ON DEVELOPING OF SMART HOME WITH PERVASIVE APPROACH

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ABSTRACT

The paper describes our study and development of smart home by taken into account the concept of pervasive technology. The system integrates pervasive concept into the design of its hardware and software architecture, functionalities and system configuration. Pervasive technology is aimed at giving users access to information sources anywhere, anytime and on -demand. Pervasive access to and from the smart home can be done simultaneously via remote control, sms, web-camera and web-based Internet connection.

***Keywords**: Smart home, Pervasive technology*

1. INTRODUCTION

Current smart home product is usually focused at functionalities of the smart system to meet the user demand. The home usually offers various features ranging from the simple one to the complex one. However, the system usually can be accessed only through single medium such as remote control at home, phones, or Internet. In addition, the smart system does not support mobile users.

In recent years there are significantly increased demands that a system supports anywhere-anytime access. This is followed by the exponentially growth of the number of mobile devices such as laptops, hand-phones and personal digital assistants (PDA).

Pervasive concept can be represented by one phrase, namely "anywhere, anytime, on-demand" [1]. It means that users can get access to information whenever they want, no matter where they are. Integrating pervasive concept into smart home system gives users more convenient and more options to control, monitor and access the home.

2. SMART HOME AND PERVASIVE TECHNOLOGY

A system is said to be smart if it has specific functions in which it can carry out a range of activities or actions based on certain inputs from sensors or other activation modes. A smart home is a combination of technology and services orientated for home environment. An aim of smart home is to improve convenience, efficiency and security of the home's resident. Smart home usually is designed to control, monitor and automate the access to home devices, either from inside or outside home [2-3].

Smart Home System Components

Smart home is comprised of interactive supported components. A home is considered smart if it has internal network intelligent control and and home automation [2]. Figure 1 shows the smart home's component.

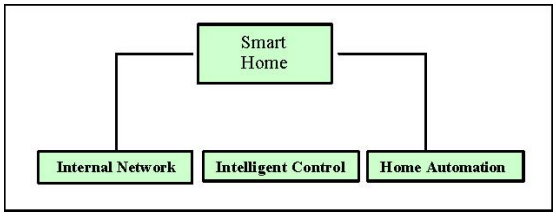

Figure 1. Smart Home Sistem Components

- *Internal network*
  It a network or interconnection between objects or home devices. The network integrates the coordinated components with a wired or wireless connection.
- *Intelligent control*
  Intelligent control is the central processor and brain othe system. It is responsible to maintain the performance of the whole system. Intelligent control is also acting as gateway for access to and from the system.
- *Home Automation*
  It is the final product of a smart home to support dynamic and electronic accessed.

Pervasive Computing Definition

Pervas ive computing is a system concept or aplication where computers influence life, unify and interact with their environment . Pervasive computing is a technology which involves various disciplines such as embedded system, wireless/mobile devices, networking knowledge, computer interfacing, remote communications, and software engineering.

Among the factors that distuinguish pervasive computing and traditional computing are the complexity of the system and ease of use. A pervasive system usually is a complex system but is presented or interfaced to the users in simple ways. Pervasive system and approach minimize interaction with users and optimize the coordiation

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between intelligent devices to support user's tasks.

Pervasive system is " *Any Where - Any Time -On Demand"* technology. This phrase means that the system can be access from any place, at any time and based on the user demand.

Pervasive System Characteristics

A system is considered pervasive if it fulfils all or most of the following characteristics [4-6]:

- *Mobility*
  The system can be operated from over one place. In addition, the system can be accessed with minimal user involvment. Samples of technology that can support this are remote control and access, mobile device input mode and speech recognitio n activation.
- *Adaptability* and *Dynamic*
  The system supports dynamic and changing condition and is adaptable to the environment. These aspects are known in pervasive term as *context aware*. A sample is when a presenter speaks in English the system is capable of automatically translating it into various languages familiar with the listeners.
- *Resources awareness*
  This is the ability of the system to monitor the available resources and allocate appropriate resources in bandwidth, memory or power limited environment. The system can also reallocate the resources for other purposes if necessary. Resource awareness is part of context aware character.
- *Secure and Privacy*
  Objects involved in pervasive system accept inputs, communicate and exchanging data in secure way . Autonomous character of the devices must ensure that no private data of the owners are exchanged or distributed.

