Team

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Problem and Solution Overview

Most people aspire to live in a clean home but often fail to make the time or simply become apathetic at the thought of having to do yet another chore. Yet, having a clean home not only has several health benefits like reducing allergies, but also has a psychological component, reducing a major source of stress in the house. The problem is that cleaning is not a top priority for many. People would rather spend their free time with their families and having fun than performing tedious house chores. Our goal is to create a design that promotes the idea of a clean house without introducing more work for the user. Our solution is a centralized dashboard to be placed at a highly trafficked area of the house. This hub enlists the help of other smart devices around the house like TVs, computers, smartphones, smart bands, and such for data collection and data output. Our system uses current motivators in the form of internal and external triggers (e.g. people coming over, how long has it really been since you last cleaned an area, etc) to get you cleaning. Finally, the hub processes your home and personal data to show you information about your house's level of cleanliness helping you keep your house neat.

Initial Paper Prototype

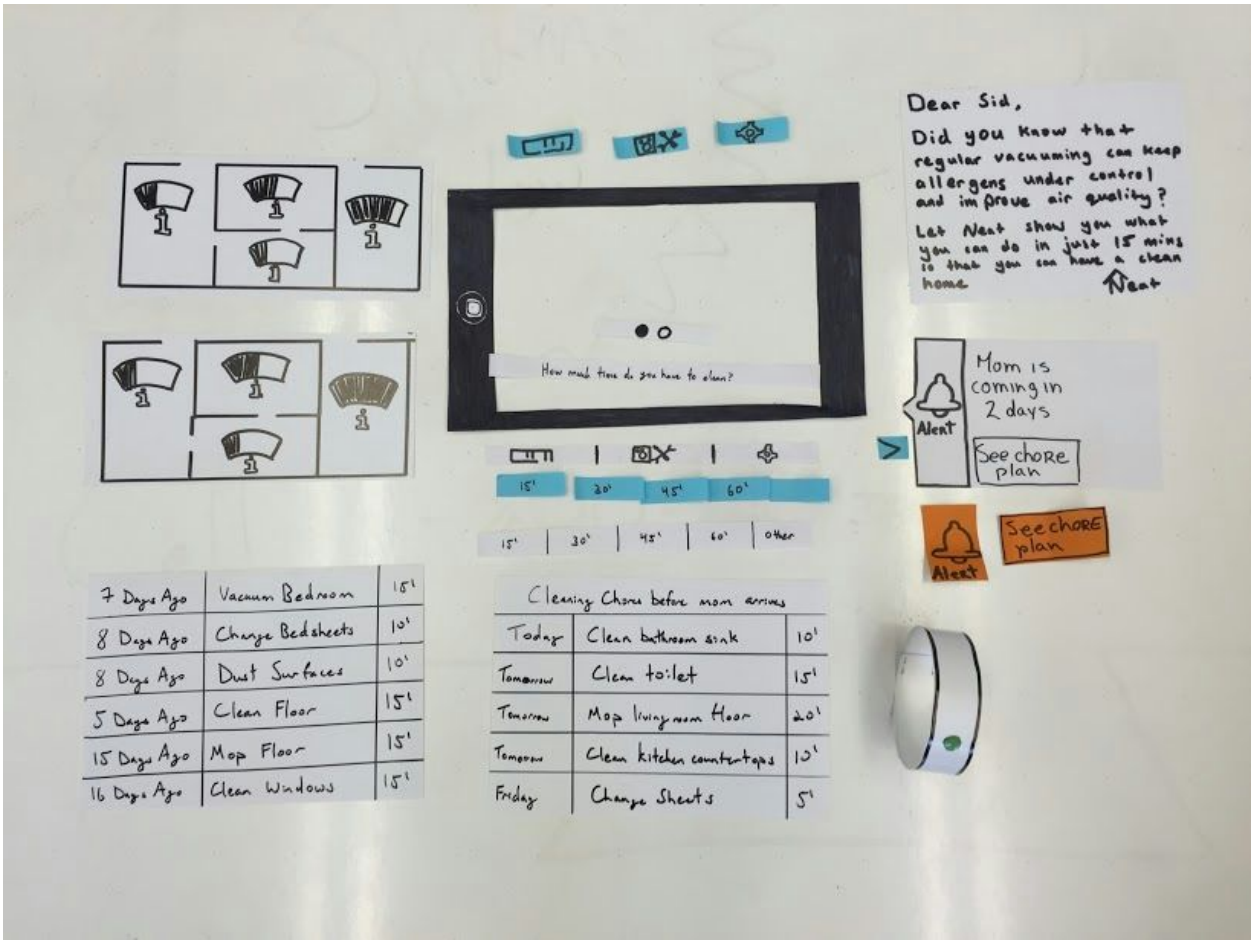


Figure 1 Overall view of the initial paper prototype

The initial paper prototype had two parts. The first main part utilized a dashboard which allows the user to gain a comprehensive view of his/her house's cleanliness from the main menu. The gauges represent the cleanliness level for each room. Clicking on each room from the house blueprint would allow the user to view more details about cleaning tasks for each room. Quick buttons at the bottom of the screen allowed the user to simply select a time period for which they were free and Neat would then suggest tasks that could be done in that time. Lastly, the prototype featured an alert system that would notify the users of any external triggers. The second part featured a wearable that the user would speak into to record cleaning metrics that would be used by the Neat system for data aggregation and estimation.

Testing Process

For our first usability session we choose to recruit at the HCDE lounge and ended up gaining access to a female student just admitted to the major. This environment allowed us in a short time to gain access to a good participant tool because many master's and undergraduate students tend to hang out in this spot, especially during lunch hour. To make sure we were getting our intended user we approached potential participants and asked some pre-screening questions:

- Are you the person responsible in your household for managing the house chores?
- Do you have a hard time allocating time for cleaning?
- Do you find that is hard to keep your household clean and organized most times?

The second and third participants were recruited through our initial CI participants. We reached out to them again and asked if they could recommend us to a couple of their friends with lifestyles similar to them for a usability session. They introduced us to a couple of friends (two males working professionals) that graciously agreed to participate in the usability study. We asked them to meet us at the Architecture Hall, where Doaa has an office. We scheduled each participant an hour apart so we could have the time to run the test and make changes to the prototype in between testing sessions. All three of our users live busy lives and have a hard time making time to do some cleaning around the house which made them suitable for testing the product we are developing.

