

Teaching product design students how to make everyday things interactive with Arduino

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Abstract. This paper describes how industrial design students made everyday things interactive with Arduino in a programming course. It also describes 6 innovative projects made by the students; (1) A beat machine inspired by Rubics Cube, (2) an interactive and moving lamp that scans the area for faces, recognizes your smile, take a picture of it, and posts it on Twitter, (3) a self-typing typewriter from 1920's which you can have a conversation with, (4) an interactive art installation where you use your own shadow to play with falling objects, (5) a digital audio workstation where you change the sound characteristics by moving tangible rubber blocks on a surface, and (6) a tangible music player where you discover new music by moving a cylinder around on a plane. The range of solution fit three different categories: (a) *Music*, both creating and playing, (b) *Everyday things with personality*, and (c) *Interactive art*. Videos of all projects are available on <http://bit.ly/1K4YPYB>

Keywords: Arduino, programming, teaching, industrial design, interactive art

1 Introduction

The Department of Product Design at the Norwegian University of Science and Technology (NTNU) offers a master program education in industrial design [1]. The master program offer two study specializations: *product design* and *interaction design*, educating product designers and interaction designers, respectively. In the same way a product designer need to know and understand the *materials* they work with, an interaction designer need to know and understand the *virtual material* they work with – in other words they need to know basic programming in order to make good interaction designs, and to be able to communicate with developers. Further, in the age of *Internet of Things*, many products designers now need to know programming in order to make their products interactive and to give them life. Therefore, the Department of Computer and Information Science at NTNU offers a course to industrial design students where they learn how to make their products or artworks interactive. This course is called *Prototyping Interactive Media* [2] and aims to teach the students the art of programming through project based work.

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1.1 Teaching industrial design students programming

In the course we teach the industrial design students programming with Arduino (using the *Processing* language), which is “an open-source electronics platform based on easy-to-use hardware and software (...) intended for anyone making interactive projects.” [3]. It is basically a small programmable computer where you can, with the help of code, sensors, servos, LEDs, and other cheap hardware components, create remarkable things. Arduino is open source, and there exist numerous code libraries where other programmers have solved problems before so that you don’t have to do it again. These are like LEGO pieces that you can connect to each other (with the help of a little code) to build new projects that does new things.

1.2 Course assignments

The course consists of two individual assignments where they get familiar with the possibilities of Arduino and the *Processing* programming language. In these assignments they build a traffic light and a music instrument. In addition the students are given an open group assignment, where about four of them collaborate:

Find an everyday thing, make it interactive and make it talk to the world (or other everyday things) or let it publish things on the Internet, for example tweet or update facebook status.

It can be that does something useful for the user, or an art project that inspire the user. It can be something for your home or something for your study desk. The design challenge is to find the valuable interaction.

1.3 Design process

Although the group assignment was open with few restrictions, the students had to reach a number of milestones with hard deadlines (which they had to show/demonstrate to the course staff).

- Project planning
- Idea generation
- Idea selection
- Wizard-of-Oz-test
- Iterations

The students had to deliver or present the following:

- A video of the project (maximum 2 minutes)
- A functional prototype presented on an exhibition where an audience could test and try it
- A short oral presentation of the project during the exhibition
- A long oral presentation of the project in a classroom

- A report that documented the product, the design process and wiring diagrams, and with references to code libraries used.
- The complete code

2 Project descriptions

Below is a short description of the resulting 6 projects. Videos are available on YouTube on <http://bit.ly/1K4YPYB>

2.1 PLAY

PLAY is an art installation where you (or you and a friend) use your own shadow to interact with falling (or flying) objects of different sizes and shapes. The objects cannot pass through your shadow, which allows you to stop, hold, bounce, hit, and pass the objects on to a friend. There are two modes, changed with the press of a button, that either shows your shadow or hide it.

The installation consist of a curved wall, where the final image is projected, a button on a pole that is controlled by an Arduino, and a back wall, which hides a projector, a Microsoft Kinect sensor, and a computer with the Processing code. The interaction with the objects is possible through blob detection and a physics simulator.



Fig. 1. PLAY

2.2 GhostWriter

GhostWriter is an old typewriter from 1920's that is given life – it responds to your input and writes it down on a piece of paper. When you write something on the typewriter, it responds as a human being; with curiosity and humor.

The typewriter is connected to wires that sense your typing, translates your key presses to a text string, sends your message to a chat-bot. Further the system translates the answer from the chat-bot to key presses, and press the keys using pneumatics so that the message is actually typed on the paper sheet.



