

SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security

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Abstract

This paper mainly focuses on the controlling of home appliances remotely and providing security when the user is away from the place. The system is SMS based and uses wireless technology to revolutionize the standards of living. This system provides ideal solution to the problems faced by home owners in daily life. The system is wireless therefore more adaptable and cost-effective. The HACS system provides security against intrusion as well as automates various home appliances using SMS. The system uses GSM technology thus providing ubiquitous access to the system for security and automated appliance control.

Keywords: Short Message Service (SMS), Global System for Mobile communication (GSM), Radio Frequency (RF), AT Commands, ubiquitous access and Automation.

Introduction

The aim of the paper is to investigate a cost effective solution that will provide controlling of home appliances remotely and will also enable home security against intrusion in the absence of home owner.

The motivation is to facilitate the users to automate their homes having ubiquitous access. The system provides availability due to development of a low cost system. The home appliances control system with an affordable cost was thought to be built that should be mobile providing remote access to the appliances and allowing home security.

Home security has been a major issue where crime is increasing and everybody wants to take proper measures to prevent intrusion. In addition there was a need to automate home so that user can take advantage of the technological advancement in such a way that a person getting off the office does not get melted with the hot climate. Therefore this paper proposes a system that allows user to be control home appliances ubiquitously and also provide security on detection of intrusion via SMS using GSM technology.

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The next section will explain the related work; section 3 explains the proposed system, methodology and algorithm. Section 4 discusses the framework, working, characteristics, strengths and constraints of the system. Section 5 explains the results and section 6 is conclusions and the future work.

Related Work

Delgado, Picking, and Grout (2006) consider the problems with the implementation of home automation systems. Furthermore the possible solutions are devised through various network technologies. Several issues affecting home automation systems such as lack of robustness, compatibility issue and acceptability among the old and disabled people are discussed.

Ciubotaru-Petrescu, Chiciudean, Cioarga, and Stanescu (2006) present a design and implementation of SMS based control for monitoring systems. The paper has three modules involving sensing unit for monitoring the complex applications. A processing unit that is microcontroller and a communication module that uses GPRS modem or cell phone via serial port RS-232. The SMS is used for status reporting such as power failure.

In their paper, Conte and Scaradozzi (2003) view home automation systems as multiple agent systems (MAS). In the paper home automation system has been proposed that includes home appliances and devices that are controlled and maintained for home management. The major task is to improve performance.

In their paper, Alkar and Buhur (2005) propose an Internet Based Wireless Home Automation System for Multifunctional Devices. This paper proposes a low cost and flexible web-based solution but this system has some limitations such as the range and power failure.

Murthy (2008) explores primary health-care management for the rural population. A solution proposes the use of the mobile web-technologies providing the PHC services to the rural population. The system involves the use of SMS and cell phone technology for information management, transactional exchange and personal communication.

Jawarkar, Ahmed, Ladhake, and Thakare (2008) propose remote monitoring through mobile phone involving the use of spoken commands. The spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller on the basis of SMS takes a decision of a particular task.

Potamitis, Georgila, Fakotakis, and Kokkinakis, G. (2003) suggest the use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real-life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition.

Preliminaries

Home Appliance Control System (HACS)

Home appliance control system is based on GSM network technology for transmission of SMS from sender to receiver. SMS 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 home appliances remotely whereas the security alert subsystem provides the remote security monitoring. The system is capable enough to instruct user via SMS from a specific cell number to change the condition of the home appliance according to the user's needs and requirements. 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.

HACS system consists of the following components (shown in Figure 1):-

PC: This unit contains the software components such as the HACS System through which the appliances are controlled and home security is monitored.

GSM Modem: It is a hardware component that allows the capability to send and receive SMS to and from the system. The communication with the system takes place via RS232 serial port. Cell phone can be attached at the place of GSM hardware but it limits the hardware functionality such as sending or receiving of SMS.