Before starting the test we gave her a little bit of background about the Neat system to provide the user with some context. We gave three scenarios to the participant and asked them to perform tasks inside the scenarios using a think-aloud protocol that turned into conversation sometimes to encourage expression. For the second and third test we also introduced the ease of use metric. We asked them after each task to rank from 1 to 5 how easy was to accomplish that task, 5 being the easiest. Based on the feedback from session we modified the scenarios to make them more general and less leading. These were the scenarios we provided to participant two and three:

- You want to check the last time you changed your sheets in the bedroom. How would you do that?
- You have decided you want to spend 15 minutes cleaning. How would you go about doing that?
- Neat just reminded you that your mom is coming over in 2 days and that you may want to start doing some cleaning if you want to have the house ready before she arrives. You want to learn what has to get clean and how long those chores will take before your mom arrives. How would you do that?

Testing Results

During the heuristic evaluations some of the biggest problems with our initial paper prototype were revealed. They all centered around one main theme: recognition. There were several recognition problems with our initial prototype. First, the experts were not able to identify the blueprint depiction of the house. We refined our blueprint to show a better division of the house and included doors and labeling of each room to jumpstart recognition. Another recognition issue identified during the heuristic evaluation was the encoding we used for the cleaning state of each room. Initially we had a some sort of bar similar to a car gauge (full when room was dirty and empty otherwise). This did not work during the heuristic evaluations. Then, we presented a bar with upper bound dirty, and lower bound clean accompanied with a checkmark symbol to indicate when it was clean, an alert symbol (!) for when it was getting dirty and urgency symbol (X) to indicate when it needed immediate attention. We were not able to resolve this issue fully after the heuristic evaluation, we needed one more iteration after our first usability test to come up with a simpler encoding to communicate the cleaning state of each room.

Our heuristic evaluators were also unable to understand how to effectively operate the wearable that ended up being a modified fitbit. This brought to our attention that we needed to incorporate instructions on how to voice control the fitbit to record cleaning metrics, specially for the novice user. In the next version of the paper prototype we included samples of commands once a chore is selected. Users can select “Don’t show me this again” once they are familiar with how to record metrics using the fitbit. In addition there was confusion with some of the selected icons for menu items and symbols like the minute symbol. To resolve the issue we reworked the menu. And because these were not standard icons we added labels at the bottom of the icons. Finally, the evaluators brought up another issue to light. We were not allowing our users to edit a chore or modify the order of the chore list if they saw an error or had a different preference. We resolved this in our next paper prototype by adding an edit button next to each chore. This edit button will bring popup for modification of task once pressed. Also, we incorporated drag and drop of the chores in our lists so the user will have the freedom to modify chore plans.

Our second paper prototype used during the first usability test benefited greatly from the revisions from the heuristic evaluation. However, this test identified some big problems that were preventing the user from completing our two main tasks.Another significant revision was making the time buttons of things you could do with 15, 30, 45, etc minutes visible to the user. Initially we had this long button “How much time do you have for cleaning?” that button after pressed will be replaced with smaller minutes buttons. However, that was not reading as a button so it was practically impossible for our first user to access that feature and accomplish the task associated with it. We proceed to eliminate the long button and turn it into a header for the smaller time buttons that will now show on the main screen. It was also unclear how to navigate to a certain task and the user had trouble searching for a particular task. To alleviate this usability problem we incorporated a search function for each room. This way the list dynamically adjusts to user input. It was during this paper prototype iteration where we got

closer to our final depiction for the cleaning state of the house. We decided to implement a simpler metaphor. We choose to go with different faces (. , □, □) to indicate the overall cleaning state of each room in the blueprint.

During user tests two and three we detected and refined smaller pain points. Users did not immediately got what “8 days ago” ment or other terms. Therefore we added headers to all chore lists to clearly label the information. Our third user struggled with some terminology from the application like “clean life”. As a fix we added a tooltip for clarification of clean life term. Finally, we streamline the message to appear in smart devices around the house to make it more to the point and motivational.

The major revisions that had the most impact on the ability of users to complete tasks were performed after the heuristic evaluation and the first usability test. By the second and third usability test our participants were able to navigate all three scenarios and complete the tasks appropriately and promptly. In addition our easy of use metric went up with every test.

From the final design critique we addressed three issues. First, it was brought to our attention that our design contained a hidden affordance. We did not have any visual cue to indicate to the users that they could drag and drop chores to reorder them. Then we added some knurling to all of our list to make sure we had the visual cue to encourage drag and drop. We also addressed some consistency in our emoticons and styled the ambivalent face to resemble more the style observed on the sad and happy face. Finally, we increased the space on the edges of the overview screen to prevent the alert notification from taking over valuable real estate. It was brought to our attention that the alert notification was too intrusive because it occupied over a third of one of our room tiles.

