PHYSICAL COMPUTING, LAB EXERCISE 3, (week 39)

Arduino 2.

The purpose of this lab is for you to continue familiarizing yourselves with the microcontroller. You will learn more advanced uses of the Arduino and how to combine knowledge from various exercises in order to create new circuits and uses of the microcontroller. You will also learn about physical space markers, and do some designing.

The following is needed (for each group):
• Computer with USB port
• Arduino microcontroller
• Breadboard (make sure the supply lines on the board are connected all the way)
• USB cable
• Several red and green LEDs
• A Potentiometer
• A Diode
• 12V lamp + socket
• BR-1050-12VDC relay
• TIP121 transistor
• 12V DC motor (computer fan)
• Servo motor
• (Stepper motor)
• ULN2003A or ULN2803 Darlington driver
• 74HC595 chip
• Various resistors
• Wires
• RFID Card Reader Serial
• Camera phone (borrow if you don't have one)
• Printable sticker paper

Grading
To pass the Lab you will need to finish exercise 1, 2 and 4. Exercise 3 is for distinction. Exercise 4 is graded 3-5, the others with pass only.

Arduino Recap
About the software environment:
http://www.arduino.cc/en/Guide/Environment
About the foundations of working with Arduino:
http://www.arduino.cc/en/Tutorial/Foundations
For references about the programming language:
http://www.arduino.cc/en/Reference/HomePage
http://www.arduino.cc/playground/uploads/Main/arduino_notebook_v1-1.pdf
Problems? Arduino troubleshooting: http://www.arduino.cc/en/Guide/Troubleshooting

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Exercise 1: High Current Circuits etc.

In this exercise you will learn how to drive high-current circuits, work with different kinds of motors, controlling motors and other high-current devices, and more.

Lamps & Relays / Transistors

1) Build the following circuit, using a 12V lamp and a 12V (BR-1050-12VDC) relay:
http://www.toddholoubek.com/classes/pcomp/?page_id=368
(comments as alt-texts)

2) Build the lamp part of the following circuit using a 12 V lamp and TIP121 transistor:
http://itp.nyu.edu/physcomp/Tutorials/HighCurrentLoads

Change the intensity of the light using the potentiometer.

DC Motors

3) Build the DC motor part of the exercise, using 12V computer fans (DC motors):
http://itp.nyu.edu/physcomp/Tutorials/HighCurrentLoads
(Setting up the transistor:
http://www.toddholoubek.com/classes/pcomp/?page_id=382)
try to change the speed of the motor using the potentiometer.

Servo Motors
4) Build one of the two circuits in the following examples
http://www.arduino.cc/playground/Learning/SingleServoExample
http://itp.nyu.edu/physcomp/Labs/Servo (you may use a pot)
and go through the code in the examples.

Stepper Motors (Optional)

(5) Build the following circuit for a unipolar stepper-motor (6 wires):
http://arduino.cc/en/Tutorial/StepperUnipolar
If you are using a ULN2803 Darlington driver instead of the ULN2003A, make sure to modify the connections of the circuit accordingly:
http://www.cs.chalmers.se/idc/ituniv/kurser/06/uc/bx24/uln2803.pdf

Physical Markers (QR Codes)

Go to http://reader.kaywa.com/ and browse through the scenario ("Play").

6) Go to http://qrcode.kaywa.com/: think of the types of information one could place onto space or objects in various situations, and generate examples of QR Codes for various types of media in order to illustrate the scenarios.

Use appropriate camera phones available in order to download a QR Code reader from http://reader.kaywa.com/ and test reading the codes you have produced.

(For a list of supported phones, see http://reader.kaywa.com/phones)

Making Motion

7) Read these instructions on how to make simple motion,
http://www.flying-pig.co.uk/mechanisms/

Exercise 2: Serial to Parallel Shifting-Out

In this exercise, you will learn how to extend the number of output pins on your Arduino board with shift-registers, once the pins start running out.

1) Read the following page: http://www.arduino.cc/en/Tutorial/ShiftOut

Build the circuits with 8 LEDS described in the exercises.

Also read the following page about how to extend the number of digital input pins on Arduino: http://www.arduino.cc/en/Tutorial/ShiftIn

Exercise 3: RFID [Distinction]

In this exercise you will learn a technique for tagging physical space with RFID markers. (Complementing the QR Code example above)

1) Do the following exercise, taking turns in using the reader:
http://www.arduino.cc/playground/Learning/PRFID
Read various RFID tags using the reader.

Discuss: What are the differences between RFID and QR Codes in terms of the type of applications they enable? Think about material, use, integration into space, power supply etc.

Exercise 4: Sketch a design solution

Come together in your group and sketch a user scenario and prototype made from any of the technology used in the labs this far. If you want to impose some limitations to this very open task, contact Johan for details.

Use a maximum of two A3 papers (one is enough) to present a possible technological solution and its use. This can be a 'flat' presentation or a mock-up, but should include some text explaining your solution.