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Igeni: Reinforcing Hygiene Practices in Children Through Dynamic Products

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Abstract

Igeni is a set of dynamic products designed to lead children towards autonomy in their personal hygiene practices. The set is composed of three objects: the Billy Brush toothbrush, the Wally Wash faucet-ring and the Fanny Flush toilet reminder. These interactive products are designed to enhance skills of personal hygiene in preschool children, thanks to sensors and actuators for multisensory communication. In this paper, we present the design process that led to the creation of this set of products and we describe the design outcome, consisting of a setoff objects aimed at exploiting the child's senses to convey messages, to create engaging experiences and to encourage healthy practices. We also present and discuss preliminary tests with users.

Keywords: dynamic products, non-verbal communication, sensory communication, health, hygiene habits, children

1. Introduction

This paper describes Igeni, a set of dynamic products designed to educate children in preschool age (3–5 years) to be more autonomous in personal hygiene practices. The paper intends to add to the field of dynamic products through a practical design case, showing how dynamic sensory features can be designed to communicate with children and affect their behaviour. It identifies and explore a potential application field for dynamic products and provides design clues that can inspire the use of dynamic features in other contexts.

Parents daily struggle with reminding children of basic hygiene practices and a lot of time and effort is dedicated to teaching them how to perform these actions in an effective way. Results are difficult to check and different practices are carried out as control mechanisms

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(e.g. visual inspection of hand and teeth, touching toothbrush to check if it is wet, etc.). These practices inspired us to explore how IoT and interaction design can be applied to the field of children's personal hygiene, in order to reinforce the educational process and to teach them to be more autonomous, while at the same time reducing parents' burdening.

We decided to explore this problem space by designing dynamic products that focus on sensory and non-verbal communication. In interaction design, diverse forms of non-verbal communication have started to be investigated recently, which regard alternative—more physical and sensory—languages for the communication of digital information to the user. Ambient interfaces [1, 2] and dynamic products are at the core of this design area. In particular, dynamic products are objects that show sensory features (visual, tactile, auditory and olfactory) that change proactively and in a reversible way over time, providing information to users by transforming their own sensory appearances (i.e. shape, colour, smell, light, sound, temperature, etc.) [3].

Dynamic products provide the possibility to convey information in an implicit and sensory way, and highlight the emergence of a new semantics, which understands the changing and dynamic appearances of products as communication means. Design can apply different strategies to effectively shape and map information into dynamic sensory features, like abstract disruption, translation, reproduction and metaphor, according to the context where the product will be used and to the communication goals ([4], p. 96). Moreover, communicating by senses seems to be a more engaging way to provide information to users and has the ability to create meaningful experiences and to affect the users' activities and practices ([4], p. 92).

However, we could not find any study in this area investigating how product's dynamic sensory features can be used to convey information or to encourage certain behaviours, having children as users, with a product and interaction design perspective. As dynamic products seem to be powerful means to emotionally engage users and affect their behaviour, we explored their potential in the field of personal hygiene in children, through a real case study.

This work intends to explore how dynamic products can be used to influence users' behaviour in a practical project, and it wants to expand their application field, by testing this approach in the area of design for children.

2. Rationale

As stated by physiological and health studies, teaching personal hygiene practices in children is fundamental for a number of reasons. Referring to literature and dedicated websites [5–9] we summarized that:

- Personal hygiene is very important for wellbeing and for a healthy life.
- Habits and competences learnt in infancy are the deeply fixed and last longer in life.
- Incorrect habits and skills of personal hygiene are often learnt; this may lead to different problems during life and are difficult to be reversed.

We took these considerations as the basis of our design activity. Indeed, we decided to design a set of objects that stimulate and improve the learning of the right hygienic habits during preschool age.

3. The design process

The design process followed the whole cycle of research, design, prototyping and testing solutions. Theories in the field of education, personal hygiene and health, and sensory communication were investigated, a benchmarking analysis was performed, consisting of a deep investigation of the current educational products, their strength and weakness, and the market. This research activity led to the definition of the design brief and to the concepts design and development. At the end, we built working prototypes and we performed pilot tests.

3.1. Research

3.1.1. The state of the art

The kickoff of this project was the perception of the lack of a fully dedicated and successful product for children hygiene, confirmed by a deep market analysis. The benchmarking highlighted that hygiene was encouraged either by making products more engaging thought an playful appearance, or by developing digital apps that gamify hygiene practices, mainly targeted to children in school age. The use of dynamic sensory features to engage and persuade was almost completely absent, with the exception of some toothbrushes, which light up while used.

