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HOME AUTOMATION & SECURITY SYSTEM USING ARDUINO ANDROID ADK

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Abstract: - Today we are living in 21st century where automation is playing important role in human life. Home automation allows us to control household appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. Home automation not only refers to reduce human efforts but also energy efficiency and time saving. The main objective of home automation and security is to help handicapped and old aged people who will enable them to control home appliances and alert them in critical situations. This paper put forwards the design of home automation and security system using Android ADK. The design is based on a standalone embedded system board Android ADK (Accessory Development Kit) at home. Home appliances are connected to the ADK and communication is established between the ADK and Android mobile device or tablet. The home appliances are connected to the input/output ports of the embedded system board and their status is passed to the ADK. We would develop an authentication to the system for authorized person to access home appliances. The device with low cost and scalable to less modification to the core is much important. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet.

Keywords: Home Automation and Security; Arduino; Embedded Systems; Android ADK; Android phone; Tablet

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INTRODUCTION

Recently, man's work and life are increasingly tight with the rapid growth in communications and information technology. The informationized society has changed human being's way of life as well as challenged the traditional residence. Followed by the rapid economic expansion, living standard keeps raising up day by day that people have a higher requirement for dwelling functions. The intellectualized society brings diversified information where safe, economic, comfortable and convenient life has become the ideal for every modern family.

It is will know that the concept of smart home has focused the attention of researchers, lifestyle practitioners, and the consumers to be directed forward the usage of the recent

Technology. Considerable efforts have been made to the development of remote control systems for home automation

Home automation is automation of the home, housework or household activity. Home automation may include centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances, and other systems, to provide improved convenience, comfort, energy efficiency and security.

Home automation for the elderly and disabled can provide increased quality of life for persons who might otherwise require caregivers or institutional care. It can also provide a remote interface to home appliances or the automation system itself, via telephone line, wireless transmission or the internet, to provide control and monitoring via a smart phone or web browser. This paper will describe the approach which we are implementing to control various home appliances with Android smart phone.

2. LITERATURE SURVEY

Currently there is no system exists at cheaper rates. Various systems are hard to install, & difficult to maintain and use them. Current systems are generally copyrighted and they are closed which means we cannot modify them by our own also they are not very customizable by the end user.

A model for Bluetooth home automation through PC is described by N Sriskanthan [1]. But drawback is, limited range and limited no of devices to be connected also lack of mobile technology support.

A prototype of Web based electric device controlling system designed by Muhammad Izhar Ramli [2]. He also set the server with auto restart if the server condition is currently down.

A java & web based system presented by Al-Ali and Al-Rousan [3]. This system consists of a PC-based server connected to a separate embedded system board at home. In this system the drawback is PC should always on & connect to the server.

A Bluetooth home automation system is proposed by Pradeep G [4] which saves lot of power and time using mechanism to save the preloaded list by not making it to setup connection all the time when required.

For controlling devices Hasan [5] developed a system in which PIC microcontroller acts as a remote controller by using telephone and PIC remote controlled device for controlling the devices pin check algorithm has been introduced where it was with cable network but this system doesn't designed for wireless communication.

An application is developed in a universal XML format by Amul Jadhav [6]. Rather than targeting a single platform this application can have ability to port into any other mobile devices.

Other than the Bluetooth to reduce power consuming and increasing the operating range, A ZigBee based automation system is proposed by Jitendra R. [7]. This system eradicate the complexities occurred in wired home automation system. There is also considerable amount of power saving possible, operating range is more than Bluetooth.

A flexible, low cost and wireless home automation system is proposed by R.Piyare [8]. This system also uses Bluetooth technology.

After rapid growth of GSM networks, this system is implemented based on that networks. When compared from the above systems this system consumes less power & standalone but the drawbacks are when GSM networks fails to deliver the commands in time major problems occurs also we have to remember those commands for every time.
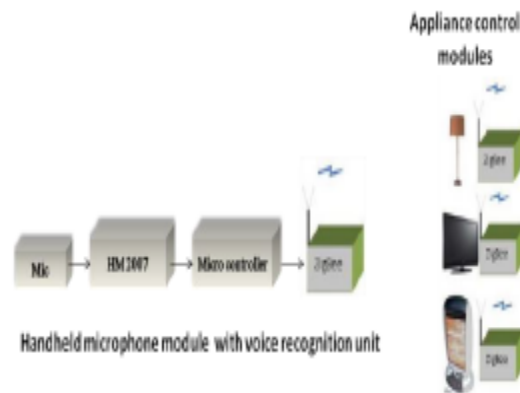
Figure 2.1: Bluetooth Home Automation
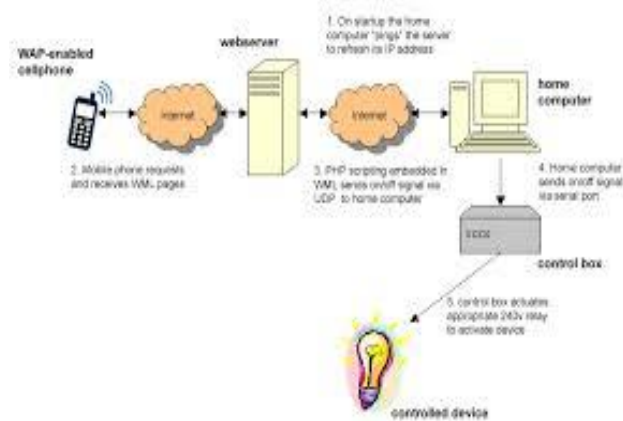

