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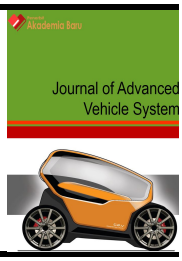

Proposition and Verification of a Design Method to Discover Latent Needs Based on Empathy, Experiences, and Working Prototype by Designing Autonomous Childcare Vehicle

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ABSTRACT

For products and services to have novelty and superiority in the market, it is important to grasp the latent needs obtained from users. Latent needs are defined as "those that many customers recognize as important but cannot be clearly articulate in advance." Various surveys in the discovery of ideas aim to uncover latent needs, but the conditions and factors that can obtain the latent needs are unspecified. In our research, non-prototype-based and prototype-based interviews were conducted to a focus group of men and women who had childcare experience. The interviews were regarding the effect of the COVID-19 pandemic on their daily life including childcare and housework. The consumer responses in the interview were then interpreted based on the guideline commonly used by other designers. Then, as we assumed that experience, empathy and knowledge on working prototype is essential elements in product development, the new additional guidelines which are 'to write a statement with empathy', 'to write a statement as a designer', and 'to write a statement as someone with experience' were proposed and utilized during interpretation to see whether these new guidelines will influence the process of identifying latent needs of consumers. From the research result, we were able to conclude that the number of interpreted needs increase when we additionally applied the new proposed guideline. Although the number of increased needs is small, the needs might not be interpreted if the new guidelines were not considered. We were also able to obtain a few important latent needs when we applied these new guidelines. We could conclude that by including these guidelines upon interpreting raw data of consumers interviews might lead into discovering important and critical latent needs of the consumers.

Keywords:
Innovative Design; Latent Needs; Consumer Needs, Interview; Prototyping; COVID-19

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1. Introduction

1.1 Importance of Latent Needs in the Initial Design Stage

Latent needs are those that many consumers recognize as important in a final product but do not or cannot articulate in advance [1]. Latent needs also can be defined as a desire or preference of consumers which cannot be satisfied due to a lack of information or availability of a product or service. By understanding latent needs of target consumers, inventors are enable to develop great innovations

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that are not delivered yet in the marketplace. The challenge in identifying latent needs is finding the method to elicit from consumers' needs which are not clearly addressed by them. The success of a product or a service is largely dependent on how far the product or the service satisfies consumer needs and demands. Therefore, latent needs are particularly critical to product innovation and success.

A good assisting method is needed to be identified in overcoming the challenge of elicitation and understanding the latent needs to create a valuable product to help the consumers in this modern society. There were various types of research conducted previously to create a guideline for creating valuable inventions for society. For example, Tsutsui *et al* [2] developed an empathy formation model as other design methodologies had low practicality of empathy. This model consisted of 4 steps of discovery, immersion, connection, and detachment and was expected to contribute to improve the empathy formation upon the innovative design. Yokoi *et al* [3] improvised the design thinking process [4] and introduced a prescriptive model of the cognitive design process that consisted of 5 steps of requirement finding, design solution finding, verification, documentation, and implementation that will assist design thinking processes. In the first step of this prescriptive model of the cognitive design process which is the requirement finding step considered empathy as an important element in the process. Therefore, we are able to observe that empathy is an important and essential element in understanding consumers and finding and designing the best solutions for them and we assumed that it was important to consider empathy in our research.

1.2 Research Purpose – Interpreting Consumer Responses into Latent Needs

In this research, the consumers' responses from the interviews in our last research were utilized. The interviews were conducted in the year 2020 during the COVID-19 pandemic. COVID-19 has caused a lot of death and infected people around the world [5]. As the pandemic spread, a lot of countries were forced to go into lockdown or declare an emergency state. Business organizations and companies promoted working-from-home to prevent the spread [6]. In addition, 99% of the world's 2.36 billion children experienced movement restrictions as schools, childcare institutions, and other facilities were closed. Most working parents were worried about their family safety and their children at home while they were also struggling to balance their responsibilities to their child and their employer according to a survey [7]. It also indicated that working mothers were affected twice more than fathers regarding work and childcare while 52% of single parents responded that it had become stressful trying to earn while taking care of their children. Therefore, the issue regarding the effects of the COVID-19 pandemic on parents, childcare workers, and children was utilized as a research sample. Parents at home were unable to work efficiently and productively because of the distraction of their children whom their schools were closed. Parents were worried that their children might involve in dangerous incidents if left unattended. In the region where the school and childcare institutions were allowed to operate, parents and childcare workers were concerned about the children's safety towards COVID-19 which led to intensive cleaning and sanitizing. Based on the situations, this research was conducted in finding the latent needs of the parents, childcare workers, and children to assist them in going through their daily life in this COVID-19 pandemic.

