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Smart Home Energy Management System with Implementation of Renewable Energy: A Review

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ABSTRACT: this paper is review on smart home energy management system. Home energy management system (HEMS) needs to consider both energy consumption and generation simultaneously to minimize the energy cost. This paper proposes a smart HEMS architecture that considers both energy consumption and generation simultaneously. ZigBee based energy measurement modules are used to monitor the energy consumption of home appliances and lights. Renewable energy gateway is used to monitor the energy generation of renewable energies. The home server gathers the energy consumption and generation data, analyzes them for energy estimation, and controls the home energy use schedule to minimize the energy cost. The remote energy management server aggregates the energy data from numerous home servers, compares them, and creates useful statistical analysis information. By considering both energy consumption and generation, the proposed HEMS architecture is expected to optimize home energy use and result in home energy cost saving.

KEYWORDS: Home Energy Management System, IoT, Renewable Energy, Power Line Communication

I. INTRODUCTION

The current energy crisis has required significant energy reduction in all areas. The energy consumption in home areas has increased as more home appliances are installed. Energy saving and renewable energy sources are considered as methods of solving home energy problem. Both energy consumption and generation should be simultaneously considered to save the home energy cost. Several researches have proposed home energy management system (HEMS). Optimization of home power consumption based on power line communication has been studied to provide easy-to-access to home energy consumption [1], [2].

A green HEMS that monitors, compares, and controls home appliances has been proposed [3], [4]. It does not consider renewable energies. As solar and wind power system are deployed, energy management systems have been studied to enhance smart home [5], [6]. These works consider only renewable energies, not the energy consumption. In this paper, a smart HEMS architecture that considers both energy consumption and generation based on ZigBee and renewable energy gateway (REG), respectively home server gathers both the energy consumption data through ZigBee and energy generation data through the REG. By taking into account both consumption and generation, the home server optimizes home energy use. This paper is extended from a preliminary work [7].

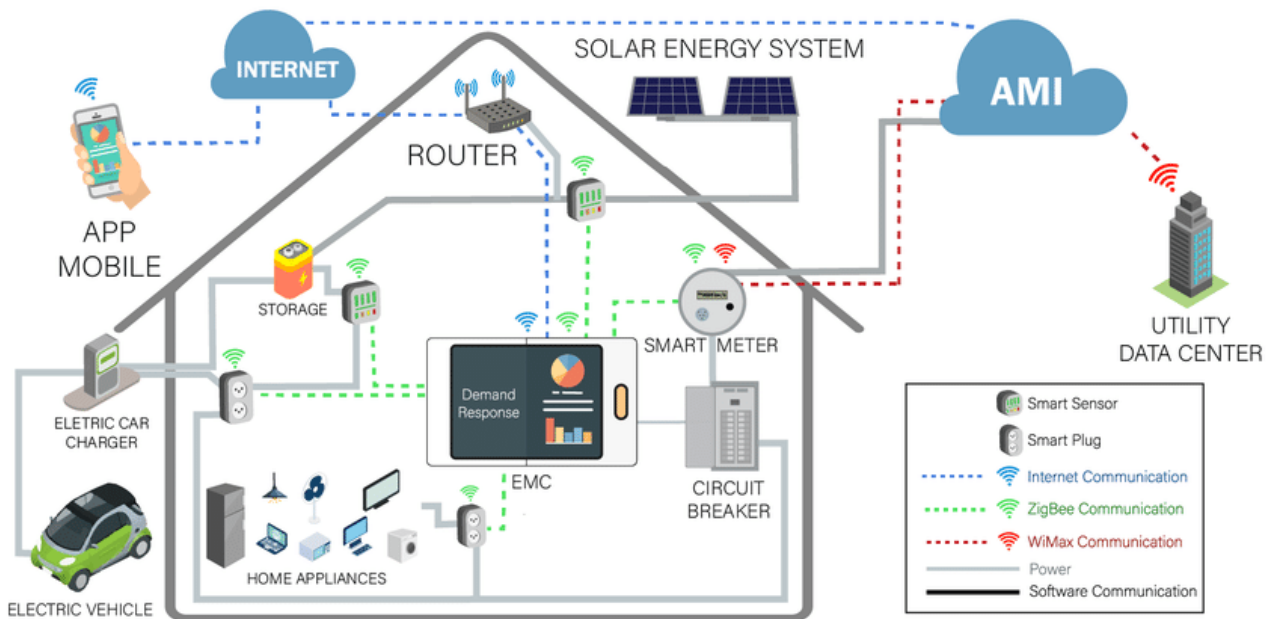


Fig 1 Illustration of home energy management system (HEMS) architecture[12]

