A REVIEW ON IOT AND ENERGY CONSUMPTION

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ABSTRACT

Due to the waste of electrical energy in residential structures in recent years, the necessity for energy efficiency and user comfort has become critical. Different strategies have been offered in the literature to handle the energy optimization challenge. The aim of each approach is to maintain a balance between user comfort and energy needs so that the user can reach the desired degree of comfort with a low energy usage. Researchers have tackled the problem using various optimization techniques and adjustments in the energy consumption reduction factors. To our best knowledge, because of its difficult nature, this issue is not yet resolved. The gaps in the literature are due to technological progress, the inconvenience of optimization techniques and the development of new optimization techniques. Furthermore, many recently suggested optimization algorithms are more accurate in the cases of benchmarks, but have not yet been used to optimise energy use in smart homes. In this research, a complete literature analysis of approaches utilised for optimising energy use and scheduling in intelligent homes was conducted. Detailed debate was conducted on several elements that contribute to thermal comfort, visual comfort and air quality comfort. The fog and edge computing approaches utilised in intelligent homes have also been examined.

KEYWORDS: IoT, Energy, Usage, Optimization.

INTRODUCTION

The biosphere of data and communiqué knowledge is evolving to link everything from anywhere, anytime, with the inclusion of new sensing and communication technologies. This interconnection is called the Internet of Things (IoT). The major problems now are safety, connection, privacy and standard communication methods in IoT-based networks[3]. Researchers are working to tackle these problems in order to properly use IoT-based networks in the real world. Predicting and optimising electricity use in residential structures also interest researchers and scientists in order to make intelligent home IoT-based systems viable. The classic energy management techniques include prediction based on statistical analyses and machine learning technologies applied to electricity metre energy consumption data. However, the hourly energy consumption forecast is not attainable using standard approaches. If we utilise digital metre acquired data and apply machine learning.

The power consumption forecast remains an issue of worry to power generators due to the increasing energy demand induced by the fast expansion in the world's population. Scientists predict that, in a few years' time, energy usage cannot be regulated. There are two ways to tackle the energy shortage: (1) generating additional power or (2) limiting the use of energy resources presently available and decreasing waste. Energy generation is a highly expensive solution to this issue, which takes time and money, but may also be done by adopting certain preventive measures. Researchers have been doing a lot of study on energy consumption prediction and optimization throughout the previous several decades. The first step in optimising energy use is energy prediction. Based on energy already spent, we must forecast the upcoming hour, month or year's energy use. In intelligent houses, when gadgets always use the same amount of energy, the notion of energy optimization is beneficial but if we use the optimization idea in intelligent homes, it will provide the precise energy supply to the devices. The technology for optimization is based on exterior room conditions such as temperature, light, humidity, air movement, air quality etc. The contentment of building occupants is a significant aspect, since clever dwellings and the optimisation of their energy usage become a fascinating issue for scientists and academics. The researchers have developed numerous strategies that address energy management difficulties and increase the comfort index for inhabitants of smart buildings based on optimisation algorithms. Ant's colony optimization and fluid logic have been applied to optimise energy consumption, but there is still a gap in information about cooling situations and the comfort index for residents has to be improved to a certain amount with less electricity. The main problem with the approaches now available is the dependence on the system's geographical region and the heterogeneity of environmental circumstances. Maintaining the balance between the comfort index and power consumption is also an important problem. The rule design in flimsy logic in accordance with environmental circumstances is another problem. The researchers seek to raise the comfort index of residents and minimise energy usage by optimising approaches and optimising the rules. By forecasting interior environmental conditions, it is feasible to reduce power use.

OPTIMIZATION TECHNIQUES

We investigated the literature on optimization techniques used for energy consumption and planning optimisation to answer the RQs. The optimization techniques are based on the method of finding minimal math values. They are utilised for the assessment of design compromise, the assessment of control systems and the identification of data patterns. The answer to the optimization issue involves reducing a difficult issue to a simpler issue and then solving each problem by applying the answer to tackle the next issue. Mathematical optimization is the choice of the best components from a number of options accessible. The optimization algorithms maximise or reduce the actual function by picking an input from a collection of values and estimating the new value of this function based on this value. The issues of optimization are separated into two difficulties based on continuous and discrete values. Optimal parameters must be found in energy management systems utilising optimization methods. Parameters are separated into two categories: the smart home environment as current indoor requirements and the required parameters for a smart home resident as user-set Parameters. These characteristics include temperature, lighting, air flow moisture, air quality and so forth.

