CyberBear: Hack an IKEA Bear into an IoT Product

FemTech Workshop for STX/HTX students, April 2017

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Human Centred Computing (HCC)
Department of Computer Science (DIKU)
Lets start to get to know each other

What is your favorite movie or serie?

What kind of music do you like?

What are your expectations for today?
What are we going to do?

- Hack an IKEA bear into an IoT product
- Learn how to create and built an Interactive Product using micro-controllers

- Learn Par-programming
- Learn Micro-controller Programming
- Learn to use Electronic textile as hardware
How are we going to do this?

**Morning: Introduction to Arduino & the Thing**
- Introduction to Par Programming
- Hello World!! Making the Thing blink?
- Making an LED blink – play with blinking patterns
- Built a button to control the LED blink
- Get the Thing on the Internet when pressing the button

**Afternoon: Hack the IKEA bear**
- Create a textile button and add it to your circuit
- Wire up the Thing with conductive thread
- Sew the Thing on the IKEA bear
- Sew the textile button on the IKEA bear
- Sew the LilyPad LEDs on the bear
Beyond the FemTech Workshop

FemTech.dk is a research project with the aim of creating new ways to facilitate inclusion in digital technology development by experimenting with new teaching methods.

We have invited you to try out these new methods and then learn from you what works and what can be improved.

Therefore we will ask you questions and collect information about this event, which we then use for research using video, audio recordings, and pictures (please help us).
What do we hope to gain from the FemTech workshop?

• We want you succeed in creating your own IoT Cyber Bear to take home
• We want you to succeed in putting your Cyber Bear on your local WIFI at home
• We want you to bring your Cyber Bear to your class and explain to others what you did and how cool it is
• We want you to help us create a small ‘workshop exclusive FemTech’ community, where you can share idea about technology with each others, while helping us to create future workshops for others

Questions or Comments?

Internet: Pernille Bjorn
Password: asyouwishes
DIKU Human centred computing researchers invites STX/HTX students for a FemTech event

At the Human-Centered Computing (HCC) section at University of Copenhagen Computer Science department (DIKU), we are researching new al-
You will be working in groups – shifting roles as navigator and driver - you will do everything twice in each group
IoT is basically a ‘thing’ which can connect to the Internet and do something.
What is the cool thing about micro controllers?

USB to power and/or computer

On/Off WiFi

Build in LED

GND

Pin 2
Pin 14

Pin 4
Pin 13
Pin 12

Pin 5 = build in LED

5V

GND

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Hello World!!! Making the Thing blink

First we need to install drivers:
• Arduino IDE
• Sparkfun ESP8266 Thing Dev

Then we make the Thing blink

Internet: Pernille Bjorn
Password: asyouwish
Website: Femtech.dk
FemTech event: Hack an IKEA Bear into a Cyber Bear
1) Installing Arduino IDE
2) Sparkfun ESP8266 Thing Dev
3) Hello world – making the Thing blink
Navigating the Arduino IDE (examples)
Arduino IDE

- Compile
- Upload
- Serial Monitor

Your Code

```c
void setup() {
  // put your setup code here, to run once:
}

void loop() {
  // put your main code here, to run repeatedly:
}
```

Debug Info
When something goes wrong....

- Make sure to turn off the Thing and unplug
- Sometimes you need to shut down Arduino IDE
- Sometimes you need to shut down/restart your computer

Check the board

Check the port

Find in reference

Check the wiring!!
Let's build something!

