IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

IOT Based Energy Efficiency Model With AI

[1]A.V. Sumanth Kumar

[1]Department of CSE, SRM Institute of Science & Technology, Chennai

Abstract: IoT-related and smart home technologies are evolving quickly, and a range of smart gadgets are being created to enable consumers to live more comfortably. Nevertheless, the lack of operating systems to connect the gadgets that make up the smart home environment limits the smart houses that are already in place. This is due to the fact that these devices are built on self-service modules and utilize separate IoT platforms created by the brand or company who created them. If a smart home doesn't have an integrated operating system, managing each device separately becomes a burden for the user. Additionally, this results in address issues like energy waste and high traffic on the smart home network. The development of an integrated management system is required to address these issues. solution that enables inter-IoT device communication. To effectively oversee IoT, we suggest As IoT platform application services for a smart house, three intelligent models are provided. The Intelligence awareness target as a service (IAT), intelligence energy, and three more models' efficiency in the cloud (IE2S) and TAS (intellectual service) (IST). IAT is in charge of "things" phase. IAT gathers data based on the environment by using intelligent learning to develop a situational awareness of the data values produced by things (sensors). Processing the data gathered by IAT, IE2S acts as a server (IoT platform). The server runs on the open-source, worldwide standards-compliant Mobius platform, and artificial intelligence is facilitated by the TensorFlow engine. In order to assist in automatically providing service, IE2S examines and learns from the users' usage habits. IST aids in the provision, management, and control of the service stage. The Internet of Things (IoT) gadgets in a smart home may collaborate with one another thanks to these three clever models.

***Index Terms* – IOT, Artificial Intelligence, Automation, Energy efficiency, Smart home, Sensors.**

I. INTRODUCTION

For this study IoT has advanced to the point that it can now recognize and understand its surroundings on its own, applying what it learns to novel settings. Thanks to advancements in computer performance, internet networks, network processing, efficient algorithms, and other areas, the speed and precision with which the Internet of Things receives and processes commands has increased significantly. The development of different algorithms has led to the exponential rise of IoT.

Numerous Internet of Things applications are included in smart houses. Whereas a traditional house consists of basic furnishings and housing to serve as a place to live, a smart home strives to offer services that increase the user's happiness and contentment. A vast collection of Internet of Things apps, a smart home goes beyond just being a place to live and enables users to experience new services, manage their daily rhythms, and follow their interests.

Many studies note that there are issues with network congestion and power consumption despite the rise of the Internet of Things industry and its technologies. The technologies available to minimize the energy and network consumption caused by modern smart home services are insufficient. Due to battery issues associated with the Internet of Things and the sharp rise in electrical energy usage, a lot of study has been done recently on alternate energy sources. This type of innovative energy creation, however, necessitates extensive, long-term study; as such, it is a very unpredictable, forward-looking undertaking. To address these issues, autonomous and effective network processing is needed, along with a technique that can operate IoT precisely depending on user usage patterns to cut down on wasteful energy consumption.

In order to address these issues, usage data from IoT users must be examined, and an intelligent manager a platform that fully controls and manages this assessed usage data is needed. Here, "intelligent manager" refers to a manager who offers services that help users build a personalized environment in keeping with the goals of a smart home, rather than an IoT platform that only links IoT devices. It also refers to network technology that reduces energy consumption.

IoT platforms now offer intelligent services, however the majority of these services just analyze vast amounts of data and do mathematical operations faster and more precisely than a human. In addition to managing groups of devices, a smart home intelligent manager uses algorithms that learn from and analyze user data to deliver user-customized services. This makes it possible to anticipate and get ready for many scenarios and settings in a smart home. In order to reduce network utilization and energy waste, these forecasts and preparations enable the Internet of Things applications to be managed and regulated in accordance with the studied data. Moreover, automated services anticipate the user's requirements, feelings, and ideas to provide a relaxing and comfortable atmosphere.

This study takes into account previous research in order to comprehend current trends and technologies in different IoT platforms and to identify the prerequisites for offering intelligent IoT energy efficiency services in a smart home. This study is able to suggest a service model with the artificial intelligence needed to improve network and energy efficiencies thanks to related research.