II. LITERATURE SURVEY

Jinsoo Han*, Chang-Sic Choi*, Wan-Ki Park*, Ilwoo Lee*, and Sang-Ha Kim*. Written in “Renewable energy based on zigbee and plc” in this paper about home energy management system based on power line communication. It combines both home network and internet. It makes use of smart meter technology and PLC to provide customers detailed information of their energy consumption patterns and smart controlling of their home appliances. The smart meter measures the power consumption in every 15-20 minutes and uploads this information to web interface via internet so that users can access. It relies on power consumption history to control appliances.

Jinsoo Han, Chang-Sic Choi, Wan-Ki Park, and Ilwoo Lee written “Green home energy management system through comparison of energy usage between the same kinds of home appliances” in this paper about PLC-based Photovoltaic System Management for Smart Home Energy Management System. It describes a photovoltaic management system. It constitutes of PLC modem, REG and smart device application. The PLC modems are connected to measure the status of PV modules. The REG aggregates the measured status values from the PLC modems. The smart device application displays the status of the PV system. A user can easily identify failures in the PV system for better performance and also maintenance. The proposed system enhances a PV system management and can create synergy with smart home energy management system.

Sethuraman M*, S. Jayanthi, written “Low cost and high efficiency smart hems by using zigbee with mppt techniques” in this paper about Low cost and high efficiency Smart HEMS by using Zigbee with MPPT techniques. This paper proposes a smart HEMS architecture which uses renewable energies. Home energy problems can be solved by using renewable energy sources and energy saving method. PIC microcontroller can be used to monitor and control the energy generation from renewable energy sources such as solar panel, wind turbine. Zigbee is used for the measurement of energy consumption from home appliances. The efficiency of power generation can be increased by using Maximum Power Point Tracking (MPPT). The energy consumption of home appliances and generation of renewable energies are collected from home server which is used for analyzing the total energy estimation and control the energy consumption in home to minimize the energy cost.

N. Shewale, Jyoti P. Bari written “Renewable energy based home automation system using zigbee” in this paper about renewable energy based home automation in which two things are consider one is energy consumption and another is energy generation. In this, ZigBee is used for monitoring energy consumption of home equipments and power line communication (PLC) is used to monitoring energy generation. Then home server collects the energy consumption data



and energy generation data and analyzes them for energy approximation and control the home energy utilization schedule to slump the energy cost.

J. Rajendhar, Srujana. M. written in this paper “Smart home energy management system by using zigbee” in this

paper about ZigBee based energy measurement modules are used to monitor the energy consumption of home appliances and lights. A PLC based renewable energy gateway is used to monitor the energy generation of renewable energies. The home server gathers the energy consumption and generation data, analyzes them for energy estimation, and controls the home energy use schedule to minimize the energy cost.

III. PROPOSED SYSTEM DEVELOPEMENT

A. Hardware

The complete system having microcontroller, sensors and actuators and energy generation. At the first level the instead of conventional energy, system using non-conventional energy sources like solar energy and wind energy. After that this hybrid energy will feed to controlling unit, where the NodeMCU IoT inbuilt microcontroller is controlling the all process. Here various sensors like temperature sensor, Light sensor, LPG sensor is connected with microcontroller after that there are two relays are connected with the microcontroller for ON/OFF the appliances automatically.

