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 which 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.

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

1. 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. EXISTING SYSTEMS

Currently there exists no system at cheaper rates. Various systems are hard to install, difficult to use and maintain. Current systems are generally proprietary and closed, not very customizable by the end user.

1. Java-based automation system through World Wide Web integrated into a PC-based server at home:-In this system the drawback is PC should always on & connect to the server.

2. Home automation system by using Bluetooth:-This system drawback is limited range and limited no of devices to be connected.

3. Home automation system by using Zig bee:-This system is implemented based on Bluetooth. It overcomes some of the drawbacks of Bluetooth system but it is also lack of range.

4. Home automation system using GSM:-After rapid growth of GSM networks this system is implemented. Compared from above system 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.
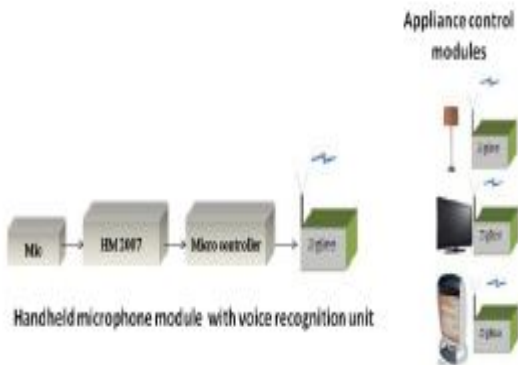
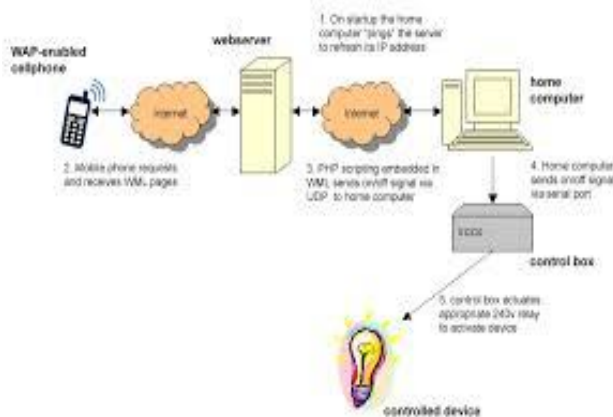**Figure 2.1:** Bluetooth Home Automation

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 flexibility and functionality in the literature survey, we designed and implemented a novel, standalone, flexible and low cost home controlling and monitoring system

The system consists of a micro Web-server based on Arduino Mega ADK with wifi shield, hardware interface modules and the Android compatible Smart phone app. The architecture presented in this work can be customized in different ways in order to accommodate different application scenarios with minimum recoding and design i.e. each time a new device is added to the micro Web-server, a new thread dedicated to the device is automatically created in the smart phone app. The architecture is divided into three layers: home environment, home gateway and remote environment
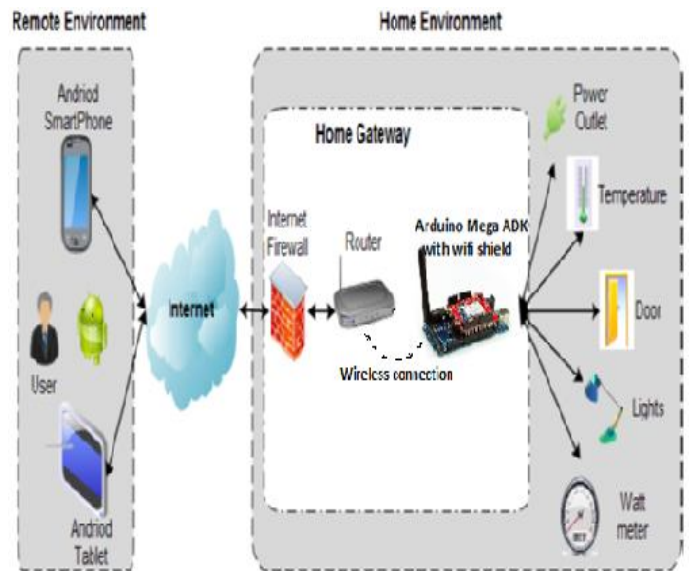

