

Domestic Resource Management System in Residential Houses using Android Phone

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Abstract—As the importance of energy saving is increasing from past half century, many researches about the energy savings of information and communication technology have been presented. Providing residents with the usage of energy has become a feasible option to promote energy savings in residential sector. Similarly it is necessary to conserve water and control on its wastages, and check on domestic cooking gas usage and its leakage detection is also necessary. We have proposed a smart home management system, which will monitor all devices from anywhere, anytime the system allows the house owner to monitor and control his home appliances, water outlets and gas valve via his mobile phone. An Android application is developed for remote controlling the devices through which he can operate devices from anywhere. In this way conservation of energy can be made easily possible, giving rise to a complete home automation system with two objectives, one is conservation and second is safety purpose.

Index Terms—Home automation, WSN, gas leakage detection, smartphone, android application.

I. INTRODUCTION

Earlier, we looked into the face of future when we use to talk about automated devices, which could do anything on instigation of a controller, but today it has become a reality and part of daily life. An automated device can replace good amount of human working force, moreover humans are more likely prone to errors and in intensive conditions the probability of error increases whereas, an automated device can work with diligence, versatility and with almost zero error.

Home automation can be useful to those who need to access home appliances while they are away from their home and can incredibly improve the lives of the disabled. The home automation systems that are available can be categorized as: locally controlled systems and remotely controlled systems. Locally controlled systems are the systems that use an in-home controller for home automation. Through these systems the user can control his home devices within the home through a stationary or wireless interface. Globally-controlled systems are those systems that use an internet connection. Such systems can be controlled through mobile devices, personal computer, laptops etc. The problem of home automation system using Bluetooth, GPRS or RFID, they need a separate hardware and software environment to be installed in each home. Moreover these systems provide the user with limited access as the access area is restricted only within a specific range. Cloud Network and mobile devices eliminate the need to install and run applications on the customer own computers

and simplify the maintenance and support. This paper integrates the locally and remotely controlled systems with the use of the cloud network. Cloud Computing provides an access on demand to the resources online which requires less management effort and can be easily provisioned. This allows the system to operate without any dependence of a mobile provider, it allows the system to be used on various smartphones, and allows the system to operate locally when phone or computer access is unavailable.

II. LITERATURE SURVEY

As described in introduction there exist various energy monitoring systems that give information of the energy usage and its status. With the help of this information it becomes easy to have a control over energy usage. An Energy monitoring system using WSN in Residential Houses aggregates the energy consumption data of home appliances and visualizes it into comprehensible forms. Visualizing the fine-grained data enables residents to understand the details of their energy usage and use behaviour [1].

This paper is not referring only to conservation of energy but also other domestic resources water and gas. For monitoring water there exists a scalable water monitoring system capable of estimating water flow rate using wireless sensor network technology. It uses inexpensive vibration sensors attached externally to the pipes. This reduces both cost and effort of installation of system [2]. Thus by just detecting the flow of water from any of the outlets and taking a controlling action by closing that outlet will help to conserve water.

The another resource of interest is domestic cooking gas (i.e. LPG gas) considered as most inflammable and combustive, so to detect the gas leakage from safety point of view is necessary. A wireless safety device for gas leakage detection is proposed in this paper. The device is intended for use in household safety where appliances that use natural gas and liquid petroleum gas (LPG) can be a source of risk. The system also can be used for other applications in industries or plants that depend on LPG and natural gas in their operations. The system design consists of two main modules: the detection and transmission module, and the receiving module. The detection and transmitting module detects the change of gas concentration using a special sensing circuit built for this purpose. If the sensor detects a change in gas concentration, it activates an audio-visual alarm and sends a signal to the receiver module [3].

From application of proposed system controlling of these electrical devices should be easily accessible. For this purpose a home Automation using Cloud Network and Mobile Devices is designed by integrating multi-touch mobile devices, cloud networking, wireless communication, and power-line communication, we will be able to design and build a fully functional home automation system. It will allow the user to control various appliances and lights within their home from any location in the world through cloud network using 1) mobile devices, 2) PCs, or 3) in-home graphics user interface (GUI) on their home servers. Using this system as framework, the system can be expanded to include various other options which could include home security feature such as open-door and motion detection, energy monitoring, or weather stations [4].

Smart Home-Control and Monitoring System Using Smart Phone is a low cost and flexible home control and monitoring system using an embedded micro-web server, with IP connectivity for accessing and controlling devices and appliances remotely using Android based Smart phone app. A novel architecture for low cost and flexible home control and monitoring system using Android based Smart phone is proposed and implemented. Any Android based Smart phone with built in support for Wi-Fi can be used to access and control the devices at home. When a Wi-Fi connection is not available, mobile cellular networks such as 3G or 4G can be used to access the system [5].

