

Designing Tangible Interaction Environment to Teach ‘Tree of Life’

Paritosh Bahirat
School of Computing
Clemson University
pbahira@clemson.edu

ABSTRACT

This report details an in-class project which was aimed at teaching tree of life as a concept. This report gives a concise introduction to the final concept, motivations to pursue the project, pre-existing research in the domain and explains different methods which were used to successfully make the prototype.

INTRODUCTION

It is difficult to teach young children complex concepts, be it the concept of time zones or division and multiplication as a part of basic arithmetic. Developing appropriate mental model plays a crucial role in understanding the underlying concept or phenomenon. Sedhighian et. al. suggest that representation, interaction protocol and feedback of information plays a crucial role in developing appropriate reflective cognition in children [8]. Zhu et. al take this idea further to demonstrate children being able to solve Bayesian problems with an appropriate representation of concepts [10]. Research exists on developing framework for tangible interactions which can be utilized to develop tangible interaction environments [4]. Marshall also presents a framework to utilize tangibles for the purpose of learning [6] [7]. Some of the literature explores the different paradigms which are associated with children learning from tangible interaction with systems where they focus on the spatiality of the environment to allow for causing action, perceptual mapping which associates physical properties with digital aspects in interactions and behavioral mapping which is the link between input behavior and output action, additional parameters as well as a few more aspects to designing [1]. Additionally, work already exists on developing embodied metaphors which can aid learning in children [3]. Some studies also show that learning happens fast when children actually interact with physical objects [2].

This project aims to build an environment to develop understanding of tree of life. This was inspired by detailed in class discussions and tree of life web project which endeavored to create a web based repository to present information of different life forms on this planet [5]. Throughout the course of this project, the aim was to embody these design principles to develop a prototype which would serve as a fun and effective tool to enable children in learning more about evolution. This project in future, aspires to be an installation at various science museums or zoos or aquariums which attract a wide age-group.

PROTOTYPE DESIGN

This section details the design of prototype which was developed as a part of in-class project assignment. Our prototype



Figure 1. The entire setup displaying different parts of the tangible interaction environment.



Figure 2. The figure shows a puzzle which the users can solve in order to access the token inside the box.

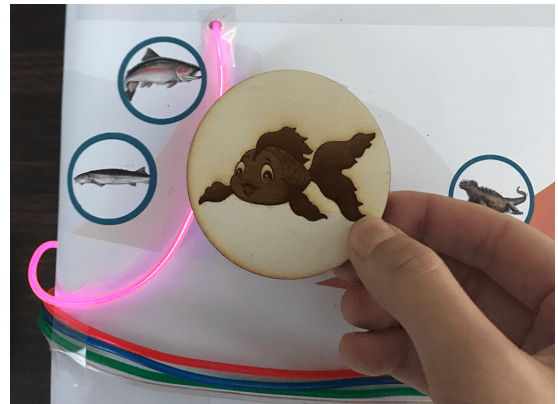


Figure 3. This images shows the token which can possible be embedded with RFID.

