RES MILITARIS
REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

A Theoretical Framework For Monitoring And Controlling An Iot-Based Energy Management System

By

Mohamed J. Saadh
Faculty of Pharmacy, Middle East University, Amman, 11831, Jordan
E-mail: msaadeh@meu.edu.jo
Orcid ID: 0000-0002-5701-4900

Abstract

This research takes into consideration the topic of Internet of Things (IoT) and its application in real-life scenarios and circumstances. Such critical directions that manifest and affect the wide range of circumstances in monitoring and control systems are related to contemporary digital technology systems and 'smart' applications to showcase notable degrees of automation and intelligence as crucial concepts. These have distinct practical components, such as a sensory module, connectivity module, microprocessor, and a prototyping platform that increase interactivity across devices. However, many other considerations have to be manifested across the board. In those terms, the emerging consequences derived and reflected all across the board shall be responsible for constituting and reflecting all kinds of outcomes and results. However, the theoretical framework developed in this case shall have to account for all the deviations that might happen in this context. Through it, the possibilities of future research development are at major degrees and concerns with the calls for energy efficiency.

Keywords: Internet of Things, IoT, Energy Management System. Digital Monitoring and Controlling, Automation, Sensors based environment, IoT monitoring and controlling, Energy Efficiency

1. Introduction

Energy use across the societal and planetary levels is essential and ubiquitous but modern usage primarily encompasses energy systems that exist in many forms and frameworks. Proper usage is a term that has been in applicative existence in referring to major domains of energy value chains, which have existed primarily in such major phases as distribution and delivery (Hossein Motlagh et al., 2020). These are directed to households, industries, markets, etc. that become major outlooks in terms of monitoring the consumption of energy, whether it is in terms of electricity, heat, direct fossil fuel etc. The vast range of different energy resources has necessitated the widespread use of technology to perform major operations and functions, among which monitoring leads the way for control measures to be implemented. Inefficiencies abound in almost all forms of these options that materialize and impact the circumstances (Georgiou et al., 2017). In contemporary systems for any energy source, say electricity; there is an estimated 35% loss in energy for a variety of reasons like transmission and distribution consumption, inefficiencies, faults, and errors, etc. (Hossein Motlagh et al., 2020)

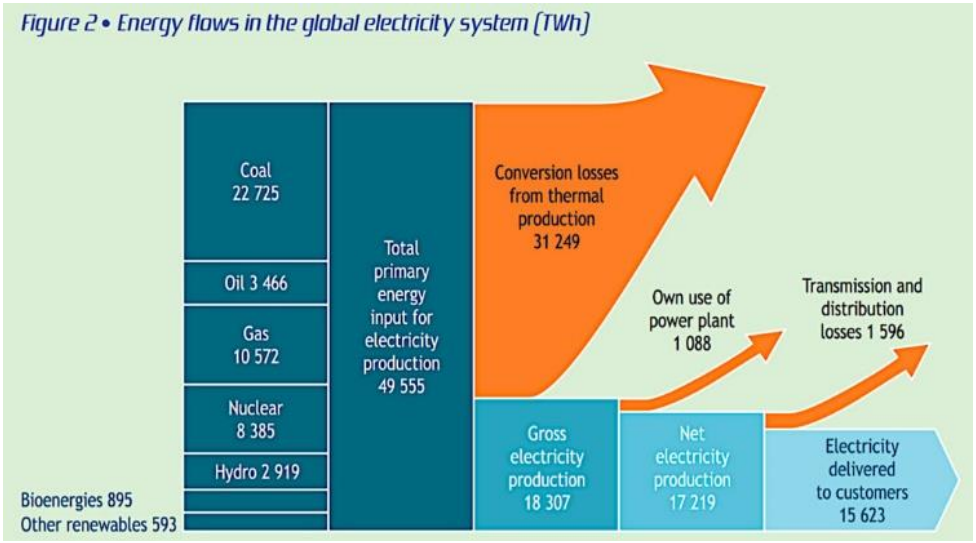

Figure 1. *Inefficiencies in Energy Consumption at a Global Level. (Source: Hossein Motlagh et al., 2020).*

Internet of Things (IoT) is a technological concept because of the continued advancements and evolution in communication, automation, complete control, and other functions reaching a point that human intervention simply is not able to achieve (Georgiou et al., 2017). Current electrical energy constitutes the majority of consumption that materializes, as well as having been called to provide a proper framework to establish the necessary outcomes. Among them, a 'smart' system applied in a household or an industrial property usually features the need for software programs to deliver necessary information (Hossein Motlagh et al., 2020), as well as automate on behalf of important breakthroughs that have been made with a variety of different censoring technology for over a decade or so.