II. METHODOLOGY

Intelligence awareness Target as a service concept:

An approach that handles intelligent situational awareness data processing at the object level is called intelligence awareness target as a service (IAT). IAT gathers data created by objects, obtaining just the information required in accordance with predefined scenarios. By doing this, needless processing is avoided and the essential procedures are followed, enabling data to be processed appropriately for the given circumstance.

In order for IAT to become aware of circumstances in advance, it defines four main categories of user actions and lifestyle patterns. IAT processes the necessary facts and becomes aware of the situation based on these.

This study separates IAT into three categories: sensor, smart phone, and smart appliance. These three devices (the sensor, smart phone, and smart appliance) are among the most capable of generating and processing large amounts of data. They are also among the easiest to use and gather user and environmental data from smart homes. The IAT may be broadly classified into two categories: the stationary IAT and the non-stationary IAT. The non-stationary IAT is usually connected to a smart phone IAT, whereas the stationary IAT usually interacts with a sensor IAT.

In the meantime, an IAT for a smart appliance can also be defined as another kind of IAT. It differs from other forms of IAT in that it is an instance of both IST (Intelligence service target as a service) and IAT. This research examines the smart appliance IAT as an extra kind of IAT as it differs from existing IATs in this way.

Sensor IAT:

A stationary objects model called Sensor IAT is designed to gather basic sensor data. It is a collection of sensors that are necessary to assess the interior environment and provide concepts and finite numerical values.

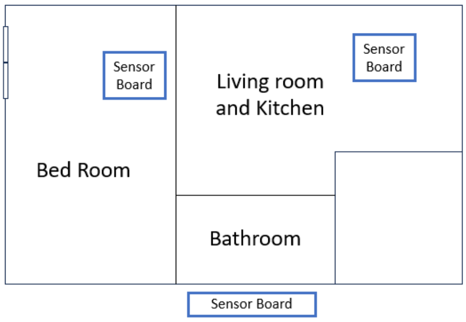

Figure-1: *Sensor placement*

The floor layout of a smart house with stationary sensor boards put in every area is shown in Figure 1. The smart boards are equipped with the bare minimum of sensors necessary to ascertain the smart home's present condition, and these sensors gather real data. Three different types of sensors are employed: rotational, motion, and sound. These sensors are meant to collect information and provide each unique area network in the smart home with an awareness of its internal environment.

sensor board	situation *a*	situation *b*	situation *c*	situation *d*
Motion	O	X	X	X
Sound	O	O	X	X
Rotary	O	O	O	X
Result	user has indoor (activating)	user has indoor (resting)	user has indoor (sleeping)	No user indoor

Figure-2: *Type of situation according to sensor condition*

In order for the ITA to anticipate the interior condition, user behaviours and lifestyle patterns are defined into four main scenarios, as seen in Figure 2. The user is engaged in an indoor activity in the first scenario. A user who is resting indoors is the second scenario. A user who is sleeping indoors is the third scenario. The user is not inside in the fourth scenario. These situational categories help to understand the user's location, movements, and patterns.

The sensor check (Figure 2) is a fairly straightforward activity that checks to see if anything has been detected or not. It doesn't involve sending a lot of data. However, IAT may swiftly assess the circumstances in advance and send data to the server only when required. The network is not used and energy consumption is reduced when no data is sent.

Sensor phone IAT:

Smart phones are the non-stationary IAT as opposed to sensor IAT

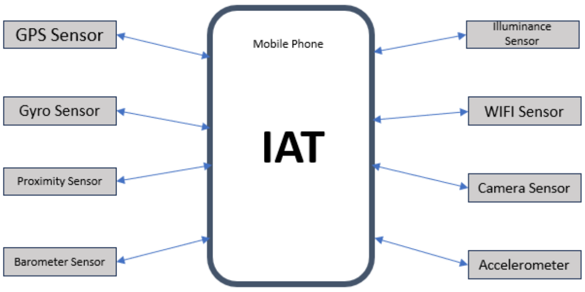

Figure-3: *Smart Phone Sensors*

As seen in Figure 3, a variety of sensors are present in smart phones. It is the most significant tool for immediately gathering data from the location nearest to the user. However, it gathers the information required to assess the user's condition. This study made use of the GPS, gyro, proximity, barometer, and illuminance sensors on a smartphone. These sensors make it possible to comprehend the user's position, movement, lighting at any given time, and other details in great detail. This information is sent to the server, where it is categorized as part of the learning data using weights.