Final Paper Prototype

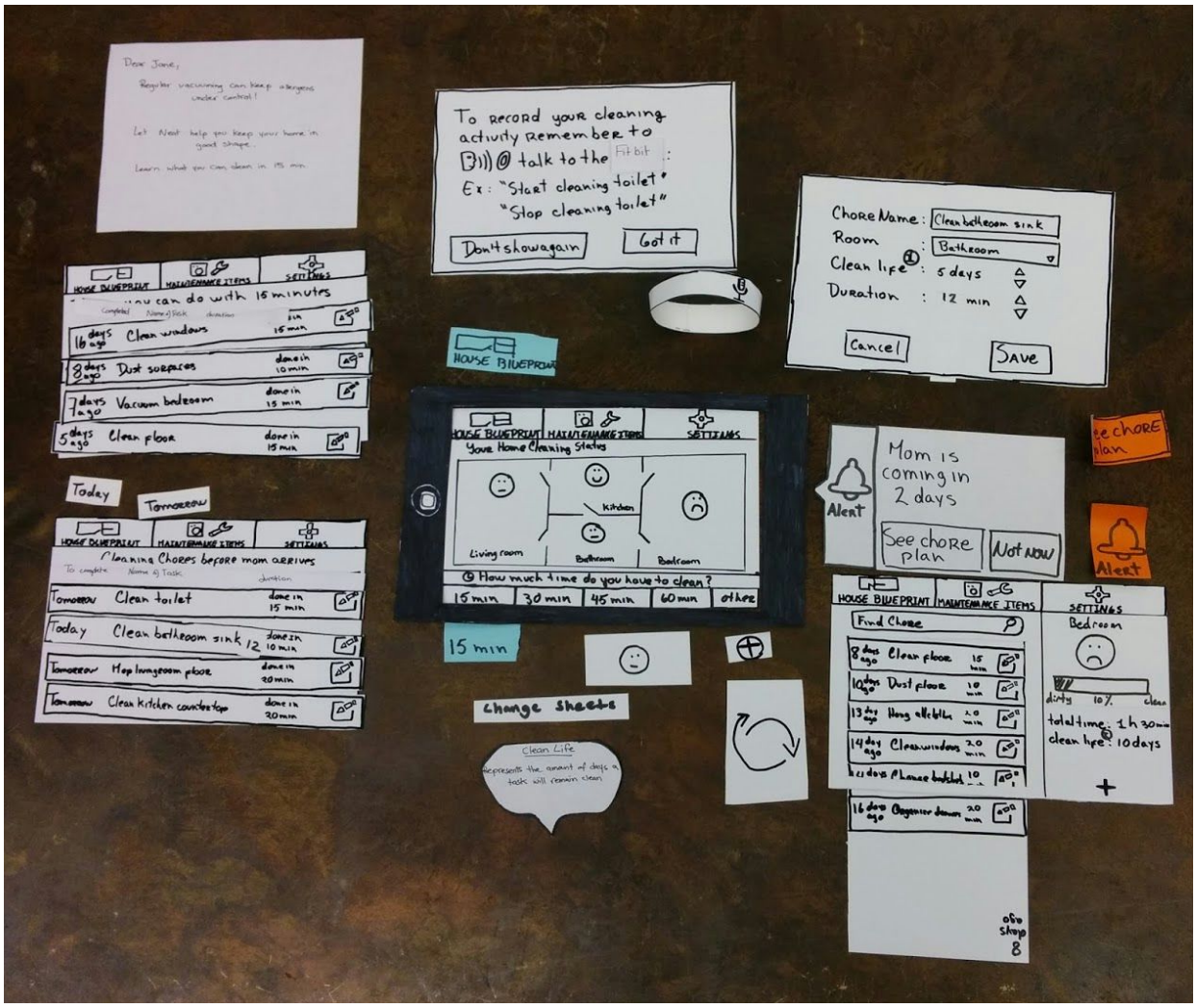


Figure 2 Overall view of the final paper prototype

Our final paper prototype aimed to evaluate our two main tasks which are, promoting cleaning activities during idle times and preventing a messy home when welcoming visitors. The first task acts as a message on the smart devices around the house to encourage cleaning during idle times. The second task acts as an external trigger by parsing through the user's emails and texts and generates an alert that is displayed on the main screen to encourage cleaning using external triggers as motivators.

There were three critical aspects of this prototype that the participants during the usability testing pointed out. First, the main screen was too cluttered with bars and symbols and the bars were too hard to read. Second, the suggested cleaning button was not readable as a button and

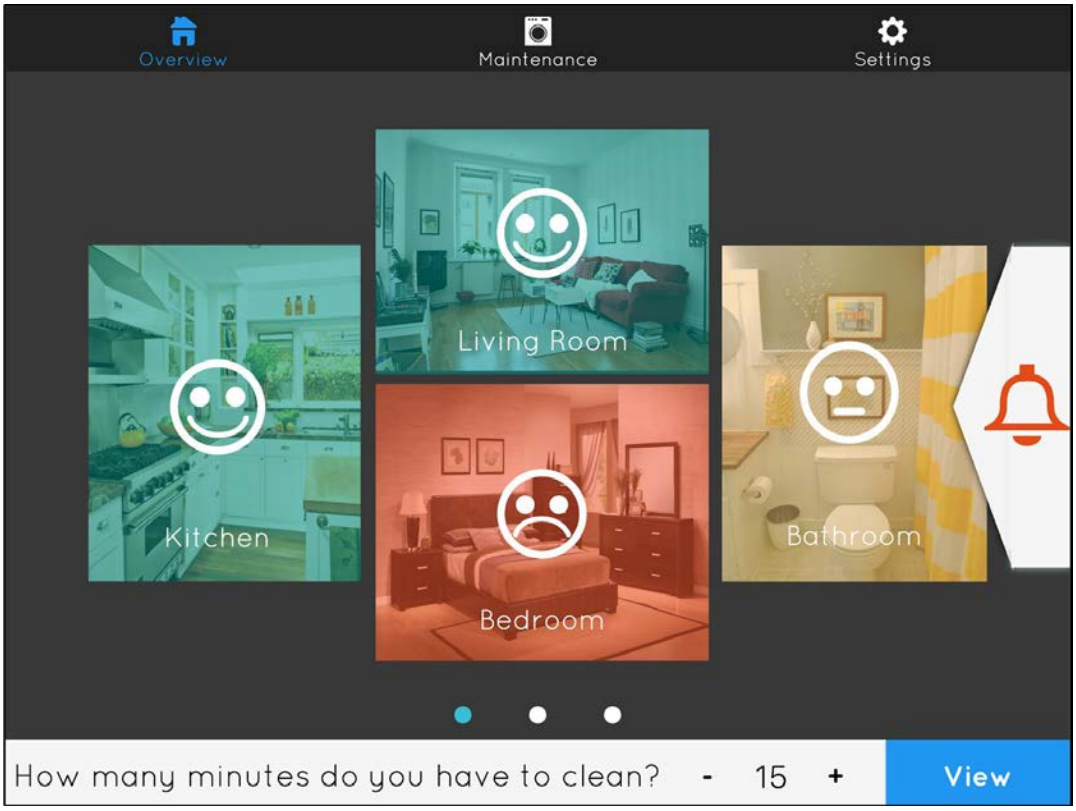
it was hard to navigate. Third, the wordings of some features were either confusing and hard to understand or too long to read.

Based on these difficulties we altered and tweaked our prototype to address flexibility and efficiency. The main screen represent the house layout with a smiling, ambivalent or frowning faces to reflect each room's status. Under the plan layout is where the user can access the suggest cleaning task by selecting the minutes the user wants to spare for cleaning. On this screen the user can choose to clean a particular room by clicking on it or selecting a time frame and Neat will provide the user with a list of tasks that can be accomplished under the selected minutes and are prioritized in order of most beneficial to the overall cleaning state of the house. After tapping on a potential task the user is presented with instructions on how to record the cleaning metrics using the fitbit. After the cleaning activity Neat automatically syncs the data into the digital board and updates the metrics and faces on the main screen.

