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# Survey on IoT based Smart Automation System with Analysis for Power Optimization

Buvaneswari S[1], Abraar Mohammed Malik S[2], Albrin R[3], Abubacker Siddique N[4]
[1]Assistant Professor, [2, 3, 4]Undergraduate Students, Department of Computer Science Engineering, Easwari Engineering College, Chennai, India.

***Abstract:*** ***The number of electrical devices and appliances in homes and offices has been on the rise, thus the need to monitor and control these devices has become a serious demand. Several problems such as over usage of power can cause inefficiency and wastage of power. These problems can be solved if the devices and appliances are properly monitored by analyzing their power usage patterns and controlling them using devices we use on a regular basis. This project solves the emerging power crises by collecting data from appliances through IoT enabled microcontrollers. A cloud server is set up and the data collected from the appliances are captured in the server and stored for analysis. The microcontroller will be connected to the cloud server via the Internet. A dashboard web application is presented to the user where the state of the all the devices and appliances are visually represented using graphs and charts for analysis. This visualization can be used to analyse the power usage of every appliance which informs the user of any wastage of power and other information. The dashboard also comes with controls that enables the user to control the devices remotely with the click of a button. Additionally, voice commands can be used to control the devices via Amazon Alexa skill which improves the usability of the application. The cloud server is powered by Amazon Web Services. The server exposes API endpoints over the internet that enables the microcontroller and the dashboard web app to send and receive data that is stored in the database. Hence, this project drastically improves the power efficiency and reduces the cost.***

***Keywords*****:** ***Internet Of Things, Power, Energy, Smart Home***

## I. INTRODUCTION

In this age of internet, plethora of devices are interconnected and are communicating with each other. IoT devices enable machine to machine communication over the internet. Home Automation is the part of the larger Internet of Things (IoT) community. It enables various devices and appliances to be monitored and controlled over the internet. In Internet of Things (IoT) each machine is given a unique identifier (UID) to be identified uniquely over the network. IoT devices can be used to monitor and control mechanical, electrical and electronic systems used in buildings. Long-term benefits could include energy savings by automatically ensuring lights and electronics are turned off. A smart home or automated home could be based on a platform or a hub that controls smart devices and appliances. The integration of the Internet with building energy management systems helps to create energy efficient and IOT-driven "smart buildings". These devices allow for remote control by users, or central management via a cloud-based interface, and enable functions like scheduling. Internet-connected devices, electric utilities not only collect data from end-users, but also manage distribution automation devices like transformers. IoT devices can not only be used to monitor and control the devices, but also be used to collect the data from these devices for power analysis and optimization.

## II. LITERATURE SURVEY

The contribution of various scholars are studied for survey and analyzing the merits and demerits in order to enhance the consequences for making the system work better.

Waheb A. Jabbar, et al. [1] discuss a possible solution for cost effective fabrication of smart home device which is like a box that could be connected anywhere. This System consist of an IoT enabled microcontroller which is connected to various sensors to collect and send data to the Adafruit server which reflects the current state of each appliance and can be controlled using IFTTT. Though, this IoT system is portable and can be controlled over the Internet ,the server which holds the current state (Adafruit) and the control Interface ( IFTTT) are two separate entities due to which many incompatibility issues may occur and the IoT Hardware operates on Battery which is not always reliable and the power source to the microcontroller must be an more reliable source like direct AC power.

S. K. Vishwakarma, et al. [2] discuss a possible solution for controlling the home appliances from anywhere in the world. This system consists of Internet connectivity module attached to the main supply unit which could be accessed through the internet. This system is very useful for controlling the appliance from elsewhere. Though, this IoT system can be controlled over the internet, it requires a static IP to be accessed, which may not be feasible in household Internet environment. Additionally, implementing static IP becomes exponentially expensive as the number of devices increase. IoT devices that work in a dynamic IP setup is preferred.

Lun-De Liao, Yuhling Wang, et al. [3] discuss a possible solution for automating homes using IoT enabled Nodemcu which could be controlled using an Android App. This System consist of a Microcontroller to which various light switches, temperature and humidity sensors, gas sensors, motion detection sensors and alarms are connected and controlled using the Android app. This system also works even if the home Internet connection is down using 3G/4G connectivity. Though, this IoT System works under adverse condition , it lacks in the department of power optimization and Scalabilty of device addition.

Chi-Sheng Shih, et al. [4] investigate the development and challenges of smart buildings and smart cities using CPS/IoT (Cyber-Physical Systems/Internet of Things) Systems. Well-designed CPS/IoT systems can reduce energy consumption, enhance safety in buildings and cities or can increase the comfortability in the building. The authors study the development in five areas of interest namely middleware, computation model, fault tolerance, quality of data, and virtual run-time environment. The middleware is being done using Virtual Machines (VM). Although VMs offer impressive set of features, almost all sacrifice performance. A reconfigurable real-time middleware for distributed CPS with aperiodic events and WuKong are the two proposed middlewares presented by the authors. The open challenges in middleware are privacy control, access control, scalability, and service management. The challenges in quality of data are to identify the causes of invalid data, the way in which to present the quality of data, and how the quality of data for computing systems can be assured. The challenges in computation models are service impedance and federating public and private services. Although many works have been conducted on these two applications, many challenges remain open.