In a pervasive system, "*Context awareness* " plays a significant role. Context awareness in closely related with the user interface model. This model consists of following sub models [6]:

- Task model describes how user commands the system.
- Dialog model explains interrelation between technical components
- Domain model defines rules on objects
- User model details how users behave in the system.

Figure 2 shows components and characteristics of pervasive computing.

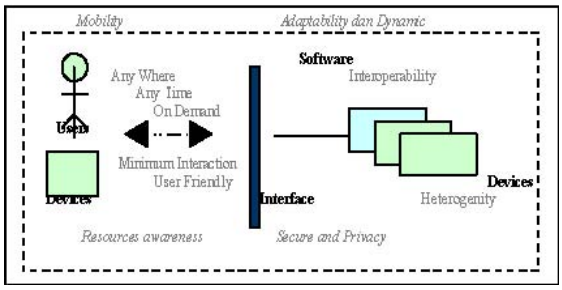

Figure 2. Pervasive Components and Characteristics

3. SYSTEM DESIGN AND ARCHITECURE

We develop a system named "SAHARA". Sahara is smart home with pervasive approach. Sahara implementation design in a home environment is depicted in Figure 3.

Sahara is designed to have various functionalities such as security, control, monitoring, information center, and communication function at home. The description of Sahara multi-functions is describ ed below.

- Home Security Sahara is equipped with video observation system inside and outside home. The system uses two web cameras. The camera is connected to computer inside home. The operation procedure of the video observation system is similar to VCD player. Users can start video, stop video, record video, capture image and setting image view such as bright, contras, sharpness, exposure, focus and digital zoom. The camera has an actuator and, hence, movable into four directions, i.e., right, left, up and down. Sahara is also equipped with fire and theft detectors.

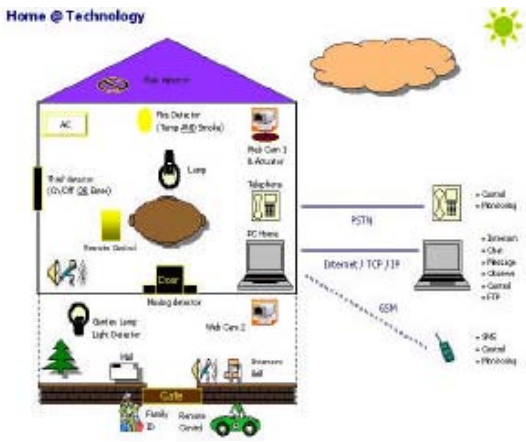

Figure 3. Sahara Implementation Design

- Control, Monitoring System and Automatization Sahara is capable of automatically turning-off and turning-on electronic home devices such as lamps, air conditions, water pump and fans. Garden lamp is turned on at night or at cloudy day, and turned off at daylight. Sahara provides also

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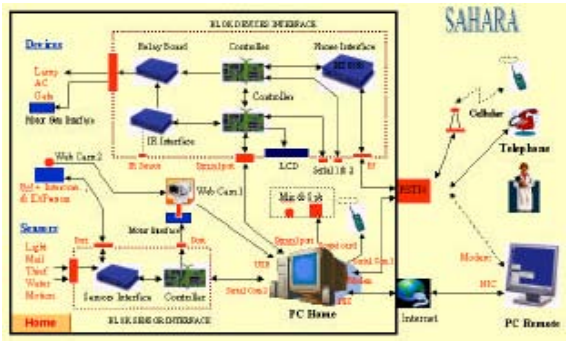
with controlling and monitoring system in addition to water, motion, smoke and temperatur and rain detectors. Sahara is capable of sending SMS automatically to family members in case of fire and theft. Sahara announces famili members through its voice machine when the rain falls and post mail arrives at the mail box.