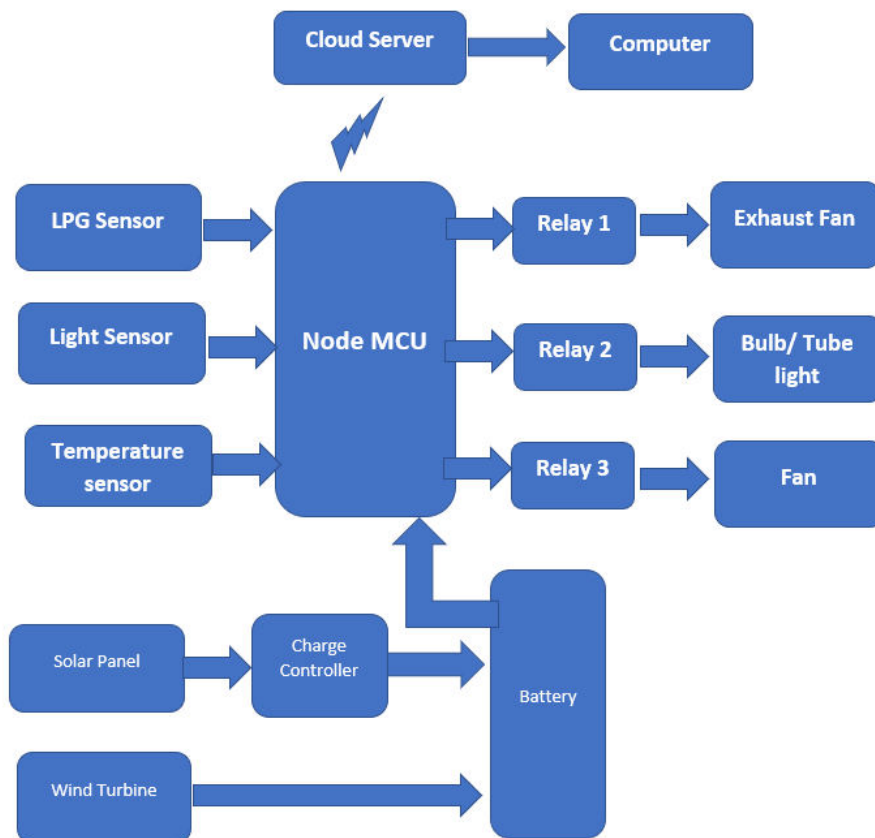


Fig 2 Block Diagram of Proposed System

For automation there is Light sensor and temperature sensor connected where light sensor detects the light intensity and if there is low intensity of light relay 1 of tubelight will be turned on and if there is sufficient light in room tubelight will be turned OFF automatically. Also, temperature sensor detects room temperature then according to temperature condition fan relay will be functioning ON or OFF. Here LPG sensor is connected for safety purpose, if there is any condition of leakage of LPG gas sensor will detect it and then buzzer will get ON and exhaust fan also gets ON.

B. Software

In software portion, there is cloud server which is used for the IoT part and firmware for the microcontroller. Firstly, the firmware is written in C using Arduino IDE software as per requirement and uploaded in the NodeMCU. After that as per configuration of firmware microcontroller collect all data from sensor and sends to the cloud server



continuously. After receiving data on cloud server, it handles data and shows the data on web browser. From the cloud server we can also operate fan and tubelight manually. For this system Adafruit cloud server is used.

IV.PREFORMANCE AVANTAGES TOWARS IMPLEMENTATION OF THIS METHOD

IoT controller provides various advantages like- high performance, very low power consumption, compressive on-chip debug, design flexibility and scalability, optimal price, fast growing support eco-system Setting up the network is very simple and easy. It does not have central controller and loads are distributed evenly across the network. Easy to monitor and control home appliances from remote. It will take the place of existing Infrared technology based devices. The network is scalable and it is easy to add/remote IoT end device to the network.

V.CONCLUSION

The smart home energy management system is works well on real time. The system can be fully controlled by controller. Power consumption details are successfully uploaded into the web server continuously. Solar power and wind energy are enough for production of power to supply the home appliances. The implementation cost of the system is low and this System is also reducing the cost of the power. During peak hour the heavy load home appliances kept off to maintain the energy management and save the energy for nature and upcoming future generations. The benefits are not only have the power but also have the knowledge of consumption.A smart HEMS including