Upon interpreting the responses, the 5 'guideline for writing need statement' method by Ulrich et al [1] was utilized. There are "to focus on 'what is the product' and not 'how the product work'", "to be specific as in original responses", "to write 'positive' and not 'negative' statements", "to list the attribute of the product", and "to avoid 'must' and 'should' in the statement". Then, by considering empathy as an important element, we introduced another 3 new guidelines which are "to write a statement with empathy", "to write a statement as a designer", and "to write a statement

as someone with experience" to compare and investigate whether these new guidelines will influence the process of identifying latent needs of the consumers and will be able to elicit important and critical latent needs.

2. Research Methods

2.1 Working Prototype for Consumers Interview

Prototyping was usually conducted for various purposes such as acquiring consumers or possible lead users' reactions, finding potential customers, avoiding costly iterations, integration and system testing, and feasibility study. Physical prototyping assists in visualizing and developing an idea or verifying a design concept and function. A working prototype represents all or nearly all of the functionality of the product and allows the designer or consumers to see and test the idea of a design concept of the product.

A working prototype of a device to help in overcoming the problems in childcare that occurred during the COVID-19 pandemic was created. The working prototype will provide the consumers high-quality channel of information and images about the solution idea of the problem. This working prototype will be used in the slide presentation in the interview.

2.2 Method of Identifying Latent Needs

Identifying needs is an important part of the product development process. This is because the process of identifying consumer needs will provide an excellent channel between consumers and designers or product developers. According to (Suh, 1990) [8], incorrect translation from consumer responses to consumer needs as he recalled as the functional requirements might lead to long process development. Although this process is closely related to the next step of product development which are to determine product specifications and generate product concepts, designing team should identify all possible need of consumers without considering concepts and specification of product that the team might select later.

For collecting raw data, a focus group interview was conducted. A focus group interview is a tool for qualitative research where a group of people were selected and asked about their opinion and perceptions about a particular topic. However, researchers need to choose suitable participants, create a comfortable environment to talk and must respect and believe that they will learn valuable information from participants. A total of 13 parents of different genders and nationalities were selected as a focus group as the objective of the interview was to obtain latent needs in childcare. They were divided into 5 smaller groups with the same gender, nationality, and occupations to create a more focused group.

Then, two different interviews were conducted with each focus group. In the first interview, a slide presentation of problems caused by covid-19 to parents and childcare workers with ideas for solutions was introduced. Then they were interviewed and their responses were recorded. In the second interview, the prototype prepared in the section above was used in the slide presentation to support the ideas for the solution. Then the parents were interviewed again and their responses were recorded. The interview results were then listed, interpreted, and analyzed according to the 5 guidelines for writing need statements by Ulrich et al (2012) [1] to identify the needs of the consumers. There are "to focus on 'what is the product' and not 'how the product work'", "to be specific as in original responses", "to write 'positive' and not 'negative' statements", "to list the attribute of the product", and "to avoid 'must' and 'should' in the statement".

2.3 New Guideline Proposition for Writing Need Statements

Ulrich's five guidelines for writing need statements are to be known as effectively working on the interpreting processes of identifying all types of customer needs, not specific for identifying latent needs. Hence, in this paper, we addressed additional guidelines to discover latent needs correctly, precisely, and deeply.

The customers' responses from both interviews were interpreted again while considering the 3 new guidelines which are

1. to write a statement while empathizing with the customers
2. to write a statement as a designer who understands the concept of the working prototype
3. to write a statement as someone with experience which in this case as a parent in this Covid-19 pandemic

