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REFLECTIVE SENSING AND CONDITIONING SYSTEM IN UBIQUITOUS HOME CARE FOR ELDERLY PEOPLE

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ABSTRACT

Ubiquitous home care is considered as a promising innovation for addressing the increase of aged population. Equipped with wearable sensors and ambient intelligence, a ubiquitous home care model called Reflective Sensing and Conditioning System Used for Elderly (ReSCUE) is proposed in this paper. A new technique as a contribution of this paper is automatic reflection of sensing gathered from wearable body sensor and ambient intelligence to home appliances, based on the needs and preferences of elderly, in oder to enhance the wellbeing of elderly people. Three essential features in ReSCUE model that are presented in this paper are learning elderly characteristics based on medical references as previous data set and preferences of elderly as experiences acquired over time, alerting to stakeholders if elderly in critical condition, and reporting to stakeholders and wellbeing experts. The combination of reinforced and adaptive learning is used in developing ReSCUE smart system.

Keywords: reflective sensing, conditioning system, ubiquitous home care, machine learning.

INTRODUCTION

Population of older people whose aged 60 years and above grows rapidly in the world. The demographic of Indonesia and many countries in the world facing the year 2050 is characterized by continuous rise of population ageing (United Nations, 2013). The decline in fertility and improvements in life expectancy have contributed to the rapidly ageing population. Due to the unique demography profile in many countries, fast growing population of elderly people has recently been a serious issue. The main challenge in maintaining the population aging is helping elderly people to stay healthy and active, also giving them better improvement for their quality of life.

Most elderly people require assistance in their daily life, including in caring of their health, maintaining their wellbeing, or responding to emergency medical situations. Wellbeing has become an important focus, particularly in facing aging population. For elderly people, usually wellbeing is related to their health condition. Many health issues come in the old age. The decline of physical function of elderly in the forms of illness, chronic medical condition, or severe pain will lead to disabilities for elderly (Sneha and Varshney, 2009). However, those with health problems also deserve an enjoyable life. They really need new tools and technologies for supporting their wellbeing.

Time and space are the most important problems for elderly to go to the healthcare providers for clinical check-up. Furthermore, elderly people who need some assistances, particularly elderly people with long term care, prefer to stay and be cared at home. Information communication technology-based services, which can adapt with the environment and can be made available everywhere (ubiquitous computing), can be used to assist elderly people at home. Ubiquitous computing (UbiCom) is the term, which is characterized by the growth of small networked portable computer products in the form of smart phones and embedded computers built into many of the devices (Krumm, 2010). The seamless integration between information communication technology-based services with real world situations, including ambient environment, is the heart of ubiquitous computing. Through the concepts of UbiCom technologies that enable ambient environments, wellbeing of elderly people can be enhanced.

Home care is a good solution for elderly people, particularly for elderly people with much incapability in accessing health care provider because of suffering from chronic diseases, even lead to some cognitive and motoric disabilities, and also for elderly people who lives independently (Bitterman, 2011). For some people, the quality of their life is better at home than anywhere else. The cost of home care is cheaper than hospitalization and almost always more affordable than nursing home. Elderly's difficulty in accessing public health services and their preference to have the convenience and comfort of staying at home are a strong justification for developing a ubiquitous home care, which is equipped with a variety of intelligent assisted living systems and controlled with various technologies remotely that provide communications with the outside world. Increasingly, smart home care not only overcomes the inconvenience of distance, but also provides elderly people with control over the time and the place for monitoring their condition, more manageable their conditions, and increasing convenience that finally can enhance the wellbeing of elderly people. However, most intelligent assisted living systems are not designed based on perspective of human, and it makes some difficulties to use, particularly for elderly people. There is a need for developing intelligent

assisted living system for home care for elderly people, which is designed based on ergonomic issues, such as high acceptance of technology, usability, and worry free from a user's viewpoints.

Every human body has various vital signs that need to be monitored. Most health problems of elderly health status related to vital sign. Vital sign status of elderly can be one of important indicators for elderly's health in detecting or monitoring medical problems. Biologic processes are exquisitely body temperature sensitive. It has long been known that increasing body temperature is associated with a respond from infectious diseases. Body temperature is one of the four main vital signs that is very important and must be measured, recorded and monitored regularly and consistency, especially for elderly people to ensure safe and effective home care of elderly people (NICE, 2007). The decreased of body metabolism at older ages, some medical problems, medications and the environment will affect the ability of elderly people to control and sense changes in its temperature.

Last few years, many researches focused on elderly people, particularly in assisting their daily life. A number of projects have been proposed, related to elderly's health issues of providing smart home, monitoring body temperature of elderly, and enhancing the wellbeing of elderly people. Different techniques used in smart homes, such as video-based techniques, audio-based techniques, and multimodal-based techniques have been presented by L. C. De Silva et.al (De Silva et al., 2012).

