A Literature Survey on UX Design Properties and Principles Of Smart Device Design for the Disabled: From the Perspective of the Value/Quality of Human Life

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Abstract

Nowadays, user experience (UX) is treated as an essential element to be considered by smart device designers. UX of the disabled is also considered important, as the welfare of the disabled has become a major issue in today's society. This study aims to propose a new concept of the value of UX, from the perspective of the human life value. UX design principles and UX design properties on a smart device design for the disabled were also defined to enhance the value of the smart device's experience. Literatures that related to UX, human/life value, and product/service's value were collected from various academic fields like philosophy, economics, ergonomics, and education to define and analyze the smart device UX. Industrial literatures related to smart device/application design guidelines, usability/accessibility guidelines were also collected to develop the UX design principles and properties. Collected literatures were analyzed to define the value elements of UX such as utilitarian value, affective value, and social value that affect the human life value of the disabled. UX design principles were developed based on the value elements of UX and existing design guidelines. The UX design properties were refined from the literatures.

Keywords: User Experience, Disability, UX Design, UX Design Principle, and UX Design Property

1. Introduction

User Experience (UX) is treated as an essential concern of product/service designers. As the welfare of the disabled has become a major issue in today's society, UX of the disabled has also become an important issue for designers. The Korean government has established several acts and decrees to encourage the disabled to participate in economic and social activities free from discrimination [1-3]. The Korean government has also established a policy that requires Assistive Technology (AT) to be provided to the disabled [4] to enhance the life quality and accessibility.

Smart devices, such as smart phones and tablets, are essential for modern life. As the smart device market has grown larger, manufacturers are forced to compete heavily for better UX, not only a better quality or function of the smart device. As a result, UX is treated as an essential element to be considered by smart device designers.

Smart devices are essential for the modern lives of the disabled, too. Smart devices with AT can provide accessibility to information and enhance the quality of life of the disabled. However, current smart device designers are only bound to accessibility or usability of user interface (UI), not UX. UX of the disabled is considered important, as their welfare is a major issue in the global society. As a result, UX design guidelines regarding smart devices for the disabled must be revised and enhanced from the UX perspective of the disabled. This study aims to establish the

UX design properties and principles to be considered by smart device designers for the disabled.

2. Literature Survey

A literature survey was performed to define UX design principles and properties. In total, 70 academic and industrial literatures were collected and analyzed. The literatures that contain, define, or analyze the concept of UX, human/life value, and product/service value were collected from various academic fields like philosophy, economics, ergonomics, HCI, sociology, and education. These literatures are used to define the value of UX and value elements.

Literatures containing UI/UX design guidelines were also collected from several organizations. Smart device/application design guidelines were collected from major smart device manufacturers, such as Apple, Microsoft, Google, and Samsung. Web and device accessibility guideline documents were also collected from several government/NGOs, such as WCAG and the Korean government. The collected literatures were used to define UX design properties and UX design principles.

3. Literature Analysis

Collected literatures were analyzed to define the value elements of UX. An analysis was performed in view of the 1) design properties influencing the UX that can be applied by the smart device designers and manufacturers, 2) values

