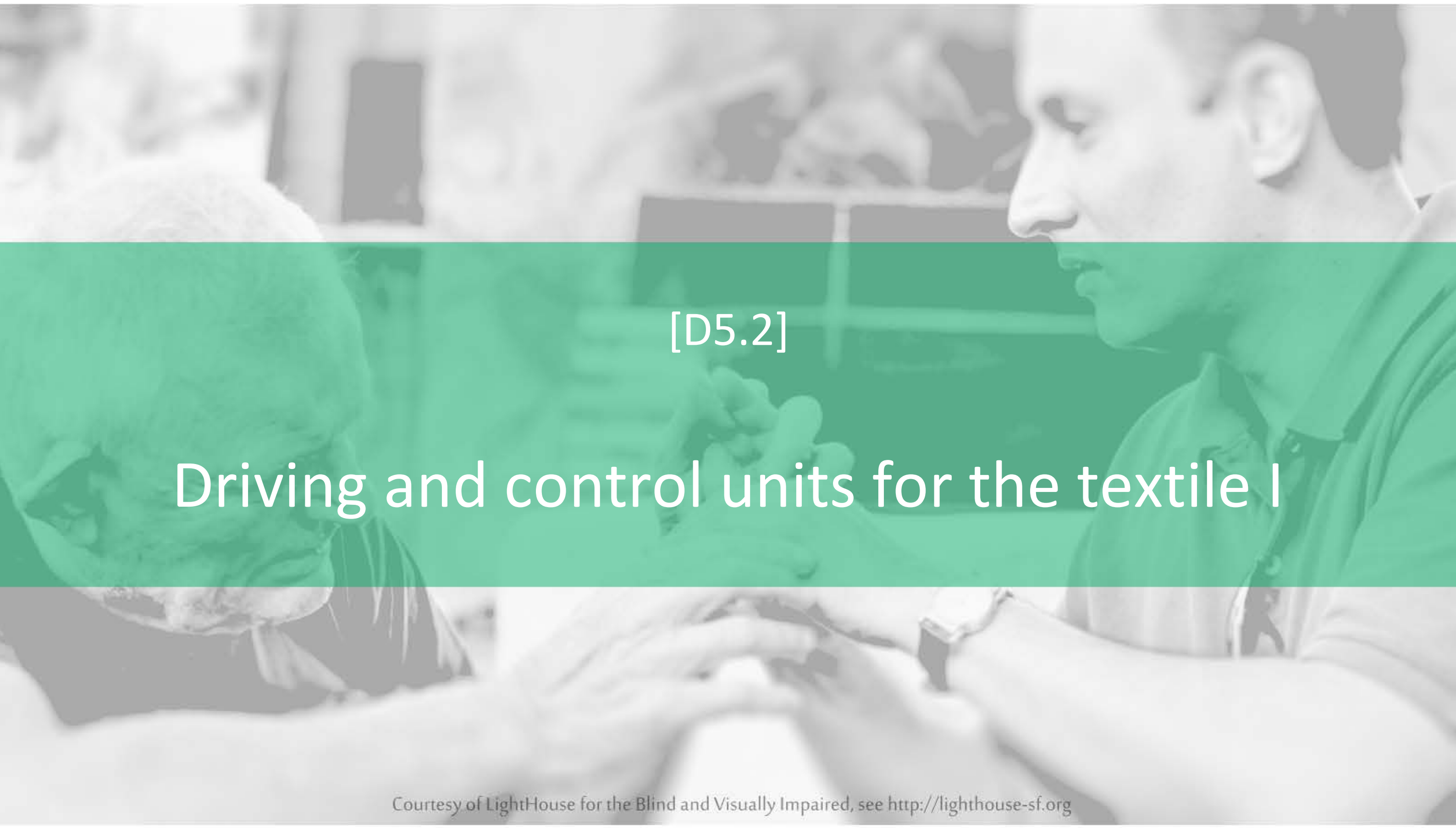
SUITCEYES

1 Jan 2018 - 31 Dec 2020

Smart, User-friendly, Interactive, Tactual, Cognition-Enhancer, Yielding Extended Sensosphere
Appropriating sensor technologies, machine learning, gamification and smart haptic interfaces



[D5.2]

Driving and control units for the textile I

Courtesy of LightHouse for the Blind and Visually Impaired, see http://lighthouse-sf.org

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Dissemination level		
PU	PUBLIC, fully open, e.g. web	X
CO	CONFIDENTIAL, restricted under conditions set out in Model Grant Agreement	
CI	CLASSIFIED, information as referred to in Commission Decision 2001/844/EC.	

