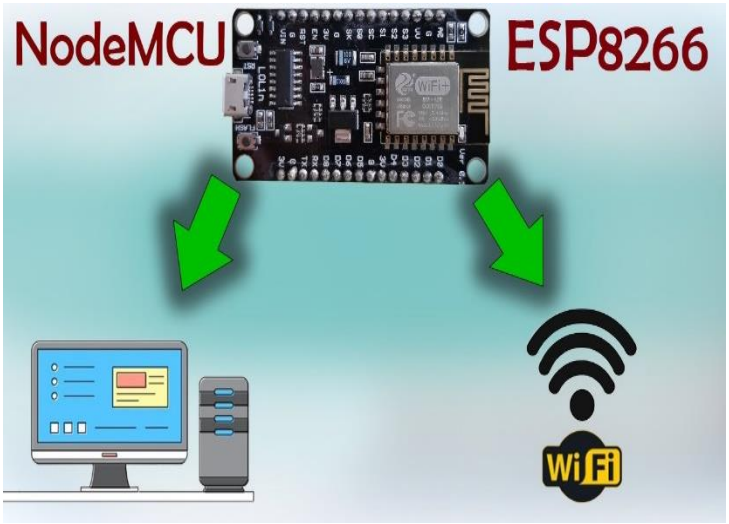

Figure 4: ESP 8266 working model

III. Conclusion

IOT interfaced smart meter was designed, implemented and tested in this project. Energy usage logs data is measured real time by our system and it controls any device hooked to power outputs. Smart Meter prototype with the measured power usage was calculated and transmitted using Wi-Fi communication to PC (Personal Computer). In the case of scheduling with TOU pricing using the PC software it was found that it imposes an economic expenditure upon the consumer side and there is no difference from a utility side perspective. We propose a smart meter system with consumer control in energy saving events that complies with smart grid concept.

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