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Requirement Engineering for Extracting Functional & Non-Functional Requirements Based on User Behavioral Analysis

BoKyung Park¹, Sung Bin Ahn, Soo Jung Woo, R. YoungChul Kim², Byoung-Ho Ahn³

¹Dept. of Computer & Information Comm., Hongik University, Korea

³Dept. of Computer Science, Chung Cheong University, Korea

[e-mail: {bk¹, bob²}@selab.hongik.ac.kr]

[e-mail: bhahn³@ok.ac.kr]

*Corresponding author: R.Young Chul Kim

Abstract

This paper mentions to extract functional & non-functional requirements based on UBA(user behavioral analysis). Until now, it used to work a customer or developer centered method for most software system developments, and also considered requirements for the customer needs or satisfactions. But we are considering of affluent and good requirements for even user needs. For future smart and ubiquitous computing systems or intelligent appliances, it should be developed with the user centered works for servicing with interoperating between a user and a system. It uses one example case of future ubiquitous smart home system.

Keywords: Requirement Engineering, Functional & Non-functional Requirements, User Behavior Analysis, User Centered Software Development

1. Introduction

In the near future ubiquitous based smart computing environment, it will be served with the effects of interoperating between a human and a smart system based on monitoring user behaviors. Due to this change, it is necessary to clearly grasp your needs through user behavioral analysis. It contains this information on developing a system[2]. This is a reason why we should identify user requirements satisfied by user needs, which be analyzed by collecting and monitoring user behaviors. A user is impossible to request service to a system developed by the existing developer centered software development.

To do this, it should be possible to extract functional & non-functional requirements from user behaviors. That is why we suggests the user centered software development for reflecting user needs. This proposed method is first to collect user behavioral data, analyzes this data with user behavior analysis(UBA), and identifies user needs. Then extract core user needs with goal oriented analysis. Finally identify functional & non-functional requirements from common behavior data. From this procedure, it is to get functional & non-functional requirements contained with user needs.

This paper describes as follows: it mentions related work in section 2, shows user centered software development process in section 3,

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describes a case study in section 4, and finally conclusion.

2. Related Work

Kim[2] mentioned knowledge based of user behavior through extracting human core behaviors from the huge observed raw data of user behavior. To analyze this basic data, she mentioned goal oriented analysis method. Kim [1,2] also mentioned requirement engineering based on user behavior analysis(UBA). We suggest how to identify requirements from user needs..

collect huge amount of user behavior data. With this collected data, analyze with user behavior analysis. Use to analyze indirective user requirement with indirective data extraction, and to identify user objectives with directive data.

• 3 step: User Behavioral Data Analysis

Identify characteristics and patterns by analyzing user behavior data extracted. Then formalize with redefined relative analysis table based on 5W1H(Who, What, When, Where, Why, and How). It shows to redefine 5W1H in Table 1.