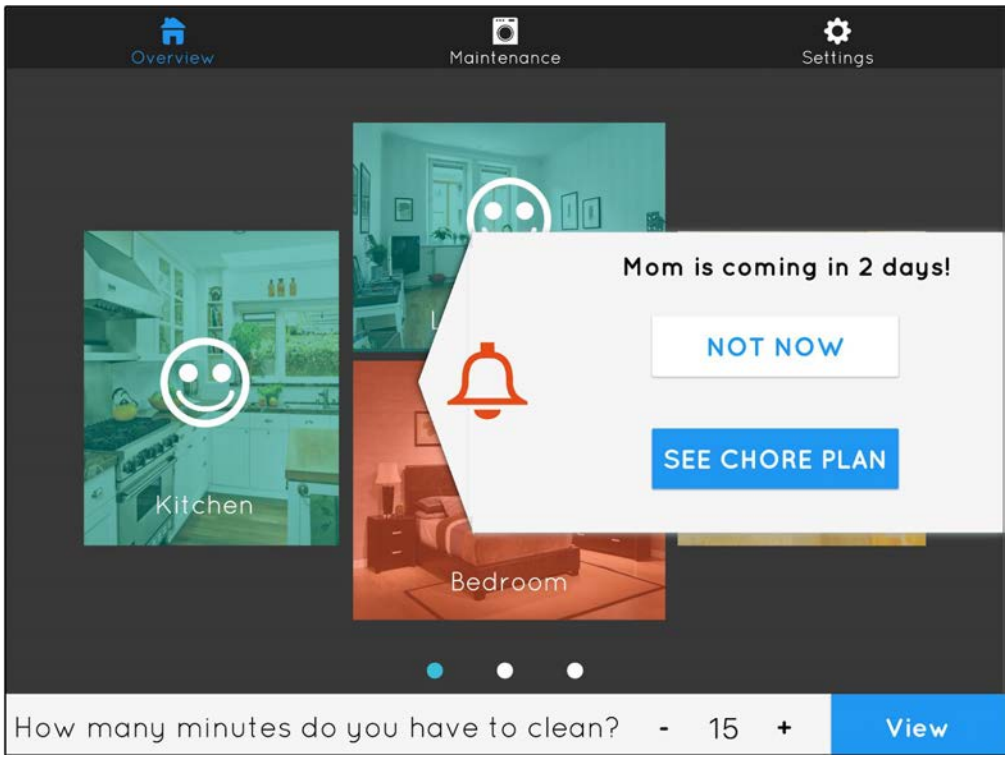
The second task applied in Neat is identifying external triggers by parsing through the user's emails and texts and generating alerts that is displayed on the main screen and among other smart devices around the house to encourage cleaning behavior. By tapping on the alert, Neat automatically generates a roadmap of tasks to complete based on the areas that are most unclean and the areas that are most likely to be seen. From here, the user can follow the suggested roadmap, edit and modify chores or can rearrange the given list. A tooltip was added to explain what clean cycle means. If the user chooses to clean the room based on the room status show on the main screen, he/she will be directed to another screen that shows more details about that room, like how clean is actually that room, how long will it take you to fully clean it, the clean life of the room, etc. This screen also lets you see the cleaning history of that room and search for a task to see when was the last time it was cleaned.

Digital Mockup

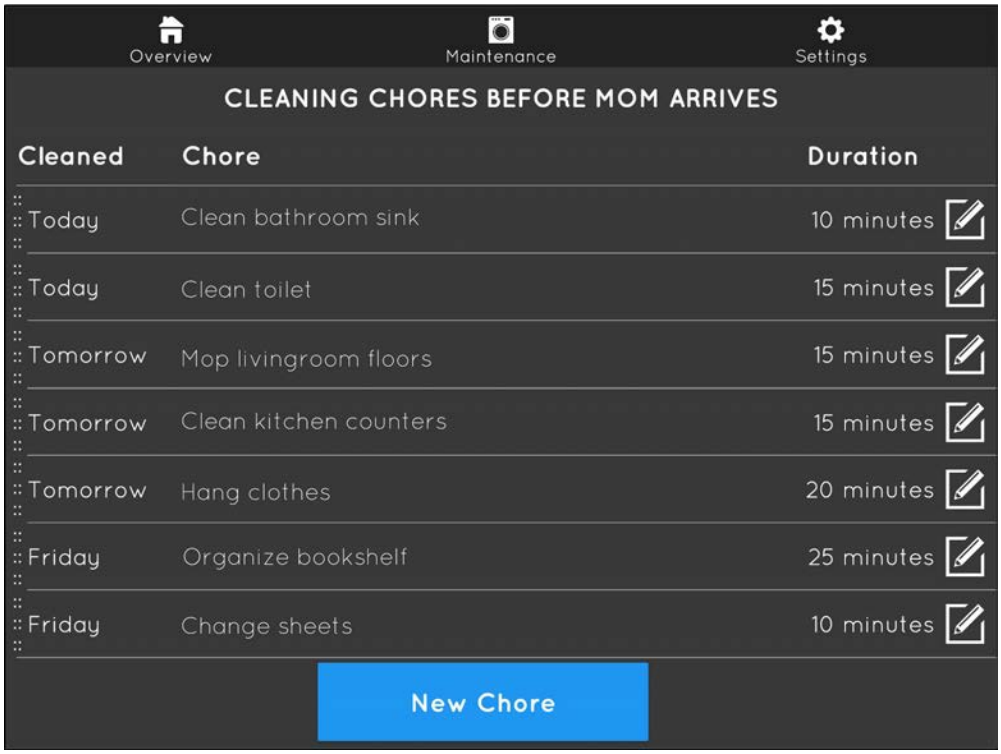
Our first task is to alert the user to events such as a parent coming over. From our contextual inquiries, we found out that having a clean home is pretty important for these situations, and want to make sure the user knows what to do to prepare for the occasion. The **Mockup Figures** below show how a user would be able to achieve this task.



