Controlling Home Appliances Using Embedded Systems

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Abstract— The vision of the system is to provide an efficient internet based system to control everyday home appliances. The system offers users an easy & effective means of controlling their various home appliances from a remote location i.e. without physically being present at home. The system makes use of the internet to enable remote access to the various home appliances. The web-controlled embedded system using mobile phone gives tremendous freedom to control devices during movements or away from site. This system is a economical setup which can be afforded by majority. The basic vision of the system is to provide a convenient & secure system to the user, which would aid the high degree of mobility & control, we aim to achieve now a days.

Keywords- HVAC, Embedded system, remote client, Ethernet, gateway, USB, IDE ports, Microcontroller, Home Automation System, World Wide Web, ADK

I.INTRODUCTION

The vision of the system is to provide an efficient internet based system to control everyday home appliances. The system offers users an easy & effective means of controlling their various home appliances from a remote location i.e. without physically being present at home. The system makes use of the internet to enable remote access to the various home appliances.

The Home Automation System will allow users to use any Internet web browser to remotely control their electric home appliances through a simple web page. The goal of this system is to develop a secure Web Based Home Automation System that will allow users to remotely operate electric home appliances, e.g. turning on/off lights, in the user's home.

The user interacts with the Home Automation System through a network, such as the Internet or a Local Area Network intranet by using an ordinary web browser. This will provide a user-friendly interface for the user to access and interact with the electric devices in the home.

Examples of practical uses for such a Home Automation System are many. These include; BULB Control, LED control, FAN control.

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. The concept of home automation has been around for a long time and products have been on the market for decades, though no one solution has broken through to the mainstream yet. 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

Recent advances in home technologies have fostered the rapid development of devices for smart home users. The Internet accelerated the availability of various appliances and devices in home that could

automate and process information for specific services required in smart home environment. In particular, these devices are aimed to comprehend efficient interoperation and integrating the smart home with cyber environment, especially with the Internet. A smart home is defined as an intelligent environment that is able to acquire and apply knowledge about its inhabitants and their surroundings in order to adapt and meet the goals of comfort and efficiency. The smart home also can be considered to be an augmented environment with the ability to offer home dwellers with the unprecedented level of access to information and assistance using cyber-physical systems. Recent expansion of services has been gradually transforming smart homes into a data cloud with many devices and appliances configured for specific domains.
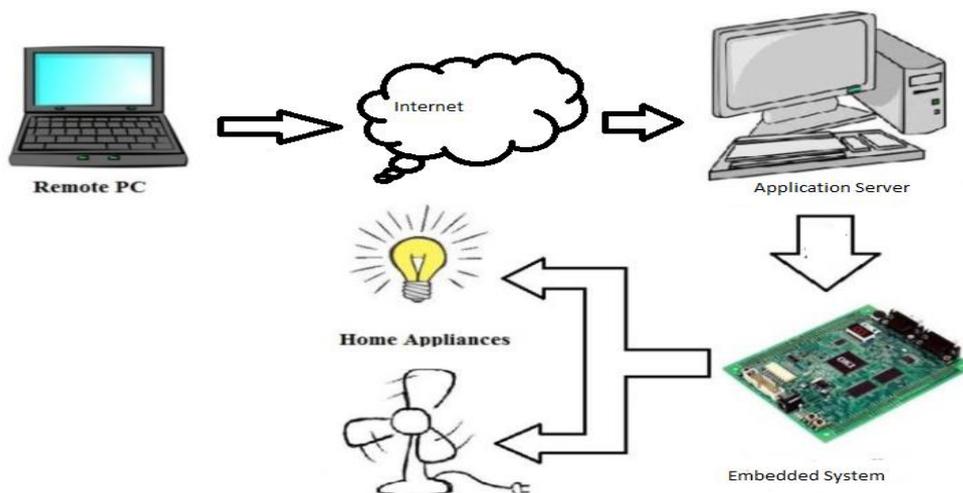

Figure.1 Home Automation Paradigm

This system is an integrated approach for effective web-service enabled smart home management systems. The proposed smart home management system able to support multiple services and devices integrated using embedded system. The embedded system is configured as residential gateway as well as interfacing with switching module and remote client. The residential gateway resides in the embedded system with a database module in the backend. The entire connectivity of the home management system takes place via Ethernet configuration. Ethernet is ideal for smart home environment due its performance in real-time as well as taking into consideration residential cabling of Cat5 that is readily available in homes. Ethernet has made its way to smart home environment due to its low cost implementation and wiring.