3.1.2. Educational theories

To understand how to design something useful and specific for children, we investigated psychological and educational theories. We focused mainly on three approaches to education: the Montessori's pedagogy, focused on the principle of educating the child to independence and on the tactile experience [10–12]; the scaffolding theory, that is centred on how adults can help children to fill the gap between their abilities and the job required, to let them become better at those activities [5, 7, 13]; the Behavioural theory, which argues that all human habits and actions are pursued or abandoned depending on the reward or punishment that follows the action [5, 7]. Considering these knowledge, some guidelines emerged that guided the design process. The resulting interactive solutions should:

- lead the children to autonomy by monitoring and remembering the actions taught by their parents,
- allow the remote control from parents but, at the same time, let freedom and independence to children,
- support the acquisition of skills and automatic actions through the repetition and the application of 'positive reinforcement' [5, 7].

It is important to underline that the aim of this set of objects is not to teach the child the action to perform starting from scratch, but to lead them to the right hygiene habits and competences, always guided and overseen by their parents.

3.1.3. Hygiene rules

We focused on three hygiene practices that require learning and following specific rules, and that usually represent the focus of education in hygiene:

- brushing teeth [14–17]
- washing hands [14, 18]
- flushing the toilet [19]

A very important part of the research process was dedicated to identifying correct rules and hygienic practices; to this aim, literature research was performed and a dentist was interviewed, to collect information about the right practices. These rules have been implemented in the design of the final products and will be described concurrently with the presentation of the concepts.

3.2. Design brief

3.2.1. Goal

The brief emerged by research findings consisted in designing a set of three products for preschool children, each one related to a specific hygiene practice: oral hygiene, hand hygiene and use of the toilet. These products should be able to communicate information to the user by working alongside, or replacing, the existent items of the toilet. The set exploits the non-verbal communication and the positive reinforcement method.

3.2.2. Users

The products are addressed to two different users: the kid and the parents. The main user is the child, who should be reminded to perform the action, and should be guided during the activity. The second category of users is the parents, who should be supported in the control of their children's activities.

4. The Igeni set

Igeni is the result of the design activity. It consists of three products: Billy Brush, Fanny Flush and Wally Wash. It is a set of dynamic products meant to support children during everyday hygiene activities and habits thanks to dynamic sensory stimuli. Each of these little monsters, cute and colourful is related to a specific hygienic practice.

By using sensors, this set monitors children's actions and send messages both to parents and children through changes in their physical and sensory appearance (**Figure 1**).

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Figure 1. The Igeni set.

4.1. Billy Brush

Billy Brush is a small green monster, a little devil or minotaur, which takes care of the oral hygiene and is made of a toothbrush and a toothbrush base (**Figure 2**).

The shape of Billy Brush's mouth is designed to host the toothbrush when unused. When the toothbrush starts to be used, its movement is detected and the monster's mouth starts to rotate. Also, a two-minute song is played, to signal the right duration of tooth brushing. When the brushing time is finished, the mouth returns to the initial position and the song stops. The monster's mouth flashes a white light when the activity is completed, to evoke a clean and healthy mouth. If the brushing is stopped earlier, Billy Brush's mouths stops in a wrong position that prevents the toothbrush storage; the music goes on and a blue flashing lights calls the child's attention. If the child does not finish his/her duty, the mouth becomes red to signal the error to him/her and to the parents. Moreover, the mouth becomes red also to signal if the toothbrush is unused for too long, this time pulsating, to encourage the child to brush his/her teeth (**Figure 3**).

4.2. Funny Flush

Fanny Flush is a small blue monster, a dinosaur or a dragon that reminds the child to flush the toilet. It consists of a body with a belly that can be pressed and of a balloon, a membrane button, connected with retractable wire. Fanny Flush should be fixed behind the WC in such a way that the WC cover lays on its belly when lifted. The balloon should be stuck to the flush button (**Figure 4**).

The aim of Funny Flush is to teach the right use of the WC. Indeed, it recognizes when the toilet is used thanks to a sensor in the belly and reminds the child to lay down the toilet cover and flush it after the use, by emitting a sound that reminds water. If the actions are done following the correct order, Funny Flush rewards the child with a "winning" sound. Otherwise, it makes a sad-loosing sound, like the ones used in videogames (**Figure 5**).



