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DEVELOPING SENSORY FUNCTIONS:
TRANSFER HUMAN SENSES FROM CONTEXTUAL PERCEPTION

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ABSTRACT

Approaches in interaction design were explored a hyperspace that human cognitive actions and interactive system in both two end. Recently, this dualism in diverse direction is integrated in a notion of context, which had brought from social science as the manifest of implicit interactions that makes "sense" from human actions or activities. In this research, we applied perception in ecological view to capture the stimuli of context in its dynamic nature, and proposed a notion of sensory function in extracting the transfer character of sensorimotor as transmitting signals to perception. Firstly, a theoretical approach in integrated context and perception was reviewed as the nature of stimuli and sensorimotor that can offer a grounded knowledge to carry images of context to perceptual actions. Secondly, we practiced a process in conductive way to analysis and synthesis the transfer function as a notion of sensory function. Thirdly, an application of prototype was built for order action that situated in a coffee shop, and implemented with a concept of "waiter cup". To conclude, this study may be important to support incentive observation at the early design stage, and provides a tool to exploring contextual perception in designing interaction.

Keywords: *Interaction Design, Sensory Functions and Contextual Perception*

1. INTRODUCTION

In decades, an interdisciplinary research of human-computer interaction (HCI) has explored the hyperspace between human ability and interactive systems [1]. Recently, the discussion of hyperspace, or said in context in enhanced human actions or activities, to be the manifest in designing interactive systems [2]. To explain in detail, this context is originally rooted in social science [3], to expressive tacit social order or rules that can be treasured in empirical approach to capture fragmentary scene, and named as ethnomethodology [4]. The

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goal of ethnomethodology is mainly unclear, to acquire insight from a record in observation, and lack of evidence in conduction process in subjective concerns.

In this approach, we intend to extract the context, by adapting a notion of visual perception in ecologic views [5] that indication to dynamic nature of sensorimotor, and the process that human has perceived in particular situation . Therefore, in order to comprehensive the mechanism of transfer sensorimotor to perception for interaction, was driven in the objective, which is described as following:

To describe the integration from contextual environment as stimuli to human perception.

To comprehensive the mechanism of sensorimotor that transfer the stimuli.

To develop a process in extract the contextual perception, and the nature of transferring functions as sensorimotor.

To design an application that applied developed process for transferring functions by sensorimotor.

2. STATE OF ART

In this part, we discussed the context and perception in parallel, and tried to frame the term of "Contextual Perception" in grounded theoretical reviews. In previous interaction design studies, the notion of context in studies of interaction design is addressed in an assumption of tangible object with intellectual space that supports designing interactions with manifest of contextual environment [6]. Also, the context can be referred as a route that social activities, which has performed human-computer interaction (HCI) in both direction of tangible computing and computer-supported collaborative work (CSCW) [7]. In this sense, however, the context was concerned as implicit, activity-centered, and situated actions in interpretation as root of interactions [8]. However, how do human beings percept the "context" via their sensorimotor can lead us to have a different view on the holistic approach for perception? Traditionally, especially the theory of perception, which based on the "images" as the output of perception system [9], and had brought the activities of visual cortex via bodily sensorimotor (i.e., the eye). The input of stimuli is concerned with color or deepness of the "images" with stable information in previous perception studies [10].

Dynamics issue in exploring the nature of stimuli was conducted with open system as ecological in visual perception. Globally, the "image" is the output and the input of ecological visual perception in vice versa, to be the continuous conductive process. This perceptual property is addressed in the term of "affordance"[11]. The notion of "affordance" that integrated visual image process is the product of how human beings sensing physical environment. Therefore, the nature of context is considerably stable as stimuli that have presented another question about: how human beings percept context via "affordance" [12] ?

Several approaches aimed at integrated contextual environment with human perception, and explored several design method that given the contextual nature to interaction design [13]. Theoretically, when a notion of "social affordance" is differed to interpret human activities as participant in initialized social order [14]. That means the context of social activities was mediated with implicit social rules. The meaning of perceptual process is under

these external social contexts of situated actions [15]. For example, the e-mail system is developed with a context of social rule as reply, or reply-for-all as situated actions from interpretation of user activities. In this sense, integrated context and perception is highlighted with exploration in design activities empirically. As "cultural probe" was developed as a data acquisition tool that investigates daily actions of users as ethnomethodological approach [16]. The "Context mapping" was developed as a mapping tool in exploring contextual environment of daily life, and given a communicational method [17].

