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Iot Based Approach For Load Monitoring And Activity Recognition In Smart Homes

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ABSTRACT

Appliance load monitoring in smart homes has been gaining importance due to its significant advantages in achieving an energy efficient smart grid. The methods to manage such processes can be classified into hardware-based methods, including intrusive load monitoring (ILM) and software-based methods referring to non-intrusive load monitoring (NILM). ILM is based on low-end meter devices attached to home appliances in opposition to NILM techniques, where only a single point of sensing is needed. Although ILM solutions can be relatively expensive, they provide higher efficiency and reliability than NILMs. Moreover, future solutions are expected to be hybrid, combining the benefits of NILM along with individual power measurement by smart plugs and smart appliances. This paper proposes a novel ILM approach for load monitoring that aims to develop an activity recognition system based on IoT architecture. The proposed IoT architecture consists of the appliances layer, perception layer, communication network layer, middleware layer, and application layer. The main function of the appliance recognition module is to label sensor data and allow the implementation of different home applications. Three different classifier models are tested using real data from the UK-DALE dataset: feed-forward neural network (FFNN), long short-term memory (LSTM), and support vector machine (SVM). The developed activities of daily living (ADL) algorithm map each ADL to a set of criteria depending on the appliance used. The features are extracted according to the consumption in Watt-hours and the times where they are switched on. In the FFNN and the LSTM networks, the accuracy is above 0.9 while around 0.8 for the SVM network. Other experiments are performed to evaluate the classifier model using a new test set. A sensitivity analysis is also carried out to study the impact of the group size on the classifier accuracy.

1. INTRODUCTION

In recent years, activity recognition systems gained importance and pursued proactively in the field of smart home environment [1]. These systems are deployed to recognize user activities for many different applications that automate their daily tasks. Recent advancement in consumer electronics and home networking prompted rapid development of various activity recognition systems. Smart home environment, being heterogeneous in nature poised with many significant challenges for tracking and recognizing activities of daily life for the comfort of home dwellers. By recognizing the daily activities, the home environment could function as an augmented smart space by responding to the needs of home dwellers. Consequently, activity recognition in smart home environment has become one of the active investigation areas with significant interest [2-3]. The Internet of Things (IoT) is a communication model that specifies smart objects of daily life equipped with intelligence and connectivity, enabling them to communicate with one another and consumers, becoming essential part of the Internet. IoT would enable seamless discovery of activity patterns, and deriving models for analytics with large chunks of activity data. It is important to note that activity data generated in smart home environment is enormous, intensive and surmounting due to rapid usage of numerous consumer devices. Hence, IoT will nurture the development of a number of smart home services that optimizes the heterogeneous activity data generated by these devices. In this paper, an IoT based activity recognition system for smart home environment is proposed based on wearable sensors.

By using IoT, we are successful in controlling the appliances in various areas, in which one of them is to control the home automation by using Node Microcontroller. We can also use other boards like raspberry pi, beagle bone etc.,

2. LITERATURE REVIEW

Tsirmpas [1] proposed a new method for profile generation in an IoT environment: An application in ambient assisted living. The current paper serves well in providing a great deal of detail about how components of the IoT might collect data to be processed into contextual information by implementing the proposed methodology of profile generation. Gomes [2] described an FPGA-based edge device for the Internet of Things. The system proposed an FPGAbased edge device for IoT which uses System-on-Chip (SOC) FPGA technology to offload important features of the communication stack to dedicated hardware, aiming to increase system performance.

Jeya Padmini & Kashwan et.al.,[3] explained an effective power utilization and conservation in smart homes using IoT. A technique based on IoT, for recognizing human activity through image processing is proposed in the paper. Energy management is done based on real time approach in which a machine to machine communication takes place.

Jinsoo Han [4] proposed a SMART home energy management system using zigbee and PLC. The server displays the web page which gives the information of the homes power consumption and generation. It is then compare with the previous data which optimize the cost and use of electricity.

Jose G. de Matos [5] explained a system to control the state of charge of the battery bank reducing the voltage on its terminals by controlling the generated power by the energy sources. Shiu Kumar [6] described a SMART home using android application. This paper presents a stand-alone system and low cost, which is based on the Android app communicate with the micro-web server provides more than the switching functionalities.

Mohanty, Panda & Pattnaik et.al., [7] discussed Implementation of a Web of Things based Smart Grid to remotely monitor and control Renewable Energy Sources. The integration of Web of Things with existing power grid architecture will provide us numerous opportunities for improvements in our energy saving techniques.

Huiyong, Jingyang, & Min et.al., [8] described a "Building a smart home system with wireless sensor network and service robot." The author elaborated examined the integration of WSN with service robot for smart home monitoring system. Minh-Thanh [9] discussed a "Towards Residential Smart Grid: A Practical Design of Wireless Sensor Network and Mini-Web Server Based Low Cost Home Energy Monitoring System" the 2013 International Conference on Advanced Technologies(ICAT) for Communications The paper presents a practical design of wireless sensor network based energy monitoring smart home system.