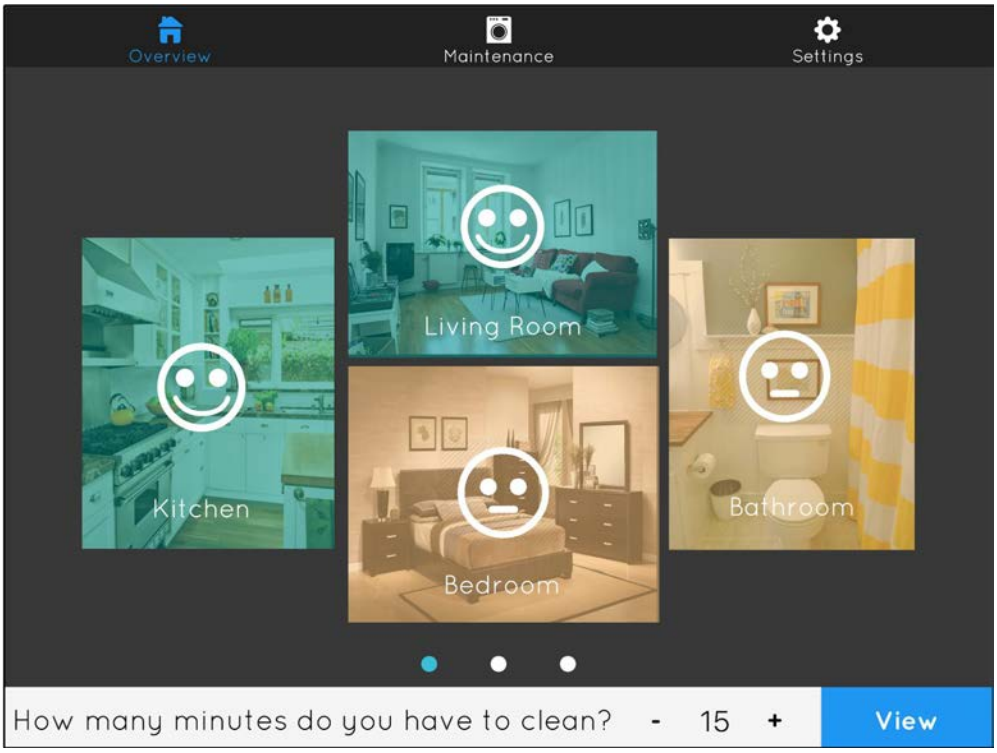
Mockup Figure 1 User is notified that there is an urgent notification requiring their attention.



Mockup Figure 2 User drags out the notification to see the details and a prompt should he or she want to begin taking action.



Mockup Figure 3 User taps to “See Chore Plan” and is presented with a list of required cleaning chores.



Mockup Figure 4 User completes chores and room cleanliness status is updated.

From the feedback and critique we received, the alert notification was too intrusive as it previously covered up a third of the far right bathroom tile. This detracted from the usability of the bathroom tile specifically as there would be significantly less room for a user to click and select the bathroom. To fix this, we increased the space on the edges of the overview by shrinking the tiles as well as the alert notification arrow. There is still an overlap, but it is minimal enough that we believe it no longer detracts from the usability of the bathroom tile in particular. This change is reflected in **Mockup Figure 1**.

Additionally, the feedback showed that the straight face that indicated a medium cleanliness status was strange as the line for the mouth connected with the face. This was disjoint in comparison to the smiley and the sad face, and it was visually weird. **Mockup Figure 4** shows a revised version of the straight face.

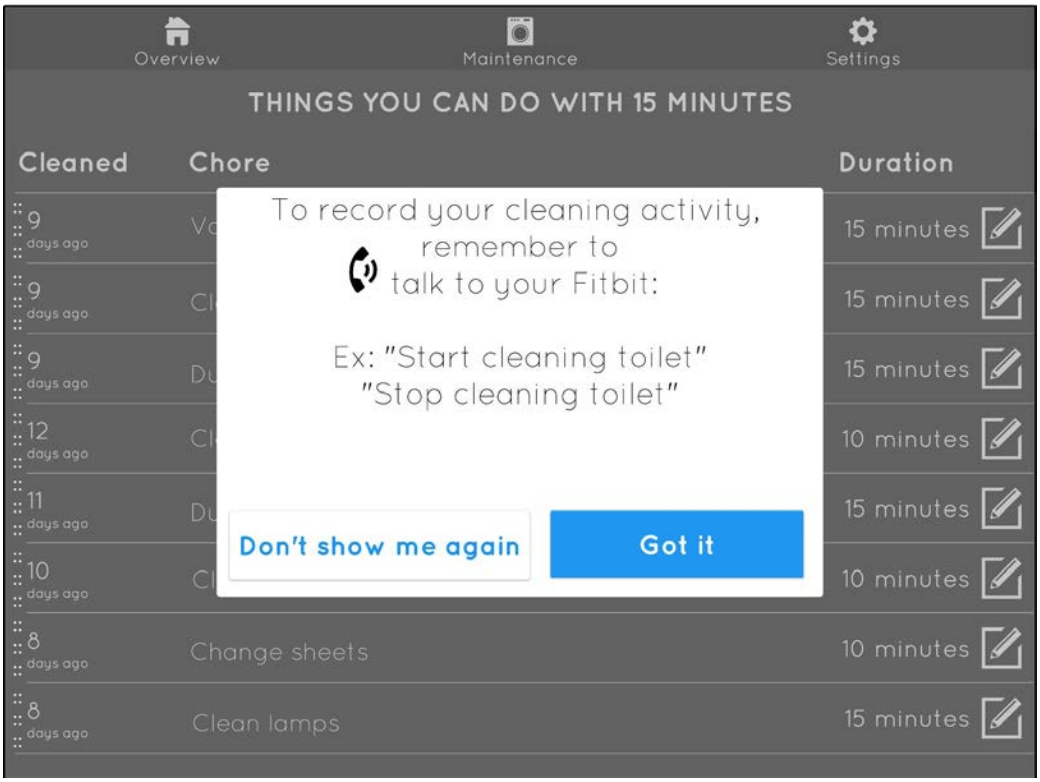
During the transition from analog to digital, we realized using an actual blueprint of a home would create spacial constraints for the room information labels. The bathroom is generally a lot smaller than a bedroom, so displaying the current cleanliness of the bathroom was harder than than displaying it in the bedroom. We then asked if proportional blueprints were important or if we could simply display similarly sized boxes as rooms and place them in the general location of the actual room. This prompted us to ask what would the blueprint offer in terms of functionality at that point where it was no longer a blueprint. This lead us to the final design choice for the blueprint, which was to remove the blueprint all together and create a tiled view of the rooms with each tile displaying the needed information as well as a photo to convey a stronger understanding to the user which room this is. The above **Mockup Figures** reflect this change.