Figure 2. Billy Brush.

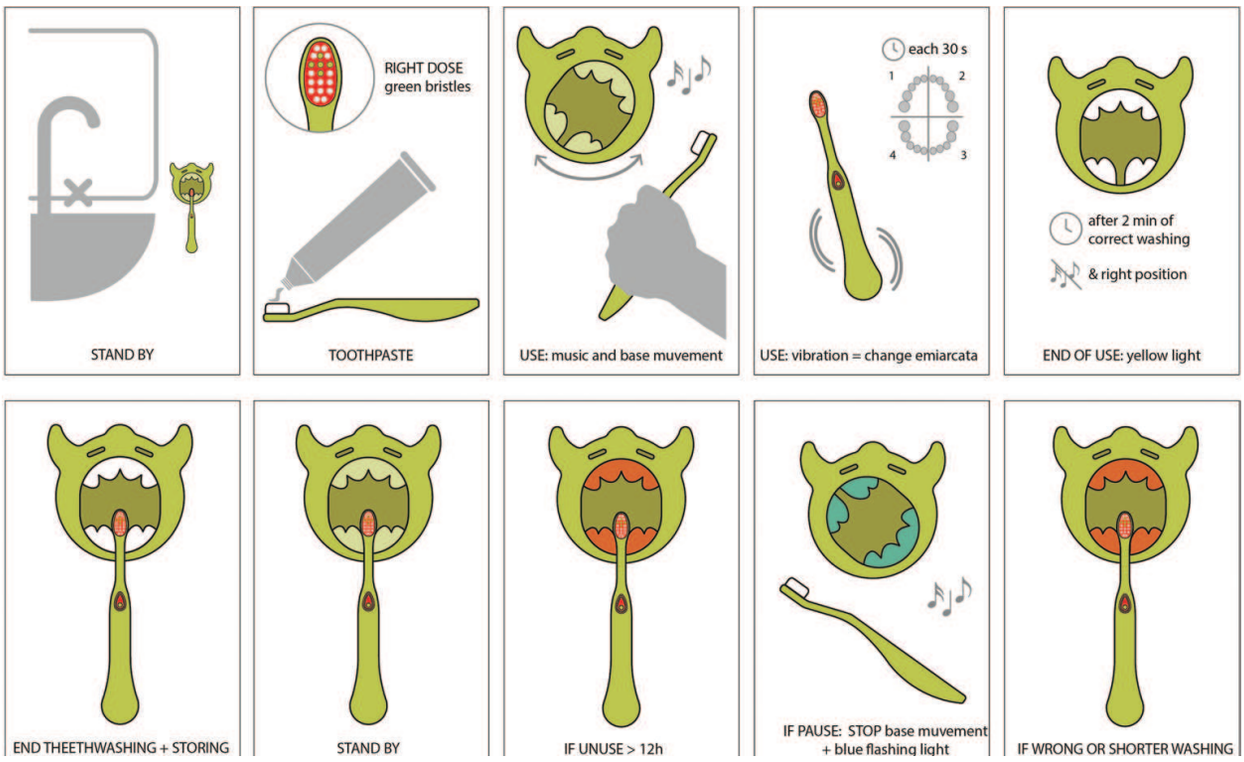


Figure 3. Billy Brush Storyboard.

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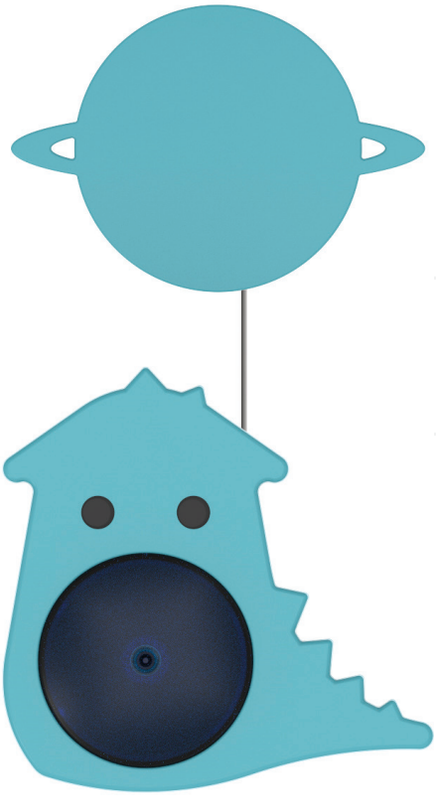


Figure 4. Funny Flush.



