

IDROPO, A Hydroponic Planting System to Teach Gardening Through Play

Figure 1. The body of Idropo



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Abstract

Idropo is a hydroponic system for children that educates by gardening and playing. For children growing a plant can be challenging, they lose interest easily. With Idropo the cultivation time can be reduced by using an hydroponical system and the educative experience can be enhanced by interacting with a dynamic and friendly companion for gardening educative experiences.

Author Keywords

Children; Play; Education; Nature; Gardening; Plant, Hydroponic System; Eco-Therapy

ACM Classification Keywords

D.2.2 Design Tools and Techniques; K.3 Computers and Education; B.4.2 Input/Output Devices

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Introduction

From the first field interviews conducted in Milan, all parents declared how they appreciate that their children take care of a plant, but that most children get bored after a short time, forgetting to pay attention to it. In this way the care of the seedling doesn't reach any educational, physical and emotional purpose. With Idropo (Figure 1) we want to remove these barriers between children and vegetables, making cultivation a pleasant, engaging and educational game. There is a main positive aspect of a greater involvement of children in cultivation: the possibility to build a healthier nutrition of the child by being able to integrate more vegetables and fruit in his diet [1]. The hydroponic cultivation in the educational system has already been tested with great success, finding an increase in consumption of vegetables for students involved in maintaining the greenhouse [2]. Even teachers benefit from cultivation: it's in fact possible to link the cultivation to different subjects, such as mathematics and science, creating a strong bond between the child and the teacher and therefore by osmosis also with schools [3].

Eco Therapy

Eco-therapy, also known as Green-therapy, can be described as a form of natural treatment, which encourages people to build mutually-beneficial

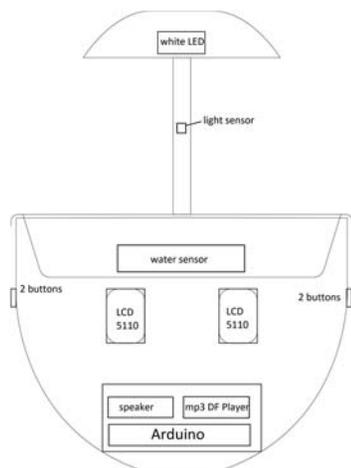


Figure 2. Idropo: technologies



Figure 3. Drop eyes when Idropo is thirsty

relationships with nature [4]. Those who have been undergoing this therapy make an attempt to use their mind, heart & senses to interact with the world. Basically, you need to get involved with different types of living species other than your own. Nature can have a positive impact on your body in numerous ways:

- *Medical Benefits:* it can help your body heal faster.
- *Emotional Benefits:* Continuous focus on everyday tasks, at work and home can drain you, causing you to feel irritable, fatigued and stressed.
- *Therapeutic Benefits:* Interacting with nature for just a few hours each day can help you combat some serious health issues, like depression and anxiety.

State of art

In the first phase of research of existing cultivation systems we have divided our attention into two categories:

1. Hydroponic systems for sale:
 - *Click & Grow* [5]: very expensive, mainly for the refills, needs to add nutrients to the water.
 - *Plantui* [6]: very expensive, needs to add nutrients to the water, but very easy to use.
2. Hydroponic concepts not marketed: *Niwa* [7] and *Ponos* [8], both are semi-completely automated and controlled by an app.

Each of these projects has a flaw: in the both categories none of the products is designed for children.

What is different about Idropo?

It summarizes the best elements by forming an intelligent product designed specifically for children's use by listening to and covering some of the main needs of every human being represented by Maslow's hierarchy of needs [9]:

- *Biological and physiological:* increased consumption of vegetables.
- *Safety:* health, learning a balanced diet.
- *Belonging and love:* friendship and affection.
- *Esteem:* accomplishment through the growth of their own plant.
- *Self-actualization:* problem solving, managing to understand how to grow plants.

The design of Idropo

Concept

The starting idea for Idropo's design is that it shouldn't be a just container of plants, but an avatar for the plants themselves. Idropo is able to communicate with children expressing in real time, through certain reactions, its needs (i.e. the plants' needs). Idropo's body shape was designed to be simple, attractive but also safe for children, and for it we were inspired by the appearance of the Pokemon character, Oddish: it presents itself as a hemisphere provided with two eyes that stands on two round feet. We have chosen such a dimension (24x35 cm) so that the children can handle it easily and at the same time so that all the components of the Arduino circuit can find space.

