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Smart Home Automation Tool for Energy Conservation

Vivek Shahare, Nitin Arora, Ahatsham, Anupam Singh, Nidhi Mouje

Abstract*: In an era of SMART BUILDING, SMART HOUSES, this project came up with an idea of building a smart device which works smartly on some level. The system always tried to use the resources in a way that it should be conserved and should also not disturb current need and fulfil it. In order to come up with a solution which will not only conserve the energy resources but will also be an assistant with its control over the device. The system using Arduino paired with sensors and bunch of algorithms which will help in controlling the device and the device which is to be controlled with this controller will be an Air Conditioner. Using the data analysis of different aspects of weather conditions and timings and will train controller to control the device with solving the W's of the situation i.e. How, When, Why and Where. The device will automatically control the air conditioner like when to power on and off, like on what temperature the AC should be and more.

***Keywords*: home automation, energy conservation, machine learning, sensor, controller.**

I. INTRODUCTION

The home automation is today's need for efficient utilization of resources and is the future of saving energy. The smart tool will do the manual steps for you once they've been set up. The priority in smart home automation is controlling the temperature according to different factors like weather, place and time. It is more like having your own personal assistant at good to go. Again it can make life a lot easier when it comes to saving on energy bills.

So it is all about making a smart tool that connects to the air conditioner and make the user tension free from switching off the appliance according to different weather conditions for saving the energy bills .This would not only save the bills for the user but it will also increase the sustainability of the product. This home automation system will drastically reduce the carbon footprint of the home in which this system will be applied to.

The automation tool will also regulate or condition the temperature of the home according to the conditions outside. The Chip microcontroller used is Arduino UNO chip.

A. Arduino UNO R3

In this Paper Arduino Uno is used which a microcontroller board, having 14 digital I/O pins and it is based on the **ATmega328P**. 6 pins are used as pulse width modulation (PWM) output, 6 are used as analog input which will take input data through sensor, a USB connection, a 16 MHz quartz crystal, a power jack, an ICSP header and a reset button. It contain everything which is needed to support microcontroller; to get Arduino UNO R3 starts it only required power with battery or any AC to DC adapter and simply it needs to connect to a computer by using USB cable.

The main difference between Uno and its all preceding boards is that it does not use the FTDI USB-to serial driver chip. In place of it, it features the Atmega16U2. It programmed as a USB-to-serial converter. The pins are shown in Fig. 1 of Arduino Uno R3 board [9].

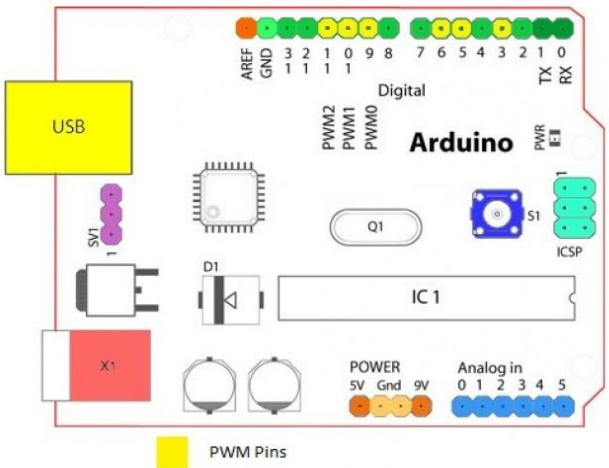

Fig. 1.Arduino Uno R3 board [9]

B. Sensor in Arduino-LM35

The LM35 series sensors are precision integrated-circuit temperature devices in which an output voltage is linearly proportional to the Degree Celsius (Centigrade) temperature. It does not require any external trimming or calibration to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full temperature range of −55°C to 150°C.