Home automation is not just limited to monitoring of electrical appliances. Conservation of energy is a necessary but along with it there is necessity to conserve domestic water and gas. At present conservation of water and gas has not taken into consideration by other systems referred above. But these resources also play a vital role in our daily life. So by combining ideas of all above paper we propose a system which will monitor resources of our residential houses. The parameters that system will monitor are: Energy, water, gas, intruder etc. This system will monitor as well as control these parameters using an Android Smartphone for its conservation and safety the house.

• System Architecture for Cloud Computing

The Home automation system that use cloud computing is shown in fig. 1. This system consists of various blocks that are shown in fig. 1; they are:

1. Cloud Server
2. Client
3. Embedded System.

These blocks are explained below as follows:

A. Cloud Server

Cloud server is used for central storage. Centralization gives cloud service providers complete control over the versions of the browser-based applications provided to clients, which removes the need for version upgrades or license management on individual client computing devices. Cloud server contains user databases, glass fish sever, and glassfish is an open source application server which is designed to make the web services accessible in an efficient and easy way.

B. Client

This is the remote user who wants to automate home appliances by using android mobile device or the client pc. Android is a Linux-based operating system primarily designed for mobile devices such as smart phones and tablet computers utilizing ARM processors.

C. Embedded System

This system consists of microprocessor to which information from sensors will be integrated and stored. This information can be received with wireless communication like Infra-red, RFID, Bluetooth, WI-FI, Zigbee etc. The sensors read the information from devices and send microprocessor. Now from microprocessor, information is stored in for of database in local server (i.e. PC). Now this information will be available to web servers or user end devices with the help of cloud computing.

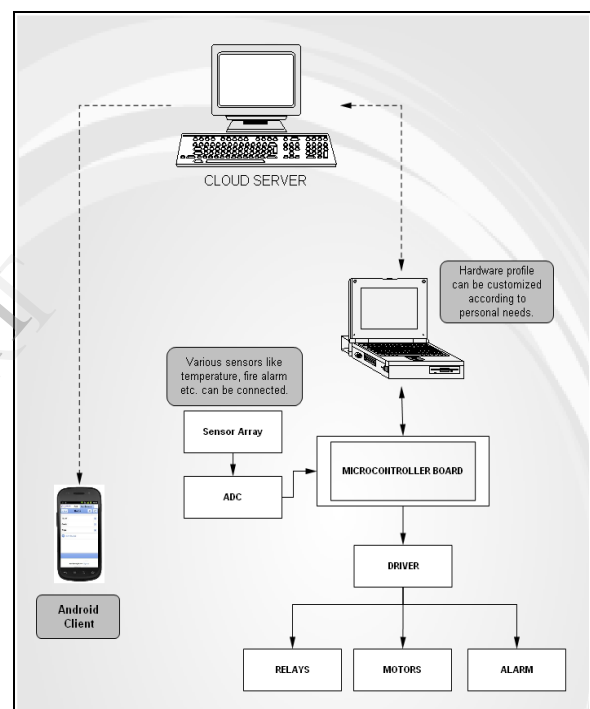


Fig. 1 System Architecture for Cloud Computing [4]

III. SYSTEM ARCHITECTURE

Home automation is a field within building automation, specializing in the specific automation requirements of private homes and in the application of automation techniques for the comfort and security of its residents. Although many techniques used in building automation (such as light and climate control, control of doors and window shutters, security and surveillance systems, etc.) are also used in home automation, additional functions in home automation can include the control of multi-media home entertainment systems, automatic plant watering and pet feeding, automatic scenes for dinners and parties, and a more user-friendly control interface.

This project implements a Visual Data Acquisition System with GPRS Networking capability using PIC microcontroller.

It implements an interface to a gas sensor, water leakage sensor, current transformer & voltage transformer [energy reading] and GPRS module.