The proposed guideline 3 was outlined as we assumed that by having someone with the similar experience with customers to interpret the raw data from customers' interviews, we will be able to interpret the raw data more precisely. Recent research by Holtta-Olto (2016) [9] indicate that people with lead user like ability to express latent needs, needs that are shared with but not originally found in regular users. von Hippel (2006) [10] defined lead users as users with a higher expectation of innovation-related benefit and are more likely to innovate as they move increasingly ahead of the trend, therefore von Hippel focused on lead user in his research on finding commercially attractive user innovations. On the other hand, empathic lead users are defined by Lin et al (2007) [11] as ordinary customers or designers who are transformed into lead users by experiencing the product in radically new ways, via user experiences. Empathic lead user interviews were observed to have a significantly positive effect on latent needs discovery in the trial study, and might emerge as a promising tool for supporting innovation and breakthrough concept generation. Therefore, we are able to observe that experience is one of an important element in interpreting latent needs.
However, the guideline 3 is limited to be applied in every case on product development as different experience is required to interpret different raw data. Based on Tsutsui et al [2] in his empathy formation model, empathy is an essential element in design process. Yokoi et al [3] considered empathy as important element in the requirement finding step of their prescriptive model of the cognitive design process. Therefore, we assumed that by having empathy to the parents and children in this case, we will be able to interpret the raw data more deeply. Then, the proposed guideline 2 was outlined as we assumed that the designer who design the prototype and understand deeply the concept of the working prototype will be able to interpret the raw data from customers' interview more correctly. Research by Lin et al [11] indicate that designers can be transformed into lead users by experiencing the product in radically new ways. Designers that act as lead users are able to demonstrate stronger domain-specific innovativeness than more "ordinary" users (Schreier, 2007) [12] as lead users perceive new technologies as less "complex" and might therefore be better prepared to adopt them.

The results were then compared to see whether these new guidelines will influence the number of interpreted needs.

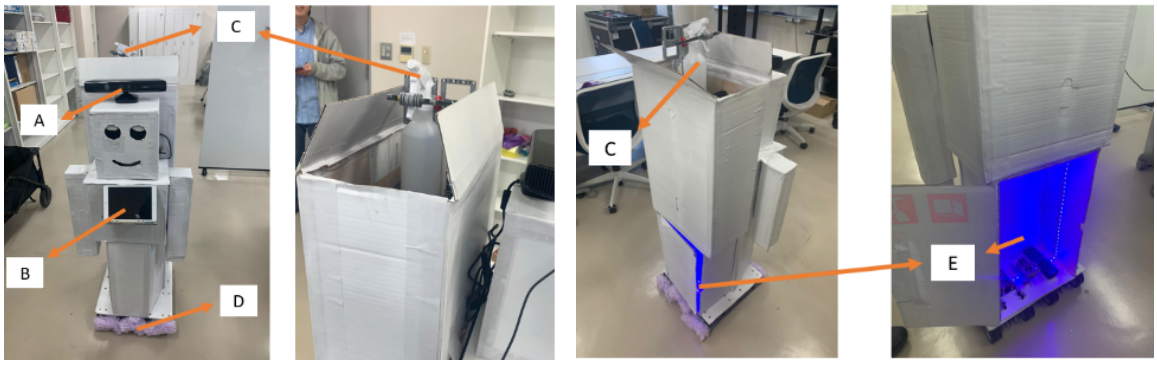
3. Results and Discussion

3.1 Working Prototype for Consumers Interview

A working prototype of a robot or device that support housework and childcare during the covid-19 pandemic was built. The main function of this prototype were childcare function, disinfection and cleaning function. The functions covered in childcare function were remote-monitoring, body

temperature measurement, crime prevention and security and also for entertainment and education. Indoor disinfection and small things disinfection were divided in the disinfection and cleaning function. Other functions of the prototype were scheduling and monitoring study and bathing time. Figure 2 shows the prototype.

The shape of the prototype is like a humanoid robot to give a more welcoming look. (a) Camera (A) is mounted on top of the device and multi-function touch panel (B) are used as the user interface, while brush (D) is attached around the tire to help in cleaning. (b) The height is about 120 cm which is above children height and safe for sanitizing process. (c) It is equipped with sanitizer spray (C) and (d) UV light sanitizer box (E).



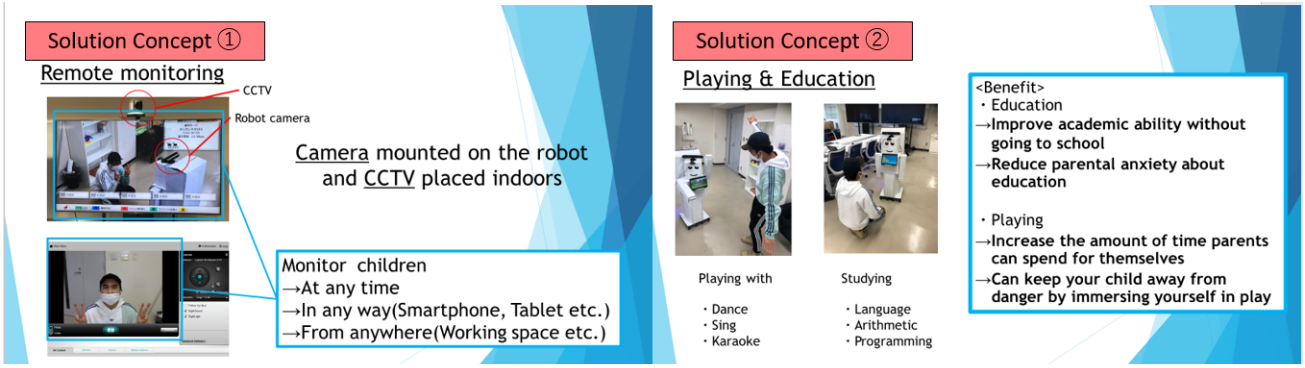
(a) (b) (c) (d)