Some researchers combined the fog computing environment with the intelligent grid to effectively regulate energy usage. The region-based division, which is allotted to each region, has been implemented. In order to balance loads on virtual computers, the balance algorithms were utilised. They employed round robin (RR), throttled and beam search (BS) algorithms and greater performance of BS methods than other methods. The model includes three layers: cloud for network-grid connection, fog for cloud-microgrid communication and intelligent grid-based communication, including several clusters for fog communication. The fogs were positioned close to the end user in order to minimise delay. The BS algorithm was suggested for the shortest reaction time. suggested a three-layered fog computing system to overcome the cloud load in a smart grid context. The model focused on reducing the electrical demand from the cloud grid. Fog connectivity was done utilising controllers. The second largest layer comprises fogs for user requests and virtual machines. The cloud layer includes data centres and utilities. The first round robin (RR), throttled and shortest time remaining (SRTF) methodologies have been used to evaluate virtual machine allocation performance. In addition, the nearest data centre service broker policy has also been employed to choose the fog. The SRTF may pick a reduced amount of requests on the VM machines. The fogs briefly store consumer data before transmitting them to the cloud for permanent storage. The performance of the suggested cost approach was superior than the other two.

IOT BASED SMART COLONIES

We cannot refute smart cities by taking into account current technological development; in the next ten to twenty years, smart cities will have made great development. Developing nations are migrating to clever cities already. Different IoT domains may be used for optimization. If we restrict it to clever houses, it can be utilised for monitoring, comfort and automation. When we analyse it from an energy management perspective, it may be employed in smart metering and intelligent grids. However, there is still much need for improvement owing to the issues with optimization algorithms and the right selection of elements such as temperature, air quality, humidity, clothes, illumination etc.

CONCLUSION

The researchers took every component into account in satisfying the comfort index and reduced energy consumption of residential structures using various optimization techniques. In comparison with the other algorithms, it may be determined that genetic algorithms have done better. The most noticeable gaps may be noted in terms of parameters and user desire. Most of them, The researchers did not account humidity in their comfort index calculation experiments. The climatic circumstances in the nations where research has been performed might be the explanation for not taking humidity into account. In Malaysia's ecological settings, humidity is the crucial aspect since humidity persists beyond the comfort zone, and we cannot thus neglect humidity consideration. Most researches did not take into account different user conveniences within structures. The main emphasis of research was to comply with the requirements specified for the building environment. Furthermore, relatively few researchers in their experiments have explored the exterior environmental elements that require attention to address this study vacuum. Few investigators took air flow (AF), heat/flow (HR/F) and thermal insulation (CTI), metabolic rate (MR) as well as water vapour pressure into consideration (WVP).