For ease of design implementation I have divided block diagram into three modules:

1. Module 1 - Controlling unit for electrical appliances
2. Module 2 - Communication Network and
3. Module 3 - Automatic water and gas monitoring unit

The block diagram of proposed system is as shown in Fig. 1

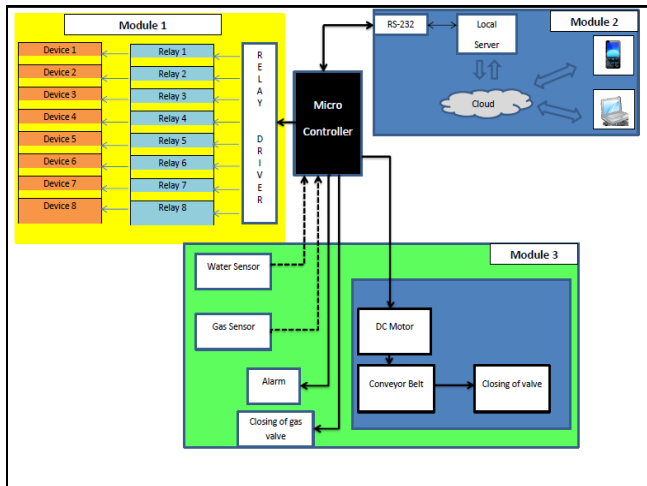


Fig. 2 System block diagram

A. Module 1 - Controlling unit for electrical appliances

Module 1 consists of electronic appliances that will be interfaced with relay drivers with microcontroller. Through these relays ON/OFF of electronic appliances that will be connected to this system is made possible. Now for monitoring and controlling purpose there will be a local server PC which will be connected to microcontroller via serial communication RS232. Now this PC will act as a local server from where controlling of appliances will be possible through a GUI which will be developed on this PC. This is the locally controlled system.

B. Module 2 - Communication Network

For the remote control of these appliances here we have developed an Android application through which status of the appliances along with its switching is made possible. The android phone will be connected to a local server PC through a cloud where the request for switching appliances will be put forward to microcontroller. This communication network created for monitoring and controlling of electronic appliances together make module 2 as shown in Fig. 2. The communication medium used is Wi-Fi which is very easy to install and easily available.

C. Module 3 - Automatic water and gas monitoring unit

This Module will be a complete automatic system that will control the gas and water parameters. This module will consist of a controller, a gas sensor MQ 5 and water level sensor and a mechanism to take preventive actions in case of

gas leakage and water flow. It will detect gas leakage and give alert regarding same on your Smartphone and an alarm which will ring if it detects any gas leakage. After detecting gas leakage automatically the main flow of gas will turned OFF so prevent situation from any Hazard. Same will be with water also.

In this way the proposed system is divided into three modules and implementation of these modules will take place in similar fashion.

IV. DESIGN IMPLEMENTATION

The proposed system consists of hardware and software architecture. For this design implementation is divided into hardware implementation and software implementation.

A. Hardware Implementation

Hardware of the system is divided into two modules:

- a. Module-1
- b. Module-3

a. Implementation of Module-1

We proposed Android controlled relay board system based on network technology for transmission of instruction from sender to receiver. Instruction sending and receiving is used for universal access of appliances and allowing breach control at home. This project include 8 relay Outputs and 4 optically isolated inputs. It can be used in various applications including load contact closure and external voltage sensing. Connection to the isolated inputs and relay outputs is via "pluggable type" screw terminal blocks. This control system is based on Android Mobile Application in network technology for transmission of Instruction from sender to receiver. Request sending and receiving is used for ubiquitous access of appliances and allowing breach control at home. The system proposes two sub-systems. Appliance control subsystem enables the user to control this remotely whereas the security alert subsystem provides the remote security monitoring. The system is capable enough to instruct user via Mobile Application from a specific Application id to change the condition of the according to the user's needs and requirements.

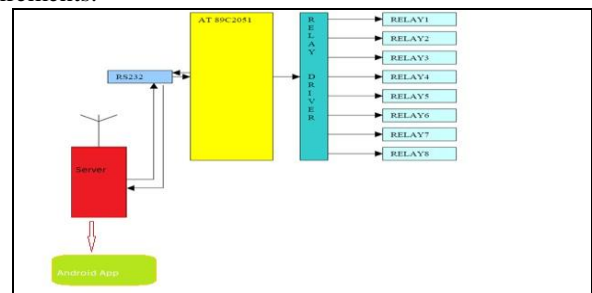


Fig. 3 Block diagram of Module-1

The second aspect is that of security alert which is achieved in a way that on the detection of intrusion the system allows automatic generation of SMS thus alerting the user against security risk. The block diagram of module-1 is shown in Fig. 3.

Assuming that the control unit is powered and operating properly, the process of controlling a device connected to the interface will proceed through the following steps:

1. The remote user sends text REQUEST from the Android application including commands to the receiver.
2. Sent messages is been updated to the centralized server of the Proposed system
3. Server receiver receives messages sent from the user android phone.
4. Server receiver decodes the sent message and sends the commands to the microcontroller.
5. Microcontroller issues commands to the appliances and the devices connected will switch ON/OFF.

