Appliance Control System based on Machine Learning and Data Mining

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Abstract *With the advent of Machine learning techniques, data analytics and massive cloud storage and retrieval capacity, the advantages of integrating the embedded system the internet is increasing. With the combination of these technology there increases the capability to make smart or rational decisions in managing machines and increase home automation. Aforementioned increases the comfort of the inhabitants based on their preference, rather than just relying on the environment or other factors. The paper discusses the role of machine learning and data mining for appliance control in the homes. Further, it explains in detail about the single and multifactor attributes taken into account for different kinds of appliances. Also demonstrates the effectiveness of the Predictive algorithms*.

Key Words: **Internet of Things, Home automation, Machine Language, Random forest**

1. INTRODUCTION

Appliance control means remotely controlling the home appliances with the Internet of Things (IoT) activated system. For the control of the system, a high number of sensors are used. Moreover, a specific higher-end appliance has different data set values. These generate a considerable amount of data. These data from the home system is transferred using the cellular network and collected at one place, here using the AWS Cloud system. This data collection helps to improve the comfort and safety of consumers.

In recent years, Data mining is said to have a high-minded effect on the various divisions of the market. For this purpose, specialized software is used to show trends in human behavior. These connected appliances are smart because they can evaluate and analyze user data. In a home automation system, significant subdivisions are safety, security, efficiency, and convenience.

In this paper, we are discussing how to increase the convenience of the people in their home by adding intelligent appliances based on the user's preference along with the environment or other factor.

2. RELATED WORKS

2.1 Cellular Based Home Automation System

The Cellular based automation utilizes the GSM Communication modems to regulate applications such as tube-light, AC, and protection system using the SMS or other alert communications. This method allows the user to regulate the end system away from the household using the communication bandwidths. The inhabitants of the place will always be able to get status of any home applications under regulation, whether turned on or off from their portable devices.

2.2 Bluetooth Based Home Automation System

With Bluetooth, an economical but secure and flexible cell phone-based automation system can be designed. The information-sharing within a phone and a processor is radioed. These systems are password-protected, which permits it to be used only to enable authorized users to access the appliances at home.

2.3 IoT Based Home Automation System

In this way, the devices and appliances can be networked collectively to provide us with a seamless command over all aspects of the home. In the IoT system, a central hub is necessary to receive a wide range of alerts and data from the remote devices. These data are transported based on the GPRS, GSM, and control through ANDROID/IOS APPLICATION. The user is allowed to access the designed local network through the web address provided for this purpose. Appliance automation has been around for several decades in forms of lighting and uncomplicated appliance control. It has grown at a tremendous rate that now voice control of a device, distant access to home appliance, security improvements have many live models and products available. The vision of making your home intelligent is now a reality.

3. CLASSIFICATION OF APPLIANCE

3.1 Univariate Data Appliance

Most appliances in a home system have a binary input-output system. Smart windows, SOS button, smart socket, light switch etc. are either in ON state or OFF state. They have only one variable which varies per sensor output or

signal from the internet.

3.2 Multivariate Data Appliance

Other intelligent appliances like Air conditioner, intensity varying lights, the alarm system, security camera, coffee machine, etc. have multiple inputs which control the functionality of the system. For example, a coffee machine has inputs as cappuccino, latte, espresso. Along with starting the machine state to ON, the coffee type is also sent as input to this system.

Another example of the multivariate home appliance used commonly is the Air conditioner. The air conditioner has these parameters – temperature and sleep enable or disable, sleep timer, swing enable or disable, fan on or off, fan speed, etc.

4. PROPOSED METHOD

In the proposed system, the IoT based Home automation system background is used to control and monitor the appliance. The appliance, either a smart switch or smart device, are connected to the home's cellular network using the modem, and this connection is used to retrieve data and control the system. Simultaneously the data is used to predict the appliance state and attributes at the given the time of day.

In the existing appliance control system, these parameters are mostly overlooked. Only power states (ON and OFF) of the most system are automated, either by monitoring the input received by the user using IoT or by sensors.

For example: When the temperature increases to a certain threshold, the Air Conditioner is switched on with the existing configuration (ex: temperature).

We are proposing an automated system wherein all the parameters of the multivariate appliances are taken into consideration when automated input is sent to the system. The multivariate user input data are consolidated in a database against time and stored. The garbage value from the cause of the internet system is removed using an appropriate filter. These data from the IoT system form the basis for the Machine learning algorithms to train and predict the future the user data according.

For example: From the user trends, a database of AC records is noted. For a given time, the dataset is processed for a specific pattern. And then the predicted values for all the AC parameters are sent through the internet to AC. Hence, AC is not only changed to ON state but with the correct temperature, fan, sleep, swing settings.