Deliverable Type		
R	Document, report (excluding the periodic and final reports)	
DEM	Demonstrator, pilot, prototype, plan designs	X
DEC	Websites, patents filing, press & media actions, videos, etc.	
OTHER	Software, technical diagram, etc.	

Deliverable Details	
Deliverable number	5.2
Part of WP	5
Lead organisation	HB
Lead member	Nils-Krister Persson

Revision History			
V#	Date	Description / Reason of change	Author / Org.
v01	-	Structure proposal	-
v02	2018-05-21	First draft for internal review	Raymond Holt / UNIVLEEDS
v03	-	Second draft addressing review comments submitted to HB	-
v04	2018-05-25	Final draft after PC's comments	Nils-Krister Persson / HB
v05	2018-05-31	Final draft submitted to the EU	Nils-Krister Persson / HB

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Partner	**Contribution type**	**Name**
HB	Reviewer / Li Guo	

Glossary	
Abbr./ Acronym	**Meaning**
SUITCEYES	Smart, User-friendly, Interactive, Tactual, Cognition-Enhancer that Yields Extended Sensosphere
modality	Examples hereof are vibration, heat etc.
HIPI	Haptic intelligent personalized interface – the goal of SUITCEYES and built as a textile structure.
Actuator	An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system.
USB	Universal Serial Bus, a port in a computer for the transmitting of data and/or electricity.
Raspberry Pi	A tiny computer made for teaching computer science. Widely used in development projects.
Windows PC	A computer using the Microsoft windows operating system
Digilent PMod3 H-Bridge	H bridge is a kind of electrical circuit such that voltage could be changed from one direction to another
Boolean direction signal	Contrary to continuous signals Boolean are having just two values often denoted 0 and 1
Breadbord	A solderless construction used for prototyping electronics and circuit design
PWA	Pulse Width Modulation signal

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Executive Summary

The first iteration of the Controller and Driver for the early version of the textile communicative interface is developed and briefly described. At this stage a thermal actuator has been used. Verification was done in the haptics lab at the Faculty of Behavioural and Movement Sciences, Vrije Universiteit in Amsterdam in April 2018 with the textile swatch and simple initial psychophysical measurements. It turned out possible to control the interface, heating it up and reading data. This opens up for other types of actuators such as vibro-tactile etc. in coming generations of controllers and haptic interfaces.

DEMO description

The purpose of this document is to describe the first iteration of Controller for Deliverable 5.2, which has been tested at the haptics lab at Faculty of Behavioural and Movement Sciences, Vrije Universiteit in Amsterdam in April 2018.

Controller Goals

The first iteration of controller has been designed to perform three functions:

1) Reading a signal from a host computer comprising a **duration** in milliseconds and an **intensity** as a percentage of the maximum intensity for a given actuator (from 0 to 100%);
2) Driving an actuator with the requested intensity for the requested duration; and
3) Returning feedback to the host computer from any sensors that are attached.

Thus from the beginning the controller is aimed for different actuators such as thermal, vibro-tactile etc.

Controller Configuration

The first iteration of controller communicates with a host computer using a serial connection via its USB port, and then translates these into a Pulse-Width Modulation (PWM) Signal to send to an actuator.

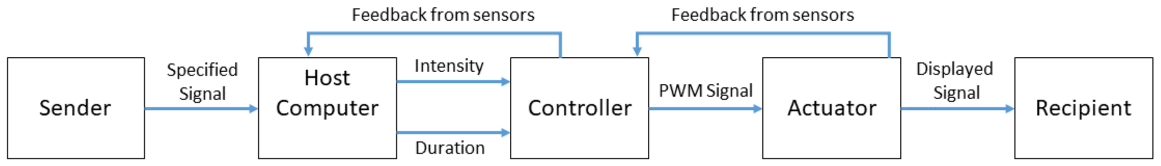

Figure 1: Block Diagram of Controller Configuration

The forms of the host computer and actuator are irrelevant to the controller – as long as the computer can generate a serial signal in the correct format, and the actuator can be operated through a PWM), then these elements can be reconfigured as required. For example, the first iteration controller has been successfully used with both a Rasberry Pi and a Windows PC as host computer, and with Peltier modules and vibration motors as actuators.