Fig. 2. GhostWriter

2.3 RubberBeats

Rubberbeats is an interactive tool for creative music production. Colored rubber blocks represent different sound clips. These clips are played when you place the rubber blocks on a transparent surface. The sound image is changed by moving the blocks; by moving the block vertically you can change the pitch of the sound, by moving it horizontally you change the tempo. You can play several sounds clips simultaneously by placing several blocks on the surface. When you are happy with the sound, you can record the sound clip and post it on the web based audio platform SoundCloud with the hashtag #RubberTracks.

Rubberbeats uses a PIXY-camera and colour recognition to recognize the different blocks. The system also translate the position of each block to the corresponding pitch and tempo.



Fig. 3. RubberBeats

2.4 Beat Ball

Beat Ball is a beat machine that allows you to combine up to 3 different beats into a more complex beat. *Beat Ball* is shaped as sphere with movable panels, inspired by a Rubik's Cube. By moving a panel you switch from one instrument into another, for example a clap into a whistle, or a base drum into a bongo drum. In this way a user can experiment and play with sounds to make a beat that they like. All the technology is hidden inside the sphere. Only a headphone jack and a power button is visible on the outside.

Rubberbeats uses a PIXY-camera and colour recognition to recognize the different blocks. The system also translate the position of each block to the corresponding pitch and tempo.



Fig. 4. Beat Ball

2.5 Argus Ball

Argus is a curious lamp. It constantly scans the room for faces. When it see you, it moves closer. When you get too close, it moves back. When you smile to *Argus*, it takes a photo, shows it to you on a computer screen, and looks down on a big blue *Twitter* button. If you are satisfied with the photo, you press the button. *Argus* then nods and posts the image on *Twitter*. If you are dissatisfied with the photo, you do nothing, and *Argus* sadly shakes his lamp head and then continue to look for smiles.

Argus has an embedded video camera in the lamp head, and uses face tracking to find faces. Six servos continuously move the lamp to scan for faces, to make sure your face is in the middle of the image and has the right size, and to simulate its personality. It uses smile detection to take a photo, and a *Twitter* library to post the image on the Internet.

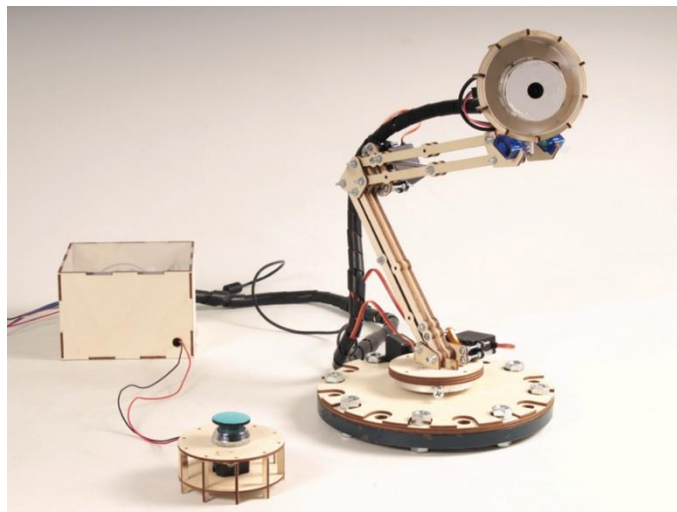


Fig. 5. Argus lamp

2.6 Discover

Discover is a tangible interface for the music streaming service *Spotify* with the intention to expand the user's musical horizon. The users start playing a playlist from *Spotify* by placing a cylinder on a circular plane. Based on where you place the cylinder, a specific music genre starts playing. At any time you can move the cylinder to play a new playlist from a different music genre. You can also push a favorite button to save the track in your favorites for later. In this way you can explore music and find new

genres and tracks that you like. You stop the music by placing the cylinder in the dock at the base of the device.



Fig. 6. Discover

3 Discussion

Looking at the variation of solutions, they can be placed in the following categories:

Music: Here we find *BeatBall*, *Rubberbeats* and *Discover*. The two first are for *creating* music, while the last is for *playing* music.

Things with a personality: Argus and GhostWriter are both everyday things with a clear personality.

Interactive art: *PLAY* is an interactive art installation where the audience can interact with the installation.

4 Credits

I thank the clever, creative and hardworking students for delivering impressive work.

Argus: Christer Rebni, Magnus Oulie, Tuva Haddal, Astri Eiterstraum

BeatBall: Truls Ottesen Johansen, Ellen Wagnild-Antonsen, Polle van Duuren and Inga Nedrebø Søreide

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GhostWriter: Kjersti Bjelkarøy, Aurora Brun, Alexander Jonassen, Sigve Lien, Ingeborg Skogsfjord

Play: Jan Magnus Neverdal, Kaja Drews, Johanne Parelius, Thea Togstad

Rubberbeats: Anja S. Hansen, Arne H. Aaraas, Emilie H. Weydahl & Viktor Rydal

References

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3. <http://www.arduino.cc/>