Three types of sensor technologies have been demonstrated by D. Ding et.al (Ding, 2011) related to ability to sense human activity in smart home, such as wearable body sensors which are worn by the residents, environment sensors where sensors are distributed in the environment, and infrastructure mediated systems where sensors are installed on an existing home infrastructure. Similarly, N. K. Suryadevara and S. C. Mukhopadhyay (Suryadevara and Mukhopadhyay, 2012) have developed monitoring system using wireless sensor network to monitor and assess elderly activities at home in real time in order to enhance the wellbeing of elderly.

B. Mohammad, et.al (Mohammad, 2013) demonstrated the design and implementation of portable wireless biomedical temperature monitoring system to continuously measure body temperature of babies, disable or elderly people. M. A. Hossain (Hossain, 2014) showed the improvements related to efficiency, effectiveness, and user satisfaction of elderly by designing elderly monitoring system based on perspectives of human factors. C. Sugimoto from Japan (Sugimoto and Kohno, 2011) has developed the intelligent measurement system utilizing wireless sensor network, which operates real time based on human thermal comfort in order to promote human satisfaction and to prevent excessive cooling and heating.

Home care monitoring and enhancing the wellbeing of elderly people have wide coverage research area and still gain much attention in many aspects. Elderly behaviour and preferences at home is highly unstructured. Conditioning system based on elderly's body and their needs is an interesting and important research area that has not yet gained much attention. It becomes an opportunity to work in this area in order to enhance the wellbeing of elderly people.

Our previous work on Contempo as a home care model to enhance the wellbeing of elderly people has three main sub systems, such as reflective sensing system, alert system, and diagnostic support system (Kurnianingsih et al., 2014). Continuing the work on Contempo, this paper proposes reflective sensing and conditioning system in ubiquitous home care for elderly people, which implements ubiquitous concepts and specifically optimised ambient sensors are used to address elderly context, environment context and elderly activity. In this research, the reflective sensing system of Contempo that is based on adaptive machine learning related to the needs and preferences of elderly is explored. We come up with a new model called Reflective Sensing and Conditioning System Used for Elderly People (ReSCUE).

RESEARCH METHOD

Materials

The experiment used components as shown in Figure-1. They consist of:

a) Body temperature Sensor for e-health platform.
   This sensor has capability to measure body temperature.
b) E-Health sensor shield v2.0 for Arduino.
   The e-Health Sensor Shield has capabiliy to perform biometric and medical applications where body monitoring is needed by using body sensor.
c) Arduino DFRobot Leonardo with Xbee socket.
   DFRobot Leonardo with Xbee socket is an Arduino Leonardo processor, based on the Atmega32u4 chip.
d) DHT11 Sensor Module.
   DHT11 is a calibrated digital temperature and humidity sensor temperature and humidity combined sensors for digital signal output.
e) Light Sensor BH1750 BHI1750FVI.
   BH1750 is a light sensor module with 16 bit AD converter built-in, which has digital signal output.
f) Xbee 2MW Wire Antenna Series 2.
   Xbee XB24-Z7WIT-004 module has capability in creating complex mesh networks and a very reliable and simple communication between systems.

Figure-1. Components used in the experiment.

Proposed Model of ReSCUE

ReSCUE consists of three functional layers of system design such as: Wearable Peripheral System on Elderly, Wall Mounted Device on Wall, Environmental Control System in environment.

- **Layer 1:** Wearable peripheral system on elderly

Wearable peripheral system represents each particular object accompanying elderly in their daily acitivies in a smart environment. It consists of wearable body temperature sensors, environmental sensors, and feedback system. Wearable body temperature sensors will be used to measure elderly's body temperature in real time. Environmental sensors consist of temperature sensors to measure temperature of environment, humidity sensors to measure humidity level of environment, and lighting sensors to sense the changes characteristics depending on light intensity. Feedback system consists of simple and advanced feedback systems. There are three items on simple feedback system that represent indicators of wellbeing (Placa, 2013), namely anxiety, satisfaction, happiness. In advanced feedback system, there's adjustment knob, which consists of three knobs, namely temperature knob to control the changes of temperature, humidity knob to control the changes of humidity, and dimmer to control the changes depending on the strength of light. Elderly can adjust their preferences of temperature, humidity, and lighting manually. As shown in Figure 2, data gathered from layer 1 will be sent to layer 2 to be proceed (see data flow a) and also will be recorded in medical record of elderly (see data flow e). Layer 1 and layer 2 will communicate using wireless fidelity (wifi) network.