Fig. 2. Prototype for Solving Problem Caused by COVID-19 Pandemic

3.2 Problem-Based Interview and Prototype and Story-based Interview

In the interview session, two different presentation slides were provided before the interview. The two presentation slides were named `Problem-based` slide and `Prototype and Story-based` slide. In the `Problem-based` slide, brief information about the latest COVID-19 cases and type of virus transmission was introduced. Then, how the pandemic affects the parents were addressed such as school closing or parents needing to work from home. The possible impacts and problems that parents and childcare workers might have in childcare and virus prevention during this pandemic were then explained. The last part was the suggested solution idea and device to help in the problem. The idea was to create a device that will cover two essential functions in house or institutions which are childcare, sanitizing, and cleaning. In the interview session, interviewees were asked about their current life in this pandemic, the good points and bad points of the COVID-19 pandemic daily life, and their opinion regarding the suggested solution idea.

In `Prototype and Story-based` slide which is partially shown in Figure 3, it started with information about the device sketch and prototype. Then, the solution concept by using prototype and story were explained. In the solution concept, how the remote monitoring concept works in helping the parents to monitor their children was explained. Next, the virus sanitizing solution such as automatic sanitizer spray or UV light sanitizer box was explained in the story. In the last part, other possible function that the prototype is able to do were also given such as put the child to sleep or ventilate the house. In the interview session, interviewees were asked about how they will use the device, the good points and bad points about device and their opinion about the improvement of the device.



(a) **(b)**

Fig. 3. Prototype and Story-Based Presentation Slides. (a) The first solution concept, remote monitoring which is a system to monitor children from other places was explained. (b)The second solution concept, playing and education which provide entertainment and educational lesson for the children

3.2 Interpretation of Needs from Consumers Responses

The raw data which are the consumers' responses from both Problem-based and Prototype and Story-based interviews and the interpretations into the needs based on the 5 guidelines by (Ulrich et al, 2012) [1] were partially shown in the Table 1 and 2 below.

Table 1
Raw data and interpreted needs from problem-based slide presentation and interview (Group 2)

Question No	Interviewee	Raw Data (Interview Answers)	Interpreted Needs
1	A	– I ask husband to shower after returning from work. – I disinfect all clothing from the outside – I always wash hands after returning from outside – I wash baby's hands after returning from daycare –	– The device will remind user to wash hand, sanitize or shower once arrived – The device will sanitize clothes brought from outside – The device provides sanitizing alcohol for hands
	B	– I separate the clothes you wear outside from the clothes you wear only inside the house. – I do laundry every day (sometimes twice a day)	– The device will remind on laundry schedule – The device will scan for virus and sanitize clothes – The device will alert user if clothes from outside are not placed properly
	C	– I limit the number of time children can play outside, and only play in areas with few people. – I separate clothes after going outside and showered after each return. – I have a special place for everything that comes in from	– The device will suggest places that is safe and less congested – The device will suggest outdoor games suitable for short time – The device will remind user to separate clothes and to take shower after going out – The device will remind user to leave

		the outside (e.g., parcels from the mailman).	things from outside and sanitize it
2	A	– I can work from home (no need to go to college)	– The device is able to be used at home or in campus
	B	– Online classes help me make more time at home while taking care of my children.	– The device is able to conduct video call for online classes – The device will take care of the children during parents' online class or meeting
	C	– Cleanliness improved at home (children wash their hands all the time) – We don't have to ask the children to take showers (they are afraid of viruses and know when to shower) – Children are more obedient when it comes to cleaning	– The device will remind user to shower, wash hand and sanitize – The device will remind children to shower, wash hand and sanitize – The device will clean up and sanitize the house – The device will suggest cleaning schedule
3	A	– We cannot go anywhere for fear of the virus. – I become paranoid (feel like the virus is everywhere) It is difficult to disinfect hands each time – Skin on my hands becomes dry (I need to bring skin moisturizer) – I need to wipe chairs and tables when eating in restaurants	– The device is able to scan and detect virus – The device will remind to sanitize – The device will provide sanitizing option that is safe and gentle to skin – The device is able to provide sanitizer with moisturizer – The device's sanitizing part is able to be taken and carried outside to sanitize
	B	– The children were bored at home because I can't go anywhere.	– The device will suggest fun game and activities
	C	– Children are bored in the house. – Children are always looking for new toys – I need to buy lots of toys (so I do not need to go out often to buy new toys)	– The device will suggest fun activities and game suitable for children – The device is able to suggest new game with toys in the house – The device is able to do shopping for new toys
4	A	– I want a hand sanitizer that does not dry out my skin. – I want a device that can see the virus (visually)	– The device is equipped with sanitizing option that safe and gentle to hands – The device is able to scan virus

