

Adopting Artificial Intelligence for Smart Home

Dr. K. Kishore kumar¹, Durga Prasad Vissamsetty², Dr.A.Srinath³, T.V.Siva Sankar⁴, Chaitanya.R⁵

¹Associate Professor, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

²PG Scholar student, Department of Mechanical engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

³Professor & HOD, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

^{4,5}Graduating students, Department of Mechanical engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

Article Info

Volume 83

Page Number: 554 - 560

Publication Issue:

May - June 2020

Abstract:

Imagine the home of future. Its smart home, the hypothesis of smart home isn't the new one. As the automation of house hold chores as been developing from at least a century. In between 1915 – 20 there has a wide introduction of electrical home appliances which closely trace the household chores. Fast forwarding the time, existing technology that control home appliance through the electrical cables to transmit signals. After inventing microcontroller, devices and appliances are controlled remotely by the users. We were making baby steps towards smart home. As going on artificial intelligence makes a step for communications between the devices, it has an ability to issue some sort of commands to control basic tasks, turning lights on or off, controlling room temperature, activating the alarm on the schedule, and sprinklers system for gardening according to the set program. With the development of sensor technology we collect data throughout the home. We used sensors that needed to detect temperature, light, motion, moisture, noise in the home environment. The data collected from devices used to make programmed algorithm or basic artificial intelligence to make decisions from that. In part of that we are acquisition two different neural networks in the system, that provide preprogrammed automatic home, self adopt learning and make intelligent home. NN has adaptive system and PDP parallel distributed processing capacity. It helps in predicting the human work based on past data. This helps in reducing the work what we do, and remembering the work what have to do, let allow the home to do work for you.

Keywords: ANN, smart home, human intelligence, back propagation, self adopt learning.

Article History

Article Received: 11 August 2019

Revised: 18 November 2019

Accepted: 23 January 2020

Publication: 09 May 2020

I. INTRODUCTION

In present era the internet has wide expansion, there is a high potential on remote controlling and monitoring on such enabled appliances. The recognized network based home automation is also rapidly increasing and it refers the computer application, electrical, and information technology for the control of domestic and home appliances. This technology results in remote home management, energy efficiency, security benefits and leading to improve the standards of life and convenience for the sake of simplicity, higher affordability and health care. However the newly

and existing opportunities to increases the connectivity and interaction between home appliances for the purpose of automating home through internet are yet to be explored. At present the systems are messed with sensors, electronic circuits, and embedded with software which called as Internet of Things (IOT). At parallel cloud computing is the other technology which helps on development of IOT based smart home. Alternatively, a motion sensor collected the data which can recognize the human real life activity in a smart home and transfer the data to cloud storage and helps to recall the data as per the daily living

nature and perform the act through actuator.

II. LITERATURE SURVEY

Several technologies are exists in making a regular home to smart home. Bromley, in 2003 provides information that “to enhance the quality of life with in the home, technologies are introduced through the provision of various services such as multimedia entertainment, telephonic health, and energy distribution”. There has a significant research moves on the field of home automation with other protocol communications like hand signals, Bluetooth, DTMF etc. The X10 industry has standard development from 1975 on interaction between electronic devices, and it is the oldest standard identification from the author point of view, providing limited control of household devices through the power lines. Baudel, in 1993 has proposed a novel control network, using hand signals, Controller uses glove to recognize the hand gestures to control the relays. Ardam, in 1998 has implanted a phone based remote controller for home and office automation. This system differ in the communication occurred over a fixed telephone line and not on the internet. In this proposed system it can accessed using telephone that supports DTMF. 2004 Al-Ali, has developed a home automated system based on java which encompass built-in network along with safety features, and produces the high secure solution. Sriskanthan 2002 introduced a Bluetooth controlled home automation system; here Bluetooth acts as a primary controller and maintain different number of sub controllers. Dragos mocrii et al 2018, has reviewed on IOT – based smart home which shows the types of software, security devices and communication technologies. Alireza Keshhavarzian et al 2019, has been discuss on the human activity recognition (HAR) through various pattern recognition and proposed different modified network methods which helps to outperform the accuracy in recognition of human activity. Hongqing Fang et al 2013, he studied on comparing two probabilistic algorithms and confined the result that BP-algorithm has better performance than other

probabilistic algorithms.

