Learning Contract for the Mobility Semester

Home University: Comenius University in Bratislava

Student Name: Matej Klobušník

Immatriculation Nr.:

Study Programme ID:

Host University: University of Ljubljana

This learning contract ensures that the ECTS credits the MEi:CogSci student acquires at the host university will be accredited at the home university.
In order to make this contract valid, please follow the procedure/steps listed below:

A Preparation Phase at the home university

1.) **Negotiation of Special Topic of Interest Module(s):** The student negotiates the *special topic of interest/phenomenon* (i.e., a cognitive phenomenon) he/she wants study and the way how he/she wants to study it (i.e., a combination of courses, lab work, self-study, literature used) with the supervisor and/or local coordinator at the *host* university.
2.) **Concrete plan of the project:** The student fills in the subject specific learning outcomes which he/she will have acquired after completing the module and specifies the work-plan for the module (elements of module, milestones, deliverables, dates,…) according to the negotiations with the supervisor at the host university.
3.) **Acknowledgement of the supervisor:** The supervisor checks and verifies the contract; by sending it (in digital version) to the local coordinator at the *home* university of the student (+ cc to the student) the supervisor acknowledges that he/she accepts the proposal
4.) **Approval by the home university:** The local coordinator at the home university approves it or requests changes (go back to step 2)
5.) **Signature of student**

B Mobility phase at the host university

6.) **Planning of studies and courses at the host university:** Student fills out the semester contract in negotiation with local coordinator
7.) Grade for the project, signature & stamp of supervisor at host university (at end of semester at host university)

C Grading & acknowledgement phase at home university

8.) **Final grading & acknowledging:** Signed contract & certificates/transcripts are returned to local coordinator at *home* university, who accredits the contract.

SEMESTER CONTRACT

S-I-CS New Trends in Cognitive Science Module 10 ECTS

Course Title	Course Type (e.g. lecture, seminar,...)	ECTS	Grade (host)	Grade (home)
Trends in Cognitive Science	seminar	10		
Module Grade				

S-I-PJ Special Topic of Interest (Project) Module 10 ECTS

Project Title	Supervisor	ECTS	Grade (host)	Grade (home)
Biofeedback game: use of implicit physiological measurements to control videogames.	doc.dr. Gregor Geršak, univ.dipl.inž.el.	10		
Course Title	**Course Type (e.g. lecture, seminar,...)**	**ECTS**	**Grade (host)**	**Grade (home)**
Module Grade				

Advanced Module Neuroscience 5 ECTS

Course Title	Course Type (e.g. lecture, seminar,...)	ECTS	Grade (host)	Grade (home)
Seminars on Clinical Neuroscience	seminar	5		
Module Grade				

W-D-C Elective Module 5 ECTS

Course Title	Course Type (e.g. lecture, seminar,...)	ECTS	Grade (host)	Grade (home)
Reflections on current cognitive and neuroscientific research on religion and religious experience	seminar	5		
Module Grade				

Date, Stamp & Signature of *Local Coordinator* at *Host* University

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Date, Stamp & Signature of Local Coordinator at *Home* University

1.) SPECIAL TOPIC OF INTEREST 10 ECTS

Your first special topic of interest must include project work (to be specified in box 1.c). Beyond that it can include courses (to be specified in box 1.b).

(Everything written in italics has to be replaced by text specified by the student and supervisor.)

Name of Supervisor, Host University:

doc.dr. Gregor Geršak, univ.dipl.inž.el. , University of Ljubljana

1.a

TOPIC OF SPECIALISATION

PHENOMENON & (PERSONAL) GOALS
Specified in project topic

LEARNING OUTCOMES

Subject specific
•*Specified in project topic*

Methodological
- Ability to approach a phenomenon in an interdisciplinary manner
- *specifics to be defined by student & host supervisor*

Generic
Instrumental
- Ability to write and follow a project plan

Interpersonal
- Teamcompetences:
  - Work within an interdisciplinary team
  - Deal with conflicts and different viewpoints
  - Moderating group work

Systemic
- Interdisciplinary work/thinking
- Project-oriented work and organisational skill
- Critical evaluation of approaches & methods
- Quick orientation & navigation in mother and/or novel complex field
- Change of viewpoint/perspectives (intellectual mobility)
- Phenomenon-oriented thinking
- Problem-solving abilities

1.b

LECTURE & COURSES
Please fill in the courses that are part of the module (in case there are some).

Course Title	Course Type	Discipline	ECTS

1.c

As part of your special topic of interest you will have to do project work. Please specify below the concrete plan and workflow of your project.

