UNIVERSITI PUTRA MALAYSIA

MULTIMEDIA INTERFACE IN SMART HOME MONITORING

YAAKOB BIN MANSOR

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of Requirement for the Degree of Master of Science

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To my parents, wife, son, brothers and sisters

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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April 2002

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Smart home environment monitoring systems will incorporate more and more multimedia information and technology, bringing a sense of visual reality into the control room and providing more effective communication using a richer vocabulary of media This is a prototype system where the top 80%, approximately, of the window is associated with the console-based interface and the bottom 20% with the command based interface

This Multimedia Interface (MUI) prototype is to convey as much possible information in the main screen display as possible, without forcing the user to burrow down through different layers of screens or menus Secondly to facilitate user-initiated changes to the system with minimal mouse/keyboard action (console) or keyboard (command-based) action on the user's part Lastly to facilitate rapid learning on the user's part, and to couple the visual feedback of both systems so that

command-based system changes are indicated on the console-based system and vice-versa

The console-based interface is activated by clicking on the appropriate widget like buttons in most cases, check boxes and radio buttons for a few systems The prototype command-based interface includes an edit box at the extreme bottom of the screen, where the user can type a command The user then clicks on the "Process Command Line" button to execute the command Immediately above the edit box is a list box (read only) in which the user's command is duplicated, and then followed by the program's response

The results are based on analytical results, questionnaire analysis and console and command based interface results From the results tell that the prototype interface is very easy to use, and that no real major changes need to be made in order to increase learn ability The analysis also showed that the open standards and security is a priority of designing the multimedia interface of smart house

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

ANTARAMUKA MULTIMEDIA DALAM PENGAWALAN RUMAH PINTAR

Oleh

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Sistem pengawalan persekitaran rumah pintar menggabungkan lebih banyak maklumat multimedia dan teknologi, membawa pancaindera berkenaan realiti maya terus ke bilik kawalan dan menyediakan perhubungan yang berkesan menggunakan saluran kata kosa yang pelbagai. Sistem model prototaip ini, 80% daripada bahagian atas keseluruhannya adalah berkenaan antaramuka berasas-panel kawalan sementara 20% lagi dibawahnya adalah antaramuka berasas-arahan.

Model prototaip antaramuka multimedia ini untuk membawa sebanyak mungkin maklumat kepada paparan layar utama, tanpa memaksa pengguna bersungguh-sungguh mencari kelainan menerusi setiap lapisan layar atau menu. Seterusnya untuk memudahkan pengguna memulakan perubahan pada sistem secara minimum bagi aksi tetikus/papan-kekunci (panel) atau papan-kekunci (arahan). Akhir sekali untuk memudahkan pengguna memahami secara pantas dan mendapatkan

maklumbalas daripada kedua-dua sistem tersebut supaya sebarang perubahan pada sistem berasas-arahan dipaparkan terus pada sistem berasas-panel dan sebagainya

Antaramuka asas-kawalan diaktifkan dengan menekan alat kecil seperti butang, kotak pemeriksaan dan butang 'radio' bagi sesetengah sistem Antaramuka asas-arahan model percubaan pula mengandungi kotak suntingan yang terletak pada penghujung bawah layar tersebut, dimana pengguna boleh memasukkan sebarang arahan Pengguna boleh menekan butang pada "Proses Arahan" untuk melaksanakan sebarang arahan Kotak senarai (nilai bacaan sahaja) yang terletak di atas kotak suntingan akan menyalin arahan pengguna dan ianya bertindak serta-merta, diikuti dengan tindakbalas program

Keputusan adalah berdasarkan keputusan secara analitik, analisa soalan yang diedarkan dan keputusan berdasarkan ujian antaramuka asas-panel dan juga asas-arahan Keputusan menunjukkan model percubaan adalah sangat mudah digunakan dan tiada perubahan besar diperlukan untuk menambahkan keupayaan pembelajaran Analisa juga menunjukkan piawaian terbuka dan ciri keselamatan menjadi keutamaan dalam merekabentuk antaramuka multimedia bagi rumah pintar

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I certify that an Examination Committee met on 26th April 2002 to conduct the final examination of Yaakob Bin Mansor on his Master of Science thesis entitled "Multimedia Interface in Smart Home Monitoring" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981 The Committee recommends that the candidate be awarded the relevant degree Members of the Examination Committee are as follows

