

Touching Newton: a round multi-touch table for collaborative learning among children

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Abstract

This poster presents a concept for a learning game on a round multi-touch table particularly designed for elementary school children. We believe that the round multi-touch table provides a more intuitive way for children to interact with the computer and will encourage collaborative learning because it allows several inputs from multiple users simultaneously. Moreover, standing orbitally around the round table is supposed to offer an equal view on the table/screen and should facilitate communication among the children. We are currently developing a dedicated software which tries to concentrate on the strong benefits of face-to-face collaborative learning. It is inspired by “Crazy Machines” a game about mechanical chain reactions that we adapt to our setup to allow a group of children to solve a particular problem collaboratively and thereby experience Newton's laws.

1. Introduction

Most hardware and software do not support collaborative learning to the full potential[13][5]. Sharing mouse and keyboard in a group makes the children without the input device easily bored[12][11] or lets them compete for control[11][8]. Furthermore, children tend to crowd in front of the computer[11], so we assume that an equal view on the monitor for all of them is hardly possible. Also most educational software is designed for individual use and therefore doesn't take advantage of the strong benefits of face-to-face collaboration[15].

Thereby research showed that when learning in small groups with the computer children are more dedicated to the subject[7], have more fun[1] and solve problems faster[8] than learning individually. Additionally children learn important social skills[3]. There are

already projects which allow children to collaborate on a shared display with several input devices[16][1]. Though we believe that sharing the same display and sharing the same input device while maintaining simultaneous interaction could reveal interesting design opportunities for children collaboration.

A such input device could be a multi-touch screen. Although some multi-touch software addresses collaborative issues[4][14][10] it seems that none of them designed software for the special needs of children.

There are several advantages when children interact with the computer but most Hardware and Software doesn't support co-present collaborative learning for children.

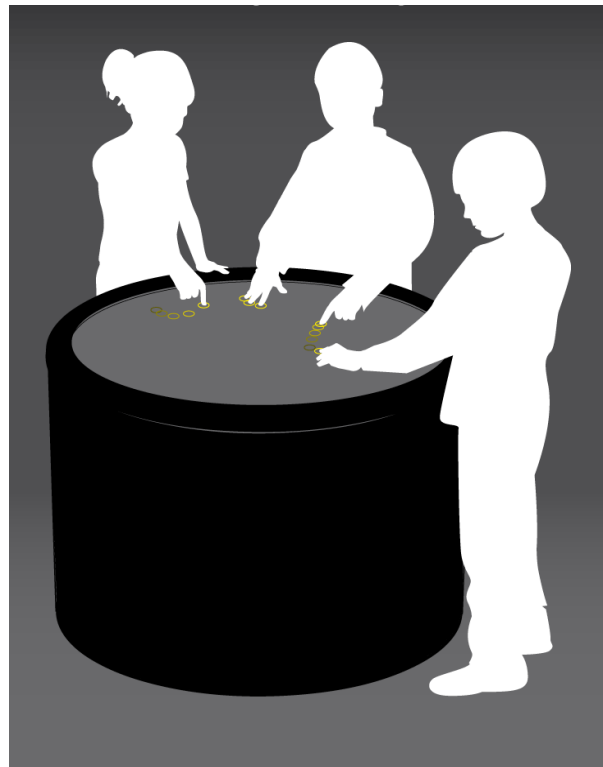


Figure 1. Illustration of the round multi-touch table

2. Round Multi-Touch table

For solving the problem with sharing a single user input device we build a round multi-touch table.

Our multi-touch table allows several inputs from several users on one shared display.

All children can interact with the table simultaneously so they don't have to wait until it's their turn. They can touch with bare hands and fingers and also gestures drawn on the screen are a possible input. For example a child could show how something works and another imitates it. The child repeating the action could even mimic while the other is still performing the action because of the simultaneous input possibilities of the multi-touch table.

