Trash Bin
IoT

1. Introduction

Problem and solution

Problem background

Waste management is a crucial piece of the circular economy puzzle—huge CO2 emission savings can be achieved via optimizing waste management processes and the whole materials lifecycle. Residential waste management, handled by HSY, is in quite good shape in the Helsinki metropolitan area and far from being the main culprit, but there is certainly room for experimentation and further improvements also here.

Problem

Residential waste collection services, operated by HSY subcontractors, are rigid as regards to trash pick-up times. These are scheduled to take place at regular intervals, usually every week or every other week. If the containers get full early, they usually just stay full or overflow. If the containers are collected half-empty, there is waste of fuel and time in the transportation process.

Solution

An IoT-based system that detects when trash bins from different locations are full (and when they are empty) and centralises this information, enabling better trash collection systems to be put in place.

Solution details, best assumption at the moment:
A trash bin will be equipped with three or more inexpensive sensors to detect when the trash bins are used and to evaluate how full they are. This information will be shown on a dashboard that could be shared with housing companies or HSY’s subcontractors.

Expected impact

If all works out, the resulting proof of concept could eventually lead to changes in trash collection practice, which would mean both better services to city residents and CO2 emissions savings. The CO2 savings potential is not huge, but significant.

Additional value may come from further uses of the data collected by such a system. For example, trends and patterns in waste creation could be found from the data and used to attempt changing consumer behaviour towards less consumption.
Project background

HSY has been building a city-wide IoT infrastructure based on LoRaWan networks. To make the most of the network, they are soon opening it up for wide use by all interested parties. At the same time, HSY is actively looking for use cases for the network themselves.

Futurice was seeking ways to start addressing climate change through Chilicorn Fund, their social responsibility program. This concept seemed to be a good fit for that and a good candidate for a student project collaboration.

Together we decided to take the project and scoped it to match the course duration.

2. Project goals

- The project’s main goal is to showcase the opportunities of IoT and low-cost sensors, using a real-life, relevant use case.
- The practical goal is to build a proof-of-concept dashboard that visualizes the data gathered from the sensors of LoRaWan network—in this case, a dashboard of trash bin containers’ status.

3. Technologies

Hardware

HSY provides the LoRaWan network for transferring the data to a cloud service.

HSY also provides the LoRaWan IoT sensors that are used to collect data to the project.

Current state of the art sensors for detecting if a trash bin is full or not are costly and therefore unpractical to be taken into use. However there are available cheap, recyclable, and versatile sensors that can detect things like temperature and movement that could be used to follow the usage of trash bins.

The sensors we will be using are called TouchTag. Here are some photos (as you can see, they are already waiting):
Software

- The dashboard should be a browser based application. It can be built with a variety of tools. Students can affect the technology-selection, however NodeJS- and React-based architecture is recommended.

- Futurice offer expertise and help with web technologies used in the dashboard.

- The IoT data is read over a cloud service. Amazon AWS is the preferred tool here.

4. Requirements for the students

- The students should be familiar with web development basics. No further experience with NodeJS or React is required, but it is preferred.

- Any experience of IoT networks or other sensors by the team members is recommended.

- The dashboard should be possible to build with fairly simple architecture, but the project will require an amount of work with cloud service integrations and usage of physical sensors.

- All code and documentation should of course be written in English.
The team should be familiar with and adopt best practices in version control, including branching, pull requests etc. Github is the required service for storing the repo.

Otherwise, we hope for commitment and passion for the work at hand.

5. Legal Issues

Intellectual Property Rights (IPR)

The results will be owned by Futurice and published under an MIT open source license, with due attribution to all contributors.

Non-disclosure agreement (NDA)

Signing the NDA included in the Aalto's contract template is not required.

6. Client

The project has two clients. Futurice will act as coach and mentor for doing software development projects. The actual client for the case is HSY.

Futurice and HSY share the product owner responsibilities, with a more active role taken by Futurice, due to past experience with similar courses.

Futurice offers personnel to guide students during the course. HSY will offer equipment and the required guidance for the IoT services.

Futurice & Chilicorn Fund

Futurice is a digital service house that has offices in Helsinki, Tampere, London, Berlin, Munich, Stockholm and Oslo. We employ over 500 experts in the fields of software development, design, and business. Our main focus is to help our customers grow their ability to work and thrive in the digital era.

Chilicorn Fund is Futurice’s corporate responsibility program that combines non-profit organisations, student groups and Futurice’s experts in projects that make our world a slightly better place.

HSY

HSY is a municipal body, which produces waste management and water services, as well as providing information on the Helsinki Metropolitan Area and environment. We organise waste management for residential properties and the public administration, both in the Helsinki
Metropolitan Area and Kirkkonummi. Aalto University is one of our clients and this use case could help even Aalto get more information on the waste amounts and waste collection.

**Client representatives**

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### 7. Additional information

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