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LIST OF ABBREVIATIONS

MUI	Multimedia User Interface
PC	Personal Computer
LCD	Liquid Crystal Display
ATM	Automatic Teller Machine
VCR	Video Cassette Recorder
TCP/ IP	Transmission Control Protocol / Internet Protocol
HTML	Hyper Text Markup Language
TRIUMF	Technology-based Remote Interviews Under a Multimedia Framework
DSL	Digital Subscriber Line
IP	Internet Protocol
3D	3 Dimensional
I/O	Input/Output
VRML	Virtual Reality Modeling Language
IrDA	Infrared Data Association
MIDI	Musical Instrument Digital Interface
USB	Universal Serial Bus

CHAPTER I

INTRODUCTION

Introduction to Smart Home Interface

With the increasing use of more and more complex technology in the home the need to facilitate the ready use by everyone of this technology becomes paramount Smart homes, or home systems, potentially compound the problem by integrating many traditionally stand-alone systems and devices giving vast arrays of options and control parameters to the user

The problems may be described by some simple scenarios, which the users may like to apply to their own home, with a typical modern family home inserted The scenarios like a family home have a feature where number of principal rooms is 7 (Note 4x bedroom, living room, kitchen, dining room), average number power outlets per room is 4, average number light fittings per room is 2 and average number windows per room is 2 (for curtain control) Sub-total number of simple devices is 56, for on/off control only The issue then is how does the smart house designers offer these more than 56 control options to the user in such a way that the system is easy and efficient to use This is not simply a question of usability but effects the whole commercial viability of the integration of technology in the home People generally do not want home automation They do not want to live in a space that appears to be doing things around in a way that they perceive as unpredictable However many people would like greater and easier control over their home and a more efficient use of energy within it Hence, for smart house systems, offering

control to the user is vital but this must be seen as making the control of the home environment easier Fortunately with careful design the very complexity and capability of the technology can be employed to simplify the user interface

The concept of smart homes is not new For more than a decade, control systems in buildings have been applied in office blocks Smart homes save energy and help the environment through intelligent control of lighting, heating and cooling A smart home can protect your family and possessions from an increasingly violent and crime-ridden society through sophisticated security and surveillance systems Home theater systems allow you to enjoy music and video from anywhere in your house The elderly and disabled can have full control of the home from their fingertips Unlike stand alone technologies, such as fax or PC, that were also first applied in office environments, smart home technology has not yet, in the short time it has been around, been applied in private homes Several reasons have been mentioned for this phenomenon However, demonstration homes built in small numbers in some Northern European countries seem to have recently attracted a considerable amount of attention from the media (Berlo, 1999)

Recent technological advances have made it possible to design multimedia interfaces of ever-increasing flexibility and complexity It is well known that humans learn and make effective decisions through association and reinforcement Multimedia technology allows a set of data to be presented to a human via different mediums It has been estimated that humans remember 20% of what they see, 30% of what they hear, 50% of what they see and hear, and 80% of what they see, hear, and do simultaneously Effective use of multimedia information will result in more

informed decision-making, safer and more economical operation, and increased productivity (Benson, 1996)

The integration of multimedia information will play an important role in future smart home systems The addition of multimedia is of little use without proper multimedia data management and communication techniques to organize, retrieve, present, share, and analyze data This research contribution is in addressing these issues, which are based on the needs and requirements of smart home users

Objectives

In this research, several objectives for enhancing the smart home monitoring by utilizing multimedia technologies is proposed

1 To study specific standard and exploiting the technologies used in smart home systems
2 To design a prototype system describe empirically based principles that multimedia user interface designers can employ to create applications that improve the likelihood that people will learn

Thesis Organization

The thesis consists of six chapters Chapter I present an introduction about the multimedia interface in smart home Chapter II presents a literature review on various aspects related to the remote monitoring system via Internet and multimedia interface management Chapter III describes the methods used to develop the system Chapter IV gives the model implementation of the system The system's performance and results are discussed in Chapter V Finally, the thesis concluded in Chapter VI with the summary, the conclusions and future research directions

CHAPTER II

LITERATURE REVIEW

Smart Home Interface

Smart home technology is the integration of services and technologies, applied to homes, flats, apartments, homes and small buildings with the purpose of automating them and obtaining an increase in safety and security, comfort, communication and technical management Imagine you have a home fitted with a variety of sensors and electronically operated devices For example windows and doors might be fitted with switches that indicate when they are open, each room might contain a temperature sensor, which measures the air temperature and a light detector in each room might sense when the lights are on