	B	– I want an air humidifier disinfectant	– The device is equipped with sanitizing option that include humidifier
	C	– I need a machine that can disinfect the entire room (like an air conditioner, but be careful not to make it difficult to breathe).	– The device is able to sanitize one whole room – The device' sanitizing process is safe to user respiratory system

Table 2
Raw data and interpreted needs from prototype and story-based slide presentation and interview (Group 2)

Question No	Interviewee	Raw Data (Interview Answers)	Interpreted Needs
1	A	– I want to take it everywhere as a helper – I can make it as a maid/nurse	– The device is able to be used indoor/outdoor – The device's power last long – The device is able to do the task for maid or nurse
	B	– I can use the robot to calm or put your baby to sleep. – It can give a pat action or put baby to sleep – It can sing a lullaby to put baby to sleep	– The device is able to calm the child – The device is able to put to sleep by patting the child – The device is able to sing lullaby to put child to sleep – The device is able to play lullaby song from mother's voice
	C	– I can instruct my children about time using the robot (e.g., time to shower, time to pray, time to study).	– The device is able alert children for their schedule
2	A	– The disinfection part is perfect.	– The device is able to sanitize the house using alcohol sanitizer or UV light – The device is able to sanitize small item in UV box
	B	– I like all the function of the robot	– The device is able to monitor children and notify parent in case of emergency – The device is able to measure body temperature – The device is able to judge the level of sickness and notify parents or authorities (hospital etc.) – The device is able to greet user or stranger at the front door – The device is able to scan and recognize user/stranger

			– The device will send/update the information of people entering/exiting the house to parents – The device will notify authorities (police etc.) if the person in/around the house is suspicious – The device is able to teach user – The device is able to play, dance, sing and karaoke with user – The device is able to sanitize the house using alcohol sanitizer or UV light – The device is able to sanitize small item in UV box – The device can clean the house while moving around the house – The device is able to sweep and vacuum the floor – The device is able to wake the child up – The device is able to put child to sleep – The device is able to give milk and bath, and change diaper – The device is able to make children to study and monitor them – The device is able to ventilate room (All the function listed in the Prototype and Story-based slide)
	C	– It is suitable for children's scheduling	– The device is able to manage the schedule for children
3	A	– The device has no first action (and the child has already been in an incident).	– The device is able to react fast in case of emergency – The device is able to react fast in case of danger
	B	– If a child is involved in an incident, it does nothing (e.g., - broken glass). – Notifying parents is not sufficient because the child may come into contact with the broken glass	– The device will stop child from touching dangerous thing (broken glass, open wire, fire etc.) – The device is able to cut electricity in case of danger – The device is able to stop water in case of danger – The device is able to clean up broken glass, spilled water etc. – The device is able to recognize items (food or not) that a child wants to put in mouth

			– The device is able to prevent child from choking – The device is able to conduct CPR – The device will notify parents in case of emergency – The device is able to decide who to notify first (parents or authorities)
	C	– It cannot detect people from outside the house – Too large (difficult to move)	– The device is able to monitor people/strangers inside/ outside/ around the house – The device's size is able to be customized according to child age or user preference
4	A	– I prefer a smaller size (easy to carry anywhere in the house) – Not require a cleaning section	– The cleaning part of the device is able to be detached. – The device's weight is suitable to be carried by user around the house
	B	– Can the robot make the first move to save the children? (e.g., collect broken glass) – ·Robot needs to be more active to track children's paces (children get bored easily) – Can it collect and put away toys (separate toys)? – I want touch screen for children to write on – I want the device to carry the baby like a mother	– The device is able to react fast in case of accident (ex. Broken glass) – The device is able to move slow or fast according to the task/activity – The device is able to clean up and arrange toys according to type – The device's display is interactive – The device is able to hold a baby like a mother
	C	– I want the robot to detect people outside the door (no point if the robot only scans people who have already entered the house)	– The device is able to scan and recognize people outside /around the house