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* Correspondence Author
Vivek Shahare*, School of Computer Science, University of Petroleum & Energy Studies (UPES), Dehradun, India. Email: vshahare@ddn.upes.ac.in
Nitin Arora, School of Computer Science, University of Petroleum & Energy Studies (UPES), Dehradun, India. Email: narora@ddn.upes.ac.in
Ahatsham, School of Computer Science, University of Petroleum & Energy Studies (UPES), Dehradun, India. Email: ahatsham@ddn.upes.ac.in
Anupam Singh, School of Computer Science, University of Petroleum & Energy Studies (UPES), Dehradun, India. Email: anupam.singh@ddn.upes.ac.in
Nidhi Mouje, Reknot Solutions Private Limited, Mumbai, India. Email: nmouje@gmail.com

Lower cost is assured by calibration and trimming at the water level. The linear output, low-output impedance and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy.

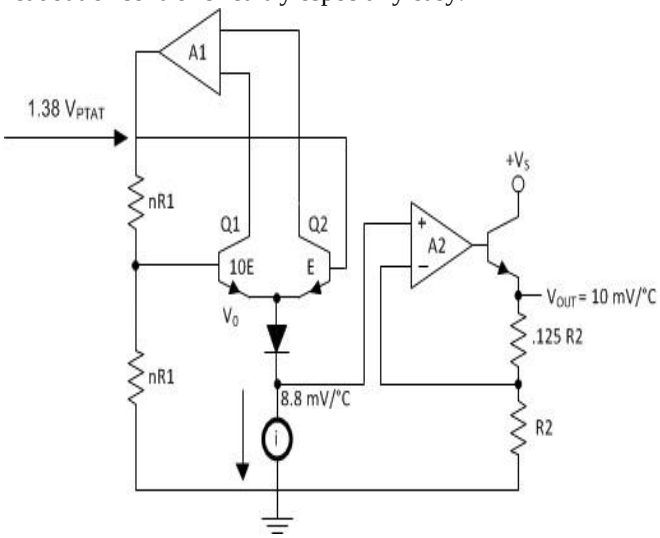

Fig. 2.LM 35 temperature sensor block diagram [10]

C. Wi-Fi module in Arduino- M302

An Open source and interactive, programmable, low cost, simple and intelligent WIFI hardware Operating hardware IO for Arduino.

Providing high-level interfaces to hardware free application developers from complex hardware configurations and register operations: Event-driven API greatly facilitates users to develop network applications.

II. RELATED WORK

Usage of many home appliances which uses high energy mainly the air conditioner systems which uses both heating and cooling mechanism.

In [1], [7] we got to know that how and where the energy is wasted and how we can plan a system which will help in minimising the energy waste in the environment with high efficiency.

In [2], [8] we got to know the real world scenario of the Automation System which we will be going to implement here in this project. This paper is an advance version of what we will be implementing. Here we also got to know that how the world is changing towards the automation and how the rapid increase in the total numbers of the internet users made an impact on the IOT trend.

In [3], which talked about "Smart home Information management system for energy efficient networks". It states how Information and communication technologies and Internet of things helped each other in the advancement of the automation system. It also states how high performance task can be achieved using energy control services.

In [4], [6], which conceptualises the idea that how the real world objects can be connected and monitored using the internet.

In [5] talks about how machine learning can be used in day today life to automate multiple tasks. It also shows different techniques or algorithms of the Machine Learning.

III. PROPOSED METHODOLOGY

Proposed methodology is divided into two stages:

A. Stage 1: Generate Data Sets

The data set will be generated with the help of the temperature sensor connected Arduino board and the data will be transferred and stored in the online cloud storage through the Wi-Fi module again connected to the same Arduino board.

B. Stage 2: Train the model and prediction

The model will be trained with the dataset stored in the cloud and using any threshold temperature and the model will be able to predict whether the air conditioner is in low(off) or high(on) stage i.e. binary situation(0,1).

IV. IMPLEMENTATION AND RESULTS

In this paper two machine learning algorithms are used as follows:

A. *Linear Regression* [11]

Linear Regression is a linear approach to modeling the relationship between a date which is a scalar response or dependent variable and temperature which is an explanatory variables.