Figure 2.2: Zigbee Home Automation
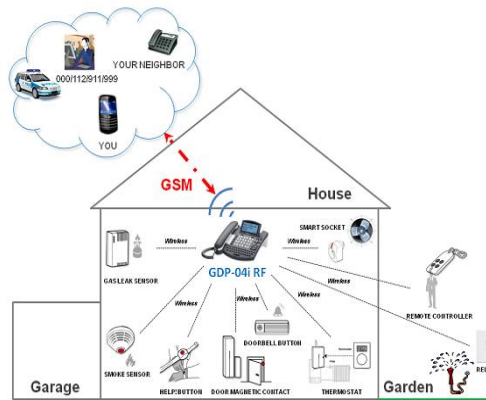

Figure 2.4: Java based Home Automation

Figure 2.2: GSM Home Automation

3. PROPOSED SYSTEM AND ARCHITECTURE

In order to address the mentioned issues of functionality and flexibility in the literature survey, we have designed and implemented a novel, flexible, standalone, and low cost home monitoring and control system. The system consists of an Arduino Mega ADK with Wi-Fi shield, hardware interface modules and the Android supportable Smart phone application.

The architecture presented in this project can be customized in several ways in order to support different application scenarios with minimum modification in design and coding i.e. each time when a new device is added to board, a new thread has to be added in the smart phone application (just replicating the code of other devices with small modifications). The architecture is divided into three different layers: home gateway, remote environment and home environment.
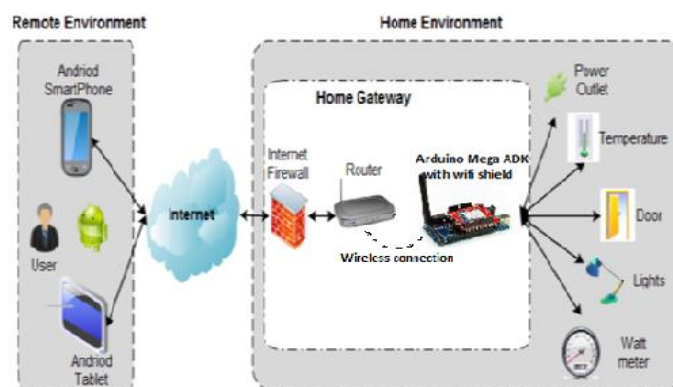

Figure 3: Architecture

4. IMPLEMENTTION

4.1: Android

For this home automation and security system we are targeting Android platform since it has huge market in the world and open source. Android is a software stack for mobile devices that includes an operating system, middleware and its key applications. The Android OS is based on Linux OS. Android Applications are made in a language which is like Java, running on a VM (virtual machine) named as 'Dalvik' which was created by Google. The Android SDK (Software Development Kit) provides the necessary tools and API (Application Package Interface)s to begin developing applications on the Android platform using the Java programming language. Accessory mode is a special feature of Android OS since version 2.3.4 (Gingerbread), version 3.1 (Honeycomb) and above.

4.2: Software Design

As discussed earlier we are developing Android application. The application consists of main function like Light controlling, Door controlling, Smoke detection and Temperature sensing. When the application starts user is first authenticated, if user is authorized he will be navigated to main screen.

The main screen has a list of all functions among which user can select any one function which he want to control. After selecting a function he would be able to see a current status of a particular device. If user wishes, he can enable or disable intended device.