3. BLOCK DIAGRAM

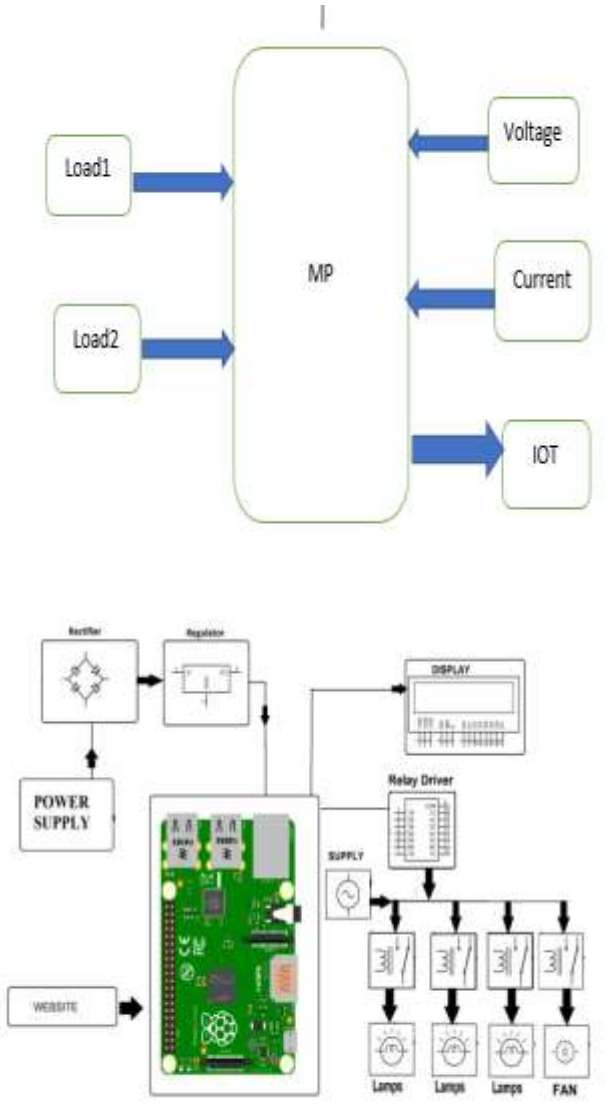

Fig 1.Block Diagram

4. DESCRPTION OF COMPONENTS

4.1 Raspberry Pi

The Raspberry Pi is a small computer about the size of a credit card. A complex board that integrates the major functional essentials in to a only chip in Raspberry Pi are its Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz CPU, 400MHz VideoCore IV multimedia GPU, 1GB LPDDR2-900 SDRAM (i.e. 900MHz) Memory along with 4USB ports, HDMI, composite video (PAL and NTSC) via 3.5 mm jack video output, 10/100Mbps Ethernet and 802.11n Wireless LAN, 17 GPIO plus specific functions, and HAT ID bus,

Bluetooth 4.1. It forms an embedded web server. All the sensors are connected to these which senses industrial parameter under control and send them to user by using either inbuilt Bluetooth or Wi-Fi. User can monitor this data from its local web browser by using dynamic IP address of Pi Module.

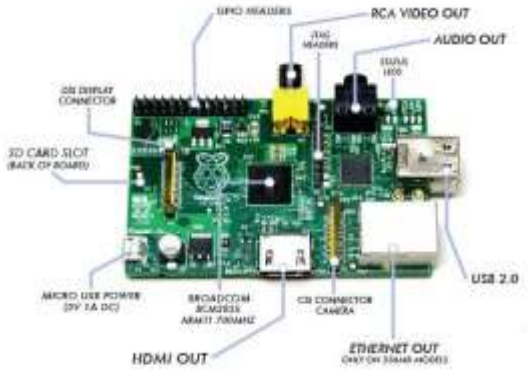

Fig 2. Raspberry Pi

4.2 LCD

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

Fig 3. LCD

5. RESULT

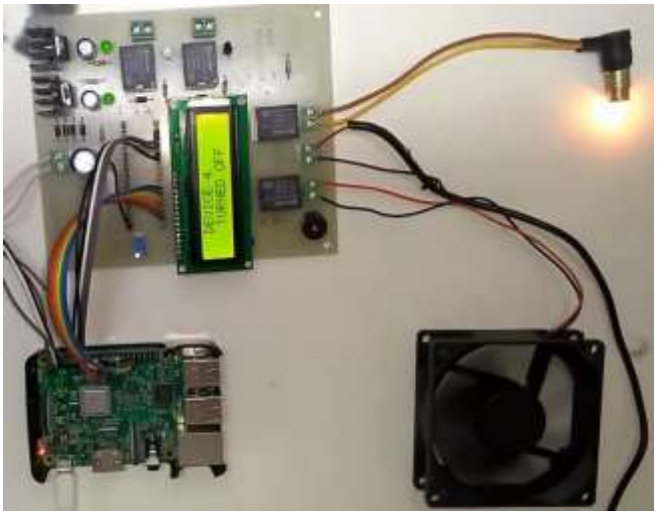

Fig 4: Output Result

CONCLUSION

The paper gives an overview about monitoring of load along with the security notification and smart switching which was managed with the help of IOT technology. It specifies various technologies used for executing the project. As every class of society has the right to secure their home considering this the project was made pocket friendly for everyone. The paper also gives an overview about the future scope of the project. In future home automation will be widely used.

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