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Universal Mobile Application Development (UMAD) On Home Automation

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Abstract

At present scenario the market is flooded with many cell phones compatibility issues intended with Operating System and hardware's, so the applications are not made in a manner to suite large mass. Till now the applications made were targeted to a particular Operating System only which restricted there usability. With the limitations of above in mind there is a need of a universal mobile application development (UMAD) platform. So that an application can be developed in a universal XML format which can be easily ported to any other mobile devices. This paper presents the design and implementation of the Home automation system on one of the Operating System and creation of a unique XML document that can be placed over the server which can be adapted by any other mobile device without any platform issues. The XML format which controls the layout of the screen remains common, only the part which needs to be coded on every platform is the downloading of the XML file from the server and parsing it. This reduces a lot of coding effort as the design part is coded only once, and the same file can be used by every other platform. We have taken Home Automation system as our application, in which all the household devices such as Bulb, Fan, AC etc. all are controlled by a smartphone which is connected to a server containing the XML file via an internet connection. Every change made by the user on the smartphone affects the data in the XML file of server, which thus helps in continuous updating of data and all other users get an updated Graphical User Interface. We have taken Home Automation as one of our application, but the same principle can be implemented in any other applications like Mobile Themes, Games etc.
Keywords: Android, Hardware Modulator, Home Automation, iOS, UMAD, Universal Mobile Application, XML.

1. Introduction

The explosive growth in cellular mobile communication in the recent decade is changing the way people live and work. Mobile handsets today are essentially handheld computers with integrated communication capabilities. The handsets allow users to download and run applications. This opens the door for introducing a vast variety of functionalities to the mobile phone and making the mobile a real intelligent device. But even after immense work on mobile platform the compatibility factor is always a constraint. The constraint is the Operating System of the mobile device. This makes the application to be used in a particular operating system. It also refers to the version of an operating system. The main objective of this paper is Universal Mobile Application Development (UMAD) which creates a platform for application portability between various mobile devices. UMAD will run across virtually all mobile platforms thus providing universal mobile applications without operating system platform limitations [18]. This feature of UMAD can be used in any type of applications ranging from small scale to large scale. We are implementing this on the Home Automation system. Home Automation allows the controlling and monitoring of various home appliances by a single system and brings greater convenience, better security, as well as higher energy-efficiency to home users. The home appliances are controlled by the home server, which operates according to the user commands received from the mobile phone via the internet as a

communication medium [17]. A key to the home automation system is the capability for remote operation. These systems rely on the internet as the medium for communication and generally feature friendly graphical user interfaces. The Internet-based approach requires a home server running on an Internet-connected personal computer all the time. In our proposed system the home server is built upon a separate Server, which will have the repository of the XML files intended to the operating system and the version being used. It also takes into the account the different screen size and resolution functionalities allowing a user to control and monitor any variables related to the home by using any smart phone. 2. Theoretical Background talks about the research work done in the past. 3. Methodology explains the overall structure of the system. 4. Graphical User Interface explains the functionality on both the server and client side. 5. Hardware interface gives details about the hardware modulator that has to be used which listens to the server instructions. 6. User Interface talks about the user interaction with the system with the help of a smartphone. 7. Future Work tells about what new features can be added in the system in the near future to make it more efficient.

2. Theoretical Background

Considerable efforts have been put into the development of remote control systems for home automation. Earlier systems are mainly based on the use of telephone line, such as a phone-based system for home automation using a hardware-based remote Controller [1][2], and a personal computer [3]. The above systems make use of the telephone as the remote controlled input device and have no friendly user interface. With the proliferation of Internet, various Internet-based remote control architectures for home automation have been proposed [4]-[8]. All the system mentioned above suffered from two main drawbacks.

1. The systems were made considering a single platform which restricted their usability. As of now market have more than 10 brands in the field of smartphones with each running on a different platform.
2. Any mobile application made till now were mostly client based, this meant that in future if an upgraded version of the application is available, then user will have to remove the old version and install the new version. This is indeed a very tedious task and definitely not what a customer wants.

In the field of application development the above mentioned points have been a major drawbacks which has restricted the growth of mobile computation in the recent past.

