Chapter 16
Intelligent Sockets for Home Automation and Security:
An Approach Through IoT and Image Processing

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ABSTRACT

The intelligent sockets are an advancement in approach to better the features and convenience offered by the existing switchboards. All updates to the board are done via a separately kept server for the web interface which connects to the home network. The features provided to the user can be bettered progressively via software updates. Features like timers which work in both automatic and manual mode, security aspect via surveillance and facial recognition, overload and usage logging with the help of the current sensor is provided. The data is also verified with the actual meter for accuracy and as a check for tampering. The data so gathered can also be used for prediction using machine learning. System first classifies various types of analog meters. Right now, the lbph classifier is trained to detect analog meter with needle and Analog meter with text readings.

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INTRODUCTION

Automation has crept into our everyday life and is helping us in myriad of ways. Very aggressive development integrating smartness in everyday appliances like washing machines, microwave ovens, air conditioners, refrigerators among others tell us this story. The smartness integrated in these can be temperature sensors and timers for periodic usage, saving power when not in use, among other helpful features. The authors are trying to implement an idea of such a smart device which is not limited to the device in question, but as a general socket switchboard used every day. Central power saving can be implemented, while retaining the locally controllable feature along with addition of remote control and other mentioned features.

Safety mechanisms can be built into each switchboard with current meters and power consumption can be logged onto the server. This will be used to keep track and optimise the power consumption. As switch boards are present everywhere, access control is provided, security mechanisms like motion detection when away, auto turn off after daylight, built in fire alarms, complete power down remotely when required and such can be easily implemented and integrated. Further expansions can be made to incorporate machine learning to smartly turn the lights on and off from known patterns to conserve energy.

Raspberry Pi is used as the central controlling unit and as server. NodeMCU is provided at each switch board for local control and to communicate with the server. Relay modules are used for mechanical control of the switches. Current sensor is used to measure the current consumption and power consumption, which is finally logged onto the server. RFID can be used for the child mode protection for driving high power devices like grinders. Protection against overload and high current is provided.

Since multiple cameras can be incorporated into the raspberry pi, tampering of the meter can also be detected along with a meter reading from the meter itself using image processing techniques. This can be used as a cross verification of the values already being logged in all the sockets as a check for the data collected using the current sensor being used as well as a security measure to prevent tapping of connections. To make the system more aesthetic touch screen can be provided at each switchboard along with timers for user interface.

EXISTING TECHNOLOGY AND ITS REVIEW

Literature Survey

- Santoro et al. proposed an innovative socket that helps in demand and response analysis and plan the generation of power. They evaluated total harmonic distortion and sent the calculated data to the monitoring station. There is no active logging system and security system (Santoro, Calderaro, Galdi, & Piccolo, 2016).
- Pawar et al. proposed an made an effort to measure power consumption with the use of Zigbee. The setup consisted of op-amp circuits to calculate continuous voltage and current sensor to calculate the instantaneous power. The cost of implementation was higher due to the use of Zigbee and decrease in the range (Pawar, & Vittal, 2017).
- Xu et al. proposed a system using low power microcontroller MSP430 to achieve wireless home intelligent socket. The system works by connecting and controlling via SMS and a mobile app.