1.1 Embedded System
The home management system is developed using embedded systems delivering both storage and gateway functionalities. For smart home management system the embedded systems forms the central module which hosts the server, drivers and software engine. Functions performed are to integrate the associated modules of home management systems and as gateway. The system is configured using Windows 8.1 and Internet Information Services 6.0. .NET 2010 Framework 2.0 is installed and configured together with USB 2.0 ports as well as two IDE ports are sufficient for external device configuration. Using RS-232 connection, the embedded system is integrated with the switching module interfacing the home devices and appliances.
These embedded systems are ideal for home environment due to their characteristics and desirable features like:

a) Extensibility: their smaller modular size enables extension to various home applications like access points and surveillance systems as well as wide range of digital and analog I/O modules.

b) Scalability: Embedded system units have wide spectrum of CPU types that allows easy scalability towards better performances for various home applications

c) Power management: The requirement of many embedded systems is low enough and could provide 24x7 uninterruptible supplies. This is an important criterion for home management systems especially for safety critical sub-systems like health monitoring that need to be in continuous operation.

d) Invisible computing: Embedded systems could realize the prospect of invisible computing in smart home environment to become more realistic.

1.2 Microcontroller

The microcontroller used is the brain of the entire system. It will receive the commands executed on the remote server and compute the appropriate instructions to control the home appliances.

II.REVIEW OF RELEVANT LITERATURE

As per our survey 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.In this very busy world and when the technology is being used efficiently to conserve the time we cannot afford to spend so much of time for doing things manually which is very time consuming.

III.DESCRIPTION OF SYSTEM

In this system the user uses a mobile phone to communicate with the devices via sms / ringing technology by sending a sms or calling the dedicated number which is connected to the system which is purely based on mobile network which would be expensive in terms of cost as only one device can be connected to the system i.e peer to peer technology. To overcome this disadvantage we would use World Wide Web as the base to control multiple devices simultaneously which will provide greater efficiency and lower cost for the user.

The smart home management system in this project uses embedded system and client device that supports web browser, as remote terminal to access the software engine. This system offers a new approach to control home appliances from a remote terminal, with an option from a local server, using the Internet. This system is accomplished by personal computers, interface cards, microcontroller, along with window-type software and microcontroller control software. The system is designed to control home appliances' on/off the devices like Bulbs and Fan. 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.

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.

3.1 The design of home automation system using Arduino Development Kit (ADK)

The design is based on a standalone embedded system board Android ADK (Arduino development kit) at home. Home appliances are connected to the ADK and communication is established between the ADK and any internet based mobile device Personal Computer's 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.

Figure.2 Arduino Board

IV.MAJOR SUBSYSTEMS

Microcontroller(Arduino Duemilanove)

The Arduino Duemilanove ("2009") is a microcontroller board based on the ATmega168 or ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. "Duemilanove" means 2009 in Italian and is named after the year of its release. The Duemilanove is the latest in a series of USB Arduino boards. The Arduino Duemilanove can be powered via the USB connection or with an external power supply. The power source is selected automatically. 5V. The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

VB.NET

The tools that are used to design a system for a front end. The system has been designed using .NET 4.0 Framework with C#.

WAMP

”WAMP's name is an acronym for Apache HHTP Server, Mysql, PHP, Perl, WAMP requires only one zip, tar or exe file to be downloaded and run, and little or no configuration of the various components that make up the web server is required. Wamp's regularly updated to incorporate the latest releases of Apache, MySQL, PHP and Perl. It also comes with a number of other modules including OpenSSL and PHP MY Admin.

