

# Hiking Tour Assistant

ELEC-E8408 Embedded Systems Development  
Mini Project

# Description

- Group effort: **Three** students in a group
- Recommended to form international groups
- Challenge different aspects:
  - Requirement engineering: **Software Requirements Specification**
  - Prototyping: Using hardware + software (Embedded system)
  - It is a **real world-like challenge**: use **Innovation, Version Control** and other online tools for teamwork

# Stakeholders

- Finland is filled with hiking routes
- Any activity can be rated and improved and one of the ways it is done in hiking is to track the activity using smart watch.
- You are in a small embedded development company that works with smart watch platforms for a few years using existing embedded platforms.
- Your company received a project from Helsinki City Council who is interested to develop an app for hikers and nature lovers. The project is expected to be used by the Finnish Hiking Tourism as well as Finnish Fitness consortium.
- It is required to satisfy main functional requirements during the project, provide all the necessary documentation and the software & hardware solution as well.

# Project idea

- It is expected to develop an application for smart wrist watch that would be able to record and display trip statistics, such as: travelled distance, step count and trip route records.
- In order to analyze results and stay motivated, it is expected to develop an external device with a web UI that allows to observe collected trip statistics.
- After all, you will be provided with a smartwatch platform for convenient development of a firmware as well as a stationary device platform for a web application development.

# Hiking Band: Main functional requirements

- Start & stop hiking sessions
- Record steps count and convert into travelled distance during the session
- Display this data on a smartwatch screen
- Synchronize and store data with RPi via Bluetooth
- Calculate estimated amount of calories burned during the session on RPi
- Initialize Web UI and show last session statistics (travelled distance, step count and burned calories)

Students will be provided with a pre-made firmware code project missing some of the features as well as a set of standard tools and libraries that cover the main functionality.

However, **teams are free to choose** the programming language, IDE and libraries if it satisfies all the requirements of the project.

# Hiking Band: Bonus functional requirements

- Establish automatic discovery and synchronization of RPi with smartwatch
- Establish communication between the smartwatch and RPi over Wi-Fi in addition to Bluetooth

You are free to propose other bonus functional requirements if it fits the overall workload during the mini project.

By completing set of Main Functional Requirements (previous slide), you may get up to 40 points (MiniProject). This slide includes set of bonus functional requirements that allows to cover up missed points and get up to 5% additionally to your final grade.

# Hiking Band: possible tools

Windows | MacOS | Linux distro

**VSCode** (v1.74)

PlatformIO (Core v6.1.5) + ESP-IDF (ESP32 platform)

Inspect and use wisely the pre-made project code materials

Raspbian OS (Debian v11, 22 Sep 2022)

**PyCharm IDE** (v.2022.3.1)

Python (v.3.8 or 3.11.1+)

Libraries: BluePy, SQLite3a

Also possible:

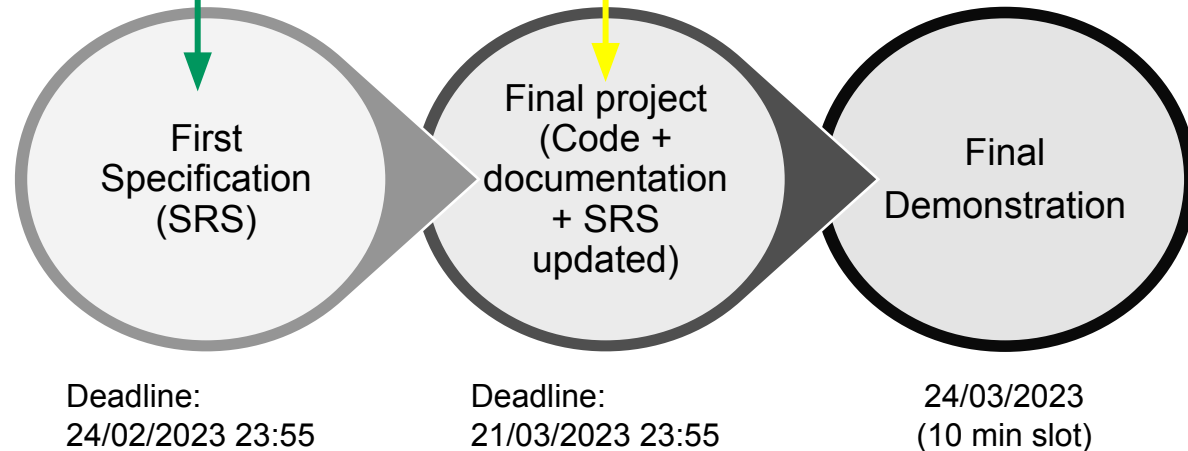
Arduino IDE (v.1.6.5 or 2.0.3+) including libs: LiLyGo, ESP32

All the links are available on MyCourses  
(External Resources section)