REFERENCES

1. Bashir, U., Jha, K. R., Mishra, G., Singh, G., & Sharma, S. K. (2017). Octahedron-Shaped Linearly Polarized Antenna for Multistandard Services Including RFID and IoT. *IEEE Transactions on Antennas and Propagation*, *65*(7), 3364–3373. https://doi.org/10.1109/TAP.2017.2705097
2. Çiftler, B. S., Kadri, A., & Güvenç, I. (2017). IoT Localization for Bistatic Passive UHF RFID Systems with 3-D Radiation Pattern. *IEEE Internet of Things Journal*, *4*(4), 905–916. https://doi.org/10.1109/JIOT.2017.2699976
3. Colella, R., Catarinucci, L., & Tarricone, L. (2016). Improved RFID tag characterization system: Use case in the IoT arena. *2016 IEEE International Conference on RFID Technology and Applications, RFID-TA 2016*, 172–176. https://doi.org/10.1109/RFID-TA.2016.7750760
4. Fan, C., Wen, Z., Wang, F., & Wu, Y. (2012). A middleware of internet of things(iot) based on Zigbee and RFID. *IET Conference Publications*, *2011*(586 CP), 732–736. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84864939256&partnerID=40&md5=48d6df2c9e0dd0aebcb7932fef789e55
5. Freidl, P. F., Gadringer, M. E., Amschl, D., & Bcosch, W. (2017). mm-Wave RFID for IoT applications. In P. T. (Ed.), *Proceedings of the 2017 International Workshop on Integrated Nonlinear Microwave and Millimetre-Wave Circuits, INMMiC 2017*. Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/INMMIC.2017.7927322
6. Hester, J. G. D., & Tentzeris, M. M. (2017). A Mm-wave ultra-long-range energy-autonomous printed RFID-enabled van-atta wireless sensor: At the crossroads of 5G and IoT. *IEEE MTT-S International Microwave Symposium Digest*, 1557–1560. https://doi.org/10.1109/MWSYM.2017.8058927
7. Kaur, M., Singh, U., & Singh, D. (2015). Design of FIR Filter Using Biogeography Based Optimization. *Proceedings - 2015 2nd IEEE International Conference on Advances in Computing and Communication Engineering, ICACCE 2015*, 312–317. https://doi.org/10.1109/ICACCE.2015.136
8. Kubo. (2015). The research of IoT based on RFID technology. *Proceedings - 7th International Conference on Intelligent Computation Technology and Automation, ICICTA 2014*, 832–835. https://doi.org/10.1109/ICICTA.2014.199
9. Sharma, V., & Kumar, V. (2016). Multi-objective optimization of laser curve cutting of aluminium metal matrix composites using desirability function approach. *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, *38*(4), 1221–1238. https://doi.org/10.1007/s40430-016-0487-9
10. Solic, P., Blazevic, Z., Skiljo, M., Patrono, L., Colella, R., & Rodrigues, J. J. P. C. (2017). Gen2 RFID as IoT enabler: Characterization and performance improvement. *IEEE Wireless Communications*, *24*(3), 33–39. https://doi.org/10.1109/MWC.2017.1600431
11. Yu, M., Zhang, D., Cheng, Y., & Wang, M. (2011). An RFID electronic tag based automatic vehicle

identification system for traffic iot applications. *Proceedings of the 2011 Chinese Control and Decision Conference, CCDC 2011*, 4192–4197. https://doi.org/10.1109/CCDC.2011.5968962

1. Junfeng, T., & Anyuan, D. (2010). An IEB-oriented ITS model combined data mining with 3S technologies. *CCTAE 2010 - 2010 International Conference on Computer and Communication Technologies in Agriculture Engineering*, *2*, 316–319. https://doi.org/10.1109/CCTAE.2010.5543340

2. Sabri, N., Aljunid, S. A., Ahmad, R. B., Malek, M. F., Yahya, A., Kamaruddin, R., & Salim, M. S. (2012). Smart prolong fuzzy wireless sensor-actor network for agricultural application. *Journal of Information Science and Engineering*, *28*(2), 295–316. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84859059512&partnerID=40&md5=26bb7701c25afd350f8a2104459c4c73

3. Rathore, M. M., Ahmad, A., Paul, A., Wan, J., & Zhang, D. (2016). Real-time Medical Emergency Response System: Exploiting IoT and Big Data for Public Health. *Journal of Medical Systems*, *40*(12). https://doi.org/10.1007/s10916-016-0647-6

4. Ray, P. P. (2014). Home Health Hub Internet of Things (H3IoT): An architectural framework for monitoring health of elderly people. *2014 International Conference on Science Engineering and Management Research, ICSEMR 2014*. https://doi.org/10.1109/ICSEMR.2014.7043542

5. Shi, Y., Ding, G., Wang, H., Eduardo Roman, H., & Lu, S. (2015). The fog computing service for healthcare. *2015 2nd International Symposium on Future Information and Communication Technologies for Ubiquitous HealthCare, Ubi-HealthTech 2015*, 70–74. htt