3.3 Interpretation of Needs with New Proposed Guideline

Then, the consumers' responses were interpreted again while considering the 3 additional new guidelines which are 'to write statement with empathy', 'to write statement as designer' and 'to write statement as someone with experience' to see whether these new guidelines will influence the number of interpreted needs. The number of needs interpreted by these proposed guidelines were listed in Table 3 below. Table 4 and Table 5 indicate partially the list of consumers' responses in both interviews and their interpreted needs while considering the proposed guideline 'to write statement while empathizing consumers' and Table 6 and Table 7 indicate partially the list of consumers' responses and interpreted needs while considering the proposed guideline 'to write statement as designer who understand the concept of the prototype' from both interviews. Table 8 and Table 9 indicate partially the list of consumers' responses in both interviews and their interpreted needs while considering the proposed guideline 'to write statement as someone with experience'.

Table 3
Number of total needs and number of needs interpreted by proposed guidelines

	Total Needs	Needs by Original Guideline	Guideline 1: With Empathy	Guideline 2: As Designer	Guideline 3: With Experience
Problem-based Interview	144	111	20	12	25
Prototype and Story-based Interview	141	95	23	19	28
Total Interpreted Needs	285	206	43	31	53

Table 4
Interpreted Needs with Proposed Guideline 1: With Empathy (Problem-Based Interview)

No	Raw Data (Interview Answers)	Interpreted Needs
1	I was worried that the kids wouldn't be able to catch up on their studies, so I sent them to cram school as well (online).	The device is able to record children's study growth and performance
2	The child is only 2 years old, so I don't know what he will do. If I take my eyes off him for a moment, he tries to go up the stairs.	The device is able to prevent children from walking up the stairs or falling of the stairs
3	I separate clothes to be worn outside from those worn only inside the house.	The device will alert user if clothes from outside are not placed properly
4	Children get bored in the house Children are always looking for new toys	The device will suggest fun activities and game suitable for children
5	I need to buy lots of toys (so I do not need to go out often to buy new toys)	The device is able to suggest new game with toys in the house
6	I failed to consider contacting friends who need help more than I do	The device will remind or update user about friends and family outside the house
7	I was most affected when I gave birth to my second child (a daughter). PCR testing was required, and my husband was not allowed to be together during delivery	The device is able to connect labor room and family member outside
8	Children's classes are online classes only (3rd and 1st grade elementary school)	The device is able to be used for more than one online class at the same time

Table 5
Interpreted Needs with Proposed Guideline 1: With Empathy (Prototype and Story-Based Interview)

No	Raw Data (Interview Answers)	Interpreted Needs
1	I like all the functions of the robot	The device will send/update the information of people entering/exiting the house to parents
2	It is good if the robot calls the police when a child is injured, and since the childcare workers cannot leave the injured child, it would be useful to have a robot that can call, contact the parents, call someone, or bring something.	The device is able to contact parents, guardians, and authorities in case of emergency and provide correct information to them
3	Childcare is about people and their relationships with each other.	The device is able to detect small changes of a child while measuring temperature

4	I want to use the robot to calm or put my baby to sleep by giving a patting action. I want the robot to sing a lullaby to put the baby to sleep	The device is able to put the baby to sleep by imitating the mother's voice, smell, and heartbeat sound, and has soft and warm skin to imitate the mother's arm and its movement
5	If a child is involved in an incident, it does nothing (e.g., -broken glass, electric shock).	The device is able to cut electricity and stop water in case of danger
6	If a child is involved in an incident, it does nothing (e.g., -broken glass).	The device is able to detect the sound and the location of broken glass, and able to steer away, save and prevent the child from touching the broken glass and, able to clean the broken glass
7	I want a function to detect facial expressions, so that I can tell if a child is concentrating in class or not. A function that can detect eye movement and head tilt.	The device is able to detect eye contact and head's tilting and turning angle during video calls of classes or meetings
8	Electricity (charging devices requires the use of large amounts of electricity)	The device's power last long

Table 6
Interpreted Needs with Proposed Guideline 2: As Designer (Problem-Based Interview)