- **Layer 2:** Wall mounted device on wall

Wall mounted device consists of environmental sensors, positioning system system, smart system, and feedback system. Environmental sensors consist of temperature sensors, humidity sensors, lighting sensors, and occupancy sensors to detect the existense of a person in a room. Feedback system on wall mounted device only has a role as an advanced system. We use adjustment knob as an advanced system, which consists of three knobs, namely temperature knob to control the changes of temperature, humidity knob to control the changes of humidity, and dimmer to control the changes depending on the strength of light.

Smart system is the central processing of this ReSCUE system. There are three main processes in ReSCUE smart system: machine learning, alerting, and reporting. All data gathered from layer 1 will be sent to layer 2 as an input to be proceed in layer 2. Layer 2, as shown in Figure 2, also gets input about wellbeing parameters from wellbeing experts (see data flow g). Wellbeing parameters are parameters concluded by wellbeing experts based on medical report from doctor (as need, see data flow e) and preferences of elderly people (as want, see data flow f). Doctor will analyse elderly's medical record (see data flow d), which is recorded directly from physiological data of elderly (see data flow c) and real time measurement from wearable peripheral system on elderly (see data flow b). The result of layer 2 will be sent to three parties, such as: (1) to layer 3 (see data flow h) as the input for layer 3, (2) to Internet cloud (see data flow j) to send report to wellbeing experts and doctors, and to alert interface cloud (see data flow k) to send alert to care givers and family members.

- **Layer 3:** Environmental control system

Environmental control system consists of temperature, humidity, and lighting, as shown in Figure 2. It will give action (see data flow p) to give comfort to elderly based on instructions from layer 2, wall mounted device on wall. Action from layer 3 will be recorded in smart system on layer 2, as a history of elderly service at the certain time. Wearable peripheral system on elderly can not send request to environmental control device directly, it has to send request through wall mounted device on wall to ask some services to environmental control system. Layer 3 and layer 2 will communicate each other using infrared as wireless personal area network (wpan), or it also can communicate each other using wired network.

The detailed data flow of ReSCUE model as shown in Figure-2 is described as follows.

a) Layer1_Data

Layer1_Data is data as the result of processing on layer 1, wearable peripheral system of elderly. It consists of body temperature data of elderly in Celcius degree, environmental temperature data in Celcius degree, environmental humidity in procentage, lighting in lumen, simple feedback data of elderly (anxiety, happiness, satisfaction), and advanced feedback (preferences data of elderly, such as temperature in Celcius degree, environmental humidity in procentage, and lighting in lumen).

b) Layer1_Historical_Data

Layer1_Historical_Data is real time data gathered from body temperature sensor on layer 1, wearable peripheral system of elderly. It will be recorded in medical record of elderly.

c) Elderly_Physiological_Data

Elderly_Physiological_Data is measurement of physiological data of elderly from laboratory, which consists of all items tested in the laboratory, such as vital sign data (body temperature, heart rate, blood pressure, respiratory), urine, fat, and other kinds of laboratory test.

d) Elderly_Medical_Record_Data

Elderly_Medical_Record_Dataconsists of elderly health status, which is maintained by each of health care providers, including personal identification; anamneses;

laboratory; radiological, and other test record (Kurnianingsih et al., 2014). Medical record data of elderly can be gathered from Layer1_Historical_Data and Elderly_Physiological_Data.