III. PROBLEM DESCRIPTION

What actually a smart home is done when human intelligence is dumped in it?

We just need to understand here is that IOT is not something that depend on a sensor or a few sensors which is connected to a raspberry pi or an arduino board, when I look at the entire architecture of IOT this is a complete eco system, where in my system sensors gather information which is again stored on a platform and processed on this, now if there have been any issues or failure that been reported by these sensors then I need to create an actionable item in order to ensure that this never really repeated again but the information once it's been processed the processed data is than passed into machine learning and artificial intelligence in order to understand analyze and identify various patterns that's out and helps to pass the information on back to the sensors this in-turn helps you have a better experience and also improve the system as a whole system. For example I come home every day at 8:30 start off my ac wait for 15 minutes for it to cool down, it is tedious processes but say today my IOT platform identifies this pattern already switches on the ac before 15 minutes to home and then cool down it for 15 minutes then I just need to come home and can relax right away. This is the key example that's out today and limitation is just our imagination.

Artificial Neural network

Artificial Neural Network is replicate to biological neural network, as human brain was more complex and non – linear data processing in parallel to time meanwhile it reflects in developing artificial neural network. It includes that an interconnected artificial neurons which helps in processing data using connectionist approach to computation. In many cases Artificial Neural Networks has adaptive learning system, during the learning processes its structures has been changed based on input or output details flows through the network.

Architecture and processing

A neural network looks like weighted digraph where neurons are connected with nodes and weighted edges. A group of local neurons can be connected as either, feed forward which having no loops, or feed backed (recurrent) which having loops in network. Using local neurons computation takes place throughout the network system.

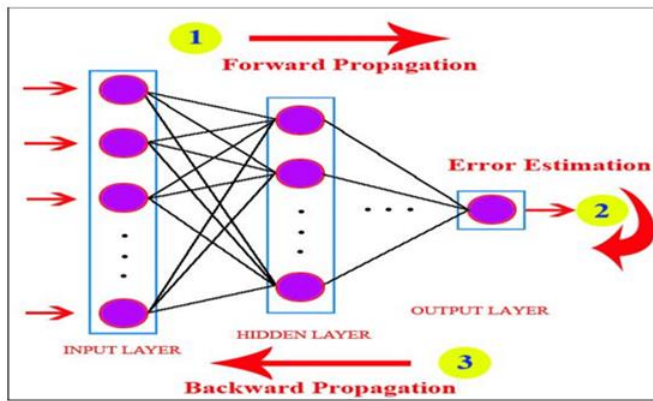


Fig (1). Neural network architecture

Where neurons transmit through electrical signals even biological neurons transmits through electrochemical signals. Each signal receives from one to other neuron through junction called synapses. Each neuron collect the set of inputs, each multiplied with weight to acquire synaptic strength. The sum of all weighted inputs determines degree of firing which called as actuation level.

$$\sum_i X_i W_i$$

Later input signal processed by actuation function to produce output.

To active the function with sigmoid function is $y = 1 / [1 + \exp(-net)]$ (1)

We take the “square of the error” to find the difference between the vector y and t is

$$E = (1/2) (T-Y)^2 = (1/2) \sum_j (t_j - y_j)^2 \dots (2)$$

The main aim of learning process is to minimize the error E , while updating the current weights between layers i.e., w_{ij} and w'_{ij} . In equation form

$$w_{ij}^{(new)} = w_{ij}^{(current)} + \Delta w_{ij} \quad (3)$$

Further to stabilize the iteration process, a second term called momentum rate, can be added as follows:

$$\Delta w_{ij}^{(n)} = \beta \partial_j o_i + \alpha \Delta w_{ij}^{(n-1)} \quad (4)$$

Where α is taken as positive constant which called as momentum rate.

Hardware implementation

The components like PIR sensor, arduino, relays, led, IR, smoke, light and much more sensor are used. We joined components with jumpers, and test the hardware it shown in the Fig (2).