Define

x: Feature factor i.e. = $\{x_1, x_2, \ldots\ldots, x_n\}$

y: Response factor i.e. =$\{y_1, y_2, \ldots\ldots y_n\}$

The Equation of regression line is given as:

$$h(x_i) = \beta_0 + \beta_1 x_i \qquad (1)$$

$h(x_i)$:is the predictive response value for any observation in equation 1.

β_0 and β_1 are here the regression coefficients that intercept the y-axis and the slope of the line of the regression.

B. *Support Vector Machine (SVM)* [12]

SVM are supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis.

- Prepare Data: read the data set from two files i.e., x.txt and y.txt file which contains the date and temperature dataset. And then split them into sets i.e. 1st training (80%) and 2nd testing (20%)
- Create an instance of linear SVM classifier
- Train a linear SVM classifier: Then train the model with the given dataset. Use the predict method of SVM class to obtain the accuracy of the model.

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C. *Results*

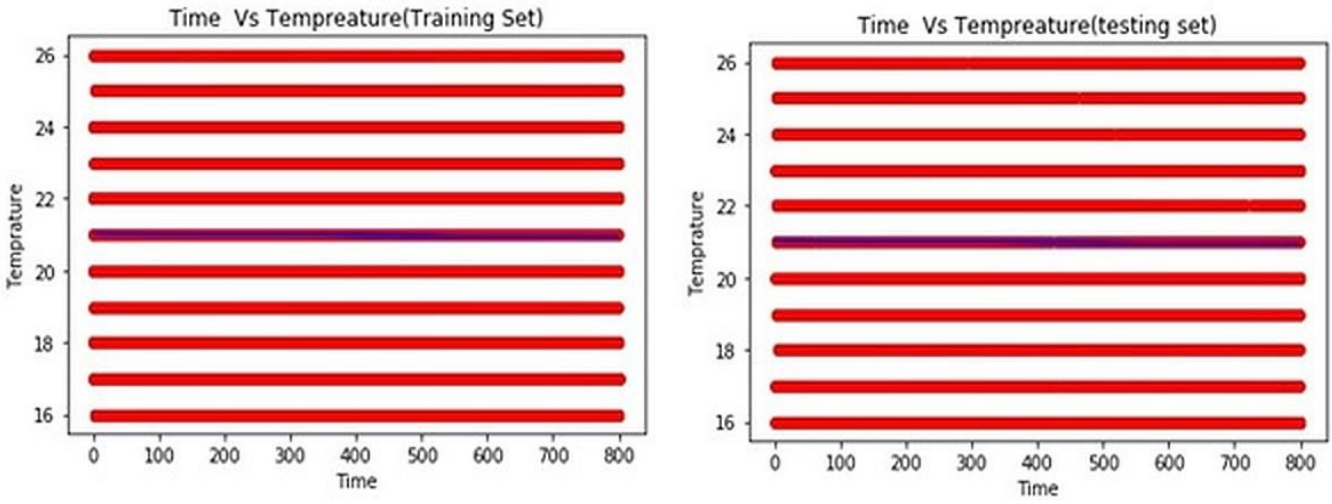

Fig. 3.Temperature Vs Time (Linear Regression)