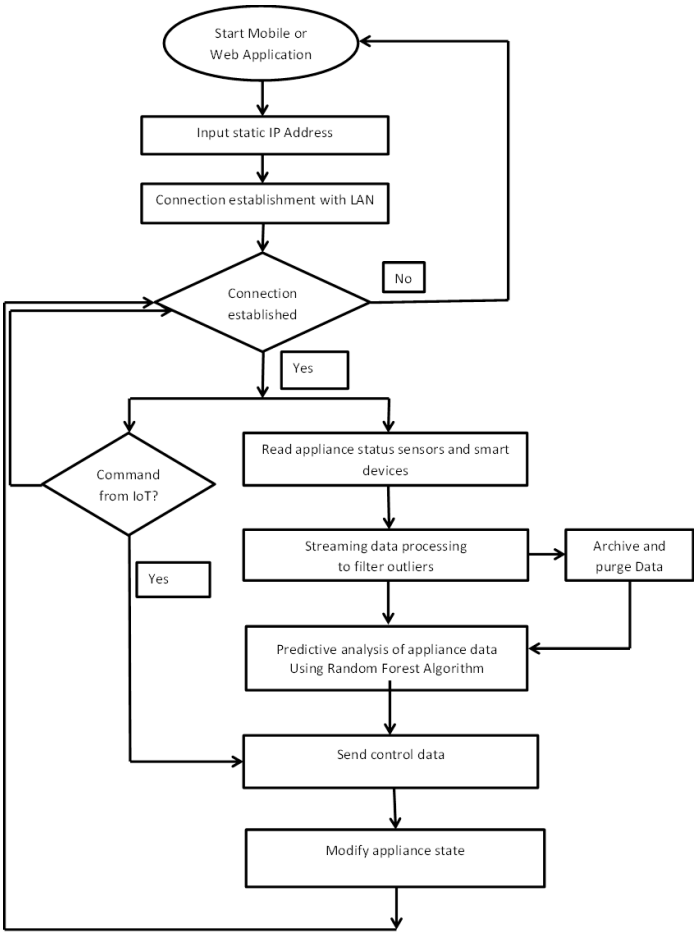

Fig -1: Flow chart of the proposed method

4.1 Machine Language

Machine learning creates a chance to develop more precise and more efficient models for control applications. Models are commonly based on the past data collected from the sensors.

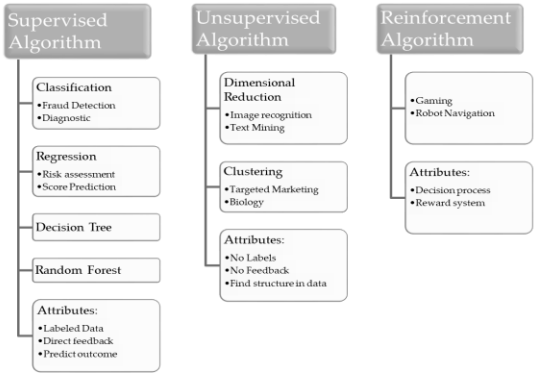

Fig -2: Classification of Machine learning algorithms.

4.1.1 Decision tree and Random Forest Algorithm:

In our development system, the data can be labeled based on its type, and it can be time classified. The main aim is to get the prediction using historical trends. Hence for predicting we are moving towards Decision tree-based algorithm

A decision tree algorithm is a non-linear mapping of a dependent and independent variable. In our case, the state of Univariate appliance is the data in the target (independent), and it is taken against time (dependent). Hence the decision tree is trained to get the relation between these two sets of data which would be used for predicting the outcome of Univariate appliances.

The modern, powerful variations of decision tree algorithm are the random forest. This algorithm is used in our paper for predicting the multivariate appliance data.

The random forest model is composed of many decision trees using arbitrary subsets of features, bootstrapping, and average voting to make forecasts, instead of just merely equating the forecast of trees. This prototype utilises two primary ideas that give the Random Forest its name. One is a random sampling of practice information points when structuring trees and second is random subsets of traits regarded when dividing nodes.

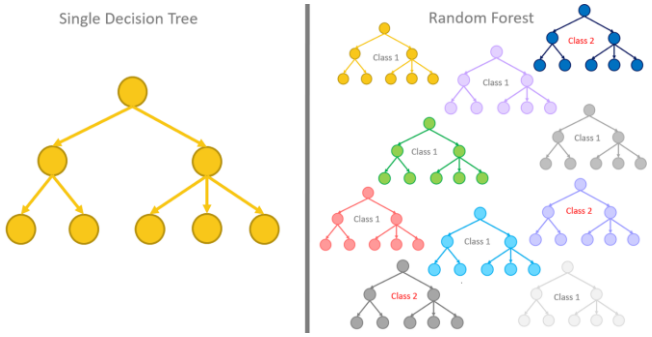

Fig 3: Single Decision Tree and Random Forest

4.2 Control applications:

The data from the predictive algorithm sends commands automatically to the appliance from the control applications created in Mobiles and Webs.

Although the control application ensures more reliable automation of an IoT system, there is an alternative for users to turn OFF IoT when the system is poorly tuned to perform specific actions. In other cases with a portable device application or web application, users can monitor the status of their appliances at home from a remote location and send commands to control applications and monitor the same.