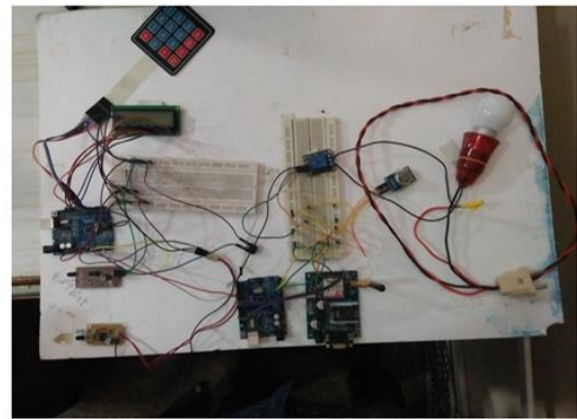


Fig (2). Hardware equipment

Software implementation

With the fully equipped motion sensors arranged a apart of 1.5 m throughout the ceiling as seen and other sensors are installed as per the requirement of living condition. Sensors are used to collected the data and provide temperature reading for control the room, and water temperature. After collecting the data it is stored in the database, which is used to train and test the human activity and recall the data as per the time sequence.

The data observed by the sensors in smart home is notified in the following table; along with it specifies time, sensor id and activity. Below table 1 shows the human wake-up and sleeping timings.

Time	Sensor ID	Activity Registered
06:16:07.134	M005	Wake up - window blinders are open
06:35:10.657	M008	Coffee machine activation
20:30:04.316	M006	Window blinders closed and air conditioner is switched on
21:15:55.307	M007	Lights off

Table 1

Data collected from the sensors through [arduino](#).

Fig. (3). Shows the working architecture, and how AI and ML are implementing in the process.

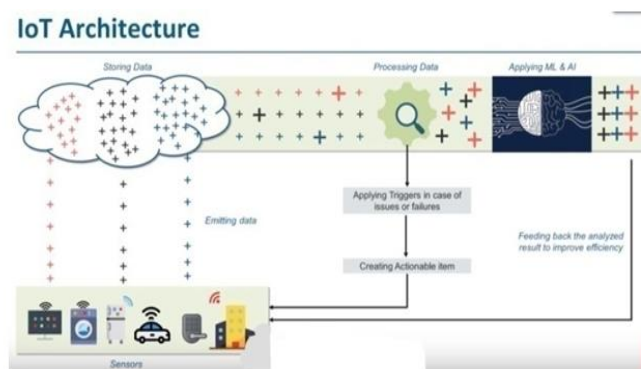


Fig. (3). working architecture

This the structure how the system is works, the data from the sensors are stored in storage data and then processing, if any issues found It create an action and again collect the sensor data, if doesn't find any issues it applies ML & AI and gives the feedback to the sensors for actuation. It is a cyclic process for this we considering non-recurrent and supervised learning is used for training neural networks, were non-recurrent is a neural network model which output can propagate to backward i.e., from left to right is called as feed forward. Supervised learning is like a teacher, were teacher familiar what's should be correct output.

Activity's considering:

- (1). Wake-up.
- (2). Lights on.
- (3). Go to kitchen, cafe is ready.
- (4). Take a bath.
- (5). Take medicine 1.
- (6). Presence home: Take decision for devices off.

- (7). Go out.
- (8). Lunch time (out).
- (9). Take medicine 2.
- (10). Back to home.
- (11). Take a bath.
- (12). Take a nap.
- (13). Wake up.
- (14). Watch TV in living room.
- (15). Have food in the kitchen.
- (16). Take medicine 1 again.
- (17). Set heater alarm.
- (18). Go to sleep.

These activities recognize along with sensor id's, along with actuation time domain. These data stored in the database, once the raw data is collected, the output data will be used as input for the convolution residual network. Considering these points were trains the neural network using python.