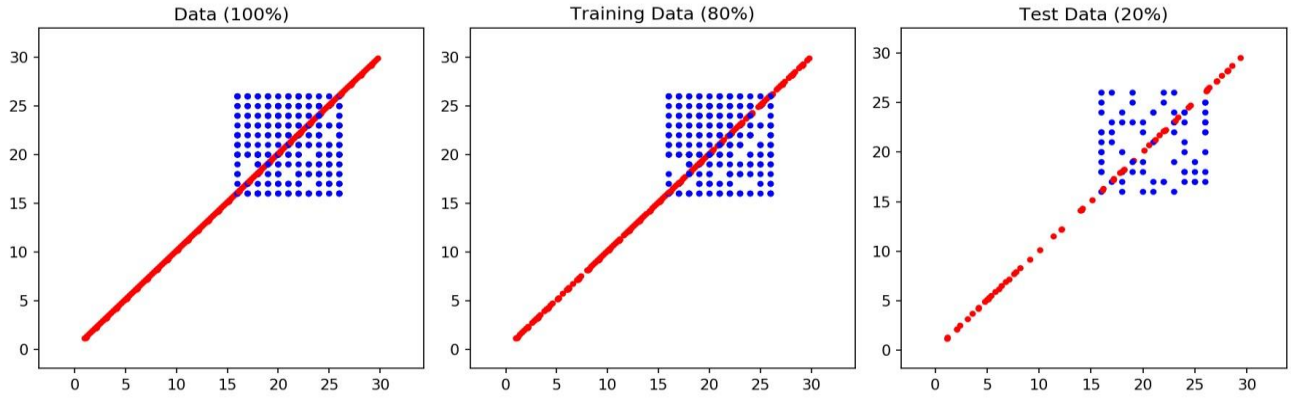

Fig. 4.Temperature Vs Time (SVM with noise)

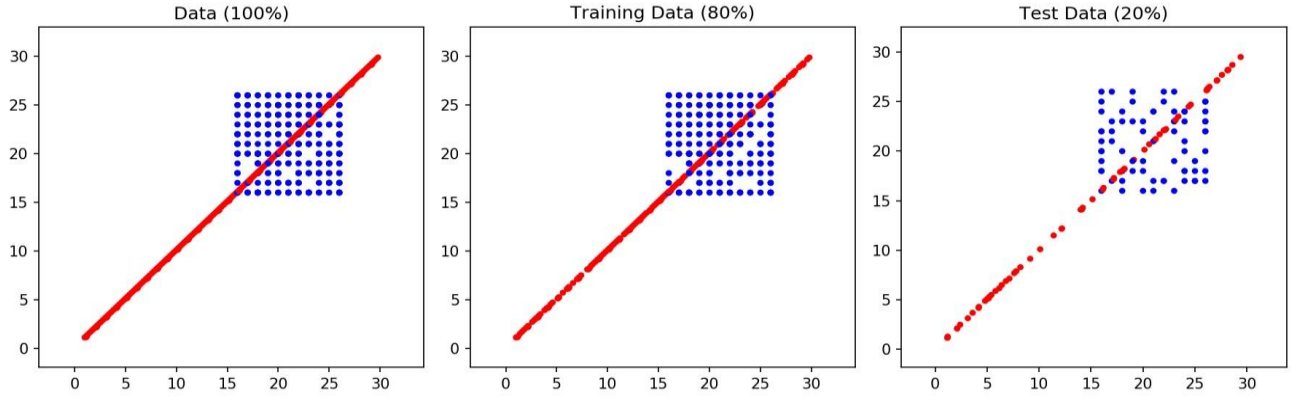

Fig. 5.Temperature Vs Time (SVM without noise with C=1)

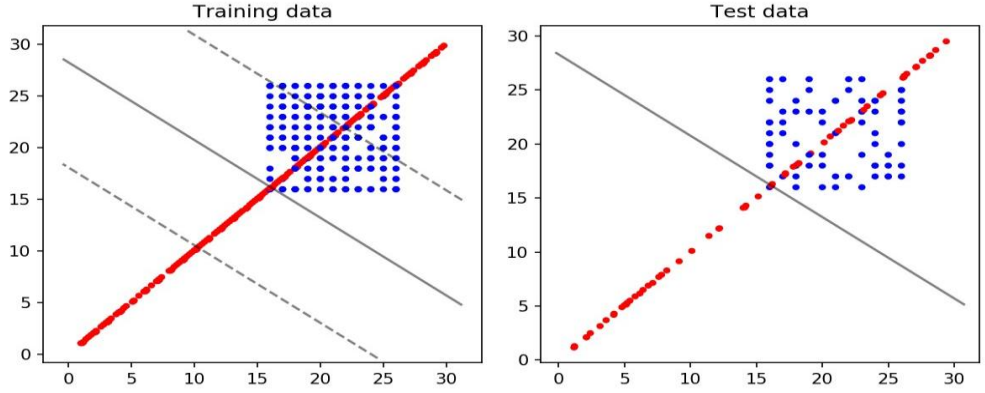

Fig. 6. Temperature Vs Time (SVM without noise with C=100)