The control unit will have the ability to connect to the cellular network automatically. The control unit will be able to receive text messages and will be able to parse and interpret text messages and instructions to be sent to the microcontroller. The microcontroller within the control unit will issue its command to the electrical appliances through a simple control circuit. The control unit will control the electrical appliances.

b. Module-3

This Module will be a complete automatic system that will control the gas and water parameters. This module will consist of a controller, a gas and water sensor and a mechanism to take preventive actions in case of gas leakage and water flow. It will detect gas leakage and give alert regarding same on your Smartphone and an alarm which will ring if it detects any gas leakage. After detecting gas leakage automatically the main flow of gas will turned OFF so prevent situation from any Hazard. Same will be with water also.

B. Software Implementation

Software is divided into two parts:

- a. For Slave i.e. Controller
 - b. For Master i.e. Smartphone
- a. Software Implementation for slave unit

The coding for slave unit is done using following algorithm, shown in Fig. 4.

The programming for controller is done using embedded development platform called Keil μ Vision. For coding we use C language using same software. The flow of this is explained as given below:

1. First controller will detect devices which are connected to relay circuit.
2. If device is detected it will go to next step or it will go back to previous step.
3. Controller will activate the relay circuits that are connected to take action like switching ON/OFF of devices, whatever we want.
4. Controller sends device status to GUI and then it will return back to step 1.

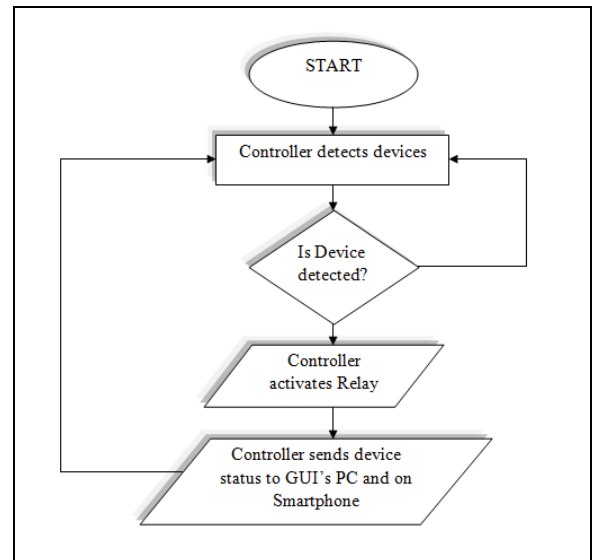


Fig. 4 Flowchart for slave unit

b. Software Implementation for Master i.e. Android Smart phone

Our goal is to build an Automated Home System which can be accessed or used using an android mobile device. This will help us to control our Home Appliances using simple mobile devices. The flowchart for developing an android application is shown in fig. 5. This application should automatically pass the instruction to the connected network system, which directly passed the instruction to the connected embedded system, which work using 8051 controller the application should have simple user interface and it should avoid resource intensive instruction parsing and methods.

When the user wants to control any device from his phone which is remotely available to the system, he launches the application on phone and login his individual ID. The application first get connected to the system using internet and information passed to the system connected to the embedded device, which control the power supply to multiple home appliances.

This architecture is developed using Eclipse, platform for developing JAVA using Android Development Kit.