A home or working environment, which includes the technology to allow for devices and systems to be controlled automatically, may be termed a smart home (Smart Home Forum, 2001) The concept of smart homes is not new for more than a decade, control systems in buildings have been applied in office blocks After years of trials, demonstrations, creative design and standardization efforts we can now experience an accelerated pace in implementing some kind of intelligence in buildings One of a smart home system component concept is about user interface

The degree to which this interface controller is exercised is variable, being a function of the cost, the person's own wishes, and the type of home into which the

technology is to be installed Homes which can automatically adjust the temperature, the level of security and permit efficient communications to the outside world, are of obvious benefit to all, providing they do not go too far and affect the freedom of choice of the person living within them

User interfaces allow the user to interact with the system by sending information to the controller or by presenting information to the user about the system The form and capabilities vary widely, depending on the system and the type of user interface Issue like a direct commands to the system (such as "turn on the kitchen lights") and obtain feedback from the system (such as the temperature of the bedroom, via a thermostat) will be highlighted Program the controller to carry out certain functions automatically, based on time, sequence, or conditions Some controllers may have an integral user interface (like the keyboard on a computer), or there may be remotely located user interfaces with varying degrees of built-in intelligence (such as wall-mounted or hand-held keypads) A dumb keypad is only used as a remote user interface for a controller A smart keypad might function as a remote user interface for a controller, but also could have enough on-board intelligence to issue its own commands to certain controlled devices, hence it could function as both user interface and controller (Cooper et al , 1999)

Similarly, a user interface device does not have to be entirely devoted to user input and/or feedback For example, a keypad might incorporate a temperature sensor or a light dimmer within the same physical enclosure

A user interface may accept a variety of user input types Keystrokes or button presses are the most common modes of entering data, but some systems may accept

voice input or other forms of communication. Not all controllers have a "user" interface. Some specialized controllers may simply use input from sensors (or other equipment) and make intelligent decisions based on that input.

Typical user interface devices include push-button panels, with or without visual displays, touch-panel displays, with fixed or programmable screen layouts, computer keyboards and monitors, hand-held remote controls, telephone interfaces to allow long-distance remote control and lastly television controllers with on-screen menus.

Many high-level home automation systems are hybrid systems, using a variety of user interface devices, each suited to certain tasks. For example, some systems might allow you to carry out all control, programming, and feedback functions from a personal computer, but might limit the number of functions available from a hand-held remote control unit or a wall-mounted push-button LCD panel.

Don't confuse user interfaces with sensors. Even though there can be some overlap in function (both can accept "input" from a user), a user interface is designed to provide a means of conscious, intentional interaction with the system. For example, a home automation system might use an infrared motion sensor to determine when enter a room and automatically send the equivalent of a button press to turn on the room lights or to trigger a whole sequence of events, but it is something that happens automatically, without any conscious choice on the part of the user.

Berlo (1999) described the user interface is the single component in such systems, upon which everything else will be judged. If the interface is confusing and badly

designed, the system will be thought of in that way Indeed, to make such systems appear simple is an extremely complex goal to achieve It is, nonetheless, very important to do so Whilst the implementing technologies may be, at heart, similar, the interface must be appropriate to the special needs of the user A person with mental impairment may require a less complex screen, presenting him or her with limited, and simpler choices at one time The use of a greater number of menus may be necessary, as may be the use of alternative indicators such as pictures or icons Such a person, in common with those having head injury problems, may benefit from systems, which make certain choices for them or suggest actions Artificial Intelligence is often employed in these cases

The user interface should be consistent with all the applications the user may employ from time to time Hence, the "look and feel" of the system should be the same whether they are accessing their environmental control system, their communicator, their telephone, their local ATM machine etc Such a requirement presents a great challenge to the interface designer, requiring the involvement of various engineers, human factors specialists and of course, the users themselves

Cooper, et al , (1999) proposed a HS-ADEPT project where the central design concept of the project was to realize a system where a portable user interface appropriate to the users' abilities could remotely control anything that was connected to their home system A range of different user interfaces could be made available and the one that best suited the users' needs selected at time of purchase The issue then in designing a universal remote control, as envisaged, is how to offer simple control over the complex system Thus the project's development of the user