3. Methodology

The UMAD-methodology is achieved through application of the following principles:

- The application functionality is delivered to the mobile device through an internet protocol thus enabling all web-enabled smartphones to universally access the application.
- UMAD-applications are hosted on an application server hence all processing for the mobile device is performed on the back-end server.
- The client intended application provides maximum level of functionality and computing power. The mobile client application works in tandem with the interface bringing mobile-relevant functionality to the user.

We are not only going to implement this in Android Operating system but also in Blackberry OS and if possible in Apple iOS too. With different Operating System running the same application, they will update the server with the latest status of the application. The architecture of the system looks like as shown in Figure 1.

4. Graphical User Interface for Mobile

4.1 Application

The mobile phone is the interface between the user and the home automation system. It has two tasks:

1. Providing a user-friendly interface for the user to input control commands and view system's

feedback.

2. Sending user commands to and receiving system's feedback from the home server.

An Android based Smartphone with enabled internet is chosen in our design due to the portability of Java and the fast increasing popularity of android-enabled mobiles. Another Operating system with which we are working is Blackberry. We will also try to work with the most advanced operating system designed by Apple Inc. iOS. The use of Blackberry makes work simple as the base is Java for developing purpose, so there is just a need of porting files from Android platform. The portability of Java ensures that applications developed in Java language are portable across different mobiles from different manufacturers. Since Android has a rich library of application program interfaces (API) providing functions such as graphical user interface, sending and receiving SMS messages and communicating via GPRS [14]-[15]. Android applications for mobile phones can be easily developed by using Android development tools commonly known as ADT. In addition, phone manufactures provide their respective handset emulators for developers to test their applications on before testing on real phones.

The major reason behind choosing Android, Blackberry and iOS is due to the market share they have achieved. The activity classification feature and synchronizing features make them outstanding in the field of smartphones.

3. 4.2 Programming Cellular Phone

The working of the home automation using UMAD is as follows:-

- A house will be fully home automated on a press of a button like locking doors, ON/OFF Tube lights and Bulbs, Fans, TV, AC etc.
- The house members residing in this house may have different smartphones of different companies (Here we are referring to different platforms).
- Our application UMAD will be installed on every smart phone device. These phones have to connect to the server for the first time to give the details of all the attributes of the particular smart phone.
- After verification the xml file with its version number is downloaded on the Smartphone with the latest updates available.
- Now the house members can start using this application through which they can toggle the functions of all the home automation and can also get the latest update of the house where they can track the activities of other members.
- Every change made is written back on the server xml, this ensures that the server gets updated instantly.
- This feature will revolutionize the home automation industry as all functionality will be implemented on the server and the changes made will affect the xml file on server.
- The client application present on the mobile will only have code to download and parse xml file on to sdcard, and will return back the unique identification number of the components (Button, Image List, Checkbox etc.) to the server.
- The server will read the unique id and accordingly will make the changes in the server xml as all functionality is provided on the server side.

The flow of events that take place in the system is shown in Figure 2. This starts from server identifying the user providing it with the required XML file and allowing read/write operations within a session.

As shown in Figure 3, the applications will start with an authentication and a request of an appropriate IP address which will download the XML file once for initiating the software application. The IP address is given a token from the server which will identify all its properties and resources.

This makes the client application with a proper session details and unique functionality intended to a specific user. The whole application is controlled by the XML file making in an effort of universal development of the same application in different Operating Systems. The file is downloaded from the server on to the sdcard of the mobile device which makes the parsing of files faster and efficient.

The application is divided in zones and its respective appliances. All these are shown in Figure 4 and Figure 5. As shown in Figure 6 application also performs dynamic updating of XML file on click events. We see that how the XML file is updated which makes the whole process simple and transparent. We have explicitly been using image views for a fantastic user experience. This particular feature of XML can be easily ported to different Operating Systems. All the images are loaded through a zip file and we can add views dynamically with keeping in mind the screen resolution of a mobile device.

Now on the similar basis this will also work on the other platforms, the only change would be to program the download and parsing of file, which is already implemented. The graphical part will remain the same in the other platforms.