Evaluation of processed data

In the evaluation of back propagation model neural network learns mapping from x_i to y_i . the following figure shows the usage of appliance in smart home, the first group from x_1 to x_4 is a sequence of different activities in home, and second shows the humidity, and third shows the controlling the activity of before to we mentioned. The last one shows the continuous spectrum of activities shown in Fig. (4). how much amount fine determination should take from x_i which depend upon complexity and accuracy. Many applications can form in this way

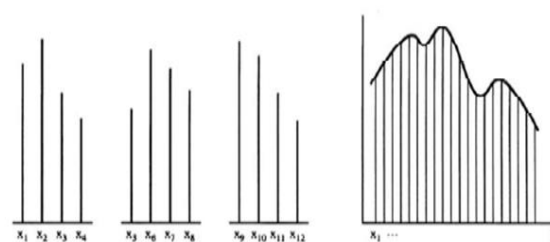


Fig. (4). Continuous spectrum from the data

Momentum factor	Learning rate	No.of Iteration
0.9	0.01	52,000

Table 2

Parameters considered for neural network.

Above considered activities we make weekly sample which collected the user data through sensors which helps in creating the behavior of user prediction during the learning of neural network. (see Fig (6)).

This network will helps in learned pattern to calculate the user activity when he started the certain pattern activities. After a particular decision taken, the system helps in arranging the required environment using smart home.

During the process evaluation we recognize the time elapse is categorized the human activity and represented in pie chart Fig. (5). Fig. (6). Shows the sample array of user's usual activities in the morning. We considered the basic human activity of daily living, every person wake up early in the morning take a cup of coffee or tea, later have some exercise, or read newspaper, next take a bath have breakfast and leave to work. Come back to home again in the evening take a nap and have bath, watching TV for avail have dinner to the time, take a medicine if necessary either go to sleep. It predicts the data when user required either coffee or breakfast. The prediction the data value in percentage. Then the prediction value is calculated using through learning process during the study stage.

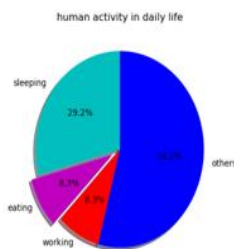


Fig. (5). Human activity representation according to time.

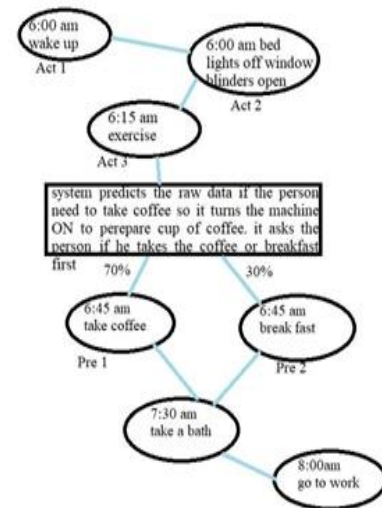


Fig. (6). Prediction of neural network.

Table 3 shows the detail trained results of neural network simulation. This helps in identifying the system working properly or not, and the accuracy of the result is identified.

neural network	no. of samples for learning	no. of samples for testing	testing results
bed lights off & window blinders open	52	34	91% accuracy
user behaviour prediction	58	41	88% accuracy

IV. CONCLUSION:

At present artificial intelligence are entering into human life, it going to mimic the human work with the help of training in neural networks. These neural networks are adaptable i.e., they can modify themselves according to the training. In this paper we describe about backpropagation method to recognize and execute as per training and results shows the human work based on particular activity, and graph represents working accuracy after training(time vs activity). Accuracy of a work based on assigning appropriate weights for particular function. If the output is not equally to the target output, then it go back to the starting of output layer, neither it backpropagate throughout the neural

network and modify weights, so output is closer to the target output. As training goes accuracy is increased, and reaction time decrease. It will helps in remember less to do, have to do. Let the home do most of the work for you

