

Telecommunication Application Project

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Degree Programme in Information Technology, Option of Device and Product Design
IN00CS94-3002 Telecommunications Application Project, part Application Project (11 cr)

Project goal

Apply the basics of telecommunications, machine learning, Python and IoT to create the functionality described below using agile methodologies.

Project description

The task is to create an Arduino application that transmits acceleration data wirelessly to a receiving device, which enters the data into a database. The data, accessed by the student through various APIs, is then used to teach a K-means clustering algorithm. The resulting model is imported back to the Arduino, where it's used to predict the alignment of the accelerometer in real time.

The project also includes sections on the basics of Linux, APIs, server management and other related subjects.

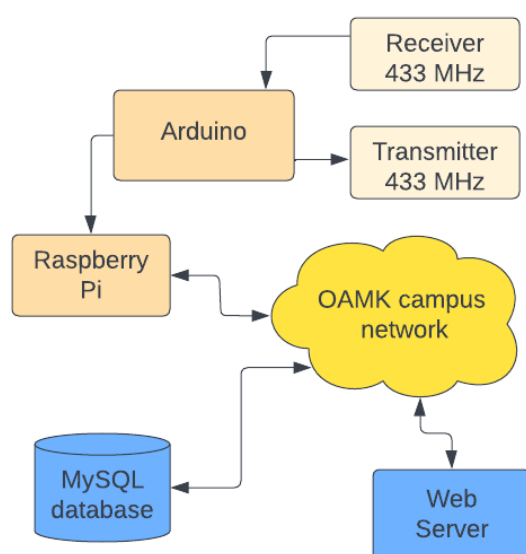


Figure 1: data architecture

Wireless transmission

A half-duplex system using ASK for signal modulation was implemented on the Arduino using the RadioHead open-source library.⁽¹⁾

This proved to be a rather challenging section for various reasons, including dealing with large amounts of unfamiliar source code, and the instability of breadboards as RF platforms.

The K-means algorithm

This was the part of the project that required the most work. The algorithm was coded in Python, and built from scratch, instead of using a library like sklearn. The goal here was to locate the center points of the data clusters. These points are then saved into an h-file for use with the Arduino.

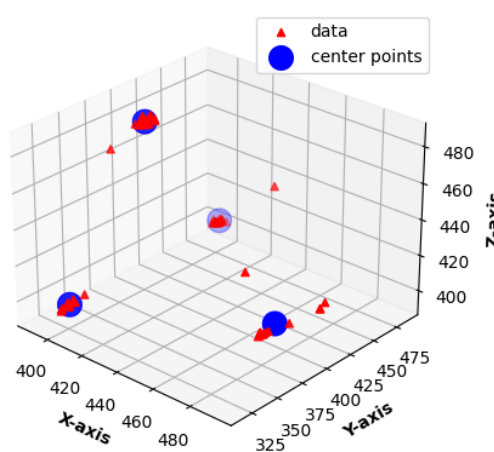


Figure 2: 3D-scatter plot of the data used in the algorithm, as well as the center points of the clusters it identified.

Results

The project was finished right on schedule. All parts of the project are working as intended, and the only things left to do are cleaning up some bits of code and finishing up the documentation.

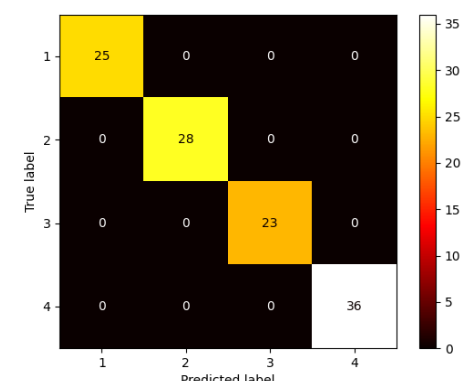


Figure 3: Confusion matrix of the results of the algorithm on the Arduino. It predicted the alignment of the accelerometer with 100% accuracy.

Takeaways

Though my code may not be the most elegant in all places, I could during the project that my programming and problem-solving skills have greatly improved. Additionally, this project has been very helpful in identifying further areas for improvement.

Though the project has been a success, I certainly want to go through all the code I've written and find ways to improve on it.

References and sources

1. <https://www.airspayce.com/mikem/arduino/RadioHead/>