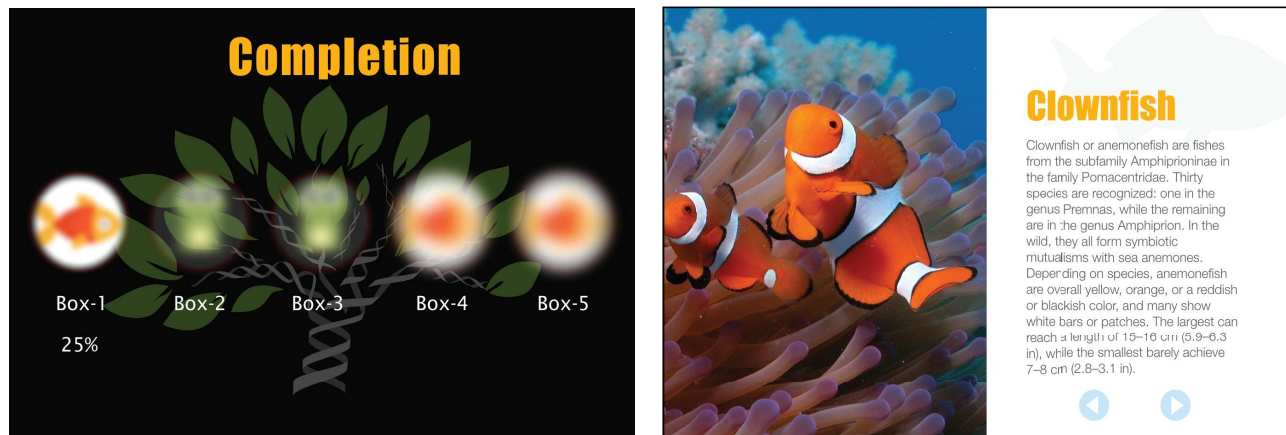


Figure 4. Left: The interface when the user is assembling the jigsaw puzzle. Right: The display shows information about the particular animal from the base of setup

comprises of five key elements. A completed prototype with all its components (See figure 1) provides its users with an experience that would enhance their learning of tree of life and also a fun activity for young children. The further subsections describe them in detail.

Tangible Jigsaw Puzzle and Wooden Tokens

The users of this prototype will first need to finish a tangible jigsaw puzzle (See Figure 2). The prototype has five such puzzles. Completion of each puzzle will open the door to the wooden box right above the puzzle. The door reveals a wooden token which serves as a small prize for the user. The user can now use the token to keep it at several points which are represented as circles with images of different animals on the basic surface of the setup (see Figure- 3). The puzzle pieces and the wooden tokens were manufactured by using wooden board and laser cutter available at Watt Innovation Center in Clemson University. For their successful operation as described in next subsection, we want our tokens and puzzle pieces to have an RFID tag embedded in them. This tag would enable the tokens and pieces to interact with the base of the setup, which currently is a plain box for demo purposes only.

Setup base and LED lights

As soon as the user finishes the puzzles and gets the token, the LED on the base of the setup lights up. This is an indication that all the circles with different animals are now “Activated”. The user can now use the token to keep it on top of different animals on the white base of setup. We envision, that base of our prototype will be made of a tangible fabric like surface which will be capable of reading RFID tags which we plan to embed in our tokens and puzzle pieces. We envision something similar to ‘Project Zanzibar’ [9].

Interactive Display

Our prototype includes a display where the information will be presented. To show display as a functional part of our prototype, we used a Microsoft Surface Pro tablet. The purpose of display is also to give a feedback about users progress when she/he is playing with the jigsaw puzzle. For the prototype,

the tokens should interact with the base which is essentially and Zanzibar. Since the token and jigsaw puzzle pieces have RFID they will interact with Zanzibar and then the Zanzibar will relay the information to the display. In the figure 4, the users get an idea of the progress which they have made with the jigsaw puzzle they are trying to solve, in the same figure on the right we show the interface which the user sees when she/he places the token on the animals over the base of the surface. We used, Adobe XD package to develop the interface in Figure- 4.

DISCUSSION AND CONCLUSION

This project demonstrates the methodology which can combine the tangible interaction, to help children learn about the complexities involved in tree of life. The report demonstrates the key ideas with which an interface/system like this could possibly be implemented. The system endeavors to combine gamification, learning and tangibles to create an environment which leads to an interactive experience to teach a complex concept.

In future this work can be extended to develop a fully functional prototype the key would be to actually implement it using Project Zanzibar and the tokens have RFID which can interact with it. Additionally, the current prototype has only a small tablet sized screen whereas the actual functional prototype could benefit from having a bigger screen with more information such as video of different animals and so on. Additionally, the system needs to have a well developed database which could lead to a more detail oriented interaction environment.

The biggest drawback of this prototype is that it does not show a how the interaction is completed, meaning how will the system reset when one user is finished using the prototype. We envision that once a user has finished playing with the system, they can hit a reset button. This button will then open the tray underneath the jigsaw puzzle area and hence all the puzzle pieces will be moved away into a common storage space where they were originally picked from.

Overall, this prototype certainly has a long way to go till its ultimate realization. This prototype need to go through the ‘Trial by Fire’ which every new product has to go through in the form of numerous usability tests with actual users to reach to its highest levels of realization.

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