Smart home research paper

Technology, Internet

Introduction

The field of Information technology has been developing in the recent past at a very fast speed. Information Technology not only makes work easier and more convenient but also ensures that there is safety and accuracy. Information Technology is being applied in almost every part of our daily lives. A smart home is one example of how technology can be used to make work easier and life more comfortable. In our study we are going to consider a smart home or automated home where almost everything is automated. In a smart home, the lighting system, ventilation and air conditioning system, opening and closing of doors and windows, irrigation, pet-feeders and the security system are all automated. The study is going to be based on how to implement a smart home by bringing the different components together and ensuring that they function as a single unit to realize the goals of a smart home.

Smart home also called domotics involves installing a high tech communications system in the home so as to achieve automation of activities. Home automation may include having centralized system to control the lighting, heating, ventilation, air conditioning and electric appliances in order to provide convenience, security, comfort and increased quality of life. An automated home is very essential for the disabled and the elderly who cannot go about carrying out all the house chores. A smart home system interconnects all the electrical appliances in the home to the central monitoring system. Some of the activities which are automated in a home include, home entertainment systems, changing the ambiance of scenes for different events,

pet feeding, lighting systems, heating systems, ventilation systems, air conditioning systems, burglary detectors, cloth removers and yard watering. Devices used in a smart home are interconnected through a computer network so as to enable the central monitoring and control of the systems. The smart home system should also allow for remote access from the mobile phone or from the internet. A web-enabled home will allow you to check the status of your home and control some activities via the internet. A smart home is capable of sending you a message about movements in the house, places accessed in the house and the general condition of the house.

In our study, we are going to consider the design of a smart home. Under the design and implementation, we are going to take into consideration the following:

i. Hardware and software requirements.

ii. Technical specifications for the hardware and software used to achieve the design objective

iii. Details of human-computer interface and hardware and software interface

iv. Technical details of different sensors used in the house

v. Social, economic and marketing issues associated with the solution.

Hardware requirements

- Some of the hardware requirements when designing a smart home include:
- Wireless network interface card – used for wireless network access
- Video capture card or device – used for personal video recorder

- CM 11A – used for X10 PC serial interface controller
- X 10 modules – used for appliance and lamp control
- CM 18 A Kit – used for wireless control of X10 modules
- Wireless X 10 Modules – used for RF Control of X10
- 8 zone amplifier – they are used to amplify signals
- Discrete receivers – they are receivers stationed strategically to receive digital signals
- Security panel (door, window, floor, strain gauges, motion sensors, water sensors)
- PBX SMDR – this is a call accounting system which stores information about telephone calls as they happen. The stored information can be kept for later analysis
- Caller ID – Also called caller Identification. This is a system that helps to monitor a caller and gives his/her identification details. It can be used to track down or limit the number of intrusions that may occur over the telephone network.
- Thermostats - This is a device used for regulating the temperature of a system. It ensures that the temperature is maintained at some predefined value.
- Projector – They are used to amplify images onto a screen placed at some strategic points.
- Driveway sensor – This is a sensor that is placed at the drive way to detect the entry or exit of a motor vehicle. The information is relayed onto a screen when a vehicle enters or leaves the drive way.

- CCTV system – Closed circuit television is used to show the occurrence of different places in the home in real time (as they occur)

Software interfaces

- ASP. NET MVC Website – This is a website that is used to interface with the smart home environment.
- E-mail – The destination recipient can be set as the e-mail so that information is relayed to a e-mail address.
- Calendar – This is used for organizing tasks and events
- Chat – Chatting software can be used for interaction between the home users and people who may be somewhere away from the home.
- RSS – Really Simple Syndication which is used to publish the most frequently updated works.
- Home Automation responses – The responses are set to be passed to different receivers which include mobile phones, e-mail addresses and a TV set. Once the information has been relayed to these gadgets, an appropriate action depending on the preset conditions is then triggered.

AUTOMATION

1. DOORS

a) Connections/links

Physical appearance

How the door operates

The door has a key slot as the one shown above. The key slot has a smart card reader. For one to enter the house, he/she has to insert the smartcard also used as they key to the slot on the door. The system will read the data and prompt the user to enter the unlock code which is assigned to every smartcard holder using the door. If the digits inserted are correct, then the motor behind the door will rotate to open the door. The user then inserts the smart card onto the key slot inside the room. This will prompt the door to close. If the card is not inserted the door remains open. Once the card has been inserted onto the key slot, lights turn on automatically. The lights will remain on for as long as the card is still on the slot. If the card is removed, the lights will go off after 5 minutes. The card removal symbolizes an exit as a person cannot move outside the house without the card.

