Clinky the Robot: Preliminary Programming for Preschoolers

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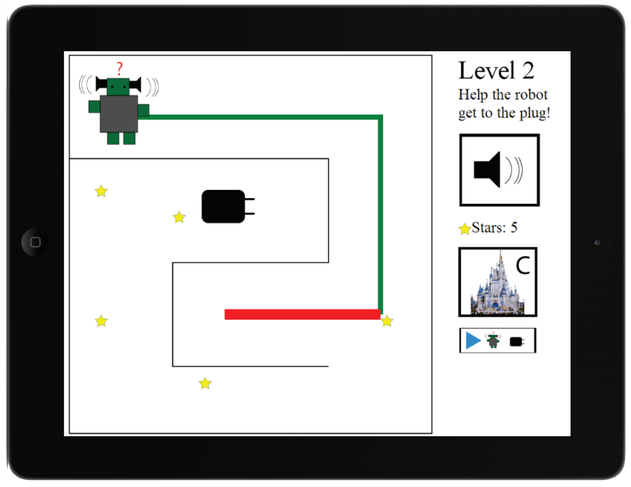
★ Overview

Acquiring skills that are fundamental to programming early on in one's life is a valuable skill. Not only does it help with the development of basic logic skills, but it also encourages children to learn more about computer science and understand technology at a more fundamental level. The goal of this project was to design and develop an iPad application that would scaffold young children (3-5 years old) in developing skills that will later support them in programming. In attempting to achieve this goal, we conducted research with children and expert child educators, while also aiming to understand the process of developing such an application on a touch screen device.



Level 2 demonstrates the concepts of debugging and planning

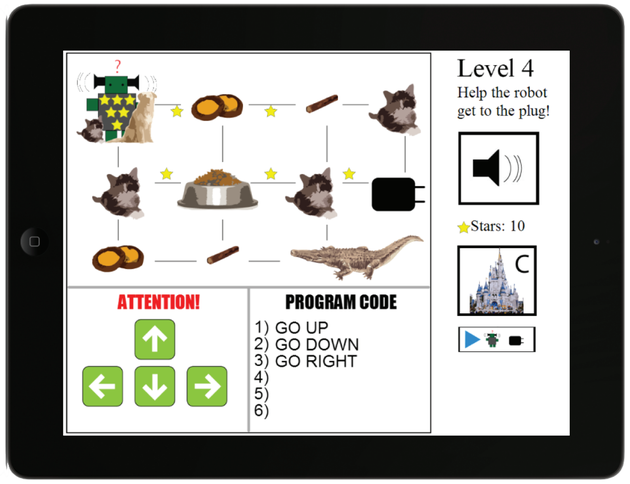
★ Background

Programming skills allow people to harness the power of computers to its full extent [1], while debugging skills are beneficial not only in terms of computer skills, but also problem articulation and solving, persistency, team working and social skills [2]. Also, computer science is admittedly not the most diverse field and exposing children to it an early age could help ameliorate this issue [3]. While programming is developmentally appropriate [4] and children like it, they are still left out of consideration in computer science learning. Since children are becoming more and more independent in their exploration processes [5], touch screens are everywhere and children like them, we decided to make an iPad game for young children (ages 3-5).

[1] D. C. Smith, A. Cypher and L. Tesler, "Programming by example: novice programming comes of age," Communications of the ACM, vol. 43, no. 3, pp. 75-81, 2000. **[2]** A. Sipitakiat and N. Nusen, "Robo-Blocks: designing debugging abilities in a tangible programming system for early primary school children," in Proceedings of IDC 12, Bremen, Germany, 2012. **[3]** A. Fisher and J. Margolis, "Unlocking the clubhouse: the Carnegie Mellon experience," ACM SIGCSE Bulletin, vol. 34, no. 2, pp. 79-83, 2002. **[4]** P. Wyeth, "How Young Children Learn to Program with Sensor, Action, and Logic Blocks," Journal of the Learning Sciences, vol. 17, no. 4, pp. 517-550, 2008. **[5]** J. Montemayor, Physical programming: tools for kindergarten children to author physical interactive environments, University of Maryland, College Park, MD, USA: Thesis, 2003.