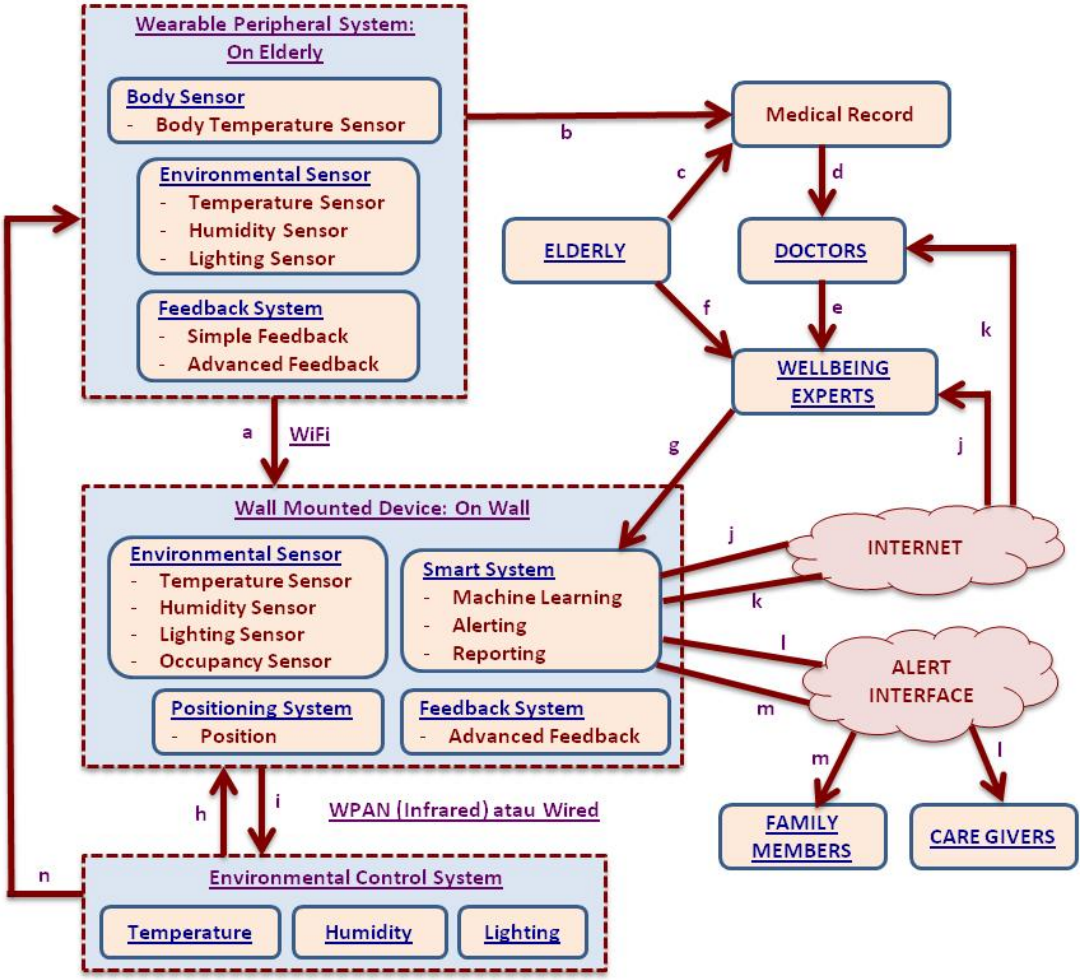

Figure-2. A proposed model of ReSCUE.

e) Medical_Report_Data

Medical_Report_Data is data reported by doctors after analysing elderly health status from Elderly_Medical_Record_Data.

f) Elderly_Preference_Data

Elderly_Preference_Data describes what elderly prefer and do not prefer.

g) Wellbeing_Parameter_Data

Wellbeing_Parameter_Data is data of wellbeing parameters, concluded by wellbeing experts. Wellbeing experts will combine data gathered from doctor's medical report and data gathered from preferences of elderly, then they will conclude the parameters that appropriate for each elderly people. Health condition of elderly and preferences of elderly are different from one to another, so this data is unique for each elderly.

h) Layer2_Data

Layer2_Data is data as the result of processing on layer 2, wall mounted device on wall. It consists of data environmental sensors (temperature, humidity, lighting, occupancy), position data of elderly, advanced feedback data of elderly, and smart system data (the central processing unit of ResCUE).

i) Layer3_Historical_Data

Layer3_Historical_Data is data as an action result of processing on layer 3, environmental control system. It

consists of temperature, humidity, and lighting. New update data on layer 3 will be recorded in the knowledge base on layer 2.

j) WellbeingExpert_ Report_Data

WellbeingExpert_Report_Data is data as the result of layer 2, which will be sent as a report to the wellbeing experts via Internet.

k) Doctor_Report_Data

Doctor_Report_Data is data as the result of layer 2, which will be sent as a report to the doctors via Internet.

l) CareGiver_Alert_Data

CareGiver_Alert_Data is data as the result of layer 2, which will be sent as an alert to the care givers via alert interface network.

m) FamilyMember_Alert_Data

FamilyMember_Alert_Data is data as the result of layer 2, which will be sent as an alert to the family members via alert interface network.

n) Elderly_Service_Data

Elderly_Service_Data is data as the result of layer3, which will be sent to layer 1 as a reflective sensing from layer 1.

ReSCUE adopts feedback control mechanism, which uses information gathered from wearable body sensor on elderly, environment sensor, and feedback from elderly to provide adaptive service. In feedback control mechanism, the environment being conditioned is measured and compared with knowledge base (preferences and medical references) to improve learning and the results close to the expected outcome.

PROCESSING UNIT OF ReSCUE

Smart system of ReSCUE

Harbor Research (Harbour Research, 2013) defines smart system as a new generation of systems, which consists of hardware, software, network technologies and managed services that integrate people, process, and knowledge to enable awareness and better decision making. IRISS (Topham, 2012) defines smart system as a combination data processing with sensing, actuating, communicating, and be able to analyse complex situation, make smart decision making, and be predictive. As the environment changes over time, the represented data also needs to be changed.