Intelligence energy efficiency as a service concept:

The Internet of Things platform, known as intelligence energy efficiency as a service (IE2S), serves as a server. The items level and the service level are both intelligently integrated and controlled by IE2S in Figure 4.

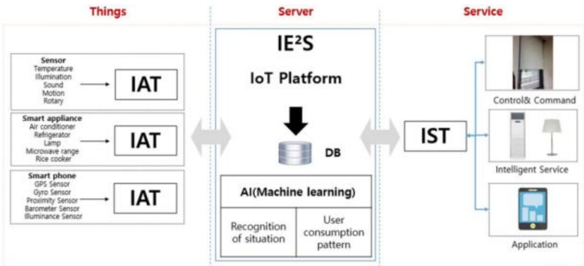

***Figure-3**: IE^{2}S service structure*

IAT communicates gathered data to IE^{2}S and becomes aware of circumstances ahead of time on the things level. The transmitted data is continually gathered and analyzed using an algorithm for neural network learning[1]. Through machine learning, IE^{2}S is able to identify situations and determine consumer consumption patterns.

For the first function, IE^{2}S continually gathers real-time data received by IAT and evaluates the circumstances inside the smart home to identify situations[2]. It finds the ideal circumstances by not only being aware of the situation but also by analysing many types of environmental data. It looks into the user's IoT usage habits in the smart home for the second function. Target data for learning is gathered from previously recorded data or data from the user of the Internet of Things. To give the user-desired scenarios in the smart home environment, learning is done continually.

III. Implementation and Analysis

Things (sensors):

The three sensors and an Arduino board are used by the smart home's sensor board. IAT has all the required sensor action codes and is modularized into a single library [3]. This helps to manage the different sensors in an integrated way. The data is read by the Arduino board by means of serial connection with the sensors. The Arduino board and the server communicate wirelessly via the MQTT protocol[4]. It sends the necessary data to the server and is continuously informed of the state of the Internet of Things.

The Arduino code utilizing the IAT technique is seen in Figure 4. The environment is detected by the sensor that is mounted on the sensor board. Condition statements (if-else) are created by the Awareningloop function so that the status may be continually monitored. Even though it is a loop, the event structure ensures that there are no significant processing costs when no events happen. When scenario conditions are set, data that is outside of the typical range is provided to the server through the filtering function, ensuring that only the necessary data is delivered even when the algorithm is aware of a situation[5].

```
int check = 1;
int uncheck = 0;

void IAT::Awareningloop(){
    if((motionSens == 1) && (soundSens == 1) && (rotarySens == 1)){
        situation = a ; //user has indoor(activationg)
    }
    else if((motionSens == 0) && (soundSens == 1) && (rotarySens == 1)){
        situation = b ; //user has indoor(resting)
    }
    else if((motionSens == 0) && (soundSens == 0) && (rotarySens == 1)){
        situation = c ; //user has indoor(sleeping)
    }
    else{
        situation = d ; //no user indoor
        rest();
    }
}

void IAT::filtering(){
    if(situation == 1 || situation == 2 || situation == 3 ){
        awareness = 1 ; // checked indoor status
         if(filtereddata == rangeindex){
             awareness = 0; // no change status
         }else{
             putDataServer();
         }
    }
}
```

Figure-4: *Arduino code using IAT functions*

Server:

The Mobius international standard platform and the IE^2S algorithm are used by the server. The Mobius server uses MySQL to create a database from the data it got from IAT[8]. The TensorFlow engine uses the Jupyter editor and the Anaconda package to learn this data.

As a basic example of implementation, a system was constructed that gathers data on the interior temperature and compares it to the user's chosen temperature values in order to determine the user's ideal indoor temperature and offer a service.