PROJECT **10 ECTS**

Biofeedback game: use of physiological states for game control.

Introduction

Physiological computing uses real-time psychophysiology to represent the internal state of the user (e.g., cognitions, motivation, emotion), which is used as the basis for real-time system adaptation or system control. Psychophysiology represents an implicit form of user monitoring and is considered to be a branch of cognitive science because it make possible to track connection between psychological states and bodily responses.

For this project we want to develop a computer game which will be controllable with physiological measurements specifically Skin Conductance (SC).
SC is influenced by sympathetic division of the autonomous nervous system and can be changed indirectly via psychological states as stress, excitement, frustration, novelty detection, anticipation ect.

Existing projects[1] in this field mostly focus on adjusting minor game variables based on physiological data to flexibly fit the game difficulty (e.g., strength of the opponents) more to user abilities or are providing small changes in game environment. We propose slightly different approach and that is to learn user to control his physiological state and via this control one of main game variables (e.g. speed of the car).

We want to create a system in which player can explore and learn how to deliberately change their SC with inducing particular psychological state. During game players will be able to observe how their psychological states relate to their physiology a try to utilize it to control the game. We would like investigate to which extend is it possible to develop such skill.

Design

Whole game will consist of following parts: ***physiological data processing model, player categorizing test, playing environment, hardware.***

Model
To implement this game we will need to design model which will be able to process and meaningfully classify measured data. This model will have to be able to filter unsuitable influences of the environment namely hand movement during steering, temperature fluctuation, and player's skin properties. This can be achieved with a use of Fuzzy logic [2] but we presuppose that additional filtering methods and classifier will need to be employed. As a main source of input we will use skin conductance measurement, but to improve stability additional physiological measurement will be considered namely heart beat rate and respiration rate.

Test
As part of the game we want to develop a simple short test which will categorize player either as an electrodhermal labile (high frequency of spontaneous skin responses slow habituation to repeated responses) or electrodhermal stabile (low frequency of spontaneous skin responses, rapid habituation to repeated responses). These traits have been correlated with a number of psycho-physiological variables [3] and can be used to setup suitable parameters for model to fit more to individual players.

Environment
We will use open source racing game simulator. We will control speed parallel together with Skin Conductance Responses (SCRs) and standard controller (pedal) at once. Game will consist of multiple difficulty levels. Those will differ in effect which SCR has over the car speed. As the player will progress to higher levels, SCR will have higher influence of speed control. In other words we will change the ratio of influence between SCR and pedal. To successfully complete particular level, player needs also have certain positive match (PM) between information from pedal and SCR. We presuppose that this setting will give a player an incentive to learn and improve above mentioned skill.

Hardware
For measuring skin conductance we will use steering wheel controller with embedded electrodes and standard sensors for heart and breath rate measurements.

Bibliography

[1] L. E. Nacke, "Directions in Physiological Game Evaluation and Interaction," pp. 1–4.
[2] Mandryk, R. and Atkins, M. A Fuzzy Physiological Approach for Continuously Modeling Emotion During Interaction with Play Environments. Int J Hum-Comput St 65, 4 (2007), 329–347.
[3] Schell, A.M., Dawson, M.E., and Filion, D.L. (1988). Psychophysiological correlates of electrodermal lability. Psychophysiology 25, 619–32. Scherer, K.R. (1978).
[4] S. H. Fairclough, "Fundamentals of physiological computing," Interacting with Computers, vol. 21, no. 1–2, pp. 133–145, Jan. 2009.

PROJECT PLAN

In order to achieve the learning outcomes specified for the module I will take the following measures:
1.) Project steps:
Literature research
Search for suitable physiological data processing techniques.
Working hours: 20

Physiological data processing model development
Exploring hardware attributes, detecting unsuitable influences, model development.
Working hours: 80

Player Categorizing test development
Choosing appropriate audio/video stimuli, incorporating personality parameters into processing model
Working hours: 20

Creation of playing environment
Establishing communication between data processing model and game environment, Level design
Working hours: 80

Game testing
Group of 5 subjects. Observation to which extend will be players able to control game with SCR. Recording PM as measure of success.
Working hours: 30

Project documentation
Topic introduction. Documentation of individual game components and report of testing results.
Working hours: 20

REPORT

Output of the project is independent software with documented source code written in Java. This software is supposed to run parallel with racing game of player's choice. It can be used with various racing games. In this particular project we used open source racing game called TORCs. Software enhances gaming experience by giving player a opportunity to influence game with his skin conductance. Software is controllable via steering wheel buttons and provides visual and auditory feedback about player's progress in the game. In following paragraphs we will describe two core subcomponents of this software.

