WaveMeIn

WaveMeIn: Authentication via Brain Waves

188.407: Management von Software Projekten

Group: 10

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Formal constraints

- Font: Times New Roman oder Computer Modern (LaTeXdefault)
- Fontsize: 11pt
- Single line spacing
- Margins: 2.5cm side and top/bottom
- Language: ENGLISH
- The proposal template should be filled incrementally. I.e., at the end there should be a full project proposal in a single PDF file.

Available templates

- Proposal (mswp-proposal.tex)
- Costs (costs.xls, costs.ods)

Supplemental material

- FWF salary scheme (http://www.fwf.ac.at/de/projects/personalkostensaetze.html)
- Travel cost regulation (http://www.fwf.ac.at/de/faq/reisegebuehrenvorschrift.html)
- Ethical issues form (ethical-issues.rtf)

1 Synopsis

1.1 Project Idea

WaveMeIn is a research project to create a new type of secure login mechanism. It consists of a small device worn by the user at the ear which authenticates the user based on brain waves.

1.2 Why do we need it?

At the time of this proposal the most used ways for authentication are manually typed passwords or biometric authentication methods. However all of the previous methods have some security problems or are simply not user-friendly. Typed passwords are easy to spy out simply by looking at the keyboard of the user or the traces of the fingers on touch displays. In the case of biometric authentication, there are for example face recognition, iris or fingerprint scans. Face recognition software can easily be tricked by face masks or photographs and moreover depends on good light conditions, the quality of the images of the web camera and other factors. Fingerprint and iris scans are the most secure options of the authentication methods mentioned before. However they also have many disadvantages. Iris scans are not practical since the hardware required cannot easily be integrated into small devices and it is not user-friendly to require the user to place his eye very close to the scanner every time he/she wants to unlock a device. Fingerprint sensors are known to fail to recognize the fingerprint correctly quite often and it is also a not very user-friendly authentication method for handicapped people that may not reach the sensor or may not have any fingers at all.

1.3 How does it work?

Brain waves are a secure and user-friendly alternative authentication method. The idea is to create a small device, called Wavy, that can be worn at the ear of the user in the same style as bluetooth headsets are already worn for communication today. The Wavy measures the brain waves near the ear in case a login is required by a client device that is connected via bluetooth. It listens for a brain wave pattern that was previously trained by the user as a password. If the correct pattern was detected by the Wavy it transmits a OK signal back to the client device.

1.4 Why should somebody care?

Nowadays people are forced to type their passwords in public places which is a security risk and also not a very efficient way for authentication. Especially when typing in password on small devices such as mobile phones this authentication method is also very error prone due to the small keyboard interfaces. On the one side people are lazy and do not want to remember and enter long and complicated passwords, but on the other side they are also concerned about the security of their data and their privacy. So the users are in need of a more secure and easier way of authentication.

1.5 Who are the beneficiaries of the results?

Basically everybody can benefit from the WaveMeIn project since it is usable in the daily life. Especially for handicapped people it is a new and more easy to use option to log into their devices. Also it grants a higher level of security than existing authentication methods so it is also well suited for environments where higher security is needed, such as access authentication is modern research labs and government or military facilities.

For our product to succeed, we need to invest into research in the area of brain wave detection and analysis. This investment can improve our understanding of this topic. After a commercial success, we have to enhance our product. This means we have to invest further into brain wave research. On the other side, we can make our world more secure. It makes hacking of accounts and password fraud more complicated.

1.6 Problem classification

The task of detecting brain waves it tightly connected to the research areas of Neuroscience, Pattern Recognition and Machine Learning. In the field of Neuroscience it touches the areas of not invasive brain

computer interfaces and neural oscillation. Since detecting and reliably identifying brain waves at the location near the ears is still technically immature the project can be seen as basic research in this area. The following research questions have to be answered before a prototype can be developed.

- Detecting braves at the ears
- Recognize brain wave patters
- Distinguish correct patterns from random signals
- Distinguish brain waves from different users

On the other hand if we take the Wavy into account, which should be the resulting product, this project is also an applied research project. It further touches the fields of computer security and privacy.