The system is smart enough to activate alarm when smoke is detected or it is programmed to auto on/off lights during late night hours. If room temperature goes very high or low it can automatically adjust fan/AC as per the temperature.
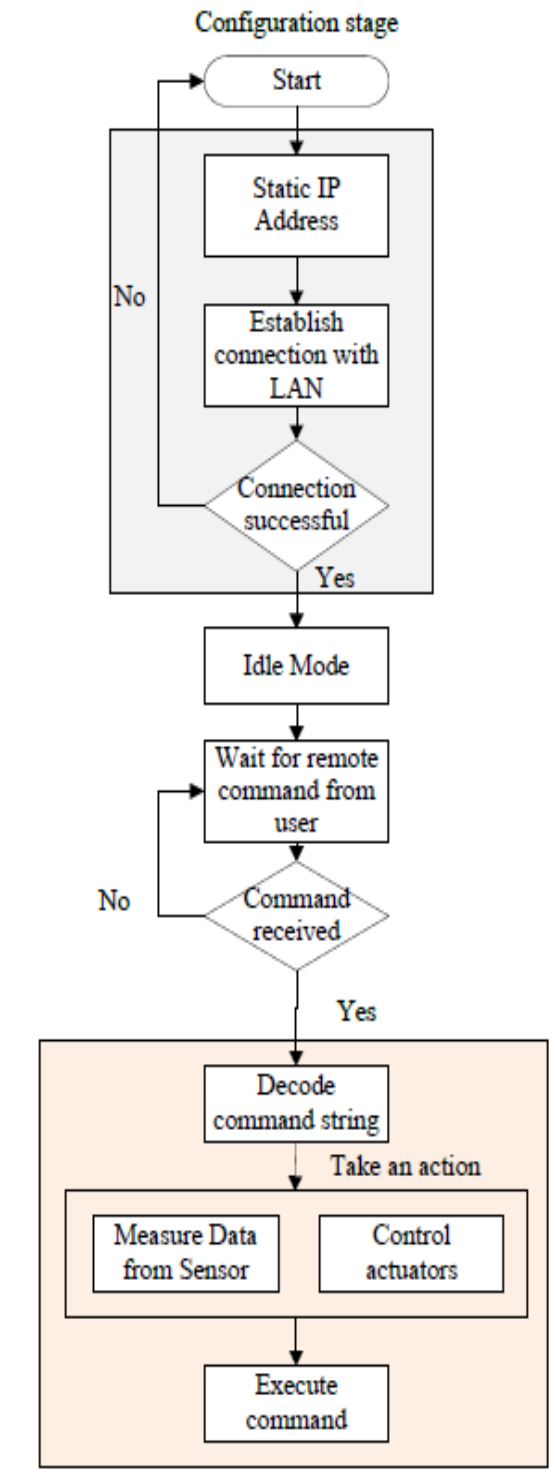
Figure: 4.2: Software Design

4.3: Android ADK

ADK stands for Accessory Development Kit. Android ADK is a hardware accessory that can be attached to your Android mobile device. These particular devices perform specific actions. For any USB accessories to be supported on particular device/devices then that device/devices must support for Accessory-mode, which is a special mode of connecting over the USB port and allows transferring the data between devices and external peripheral devices.

The ADK (Android Open Accessory Development Kit) is the implementation based on the reference of Android Open Accessory, which is based on the open source electronics prototyping platform of Arduino. The good thing is it provides accessory's hardware design files as part of the kit to help the hardware builders to get started building their own accessories.

The Arduino ADK is a microcontroller board based on the ATmega2560, which has a USB host interface to connect with Android mobiles, grounded upon on the IC named MAX3421e. The ADK's main hardware and software components include "Arduino Mega ADK" board, Arduino IDE which was designed to work with Android platform. The 'Arduino Mega ADK' board is a plagiaristic of the 'Arduino Mega 2560' board. The USB host chip allows us to connect any USB device to Arduino which we can later implement as an Android USB accessory.

Arduino have so many "Shields", which can be interfaced directly to any other versions of Arduino boards. ADK provides input and output pins so that you can implement your own "shields". With any Android device and the 'Mega ADK', you can built your own accessories by using different actuators and sensors, which may include a LED outputs, temperature sensors and light sensors, etc.
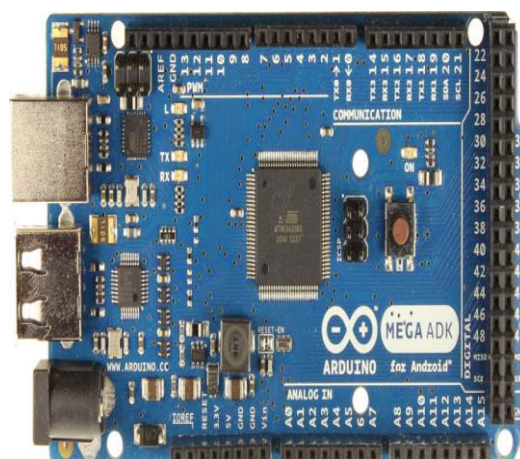

Figure 4.3: Arduino MEGA ADK

4.4 Android Open Accessory Protocol

This protocol allows any external USB hardware (in our case, Android USB accessory) to communicate with an Android device in a special mode called as accessory mode. If any Android-powered device is in accessory mode, then the coupled accessory acts as a USB host and the Android device plays USB accessory role. The Android Open Accessory Protocol allows detecting accessory mode supportable Android-power devices. But this mode is finally dependent on the device's hardware. So some devices doesn't support accessory mode.