We build a round table/screen because we believe that by standing orbitally the children can better communicate because they don't lose sight of each other that quickly while interacting. Also children have a higher motor activity and when they want to change position we think it's easier to move along a round table than a squared one. To correspond to the top view of the table, our game shares a birds eye view only. Therefore each side of the table is equally good to work at.

3. Collaborative Software

In order to better test the hardware we particularly designed a software inspired by "Crazy machines" which is a puzzle game designed for only one player.

The aim of the original game is to complete a chain reaction through placing virtual objects like balls and boxes in the right place. The game properly simulates the physical behavior of the objects. Therefore experimenting with the physical properties of the objects and observing the results is the main part of the game.

We think that games are good for learning processes rather than data. In our case this would be the interaction between forces and objects. Therefore we adapted the basic concept of "Crazy Machines" to our setup and made an own game which allows children to play the game simultaneously and experience physics through play. With their fingers the children can move around virtual objects on the screen and manipulate them with simple gestures. Some smaller tasks can be solved individually while other tasks demand cooperation among the children.

Figure 2. Topview of the table. Objects have to be manipulated to solve a level.

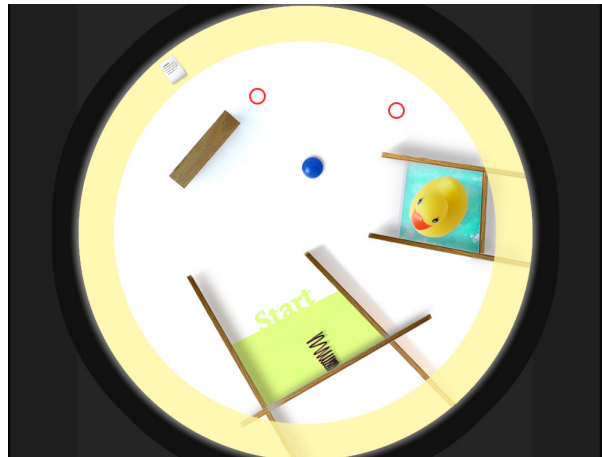


Figure 2. Topview of the table. Objects have to be manipulated to solve a level.

4. Technical details

The multi-touch table is based on the technique developed by Jefferson Y. Han [6] which we are trying to improve.

The technique is a combination of computer vision based tracking and the phenomenon of frustrated total internal reflection (FTIR). When a finger touches an acrylic plate infrared light which is sent into the sides of the plate is scattered at the point of touch. A camera mounted behind the clear acrylic plate can see this light as bright spots. Through image processing the bright spots are converted to x and y coordinates and so can be used as input for an application.

Because there are several problems with the acrylic plate as a touch surface, Han proposed a compliant surface to be laid on top of the plate. He mentioned a vinyl rear-projection screen called "Rosco Gray" to be a reasonable overlay though still sees room for improvement. Unfortunately Rosco Gray is not suitable for our application because it needs hard pressure to cause the FTIR effect which would probably fatigue children quickly.

In order to find a compliant surface which needs nearly zero force pressure to cause the FTIR effect we are currently experimenting with various materials. Among other we tried coating cloth with a thin layer of latex or silicon which didn't lead to fully satisfying results. Silicon foam was perfectly causing the desired effect though it isn't translucent enough. A patent by R. Kasday [9] which uses also a similar technique for tracking fingers uses silicon rubber as a compliant surface though another patent [2] claimed to have a better solution which is a basically a pouch with gel in it. We haven't tried out these solutions yet though we

think that laying cloth or simple paper on top of the silicon rubber could make the desired compliant surface.

5. Summary and Future work

We have presented a concept for a learning software on a round multi-touch table which will support collaborative learning. At this the hardware plays a vital role in supporting the demands of the software and vice versa.

In the next weeks we still have to work on the compliant surface to allow smoother interaction with the table. A first prototype of our game is currently programmed. We will concentrate on designing interfaces and tasks which will help (or sometimes even force) collaborative behavior. Finally we want to see how much the learning process actually gains from collaboration.

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