Guneet Bedi, et al. [5] presents the important role of IoT in transforming Electric Power and Energy Systems (EPES). IoT has a significant impact on EPESs and offers several opportunities for growth and development. The authors discuss various areas of interest such as the role of IoT in Intelligent Electric Power Networks, the impact of IoT on Electric Power and Energy Systems, and the constraints for the deployment of IoT in Electric Power and Energy Systems. Deploying IoT in EPESs has several advantages, but some challenges exist such as: sensing, connectivity, power management, big data, computation, complexity, and security. The authors provide recommended solutions to overcome these challenges. Digitizing the electric power ecosystem using IoT helps to better account for DER integration, reduce energy wastage, generate savings, and improve the efficiency of the electric power networks.

Weitao Xu, et al. [6] reported the design, implementation, and deployment of an emergency light-based smart building solution. The development of smart buildings is impeded by the high installation/maintenance cost and the difficulty of large-scale evaluation. The authors propose the use of LoRa mesh network to cover the whole building using one gateway only. This system is built on top of existing facilities in the building, so that the deployment and maintenance cost is reduced. Evaluation results show that the systems are stable and robust to environmental changes.

Ali Parsa, et al. [7] provide the design and implementation of a smart home control system where load shedding and reduced energy consumption is encouraged. The authors propose the use of a central controller that incorporates Brute Force search algorithm and gives On/Off commands to the smart plugs that are connected to the electrical appliances, based on the Time of Use (TOU) tariffs and the load shedding commands produced by the power utility. The proposed system aims at reducing the consumption and cost by the implementaion of Conservation Voltage Reduction (CVR). This implementaion in the system leads to reduced cost and voltage which makes the system efficient.

Eunil Park, et al. [8] propose a technique that serves as a foundation for improving IoT technologies for smart home environment. This paper focuses on user experiences and explores the key determinants of user acceptance of IoT technologies in smart home environment with the integration of five motivating factors - enjoyment, compatibility, connectedness, control, and cost. Both Confirmatory Factory Analysis (CFA) and Structural Equation Modeling (SEM) methods were employed to present the structural connections in determining the intention to use the technologies. The Technology Acceptance Model (TAM) proves to be the most successful approach as it provides a framework for presenting information related services and products. The drawbacks of this study is that it cannot provide enough explanations for the results achieved. Also, individual information was not considered for the investigation, and the study is constrained to one country.

Yi-Bing Lin, et al. [9] have proposed a smart socket system known as the MorSocket that allows users to control multiple sockets from a single webpage. The cost of MorSocket is less as the sockets share a single wireless communication system. The MorSocket system integrates MorSensor using an IoT management platform IoTtalk. The MorSensor system can be easily configured through IoTtalk GUI. This MorSensor system is used to control the MorSocket system through simple plug and play. The success of

 

MorSocket system is characterized by two factors - response time, $t_m$ and user tolerance delay, $t_b$, where the response time should be lesser than user tolerance delay. The only drawback is that in case of microcontroller failure, all the sockets will stop responding.

Sai Mounika Errapotu, et al. [10] provide a solution that aims at scheduling the appliances and optimizing the energy consumption in a Smart Home-IoT environment. The objective of the system, namely Secure Appliance Scheduling for Flexible and Efficient Energy Consumption (SAFE) is to minimize the utility cost at the user's end as well as the provider's end. In SH-IoT environment, while appliances are scheduled, there is potential risk of user's data being compromised. To solve this issue, they propose the use of a homomorphic encryption approach, known as Alternating Direction Method of Multipliers (ADMM) and Pailier cryptosystem that keeps the user data safe from curious utility providers. One of the drawbacks of SAFE is that it increases the computational overhead due to repeated encryption every time a request is generated which eventually increases the latency.

Table 1: Comparison on Various Methods Used in Smart Home Automation and Power Optimization