Signal processing

Skin conductance is measured by two dry electrodes which are build in the steering wheel and connected to Arduino board which sends the measurement of the signal to the computer via USB. The sampling rate is 200 Hz. Signal is very sensitive to the changes of grip or pressure on the electrodes. It can be also influenced by other electrical devices thus we are using several filters to remove these undesirable disturbances.

After reading and parsing the signal we average two sequent measurements and thus reduce the sampling rate to 100 Hz. Subsequent signal is processed with event triggered filters. For instance one such filter is applied when player makes fast turn with the steering wheel or turns it above certain angle. These events require player to use more force on the wheel and have higher probability to produce disturbances due to changes of the pressure on the electrodes. When such event occurs then these deviations are corrected with linear approximation. At the end the signal is smoothed with running average.

While measuring skin conductance, two types of skin conductance are characterized, tonic and phasic. Tonic skin conductance is the baseline level of skin conductance, in the absence of any particular discrete environmental event, and is generally referred to as Skin Conductance Level (SCL). Each person has a different SCL. Tonic skin conductance levels vary over time in individuals depending on her or his psychological state and autonomic regulation and in our case they vary also on the type of grip player chooses. Phasic skin conductance is the type that changes when events occur. Discrete stimuli will evoke time related changes in skin conductance. These are generally referred to as Skin Conductance Responses (SCRs). During initial testing we have found out that players are prone to change their grip during game and subsequently they can change their SCL. SCR are not affected by this change and they are key elements enabling more dynamic interaction. For this reasons we have decided to use SCRs as our variable to control the environment in the game.

To detect SCRs we have computed derivations of incoming signal over short time period and compared them with expected signal characteristic of SCRs. Detecting function has following output: 1. small SCR, 2. large SCR 3. disqualified 4. nothing detected. Player is disqualified when the derivations are above threshold and it's highly probable that player has changed his grip.

Game environment

Two game modes were created "Adrenaline Rush" and "Serenity". Each mode has multiple levels of difficulty.

In "Adrenaline Rush" mode the player's goal is to generate SCRs in 20 second time window in order to make his gas pedal effective in next time window. For instance in level 2 player needs to have two SCRs in order to have full gas pedal effectiveness for the next time window. When the software detects just one SCR then the effectiveness will fall to 50 %. With zero SCRs it falls to 10 %. In higher level player needs to generate more SCRs for same pedal effectiveness. Detection of large SCR gives player immediate full pedal effectiveness and disqualification deletes all previously gained SCRs and thus provides an incentive for player to hold his grip.

In "Serenity" mode player has to remain calm in order to have his gas pedal effective in next time window. For example in level 1 after detecting one SCR the pedal effectiveness falls to 75 %. During game a smoothed signal is displayed and player can see number of gained SCRs and time remaining till the end of current time window. Auditory feedback is provided for every above mention event (detection, disqualification, end of time window etc.).

Final Grade for the Project

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host grade/home grade
see grade conversion matrix on last page

Date, Stamp & Signature of Supervisor
at Host University

I herewith confirm that I will follow the module plan in order to successfully complete the module.

Signature of Student

I herewith confirm that I will follow the module plan in order to successfully complete the module.

Signature of Student

Grade Conversion Matrix

BRAT		BUD		LJUB		VIE		ZAG	
A	výborne (excellent)	**5**	jeles (excellent)	**10**	odlično (excellent)	**1**	sehr gut (excellent)	**5**	odličan (excellent)
B	vel'mi dobre (very good)	**4**	jó (good)	**9**	prav dobro (very good)	**2**	gut (good)	**4**	vrlo dobar (very good)
C	dobre (good)	**4**	jó (good)	**8**	prav dobro (very good)	**2**	gut (good)	**4**	vrlo dobar (very good)
D	uspokojivo (satisfactory)	**3**	közepes (fair)	**7**	dobro (good)	**3**	befriedigend (satisfactory)	**3**	dobar (good)
E	dostatočne (sufficient)	**2**	elégséges (satisfactory)	**6**	zadostno (sufficient)	**4**	genügend (sufficient)	**2**	dovoljan (satisfactory)
F	nedostatočne (insufficient)	**1**	elégtelen (fail)	**5**	nezadostno (insufficient)	**5**	nicht genügend (insufficient)	**1**	nedovoljan (insatisfactory)