Mobile Device: Cellular phone containing SIM card has a specific number through which communication takes place. The device communicates with the GSM Modem via radio frequency. Mobile user transmits SMS using GSM technology.

Framework Overview

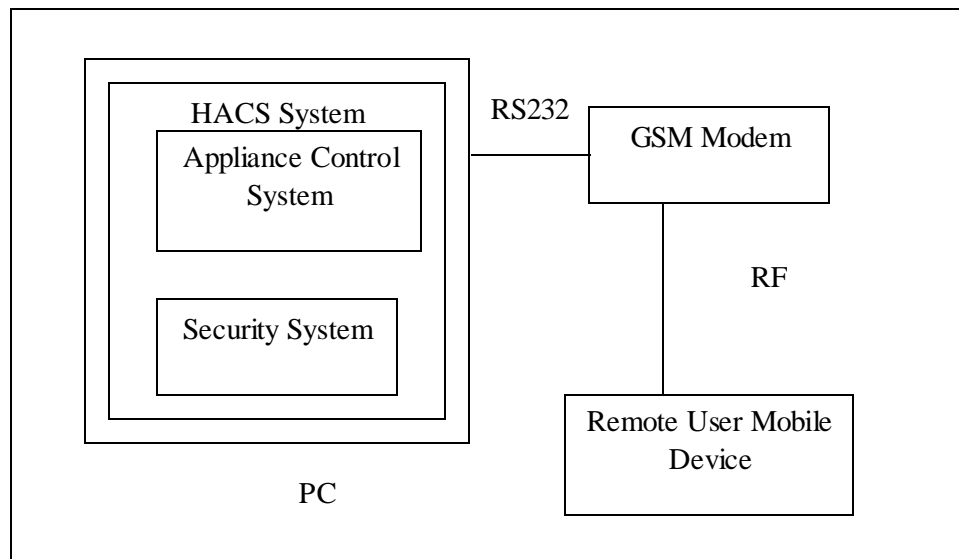


Figure 1: Model of HACS

Working

The working of HACS model (shown in Figure 1) is explained:-

PC: PC being the main module has HACS system installed on it. The two subsystems; one being appliances control is responsible for ubiquitous access of appliances and the second subsystem being security alert is responsible for security intrusion detection. Both subsystems work on GSM technology for transmission of instructions from sender to receiver.

GSM Modem: GSM modem is a plug and play device and is attached to the PC which then communicates with the PC via RS232 port. GSM modem is a bridge responsible for enabling/disabling of SMS capability.

Cell Phone: Mobile device communicates with the GSM Modem via radio waves. The mode of communication is wireless and mechanism works on the GSM technology. Cell phone has a SIM card and a GSM subscription. This cell phone number is configured on the system. User transmits instructions via SMS and the system takes action against those instructions.

Methodology

The methodology followed in the HACS is given as:-

- GSM hardware tests are run in order to check the hardware support. The system will call GSM modem and it will get activated.
- After activation the Modem will check for hardware support. If the hardware is missing or some other hardware problem there will be error, resulting in communication failure and the application will be terminated.
- If hardware responds then the serial port will be opened for communication and GSM hardware will allow transmission of SMS.
- The system will then connect and after connection establishment the system will be able to detect intrusion and will alert user about the breach and similarly the system will update status of appliances by receiving SMS from the pre-defined cell number.
- SMS will be silently ignored if cell number is unauthorized.

Pseudo code

The pseudo code for HACS is given as:-

begin

 Run Tests

 If Test = 0

 Terminate program

 If Test = 1

 Communication = OK, port will open

 Click Connect

 Controls {C_j | j=1, 2, 3, 4} = enable

 If intrusion = 1

 Send security alert

 If incoming SMS = 1

 Simulate appliances

end

Characteristics of HACS

The proposed system characteristics involve remote controlling of appliances, intrusion detection, system security and auto-configuration such that system automatically adjusts the system settings on running hardware support check. The system has useful features such as displaying of battery level, charging status and signal strength of the mobile thus making system reliable.