Figure 5. Funny Flush Storyboard.



Figure 6. Wally Wash.

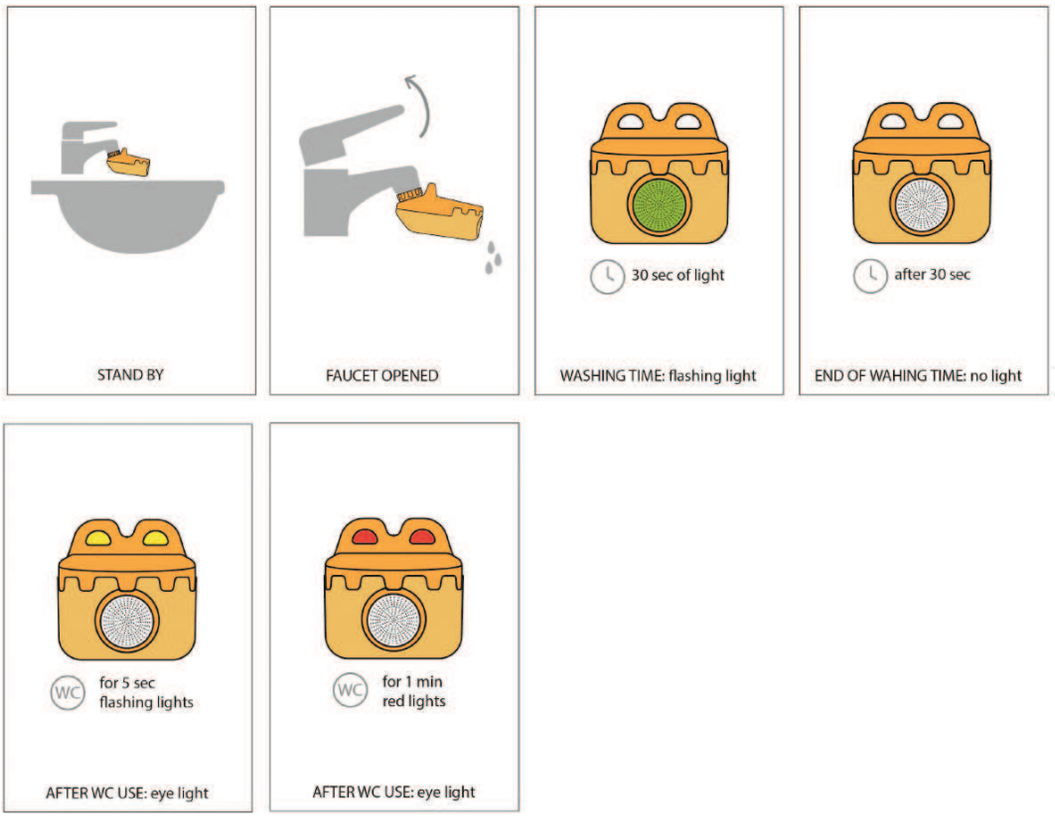


Figure 7. Wally Wash Storyboard.

4.3. Wally Wash

Wally Wash is the last item of the Igeni set. It consists of a little orange monster resembling a crocodile, and a faucet adapter. This dynamic product promotes child's correct faucet use and hand hygiene in an engaging way, thanks to sensorial communication. Moreover, Wally Wash is designed to centre the water flow in the sink, making hand washing easier for children (**Figure 6**).

Wally Wash is connected to Fanny Flush and activates itself to remind the child to wash his/her hands after the toilet use. It calls the child's attention by flashing light through its eyes. If the child does not wash his/her hands the eyes become red. Furthermore, its mouth lights up for 30 seconds when the faucet is opened (an inner dynamo registers the water flow), to suggest the correct duration of hand washing, in order to avoid water waste (**Figure 7**).

The recall of the design in this paper is mostly focused on the products' dynamic features. Other important details should be considered in the final product design (e.g. anti-bacterial coating) but our intent was to discuss the relevance of the products in terms of how they change the experience and influence the user's behaviour thanks to dynamic elements.

5. User tests

A prototype of the Igeni set was built and tested with users in order to evaluate the efficacy of the sensory communication, the pleasantness of the experience and the overall effectiveness of the system (**Figures 8** and **9**).