V. REFERENCES

1. Keshavarzian, A., Sharifian, S. and Seyyedini, S., 2019. Modified deep residual network architecture deployed on serverless framework of IoT platform based on human activity recognition application. *Future Generation Computer Systems*.
2. Fang, H., He, L., Si, H., Liu, P. and Xie, X., 2014. Human activity recognition based on feature selection in smart home using back-propagation algorithm. *ISA transactions*, 53(5), pp.1629-1638.
3. Jain, S., Vaibhav, A. and Goyal, L., 2014, February. Raspberry Pi based interactive home automation system through E-mail. In 2014 International Conference on Reliability Optimization and Information Technology (ICROIT) (pp. 277-280). IEEE.
4. Mocrii, D., Chen, Y. and Musilek, P., 2018. IoT-based smart homes: A review of system architecture, software, communications, privacy and security. *Internet of Things*, 1, pp.81-98.
5. AI-Ali A. R. and AI-Rousan M., "Java-based home automation system", *IEEE Transactions on Consumer Electronics*, vol. 50, no. 2, pp. 498-504, 2004.
6. Ardam H. and Coskun I., "A remote controller for home and office appliances by telephone", *IEEE Transactions on Consumer Electronics*, vol. 44, no. 4, pp. 1291-1297, 1998.
7. Baudel T. and Beaudouin-Lafon M., "Charade: remote control of objects using free-hand gestures", *Communications of the ACM*, vol. 36, no. 7, pp. 28-35, 1993.
8. Sriskanthan N. , Tan F. and Karande A. , "Bluetooth based home automation system", *Microprocessors and Microsystems*, Vol. 26, no. 6, pp. 281-289, 2002.
9. Ciabattini, Lucio, Gianluca Ippoliti, Alessandro Benini, Sauro Longhi, and Matteo Pirro. "Design of a home energy management system by online neural networks." *IFAC Proceedings Volumes* 46, no. 11 (2013): 677-682.
10. Gunge, Vaishnavi S., and Pratibha S. Yalagi. "Smart home automation: a literature review." *International Journal of Computer Applications* 975 (2016): 8887.
11. Li, Baoan, and Jianjun Yu. "Research and application on the smart home based on component technologies and Internet of Things." *Procedia Engineering* 15 (2011): 2087-2092.
12. Kovatsch, Matthias, Markus Weiss, and Dominique Guinard. "Embedding internet technology for home automation." In 2010 IEEE 15th Conference on Emerging Technologies & Factory Automation (ETFA 2010), pp. 1-8. IEEE, 2010.
13. Li, Mingfu, and Hung-Ju Lin. "Design and implementation of smart home control systems based on wireless sensor networks and power line communications." *IEEE Transactions on Industrial Electronics* 62, no. 7 (2014): 4430-4442.
14. Senthil, P. V., VS Aakash Sirushti, and T. Sathish. "Artificial intelligence based green manufacturability quantification of a unit production process." *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)* 9.2 (2019): 841-852.
15. Nawalagatti, Amitvikram, and Prakash r. Kolhe. "A comparative study on artificial cognition and advances in artificial intelligence for social-human robot interaction." *International Journal of Robotics Research and Development (IJRRD)* 8.1 (2018):1-10.
16. Chowdary, Undavalli Vivek, et al. "Home automation system using IR sensors." *International Journal of Electrical and Electronics Engineering (IJEET)* 4.6 (2015): 11-16.
17. Bepery, Chinmay, et al. "Advanced home automation system using Raspberry-Pi and Arduino." *International Journal of Computer Science and Engineering (IJCSE)* 8.2 (2019): 1-10.
18. Shankar, Shivani. "Internet of things: an overview." *International Journal of Computer Science and Engineering (IJCSE)* 5.4 (2016):23-30
19. Tanksale, Pallavi R., and Snehal Kathale. "a review of wireless home automation system using voice recognition, Gsm and a web portal based on

- Zigbee." International Journal of Computer Science and Engineering (IJCSE) 3.3 (2014):41-44
20. Venaik, Anita. "An impact on Sustainable development due to rise of the automation and artificial intelligence." International Journal of Business Management & Research (IJBMR) 8.5 (2018):23-38.
21. Nawalagatti, Amitvikram, and Prakash r. Kolhe. "A comprehensive review on artificial intelligence based machine learning techniques for designing interactive characters." International Journal of Mathematics and Computer Applications Research (IJMCAR) 8.3 (2018):1-10