1 Aims and objectives

In this section, the aim and objectives set out in the thesis will be compared to the material achievements of the project.

Aim	Remarks
Fundamentals - minimum requirements to demonstrate the viability of the product.	
Obtain GPS location.	The tracker obtains accurate GPS coordinates, within 5m, and is capable of including information like altitude, speed, and whether the reported location is 'current'.
Transmit location to a receiver via LoRa.	Information is successfully transmitted via LoRa, however there is a small issue with occasional corruption of packets.
Continue transmission remotely for a significant period of time.	Battery life allows transmission of up to 15 hours.
Transmit at a regular interval.	The last updated location is transmitted every 5s.
Improvements - upgrades to the product to improve the user's quality of life when using the product.	
Ergonomics for owner and pet (fitting and wearing).	While a case was designed and houses the components quite well, the primary aim was protection of the electronics during testing, as opposed to suitability for this use.
Stability of the system (high uptime).	The system is capable of running unattended for long periods of time, however only the receiving end has any error handling capabilities. While it is unlikely for the transmitter to crash for any reason, this has not been stress tested in any manner.
Installable by an average person.	Setting up the antenna or other system components is not particularly difficult. The system overall could benefit from tooling (e.g. a base for the antenna) to make this viable. Furthermore, accessing the receiver software to run it requires some knowledge of Bash, which is not a fair expectation of the average person.
Location information easily viewable.	The location information is not difficult to see since it is stored plain-text in a file on the receiver. It also is not exactly easy, either, for the same reasons as above.
Production - requirements to ensure the product is suitable for manufacture.	
General safety and suitability to be worn.	This follows ergonomics, wherein the case is not designed to be worn at the stage that it is at as it cannot be attached in any way. It therefore has not been assessed for more than a superficial safety check (i.e. the battery wires will not cross over and cause a fire).
Resistance to damage and weather.	It offers no protection from the environment. However, the electronics are protected from damage and, by separation via insulating plastic, the user is protected from the electronics.
Certification requirements and law compliance.	Not considered.

Aim	Remarks
Scale considerations, especially manufacturing.	Not considered.

Table 1: Aims evaluation

Objective	Remarks
Research cat characteristics, like roaming distances and time spent outdoors.	This was well met, with the level of detail in research appropriate for defining the required specification points for the tracker.
Research LoRa radio requirements for use, and competitive products.	The exact details of the workings of LoRa radio were not delved into deeply due to limited relevance, however an overview was provided. Research into alternative products and patents was of sufficient depth to justify the relevance of the tracker.
Design the system on a macroscopic level to inform hardware and software requirements. This may include defining a specification of requirements the tracker must achieve.	A general overview was provided, including a software flowchart and hardware block diagram, so the tracker can be understood in generality. A detailed specification was also written using the aims and research as a foundation.
Develop the tracker such that it meets the outlined aims.	Some of the specification points were met, but not all of them. The aims' evaluation in table 1 provides a general overview of this, as the specification is essentially a more granular version of the aims. The tracker did meet some of the core aims, and with further work, could certainly meet outstanding points. The aims may have been too ambitious in scope given the time available, however nothing impossible was specified.
Perform tests to verify the efficacy of the tracker.	Various tests were performed to ascertain different characteristics. This included testing the lifespan and distance-transmission capabilities. The distance tests were not sufficiently thorough in order to draw solid conclusions about the tracker. This largely came down to time constraints (i.e. project development ended at this objective). The tracker would certainly have benefitted from a more thorough suite of tests on this characteristic. That is not to say the data gathered was entirely useless. With confidence, the tracker works in very poor conditions within 175m.
Develop a PCB for the tracker to minimise form-factor, and produce adequate casing for it to be fitted to a pet collar or harness. This includes verifying basic functions again, in addition to suitability for intended use on an animal.	As time ran out for test thoroughness in the previous objective, from hereon no further points were tackled. The plan was to lift the components of the tracker onto a PCB that would have minimised the size, and then develop casing around it that would be useable with a harness, however this could not be attempted due to the time available. Therefore, this point in its entirety was not engaged with.

Objective	Remarks
Gain required certifications for the product to be moved to manufacture, and design a manufacturing plan.	This objective would have defined the tracker to a point where it was potentially patentable, however was not addressed at all due to where development for the project had to end.