Controller Design

The hardware for the first iteration of controller is shown in Figure 2. It is based around an Arduino Nano and a Digilent PMod3 H-Bridge. The H-bridge takes in a Boolean direction signal (High for one direction, Low for the other) and a PWM signal, and gives out the same PWM signal in the requested direction. H-bridge is a common circuit arrangement for actuators and robotics.

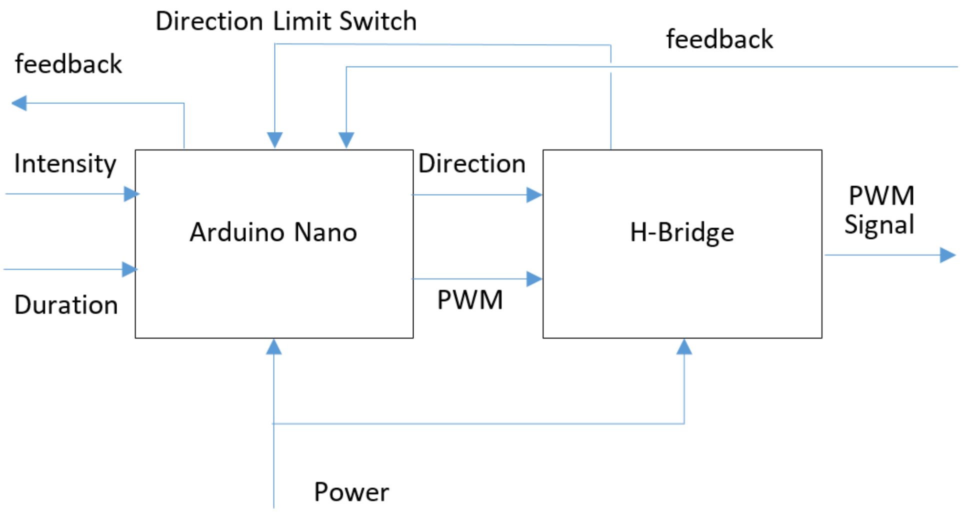

Figure 2: Block Diagram of Controller Hardware

The H-Bridge serves two functions: it allows bidirectional displays (such as Peltier modules, where the direction of current must be reversed to shift from hot to cold; or a motor where reversing the direction of current will reverse the direction of motion) and it allows actuators to be powered from sources other than the Arduino, so that the display is not restricted by the current and voltage the Arduino can provide. The first prototype controller was built on a solderless breadboard, so that the circuit could be easily reconfigured. A photograph of the physical circuit configured to display temperature signals through a Peltier module and capture temperature feedback through a thermistor is shown in Figure 3.