# Schedule

- **Introduction** 27/01/2023 10:15 to 11:00
- **Group formation open in MyCourses** 27/01/2023 12:00 to 03/02/2023 12:00
- **Handout of hardware** 03/02/2023 10:00 to 14:00
- **Deadline for part A - requirement engineering** 24/02/2023 23:55
- **Deadline for part-B implementation and final project document** 21/03/2023 23:55
- **Demo & Presentation day** 24/03/2023 09:00 to 13:00 (online)
- **Internal Peer Review deadline** 28/03/2023 23:55
- **External Peer Review deadline** 31/03/2023 23:55
- **Hardware return** 31/03/2023 10:00 to 14:00

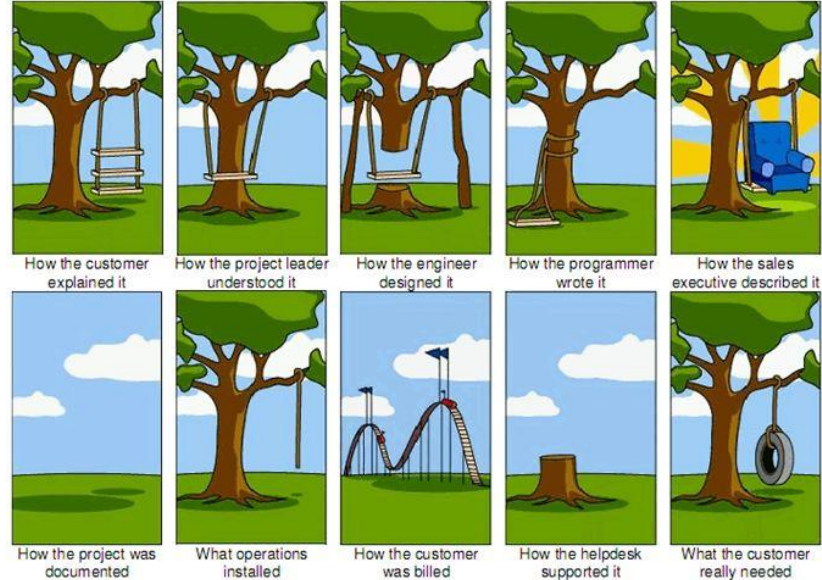
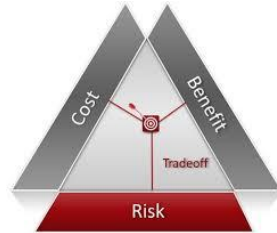
Stage	Relative cost to fix
Requirement Time	1-2
Design	5
Coding	10
Unit Test	20
Acceptance Test	50
Maintenance	200





# Requirements Engineering

- You know about this famous picture:
- So, The listed requirements are not enough
- You should:
  - Ask and consult
  - Assume
  - Be innovative



So, this is the starting point for your group work to prepare a Software Requirements Specification (SRS) for the new product for Hiking Tour Assistant. As you can see, there are numerous open issues that you must address yourself to be able to prepare such a comprehensive document.

# Software Requirements Specification

- Requirement's engineering is the first phase of the software development process for embedded systems.
- In such an extreme scenario, it does not matter how well the system was designed or implemented.
- A decent recovery from inadequate requirements engineering can be costly and lead to considerable losses of revenue; some amount of redesign and reimplementation—including testing—must be done, and hence the product may come to market with a significant delay.

# Software Requirements Specification (SRS)

It is highly recommended to base your SRS on good practices and standards:

IEEE 830:1998 IEEE Recommended Practice for Software Requirements Specifications  
<https://ieeexplore.ieee.org/document/720574>

ISO/IEC/IEEE 29148-2011 International Standard - Systems and software engineering -- Life cycle processes -- Requirements engineering

<https://ieeexplore.ieee.org/document/6146379>

Be aware that both are large documents. It takes some time to read and understand.

Use Aalto VPN to access the documents.

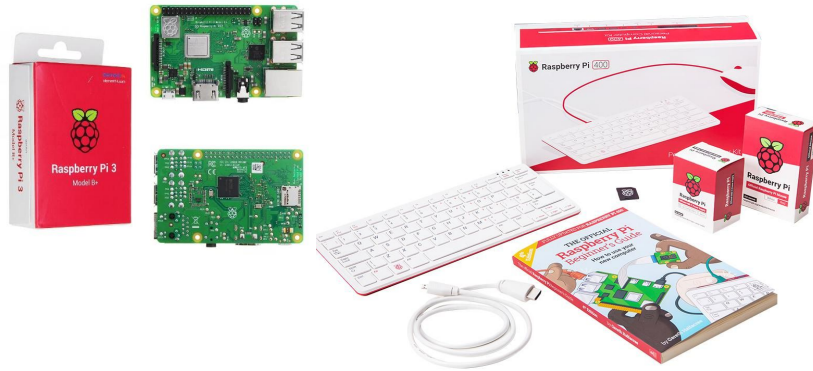
# Deliverable part A : SRS

Minimum content:

- Context diagram with complementary definitions
- External interface requirements for inputs and outputs
- Functional requirements (formal/semi-formal/informal specification techniques as seen appropriate)
- Performance requirements
- Design constraints (such as hardware, operating environment, and possible standards)
- Software-system attributes (including, for example, maintainability, reliability, and security)

# Hardware

Raspberry Pi 3B+ or 400 kit  
Including: Memory card, Power adapter,  
Case, HDMI cable  
(mouse included for 400 kit)



<https://www.aalto.fi/en/aalto-university/information-on-coronavirus>

Smart Wrist Watch  
LiLyGo v2 or v3  
(ESP32 based)



## Hardware handout:

03/02/2023 from 10:00 to 14:00

Aalto Factory of the Future  
Konemiehentie 2 H

Computer Science building,  
room B141 (outside it's a big garage door)

<https://goo.gl/maps/craDk8mKt6YTW68SA>

# Deliverable part B

Documentation:

- A design report which might allow your work to be used and maintained in the future for other people
- A user manual to operate the system (Including a test plan)
- The updated versions of your SRS document
- A back up of your code and if available, the link to your public repository
- **Bonus points** for repositories with comprehensive readme

# Presentation / Demo Day

- Book your group's timeslot on MyCourses before the pitch.
- 
- Your group should present the prototype in a 10-minute pitch.
- The presentation should go based on your test plan from your documentation
- You should comment about how you meet the requirements from the SRS in your system
- Please provide both recording and real-time presentation
  
- Be creative and serious :)

# Internal peer review

- After the submission date an Internal Peer Review section at MyCourses would be available providing a form to assess performance of the students within each group
- Submit your form before 28/03/2023 23:55
- Internal Peer Review is **compulsory**. It does not affect the total grade of the project, but affects each student member's grade, allowing us to understand key contributions and faults along the development process
- There will be a penalty for not submitting (50% from the personal grade)



# External peer review

- After the submission date a Peer Review section at MyCourses would be available providing a project materials from another random group to grade.
- Check the content and fill the grading form (ELEC-E8408 Mini-project grading 2023.xlsx)
- Submit your form before 31/03/2023 23:55
- Your final grade for the MiniProject will be recorded only after your group complete successfully the peer review

# Hardware return

Return the hardware in original box.

Date: 31/03/2023 from 10:00 to 14:00

Place:

Aalto Factory of the Future,

Konemiehentie 2 H

Computer Science building,

room B141 (outside it's a big garage door)

<https://goo.gl/maps/craDk8mKt6YTW68SA>

(Same as pick up point)



# Rules of using the hardware

- Hardware needs to be returned, if there are any missing or damaged components, group will be penalized depending from the value of the component (up to 50% of the total grade)
- All the hardware has been tested before the beginning of the MiniProject, so if during the hardware return, there is any damage, it would be required to explain and investigate the reason
- It is strictly forbidden to tinker/solder/modify any parts of the hardware. The only exclusion for this rule is to add 3d-printed parts or hardware modules that must be detached before returning the hardware (in a state it was given to you)

# Tips

- There are no specific requirements about what programming language / tools should be used. You can use the one of your preference. Python can also be used to some extent, although to work with the LiLyGo, the most feasible programming language might be C / C++. Arduino IDE can be used as the development tool.
- If you plan to implement some web interface, we recommend using such frameworks in Python as Flask or Django, and CSS, Bootstrap, Bulma or Foundation to simplify the creation of your system. Libraries as SQLAlchemy may help handling of databases.
- It is recommended to establish communication between LiLyGo and RPi using Bluetooth 4.0 or BLE, but implementing communication over Wi-Fi in addition to the Bluetooth will bring bonus points (consider potential difficulties in port forwarding)
- If you feel lost coding, remember you are not alone. Always try to read online documentation, comments on communities (like Stack Overflow)

# ALWAYS:

**FOLLOW THE RECOMMENDATIONS FROM AALTO  
UNIVERSITY AND THE OFFICIAL ORGANIZATIONS  
ABOUT THE CORONAVIRUS RESTRICTIONS**

**Take care of yourself and your community**

<https://www.aalto.fi/en/aalto-university/information-on-coronavirus>

<https://thl.fi/en/web/infectious-diseases-and-vaccinations/what-s-new/coronavirus-covid-19-latest-updates/situation-update-on-coronavirus/the-covid-19-epidemic-regional-situation-recommendations-and-restrictions>

<https://www.hus.fi/en/newsroom/coronavirus-covid-19/regional-situation-coronavirus-epidemic-and-issued-recommendations>

# Good luck!



[aalto.fi](https://aalto.fi)



Aalto University  
School of Electrical  
Engineering