2. Lighting system

Operation of the lighting system

Once a person enters the house, he/she inserts the smart card on the slot next to the door. A signal is sent to the server which prompts the system to light up. If the card is removed from the door, the lights go off automatically after 5 minutes. This helps to save energy as the system assumes that if the card is not on the door then a person has moved out or is no longer interested in having the lights on. However, there is a manual control panel which a person can use to change the ambiance and intensity of the lights. The control panel can also be used to switch off the lights manually.

3. HVAC (Heating Ventilation and Air conditioning) System

Operation of the HVAC system

This system is responsible for taking care of the climatic conditions of the house. There are different HVAC sensors placed at strategic positions in the house. Thermometers are also placed at different points in the house to measure the temperature of the house. If the temperature goes above the recommended value, the fans are switched on cools the room. If the temperature goes below the recommended value, the heaters are switched on and heat the room. This ensures that the room’s climatic conditions remain constant.

The interfaces between different components of the smart home

Source:

The success of implementation of a smart home does not depend entirely on one system but it depends on how the different systems can communicate with each other successfully.

A typical example of a smart home interconnections

Source: Junestrand, 2004

Sensors

There are many types of sensors which can be used in a smart home. The function of each of the sensors varies depending on the condition they are supposed to measure. They measure temperature, pressure, humidity, motion, light, presence or absence of an object and sound.

Diagrammatic representation of a house with sensors placed strategically

- Inside the house
- Outside the house
- Explanation

The biometric reader on the door reads the personal details of the person who wants to be granted access into the house. After verifying the person's details, the system prompts the person to enter some codes used to unlock the door. The codes are assigned to all the users of the house. If the codes are correct, the door opens. Once the person enters the house, the motion sensor at the entry point detects that a person has entered the house and therefore all the environmental conditions are checked. There is smart card holder next to the door near the motion sensor. The smart card is placed onto that slot. The card will stay for as long as the person wants to have the lights on. Once the smart card is removed from the slot the system assumes that the person has left the house and therefore the lights will be switched off. The HVAC system continues to maintain the climatic conditions of the house unless it is manually stopped by the user. The temperature sensor in the house will measure the temperature and if it goes down beyond the limit, a heater is automatically switched on. If the temperature goes high above the limit, the cooling fan is turned on. This will ensure that the environmental condition of the house remains the same.

OUTSIDE THE HOUSE

Explanation

Outside the house there are two motion sensors placed diagonally on opposite sides of the driveway. The sensors are placed diagonally so that they detect the moving vehicle at different times hence it is possible to detect the direction of motion. The information is relayed via RF frequency using the antennae placed on the roof of the house. The information then goes to the central processing unit for the right action to be taken.

Social economic and marketing issues

A smart house has several benefits. As they ensure the following:

- Top of Form
- Smart homes help in improving the quality of life for the disabled
- They also help in increasing the way elderly people can access facilities form their homes without straining.
- They help in economizing the resources in the home by proper management achieved through the automation process
- They help in burglar detection thus lowering the number of theft cases in homes.
- Challenges of a smart home and suggestions
- There are several challenges that face the implementation of a smart home. Some of the challenges include:
- Computer literacy – There are people who are computer illiterate and the implementation of a smart home can be a very big challenge to them.

In order to counter this challenge it is important to offer adequate training to the people who will be using the system so that they can properly

understand how to operate the system.

Security concerns – Hackers who can access the system via the network can turn off alarm systems and the lighting system thus making the home vulnerable to break in.

Recommendations and future developments

Smart home makes life very comfortable especially when it used properly. The Information technology industry is developing at a very high speed and soon many homes will be implementing this technology. The smart home invention has a potential for improvements as most of the challenges experienced when implementing it are soon becoming forgotten cases. I would strongly recommend the adoption of the smart house considering the benefits it has which far much surpasses the limitations. The new innovations like Bluetooth are also being incorporated into the smart home thus making it more efficient and intelligent.

Summary

The smart homes are very intelligent and it has made work easier for the disabled and the elderly. Sensors used are able to track any movement in the house and its environs thus boosting security in our homes. The smart homes have also helped in saving costs incurred to employ security personnel who in some cases turn out to be robbers and organizing for insider thefts. The use of smart home can bring all these mishaps to an end.

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