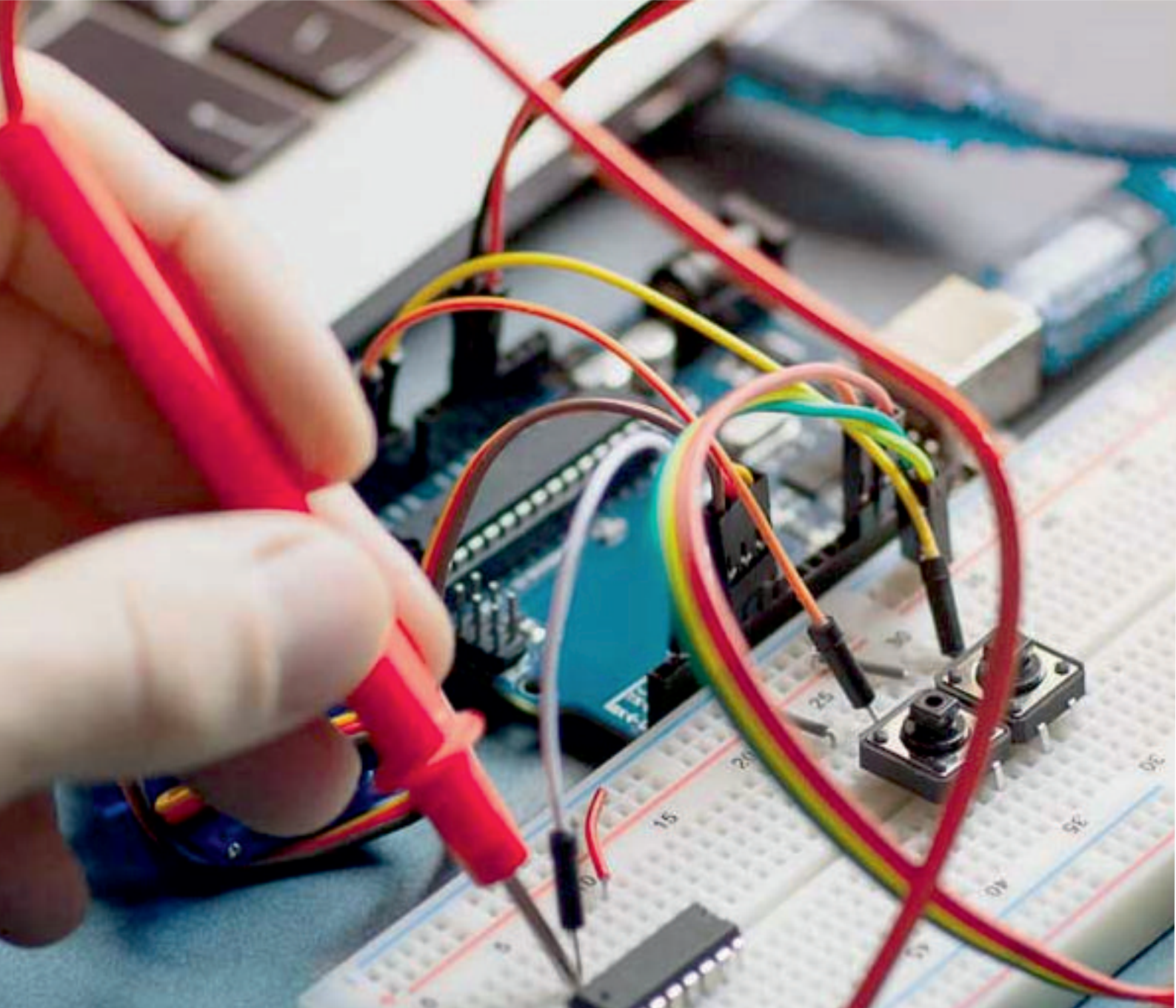
energy generation based on wireless and wired heterogeneous network. The present paper describes the system architecture and implementation results. The use of low-power IoT communication network to measure and transfer the power and energy of home appliances and lights. Through the EMCU, all energy information of home appliances and lights is aggregated for analysis in the home server. The home server provides various aspects of data analysis that is helpful to optimize home energy use. By considering the information of energy consumption and generation simultaneously, the home server can achieve home energy conservation and save the energy cost. In order to support raw ongoing energy crisis residential homes can make use of installed renewable energy sources to save the energy cost, and it is important that both energy consumption and generation are simultaneously considered in HEMS

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