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Research Article

Android Based Smart Home System

Gayatri Kulkarni†*, Priyanka Gode†, Jadi Pratap Reddy† and Madhura Deshmukh†

†Department of Computer Engineering, Savitribai Phule Pune University, All India Shri Shivaji Memorial Society's College of Engineering, Pune, Maharashtra, India

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Abstract

The main purpose of our project is to create a home automation system i.e. a home which will act as an intelligent agent. Voice commands are given as an input by the user. An android application is created for this purpose. This application consists of a list of rooms, room- switches and the operations which are to be performed. We are using the current system time and weather conditions. Datasets are built for analysis purpose and then stored in the switch history table. We perform data mining on the switch history table. It means that a new record which is added in the switch history table will perform action based on the previous records which are stored. The current status is predicted and the output is sent to the Arduino kit. The corresponding led will glow for on and off state of light. A stepper motor is fixed for showing the status of the fan.

Keywords: *DDMS (Dalvik Demon Debug Service), Arduino Kit, ID3 (Iterative Dichtomiser 3).*

1. Introduction

This project aims at creating an automated home. The main purpose is to maximize the comfort of the inhabitants of the house. Furthermore, people who are physically disabled will also be benefitted using this product. We give input in the form of the voice commands to the android application which is created. These voice commands, weather conditions and the system time and date will be used to perform the basic domestic automation. According to the input given and the datasets trained, the output action will be performed and then it will be depicted on the Arduino kit.

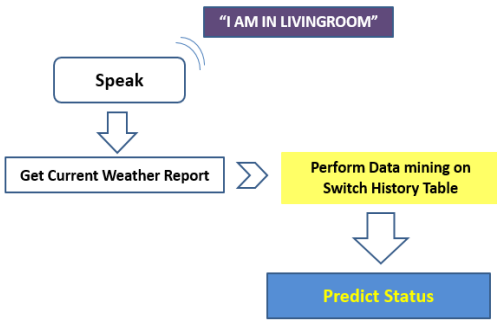

Fig.1 Basic Flow of the system

The domestic automation will be easily performed by a person who is physically disabled. Product can be also be used by a normal person who is temporarily disabled or it can be used by old aged people who find it difficult to manage the basic home automation(R. Vinay Chand *et al*,2013;M.Veda Chary *et al*,2013).

The basic flow of the system is depicted in the figure given. It consists of various modules like android application, weather report generation, data mining on the datasets provided and then predicting the status of the given operations on the previous data which is provided. DDMS is used as a debugging tool for the android application and works with both emulator and a connected device.

2. Methodology

1) An android application is designed for accepting speech as an input, which the user will give as an input to the system.

2) Voice recognition will be seen on the android application. Android application will include room list, room switches and the corresponding operations to be performed.

3) During the process of giving the voice commands to the system, care must be taken that there is minimum background noise so that the unnecessary background noise will be automatically eliminated.

4) System time and date are detected. The system time and date must be properly adjusted so as to get the desired output.

5) Current weather conditions are detected by using

*Corresponding author: **Gayatri Kulkarni**

Google API's (lat-long). We get a stream of the parameters and its values, which are stored in the switch history table.

6) The system considering the given input and the previous datasets used for its training will predict a proper operation (*action*).Finally the predicted operation (*action*) will be performed by the system.

7) Desired proper output i.e. user will get a proper operation performed (*action*). Improper date and time will result in an improper action performed.

8) Consequently, after the operation is performed its data is stored in the database i.e. history table and that can be used in future for predicting the operations.

3. Modules

3.1. Android Development

Android is an operating system consisting of operating systems as well as middleware and key applications. Android SDK provides the necessary API's for developing the applications on the android platform. Hence the use of android applications is increasing day by day (Ms. Anuja Jadhav *et al* ,2012 ; Prof. Arvind Patil *et al* ,2012)

3.2. *System Time and Date*

System time and date can be found out by using Java code. Specific date packages need to be installed for finding the time and date at given instant. Date can be displayed in any of the specified formats.

3.3. *Detecting conditions of the particular day*

This will be carried out by using a GPS tracker which contains a lat-long function. Through this function we derive the parameters and the attribute values of the weather conditions at a particular instant. Then the prediction is done by using the records which are previously stored in the switch history table.

