Acronym and Title

IoT Platform for Asset Tracking with Low-Power Wide-Area Network (LPWAN)

Target

[x] This proposal can be announced to all student groups. It can be assigned to any student group.
[ ] This proposal is restricted to the following students/groups.

Proposer Information

Names(s):	*Haldun Yildiz, Parabol Yazilim Ltd. Şti.*
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Supervisor

[ ] The project will be supervised by _____.
[x] The project can be supervised by any faculty member. Suggestions: Dr. Cevat Sener

Project Description

Over the last 10 years, due to their decreasing costs, sensors started to be used in a wide range of areas such as transportation, energy and all kind of public. Along with the rising "smart city" concept, the city authorities need to monitor, control and manage "things" (assets, vehicles, events etc.) of the cities for effective governance.
In this context, the new wireless communication technologies and standards started to emerge, such as Low Power Wide Area (LPWA) networking protocol. This protocol (LoRa 1) helps to wirelessly connect battery operated 'things' to the internet in regional, national or global networks, and targets key Internet of Things (IoT) requirements such as bi-directional communication, end-to-end security, mobility and localization services.

A short video for LoRa Alliance and LoRaWAN protocol is available at YouTube[3].

One of the most beneficial usage areas of LoRa technology is the **asset tracking** in smart cities context. The envisaged end product of the project will be **an asset tracking system** which gathers the data from LoRa sensors embedded to field assets of a city (road signs, garbage bins, street lights etc.) over a city landscape, even at the outskirts of a city.

The proposed project will use LoRa sensors to connect assets to a central cloud platform and establish one or bi-directional communication between the field and center. The project will provide an opportunity to broaden skills and knowledge of emerging communication protocols, embedded systems and cloud technology.

The end product at the end is expected to include:
1. LPWA based LoRa sensors (in fact, off-the shelf RF modules) located at the edge e.g. on the assets, devices etc.);
2. LPWA gateways carrying embedded software to transfer raw data from the sensors to the center;
3. The central software, possibly deployed on a cloud platform.

Tentative Plan

1. Literature Research (0.5) x 8 = 4 man-month
2. System Analysis & Design (0.5) x 6 = 3 mm
3. Transmitting data from assets to central server via LoRaWAN (includes placing LoRa gateways and sensors to fields, triangulation for positioning) (2.0) x 4 = 8mm
4. Preparing the Cloud Server for the project. (1.0) x 4 = 4mm
5. Creating Asset Management backend services (1.0) x 4 = 4mm
6. Creating Asset Management dashboard UI (1.0) x 4 = 4mm
7. Integration and Testing (0.5) x 4 = 2 mm

The planned start and end dates are on above graph. This plan can change depends on the school holidays or supervisor's recommendations and any other specific conditions.

Similar Products/Projects

[1]Smart City Project in Vilnius

[2]KPN Nationwide Lora Network in Netherlands
As shown in the references, there are many cities using LoRa network to enrich their infrastructure capacities. In Netherlands, with the KPN's LoRa project, they have successfully covered most of the Netherland with LoRa network. Currently, they are able to track and manage most of the assets in nationwide.

Contributions, Innovation and Originality Aspects of the Project

The envisaged end-product will help to decrease the costs of monitoring various field assets for the city authorities. LoRa sensor average battery life is more than 10 years which decreases the maintenance cost tremendously compared to existing sensor technologies. Furthermore, LoRa sensors have a wider range of communication (approximately 15 kilometers) and uses radio wave signals which lowers the infrastructure requirements. (cabling, electricity etc.)
Finally, the proposed project will transform the "dumb" field assets (road signs, garbage bins, street lights etc.) into "smart" devices in the cities.

Success Measures

- Positioning assets with high accuracy (< ~500 meter)
- Coverage area of the network (> ~100 km^2)

Project Development Environment

Hardware:
-LoRa gateways
-LoRa sensors

Software (Suggested):
-IOT dashboard UI to track assets
- Technologies: HTML, CSS, Javascript (ReactJS, Angular, Vue etc.)
-Central Cloud Server
- Technologies: Microsoft Azure, AWS, Google Cloud etc.
-Backend
- NodeJS, ExpressJS: In order to
-Communication Protocols:
- MQTT, HTTP etc.
-Database
- NoSQL etc.
-Programming Languages:
-Javascript (es6), TypeScript, NodeJS, python, java etc.
-Version Control
-Git
-Operating System
-Linux based distributions like Debian, Ubuntu

External Support

The company Parabol can provide the necessary hardware to develop LoRa gateways and sensors.

The project group can visit and contact with the company, preferably twice a month. During these visits the company will be available for the mentoring and help to solve the issues, especially about the LoRa protocol, devices, embedded software, etc.

All the data in the project will be collected as a part of the project. Parabol could set up test & pilot environment for the project by communicating the municipalities. It could also be possible to set up a test and demo platform on the campus.

Intellectual Property Information

The proposed project possible end product's intellectual property rights will be owned by the company. The high performance achieving project members can be invited for job positions in the company after graduations.

Major Risks and Risk Plan

Risk: Technologies used in this project (LPWA, LoRa, LoRaWAN) are relatively new in the field. Therefore, lack of the research material or resources is major risk/problem.
Suggested Solution: Parabol can provide extra resource materials for the students.

References

[1] *http://www.smartcityvilnius.com/*

[2] *https://www.kpn.com/zakelijk/grootzakelijk/internet-of-things/en/lora-connectivity.htm*

[3] *https://www.youtube.com/watch?v=m6IvwcjcxQc*