Designing and Making a Tangible Tabletop Game with ToyVision

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Abstract
Studio participants will design and prototype tangible board-games for NIKVision: a tabletop computer for young children. The goal of this studio is to give designers and developers hands-on experience of developing a functional prototype of a tangible tabletop application without the intrinsic difficulties of managing electronic sensors, actuators and machine vision algorithms. During the studio attendees will complete a simple but conceptually complete tangible board-game prototype during the workshop day by abstracting the technologies and keeping focus firmly on the application *behaviours* and the *interaction*s between users, objects and the system. This will be achieved through using the ToyVision toolkit, a set of software tools that lowers the threshold of prototyping both the "bits" and "atoms" of interactive tabletop games.

Keywords
Tabletop; toolkit; tangible; games; playing pieces; design.

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation: User Interfaces—Input devices and strategies, Interaction styles.

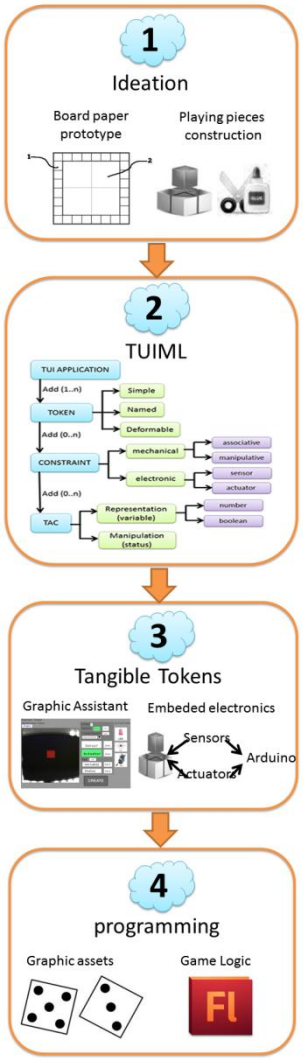

Figure 1. Process of creating a game with the ToyVision toolkit.

Introduction

Tabletop computing promises a new generation of education and entertainment applications that extend and augment traditional paper and piece based board games. This will be enabled by systems that support the detection, identification and tracking of not only fingers and hands, but also conventional objects and/or playing pieces placed on the table surface. Powerful and flexible instantiations of many of the core technologies required for this vision, typically in the form of hardware platforms [4] and finger [1] or marker [5] tracking software, already exist.

However, despite the rich functionality afforded by such systems, prototyping and creating designs for conceptually complete tangible interfaces and applications remains a challenging task. We argue this is largely due to a lack of high-level design and modelling tools linked to executable software frameworks. For example, current marker tracking systems typically provide authors with reliable reports of the presence and position of objects on a table surface. While such information is essential, it is also low-level and poorly matched to more abstract application level behaviours – designers are left to bootstrap these overarching frameworks independently.

This studio addresses these issues by presenting ToyVision [3], a software toolkit that lowers the threshold for prototyping both the bits and the atoms of tangible tabletop games. Its goal is to provide a toolset that supports designers in exploring rich, expressive and complete tangible interactions in computer augmented board-games. It is based on the Tangible User Interface Modelling Language (TUIML) [7], a pen and paper specification tool designed for tangible systems. ToyVision's development was inspired by the pivotal role played by application and interface frameworks in supporting and facilitating design, prototyping and development activities in other domains such as desktop GUIs [2] and the web [6].

Studio Proposal

ToyVision lowers the bar to the design and creation of tabletop tangible applications. In the space of the studio day, participating designers and developers will learn to use and apply high abstract modelling tools (TUIML) to model tangible interaction with conventional objects, and they will have the opportunity to discover and explore the toolkit through prototyping their own tabletop board-game. The studio will close with a discussion on the role that toolkits will have in the maturation of Tangible Interfaces.

The Studio structure is divided in the following phases (see fig. 1):

- **9:00-09:45 - Intro to tabletop interaction.** Participants will be introduced to a NIKVision tabletop [3]: an interactive horizontal surface designed to be used by children. Through experiencing a set of existing ToyVision tangible games created for NIKVision (see fig. 2), participants will be introduced to (and inspired by) the affordances, capabilities and constraints of both systems.
- **9:45-10:30 – Game and Playing Pieces Ideation.** Either alone or in small groups, participants will propose and develop game concepts. To seed this process, the organizers will provide handouts detailing 3-5 game ideas (see fig. 2 for a fully worked out example) and media and