A smart system requires learning capability. Learning refers to the ability of a machine to get some knowledge to improve machine's functionality (Raducanu and Vitria, 2008). Some research has been concentrated on applying machine learning to work with user preferences. The Dynamic Incremental Associative Neural NEtwork (DIANNE), has been proposed to handle user behaviour anomalies and provide accurate user preferences (Gallacher et al., 2012). Other projects, such as Ubisec (Groppe and Mueller, 2005), MobiLife (Sutterer et al., 2007), SPICE (Cordier et al., 2006) and iDorm (Hagras, 2007) also work in user preference processes in an attempt to provide adaptive service systems that are more responsive to preference changes.

Smart system of ReSCUE is the central processing unit of ReSCUE, which has a reflective capability. We use the term 'reflective sensing and conditioning system' to emphasize ReSCUE's capability of (1) responding immediately to every changes of elderly condition in peripheral environment; (2) alerting to stakeholders (such as care givers and family members) automatically if elderly in critical condition; (3) carrying out automatic update of the results of context learning to the knowledge base.

The decline of motoric function and cognitive function of elderly people in the old age makes difficulties for elderly people to control surrounding environment. The roles of assistive technology that has capability to learn elderly's needs and preferences, which is adjusted with surrounding environment and, and also to aware of the context is really needed. There are three main sub system in smart system of ReSCUE, namely: (1) machine learning, (2) alerting, (3) reporting. Machine learning will learn from elderly's context, including their preferences too, so one day smart will automatically recognise the person in smart way, without any interfere human's manual input. Alerting system will give alert to stakeholders (care givers and family members) if elderly is in critical or emergency condition. Reporting system will give report about human/elderly's states and preferences to caregiver and wellbeing expert.If someone who does not use wearable peripheral device enters a room which has this wall mounted device on wall, the system will do detect those one and give comfort in general based on real time sensing gathered by sensors at that time. If someone or elderly who uses wearable peripheral system enters a room which has this wall mounted device on wall, the system will recognise the person's context based on data in elderly's wearable peripheral device. The wall mounted device will change priority of the system. Then the wall mounted device will use the smart system data on elderly's wearable peripheral device to do action based on elderly's states and preferences. At the same time and at the same location, the wearable peripheral device and wall mounted device who have each smart system will work together and will do database synchronization, then the wearable peripheral device will take over to do requests to environmental control system to give comfort to elderly. In this case, the wearable peripheral device has higher priority than wall mounted device.

Machine learning in ReSCUE smart system

The mechanism of ReSCUE's machine learning is depicted in Figure-3. Three types of machine learning in ReSCUE smart system, are: (1) Machine Learning for

Temperature; (2) Machine Learning for Humidity; (3) Machine Learning for Lighting. Each type of machine learning has different input and output to environmental control systems. All machine learning components have input from knowledge base.

Knowledge base in ReSCUE smart system is a centralized repository for wellbeing parameters, which consists of needs and preferences of elderly. Needs of elderly are derived from doctors' medical report by analizing medical record of elderly, while preferences of elderly are derived from wellbeing experts by interviewing directly to elderly people about what they want.

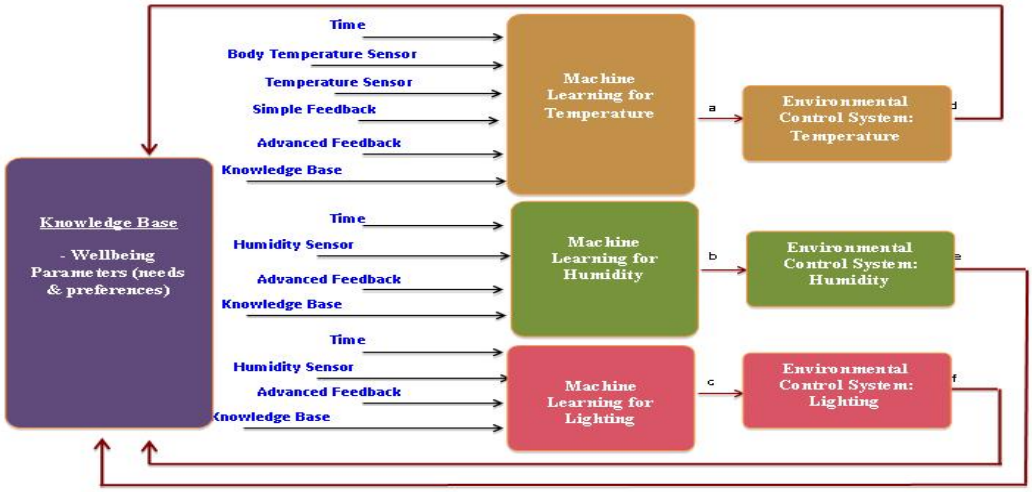

Figure-3. Machine learning in ReSCUE.