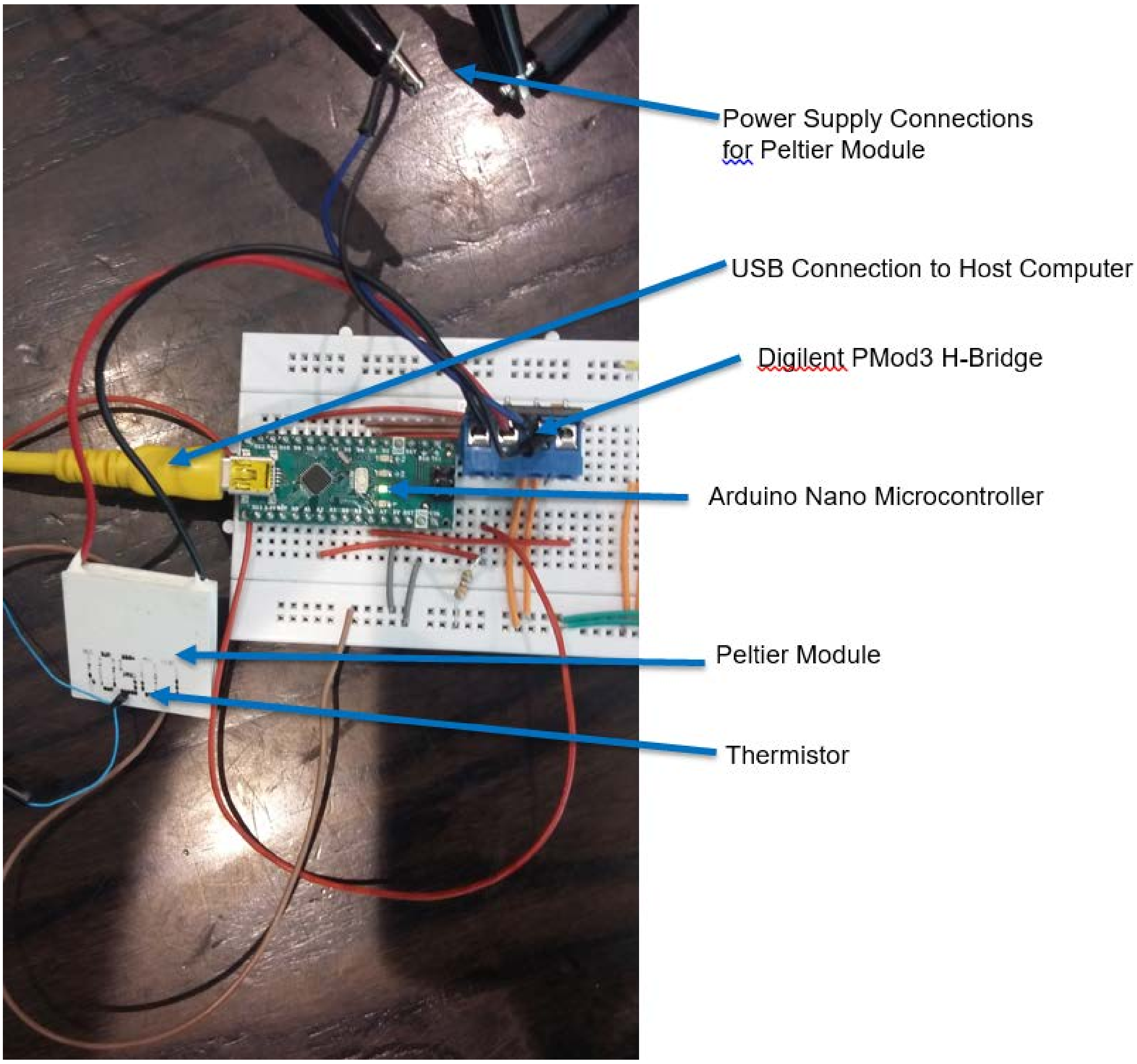

Figure 3: Physical Circuit Set up to display temperature signals via Peltier Module and Capture Feedback.

The controller is set up such that the output to the actuator is a PWM signal using a percentage of the duty cycle equal to the requested intensity. For a monodirectional display, this is trivial, as the PWM duty cycle is equal to the intensity requested. However, for a bidirectional signal (such as a Peltier Module) needs to be scaled across both directions of the actuator, such that a requested intensity of 0 is actually 100% in one direction and a requested intensity of 100% is 100% in the other. As an example - with a Peltier module, an intensity of 0 requests 100% cooling; an intensity of 50 would request neither heating nor cooling; and an intensity of 100 would request 100% heating. The controller therefore reads the requested intensity, and uses the direction limit switch reading to determine whether it should be treated as monodirectional (such as a vibration motor) if the switch is closed, or bidirectional (if the switch is open).

If the display is monodirectional, then direction is always 1, and the PWM signal presented to the H-bridge is always equal to the requested intensity. If the display is bidirectional, then Intensity is recalculated as:

Calculated Intensity = (Requested Intensity * 2) -100

In this way, a Requested Intensity of 0 gives a Calculated Intensity of -100, a Requested Intensity of 50 gives a calculated Intensity of 0, and a Requested Intensity of 100 gives a Calculated Intensity of 100. The output direction is 1 for calculated Intensities of 0 or above; and 0 for Calculated Intensities below 0. The PWM signal sent to the actuator is then given by the magnitude of Calculated Intensity.

Conclusions

The first iteration of the Controller and Driver for the early version of the textile communicative interface is developed. It turned out possible to control the interface and read data. This opens up for other types of actuators such as vibro-tactile etc as well as initial psychophysical experiments. A second generation of Controller for other modalities is to be developed for the next iteration of the controller.