| S.NO | Paper | Technique | Result | Issues |
|---|---|---|---|---|
| 1 | Design and Fabrication of Smart Home with Internet of Things Enabled Automation System. | IoT based smart home using Adafruit and IFTTT. | A portable smart home system that can be controlled over the Internet | Two separate entities Adafruit and IFTTT is used which may cause incompatibility issues and the power source is battery can be changed into a more reliable AC mains. |
| 2 | Smart Energy Efficient Home Automation System Using IoT | IoT Based Home Automation using IFTTT and Adafruit | A Smart Home system that can be controlled and monitored from everywhere. | Though, this system can be controlled from anywhere in the world it requires an static IP to access it and due to the increasing number of smart Devices not all can be given a Static IP. |
| 3 | Design and Validation of a Multifunctional Android-Based Smart Home Control and Monitoring System. | NodeMcu an IOT enabled microcontroller which is controlled using an android app. | A more reliable IoT system which could even work when the internet is down using 3G/4G connectivity. | It lacks in the department of power optimization and Scalability of device addition. |
| 4 | Designing CPS/IoT applications for smart buildings and cities | Reconfigurable real-time middleware and WuKong | Reduced energy consumption, enhanced safety, and increased comfortability in buildings and cities | The performance of Virtual Machines used as middleware can be a potential bottleneck in designing the CPS/IoT systems. |
| 5 | Review of Internet of Things (IoT) in Electric Power and Energy Systems | Decarbonization of Electric Power and Energy System, Decentralization of Electric Power and Energy Production, and Transportation Electrification | Improved asset visibility, optimal management of distributed generation, elimination of energy wastage, and energy savings. | Since IoT sensors are used to monitor electric power and energy systems, the computational overhead will possibly take a meteoric rise in the near future. |
| 6 | The Design, Implementation, and Deployment of a Smart Lighting System for Smart Buildings | LoRa mesh network | Reduced system deployment and maintenance cost, stable and robust to environmental change, node, and gateway failure. | Since it uses a single gateway node to communicate to the internet, there is a possible risk of single point failure. |
| 7 | Hierarchical Smart Home Control System for Imporving Load Shedding and Energy Consumption: Design and Implementaion | IoT, Brute Force search algorithm | Optimized energy consumption and reduced voltage usage. | The failure of central controller poses as a risk to the whole system. Brute Force search algorithm tends to be slower when compared to other search algorithms. |
| 8 | Comprehensive Approaches to User Acceptance of Internet of Things in a Smart Home Environment | Structural Equation Modeling (SEM), Confirmatory Factory Analysis (CFA) and TAM (Technology Acceptance Model) | Successful approach to smart home environment considering user acceptance. | Individual information was not considered for the investigation, constrained to one country, and this study cannot provide enough explanations. |
| 9 | MorSocket: An expandable IoT-Based Smart Socket System | MorSensor, IoTtalk | Provides easy control of multiple sockets through a single wireless system, thus turns out to be cost effective. | In case of microcontroller failure, all the sockets will be affected. |
| 10 | SAFE: Secure Appliance Scheduling for Flexible and Efficient Energy Consumption for Smart Home IoT | ADMM, Pailier Cryptosystem | Secure and Optimized Energy Consumption approach to Smart Home IoT | Increases the computations due to constant encryption for every request, which in turn increases the latency. |

## III. CONCLUSION AND FUTURE WORK

Many systems have been developed for controlling the appliances using IoT but most of them lack in the department of power optimization. In Table 1, the focus is on controlling the appliances using the internet and various other alternatives such as 4G, LoRa mesh, etc. The main potential of IoT is not used to its fullest. Thus, the data collected from each IoT devices can be visualized using Graphs and Bar charts for future power optimization. In the future, the IoT devices can be voice automated for easy control of devices remotely.

## REFERENCES

[1] W. A. Jabbar et al., "Design and Fabrication of Smart Home With Internet of Things Enabled Automation System," in IEEE Access, vol. 7, pp. 144059-144074, 2019.
[2] S. K. Vishwakarma, P. Upadhyaya, B. Kumari and A. K. Mishra, "Smart Energy Efficient Home Automation System Using IoT," 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), Ghaziabad, India, 2019, pp. 1-4.
[3] L. Liao et al., "Design and Validation of a Multifunctional Android-Based Smart Home Control and Monitoring System," in IEEE Access, vol. 7, pp. 163313-163322, 2019.
[4] C. Shih, J. Chou, N. Reijers and T. Kuo, "Designing CPS/IoT applications for smart buildings and cities," in IET Cyber-Physical Systems: Theory & Applications, vol. 1, no. 1, pp. 3-12, 12 2016.
[5] Bedi, G., Venayagamoorthy, G. K., Singh, R., Brooks, R. R., & Wang, K.-C. (2018). Review of Internet of Things (IoT) in Electric Power and Energy Systems. IEEE Internet of Things Journal, 5(2), 847ñ870. doi:10.1109/jiot.2018.2802704
[6] Xu, W., Zhang, J., Kim, J. Y., Huang, W., Kanhere, S., Jha, S., & Hu, W. (2019). The Design, Implementation, and Deployment of a Smart Lighting System for Smart Buildings. IEEE Internet of Things Journal, 1ñ1.
[7] A. Parsa, T. A. Najafabadi and F. R. Salmasi, "A Hierarchical Smart Home Control System for Improving Load Shedding and Energy Consumption: Design and Implementation," in IEEE Sensors Journal, vol. 19, no. 9, pp. 3383-3390, 1 May1, 2019.
[8] Park, E., Cho, Y., Han, J., & Kwon, S. J. (2017). Comprehensive Approaches to User Acceptance of Internet of Things in a Smart Home Environment. IEEE Internet of Things Journal, 4(6), 2342ñ2350.
[9] Y. Lin, C. Huang, L. Chen, G. Sung and C. Yang, "MorSocket: An Expandable IoT-Based Smart Socket System," in IEEE Access, vol. 6, pp. 53123-53132, 2018.
[10] Errapotu, S. M., Wang, J., Gong, Y., Cho, J.-H., Pan, M., & Han, Z. (2018). SAFE: Secure Appliance Scheduling for Flexible and Efficient Energy Consumption for Smart Home IoT. IEEE Internet of Things Journal, 1ñ1.