- Machine Learning for Temperature

Machine learning for temperature will learn the characteristic of temperature for elderly that can give level of comfort to elderly by learning continuously the body temperature of elderly adjusted with environmental temperature, while considering the needs (medical report of elderly) and temperature preferences of elderly. Machine learning for temperature has six inputs: time, body temperature sensor, ambient temperature sensor, simple feedback, advanced feedback, and knowledge base. Time will record time of event. Body temperature sensor will give input about the measurement of body temperature of elderly in real time. Ambient temperature identifies the surrounding environmental temperature. Simple feedback will give input to machine learning about the condition of comfort level of elderly that represent wellbeing indicators, such as anxiety, happiness, satisfaction. Advanced feedback will give input the temperature preference of elderly. Knowledge base will give input the wellbeing parameters of temperature for elderly based on medical references and preferences of elderly. Output for the machine learning for temperature is temperature_parameter_data (Figure-3, data flow a) to control temperature peripheral on environmental control system. Environmental control system results historical_temperature_data (Figure-3, data flow d). Historical_temperature_data is historical data about temperature sent to elderly, which will be recorded to knowledge base to update the knowledge about temperature for elderly. New update of knowledge about temperature will replace the existing one. Machine learning will learn the appropriate temperature for elderly every time in weekday period.

- Machine Learning for Humidity

Machine learning for humidity will learn the characteristic of humidity for elderly that can give level of comfort to elderly by learning continously the environmental humidity, while considering the needs (medical report of elderly) and humidity preferences of elderly. For elderly with special case, such as elderly who have problem in respiratory should have certain level of humidity. Machine learning for humidity has four inputs, such as: time, humidity sensor, advanced

feedback, and knowledge base. Time will record time of event. Humidity sensor will give measurement about surrounding environmental humidity. There is no simple feedback needed for machine learning for humidity. Advanced feedback will give input the humidity preference of elderly. Knowledge base will give input the wellbeing parameters of humidity for elderly based on medical references and preferences of elderly. Output for the machine learning for humidity is humidity_parameter_data (Figure-3, data flow b) to control humidity peripheral on environmental control system. Result from environmental control system is historical_humidity_data (as shown in Figure-3, data flow e). Historical_humidity_data is historical data about humidity sent to elderly, which will be recorded to knowledge base to update the knowledge about humidity for elderly. New update of knowledge about humidity will replace the existing one. Machine learning will learn the appropriate humidity for elderly every time in weekday period.

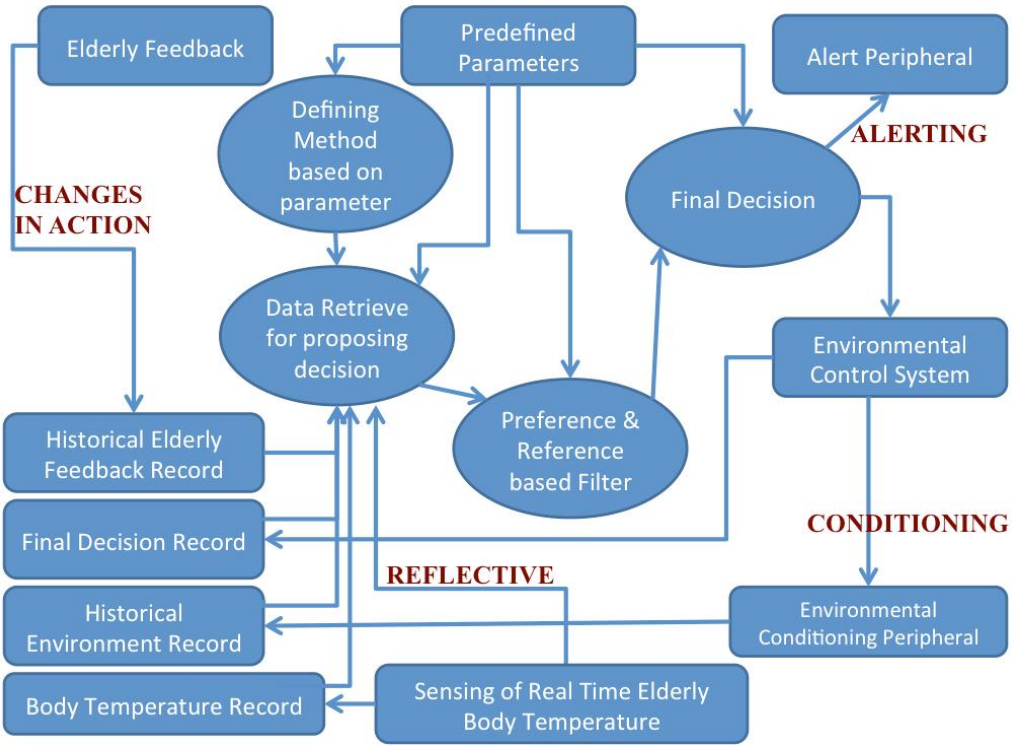

Figure-4. Building the decision network of adaptive reinforcement learning of ReSCUE.