Strengths of HACS

HACS system has many advantages such as remote controlling of home appliances, availability and ease of users. The user can get alerts anywhere through the GSM technology thus making the system location independent. The system contains low cost components easily available which cuts down the overall system cost.

Moreover system alerts user about breach via SMS providing home security also it allows secure access due to pre-configured number. The ease of deployment is due to wireless mode of communication. GSM technology provides the benefit that the system is accessible in remote areas as well. The system reliability increases due to the useful features such as battery level checking, charging status and signal strength indicating the system about threats. The system integration is

simple and is also scalable and extensible. The auto-configuration capability allows the system auto enabling/disabling of certain features.

Constraints of HACS

The system functionality is based on GSM technology so the technological constraints must be kept in mind. The system is vulnerable to power failure but this disruption can be avoided by attaching the voltage source thus allowing users to avail the great advantage of this system.

Results

The results of the HACS system:-

Figure 2 shows various GSM hardware tests that will be run to check the hardware support.

The system then opens the serial port for communication with the GSM modem. On successful port opening the system communicates with the GSM Modem but if fails system does not communicate.

The system checks support for battery level, signal strength and GSM modem SMS sending and receiving capability. If these tests succeed the system gives response of 'Ok', if not then 'ERROR' is returned.

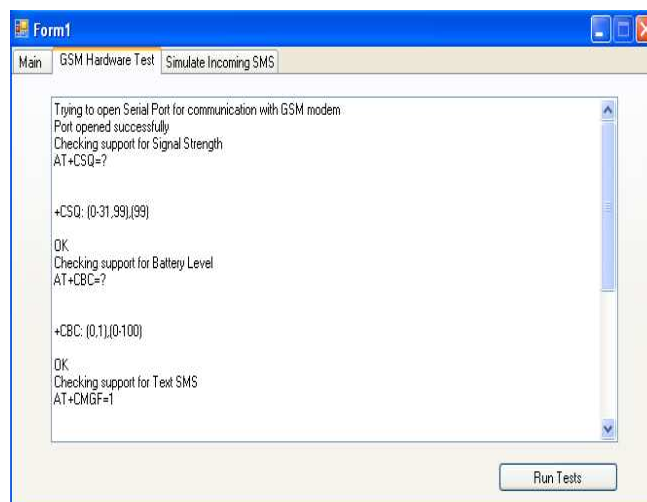


Figure 2: GSM Hardware Test

Figure 3 shows that a particular home appliance is simulated on the reception of SMS sent by the remote user.

The remote user sent SMS from a pre-configured cell number on the HACS system to turn on the sound alarm and the system performed the respective function by simulating the alarm to green color as directed by the user.