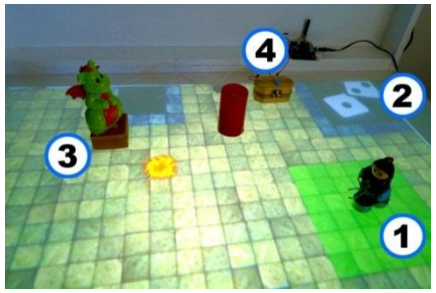

Figure 2. NIKVision tabletop with an example of an existing tangible game created with the ToyVision toolkit: The "Dragon's Cave". This is a role playing game for young children in which one or more Hero playing pieces (1) take turns to move a number of tiles specified by a virtual dice (2). Their goal is to seek a Sword kept in a Chest toy (2) and kill a Dragon (3) before the Dragon finds the Hero and attacks with a fireball. This game combines both passive tokens (the Heroes and sword) with active tokens in the form of the Chest lid (automatically opened by the system) and the Dragon's mechanically swiveling (and hero-homing) head.

playing pieces from conventional tabletop games and materials for building custom pieces (e.g. LEGO construction blocks, foam core, card, glue) will be made available. The concepts will be discussed with the organizers to ensure the feasibility of realizing them during the workshop.

- *10:30-11:00- Coffee Break.*
- **11:00-12:30 – Modelling in TUIML.**
  A handout detailing the TUIML language will be distributed and the participants supported as they develop models expressing their game or application. This will culminate with participants developing a visual abstraction of the tangible tokens and behaviours in their application. At the end of the session each of these models will be presented to the whole group.
- *12:30-14:00 – Lunch.*
- **14:00 – 15:30 – Creating ToyVision Tokens.**
  ToyVisions' Graphics Assistant will be introduced and participants will use it to translate the previously created TUIML models of their playing pieces into the ToyVision toolkit. The Graphic Assistant supports both passive tokens (e.g. traditional graspable playing pieces) and active tokens that can be controlled by the computer system by embedding electronic actuators and sensors. The Graphic assistant will support participants connecting these sensors and actuators to a microcontroller (e.g. Arduino). It will also produce a printable set of visual markers that represent each of the tokens in their game.
- *15:30-16:00- Coffee Break.*
- **16:00 – 17:30 – Creating a game.**
  Participants will test their tokens in the ToyVision Framework. They will then use the Adobe Flash development environment and Action Script 3 (AS3) programing language to create the dynamic behaviour in their games. ToyVision provides an AS3 API that delivers high-level information relating to the events occurring to the tokens in a game. Therefore, participants need only develop the graphical assets and game logic. Organisers will support them in this process and the session will close with a demo of the completed prototypes.

This studio requires participants with an intermediate level of technical skill. Some experience with programming interactive graphics applications is essential; Adobe Flash and Action Script will be used in the afternoon session. Some participants may also work with simple electronic prototypes (e.g. Arduino). Prior experience with developing computer games and rapid creation of art assets would also be helpful. Finally, participants will be invited to a post-studio dinner where the role and nature of toolkits in the development and maturation of the field of tangible interaction will be discussed.

Studio Topics and Themes

This studio proposal will cover the following topics:

- Techniques to bring tangible interaction to digital augmented horizontal surfaces. While this studio will focus in the context of tabletop games, we hope it will also serve to inspire participants to enrich any other forms of tabletop application with tangible tokens.
- Abstraction methods and modelling languages to diagrammatically specify tangible interaction in computer applications.

- The role of software toolkits to support designers and developers in the implementation of innovative interactive applications.

Expected Outcomes

This studio provides an opportunity to lower the bar to entry and bring tangible interaction out of research lab environments. We expect that participants already have experience in designing or developing conventional interactive applications (e.g. for desktops or on touch-surfaces), but that the studio may be their first opportunity to create an application based on the manipulation of tracked physical tokens and objects. To support these activities, the ToyVision toolkit isolates participants from the intrinsic complexity of hardware and low-level programing and will let them more freely explore the physical affordances of objects to interact with a digital interactive application. The ultimate output of the studio will be a series of participant produced fully functional mini-games that we will document and release the media and source-code for on the ToyVision website. Participants will also have the opportunity to discuss and share new concepts for tangible computer games in the context of a creative environment where they can rapidly and iteratively prototype and refine their ideas.

Studio Supporting Web Documents

The ToyVision toolkit can be downloaded and used under an open-source license. It is available here: http://www.toyvision.org. It is fully documented and there are a wide range of samples and examples that anyone with an optically tracked tabletop device can use. Furthermore, for the purpose of this Studio, we will extend the webpage with additional material for participants to support them before, during and after the Studio.

Acknowledgments

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