Table 1. UX Design Properties

Category		Description	UX Design Property	Examples
Information Design Property	Information Controls	– Forms, properties, and methods of device inputs and controls to collect information from the user	Text/Speech Input	Verbal Command, Keyboard, Pen, Text Edit Menu (Select, Copy, Paste, etc.)
			Image Drawing/Movie Record	Image Drawing, Photo Taking, Animation/Movie Recording
			Haptic Gesture	Touch Gesture, Motion Gesture, etc.
			Other controls	Non-verbal Sound Recognition, Physiological Signal, Environmental Signal, etc.
	Information Perception	– Forms and properties of information provided by the device to the user	Text Information	Character (Font, Color, Typography, Size), Contrast, Writing Style, etc.
			Image/Icon/Animation/Movie	Image, Icon, Color, Animation, Movie, Chart, Visual Effect, etc.
			Sound/Speech	Verbal Speech (Pitch, Tone, Nuance, Diction, Grammar, vocabulary), Nonverbal Sound, Alert, etc.
			Haptic Feedback	Vibration, Force Feedback, etc.
	Information Structure	– Spatial and sequential layout/structure of the information	Navigation (Hierarchy) & Layout	Menu structure, Menu sequence, View layout, Object layout, Flow/sequence of the contents, etc.
Hardware Design Property	Input Device	– Physical modules/tools to input information regarding their properties	AT Input	Special mouse for the disabled (Eyeball mouse, tongue mouse, etc.), Braille keyboard, etc.
			Motion Sensor	Accelerometer, etc.
			Button, Keyboard	Button Size, Button Pressure, etc.
			Touch Screen, Camera, MIC	Modules Size, Location, Performance, etc.
	Output Device	– Physical modules/tools to provide information from the device to the user	Display, Speaker	Modules Size, Location, Performance, etc.
			AT Output	Braille display, etc.
	Casing	– Physical, external design of the device	Texture & Material	Case Texture, Glare, Temperature, Color, etc.
			Volume & Weight	Case Volume, Weight, Shape, etc.
Functional Design Property	Provided Feature /Functions	– Properties of the contents of the narrative/plots	Applications & Functions	Major/minor function that provided to user by the service and product
			OS Level Assistive Technology Features	Features that implemented on the OS level to support the usage of the product, service, and functions for the disabled.
	Narrative	– Properties of the contents of the narrative/plots	Plot & Character	Plot, Character, Conflict, Events, Setting, etc.
Sociability Design Property	Brand & Marketing	– Social, cultural, or religious image or symbolic image of the product/service/brand	Socio-Cultural Brand Image	Socially/Culturally Shared Meanings, Brand Image, Brand Value, Promotion and advertisement, etc.
	After Service	– Support system to solve the problems that happen during use	Warranty & Troubleshoot	A/S Warranty, Quality Warranty, Technical support, Internet support, etc.

provided by the smart device UX, and 3) design principles that must be considered to enhance the value of UX. Any keywords, concepts, and definitions were collected and analyzed to define the UX design properties and principles.

3.1. UX Design Properties

Tangible or intangible elements that can influence the satisfaction, value, and quality of UX of a smart device were collected from literatures. Major design properties collected from UI/UX accessibility guidelines were related to UI elements, hardware components, and AT modules/functions. Information design properties and hardware design properties were deduced and defined from the elements related to information processing and usability. On the other hand, several distinguishable elements were collected from philosophy, economics, sociology, and education fields. The narrative of the story, such as the properties of the main characters and plot or social discrimination by the brand or product type, is

collected and considered an element influencing the UX. Functional design properties or social design properties were constructed with these intangible/abstract properties (See, Table 1.).

3.2. Value of UX: UX Design Principles

Literatures were also analyzed to understand the values provided by the smart device UX. Gutman [5] defined the products as potential satisfiers of people's value and Park and Han [6] defined the product/service value of the user as a subjective evaluation of a product/service that facilitates achieving the user's life value. As a result, the value of the smart device UX can be defined as the subjective evaluation of the experience that facilitates achieving the user's value.

Table 2. Category of User Value Elements

Value	Definition	Examples
Utilitarian Value	Value achieved by fulfilling desires related to convenience/sloth	Convenience, Comfort, Relaxation, etc.
Affective Value	Value achieved by fulfilling aesthetic/emotional desires	Appearance, Beauty, Cleanness, Sensitivity, Excitement, Cheer, etc.
Social Value	Value achieved by fulfilling desires related to social/cultural activity	Relationship, Friendship, Kinship, Love, Ethics, Belief, Self-expression, Identity, Proud, Power, Ambition, Accomplishment, etc.
Physiological value	Value achieved by fulfilling desires related to survival, safety, and reproduction	Security, Peace, Privacy, Breeding, etc.