To further definition of contextual perception, the notion of context-awareness has to be compared with, and provide a clear definition in their properties. The context-awareness was an approach as implicit interaction (i.e., the context) that can be designed as the metaphor in trigger human awareness [18]. However, the perceptual stimuli might be the missing part in generating the "image" that affords and supports situated actions which user behave in the context. The notion of contextual perception is inferred as the inner mechanism (i.e., sensorimotor) that trigger dynamic perceptual images [19]. Therefore, the nature of transformation should be referred, to adopt human activities in particular intention, to be carried on human senses physically and sensations socially. In this sense, the set of sensorimotor plays a mediated-position in delivering signals both to awareness and perception, and to produce "image" in objective expression and can be interpreted by human beings through functional meanings.

3. METHOD

A merged method is proposed by extracting the sensory function (FS), which is perceived and expressive in a certain context. To probe the context, the ethnomethodology has suggested to exploring the "immersion experience" for each participant. Therefore, a method of functional analysis (FA) [20] can help us to achieve the goal of developing sensory as transfer functions [21]. Also, the four stages are presented as Figure 1, as observation for the context, interpretation for clusters, analysis for functions and prototyping for reflection.

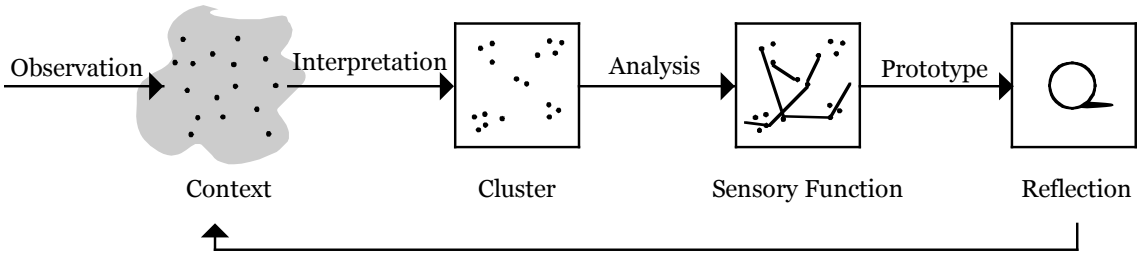

Figure 1: Stages for capture contextual perception

The objective of develop FS is focused on explore possible situated actions that happens under as an implicit interaction. Instead of complex activities of sensorimotor that transferred to the perception, the essential function should be explained, and confirmed with the set of actors. Firstly, in the stage of observation, two questions were asked: (1) what is the situation, which should be selected to limited time factor for simplified the context, and (2) "who are the actors", which subject is observed as a set of actors that played in certain situation. For more explanations, although the notion of actor is to eliminate classified label

(e.g., the occupation, social position or sexual difference), the "artificial actor" is allowed with expand the observational properties. Secondly, the interpretation was processed, to collecting activities of each set of actors, or extracting into sense set. The cluster of senses (i.e., sight, hearing, taste, smell, touch, balance, and temperature) has defined in nature, and was contributed to transfer the FS. Thirdly, the analysis for FS was proposed to adapt transfer functions (FT) that each function should be transferred from one cluster to others. The characterized FS also needed through critical, specified cluster of senses. Finally, the prototype was suggested in this stage, to be the output of exploring contextual perception. Users, who interacted with the prototype, with their curiosity, were reflected to the situated actions that we desired to achieve.

4. RESULT

An application of sensory function (FS) was processed with exploring situated actions with applied for contextual perception. The situations as social settings or perceived "stimuli", and provide a situated observation during the ordering a coffee as a situated action. In coffee shop we know, a place for social activities in a city, and provide various drinks (mainly about coffees) for customers. Most of the time, when we walk into a coffee shop, a dialogue is happened in ordering drinks to serviceperson, which we defined as the "ordering process". With applying the functional analysis method, we can develop FS through observation systematically.

4.1. Observation for the context of "coffee shop" and "order process"

The incentive observation is processed as the first engagement to exploring FS. The setting of coffee shop is different with its characteristics as Figure 3. has shown. In this stage, we asked:

What is the situation? Globally, at least, five situations are expressed within the space; (1) a dialogue of waiter or clerk, (2) waiting for drinks to be prepared, (3) waiter send the drink to the desk (or take-out), (4) enjoy your drink with your friends, newspapers, books or working with PC, (5) finish the drink and out of the coffee shop. A single "order process" should include in (1), (2) and (3) as situations.