Gambar 4. Arsistektur Sistem SAHARA

- Information and Communication System Sahara is equipped with computer-based teleoperation system through Internet. Sahara components can be accessed and activated through public switch telephone network (PSTN) and wireless infrastructure.

Sahara is a complex integration of hardware and software. Its implementation involving system level engineering stage. Sahara architecture is depicted in Figure 4.

Functionalities that are supported by SAHARA for smart home environment can be seen in Table1.

Tabel 1. Fungsi Sahara

Fungsi Sistem	*Keterangan*
1. Keamanan Rumah	- Pengamatan (*observation*) rumah secara *audio* dan *video* - Deteksi kebakaran, pencurian dan gerak (*motion*)
2. Kontrol dan monitoring Rumah	- Kontrol/monitoring nyala-mati (*on/off*) perangkat listrik rumah - Deteksi cuaca hujan dan surat di kotak pos - Monitoring keberadaan anggota keluarga di dalam rumah
3. Otomatisasi Rumah	- Otomatisasi nyala – mati lampu taman - Otomatisasi pengiriman pesan singkat (SMS) dan bunyi alarm
4. Informasi dan Komunikasi rumah	- *Intercom, Short Massege, Chat, File transfer* - *Teleoperasi* melalui *telephone, handphone, internet* dan *remote control*

4. SAHARA IMPLEMENTATION

Integration and implementation is depicted in Figure 5.

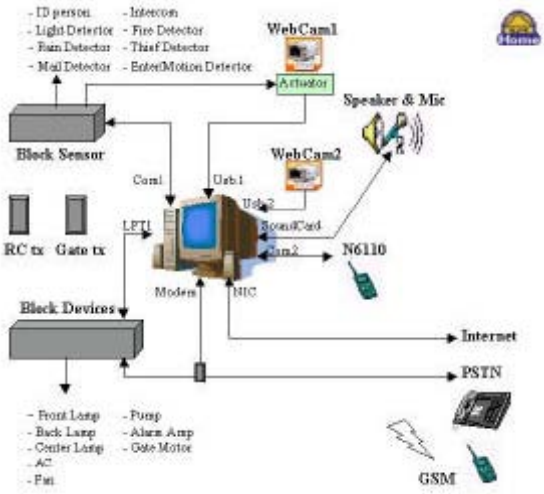


Figure 5. Integration System SAHARA

Intefaces that connects Sahara components and users are shown in Figure 6, Figure 7 and Figure 8 respectively. This interface is very important, since it potentially encourages users to use the system conveniently and easily.

To date of this paper submission, we are conducting functional and performance evaluation. We expect the result can be presented on conference day.

Figure 6. Main Menu of SAHARA

Figure 7. SAHARA's Interface

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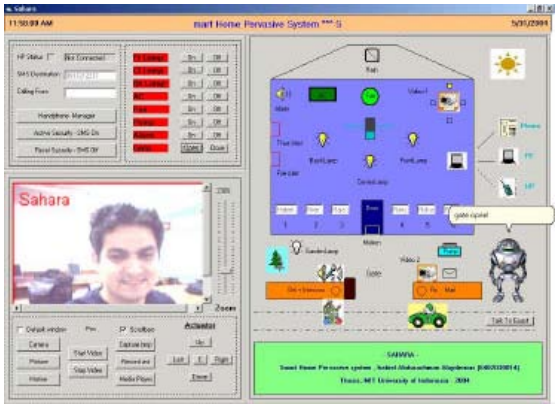

Figure 8. SAHARA in Action

5. CONCLUSION

Sahara is designed and implemented based on pervasive concept. It consists of three main components to fulfill the smart home and pervasive requirements. Those components are internal network, intelligent control and Home automation.

Sahara uses cable and wireless medium to connect sensors and detectors to central and independent controllers. Connection between controllers is managed by a computer through serial and parallel ports. Computer connects outside world through PSTN and Internet .

Sahara utilizes computers as central system management and gateway to outside world. All Sahara components are dictated and activated by coordinated micro-controllers, sensors and detectors.

Sahara works as security, measurement, monitor ing, controlling system. Sahara infomration and communication system can be accessed inside and outside home.

Acknowledgment

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