Fig. 3 show the output of linear regression on input data of date and temperature. Fig. 4 showing the results of SVM with noise, means there is overlapping between the classes and Fig. 5 and Fig. 6 shows the output for SVM without noise with value of C is 1 and 100 respectively. Here linear regression consider for the trial purpose as there need to keep some threshold for getting the results.

After implementation of all the algorithms and plotting the graph for each algorithm it found out that

- Accuracy SVM with noise: **73.57142857142858%**
- Accuracy SVM without noise: **73.57142857142858%**

The accuracy is almost same in both the test cases. So, any of the algorithm may consider for the implementation.

V. CONCLUSION

This tool provides a futuristic approach towards smart living by enhancing daily utility devices in such a manner that they can be used efficiently in respect to money as well as energy. The tool developed will smartly control appliances functioning in care to save energy and money. Here, appliance being an Air Conditioner thus the controller will control the active time of the appliance. To prepare the controller we have train the controller with data set of temperature corresponding to days and its each hour. The data set is created by using LM-35 sensors. This data set is then stored at cloud for future references, computational works as well for training the controller. The data set is computed to carry out prediction to control the devices by generating highs and lows for the device. The prediction is carried out by applying linear regression on the data set.

Future Enhancement:

- Currently we are working on hourly basis Data set but in future we will expand it to it will predict the temperature according to different months and seasons.
- Currently we are classifying our data set into two parameters high and low but in further enhancement we will classify our data set in the three parameters high, low and mid by which the appliances can be controlled and save more energy.

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AUTHORS PROFILE

Vivek Shahare is Assistant Professor in School of Computer Science, University of Petroleum & Energy Studies, Dehradun. He has recieved his B.Tech from Government College of Engineering, Amravati in 2012 and M.Tech from Visvesvaraya National Institute of Technology (VNIT), Nagpur in 2016. His research interest includes Bioinformatics and Theoretical Computer Science.

Nitin Arora received B. Tech. (Comp. Sci. Engg.) from NIT ALLAHABAD in 2008 and M. Tech. (Comp. Sci. & Engg.) in 2012 with GOLD MEDAL from Uttarakhand Technical University, Dehradun, the member of IAENG (USA), ISOC (USA) has published over Fifteen plus research papers in National and International Journals/Conferences and IEEE proceeding publication in field of Data Structures and Algorithms, Mobile Ad-hoc networks & Digital Image Processing. He is working as an Assistant Professor (Senior Scale) at University of Petroleum and Energy Studies (UPES), Dehradun.

Ahatsham was born in Roorkee, India in 1993. He received his B.tech degree from Uttrakhand Technical University in 2014 and M.tech degree from VNIT Nagpur in 2016.He is currently working as Assistant Professor in University of Petroleum and Energy Studies, Dehradun, India. His research interests include data mining, machine learning and data streaming.

Anupam Singh is Assistant Professor in Department of Informatics, School of Computer Science, University of Petroleum & Energy Studies, Dehradun. He is pursuing Ph.D. from Dr. A P J Abdul Kalam Technical University Lucknow. Formerly UPTU Lucknow). He has done B. Tech. in 2004, M. Tech. in 2011 from Uttar Pradesh Technical University Lucknow. His area of interest are Formal Methods, Distributed System and Database System. He is Reviewer of many referred journals. He has evaluated many presentations in International Conference as Session Chair.

Nidhi Mouje is Senior Software Engineer in Reknot Solutions Private Limited, Mumbai. She received her B.E and M.E. degree from RSTM Nagpur University. She had vast experience in industry, teaching and research. Her area of interest are Wireless mobile computing, Query optimization.