Our second task is to allow users to input the amount of free time they have and receive a list of suggested cleaning chores. **Mockup Figure 5** below highlights the prompt on the bottom of the main screen that users can see and use to receive their suggested cleaning chores list. The remaining **Mockup Figures** below illustrate how a user would input the amount of free time they have and go about cleaning.

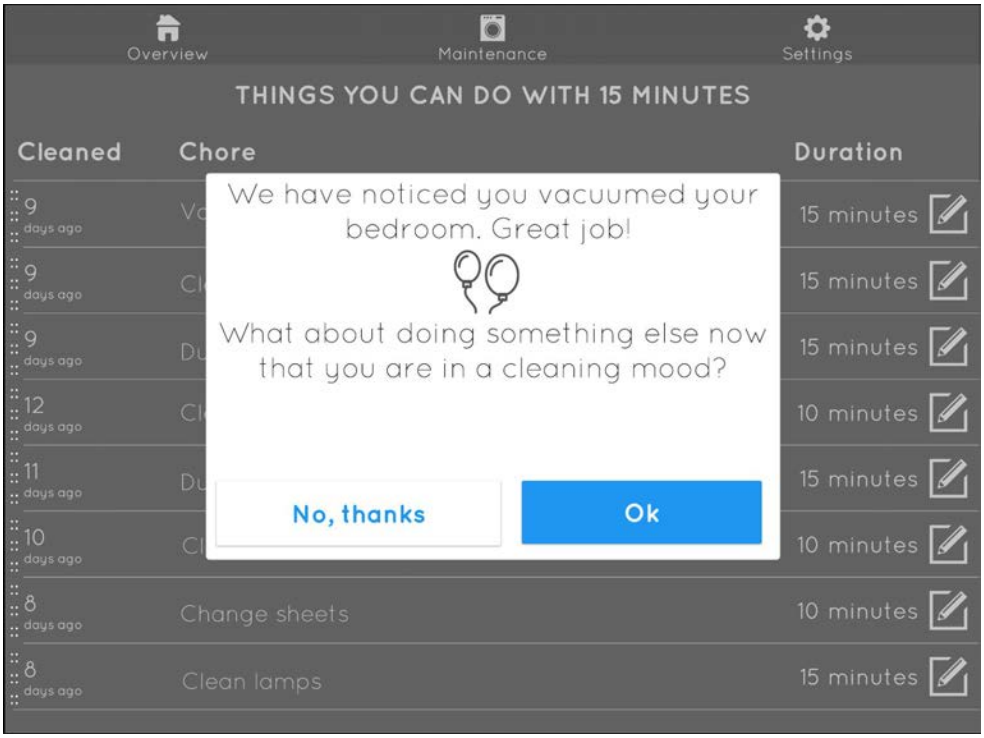
Mockup Figure 5 Prompt for users to select the amount of free time they have.

In the transition from paper prototype to digital mockup, we changed this bottom bar that allowed users to select the amount of free time they had to receive a list of suggested cleaning chores. We returned somewhat to our original design with a single row for the time prompt. Instead of using that row as a button, however, we created a new mechanism for users to input the amount of free time they have. The earlier problem from prototyping where users didn't know that the row was a button was solved by platform conventions. We ran a quick usability test on this new mechanism and found that users were able to understand its purpose and effectively navigate and use the new bar.

Mockup Figure 6 User is presented with a list of suggested cleaning chores that can be completed within the specified amount of free time.



Mockup Figure 7 User is shown a prompt that gives instructions on how to record the chosen cleaning activity.



Mockup Figure 8 User completes cleaning activity and is prompted to possibly clean something else now that momentum has been built up (based on CI finding).

Discussion

Our team has found the process of iterative design to be rewarding and fruitful. We believe it to be an effective method of finding out what is important, fixing features that aren't entirely clear, and implementing and integrating new ideas into the existing design.

Throughout the process of sketching, prototyping, and testing, we have been able to quickly find the shortcomings of each design choice in each iteration. During the sketching process, we had placed the overview of the blueprint in a way that didn't suit the layout of traditional homes. Additionally, we had created a sidebar that placed too much emphasis on alerts that would only appear occasionally. While these were all features we wanted to include, we had to change the layout of the main screen. To alleviate these problems, we moved the suggested cleaning chores within a fixed amount of time to the bottom, stretched out the blueprint of the home into a more rectangular format, and deprioritized the alert system such that it would appear in a distinct, but non-intrusive way when needed.

During the prototyping phase, we learned that actionable items such as button clicks aren't as clear as we thought. After moving the suggested cleaning chores feature to the bottom, we first

implemented a design that would allow users to click on a bar button that said “How many minutes do you have to clean?”. After clicking the button, the bar button would be replaced with a bar set of minute options (e.g. 15 minutes, 30 minutes, and so forth) such that the user could select the amount of time they had free. This would be a two-step process. However, during prototyping, we found that users weren’t able to figure out that the button with the prompt was an actual button they could click on. Thus, the suggested cleaning task wasn’t fulfilled. To fix this, we instead shifted button up and turned it into a label with the time options underneath. This made it more clear to users that there were buttons on the bottom of the prototype.

Interestingly, however, we realized that users not recognizing a button was due to the limitations of paper prototyping. A button isn’t entirely clear when it is on paper and doesn’t afford a click. As we created the digital mockup, we noticed that there were ways to use platform conventions to convey an understanding to the user that certain items were actionable such as a button click. Thus, in our digital mockup, we decided to implement a new mechanism similar to a spin button to allow users to select the amount of free time they have and integrate it into the existing design. This transition happened smoothly thanks to iterative design.

Overall, we believe iterations are crucial to our design process. We iterated a number of times in the sketching, prototyping, testing, and mockup phases and found each iteration to be key in developing our understanding of user needs and interactions as well as a solution to the problems our tasks uncovered. Iteration helped us find those problems and fix them according to our desired task without having to change the task itself. If we had to do it all over again, we would add a few more iterations to fully flush out each phase as we firmly believe in the power of the process of iterative design.

Appendix

Usability Testing Plan and Protocol

INTRODUCTION

The purpose of this research is to explore the user's mental model of the Neat paper prototype and identify areas of confusion and to provide actionable recommendations to improve navigation and task flow for the next iteration.