No	Raw Data (Interview Answers)	Interpreted Needs
1	I took my son out of daycare for a month. I am afraid of because children are weaker and more susceptible to illness. I am afraid they touch this and that.	The device will record places that user/people touch, scan and sanitize
2	Home is clean because I am at home for a long time. Plenty of time to clean	Detailed cleaning task and schedule are able to be programmed to the device
3	The Japanese Covid-19 pandemic began last January. I started to panic, but the good news is that I live in Ube, Japan.	The device is able to be used in any region or any weather
4	I provide a special place to put everything brought in from the outside (e.g. - parcels from the postman)	The device will remind user to leave things from outside and sanitize it
5	I wanted my husband to be present at the birth of my child, but was disappointed that he could not do so because of the covid-19 pandemic.	The device is able to scan and sanitize labor room fast
6	No outbreak of vomiting and diarrhea (norovirus, cold virus). No flu because everyone is disinfecting?	The device is able to sanitize and kill other virus
7	Not a mist that completely sterilizes you when you pass through it, but like before you enter the operating room, but sterilized when you pass through it.	The device is able to spray with sanitization mist/UV once user walk through it
8	A: It can control room temperature, humidity, and sterilization. C: Like a humidifier	The device is able to adjust temperature and humidity in a room while sanitizing

Table 7
Interpreted Needs with Proposed Guideline 2: As Designer (Prototype and Story-Based Interview)

No	Raw Data (Interview Answers)	Interpreted Needs
1	I fear that the device will provide physicians with incorrect information about the child	The device is able to give right/ precise information to authorities (police, hospital etc.)

2	I want a function to get angry instead of myself, when I am annoyed.	The device is able to talk and scold by changing the voice tone and is able to notify and warn by sound, light, movement, and vibration
3	I think skin to skin contact is important, and I hope this device can support only when needed	The device can be set to use when needed only and the device's operating time is able to be set by user
4	This device is better than hiring someone else (such as a housekeeper) (who may invade the family's privacy)	The device can be turn on and off by the user if the use require privacy
5	Better not to clean all areas (for fear that the robot will clean places it shouldn't)	The device will only clean the part of the house set by user
6	Not enough if the robot only has a screen to play with children (children are easily bored)	The device is able to interact with children with display, facial expression and arm movement
7	I don't want you to spend less time with your baby.	The device is able to monitor how much time spent in each of its activities, and how much time spent between the parents and the children, and able to record and analyze the interaction data and notify the parents if they need to communicate more with their children
8	Parents fear they will lose value if robots do all the work with their children	The device's functions are able to be set up only for house chores

Table 8
Interpreted Needs with Proposed Guideline 3: With Experience (Problem-Based Interview)

No	Raw Data (Interview Answers)	Interpreted Needs
1	The child is only 2 years old, so I don't know what he will do. If I take my eyes off him for a moment, he tries to go up the stairs.	The device is able to prevent children from falling of stairs
2	I separate clothes to be worn outside from those worn only inside the house.	The device will alert user if clothes from outside are not placed properly
3	Children get bored in the house. Children are always looking for new toys	The device will suggest fun activities and game suitable for children
4	I need to buy lots of toys (reason: don't have to go out often to buy new toys)	The device is able to suggest new game with toys in the house
5	I took my son out of daycare for a month. I am afraid of because children are weaker and more susceptible to illness. I am afraid they touch this and that.	The device will record places that user/people touch, scan and sanitize
6	I failed to consider contacting friends who need help more than I do	The device will remind or update user about friends and family outside the house
7	Skin on hands become dry (must bring skin moisturizer)	The device will provide sanitizing option that is safe and gentle to skin
8	I sanitize all clothing from the outside.	The device will sanitize clothes brought from outside

Table 9
Interpreted Needs with Proposed Guideline 3: With Experience for (Prototype and Story-Based Interview)

No	Raw Data (Interview Answers)	Interpreted Needs
1	I like all the functions of the robot	The device will send/update the information of people entering/exiting the house to parents

2	I fear that the device will provide physicians with incorrect information about the child	The device is able to give the right/ precise information to authorities (police, hospital etc.)
3	It is good if the robot calls the police when a child is injured, and since the childcare workers cannot leave the injured child, it would be useful to have a robot that can call, contact the parents, call someone, or bring something.	The device is able to contact parents, guardians, and authorities in case of emergency and provide correct information to them
4	Let the robot play the role of a robot, and never do the parts that a robot can't do (changing diapers, human eyesight, looking at rough skin, etc., I believe that a robot can't see small changes, I believe that only a human can do it).	The device is able to detect small changes in a child such as body temperature, facial color, expression and emotion, skin texture and color, voice, etc. by comparing with past day data and able to alert the parents
5	Does the robot talk? Interesting if the robot's voice or intonation changes, when it is angry, when it is kind.	The device is able to change the voice tone to a warning voice, angry voice and kind voice.
6	I want to use the robot to calm or put my baby to sleep by giving a patting action to put baby to sleep. I want the robot to sing a lullaby to put baby to sleep	The device is able to put the baby to sleep by imitating mother's voice, smell and heartbeat sound, and have soft and warm skin to imitate mother's arm and its movement
7	I think it is important for a baby to feel the warmth from a human. I don't want to reduce the amount of time I can spend with my baby. I think it may be lucky for the mothers, but I don't think it is good for the babies to interact with robots	The device is not for simulating, showing and teaching love and human-like relationship with consumers and their children but for monitoring by watching facial expression, posture, and temperature
8	If a child is involved in an incident, the robot done nothing (e.g. – broken glass)	The device is able to cut electricity and stop water in case of danger