Based on those details, this research shall aim to explore and provide a proper theoretical framework for IoT-based monitoring and controlling in an energy management system by considering all the necessary propositions and determinations made in the literature.

The research question will be:

What are the key aspects and details of a framework that might be presented as appropriate and true for all IoT-based monitoring and controlling in energy management systems?

2. Literature Review

The basis of the considerations and factors affecting them is related to several perspectives that have been offered in this consequential vein. Mani, Abhilasha, and Lavanya (2017) have collectively addressed this in the context of India with the help of which they have directly attributed the breakdown of the practical components of an IoT energy management system. These include sensors, Arduino, WiFi module ESP8266, and the Edge level processors in raspberry pi3, which connect with modules that became a prototype that is perceived as a general overview through Figure 2 (Mani, Abhilasha and Lavanya, 2017). These underlying factors relate to electronic prototyping in terms of the wireless data that is collected in terms of interpreting them to feed into the microprocessing system so that proper responses might be applied. However, the most critical aspect of this energy management

system by Mani, Abhilasha, and Lavanya (2017) is the measurement of errors in energy consumption so that proper outcomes in terms of energy efficiency could be ensured.

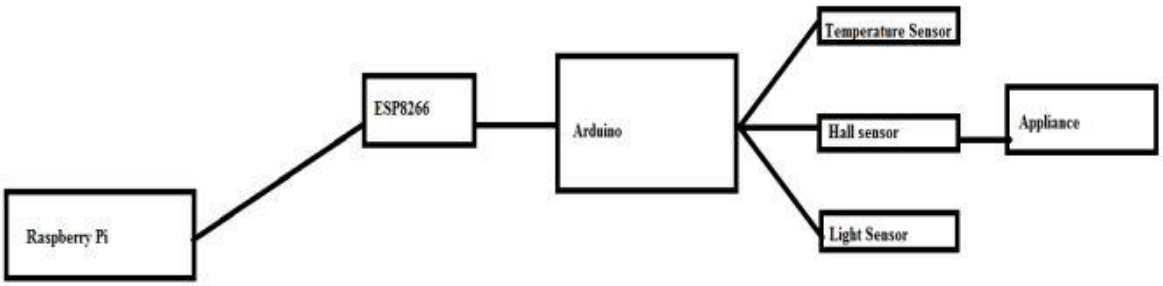

Figure 2. *An Overview of a Conventional IoT system. (Source: Mani, Abhilasha and Lavanya, 2017).*

In Hasan et al. (2021), there is a distinct recognition of the fact that certain outlooks and explanations that could be obtained shall be strongly related to formulating a system that is close to what has been introduced in Mani, Abhilasha, and Lavanya (2017). These factors, however, guide the notion of implementing usage data to the maximum degree imaginable. The conditions that shall permeate, however, have to be delivered through an advanced transmitter capability, known as smart monitoring and control systems (SMACs) (Hasan et al., 2021). They highlight some crucial factors that could be brought fully with the integration of the IoT framework that is constructed and is evident in Figure 3. The major objectives of this kind of transmission include measuring current directly via current sensors, voltage sensing by a transformer, zero crossing technique based on sensing frequency, as well as load tripping and shifting. The critical direction that this leads is a wireless ZigBee transmitter and an Ethernet network as necessary for its implementation across a widespread transmission and distribution system (Hasan et al., 2021). The necessity in this circumstance is driven critically for the establishment of a proper way to approach and resolve the issues presented and highlighted by Pawar and TarunKumar (2020) who point this to be resolved with the help of design-side management.