3.4. Interfacing

The processes which are carried out will determine the operation to be performed. Arduino kit is used for final output. For domestic devices like light, tv etc led's are used and for fan stepper motor is used.

4. Implementation

4.1. Android application

Android application is developed to accept the voice commands given by the user. This application consists of the room lists, various room switches and the operations to be performed i.e. switch on or off of automation. The mobile phone consisting the automation application is connected to the server by socket programming. For connecting the mobile phone, the server's ip address is given in the application using which it is connected to the server. In this case the server will be the laptop or the desktop itself. After successful connection with the server the user can select the room in which the user wants to perform the automation task and then accordingly give the voice commands to the system.

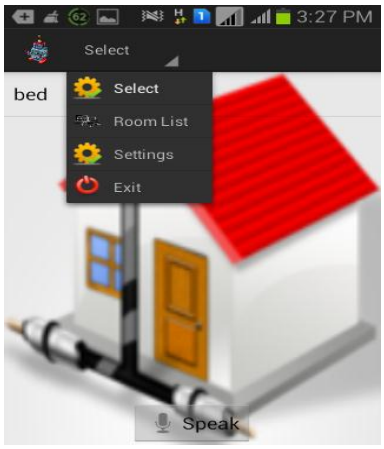

Fig.2 Android application

User also has an option in the application to directly perform the automation without giving any voice commands to the system. Furthermore, two types of modes are included in it i.e. home mode and away mode. In HOME MODE all the automation in that particular room will be switched ON whereas in AWAY MODE all the automation in that room will be switches OFF.

Fig.3 Home Mode Activation in android application

4.2. Interfacing

User has to create a login account by using his mobile phone's imei number. The mobile phone consisting of the automation application is then connected to the server by socket programming. For connecting the

mobile phone, the server's ip address is given in the application as well as its port number using which it is connected to the server. A debugging tool called as DDMS (Dalvik Debug Monitor Service) which provides port-forwarding services, logcat and other services. It is integrated in the in the SDK directory. It works with both emulator and the connected device. It acts as a mediator to connect the IDE to the applications running on the device (Hyeon-Ju Yoon *et al*, 2012),

4.3. Database

After recording the system's time and date we need to find out the weather conditions. This will be carried out by using a GPS tracker which contains a lat-long function. Through this function we derive the parameters and the attribute values of the weather conditions at a particular instant. Then the prediction is done by using the records which are previously stored in the switch history table. All the changes are depicted in the tables stored in the Mysql-query-Browser. It contains all types of tables like rooms, room-switches, switch-history, user-accounts.

4.4. ID3 Algorithm (Iterative Dichotomiser 3)

ID3 is a simple decision tree algorithm developed by Ross Quinlan (1983).The basic idea of ID3 algorithm is to create a decision tree of given set, by using top-down greedy search to check each attribute at every tree node. To select the most useful attribute using classification technique, we present a metric---information gain and to catch an optimal way to classify a set, we need to minimize the depth of the tree. Thus, we need some function which should be able to measure the most balanced splitting. The information gain metric is such a function that we can use for efficient balanced splitting (Rupali Bhardwaj *et al*, 2013; Sonia Vatta *et al*, 2013).

Shannon Entropy finds its application in many fields. Here, Shannon Entropy has been used in ID3 algorithm to calculate the Information Gain contained by data, which helps to make Decision Tree.

4.4.1. Description with an example

Table 1: ID3 Attributes

Time	Weather	Operation
Morning	Clear	Off
Afternoon	Clear	Off
Evening	Clear	On
Morning	Cloud	Off
Afternoon	Cloud	On
Evening	Cloud	On
Morning	Rain	Off
Afternoon	Rain	On
Evening	Rain	On

Calculating for the Classification Entropy

I_E= - (5/9) $\log_2$ (5/9)-(4/9) $\log_2$ (4/9) = ~0.991.
Then we calculate Information Gain of remaining attributes to determine the root node.