Who are the actors? The waiter, the clerk, the coffee maker, the coffee cup and the drinker.

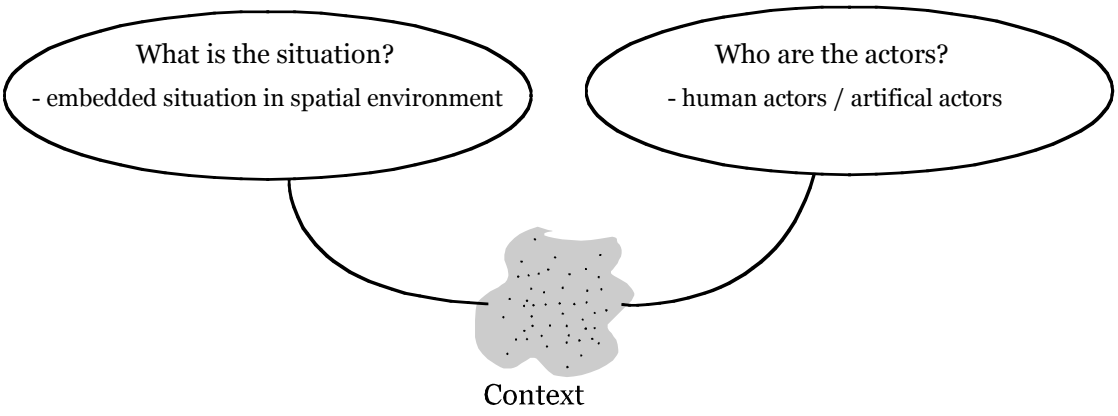

Figure 2: Observational questions: the context and actors

4.2. Interpretation from "order a drink"

Specified situated actions as ordering a drink was impressive with implicit social interactions. According to observed data, as ethnomethodology suggested, was extract beyond the situated actions. Figure 4. has shown that clusters of object (i.e., coffee cup, table, cash register, and menu), sensory organs (i.e., eyes, hands, ears, nose, and mouth), drinks (i.e., coffee, macha, latte and tea), and spatial (i.e., room and counter).

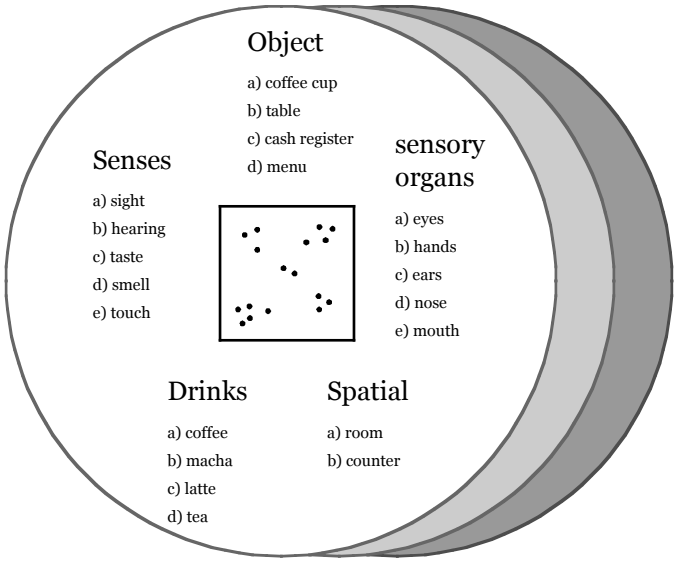

Figure 3: Clusters in "ordering process"

4.3. Analysis for sensory function: touch, tag, tap, twist and push

Since FSs were formulated in this stage with consideration to open system of clusters. This nature of FS is manifested, to be adopted by the definition of transfer function, which were at least two different clusters that interacts by the means of the system. Each FS was developed to respect the formulation absolutely. Figure 4 presents several samples that defined as FS, by following situated actions in interpretation with context. For example,

FS 4: the ordering processing should provide menus that coffee drinker in seeing (eyes) their preferable drinks.

FS 9: the ordering process should provide coffee cups for coffee drinker in seeing (eyes) the drinks to be filled with.

