# Usability and Security of Brainwave-Based Authentication in Real-World Applications

# – Study Protocol

## 1 Pre Study Checks

The following checks should be performed before the participant arrives.

- ☐ Study computer is running and has a working internet connection
- ☐ FPM settings are set to default values (if not, delete the settings.json file and restart the application)
- ☐ FPM is started, a working, empty database is loaded and unlocked (databases: EmptyDatabase.fpw)
- ☐ Muse device is clean, has power, and is connected to FPM
- ☐ Firefox Browser is running and has an auxiliary extension installed
- ☐ English and German consent forms are available, as well as a pen for signing
- ☐ Prepare a blank sheet of paper with an estimated starting time for note-taking

## 2 Introduction

The introduction phase is separated into two different sub-phases. Before the start of any sub-phase, the participant should be greeted.

### Sub Phase: Formalities

- ☐ Remind participant that participation is voluntary
- ☐ If needed, provide a printed consent form
- ☐ Make sure the participant has understood and signed the consent form
- ☐ Remind participants that they can stop the study at any time
- ☐ If the participant ticked optional prolonged storage, make sure the logging option is turned on in FPM
- ☐ Start timer

### Sub Phase: Introduction to Study, FPM, and Muse device

- ☐ Shortly reiterate the structure (experiment phase and survey phase) and purpose (real-world evaluation of usability) of the study
- ☐ Shortly go over the FPM and the auxiliary browser plugin
- ☐ Explain that this usage of brainwaves is the main focus and not the FPM
- ☐ Explain Muse device
  - Device for recording brainwaves, based on EEG
  - Is NOT able to read concrete thoughts, only to get the general "mood" of your brain
  - Analogy: You can determine the mood of a crowd at a concert but not of a single individual
  - "Presses" several contacts tight to the scalp, measures currency differences
- ☐ Guide participant on how to best put on Muse device (as tight as possible)

## 3 Experiment Phase

In this phase, the participant interacts with the system. It is divided into two sub-phases. As we want to evaluate the usability under real-world conditions as much as possible, there is no strict list of steps that need to be taken here. The participant should explore the system as they might on a future device supporting the technology.

### First Sub Phase: Understanding and Exploring the System

In the first sub-phase, participants must enroll to use the authentication system. Following this, the participant should be encouraged to visit some of the different websites for which credentials are stored to get familiar with the system.

- ☐ Ask the participant to perform enrollment
- ☐ Provide participant with a list of supported websites
- ☐ Encourage the participant to test the limits of the system (e.g., take the device off during authentication)

### Second Sub Phase: "Hacking" the System

In the second sub-phase, the database is exchanged with a prepared one, which can not be circumvented. No enrollment should be performed in this sub-phase. Encourage the participant to "hack" the system by trying to authenticate on any of the provided websites. The fact that the authentication cannot be circumvented using this database should not be disclosed to the participant until after finishing the survey. This is done to maximize exposure time to the system and collect more samples.

- ☐ Change database to prepared one
- ☐ Remind participant to think aloud
- ☐ Perform NO enrollment
- ☐ Encourage the participant to try to "hack" the system

## 4 Survey Phase

In this phase, the participant should fill in the prepared survey. Depending on the participant's preference, this can be done in German or English. Remind the participant about the possibility of skipping questions. Further, remind the participant that we want to primarily evaluate the authentication in the browser, not necessarily the FPM itself.

- ☐ Remind participant that all questions regarding personal data are optional, and the focus is on the authentication in the browser

## 5 Debriefing and Post Study Checks

After finishing the survey, the participant is done. Following this, they may ask questions of their own. Else, they are free to leave. The following checks should be performed after the participant finished the survey and leaves.

- ☐ Stop timer and note down timing
- ☐ Muse device is cleaned and plugged into a power outlet
- ☐ If the participant agreed to the prolonged storage, the log file directory is zipped and stored on an external drive
- ☐ Log file directory is deleted
- ☐ All browsing data is deleted from Firefox