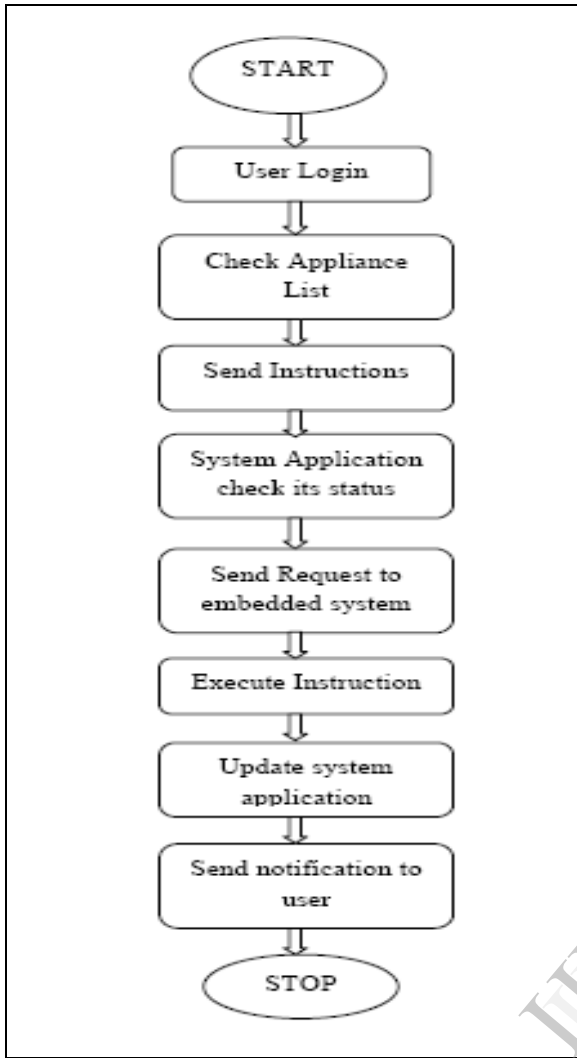
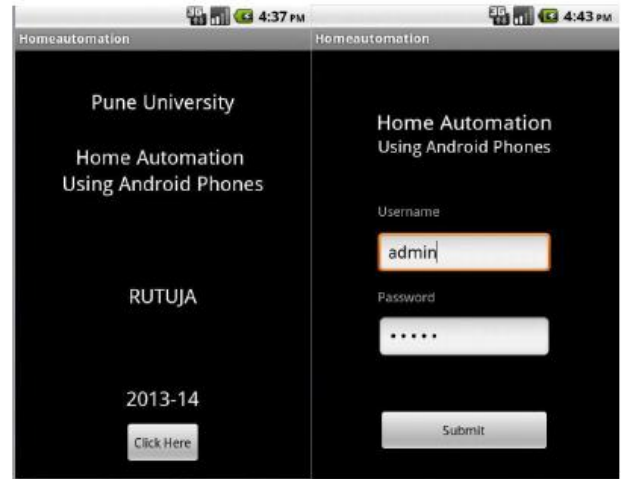


Fig. 5 Flowchart for Android application

V. RESULTS

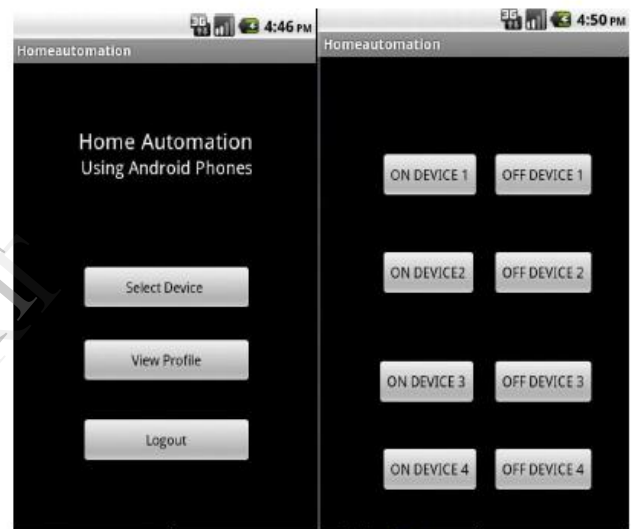
Android Application is developed using Eclipse, platform for developing JAVA using Android Development Kit. The result shows user interface screens using Android application

There are total five forms that are developed for Android Application.



(a) Welcome page

(b) Login page



(c) Menu

(d) List of devices



(e) User Profile

Fig. 6 Developed Android Application

First page is the welcome page of Android Application as shown in Fig 6(a). Second page i.e. Fig. 6(b) asks you for username and password for security reasons.

After entering username and password we come to third page shown in Fig. 6(c) which gives you three options:

1. Select Device
2. View Profile
3. Logout.

After selecting, "Select Device", you come to page four, Fig. 6(d) which consists of all devices that are connected to relay circuit. Any particular device can be made ON/OFF by just selecting appropriate option.

By selecting "View Profile", you will come to page number five, Fig. 6(e) which has details of user.

Now third and last option is Logout. After selecting this option you will again come to Login page.

VI. CONCLUSION

In the home automation system, by integrating multi-touch mobile devices, cloud networking, wireless communication, and power-line communication, we will be able to design and build a fully functional home automation system. From this following conclusions are drawn:

It will allow the user to control various appliances and lights within their home from any location in the world through cloud network using

- 1) Mobile devices,
- 2) PCs, or
- 3) In-home graphics user interface (GUI) on their home servers.

Here by using Wireless sensor network allows easy installation on old homes and changes required for controlling and monitoring system are less. Using WSN it will also reduce wiring of appliances with the home automation system.

With the use of cloud computing concept, the information of devices is stored in cloud so that it can be accessed remotely for monitoring and controlling of devices.

In our future work, we will introduce our system into residential homes and confirm the effectiveness of our system with respect to energy savings.

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