Technologies

To implement the different features of Idropo we used different sensors and actuators (Figure 2).

For the eyes we used two LCD displays connected with two sensors, one for the water and one for the light: when the brightness is low, the X-shaped eyes will be shown, when there will be little water the drop-shaped eyes will be shown (Figure 3). For the lighting we used a led that the child can turn on when Idropo needs more light. The other important feature is the voice: we used an mp3 Player that contains the different audios



Figure 4. Filling Idropo with water

that the child can activate by pressing the buttons in the right and left side of Idropo. The core of Idropo is an Arduino. The electric circuit is soldered on a board and located inside Idropo's body, below the saucer. All the other components are connected by this circuit using connectors, enabling easy disassemblament and substitution of broken components. Idropo has four buttons, two on the right and two on the left side. Each button has a specific function:

- One presents Idropo, explains how it works and how to put the plants and water.
- One says some curiosities about the natural world.
- One initializes the date when the plants is put
- The last one says how many days have passed from the initialization.

Interaction

The strong point of Idropo is the ability to enclose different functions for the child: it is, first of all, a smart hydroponic system but also a toy and a friend, as well as a teacher. Children can interact with Idropo in 2 ways:

- Physically, by touching it, placing the plant cups, filling it with water (Figure 4), turning on/off its light (Figure 5) and pressing the buttons on its body.
- Sensory, thanks to a direct communication between the object and the user. Idropo can speak and express its 'feelings' and needs with its eyes, in this way the experience can be very engaging for the child. [10].

Settings

For the evaluation of Idropo we brought the prototype into two schools, a primary school and a kindergarten, for a total of 93 children aged between 5 and 7 (56% females,

44% males). In both cases the evaluation procedure and the phases of the study were carried out in the same way and in the same order shown below:

1. Idropo Test

A written test was done after having the children interact with Idropo (Figure 6) in order to allow an evaluation of the functionality of Idropo. The questions were specific about the activity with Idropo, and every single question led to a precise element of the prototype:

- Name, age, class: general information.
- General evaluation of the interaction with Idropo.
- Evaluation of the different steps in Idropo.
- If children prefer to play at home or in the class.
- If children prefer to play alone or with friends.

2. Interviews

Unlike the two previous tests, this was an oral interview in pairs with children (Figure 7), in order to have more extensive and qualitative information of the interaction with Idropo compared to the two previous phases. The questions developed around 3 macro-topics:

- Their relationship with the care of plants/animals.
- Which parts they have preferred in Idropo.
- Which parts they wanted to add in Idropo.

Results

1. Idropo Test

The results of the prototype test were quite positive, both through numerical and visual factors. Children were happy with the interaction with Idropo, out of a total of 54 children the overall grade was 3.9/4. As evaluations of the other components results:

- Evaluation of jars: 3.60/4
- Evaluation of watering: 3.45/4
- Evaluation of light: 3.3/4
- Evaluation of speech interaction: 3.40/4



Figure 5. Turning on/off the light



Figure 6. Children interact with Idropo



Figure 7. Interviews with children

The majority of children prefer playing with Idropo with friends (75%) and at home (57.6%) rather than alone (18.4%) and at school (37%). These percentages have made us understand how although Idropo has been well accepted at school, according to the same children for them it would be preferable to play in the home with their friends.

Discussion

During the experimentation phase in schools we received direct feedbacks from children. The first concerns a factor that we had already considered in retrospect: the use of a Chatbot to allow a more natural and genuine interaction between children and Idropo. Other direct secondary implementations suggested are the possibility of choosing the Idropo's colour and, in the absence of the Chatbot, of the increase of the information and entertainment that Idropo provides by pressing the relative button. Observing the children interacting with Idropo, a further implementation was evident: the volume adjustment, so that the sound could be comprehensible in every situation, even in a place with more noise such as a class with 25 children

Conclusions

Idropo is a hydroponic system that interacts like an avatar, becoming a growth and learning partner for children. Through sensory interactions he manages to involve children by allowing their entertainment and expanding both their theoretical and practical knowledge about the natural world.

From our research there are currently no hydroponic systems designed specifically for children and that also help their learning. We can therefore say that at the moment Idropo is unique in its kind and its purpose.

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Note: Parents and/or legal guardians of children depicted in this work have expressed their permission and signed a consent form to interview, film, photograph, tape, and make a video reproduction of their children.