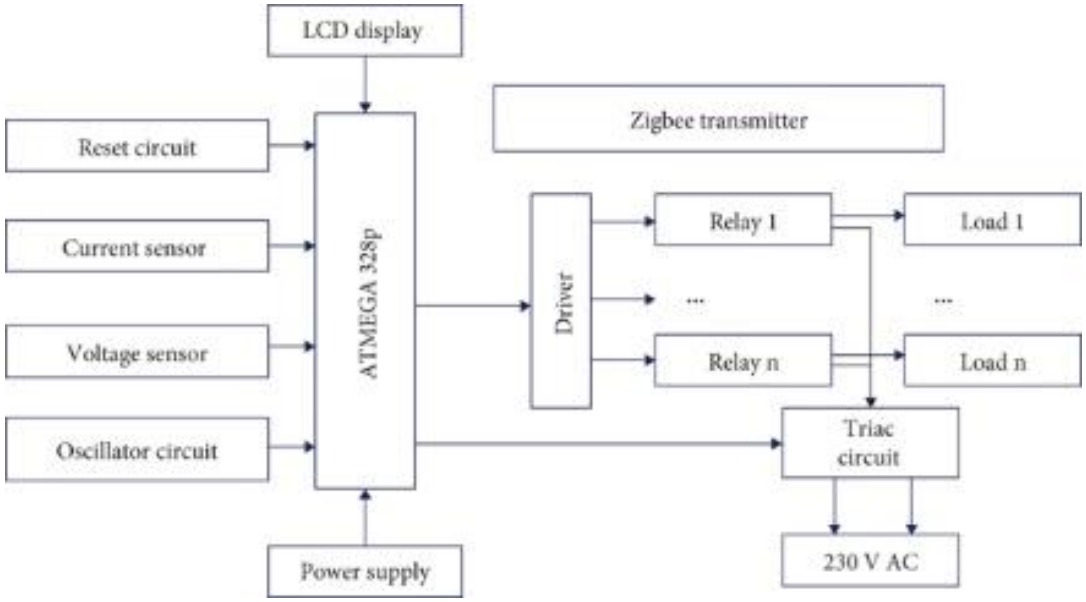

Figure 3. *Transmitter Sub-System in IoT for monitoring and controlling energy. (Source: Hasan et al., 2021).*

Pawar and TarunKumar (2020) have projected that the demand side affairs require resolutions that seem to be strongly related and associated with different major requirements. These include machine learning methods, prediction models developed through particle swarm optimization, experimental hardware setups, and a secure IoT environment most of all, which could deliver the necessary indications and outcomes. Saleem, Usman, and Shakir (2021) have derived and presented some helpful and critical perspectives with the help of which demand side management has been considered as a crucial way of ensuring that all the proper outcomes be delivered and consolidated. The techniques of this management include peak clipping, valley filling, and load shifting on the major parameters during distribution and transmission.

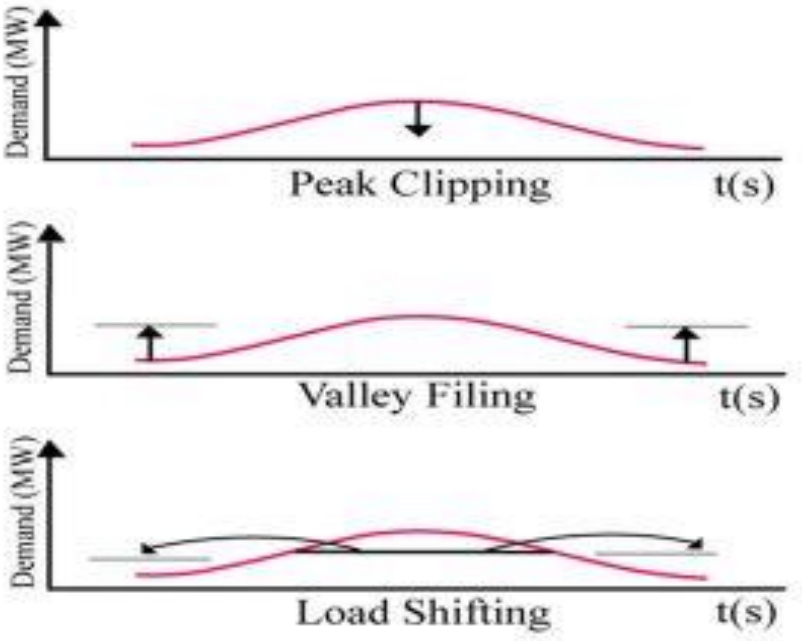

Figure 4. *Types of Design-Side Management. (Source: Saleem, Usman, and Shakir, 2021).*

3. Materials And Methodology

The methodology is conceived of the sudden and considerable shift in academic interest in IoT, and this would congregate the availability of a vast degree of secondary literature. While the literature review serves as a helpful introductory note under these conditions and circumstances. It makes sense to manifest and reflect a wide variety of outcomes when relayed with the increasing accumulation of the literature review in question (Ruggiano and Perry, 2019). Through the help of an inductive approach, and the necessary creation of a theory based on the main topic of research, the appropriate method would be qualitative secondary research as it shall take shape in the form of a systematic literature review. However, the materials obtained shall be followed by extensive search operations on a variety of places where scholarly resources about this topic could be obtained, such as SCI, Elsevier, Springer, Taylor Francis Journal, etc. (Long-Sutehall, Sque and Addington-Hall, 2011) They shall be collected and reviewed based on a few academic metrics, which could be presented and highlighted according to peer review citations, journal name, ranking, etc. The online libraries shall constitute a set sample of 30 articles that shall directly address this issue by and large.

The relevant perspectives to conduct the necessary data analysis shall exceptionally relate to and conduct in terms of a systematic literature review. It shall consist of necessary texts extracting quotes, observations, and results, which could be applied to a coding process (Ruggiano and Perry, 2019). The important ways in which they would be produced as results shall effectively guide all the notable factors that would be based on distinct themes as they shall constitute the framework that is being built. Under such scenarios, the overlying conditions would be based on gaining consensus based on the critical factors and outlooks that might be produced and reflected (Long-Sutehall, Sque, and Addington-Hall, 2011). The critical directions would help in ascertaining the critical descriptions that might be presented in terms of the final framework.