★ Description

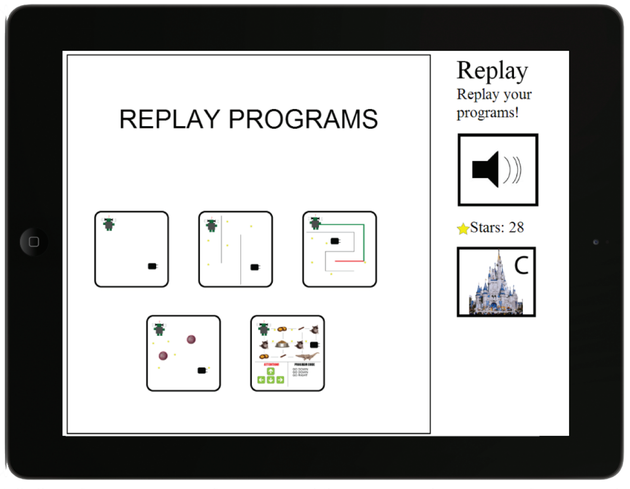
The goal of this research was to design and implement an iPad application that aids young children (3-5) in developing programming skills.



Level 4 demonstrates syntax and semantics, while expanding on the concept of planning

★ Product

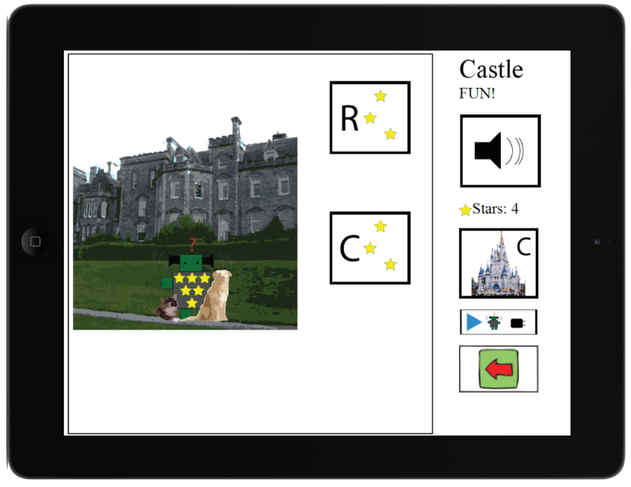
The player controls a robot called "Clinky", who is running out of power but can't go back to his plug by himself. The goal is to help Clinky charge by programming him in different ways. The game consists of 5 different progressive levels. The players can collect stars as currency, which can later be used to buy upgrades for the user's castle and robot. Feedback is provided in the form of two types of audio (robot and narrator), animations and text.



The Replay Hall allows for re-execution of programs, while conveying the concept of compound procedures

★ Methods

Since this product is designed for children, we strongly believe that children should be involved in the design process. Overall, we employed techniques that revolve around Cooperative inquiry [6] and other techniques developed in the Human-Computer Interaction Lab. The implemented design was developed after conducting 2 participatory design sessions with 7-11 year old children from a children-adult design team called "Kidsteam" (run by the HCIL). After the first session, we made a wireframe that was further elaborated on by Kidsteam. While iterating on the design, multiple guidelines from previous research were employed. The product was implemented and brought to the Center for Young Children, where formative evaluation took place. It was first evaluated with 4 teachers of children 3-5 years old in informal interviews and subsequently with 6 children ages 3-5, also at the CYC.



The Castle allows players to buy Castle and Robot upgrades using the stars they have collected

★ Findings & Future work

Overall, the teachers found the game to be a valuable tool and the children loved it (all children gave it a rating of 5/5). However, since there was only limited time, the product is not final. The ability to repeat the levels needs to be implemented, together with a larger number of levels and a smoother transition between them. The learning outcomes will also need to be evaluated in a long term case study. Finally, as children of ages 3, 4 and 5 differ significantly, the next iteration of the application's should consider that in the design process, as well as the style of the activity (guided VS independent).

[6] A. Druin, "Cooperative inquiry: developing new technologies for children with children," in Proceedings of CHI 99, Pittsburgh, PA, USA, 1999.