Month	Average temp(℃)	User desire temp
1	-1.8	25
2	-0.2	23
3	6.3	22
4	13.9	22
5	19.5	23
6	23.3	22
7	26.9	21
8	25.9	20
9	22.1	22
10	16.4	23
11	5.6	25
12	-1.9	26

Figure-5: *Monthly average temperature in Seoul and user preference temperature*

The Seoul City Weather Service's 2017 weather data is seen in Figure 5. These are the standard temperature values used for learning, and it displays the standard values for the present state of the environment in terms of monthly average temperatures[6]. The data that the smart appliance air conditioner gathers are the "user desire temp" values. The user's preferred temperature patterns were predicted based on the temperature differences at which the air conditioner was turned on[9]. This data is digitalized and processed individually to provide a dataset that may be used for education. The TensorFlow engine learns from the data and determines the final interior temperature.

```
Step:  0   Cost:  513.8344   W:  [0.99421155]   b:  [14.490607]
Step:  1   Cost:  80.231926   W:  [1.6422824]   b:  [19.767506]
Step:  2   Cost:  14.820018   W:  [1.8395431]   b:  [21.824331]
Step:  3   Cost:  4.9327855   W:  [1.8620838]   b:  [22.630646]
Step:  4   Cost:  3.4191496   W:  [1.8171172]   b:  [22.951296]
Step:  5   Cost:  3.1685658   W:  [1.7462755]   b:  [23.083298]
Step:  6   Cost:  3.1087363   W:  [1.665724]   b:  [23.141994]
Step:  7   Cost:  3.0779524   W:  [1.5817379]   b:  [23.172176]
Step:  8   Cost:  3.0518227   W:  [1.4967519]   b:  [23.191238]
Step:  9   Cost:  3.0266664   W:  [1.4117094]   b:  [23.205936]
Step:  10   Cost:  3.0019257   W:  [1.3269747]   b:  [23.218893]
                         •
                         •
                         •
Step:  990   Cost:  1.069425   W:  [-11.958592]   b:  [25.081951]
Step:  991   Cost:  1.0694257   W:  [-11.958758]   b:  [25.081974]
Step:  992   Cost:  1.0694257   W:  [-11.958923]   b:  [25.081997]
Step:  993   Cost:  1.0694255   W:  [-11.959087]   b:  [25.08202]
Step:  994   Cost:  1.0694256   W:  [-11.95925]   b:  [25.082043]
Step:  995   Cost:  1.0694249   W:  [-11.959413]   b:  [25.082066]
Step:  996   Cost:  1.0694246   W:  [-11.959574]   b:  [25.082088]
Step:  997   Cost:  1.0694252   W:  [-11.959734]   b:  [25.082111]
Step:  998   Cost:  1.0694246   W:  [-11.959893]   b:  [25.082134]
Step:  999   Cost:  1.0694246   W:  [-11.960052]   b:  [25.082155]
```

Figure-6: *The process of learning 1000 times*

```
Test!

1monthTEMP: -12.6 Prediction: [26.454453]
2monthTEMP: -6.4 Prediction: [25.720345]
3monthTEMP: 10.7 Prediction: [23.695627]
4monthTEMP: 16.6 Prediction: [22.99704]
5monthTEMP: 20.24 Prediction: [22.566048]
6monthTEMP: 23.1 Prediction: [22.227411]
7monthTEMP: 26.4 Prediction: [21.836676]
8monthTEMP: 22.1 Prediction: [22.345816]
9monthTEMP: 18.2 Prediction: [22.807592]
10monthTEMP: 16.28 Prediction: [23.03493]
11monthTEMP: 8.6 Prediction: [23.944275]
12monthTEMP: -4.9 Prediction: [25.542736]
```

***Figure-7**: The result of executing TEST on learned program*

The process of learning anything 1000 times is depicted in Figure 6. As can be observed, the price begins at 513 and decreases steadily to 1.06.

The test results obtained from utilizing the learning application are displayed in Figure 7. First, several values of x are input at random for the monthly temperature data[10]. The learning algorithm can confirm the prediction values. The output values closely resemble the temperatures that the user prefers.