4. Results And Discussion

This part of the entire research shall be notably affected by a series of concerns that have been provided already in the methodology of this dissertation research. As already noted, it shall be strongly based on finding the best possible outcomes that shall materialize as a qualitative analysis by way of a systematic literature review. It shall broadly constitute thematic analysis in terms of conveying the sense of what would be required in explaining and consolidating the theoretical framework that shall emerge from this context by and large. It also will be tabulated to grant visibility and the necessary ways of parsing through data and information all across the board. The important detail that could be explored based on these grounds shall be ascertained in finding similar coding to gain consensus based on contributing in terms of reflecting the grounds in terms of reflecting the results.

For example, the likely theme generated is that "the interactive field generated on the grounds of networking module, a sensing module, microprocessor and a prototyping software to convert the sensory data systematically". It shall result in the following tabular form:

Source	Extract	Code
Mani, Abhilasha and Lavanya (2017)	“In this system, Sensors control the energy consumption of home appliances… Energy data from numerous home servers the PC server and accordingly compare them for producing statistical analysis information.”	The basis of sensors needs to formulate exceptionally with other components to ensure all functions
Hasan et al. (2021)	“IoT is a wide-open and complete network of smart and intelligent objects… full capability and capacity to auto organize; share information, data, and resources; and act and react to any circumstances or atmosphere of the changing environment”	IoT and objects need to ensure fulfillment on the conceptual and practical levels in satisfying all necessary functions
Pawar and TarunKumar (2020)	“... it seeks for the design and development of an intelligent system with day-aheadplanning and accurate forecasting of energy availability.”	The IoT system must be based on an advanced design that shall necessary conceptual design side management

This is just one of several examples that shall be applied to derive comparable outlooks based on themes that shall result in the derivation of all kinds of outcomes. The important relation that must be explored and satisfied shall have a strong basis on associating with the various needs and demands, which might arise as a direct result of these conditions. They might involve a wide degree of distinctions being manifested as a result of various possible directions in terms of components, technological factors, programming, etc.

5. Conclusion And Future Scope

The manifestation of the outcomes shall be derived and pointed out in terms of reflecting all kinds of concerns that shall formulate the theoretical basis of the emerging conditions all across the board. It shall be associated with a basic understanding of machine-to-machine communication, as well as integrating a variety of automation and self-learning capabilities. They shall nevertheless coincide and reflect strongly to the variety of scenarios and possibilities of implementation, which shall only become only on interpolating and adapting all the adaptive factors to be distinguished in terms of the outcomes. The future scope of IoT is immense as the paradigm is supposed to transform the entire world and reduce the separation between virtual and physical.

6. Recommendations

Based on these grounds, the future possibilities obviously constitute scientific experiments to transform or change some distinct aspect in the engineering and technical details applied to all the considerations and factors. Furthermore, meta-analysis like itself shall also play a critical role in deriving and portraying all kinds of different results and possibilities.

Reference List

Georgiou, K., Xavier-de-Souza, S. and Eder, K., 2017. The IoT energy challenge: A software perspective. IEEE Embedded Systems Letters, 10(3), pp.53-56.

Hasan, M.K., Ahmed, M.M., Pandey, B., Gohel, H., Islam, S. and Khalid, I.F., 2021. Internet of Things-based smart electricity monitoring and control system using usage data. Wireless Communications and Mobile Computing, 2021, pp.1-16.

Hossein Motlagh, N., Mohammadrezaei, M., Hunt, J. and Zakeri, B., 2020. Internet of Things (IoT) and the energy sector. Energies, 13(2), p.494.

Long-Sutehall, T., Sque, M. and Addington-Hall, J., 2011. Secondary analysis of qualitative data: a valuable method for exploring sensitive issues with an elusive population?. Journal of Research in Nursing, 16(4), pp.335-344.

Mani, V., Abhilasha, G. and Lavanya, S., 2017. Iot based smart energy management system. International Journal of Applied Engineering Research, 12(16), pp.5455-5462.

Pawar, P. and TarunKumar, M., 2020. An IoT based Intelligent Smart Energy Management System with accurate forecasting and load strategy for renewable generation. Measurement, 152, p.107187.

Ruggiano, N. and Perry, T.E., 2019. Conducting secondary analysis of qualitative data: Should we, can we, and how?. Qualitative Social Work, 18(1), pp.81-97.

Saleem, M.U., Usman, M.R. and Shakir, M., 2021. Design, implementation, and deployment of an IoT based smart energy management system. IEEE Access, 9, pp.59649-59664.