TARGET AUDIENCE

Targeting participants with a busy schedule, it's hard for them to make the time for cleaning and that find it hard to keep the house clean and organized.

OBJECTIVES

The data that we will be obtaining around each scenario will include:

- How the proposed workflows will be received.
- The exact path participants take in completing the task.
- Identifying pain-points/failures in the path.

QUALIFYING QUESTIONS

- Are you the person responsible in your household for managing the house chores?
- Do you have a hard time allocating time for cleaning?
- Do you find that is hard to keep your household clean and organized most times?

STUDY SCRIPT

Welcome and thank you for attending our usability session. You'll be asked to complete tasks based on specific features on a paper prototype and provide feedback around what works for you and how we might improve upon it. What you will be seeing today is work in progress so it may not always give you the expected results or even error messages. You are not the one being tested, but rather the application. There is no right or wrong answer. The goal for us is to learn how you evaluate what you see, so please nd verbalize your thoughts while you are trying out the new designs. Please answer the follow-up questions at the end of each task.

The system we will be showing you today is Neat. The Neat program connects with the other smart devices around your house to help keep the house clean at all times by motivating you and providing a comprehensive view of the cleaning status of the house, your cleaning history and generating automatic cleaning suggestion that will keep you on track doing a little at a time.

TASKS

The following three scenarios will be evaluated focused on navigation and assumes the participant has installed the Neat system in their house and has been collecting data from a few months already:

1. You want to check the last time you changed your sheets in the bedroom. How will you do that?
2. You have decided you want to spend 15 minutes cleaning and you want to find out what will be the most beneficial way to spend those 15 minutes to improve the overall cleanliness of the house. Can you show me how will you do that?
3. Neat just reminded you that your mom is coming over in 2 days and that you may want to start doing some cleaning if you want to have the house ready before she arrives. You want to learn how long will it take you to clean and what has to get clean before your mom arrives?

Expected results: The participant navigates to the appropriate entry point and will complete the task.

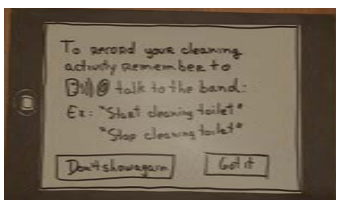
What we'll learn:
Identify pain-points/failures in the path
How well the navigation and content supports user tasks

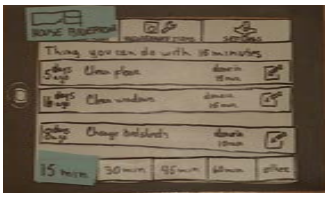
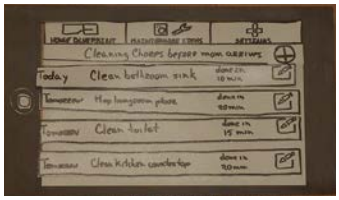
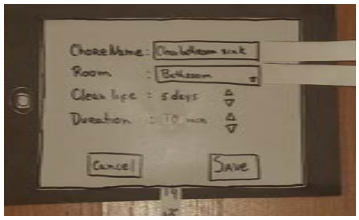
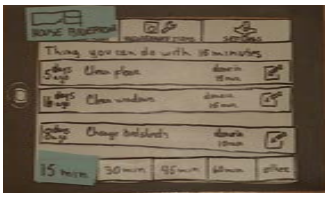
How we'll measure success: Participant satisfaction of workflow (ease of use)

Follow-up task question:
Single ease of use question after each task:
Overall, this task was very easy.
1 = Strongly Disagree 5 = Stongly Agree
Enter rating number: _____

Why? (This will provide immediate answers to poor ratings given by users when they expect something that isn't there. This might also help to inform the future questions around value. This question will work on any device or paper prototypes)

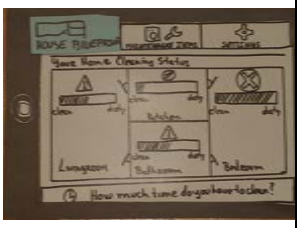
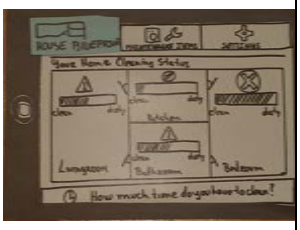
Heuristic Evaluations Table

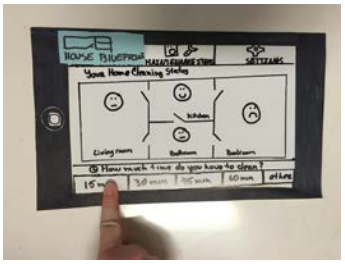
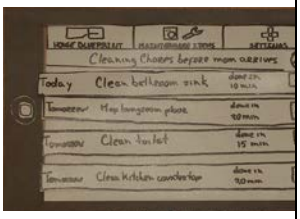
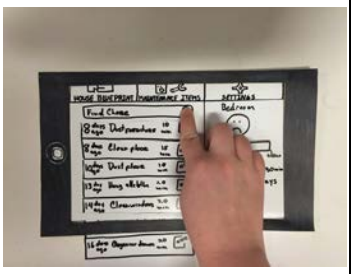
Image	Issue	Severity	Change	Fixed Image
	The blueprint depiction of the house was not recognizable as a the room divisions of the house. Heuristic violated: Match between system and the real world.	4	Header added to blueprint “User’s home” to indicate what the graph is. Also each room was properly labeled indicating what room each quadrant represented.	
	Unable to identify bar in each room as cleaning status indicator for that room. “looks like a gas tank indicator” Heuristic violated: Match between system and the real world.	4	Bar was modified to show lower bound: “clean” and upper bound: “dirty”. Ok, Urgent and Emergency icons were added on top of bar for fast recognition of room status	
	Did not know how to interact with the band. “Should I tap to speak”. Heuristic violated: Visibility of system status and Consistency and standards	4	Speech icon added to band to indicate how to use it and once a chore is selected on the board a screen shows up indicating the novice user how to record cleaning metrics using the band. User can select	 

