Working Title

Power analysis of an autonomous LoRa mesh network for rural agriculture environment

Hypothesis or Research Question

Can we rely on an autonomous LoRa mesh sensor network to work efficiently in distant areas without network or electricity infrastructure? What is the power performance of mesh nodes in this case?

Background

LoRa sensor networks work best when surrounded by gateways, but this tends to be difficult or extremely costly in certain situations where no network or electrical infrastructure is available, such as vast and remote agriculture lands, oil pipelines, underground tunnels or deserts (Pagano et al., 2022). Research community is currently trying to investigate the practicality of using LoRa mesh networks to achieve lower costs and more dynamic deployments (Marahatta et al., 2021; Nurgaliyev et al., 2020)

In previous studies, the analysis of LoRa mesh networks has taken several factors into consideration; security, communication, power, cost and scalability (Cotrim and Kleinschmidt, 2020). This research is focused on analysing the power factor using agriculture as a case study. Although there were multiple earlier studies in this field (Rodríguez-Robles et al., 2020; Suji Prasad et al., 2022; Codeluppi et al., 2020), they seemed to have focused on the networking side of mesh networks more than studying the power performance of the autonomous sensors.

In this research, energy harvesting would be used at end nodes in addition to specific algorithms to optimise the power efficiency of the mesh network in the selected case study.

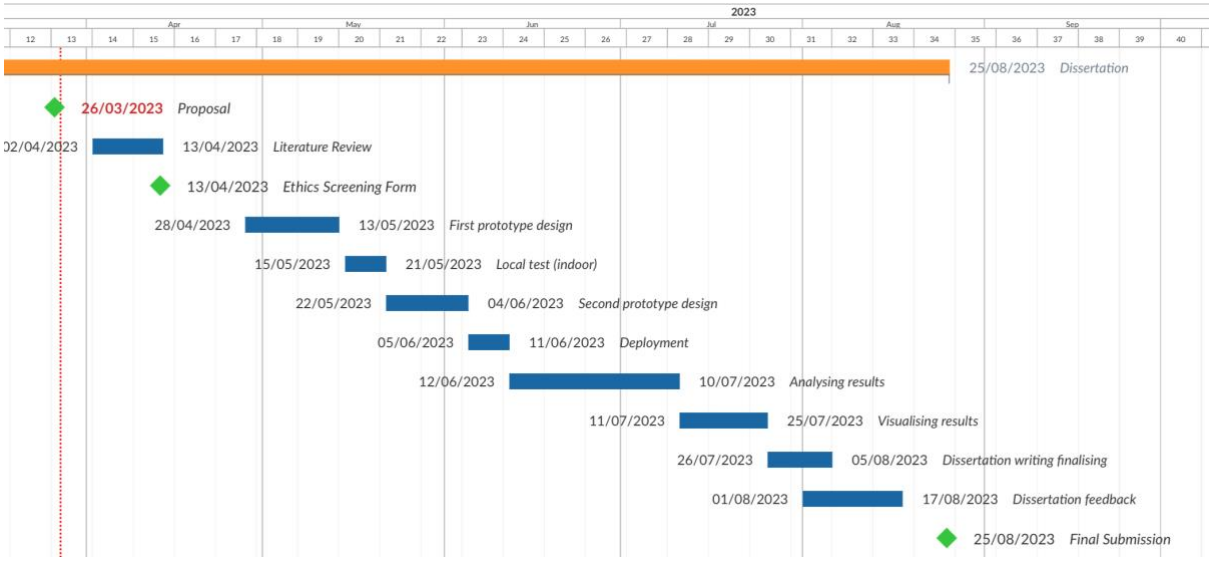
Research Design (Sense, Deploy, Communicate)

The project includes designing a small cluster of devices to sense one or multiple agriculture parameters, such as; air humidity, air temperature, light, and soil moisture. Each of these devices consists of LoRa-powered devices with the previous sensors, a battery, and a small solar panel. All nodes will be deployed in the QEOP and will be using a private gateway to communicate their data to the outer internet.

Technical details:

Nodes will use the ESP32-based Lopy4 modules (Pycom, 2023) with an auxiliary solar charging module, in addition to one or more related sensors. Nodes will use the powerful Pycom Pymesh (2023) library which supports multiple mesh topologies, and those nodes will be able to take decisions to alter their behaviour according to their power consumption. All nodes will be sending their data through each other to a Mikrotik LoRa gateway (Mikrotik, 2023). Sensors' readings will be stored in an InfluxDB hosted on a private server on the internet to be visualised later through Grafana or custom web dashboards.

Timetable



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