Power USB connected to computer
Breadboard – to help us connect stuff to the Thing
Double Breadboard (avoiding short circuits)
Let's make an external LED turn on (wiring up the board)
Let's make an external LED turn on (the code)

```cpp
const int ledPin = 14;

void setup() {
  pinMode(ledPin, OUTPUT);
}

void loop() {
  digitalWrite(ledPin, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000);                // wait for a second
  digitalWrite(ledPin, LOW);  // turn the LED off by making the voltage LOW
  delay(1000);                // wait for a second
}
```

Try to change the blinking pattern.
Changing blinking patterns
(Creating a method and calling it later in the code)

Blinking patterns in the loop

```
void loop() {
  digitalWrite(ledPin, HIGH);
  delay(1000);  //
  digitalWrite(ledPin, LOW);
  delay(1000);  // wait for a sec
  digitalWrite(ledPin, HIGH);
  delay(500);  //
  digitalWrite(ledPin, LOW);
  delay(500);
  digitalWrite(ledPin, HIGH);
  delay(1000);
  digitalWrite(ledPin, LOW);
  delay(1000);
}
```

Blinking patterns method (outside and before the loop)

```
void blinking_LED (const int output_led, int delay_nr, int total_blink) {
  digitalWrite(output_led, LOW);
  for (int i = 0; i < total_blink; i++)
    {
    digitalWrite(output_led, HIGH);
    delay(delay_nr);
    digitalWrite(output_led, LOW);
    delay(delay_nr);
  }
}
```

Calling the Blinking patterns method within the loop

```
if (response == 0)
{
  //LED_PIN = output for blinking, for how long, and how many times
  blinking_LED (LED_PIN_GREEN, 500, 5);
} else if (response == 1)
{
  blinking_LED (LED_PIN_RED, 500, 5);
}
```

Try to write the FOR method and calling it in the loop

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BREAK
Lets make a button to control the LED (wiring)

Adding to the breadboard

- Orange/brown resister (GND-Button)
- Green (signal) to button go to Pin13
  Button to +
Let's make a button to control the LED (code)

```cpp
const int buttonPin = 13;  // the number of the button
const int ledPin = 14;  // the number of the LED

// variables will change:
int buttonState = 0;  // variable for reading

void setup() {
    // initialize the LED pin as an output:
pinMode(ledPin, OUTPUT);
    // initialize the pushbutton pin as an input:
pinMode(buttonPin, INPUT);
}

void loop() {
    // read the state of the pushbutton value:
    buttonState = digitalRead(buttonPin);

    // check if the pushbutton is pressed.
    // if it is, the buttonState is HIGH:
    if (buttonState == HIGH) {
        // turn LED on:
        digitalWrite(ledPin, HIGH);
    } else {
        // turn LED off:
        digitalWrite(ledPin, LOW);
    }
}
```

Change
"cont int buttonPin = 2;" to
"cont int buttonPin = 13;"
Change
"cont int ledPin = 13;" to
"cont int ledPin = 14;"
Lets get the Thing on the Internet

- FemTech.dk – choose point 5)
- Open a new sketch and paste in the code
- Open the Serial monitor to see what is going on

- Lets look at the code
- Connecting the a Network with password
- Connecting to a website
- Sending a request to a server
- FOR loop for blinking patterns (notice you have only one LED attached to a pin right now)
- Setup (once)
- Loop (continuously)
The FemTech Server

FemTech server:
1. http://femtech.dk/cyberbear

client.println("GET http://femtech/cyberbear/isnorain.php?cityName=[Copenhagen] HTTP/1.0");

Change you HARDWARE to fit
const int BUTTON_PIN = 14; //where your button signal is incoming
const int LED_PIN_RED = 16; // red LEDs for pin 16 YOU DO NOT HAVE THIS IN YOUR CURRENT SET UP
const int LED_PIN_GREEN = 13; // green LEDs for pin 13
Finding your school ID and student ID in Lectio

Lectio looking up Allerød Gymnasium, and the student Line Poulsen (fake name)

Allerød Gymnasium = gymID=51
Line Poulsen= elevID=12594771108
Congratulations!!!

Your ‘Thing’ is now a prototype for an IoT device, which can connect to the Internet and do something.

After lunch we are creating the Interactive Device using what you have so far.
DRAwING and QUESTION

1) What interactive product could you imagine developing with the knowledge you have now?

2) What do you know now about technology development now that you did not know this morning?