			“Don’t show me this again”.	
 Menu icons are in all screens and the minute symbol is in many screens. This is just an example that has both points.	Confusion with some of the selected icons for menu items and symbols like the minute symbol. Heuristic violated: Recognition rather than recall and Consistency and standards	3	Menu icons reworked. Since these are not standard icons we added labels at the bottom of the icon and as part of the button.	
	Wanted to edit a chore and modify the order of the chore list and was unable to do it. Heuristic violated: User Control and freedom	3	Added an edit button next to each chore to allow user to modify the chore. Edit button will bring popup for modification of task. Also allow for drag and drop of the chores so the user can have the freedom to modify the chore plan.	 
	Unclear of what to do with the cleaning history after they select how much time they have available to clean. Heuristic	4	Added header to cleaning history to make sure user understands that these chores can be accomplished in the time the user previously entered to	

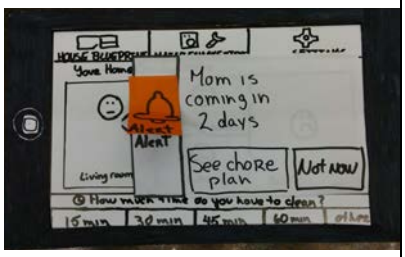
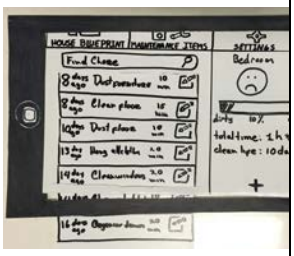
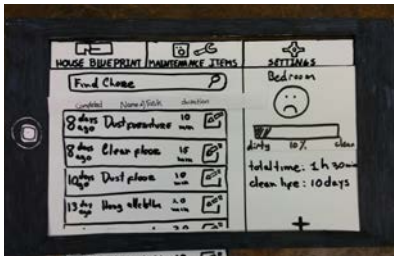
	violated: Recognition rather than recall.		indicate how long they have for cleaning.	

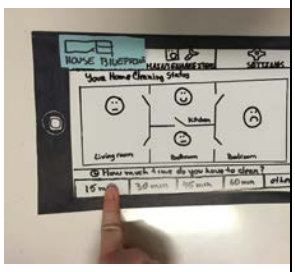
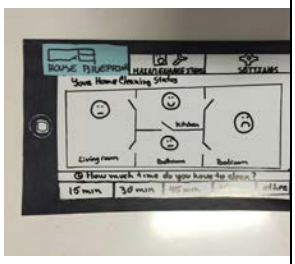
Usability Testing One Table

Image	Issue	Severity	Change	Fixed Image
	The bar and the symbols added too much clutter to the screen. The user had trouble determining if an area was clean because she did not understand the symbols and she thought the bar should be backwards. Heuristic violated: Match between system and the real world.	3	The bars and symbols on the main screen have simply been replaced with three faces (smiling, ambivalent and frowning) that reflect the room's status	
	The user had trouble accomplishing our first task which asks the user to navigate to the suggested cleaning list given an input time. Instead of touching on	4	The time options have been added underneath the "How much time do you have to clean?" button and the button now serves just as a heading. Touching one of	

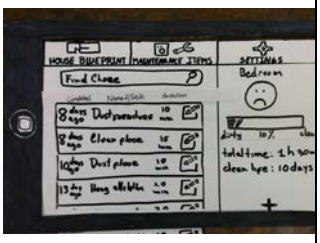
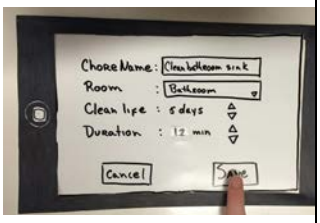
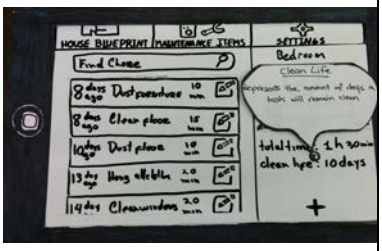
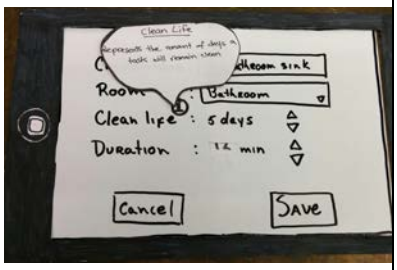
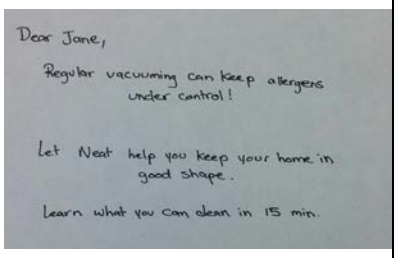
	the bar at the bottom, the user got stuck in navigating through the room. She did not identified this as a button for a long time. Heuristic violated: Consistency and standards		the time options brings up the suggested cleaning	
	It was unclear how to navigate to a certain task and the user had trouble searching a particular task Heuristic violated: User control and freedom Flexibility and efficiency of use	3	A new search function has been added. The list dynamically adjusts to user input	

Usability Testing Two Table

Image	Issue	Severity	Change	Image
	The user expressed a desire to postpone the notification. Although, the user can simply swipe the notification back, there exists some confusion as what to do if the user does not want to immediately address the task Heuristic violated: Flexibility and efficiency of use	1	Added not now button	
	The user did not immediately get the meaning of “8 days ago”, after completing some of the tasks, he learned that it was meant to show when a cleaning task was last completed.	3	Added header to clearly label the information so it apparent	

	Heuristic violated: Consistency and standards			
	Having a wearable device that only records voice adds complexity and is not necessary. Heuristic violated: Match between system and the real world.	1	Decided to go with modified fitbit concept. This modification of the fitbit will allow it to also serve to record cleaning metrics and is a device that most users already have and wear at all times.	
	User was able to recognize that the faces (□, □, □) were referring to the status of the room.	NA	NA	NA
	Action buttons were easily recognizable. User was able to select that they had 15 minutes to clean very quickly.	NA	NA	NA

Usability Testing Three Table

Image	Issue	Severity	Change	Image
 	The user had trouble understanding what the term clean life meant. Heuristic violated: Flexibility and efficiency of use	3	Added tooltip for clarification of clean life term	 
	The message happened to be too long and the user was not interested in reading it. Also happened to be too much of a nag Heuristic violated: Flexibility and efficiency of use	2	Streamline message to appear in devices like the smart tv. More to the point and more motivational. Also added whitespace.	

	User effectively understood and carried on the voice commands to record cleaning metrics using the modified fitbit.	NA	NA	NA