FS 11: the ordering process should provide a counter that waiter can using their hands (touch) on the cash register.

FS 12: the ordering process should provide a room that coffee drinkers and waiters can see (eyes) and hear (ears) to each other.

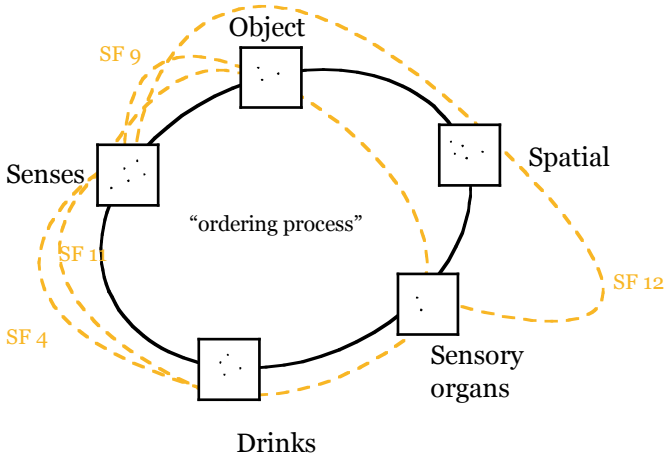

Figure 4: The extraction of transferring sensory function (FS)

The simple synthesis in generating FS to be installed as embedded actions with a certain object was mentioned in "coffee cup". A set of FS was differed to a tangible input and sensory output. The tangible functions, with respect of embedded actions that may trigger the perceptual action, were designed as five inputs: (1) "push" for adjust the deepness of drink, (2) "tap" for adding the sugar, (3) "touch" for select the volume, (4) "tag" for choosing the variation of drinks, (5) "twist" or adjusting temperature. As Table 1. has presented the synthesis process in proposed nature of embedded interaction with contextual perception performs.

Table 1: Synthesis from tangible input and sensory output

Tangible input	Sensory output	Sensory function (FS)
Push	Visual: the red circle to be enlarged by the pressure of push	FS 2: the ordering process should provide selection of FS 7: the ordering process should provide touch of receive the coffee cup from the waiter.
Tap	Sound: the water drops for simulating that one sugar has added	FS 3: the ordering process should provide drinkers to have hearing (ears) and seeing (eyes) to add of sugar. FS 4: the ordering processing should provide menus that coffee drinker in seeing (eyes) their preferable drinks.
Touch	Visual: the linear LED	FS 7: the ordering process should provide touch

	lights when user point the volume of drink	of receive the coffee cup from the waiter. FS 9: the ordering process should provide coffee cups for coffee drinker in seeing (eyes) the drinks to be filled with. FS 10: the ordering process should provide coffee drinkers and clerk to both have sight in measuring the volume as coffee cup. FS 11: the ordering process should provide a counter that waiter can using their hands (touch) on the cash register.
Tag	Visual: select drinks with RFID chips	FS 6: the ordering process should provide menu for seeing and pointing (hand) FS 8: the ordering process should provide counter that the coffee cup can be set or drinks FS 11: the ordering process should provide a counter that waiter can using their hands (touch) on the cash register.
Twist	Visual: the temperature shown on the counter	FS 11: the ordering process should provide a counter that waiter can using their hands (touch) on the cash register. FS 15: the ordering process should provide a selection from temperature of drinks.

4.4. Prototpying for reflection

The prototype was implement by physical computing to achieve the tangible input and sensory output as interactive system, which has shown in Figure 5. Several sensors are applied for receive the signals from actions: pressure sensor for push, touch sensor for tap, slide touch sensor for touch, RFID sensor and receiver for tag, and rotation sensor for twist. Figure The working model was performed in real-time computing as providing the perceptual stimuli or contextual perception that human beings can be perceived.

