Project Planning Report

School of Engineering and Built Environment

Griffith University

Jessy Barber

17 March 2023

Contents

1 Aims and Objectives

The aim of this project is to develop an Internet of Things (IoT) system to regularly monitor the health of the Griffith footbridge through three dimensional vibration analysis. The high level system of this project comprises of three sensor nodes placed across the length of the footbridge that transmit packets over the LoRaWAN protocol. These packets are received by a gateway placed at the end of the bridge and are uploaded to The Things Network (TNN) cloud for data processing. Arduino MKR 1300 and 1310 boards will be used as the carrier boards for these sensor nodes. Figure 1 shows the high level hardware diagram for this IoT system.

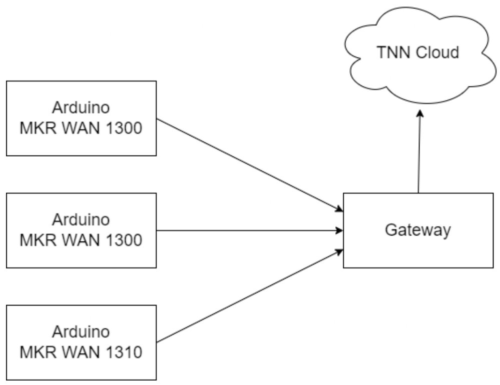

Figure 1: High Level Hardware Diagram

Each sensor node will include an accelerometer to detect, log and transmit movement in three dimensions (x, y and z axis). This data is sent to the on-board processor of the Arduino carrier board where it is logged. The average movement on each axis as averaged and sent via data packet over LoRaWAN via a dipole antenna every hour. The carrier board itself is powered with a simple solar panel / battery setup. The pro gateway is listening for packets on the LoRa network via a mono-pole antenna. These packets are then sent to the on board Raspberry Pi 3 model B+ processor. The processor transmits these packets to the TNN cloud. This more detailed system can be seen in figure 2.

Figure 3 displays the higher level software diagram for the transceiver and receiver. One of the major aims of the project will be to further explore this software design which is heavily dependent on the functional requirements of the system. The functional requirements of the system will dictate the packet size and transmission frequency. Additionally, different types of windowing techniques for the Fast Fourier Transform will be explored to remove noise from accelerometer analog inputs.

