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A NON-INTRUSIVE LOW-COST REMOTE MONITORING AND CONTROLLING SYSTEM FOR ELECTRICAL APPLIANCES

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Abstract

Smart energy meters help consumers easily monitor their total energy consumption. However, these meters do not provide a detailed breakdown of energy consumed by individual appliances and cannot be used to turn off connected devices remotely. This paper proposes a non-intrusive load monitoring (NLM) and controlling system for small-home owners. Although various NLM solutions were proposed in the past, their results have often been obtained via simulations and by performing tests in controlled laboratory environments. Thus, the real-world applicability of existing solutions in the literature remains a question. Moreover, a solution that incorporates NLM and remote controlling are yet to be developed. The proposed solution in this paper consists of a plug-and-play type product and a user-friendly mobile application. Not only can our proposed method identify electrical appliances individually, but it can also change their operating status remotely. The system comprises a data acquisition unit, a controlling module, a mobile application, and a low-complexity heuristic algorithm. The energy signatures of different appliances are captured by the current transformer of the data acquisition unit. A 12-bit analog-to-digital converter and the ESP 32 module are used to process and relay the information to the database for analysis. The developed algorithm distinguishes individual appliances by evaluating the captured signals' current and power factor values. A detailed energy report is then presented to the consumer via the mobile application. A solid-state relay is used within the control module to manage the operating state of the circuit breakers. The control module was carefully fabricated to be housed within existing distribution boards. The mobile application allows the user to change the operating status of the appliances with a single touch. Actual experiments were performed with multiple appliances both in a laboratory environment and in true consumer premises to verify the accuracy of the proposed system.

Keywords: *electrical load identification, control, data acquisition, mobile application, remote sensing, NILM, appliance monitoring, energy reporting*