6. Tyagi, S., Agarwal, A., & Maheshwari, P. (2016). A conceptual framework for IoT-based healthcare system using cloud computing. In S. A. Bansal A. (Ed.), *Proceedings of the 2016 6th International Conference - Cloud System and Big Data Engineering, Confluence 2016* (pp. 503–507). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/CONFLUENCE.2016.7508172

7. Baker, S. B., Xiang, W., & Atkinson, I. (2017). Internet of Things for Smart Healthcare: Technologies, Challenges, and Opportunities. *IEEE Access*, *5*, 26521–26544. https://doi.org/10.1109/ACCESS.2017.2775180

8. Catarinucci, L., De Donno, D., Mainetti, L., Palano, L., Patrono, L., Stefanizzi, M. L., & Tarricone, L. (2015). An IoT-Aware Architecture for Smart Healthcare Systems. *IEEE Internet of Things Journal*, *2*(6), 515–526. https://doi.org/10.1109/JIOT.2015.2417684

9. Chen, M., Wan, J., & Li, F. (2012). Machine-to-machine communications: Architectures, standards and applications. *KSII Transactions on Internet and Information Systems*, *6*(2), 480–497. https://doi.org/10.3837/tiis.2012.02.002

10. Geller, J., Grudzinskas Jr., A. J., McDermeit, M., Fisher, W. H., & Lawlor, T. (1998). The efficacy

of involuntary outpatient treatment in Massachusetts. *Administration and Policy in Mental Health*, *25*(3), 271–285. https://doi.org/10.1023/A:1022239322212

11. Gia, T. N., Jiang, M., Rahmani, A.-M., Westerlund, T., Liljeberg, P., & Tenhunen, H. (2015). Fog computing in healthcare Internet of Things: A case study on ECG feature extraction. In J. S. L. L. C. R. A. H. J. M. G. G. N. W. Y. Atzori L. Jin X. (Ed.), *Proceedings - 15th IEEE International Conference on Computer and Information Technology, CIT 2015, 14th IEEE International Conference on Ubiquitous Computing and Communications, IUCC 2015, 13th IEEE International Conference on Dependable, Autonomic and Secure Computing, DASC 2015 and 13th IEEE International Conference on Pervasive Intelligence and Computing, PICom 2015* (pp. 356–363). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/CIT/IUCC/DASC/PICOM.2015.51

12. He, D., & Zeadally, S. (2015). An Analysis of RFID Authentication Schemes for Internet of Things in Healthcare Environment Using Elliptic Curve Cryptography. *IEEE Internet of Things Journal*, *2*(1), 72–83. https://doi.org/10.1109/JIOT.2014.2360121

13. Hiremath, S., Yang, G., & Mankodiya, K. (2015). Wearable Internet of Things: Concept, architectural components and promises for person-centered healthcare. *Proceedings of the 2014 4th International Conference on Wireless Mobile Communication and Healthcare - "Transforming Healthcare Through Innovations in Mobile and Wireless Technologies", MOBIHEALTH 2014*, 304–307. https://doi.org/10.1109/MOBIHEALTH.2014.7015971

14. Hossain, M. M., Fotouhi, M., & Hasan, R. (2015). Towards an Analysis of Security Issues, Challenges, and Open Problems in the Internet of Things. In Z. L.-J. Bahsoon R. (Ed.), *Proceedings - 2015 IEEE World Congress on Services, SERVICES 2015* (pp. 21–28). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/SERVICES.2015.12

15. Hussain, A., Wenbi, R., Da Silva, A. L., Nadher, M., & Mudhish, M. (2015). Health and emergency-care platform for the elderly and disabled people in the Smart City. *Journal of Systems and Software*, *110*, 253–263. https://doi.org/10.1016/j.jss.2015.08.041

16. Jara, A. J., Alcolea, A. F., Zamora, M. A., Gómez Skarmeta, A. F., & Alsaedy, M. (2010). Drugs interaction checker based on IoT. *2010 Internet of Things, IoT 2010*. https://doi.org/10.1109/IOT.2010.5678458