2 Introduction and problem description

WaveMeIn is a research project to show the potential of brain waves a new method of electronic authentication via a small wearable device. Its aim is to investigate the usage of rain waves to replace passwords or other authentication methods. Therefore the properties of brain waves regarding uniqueness and reliability have to be explored. The project shall demonstrate via a small prototype that the recognition is possible without large sensors on top of the users head. A requirement for such a method of authentication clearly exists as demonstrated by the following use cases:

2.1 Use Case 1

Assume a user needs to log on to a device (e.g. a notebook) that contains sensitive information in public. Typing in the password is not an option as it can easily be monitored by another person. Fingerprints are also not a good alternative as they can easily be taken from any surface the user touched and be copied onto synthetic materials to deceive the fingerprint reader. Brain waves are (as of current knowledge) unique for each person even if two people are having exactly the same thought. If the intruder does not know the precise brain wave pattern of the user's pass phrase/thought it is impossible to duplicate.

2.2 Use Case 2

Assume an average user wants to unlock his/her smart phone in a crowded area such as the subway. Nowadays this is done by entering a pin or drawing a pattern on the screen. A person with the intention to steal a users phone just needs to observe its victim while entering the pass code or pattern. Afterwards it is easy to unlock the phone and steal the victims personal data or cause large costs while using it for phone calls and mobile data. Locking the phone via a brain wave authentication mechanism may not prevent the theft but the costs arising from the phone being used afterwards.

2.3 Current Authentication Methods

In theory brain waves will be rank among the most secure authentication methods, probably being the most secure one if the research proves successful. The particular brain wave of a user required to unlock a device can not be easily be obtained other than strapping the user to a chair and forcing him/her to think his/her pass thought. Other authentication methods are password, drawing patterns, fingerprint, iris scan, voice recognition. Passwords and pattern drawing are the least secure ones as the user can be observed while typing or drawing without much effort. Fingerprint, iris scan, voice recognition may require more technical or social effort to obtain, but in the end all of them are features of a person that are always visible for the outside world and therefore copyable with more or less effort.

2.4 Unresolved Problems and Opportunities

The unknown factor of this research project is that no research has been done on measuring brain waves at other locations (e.g. the ears) of the body except directly at the users head. Additionally it is unknown if the brain waves of are person are distinctive enough to distinguish a pass thought of a user from other thoughts and if the brain waves of different users while thinking the same thought are distinctive enough.

At the time of writing this proposal there exists no device that is capable of the features mentioned above as well as being small enough to be worn as an accessory. Therefore this is an important area of research with practical future applications.

2.5 Domain Specific Terms

- Brain waves:
-
  - *Length: 2-3 pages*
  - **Why?**
  - Introduction
  - Context
  - What is the current situation?
  - What is the open/unresolved problem or opportunity?
  - Why is it a problem?
  - What is unknown?
  - What could be improved?
  - Explanation of fundamental terms and basic definitions.

3 Project goals and deliverables

The following sections will provide an overview over the research questions and hardware questions associated with the project.

3.1 Research questions

- How can be brain waves be detected by the a small device at a single location?
- How reliable is the detection of individual brain waves of the same person?
- How reliable is unique identification of the brain waves of different persons?
- Is it possible to detect brain waves at other body locations than the head?

3.2 Hardware Design

- How can the required hardware be minimized to be small and practical (Wavy Device)?
- Are the existing sensors for measuring rain waves good enough for the projects requirements?

3.3 Expected Results

- Successful research on the identification of brain waves.
- Algorithms to reliably identify brain wave patterns.
- Creation of a small prototype device capable of reading brain waves.

At the end of the project it should be clear if:

- The detection of brain waves is possible at different locations of the body.
- The same thought produces a repeatable and reliable brainwave pattern. (Reliability)
- Different people have different patterns when thinking the same thought. (Uniqueness)
- Brain waves can be used as authentication method.
- The necessary can e integrated into a small device.

3.4 Non-Goals

- No mind reading device
- No client software (just the brain wave research, hardware and interface)
- No design or usability study (just a prototype that works and is small enough)
- No end-user/consumer product (just a prototype)

4 Scientific relevance and innovative aspects

- *Length: 1-2 pages*
- Why is the project scientifically interesting?
- Did others point out that this is an open question?
- What are the innovative aspects that make it interesting?
- How could the project break new ground scientifically?
- To what extent are the objectives ambitious and beyond the state of the art (e.g. novel concepts and approaches or development across disciplines)?

5 State of the art / current knowledge

- *Length: 2-5 pages*
- What results and approaches have already been presented in this or related areas?
- Relation to the international scientific work in the field (international status of the research)
- Description and critical discussion of related scientific work

6 Method

- *Length: 2-5 pages*
- **How?**
- How should the expected results be achieved?
- What method(s) will be applied? (e.g., empirical study, user-centered design, prototype implementation,...)
- Description of the methods.
- Justifications for chosen methods.

