Danmarks Tekniske Universitet

Networking Technologies and Application Development for IoT
LoraWAN and BLE location tracker for keys and more

Group 4

Bjarni Arason, s232718 Oscar Theilvig Stømsborg, s204722 Sebastian Zeest Rydahl, s173931
Dagur Mooney, s232720 Simon Langlais, s222593 Snædís Lilja Daníelsdóttir, s223425

Teacher: Martin Nordal Petersen
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Project Description

Our objective is to make a local location finder, similarly to the existing AirTags[1] and Tile[2], to help us find our keys, backpacks or other small items that frequently get lost around the house or larger buildings - almost always during critical times.

A lot of people don't have iPhone, making AirTags a non-valid option. AirTags are also expensive and dependent on the mesh that the mass of iPhones in public form. We want to make an alternative, providing the same features non-dependent on the iPhone mesh, instead utilizing modern IoT solutions.

Our idea is to have one *master device* that will be used to find the *slave devices*. The master device would be inside a 3D printed casing, including an appropriate MCU, appropriate communication modules, LCD to provide information on connected devices, and few LEDs to indicate the signal strength of how close it is to the searchable object - the slave device. It would also be connected to WiFi in order to get the latest location data from the slave. It will also be BLE enabled to connect to the slave when in close proximity for precision tracking.

The slave device will be using LoRaWAN for transmitting global geolocation information along with other data regarding the device (BLE status, Battery percentage). The geolocation data will be aquired by scanning for nearby WiFi access points. Forwarding that data to the backend. This information will be used for gathering the more or less precise location of the access point, and thereby the device. This is an alternative to the unavailable LoRaWAN geolocation service, which would have provided a more precise location while using less power. Unfortunately this is not yet available in Denmark.

Furthermore, the slave will use BLE for precision location while in close proximity. This feature will be enabled on demand via LoRaWAN downlink. Idle mode for the slave will be sleep mode. We will use a tilt sensor and an RTC module to wake up the device either on movement or by time.

[1] Apple Airtag
[2] Tile by life360

Requirements

- Wireless communication: BLE and LoraWAN
- Sensors (analog and digital): Battery charge sensor with ADC and a tilt sensor for movement
- Uplink and downlink communication: Downlink for the master device, uplink to server from the slave device.
- Backend/visualization: Cloud database service, WebServer showing location (potential)
- Actuation: LCD display, LED

Components overview

Component	*Function description*
2x ESP32	MCU for both master and slave
Radio module and antenna	For communication
Built-in radio module	For WiFi-scanning
LCD display	Display basic information regarding battery life and last position
5-10 LEDs, red yellow and green	Indicate the strength level of connection between the slave and master
3.7V Lithium-Ion/Primary batteries	To make both the master and slave wireless.
3D printed cases	Housing for electronics for both master and slave
Printed Circuit Board	Increase Reliability (not actually implement, only design)
Battery charge sensor	For information on battery life
Tilt sensor	For turning on the slave device if moved
RTC module	To wake the module on a clock / timer
Speaker module (optional)	Audible feedback from the slave device

Block Diagram

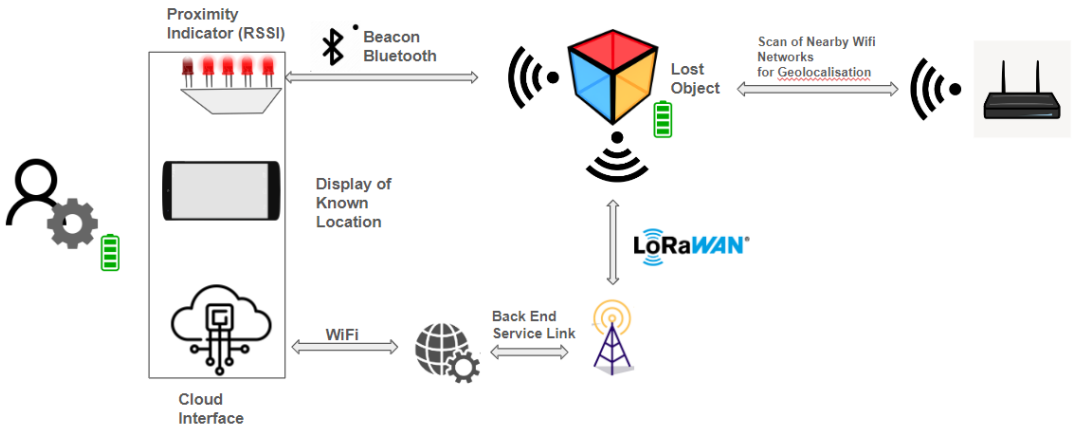

Figure 1: Block diagram of the Project

Team Responsibilities

These are the initial team responsibilities, over time the project will be refined and more accurate topics will be distributed amongst the group members.

Possible topics:

CONTROLLER: LoraWAN BLE Proximity Toggle switch w. LEDs Battery system OLED/LED/LCD display

SLAVE DEVICE: LoraWAN BLE Proximity Battery system + Voltage divider Energy optimization + Tilt-sensor on interrupt WiFi-scanning

OTHER: Cloud interface and backend Slave PCB CAD

Student	*Topic(s)*
s173931 - Sebastian	WiFi-scanning, backend, toggle swith w. LEDs
s204722 - Oscar	WiFi-scanner, backend, tilt-sensor on interrupt
s222593 - Simon	BLE Proximity
s223425 - Snædis	LoraWan, energy optimization
s232718 - Bjarni	Battery System + Voltage divider + OLED display + LoraWan
s232720 - Dagur	Battery System + Voltage divider + OLED display + LoraWan