Figure 3: Architecture

4. IMPLEMENTTION

4.1: Android

For this home automation and security system we are targeting Android platform since it has huge market and open source. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. The Android OS is based on Linux. Android Applications are made in a Java-like language running on a virtual machine called 'Dalvik' created by Google. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Accessory mode is a feature of Android OS since version 2.3.4 Gingerbread and 3.1 Honeycomb and above.
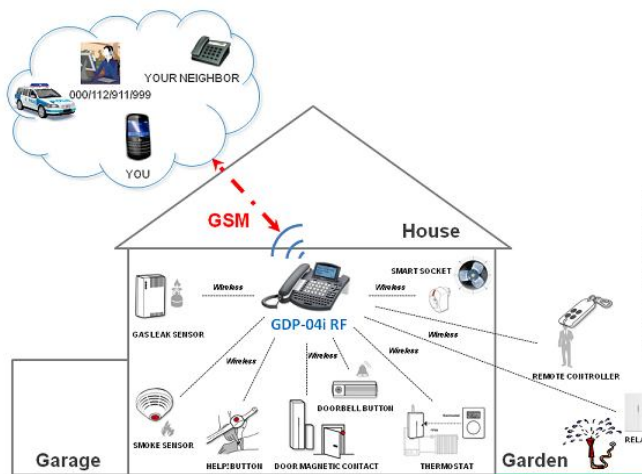
4.2: Software Design

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.

4.3: Android ADK

ADK stands for Accessory Development Kit. Android accessory is a physical accessory that can be attached to your Android device. These particular devices perform specific actions. For USB accessories to be supported on a particular device, there must be support for the accessory-mode, a special means of connecting over the USB port. This allows data transfer between devices and external peripherals.

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

The Arduino ADK is a microcontroller board based on the ATmega2560. It has a USB host interface to connect with Android based phones, based on the MAX3421e IC. The main hardware and software components of the ADK include 'Arduino Mega ADK', which was designed to work with Android. The 'Arduino Mega ADK' board is a derivative of the 'Arduino Mega 2560'. The host chip allows any USB device to connect to the Arduino which we will later implement as an Android USB accessory.

The ADK board provides input and output pins that you can implement through the use of attachments called "shields." With an Android device and the 'Mega ADK', you can use whatever sensors and actuators you require to create your own accessories. This may include a LED outputs, and temperature and light sensors.
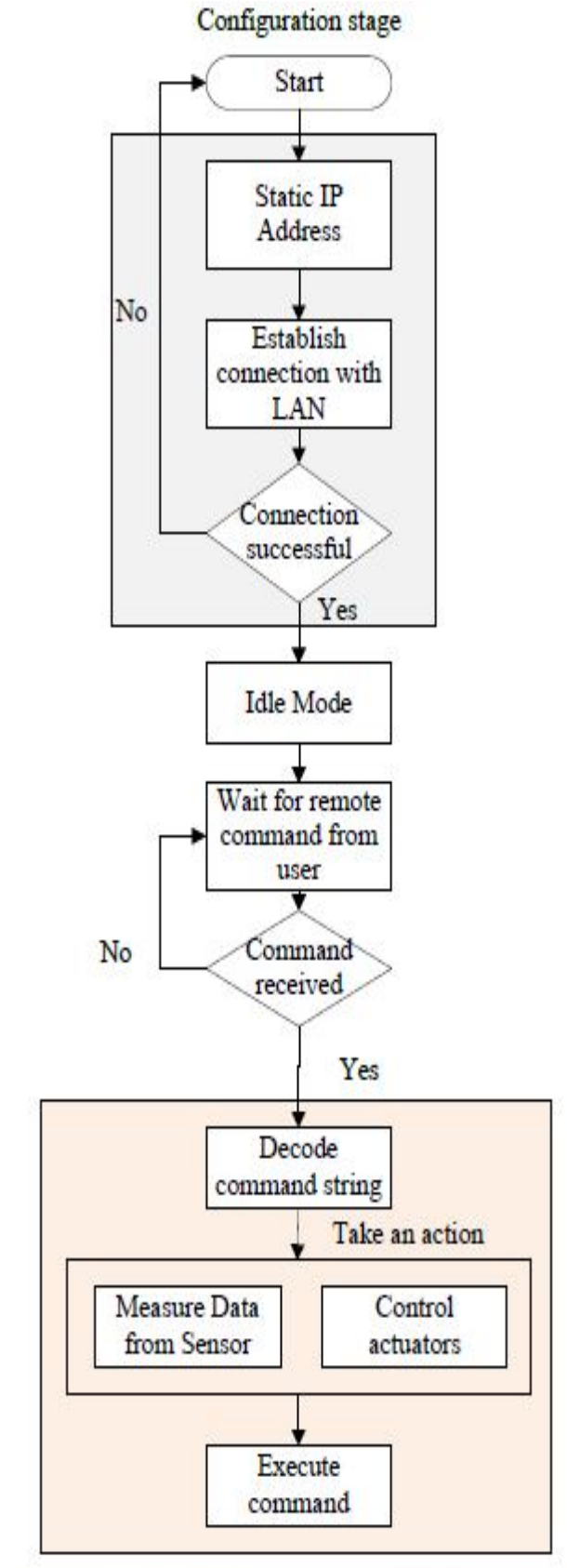
Figure: 4.2: Software Design
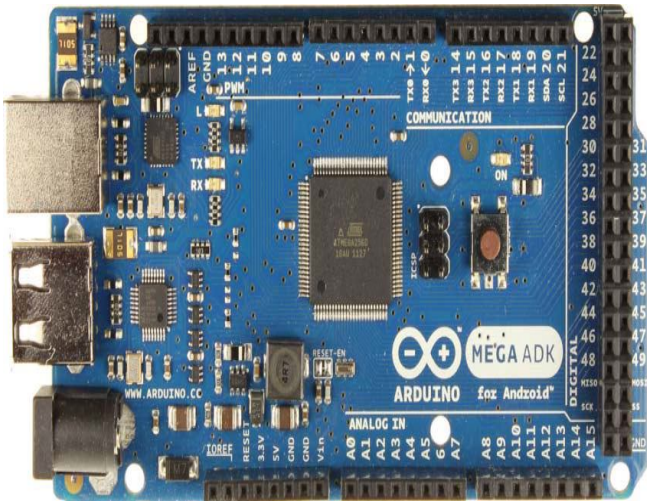
Figure 4.3: Arduino MEGA ADK