7 Detailed description of the workpackages

- *Length: 2-4 pages*
- Structuring the project into self-contained parts.
- Additional verbal descriptions.
- Work packages
  - title
  - goal(s)
  - description
  - expected results
  - responsible person(s)
  - dependencies

8 Time plan (Gantt chart)

- *Length: 1-2 pages*
- Realistic estimation of schedule based on workpackages.
- Including milestones (not only when but also what is to be achieved for each milestone).
- Generation of a Gantt chart. (Including phases, milestones, buffer times, critical areas, etc.)

9 Human resources / team

- *Length: 1-2 pages*
- Description of the team that is needed to carry out the project. (For the execution phase of the project, not the planning phase.)
- How many people?
- To what extent are individual members needed?
- What knowledge, skills, and experiences are needed for each member?
- Demonstrate that the members will be able to carry out the project successfully.
- Work structure
  - Who will lead the project?
  - How do they work together?
  - Management and coordination
    - What communication structures will be established? (e.g., mailing list, blog, CMS, CVS, ...)
    - How often will meetings take place? (Who will participate?)
    - How will the work be documented?
    - How will information be stored and shared?
- Cooperations
  - Will external cooperators be part of the project? (e.g., other research institutions or companies)
  - What is their role?
  - Why are they needed?

10 Costs

- *Length: 2-3 pages*
- Rough estimation of cost in form of calculation (table(s)) + descriptive text.
- Justification for the personnel and non-personnel costs (equipment, material, travel and other costs)
- An Excel template is provided as supplementary material to support budgeting.
- Personnel costs
  - Justification for the personnel to be assigned to the project (type of position(s), description of nature of work, length and extent of involvement in the project)
  - The application should include all persons who will be required for the proposed project (project lead, researchers, developers, advisory board, etc.). The available legal categories of employment are contracts of employment for full- or part-time employees (DV) and reimbursement for work on an hourly basis (GB). In addition, a part-time contract of employment (DV 50%, "studentische Mitarbeiter") may be requested for people who have not yet completed a Master or Diploma program (Diplom) in the relevant subject.
  - The justification of the requested personnel should contain:
    - description of type of work;
    - extent of involvement (part-time contracts are permitted).
  - Exact numbers of employment categories can be found on the FWF Website (http://www.fwf.ac.at/de/projects/personalkostensaetze.html)
- Equipment costs
  - Indicate reasons for equipment costs. The "scientific equipment" category includes instruments, system components, costs for the use of software required by the project and other durable goods provided the cost per item (including VAT) exceeds EUR 1,500.00.
- Material costs
  - This category encompasses consumables and smaller pieces of equipment where the cost per item is below EUR 1,500.00 including VAT. The calculation of requested material costs should be justified with reference to the schedule, work plan and experimental plan. Experience with previous projects should be taken into account.
- Travel costs
  - Funding may be requested for the costs of project-specific travel and accommodation, field work, expeditions, etc. Applicants are to provide a detailed travel (cost) plan broken down by project participant. For brief stays, the calculation of the travel and accommodation costs should be based on the federal regulations governing travel costs (RGV). The RGV rates governing Austria and abroad may be found in the FAQs on the FWF Website (http://www.fwf.ac.at/de/faq/reisegebuehrenvorschrift.html). For longer stays an appropriate and comprehensible cost plan should be prepared.
- Other costs
  - Independent contracts for work and services (costs for work of clearly defined scope and content assigned to individuals, provided that this is scientifically justifiable and economical)
  - Costs that cannot be included under personnel, equipment, material or travel costs, such as:
    - reimbursement of costs towards or for the use of research facilities, e.g. of large-scale research facilities (project-specific 'equipment time'). Applicants should obtain and submit multiple offers;
    - costs for project-specific work carried out outside the applicant's research institution (e.g. for analysis work performed elsewhere, for interviews, for sample collection, for preparation of thin slices etc.). Applicants should obtain and submit multiple offers;
    - honoraria for test persons;

11 Expected implications and risks

- *Length: 1-2 pages*
- Importance of the expected results for the discipline
  - To what extent does the proposed research address important challenges?
- Importance of the expected results for other areas
- What are possible risks of the project and how can they be alleviated?
  - What factors could lead to a failure of the project?
  - Which factors or persons could support the project and increase the chance for success?
  - What if important team members leave the project?

12 Ethical considerations & security issues

- *Length: 1-2 pages*
- Provide a brief explanation of the ethical issue involved and how it will be dealt with appropriately.
- Are there any security-sensitive issues that apply to your proposal?

Abbreviations

MSWP Management von Software Projekten

WP Work Package