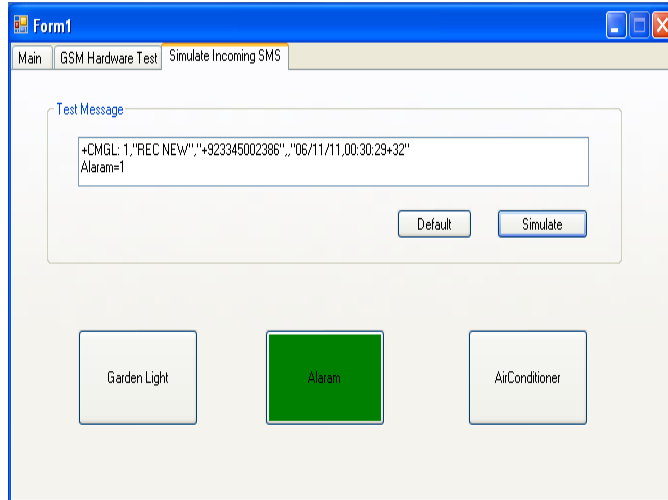


Figure 3: Simulation of Home Appliance

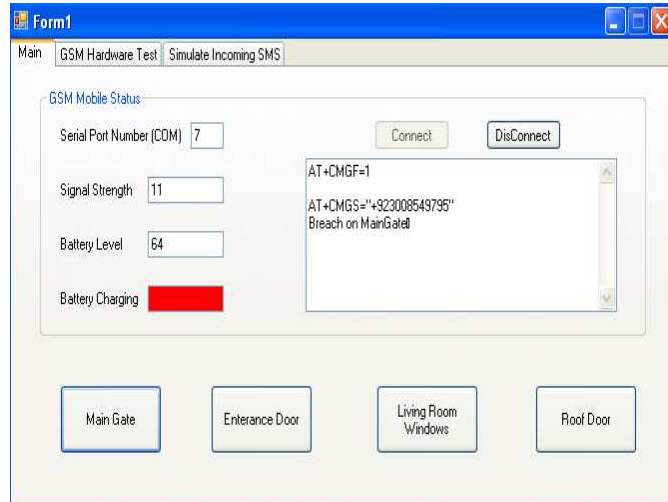


Figure 4: SMS alert on Intrusion Detection

Figure 4 shows the result when the event of intrusion was triggered then the system automatically generated SMS to inform the user about the security risk.

The system is constantly monitoring the battery level, charging status and signal strength. In Figure 4 is illustrating that the communication between system and GSM hardware device is taking place via COM port 7.

The tabulated results are presented in Tables 1 and 2.

Table 1: Appliance Control Sub-system

a. Results of Appliance Control Subsystem:

APPLIANCE	SMS INTRUSION SENT BY USER	SYSTEM RESPONSE
Air Conditioner	Air Conditioner = 1	AC button simulated to green
Alarm	Alarm = 0	Alarm button simulated to red
Light	Light = 1	Light button simulated to green

Table 2: Security Alert Sub-system***b. Results of Security Alert Subsystem:***

APPLIANCE	SYSTEM ACTION	ALERT SMS RECEIVED BY USER
Main Gate	Intrusion detected on Main Gate, SMS generated to user	SMS received "Breach on the main gate"
Entrance Door	Intrusion detected on Entrance Door, SMS generated to user	SMS received "Breach on the Entrance Door"
Living Room Windows	Intrusion detected on Living Room Windows, SMS generated to user	SMS received "Breach on the Living Room Windows"
Roof Door	Intrusion detected on Roof Door, SMS generated to user	SMS received "Breach on the Roof Door"

Achieved analytical results:-

- System allowed the provision of security such that system took no action against the instructions received from unauthorized number. The required task was performed only when the pre-configured number instructed the system.
- System sent breach alert when the intrusion was detected.
- Remote Controlling capability of the system allowed user to switch on/off through simulating the appliance as directed by the incoming SMS.
- The system automatically performed tests and checked support for available features and SMS sending and receiving capability and configured system accordingly.

Conclusion and Future Work

In the paper low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution for automation of homes has been introduced. The approach discussed in the paper is novel and has achieved the target to control home appliances remotely using the SMS-based system satisfying user needs and requirements.

GSM technology capable solution has proved to be controlled remotely, provide home security and is cost-effective as compared to the previously existing systems. Hence we can conclude that the required goals and objectives of HACS have been achieved.

The basic level of home appliance control and remote monitoring has been implemented. The system is extensible and more levels can be further developed using automatic motion/glass breaking detectors so the solution can be integrated with these and other detection systems. In case of remote monitoring other appliances can also be monitored such that if the level of temperature rises above certain level then it should generate SMS or sensors can also be applied that can detect gas, smoke or fire in case of emergency the system will automatically generate SMS.

In future the system will be small box combining the PC and GSM modem. This hardware can be imported from Taiwan and Singapore. The hardware will be self contained and cannot be prone to electric failure. This appliance will have its own encapsulated UPS and charging system.

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Biographies



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