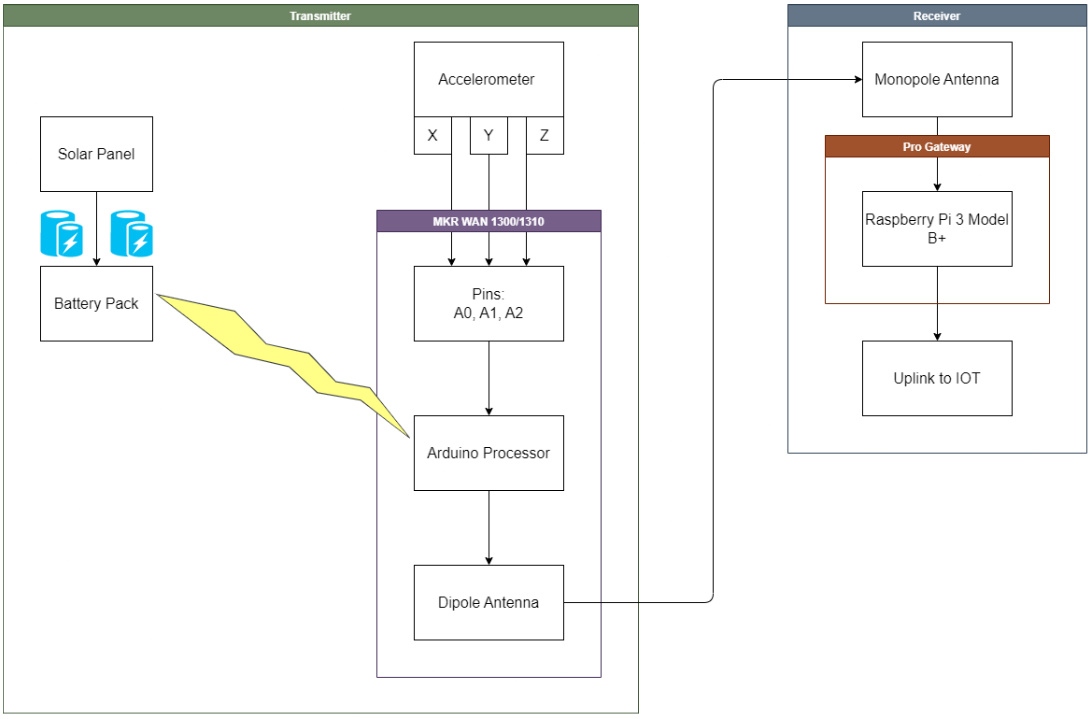

Figure 2: Detailed High Level Hardware Diagram

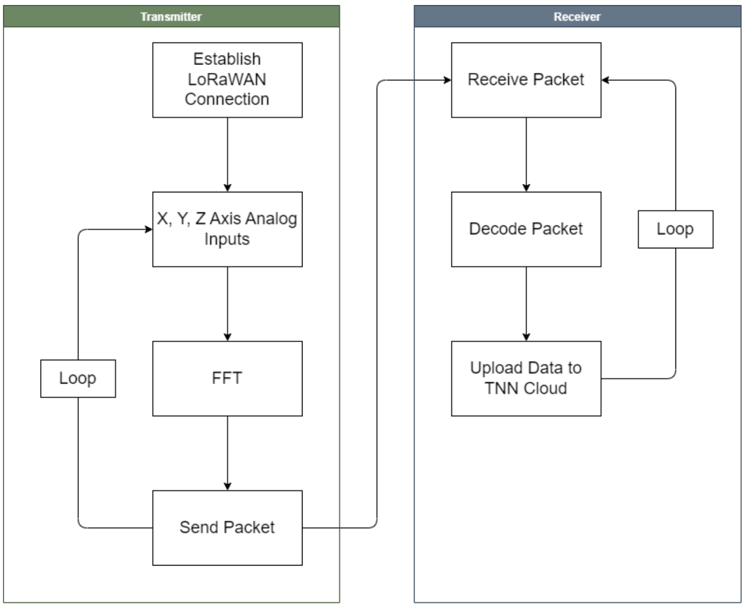

Figure 3: High Level Software Diagram

2 Expected Project Outcomes

This project involves multiple outcomes that are confined within the scope of the project. The first outcome to meet is a proof of concept that satisfies the high level hardware and software diagrams. This will initially be completed with one sensor node and will achieve the objective of creating a functional IoT system in a closed loop environment. The next outcome to meet is introducing three sensor nodes into the system and writing the software to distinguish between each node's packets. To complete the closed loop testing the nodes will be placed on a test beam set up in the mechanical engineering labs that simulates vibration. Once the closed loop testing has been completed, the permanent implementation of the device will commence. This involves a solar-battery system sufficient of powering the low-powered devices at all times. Theoretical calculations and quantitative testing will be conducted to determine the power drain characteristics of these sensor nodes. Finally, an enclosure will be modeled and printed to house the electronics and power systems and will be used to mount the devices to the bridge. These enclosures also serve the purpose of weather-proofing the sensor nodes. The final outcome is to have a functional IoT system over the length of the Griffith footbridge that is capable of transmitting packets 24/7 to a gateway that will be placed up to 600m away.

3 Methodology And Project Schedule

3.1 Project Methodology

This project is fundamentally a design project and so the design will heavily depend on the system functional and non-functional requirements. These requirements will be verified through experimental analysis using both the mechanical and electrical engineering laboratories. Experimental analysis includes closed loop testing of the IoT system and power consumption of the Arduino carrier boards. The closed loop testing will provide experimental analysis to verify that the accelerometers, temperature sensors, ADC conversion, packet transmission and retrieval meet the design requirements of the system. Testing will also be conducted on the designed enclosure to ensure the system is sufficiently weather proof against heat and rain.