Information Gain:

Time: 3 Morning , 3 Afternoon, 3 Evening. 3 values for attribute Time, so we need 3 entropy calculations:

Table 2: Information gain of the attributes

Morning: 0 ON,3 OFF	I_M=-(0/3)$\log_2$(0/3)(3/3) $\log_2$(3/3) = ~0
Afternoon:2 ON, 1 OFF	I_A=-(2/3)$\log_2$(2/3)-(1/3) $\log_2$(1/3) = ~0.9182
Evening: 3 ON, 0 OFF	I_M=-(3/3)$\log_2$(3/3)-(0/3) $\log_2$(0/3) = ~0

IG_{Time} = IE(S) – [(3/9)*I_M+ (3/9)*I_A + (3/9)*I_E]
IG_{Time}= 0.991 – 0.306 = 0.685

Similarly entropy and information gain is calculated for weather:

IG of Time=0.685
IG of Weather=0.07

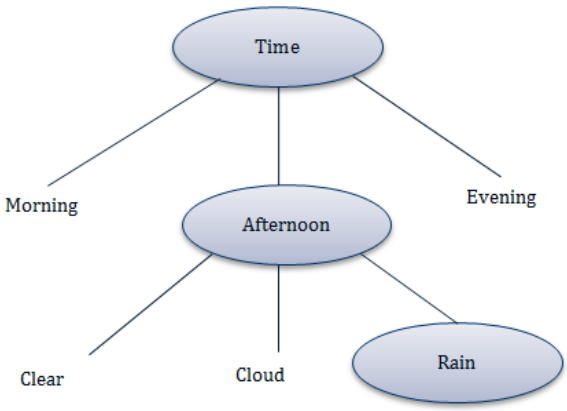

Fig.4 Decision Tree

So time is the first root node. The information gain of the afternoon time is more than others. Hence afternoon is selected as the root node. Again we find the information gain for all the attributes of weather. The attribute having the largest value will be the root node.

4.5. Final Output

The final output is shown on the Arduino kit. For domestic devices like light, tv etc led's are used and for fan stepper motor is used. For the 'ON' and 'OFF' operation the corresponding led will glow. Stepper motor is used for fan. The increase in the speed of the stepper motor indicates increase in the speed of the fan and vice versa.

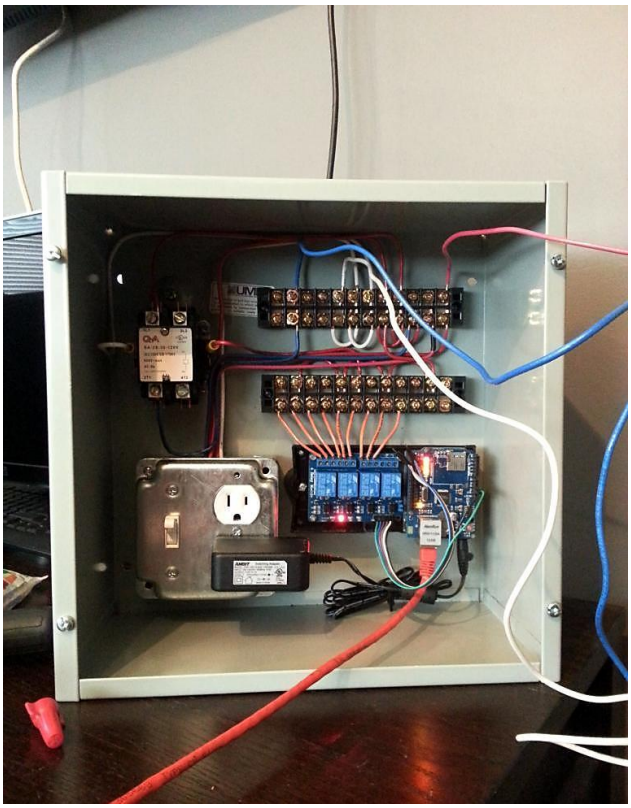

Fig.5 Arduino Kit

Conclusion

1) This paper presented an approach to create a smart home system which can be handled by inhabitants of the house especially the handicapped ones.
2) The development of our project is based on data mining techniques.
3) Home Automation System is implemented with mobile devices due to their increasing popularity among consumers and also with web devices.
4) Home Automation System follows the client–server architecture model commands and controls are sent from the client to the server when necessary, alerts are sent from the server to the client.
5) For home automation, we chose to use Arduino kit technology due to its popularity and also ease of installation since it requires no additional wiring

Future Scope

1) The proposed system is speaker independent. A speaker dependent system can be devised in future.
2) Also speaker input provided should be accessed in different languages as desired by the speaker.

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