- Machine Learning for Lighting

Machine learning for lighting will learn the characteristic of humidity for elderly that can give level of comfort to elderly by learning continously the environmental lighting, while considering the needs (medical report of elderly) and humidity preferences of elderly. Machine learning for lighting has four inputs, such as: time, lighting sensor, advanced feedback, and knowledge base. Time will record time of event. Lighting sensor will give measurement about the real time surrounding environmental lighting of elderly. There is no simple feedback needed for machine learning for lighting. Advanced feedback will give input the lighting preference of elderly. Knowledge base will give input the wellbeing parameters of lighting for elderly based on medical references and preferences of elderly. Output for the machine learning for lighting is lighting_parameter_data (Figure-3, data flow c) to control lighting peripheral on environmental control system. Result from environmental control system is historical_lighting_data (as shown in Figure-3, data flow f). Historical_lighting_data is historical data about lighting sent to elderly, which will be recorded to knowledge base to update the knowledge about lighting for elderly. New update of knowledge about lighting will replace the existing one. Machine learning will learn the appropriate lighting for elderly every time in weekday period.

Decision network of ReSCUE

The proposed model of ReSCUE smart system concerns on adaptive reinforcement learning. Adaptive

reinforcement learning refers to learning with ability of context aware, decision scenario, or a learning problem. Adaptive reinforcement learning can be viewed as a model for elderly people to adjust to changing environment. In reinforcement learning, a learner makes decisions and actions in association with the environment while an agent is any human being who keeps learning continously, interacts with the environment and decides the best action. In real life, the environment is not deterministic and generally dynamic. Trial and error based learning related to the environment is the point of reinforcement learning. A system interacts with environment and takes feedback. Feedback is based on the adjustment of preferences to expect comfort performance in order to improve results and learning. The feedback is used to deliver required action from elderly people and tune the learning system.

Decision making is very important in adaptive reinforcement learning that can be the directives for actions. Decision making in ReSCUE is used for alerting system as a reflective action and for controlling the peripheral environmental system as a conditioning action. Managing decision information, related relationships and attributes will build the decision network. In the decision network, a decision will retrieve and interprete information, including environment condition (Kulkarni, 2012). The decision network of ReSCUE includes information about elderly present state, possible actions from environment, elderly's feedback, transition, and learning process mode. Figure-4 describe the process of decision network of adaptive reinforcement learning of ReSCUE.

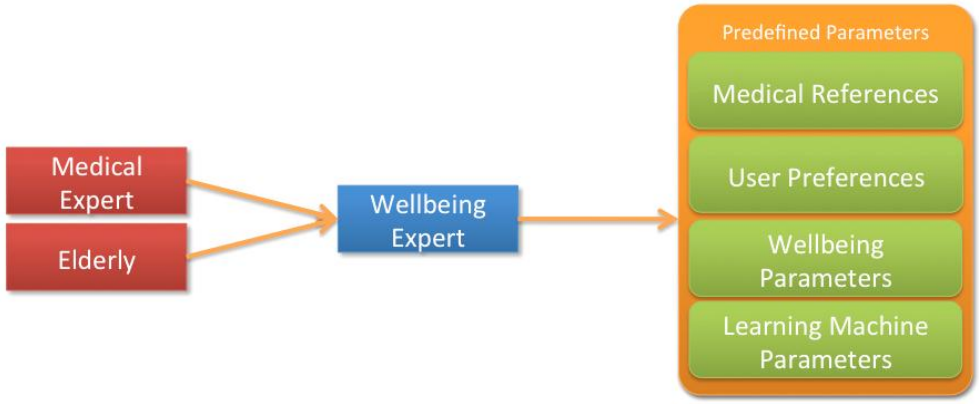

Figure-5. Predefined parameters of ReSCUE smart system.