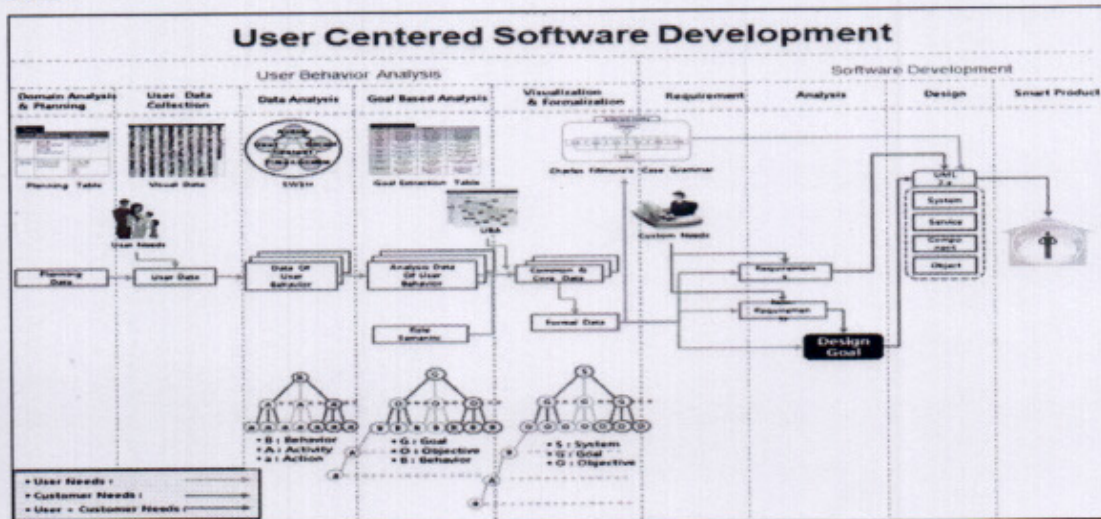


Fig. 1. User Centered Software Development Process

3. User Centered Software Development Process

Fig. 1 shows user centered software development process. This process consists of two parts: user behavior analysis and software development. This involves user centered software development, which analyzes the collected data with user behavior analysis, and then extracts functional & non-functional requirements belonged in user needs. User centered analysis method is described as follows:

• 1 step Domain analysis and planning

Define a whole domain, and identify detail domain. then plan identified domain.

In planning, describe in detail on goal, target, and content, and also determine how to do it.

• 2 step: Collect User Data

In user data collection, directly and indirectly

It redefines 5W1H as limited elements to analyze user behaviors in Table 1. The limited elements are possible to recognize from user behaviors, which are mapping into 5W1H. With this, it is possible to recognize only necessary elements through vast user behaviors.

Table 1. Redefinition of 5W1H

5W1H	Redefinition	Description
Who	User	User Only
How	Action	Manipulated Behavior Only
What	Object	Target Only
When	Time	Vision Only
Where	Location	Place Only
Why	Goal	Purpose Only

• 4 step: Construction of User behavioral Information

The user circumstance information identified

with user behavior analysis contains data with a partial purpose of the user. To refine this data contained with user needs, it considers two states (pre-state and post-state) from 'action state' based on user behavioral objectives, and then constructs user behavioral information into relative tabulation. During this process, it will be classified into types of user behavior, which is constructed with user behavioral information contained for user needs. Table 2 shows information of user behaviors.

Table 2. Construction of User behavioral Information

Behavior Name		
Activity	Activity	Activity
Pre-State	State	Post-State
User	User	User
Pre-Action	Action	Action
Object	Object	Object
Pre-Time	Time	Post-Time
Pre-Location	Location	Post-Location
Goal		

• 5 step: Goal extraction with Goal oriented Analysis

It should identify common objectives from user behavioral information with goal oriented analysis. If user needs contained the identified objectives coincides with common objectives, user needs seem to coincide all user needs. It is possible to identify user needs. Common objectives by user needs are represented as tabulation like table 3.

Table 3. Goal Extraction with Goal Oriented Analysis

Objective	Object Name		
Behavior	BehaviorName	BehaviorName	BehaviorName
State	State Condition	State Condition	State Condition
Activity	Activity Name	Activity Name	Activity Name
User	User Name	User Name	User Name
Action	Pre-Action or Action or Post-Action	Pre-Action or Action or Post-Action	Pre-Action or Action or Post-Action
Object	Object	Object	Object
Time	Pre-Time or Time or Post-Time	Pre-Time or Time or Post-Time	Pre-Time or Time or Post-Time
Location	Pre-Location or Location or Post-Location	Pre-Location or Location or Post-Location	Pre-Location or Location or Post-Location

Goal	Pre-Goal or Goal or Post-Goal	Pre-Goal or Goal or Post-Goal	Pre-Goal or Goal or Post-Goal
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• 6 step: Functional/Non-Functional Requirements Extraction Method

After extracting common objectives, identify functional/non-functional requirements. It identifies the detailed ones through common objectives, and extracts functional requirement from functional requirement scenarios. According to GSOCr Notation [1], it is classified non-functional requirements of customer requirements, and then extracts non-functional requirement from functional requirements.

4. A Case Study

Figure 2 shows a smart ubiquitous home domain.