3.2 Tasks and Schedule

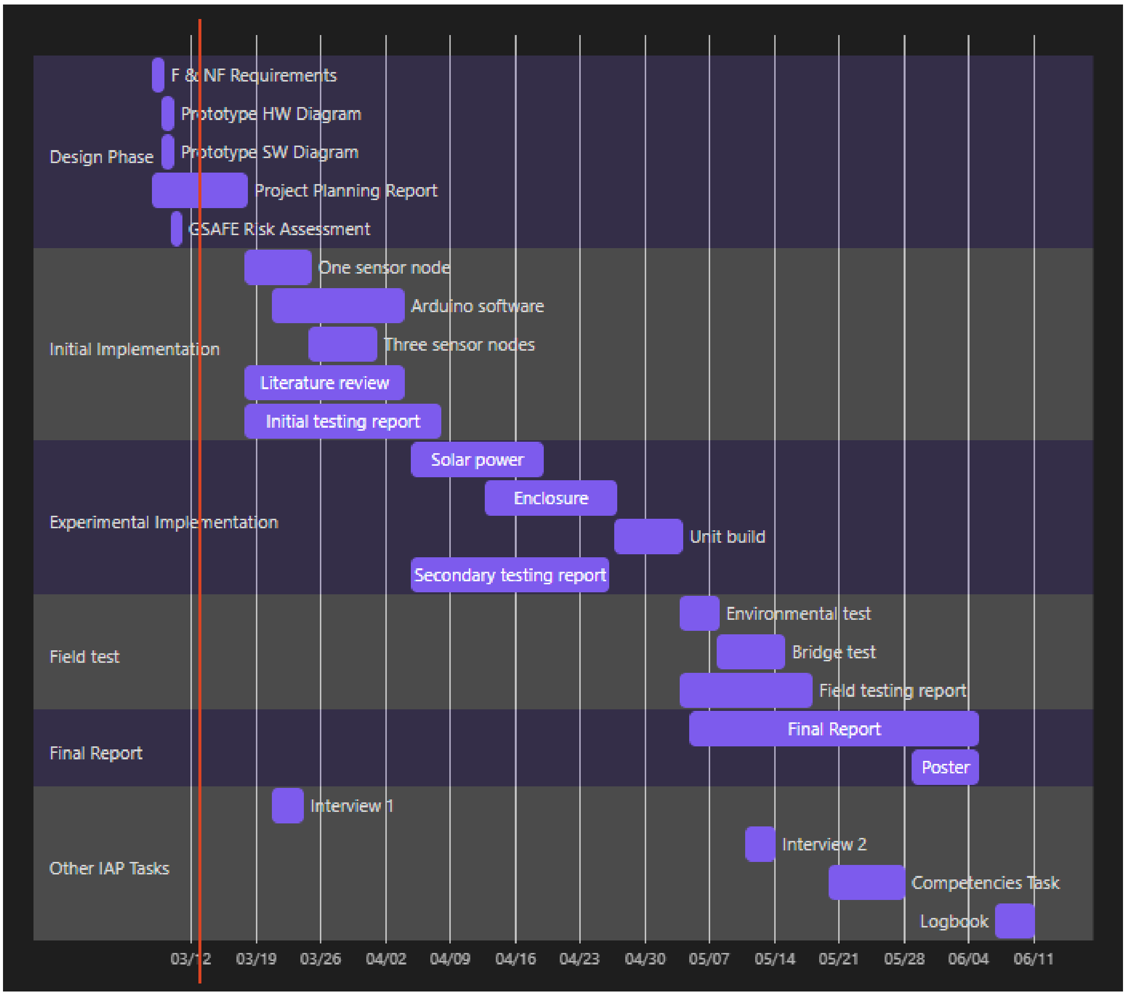

Figure 4: Project Timeline Gantt Chart

3.3 Resources