Table 3. UX Design Principles

Category	Description	UX Design Principle	Definition
Utilitarian Value Principle	Design principles to fulfill desires related to convenience and sloth	Functional need	Product/service's functions must be designed to meet user's varicose functional requirements
		Flexibility	Product/service must be designed to cope flexibly with the user's varicose usage contexts, such as the task, environment, and user type
		Learnability	Product/service must be learned easily or memorized to use
		Efficiency	Product/service must be designed to achieve the purpose with the least effort
		Simplicity	Product/service must be designed to be simple
		Informativeness	Product/service must be designed to provide clear and detailed information
		Error Prevention	Product/service must be designed to minimize user errors and to recover easily from the errors
		Accessibility	Product/service must be designed to be accessible to information and control
		Consistency	Contents, structure, interaction, and design of product/service must be consistent
Affective Value Principle	Design principles to fulfill aesthetic/emotional desires	Directness	Control of the product/service's function or interface must be given to users
		Delicacy	Product/service must be designed to be delicate
		Reliability	Product/service must feel reliable
		Comfort	Product/service must feel comfortable and stable
		Simplicity	Product/service must feel clean, neat, and ordered
		Aesthetics	Product/service must feel aesthetically satisfactory
		Addictiveness	Product/service must be designed to make the user want to keep using the product/service
Sociability Value Principle	Design principles to fulfill desires related to social/cultural activity	Pleasure	Product/service must be designed to make the user feel pleasure and delight when using the product/service
		Relationship	Product/service must be designed to support the user to establish and maintain social relationships
		Socio-cultural value	Product/service must be designed to meet the user's social/cultural/religious frameworks
		Pride	Product/service must be designed to make the user feel ascendant and superior to others
		Equality	Product/service must be designed to make the user not feel discriminated against by others
		Identity	Product/service must be designed to support the user to express their identity

To define a user's value, a total 61 value elements and their definitions were extracted and analyzed from 16 literatures. Duplicated or resembling elements were merged. Collected value elements were categorized into utilitarian value, affective value, social value, and physiological value. The proposed categories were based on the common categories used for the classifications of related academic works [7, 8, 9] (See, Table 2).

Physiological value refers to the most basic needs/desires of human beings that must be met [7]. However, based on this research, the physiological value is excluded, as the physiological needs are assumed to be already satisfied by the current smart device usage

situation. Proposed value elements and categories were used to establish the UX design principles.

UX design principles collected from the literatures were re-arranged based on the value element categories. A number of usability principles collected from the UI/UX guidelines were designed to be major components of the utilitarian value principles. Affective value principles are based on the research of Part et al. [10] and several Kasei engineering literatures (See, Table 3).

Discussion and Conclusion

This study aimed to collect and compile the UX design principles and properties of smart device design for the disabled from literatures. Several UX design properties and principles are drawn and categorized by the perspective of the human life value and the concept of the value of UX.

UX design principles and properties of smart device design for the disabled were also defined to enhance the value of the smart device's UX. Literatures related to UX, human/life value, and product/service value are collected from various academic fields, including philosophy, economics, ergonomics, and education, to define and analyze the elements of the smart device UX. Industrial literatures related to smart device/application design guidelines and usability/accessibility guidelines were also collected to develop the UX design principles and properties. Collected literatures were analyzed to define the value elements of UX, such as utilitarian value, affective value, and social value, which affect the human life value of the disabled. UX design principles were developed based on the value elements of the UX and existing design guidelines, and UX design elements were refined from the literatures.

This research has several limitations. Suggested design properties and principles must be verified and validated. Furthermore, systematical design methodologies are essential to apply the suggested concept to the smart device design process.

The results of this study could be used to help the disabled and smart device manufacturers evaluate the current state of UX of the disabled and enhance the designs of smart devices and related services. In conducting further research, the proposed UX design elements and UX design principles could be used to create a systematic methodology to generate detailed UX design guidelines for the disabled.

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