ReSCUE decision network is built using sensing of real time elderly body temperature, historical environmental record, historical elderly feeback record, and final decision record, predefined parameters. Figure-5 depicts predefined parameters of ReSCUE consist of:

a. Medical references of elderly, namely body temperature range, humidity range, lighting range

b. Elderly preferences, namely body temperature rate, humidity rate, lighting rate

c. Wellbeing parameters

d. Learning machine parameters, namely mode [historic | behaviour | heuristic], period [daily, weekly, monthly/date], priority [medical reference | user preference | median]

ReSCUE in ubiquitous home care

The physical limitation of elderly people needs technologies support mobility and assistive living seamlessly. ReSCUE, which is based on the needs and preferences of elderly, will make assistive living technologies become seamlessly integrated. Seamless integration is at the heart of UbiCom, which provides systems and can be understood by elderly. Three basic architectural designs of UbiCom (Poslad, 2009) are Smart Devices (D), Smart Environments (E), Smart Interaction (I), and it is called smart DEI (Device, Environment, Interaction). Smart reflects active, digital, networked, autonomous, reconfigurable, and local control characteristics. Smart devices means devices tend to become smaller and lighter in weight, cheaper to produce, prevalent, made more portable and can appear less obtrusive. Smart environment means that environment has capability to embed devices in the physical environment and can sense and react to events such as people. Smart interactions have capabilities for more interoperable distributed mobile devices and promotes unified & continuous interaction model between UbiCom applications and UbiCom infrastructure, physical world & human environments. Wearable body sensor and environmental sensor that embedded in the environment,

and interaction among devices as shown in Figure-2 shows that ReSCUE has met the DEI requirements of basic architectural designs of UbiCom.

There are five properties of UbiCom (Poslad, 2009), namely: distributed, implisit human-computer interaction, context aware, autonomous, and intelligent. The design of ResCUE refers to five properties of UbiCom viewpoints, namely:

1. Distributed

ReSCUE provides a platform for seamless connection, which is designed to be able to connect anyone (elderly, family member, doctors, care givers, or others), anywhere (at home, at work, at health care providers, in the city, in the country or on move), anything (household appliances, environments, individual items), anytime (24 hours, day and night), and any devices (on a multi-platform devices). The design of ReSCUE model makes information exchange among heterogeneous system with different format in ReSCUE become seamless, synchronised and coordinated. Data is open and transparently distributed among applications that work together across domains in a target environment.

2. Implicit human computer interaction

The design of ReSCUE model has met the characteristics of human centered design that concerns on user awareness, proactive, sense of presence, calmness, and virtual. From the main user's (elderly) point of view, the ease of use on assisting technology for elderly can be provided by automatic reflection of sensing mechanism. Wearable body environmental sensors make the technology become seamless. Home appliances is also designed seamless to give service to elderly without interfere elderly's activities. From the supporting user's point of view (care givers, doctors, family members, wellbeing experts), the easy to use on assisting technology for elderly can be provided by automatically alerting if elderly in critical condition and automatically reporting to supporting users related to elderly health status. It is designed as a seamless technology so that can make the easy to monitor and analyze elderly automatically.

3. Context aware

Context awareness of environment for ReSCUE is a crucial matter in the design of solutions for inhouse safety. ReSCUE integrates residents, household appliances, sensors, and services by the use of wireless network technology, so that environment would become more intelligent to learn to user's needs and preferences and provide adaptive services to elderly. As an adaptive ReSCUE, ReSCUE can adjust to the needs and preferences of elderly based on medical references. As an informative ReSCUE, context information related to elderly wellbeing such as location and health status will be obtained by occupancy and position sensors, body temperature sensors, and environmental sensors such as temperature, humidity and lighting. The information can then be further processed and combined with wearable body sensor data to give appropriate condition of elderly health status. The results of this will reflect to home appliances.

4. Autonomous

ReSCUE is equipped by an automated stand-alone surveillance method utilizing wearable sensor and ambient intelligence that embedded into environment. It is suitable, particularly for elderly people who lives autonomously at home. Elderly can manage their daily activities by themselves.

5. Intelligent

ReSCUEsmart system consists on three main sub systems, such as machine learning, alerting, and reporting. This smart system will deliver information related to condition of the elderly, adjusted to preferences of elderly, while considering medical references. ReSCUE system provides automatically reflection of sensing gathered from body sensor and ambient environment sensors and has learning capabilities based on needs and preferences of elderly.

CONCLUSIONS

As people going through older age, motoric and cognitive function tends to decline. Many lessons have been learned about physical limitation and disabilities of elderly people. Unfortunately, the other facets of decline due to natural ageing are still gaining little attention. It brings the problem of having convenience for the elderly people living at home. We proposed a ubiquitous home care model of reflective sensing and conditioning system used for elderly. Automatically intelligent reflection of sensing gathered from elderly's wearable body sensor and the surrounding environmental conditions, which has capabilities in learning of elderly's preferences, while considering medical references, and providing adaptive services in environment conditioning needs is the new concept to assist elderly people with physical limitation and disabilities in order to improve their quality of life, and it becomes our challenging work.

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