The use of off-the-shelf components and available materials and technologies led to some small changes in the prototype, compared to the real design. In particular, the toothbrush prototype shows a split body, to host interchangeable heads and to improve safety during the tests. However, the main features, especially the dynamic ones, were kept identical to the design.

5.1. Tests deployment

Six pilot tests were performed. The Igeni set was installed in six homes and was tested by each family. Altogether, the trial was performed with six children (two male and four female), two fathers and four mothers (**Figure 10**).

The test was divided into four parts:

- a preliminary interview to investigate the child's habits and feelings about personal hygiene;
- an explanation of the products and their main features;
- an interaction with the set by the children and the parents;
- a final interview with both children and parents, performed separately. Children were questioned about their experience and comprehension of the products. Parents were asked to give feedback about the set.



Figure 8. Igeni prototypes outside.



Figure 9. Inside of Igeni prototypes.

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Figure 10. Children interacting with the Igeni prototypes during tests.

5.2. Preliminary results

The tests were mainly focused on evaluating the effectiveness of the communication by the products' dynamic sensory features and the children's overall experience. Results show that the communication by dynamic sensory features was very effective and all the messages were understood by children without difficulties. In particular, sounds and lights were appreciated as clear stimuli. The use of colours associated with meanings (white for a clean mouth as a reward, red for alert) and the use of metaphoric sound, like the water, were very easy to understand and recall. The careful choice of the dynamic sensory stimuli in the design process turned out to be successful. Children considered the experience very fun and engaging, they liked a lot interacting with "living" characters, they enjoyed performing hygiene practices thanks to the dynamic, simple and friendly communication between them and the monsters. Moreover, the mere presence of the objects in the bathroom caught the children's attention and reminded them of specific actions like flushing the toilet or brushing teeth.

The use of sensory features instead of screens or interfaces and the possibility to give contextual feedback was highly appreciated by parents that also found the sensory stimuli effective in communicating the messages addressed to them.

Experience was evaluated on a five-point Likert scale. Some of the results are shown in **Figure 11**.

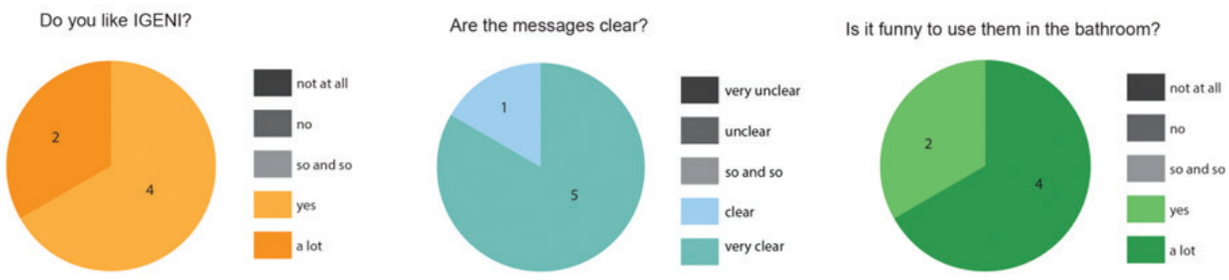


Figure 11. Test results.

6. Discussion and conclusion

A set of dynamic products was designed to reinforce hygiene practices in children from 3 to 5 years old. The design was focused on mapping messages into dynamic product features. The following sensory features were chosen to convey different kinds of messages:

- Encouragement: flashing light, sound or vibration were used to grab the child's attention in order to remind him/her to perform an action like flushing the toilet, washing hands or changing arch. Both abstract stimuli (flashing light) and metaphors (the sound of water to remind to flush the toilet) were employed. They both came out to be very effective, because also in the case of flashing lights in Billy Brush and Wally Wash, the stimulus was connected to the object, therefore easily associated to the suggested activity.
- Feedback: Still coloured light and sound were used to give feedback about the correctness of the activity. Red light was immediately associated to an error, and both high-pitch joyful sounds and low-pitch and sad sounds were instinctively connected with reward or "punishment". Sound came out to be stronger than light in conveying the idea of a right/wrong action.

The system is going to be tested for a longer period in households, in order to evaluate the impact of the use of such products on children's hygiene practices and to understand how to improve the design and the sensor application. The preliminary tests confirmed the ability of dynamic products to convey messages in an effective, engaging and contextualized way and their potential in encouraging positive and healthy habits in this context.

The preliminary findings reported in this paper can inform the design of dynamic features in other contexts, especially with children, where communication and encouragement are at the centre of the design activity.

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