5. Hardware Interface

As for Home Automation application the hardware requirement is basically a Smartphone with a server placed as a backend. A hardware which will communicate with the home appliances will be placed inside the house which will listen to the instructions from server and accordingly will take necessary action. This hardware is nothing but the Hardware Modulator, which will have the function of reading the server commands and connecting to the hardware devices in response of which the devices will do the appropriate function [16]. For e.g.: If user wants to switch On the bulb then he will click the required button on the Smartphone and that will give a message to the Server which will command the Hardware Modulator to switch on the bulb. Our main focus is on the software part and which will provide the interfaces to execute these functions. The Hardware Modulator which is already present in the market will be just an extension as a connecting device.

When it comes to hardware PRO-100 [19] from Zigbee is the most efficient as it provides all the hardware interfaces to the software through its protocols.

6. User Interface

The system interacts with the user with the help of a smart phone. When the user switches on the application, it first tries to connect to server and get the details of GUI from it. If the connection is not available then it restores the most recently used page as its default page placed in the sdcard. According to ADA (American Disability Act) it is mandatory that it should work out for even disabled person, so in the case of a blind person operating a Smartphone should possess an audio interaction which can help the person to communicate in an easy way.

7. Advantages of UMAD

1. Cross-platform mobile frameworks being open source has support from a large community of developers.
2. Increases sales/profits.
3. Augments your brand like never before.
4. Users can have access the apps from various places instead of one.
5. Once written, used everywhere coding of app - saves lot of development time.
6. Distribute same app to a huge user base.
7. Achieve more diversity on different app development platforms.
8. Get option of integrating native features of smartphones/mobiles.
9. Problem of versioning system is removed as both GUI and functionality code for all the components of the XML file is provided on the server side.
10. This ensures that if an update is available then the old version need not be removed to use the new version.

User can now buy application once and use it on any mobile or web platform that supports it.

8. Future Work

The work on Android is done and it is also feasible on Blackberry OS as it becomes easy to import the java files and the main universal part i.e. the XML will remain the same in the entire context. If this is possible

on two platforms it opens the market to all the OS, as the crux is the transport of dynamism provided by the XML files. This makes it all platform compatible in a very near future.
As the application we are developing is wholly internet based the server functionality can be put in cloud which makes sense as it gives faster access and saves the cost of maintaining the servers also. So Cloud Computing can be used for cost effectiveness and maintenance benefits.

9. Conclusion

The design and implementation of a novel mobile-based home automation system without Operating System constraint is presented. The design consists of a mobile phone with Android or Blackberry or iOS applications, a cellular modem, and a microcontroller (basically the Hardware). The home appliances are controlled by the microcontroller, which operates according to the user commands received from the mobile phone via the modem. Such a design transforms a mobile phone into a portable remote controller for home automation. It is noted that the proposed system is not restricted to home automation, it can be applied directly to remote control of many industrial devices.

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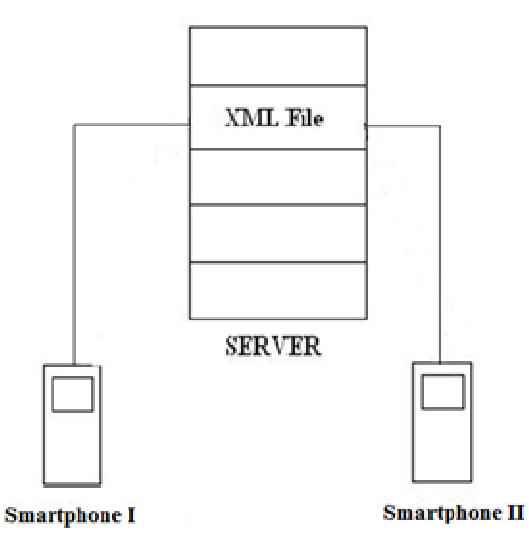

Figure 1. Simple Architecture of the overall system with a universal XML file placed over the server and two different smartphones accessing the same resources without any platform compatibility issues.