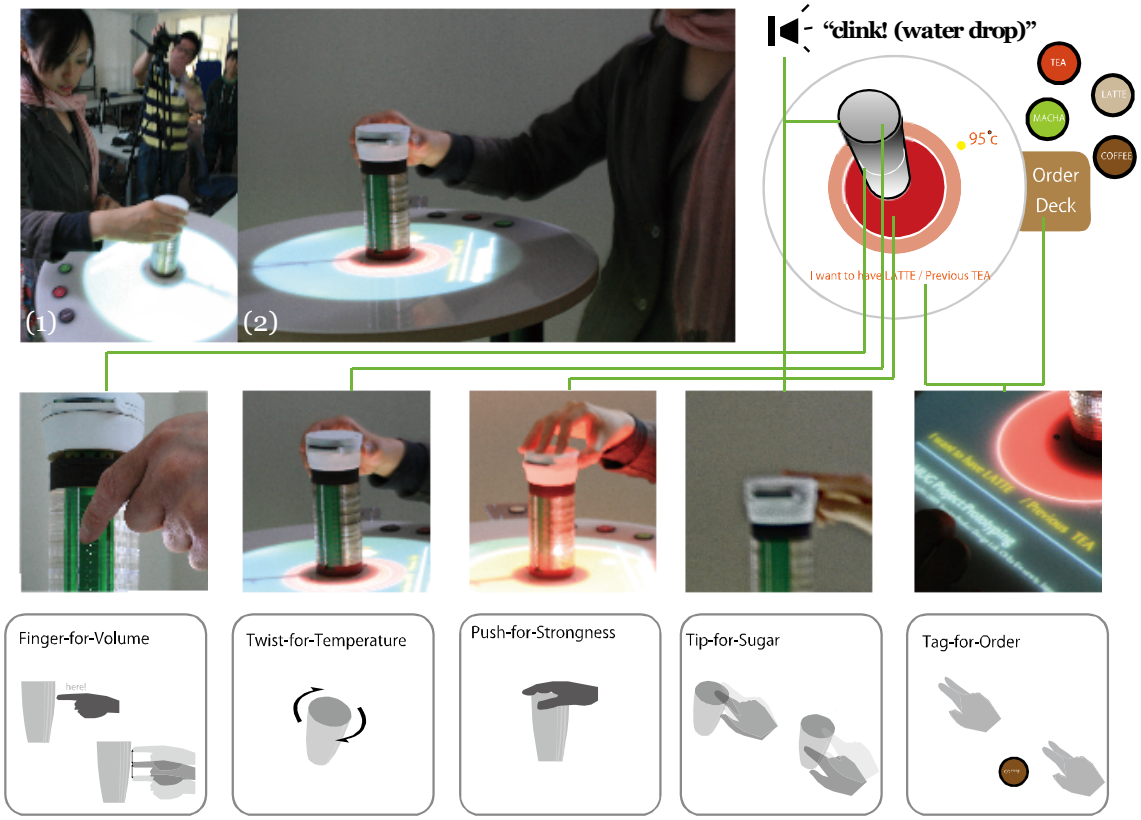

Figure 5: Prototype of "waiter cup"

A slight reflection was addressed that, empirically speaking, the perceptual understanding by FS is delivered to create "image" from context was achieved as comprehensive the tangible input. 33 users were separated into two groups of valid and invalid information before, and asked for using the "waiter cup". The accuracy of invalid group for each tangible input was tested by reminding the functions after interacting with the "waiter cup", and listed as followings:

"Push": for accuracy of 40.6%, and several users shows the push for deepness is not easy to understand.

"Tap": for accuracy of 43.8%, and the sound of water drop is sensed on diversity of opinion.

"Touch": for accuracy of 46.9%, and mostly sense by the light but regardless of meaning.

"Tag": for accuracy of 93.8%, and almost people realize the meaning and acts felicity.

"Twist": for accuracy of 90.6, and which is almost the first approach to the "waiter cup".

5. CONCLUSION AND DISCUSSION

By adapting the functional analysis with transfer sensorimotor to sensory function as extract situated actions to embedded interaction, the approach for exploring contextual perception was proposed to achieve the objective in investigate humanities for interaction design. To conclusion, we may treat the notion of contextual perception as the metaphor in exploring human situated actions to perception, and can be observed in implicit contextual manifest. When the artificial object is designed for interactive purpose, the contextual

perception should be concerned, to expand and improve the system for more humanities. Thus, a further discussion of the "waiter cup" was designed as prototyping that reflected the situated action in certain context. However, the mechanism in deliver bodily signals to minds will be the next topic to comprehensive the situated actions, and how to design the embedded interaction in serving perceptual "images" in dynamic properties. For this reason, the nature of contextual perception is needed more theoretical and empirical approaches, and a reflection to visual-based representation is necessity.

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