Self-contained, multiple instances of WAMP can exist on a single computer, and any given instances can be copied from one computer to another. It is offered in both a full, standard version and smaller version, Officially WAMP;s designers intended it for use only as development tool, to allow website designers and programmers to test their work on their own computers without any access to the internet.

PHP

PHP is accessible and available for free. Development of code in PHP is very quick and there is wealth of online information regarding PHP. A basic PHP script can be created without a firm understanding of programming principle, compilation, and other currently important programming concept. It runs on different operating system. Easy to access other web-based tools through PHP.

HTML

HTML stands for Hyper Text Markup Language . The purpose of a web browser (Chrome, IE, Firefox, and Safari) is to read HTML documents and display them. This browser reads the file and translates the text into a visible form, hopefully rendering the page as the author had intended.

V.EXPERIMENTAL RESULTS

5.1 Switching Module

One of the core modules for the home management system is the switching module that handles incoming signal for control and monitoring the home devices. The switching module is an expanded unit interfaced with the embedded system through the Ethernet connection. The functionalities of this module are listening to the incoming data, analyze, and perform triggering operation of the connected home devices via the smart home management system.⬜⬜The format of a feedback signal is Little-Endean; and the status signals are interpreted in binary. The programmed codes for switching module on both ON and OFF mode are shown in Table 1 and Table 2 below.

Table.1 Switching Module Control Codes

Binary Code	Hex	Digital Code
00	0	Bulb=OFF
01	1	Bulb=OFF
10	2	Bulb=ON
11	3	Bulb=On Fan=ON

Table.2 Status of the module

Interface	Status	
Bulb	ON	OFF
Fan	ON	OFF

The switching module is designed using an 8-bit microcontroller that is programmed for performing fetching mechanism of the incoming data from interfacing module and generate corresponding output switching signal. The form status and interface are shown in below Figure 3 and 4.
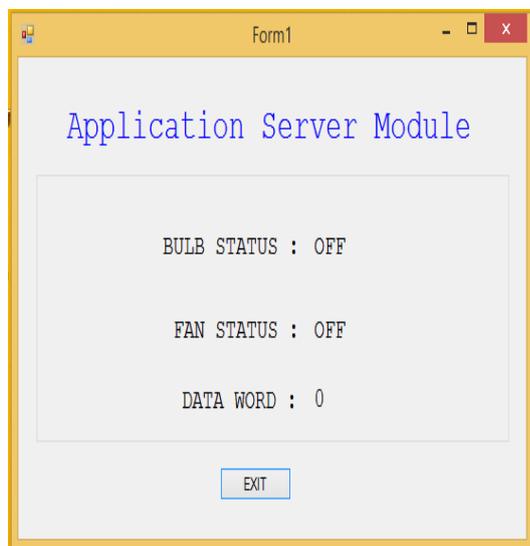

Figure. 3 Form Status

Figure. 4 Interface

VI.CONCLUSION

The system has a vast scope & almost limitless application in today's technology driven market. By wireless control of electrical appliances used in home/office, we have flexibility to make our living hood a comfortable. The web-controlled embedded system using mobile phone gives tremendous freedom to control devices during movements or away from site. The internet access using 3G technology gives a faster processing than GPRS. Therefore, most of the currently available mobile phones have 3G features. This system is a economical setup which can be afforded by majority. The system can be made efficient by modularizing each and every component of the system hence ensuring that it can be integrated with a varied range of devices. The basic vision of the system is to provide a convenient & secure system to the user, which would aid the high degree of mobility & control, we aim to achieve nowadays.

LIMITATIONS

The most significant limitation of the system is that it is completely dependent on the internet for the feature of remote access. In case of loss of internet connectivity, the user will still be able to control the home appliances directly from the Local Server using the GUI created for it.

For the system to function properly, all appliances must be connected to the main power supply at all times. If appliances are disconnected from the main supply, they can no longer be controlled by the user & that part of the system would be rendered non-functional.

VII.FUTURE ENHANCMENTS

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 system 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.

VIII.ACKNOWELEDGMENTS

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