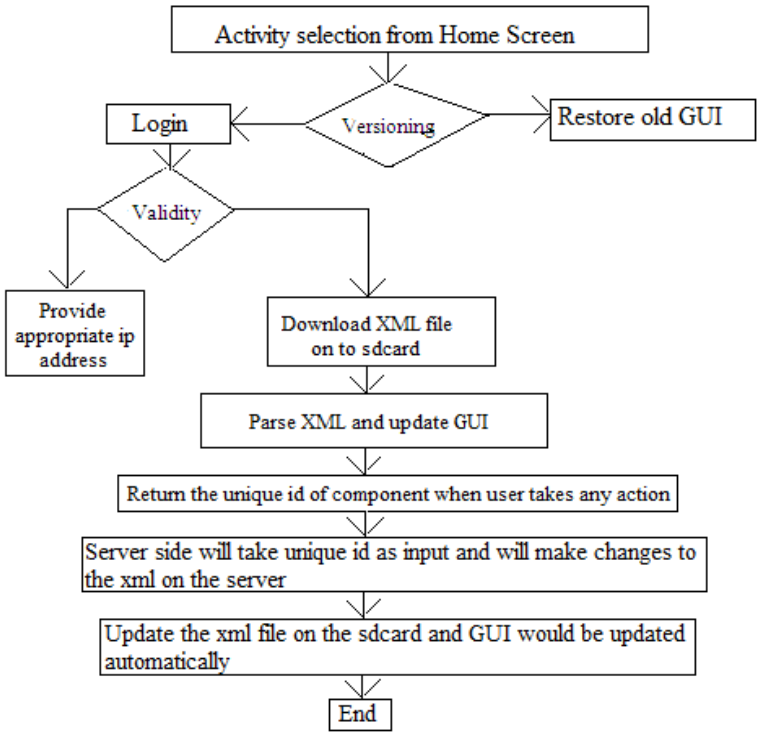

Figure :2 Flow chart

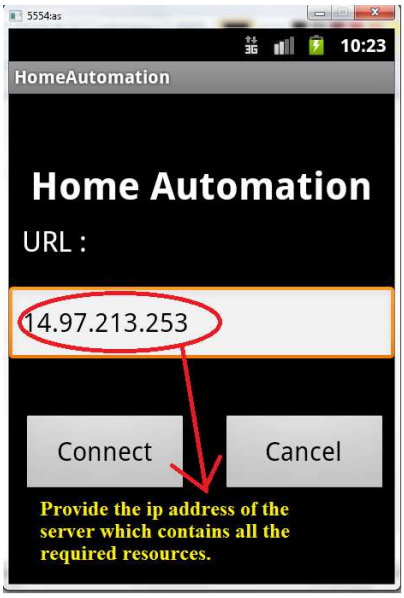

Figure 3: Login screen to connect to the server

Figure 4: List of zones

Figure 5: List of Appliances

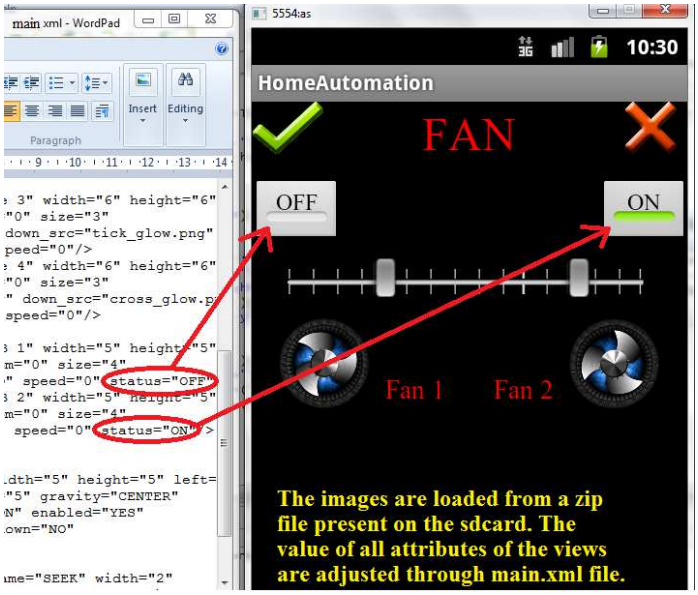

Figure 6: Updating XML (Here status of button on click event is updated on the server XML)