4.4 Android Open Accessory Protocol

Android Open Accessory support allows external USB hardware (an Android USB accessory) to interact with an Android-powered device in a special accessory mode. When an Android-powered device is in accessory mode, the connected accessory acts as the USB host (powers the bus and enumerates devices) and the Android-powered device acts in the USB accessory role. Android Open Accessory Protocol allows to detect Android-powered devices that support accessory mode. Accessory mode is ultimately dependent on the device's hardware and not all devices support accessory mode.

Android Open Accessory support is included in Android 3.1 (API Level 12) and higher, and supported through an Add-On Library in Android 2.3.4 (API Level 10) and higher. Android 4.1 and higher has support for audio output over a USB connection or Bluetooth An Android USB accessory must adhere to Android Accessory Protocol, which defines how an accessory detects and sets up communication with an Android-powered device .In general, an accessory should carry out the following steps:

1. Wait for and detect connected devices
2. Determine the device's accessory mode support
3. Attempt to start the device in accessory mode if needed
4. Establish communication with the device if it supports the Android accessory protocol.

The Android Open Accessory Protocol 2.0 adds two new features: audio output (from the Android device to the accessory) and support for the accessory acting as one or more Human Interface Devices (HID) to the Android device. on-board amplifier.

4.5 Smartphone Application & Features

The Smart phone app for home control and monitoring applications provides the following functionalities to the user:

1) Remote connection to the Home Gateway.
2) Device Control
3) Device Monitoring
4) Managing the Schedule

Below Figure shows the graphical user interface for controlling and managing the home environment using Smart phone.
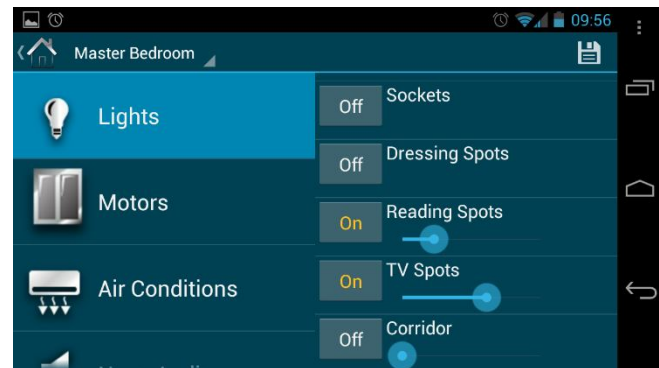
Figure 4.5: Smartphone GUI

5. APPLICATIONS

Following are the applications of Home Automation and Security System

- Medical alert / Teleassistance.
- Precise and safe blind control.
- Detection of fire, gas leaks and water leaks.
- Smoke detector can detect a fire or smoke condition, causing all lights in the house to blink to alert any person of the house to the possible emergency.
- The system can call the home owner on their mobile phone to alert them, or call the fire department or alarm monitoring company.
- In terms of lighting control, it is possible to save energy when hours of wasted energy in both residential and commercial applications by auto on/off light at night time in all major city office buildings, say after 10pm.
- Control and integration of security systems and also the potential for central locking of all perimeter doors and windows.
- Security cameras can be controlled, allowing the user to observe activity around a house or business right from a Monitor or touch panel.

- Security systems can include motion sensors that will detect any kind of unauthorized movement and notify the user through the security system or via cell phone.
- An intercom system allows communication via a microphone and loud speaker between multiple rooms.

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

ACKNOWLEDGEMENT

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