IV. CONCLUSION:

IoT and smart home technologies are evolving quickly, and a lot of smart gadgets are being created to make people's lives more pleasant. Nevertheless, the lack of operating systems to connect the gadgets that make up the smart home environment limits the smart houses that are already in place. This is due to the fact that these devices are built on self-service modules and utilize separate IoT platforms created by the brand or organization that created the device. If a smart home does not have an integrated operating system, managing each device separately becomes a burden for the user.

The quick and widespread development of IoT and smart home technologies has led to a number of issues, including energy waste, inefficient operating systems, and high network traffic. The development of an integrated management system that links IoT devices to one another is required to solve these issues. We have suggested three intelligent models as IoT platform application services for a smart house in order to handle IoT effectively. IAT, IE^2S, and IST are the three models. By using these three models, intelligent learning is applied to the data produced by IoT devices, enabling them to recognize and understand their immediate environment. IAT activates IoT and obtains the information required based on the current scenario. IoT is currently only enabled in when circumstances dictate that it is necessary. IE^2S acts as the (Internet of Things server platform) and applies a TensorFlow engine to the data that IAT has gathered. It gains knowledge and evaluates the user's use habits to deliver the best possible forecast information. Within the trial conducted in this study was comparing monthly average temperature data with that extremely comparable predicted temperature results were found for the user's chosen temperature and generated via deep learning. It generated forecast numbers that were extremely close to the user's intended temperature, even when random values were provided as the monthly average temperature. The prediction accuracy rises in direct proportion to the volume of user data collected; more study is required to determine how to boost forecast accuracy through ongoing data collection in the future. In order to ensure system stability, more study must be done on the tangible physical structure and characteristics of the intelligent algorithm, real data must be gathered, and forecast accuracy must be increased. The network has to be directly analyzed and tested further. It will be possible for IoT devices in a smart home to collaborate with one another by studying these three intelligent models. This research offered energy-efficient automation services for smart homes. Future structured intelligent IoT platforms for smart homes will offer smart, energy-efficient living environments for healthy lives in addition to basic indoor dwellings, pending more study on intelligent models.

Acknowledgment

I would like to thank Faculty of Department of CSE, SRM Institute of Science & Technology, Chennai for their support in completing and publishing this paper.

REFERENCES

[1] Chahuara P, Fleury A, Portet F, Vacher M (2016) On-line human activity recognition from audio and home automation sensors: comparison of sequential and non-sequential models in realistic smart homes. J Ambient Intell Smart Environ 8:399–422.

[2] Biswas MAR, Robinson MD, Fumo N (2016) Prediction of residential building energy consumption: a neural network approach. Energy 117:84–92.

[3] Mba L, Meukam P, Kemajou A (2016) Application of artifcial neural network for predicting hourly indoor air temperature and relative humidity in modern building in humid region. Energy Build 121:32–42.

[4] Zhong BC, Lu K, Lv DH, Luo J (2015) Short-term prediction of building energy consumption based on GALM neural network. In: Liu M, Zhang X (eds) Proceedings of the international conference on advances in mechanical engineering and industrial informatics, vol 15. Atlantis Press, Paris, pp 867–871.

[5] Yuce B, LI HJ, Rezgui Y, Petri I et al (2014) Utilizing artifcial neural network to predict energy consumption and thermal comfort level: an indoor swimming pool case study. Energy Build 80:45–56.

[6] Lv DH, Zhong BC, Luo J (2015) Application of GLBP algorithm in the prediction of building energy consumption. Int J Adv Comput Sci Appl 6(6):45–48.

[7] Midilli A, Dincer I, Ay Murat (2006) Green energy strategies for sustainable development. Energy Policy 34(18):3623–3633

[8] Huh JH (2017) Smart grid test bed using OPNET and power line communication," advances in computer and electrical engineering. IGI Global, Pennsylvania, pp 1–425.

[9] Huh JH, Otgonchimeg S, Seo K (2016) Advanced metering infrastructure design and test bed experiment using intelligent agents: focusing on the PLC network base technology for smart grid system. J Supercomput 72(5):1862–1877.

[10] Abadi M et al (2016) TensorFlow: a system for large-scale machine learning. In: 12th USENIX symposium on operating systems design and implementation, Savannah, 2–4 November 2016, pp 265–283.