17. Karafiloski, E., & Mishev, A. (2017). Blockchain solutions for big data challenges: A literature review. In K. L. Latkoski P. Cvetkovski G. (Ed.), *17th IEEE International Conference on Smart Technologies, EUROCON 2017 - Conference Proceedings* (pp. 763–768). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/EUROCON.2017.8011213

18. Laplante, P. A., & Laplante, N. (2016). The Internet of Things in Healthcare: Potential Applications and Challenges. *IT Professional*, *18*(3), 2–4. https://doi.org/10.1109/MITP.2016.42

19. Lee, Y. H., Jang, M., Lee, M. Y., Kweon, O. Y., & Oh, J. H. (2017). Flexible Field-Effect Transistor-Type Sensors Based on Conjugated Molecules. *Chem*, *3*(5), 724–763. https://doi.org/10.1016/j.chempr.2017.10.005

20. Mandula, K., Parupalli, R., Murty, C. H. A. S., Magesh, E., & Lunagariya, R. (2016). Mobile based home automation using Internet of Things(IoT). *2015 International Conference on Control Instrumentation Communication and Computational Technologies, ICCICCT 2015*, 340–343. https://doi.org/10.1109/ICCICCT.2015.7475301

21. Mano, L. Y., Faiçal, B. S., Nakamura, L. H. V, Gomes, P. H., Libralon, G. L., Meneguete, R. I., Filho, G. P. R., Giancristofaro, G. T., Pessin, G., Krishnamachari, B., & Ueyama, J. (2016). Exploiting IoT technologies for enhancing Health Smart Homes through patient identification and emotion recognition. *Computer Communications*, *89–90*, 178–190. https://doi.org/10.1016/j.comcom.2016.03.010

22. Moosavi, S. R., Gia, T. N., Rahmani, A.-M., Nigussie, E., Virtanen, S., Isoaho, J., & Tenhunen, H. (2015). SEA: A secure and efficient authentication and authorization architecture for IoT-based healthcare using smart gateways. In S. E. (Ed.), *Procedia Computer Science* (Vol. 52, Issue 1, pp. 452–459). Elsevier B.V. https://doi.org/10.1016/j.procs.2015.05.013

23. Muhammad, G., Rahman, S. M. M., Alelaiwi, A., & Alamri, A. (2017). Smart Health Solution Integrating IoT and Cloud: A Case Study of Voice Pathology Monitoring. *IEEE Communications Magazine*, *55*(1), 69–73. https://doi.org/10.1109/MCOM.2017.1600425CM

24. Nawir, M., Amir, A., Yaakob, N., & Lynn, O. B. (2017). Internet of Things (IoT): Taxonomy of security attacks. *2016 3rd International Conference on Electronic Design, ICED 2016*, 321–326. https://doi.org/10.1109/ICED.2016.7804660

25. Ndiaye, M., Hancke, G. P., & Abu-Mahfouz, A. M. (2017). Software defined networking for improved wireless sensor network management: A survey. *Sensors (Switzerland)*, *17*(5). https://doi.org/10.3390/s17051031

26. Pang, Z., Zheng, L., Tian, J., Kao-Walter, S., Dubrova, E., & Chen, Q. (2015). Design of a terminal solution for integration of in-home health care devices and services towards the Internet-of-Things. *Enterprise Information Systems*, *9*(1), 86–116. https://doi.org/10.1080/17517575.2013.776118

27. Rahmani, A.-M., Thanigaivelan, N. K., Gia, T. N., Granados, J., Negash, B., Liljeberg, P., & Tenhunen, H. (2015). Smart e-Health Gateway: Bringing intelligence to Internet-of-Things based ubiquitous healthcare systems. *2015 12th Annual IEEE Consumer Communications and Networking Conference, CCNC 2015*, 826–834. https://doi.org/10.1109/CCNC.2015.7158084

28. Rajandekar, A., & Sikdar, B. (2015). A survey of MAC layer issues and protocols for machine-to-machine communications. *IEEE Internet of Things Journal*, *2*(2), 175–186. https://doi.org/10.1109/JIOT.2015.2394438