Make a drawing/Brainstorming together
Welcome back

Any questions or comments which you discussed or thought about during lunch you want to share?
Where were we?

Hardware

Internet

Software

Your ‘Thing’ is now a prototype for an IoT device, which can connect to the Internet and do something.

After lunch we are creating the Interactive Device using what you have so far.
Agenda

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Afternoon: Hack the IKEA bear into Cyber Bear
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- Sew the Thing on the IKEA bear
- Sew the textile button on the IKEA bear
- Sew the LilyPad LEDs on the bear
Who is CyberBear?

User scenario
- Sleeping longer
- Is it not raining?
- Is it Friday?

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What do CyberBear really do?

Bear-Thing looks up FemTech website, which runs a php script looking at other websites on the Internet.

When user press Bear-Thing paw, the code Sketch is executed, returning the results in LED (green or red)
Lets create a Textile Button

Rigid Electronics vs Soft Circuits

Curtesy of Paul Strohmeier <p.strohmeier@di.ku.dk>
Textile Button

Paul Strohmeier’s design
Adding the textile button to the circuit

TRY with tape first and test it out with your current hardware setup replacing the button on the breadboard

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Wire the Thing up with conductive thread

Pull conductive thread through all the pins we need, tie a knot and potentially put plastic flex on to make it stay. The end result you should have conductive thread in six pins (three on each side) using GND close to the USB socket.

We need **6 conductive thread** in pins **16, 13, and GND** (on the left side of the board) and in **pin 5V, 14, and GND** (on the right side)
Attach the Thing to the IKEA bear (upside down)

Sew the Thing on the back of the bear with ordinary thread – be careful that threads are not touching
Sew up CyberBear textile button

- Sew threads from pin 5V, pin14, and GND to the button. Make sure they do not touch.
- Sew pin16 to + on the Red LED (over the shoulder of the bear)
- Sew pin13 to the + of the Green LED (under the arm)
- Sew GND to the – of the Green LED and continue to the – of the Red LED and end.
Sew up CyberBear with LilyPad LEDs (check +/-)

- Sew threads from pin 5V, pin 14, and GND to the button. Make sure they do not touch.
- Sew pin 16 to + on the Red LED (over the shoulder of the bear).
- Sew pin 13 to the + of the Green LED (under the arm).
- Sew GND to the – of the Green LED and continue to the – of the Red LED and end.
1) What interactive product could you imagine developing with the knowledge you have now?
2) What do you know now about technology development now that you did not know this morning?

Make a drawing/Brainstorming together
Plenum

- What worked well?
- What could be improved?

- If you were to describe what you have been creating today to your class at home, what would you say?
After the FemTech event

1) Get CyberBear on your home WIFI (only 5V!!)
2) Share experience on FaceBook (picture)
3) Pimp up your CyberBear and share picture
4) Bring CyberBear to school and present 10 min about what it is and what it can do, and how you made it? (sent us a video)
5) Write us an email about your experience what worked what could be improved?
6) Next workshop – ideas for new Interactive Products?
Questions & Comments?
How does the Textile Button work?

\[ V_{in} = \text{Voltage input} = 5v \]

\[ V_{out} = \frac{R_2}{R_1 + R_2} \cdot V_{in} \]

- If \( R_1 = R_2 \) then
  \[ V_{out} = \frac{1}{2} \cdot V_{in} \]

\[ V_{out} = \frac{R_2}{R_1 + R_2} \cdot V_{in} \]

- \( R_1 = R_2 \): \( 10/(10+10) = 1/2 \) of 5V = 2.5V
- \( R_1 < R_2 \): \( 10/(1+10) = 10/11 \) of 5V = 4.5V
- \( R_1 > R_2 \): \( 1/(10+1) = 1/11 \) of 5V = 0.4V

Pressure on fabric resistor = *much* lower resistance

\( V_{in} \) = Voltage input = 5v

Vout = Voltage output

We are using
\( \text{digitalRead} = 0/1 \)
\( (2.5 = '1'; 0.4 = '0') \)

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