This protocol support is included higher versions from Android 3.1 (API Level 12), and for the versions below 3.1 an external Library need to be added to support this protocol. Gingerbread (Android 4.1) and higher versions has support for audio output over a Bluetooth or USB connection. Any USB accessory of Android must obey to Android Accessory Protocol, it defines how an accessory is detected and setting up the communication with an Android device . Usually, an accessory must perform the following operations:

1. Wait for the devices and detect connected devices

2. Check that the connected device's supports accessory mode.

3. If needed, start the device in accessory mode

4. If it supports the Android accessory protocol then establish communication with that device.

This protocol version 2.0 adds two new features to the device: one is "audio output" which means from the Android device to the accessory and another one is support for the accessory acting as one or more HID (Human Interface Devices) to the Android device such as On-board amplifier.

4.5 Smartphone Application & Features

The Smart phone application which we had developed for home control and monitoring provides the following functions

1) Remote connection to the Home Environment.

2) Device Monitoring.

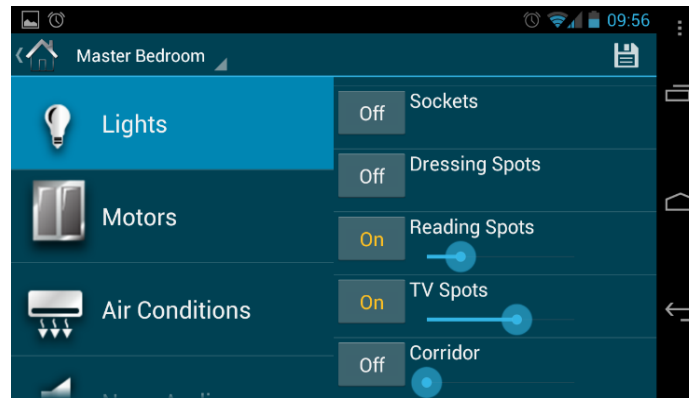3) Device control.

4) Managing schedule.

Figure 4.5: Smartphone GUI

5. APPLICATIONS

Following are the applications of Home Automation and Security System

- Tele-assistance/ Medical alert.

- For blind people it is more safe and precise control.

- Water leaks, gas leaks and detection of fire.

- Lights in the home will blink to alert the persons of the house to take any emergency steps if any smoke or fire is detected.

- Home owner or Fire offices or any alarm monitoring office get called by this system to alert/give information in case of emergency.

- After 10pm some appliances like fans, AC's, lights can be automatically turned off/on to save energy in residential and office buildings of major metropolitan cities

- In our home or office we can merge this system with security systems integration and controlling also it can have ability to lock all the windows and doors with in the range of our perimeter.

- By using this system we can control the security cameras to monitor the activities happening surrounding to our houses or office building by means of a touch panel or Monitor.

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- Via mobile phone or through the security systems, this system will inform you if any unauthorized movements occurs in our surroundings by using motion sensors

- Between multiple rooms this system has ability to provide communication through loud speaker and microphone

6. FUTURE WORK

Looking at the current situation we can build cross platform system that can be deployed on various platforms like iOS, Windows. Limitation to control only several devices can be removed by extending automation of all other home appliances. Security cameras can be controlled, allowing the user to observe activity around a house or business. Security systems can include motion sensors that will detect any kind of unauthorized movement and notify the user. Scope of this project can be expanded to many areas by not restricting to only home. It will be flexible to support various wired as well as wireless technologies like Bluetooth, Zigbee, Wi-Fi, World Wide Web.

7. CONCLUSION

Our prime objective is to assist handicapped/old aged people. This paper gives basic idea of how to control various home appliances and provide a security using Android phone/tab. This project is based on Android and Arduino platform both of which are FOSS (Free Open Source Software). So the overall implementation cost is very cheap and it is affordable by a common person. Looking at the current scenario we have chosen Android platform so that most of the people can get benefit.

The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the android phone and send control signal to the Arduino ADK which in turn will control other embedded devices/sensors. We have discussed a simple prototype in this paper but in future it can be expanded to many other areas

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