4. Discussion

Based on the interpretation needs from both interviews, although the number of interpreted needs while applying the new proposed guidelines are lower than the conventional guideline, we were able to obtain a few important latent needs. By applying the proposed guideline 3: 'to write a statement as someone with experience which in this case as a parent in this Covid-19 pandemic', a latent need collected is "The device is not for teaching love and humanity but for monitoring by watching facial expression, posture, and vital signals such as temperature and heart rate", which was interpreted from the raw data "I think it is important for a baby to feel the warmth from a human. I don't want to reduce the amount of time I can spend with my baby. I think it may be lucky for the mothers, but I don't think it is good for the babies to interact with robots". Another latent need collected is "The device is able to detect small changes in a child such as body temperature, facial color, expression and emotion, skin texture and color, voice, breath and heart rate etc. by comparing with past day data and able to alert the parents", which was translated from raw data "Let the robot play the role of a robot, and never do the parts that a robot can't do (changing diapers, human eyesight, looking at rough skin, etc., I believe that a robot can't see small changes, I believe that only a human can do it)". We considered the above need as latent needs as the needs was not found in existing patents confirmed by overall patent survey using a patent database that covers patents published in more than 90 countries [13]. We are able to say that by applying this guideline, we were able to obtain an important latent need.

This guideline 3 is limited to be applied in every case of product development as different experience is needed to interpret different raw data. The proposed guideline 1: 'to write a statement while empathizing with the consumers' was assumed as important as the proposed guideline 3 to interpret consumers' problems or their negative statements by empathizing with the interviewees. By applying this guideline too, we were able to elicit a few important latent needs. By having empathy with children, a latent need collected was "The device is able to put the baby to sleep by imitating the mother's voice, smell, and heartbeat sound, and have soft and warm skin to imitate the mother's arm and its movement", which was translated from raw data "I want to use the robot to calm or put my baby to sleep by giving a patting action to put baby to sleep. I want the robot to sing a lullaby to put baby to sleep". Another latent need collected by having empathy with the parents is "The device is able to detect the sound and the location of broken glass, and able to stay the child away, save and prevent the child from touching the broken glass and, able to clean the broken glass", which was interpreted from raw data "If a child is involved in an incident, it does nothing or do something? (e.g., -broken glass)". We are able to say that although the interpreted needs in both guidelines are 80% similar, the proposed guideline 1: 'to write a statement while empathizing with the consumers' is still considered as important to interpret the needs that were unable to interpret without experience.

On the other hand, by considering the proposed guideline 2: 'to write a statement as a designer who understands the concept of the prototype', we were able to collect a few latent needs. One of the latent needs is "The device is able to talk and scold by changing the voice tone and is able to notify and warn by sound, light, movement, and vibration", which was interpret from "I want a function to get angry instead of myself, when I am annoyed". Another latent need gained was "The device is able to monitor how much time spent in each of its activities, and how much time spent between the parents and the children, and able to record and analyze the interaction data such as physical distance, eye direction and voice during communications, and notify the parents if they need to communicate more with their children", which was translated from raw data "I don't want you to spend less time with your baby". We are able to say that by applying this guideline 2 we were able to elicit important latent needs from the consumers as the needs was not found in existing patents confirmed by overall patent survey too.

5. Conclusion

In this research, we were able to interpreted raw data of consumers' interviews to the consumer needs. We were able to conclude that the number of interpreted needs increase when we additionally applied the new proposed guideline. Although the number of increased needs are small, the needs might not be interpreted if these 3 new guidelines were not considered. We were also able to obtain a few important latent needs when we applied these new guidelines. We could conclude that by including these guidelines upon interpreting raw data of consumers interviews might lead into discovering important and critical latent needs of the consumers.

This prototype based experimental approach also recorded a customer-device relationships including movement, voice, and interactions as some movies and voice data. In the future, by observing the raw data on relationships and utilizing this new proposed guidelines, more latent needs that could not even figured by customers could be discovered.

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