TABLE -1: SAMPLE DATA Set for AC

DATE	TIME	ROOM ID	APPLIANCE NAME	STATE	TEMP(IN C)	SLEEP TIMER STATE	SLEEP TIMER	SWING STATE	FAN LEVEL
20-02-2020	00:00:00	2	AC2	1	20	1	05:00:00	1	2
20-02-2020	01:00:00	2	AC2	1	20	1	05:00:00	1	2
20-02-2020	02:00:00	2	AC2	1	20	1	05:00:00	1	2
20-02-2020	03:00:00	2	AC2	1	20	1	05:00:00	1	2
20-02-2020	04:00:00	2	AC2	1	20	1	05:00:00	1	2
20-02-2020	05:00:00	2	AC2	0	20	1	05:00:00	1	2
20-02-2020	06:00:00	2	AC2	0	20	1	05:00:00	1	2
20-02-2020	07:00:00	2	AC2	0	20	1	05:00:00	1	2

Temperature is in Celsius.
In states 1 indicates "ON" state and 0 indicates "OFF" state.
The Date is in day:month:year format.
Time is in hh:mm:ss format

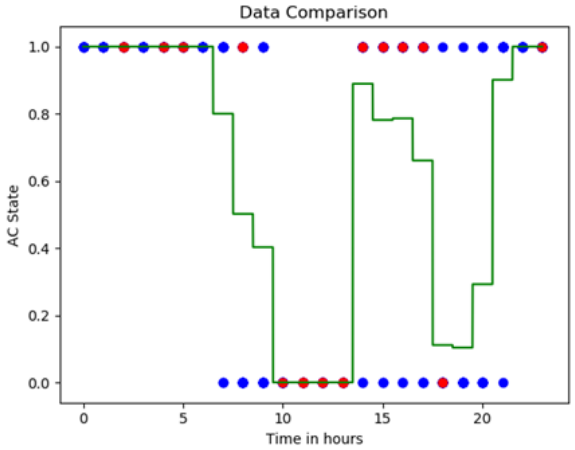

Fig 4: Reference plot for AC state prediction

5. CONCLUSION

Thus the project has incorporated all requirements that a user may need monitoring and controlling his target place. This product entirely based on Wi-Fi technology. The user can load the Web address and control the equipment at anywhere and anytime. Communication through web address is a reliable and economic methodology than other similar technology available. The use of PIR sensor makes it more comfortable to detect human intervention. This paper also aims at building an appliance control system for a home which includes an advantage of the machine learning algorithm to improve the user experience based on their historical patterns of usage. Machine Language usage carries the drawback linked to machine learning and predictive analysis. The

reliance on the predicted value may also not be suitable for the human tendency. Currently, this paper is aim for a single user environment where all the data is taken from one user. For example, AC control in room one and room two is taken as an input for the same user. In the future, this can be enhanced for a multiuser environment where the user can be identified, and the data prediction is according to the specific user.

REFERENCES

[1] Ravi Wankhade, Shashank Karhade, Pratik Mohite, Kanchan Dhole, Akash Ganvir, Bharti Khedkar, Sharayu Sangekar, "Home Automation System Based on IOT using Cellular Devices" in IJSRST Vol. 6 Issue 1 , 2019

[2] Sadi Mahmud, Safayet Ahmed, Kawshik Shikder, "A Smart Home Automation and Metering System using Internet of Things (IoT)" in in IJSRST Vol. 6 Issue 1, 2019

[3] Swapnil Thakare, Sharad Yadav, Amar Waghade "IoT and AI bases Home Automation System" in International Conference on Robotics,Electrical and Signal Processing Techniques (ICREST), 2019

[4] Suraj, Ish Kool, Dharmendra Kumar, Shovan Barma,, "Visual Machine Intelligence for Home Automation" in by IEEE, 2018

[5] Kazarian A, Teslyuk V, Tsmots I, Mashevska M, "Units and Structure of Automated "Smart" House Control System Using Machine Learning Algorithms" CADSM 2017, 21-25 February, 2017, Polyana-Svalyava (Zakarpattya), UKRAINE

[6] Jin Wang, Member, IEEE, Jiayi Cao, Bin Li, Sungyoung Lee, Member, IEEE, and R. Simon Sherratt, Fellow, IEEE, "Bio-inspired Ant Colony Optimization based Clustering Algorithm with Mobile Sinks for Applications in Consumer Home Automation Networks" in International Journal of Machine Learning and Computing, Vol. 4, No. 2, April 2014.

[7] Aditi Dixit and Anjali Naik, "Use of Prediction Algorithms in Smart Homes," in International Journal of Machine Learning and Computing, Vol. 4, No. 2, April 2014.

[8] Sean Dieter Tebje Kelly, Nagender Kumar Suryadevara, and Subhas Chandra Mukhopadhyay, Fellow, IEEE "Towards the Implementation of IoT for Environmental Condition Monitoring in Homes" in IEEE SENSORS JOURNAL, VOL. 13, NO. 10, OCTOBER 2013