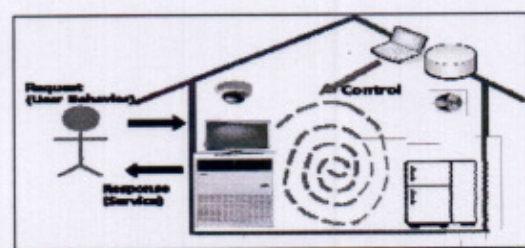


Fig. 2.A Smart Home Domain



Fig. 3. Collection of Visual User Data

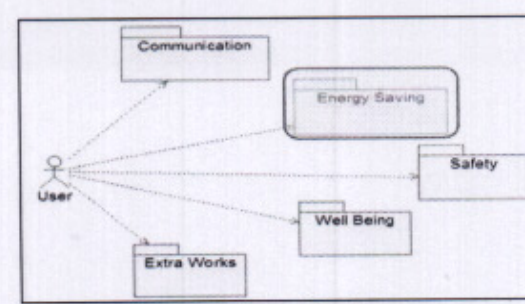


Fig. 4. Use Case Model of U-Home

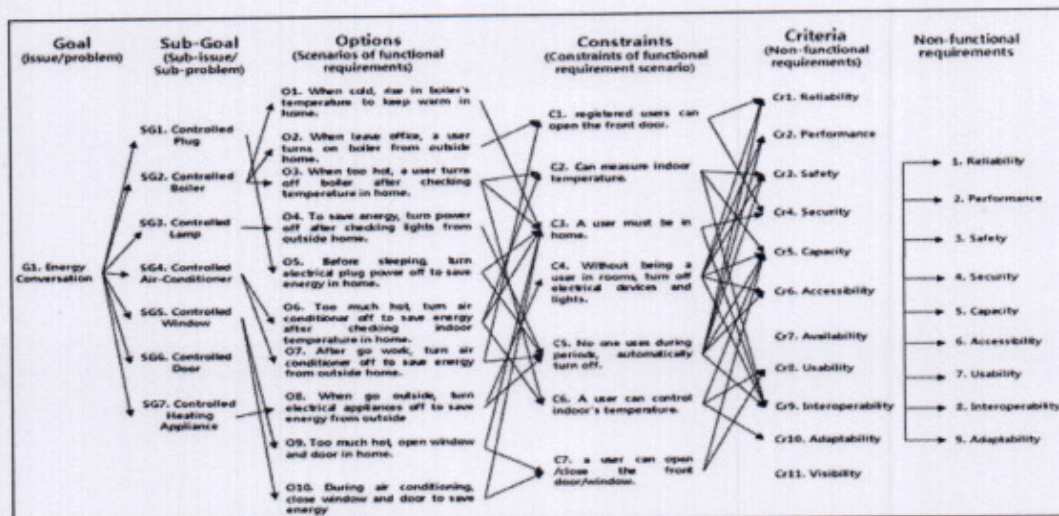


Fig. 5. Functional / Non-Functional Requirements Extraction Method[1]

As a user requests his/her demands on this domain, the system should work what a user needs through interoperating with the user. The system does work corresponding with the human behaviors which are based on human behavioral patterns. To do this process, it is important to analyze user behaviors, and extracts core behavioral patterns.

Figure 3 shows to collect the user visual data. It needs to convert textual data with this visual data based on 5WIH. Figure 4 shows use case model for Smart U-home Domain. It consists of 5 use cases in use case diagram. Figure 5 shows functional & non-functional requirements.

Table 4. Functional Requirements

Option	Function
O1	Temp_check(), Boiler_On()
O2	Temp_check(), Boiler_Off()
O3	Temp_check(), Temp_Control(), Boiler_Off()
O4	Energy_Saving_Mode(), Lamp_Check(), Lamp_Off()
O5	Energy_Saving_Mode(), Plug_Check(), Plug_Off()
O6	Temp_check(), Temp_Control(), Air_Conditioner On()
O7	Energy_Saving_Mode(), Air_Conditioner Off()
O8	Energy_Saving_Mode(), HA_Off()
O9	Temp_Check(), Window_Open(), Door_Open()
O10	Temp_Check(), Window_Close(), Door_Close()

It extracts functional requirement from functional requirement scenarios according to GSOCr Notation [1]. It is classified Table 4 mentions functional requirements from functional requirement scenarios.

5. Conclusions

This paper mentions to extract functional & non-functional requirements based on user behavioral analysis. Until now, it used to work a customer or developer centered for most software system developments. Therefore it considers requirements for the customer needs or satisfactions.

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