Table 2: Objectives evaluation

2 Project management

Time constraints were mentioned a number of times when assessing the aims and objectives. The project development was performed in a rather rushed manner and overall happened extremely quickly. Getting to the point of functioning code on both the transmitter and receiver took roughly a weekend to complete, with refinements occurring in small amounts over the following weeks as issues popped up during testing. Similarly, the first case was designed in a matter of hours, with the biggest delay being printing issues. Overall, development on the tracker started on the 14th of January, and ended on 17th of February, the day the distance tests were performed. All that is to say that development was handled extremely rapidly, and that given this speed, meeting the outstanding objectives given the total time period available would have been possible.

The question, of course, is what led to development starting so late into the project lifetime. Ultimately, the primary cause was hardware delays and issues relating to it. The minimum of necessary parts were only available in late-December, and did not have all the necessary parts required to perform distance testing. While some delays for delivery were accounted for, losing the entire first term was far out of expectations. However, this was still adapted

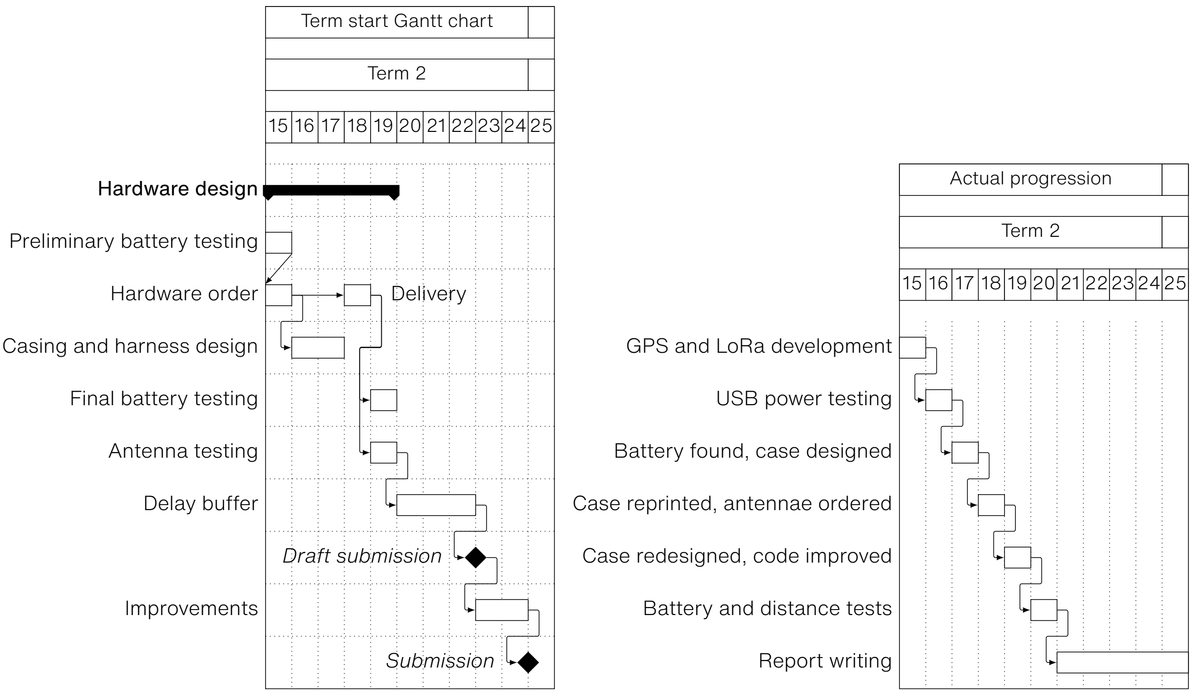

Figure 1: Gantt charts

to, and an updated Gantt chart was created to maximise the time available and achieve the fundamental aims. This was achieved, despite lacking a little in thoroughness for the final test.

Figure 1 shows the Gantt chart as developed at the beginning of term 2, and a Gantt chart of the actual progression of development throughout the term. It can be seen that, while the order may not have been exactly the same, the key points of development and testing were met.

The progression of the second chart would have been ideal for the first term (contingent on the hardware having been available). This would have left the tracker in a position where further tests could be carried out to determine the range suitability to a finer degree, and subsequently focus the second term of development on PCB design and harness attachments.

Another notable aspect of the actual progress is the time required to typeset the technical report. This part was not explicitly accounted for, but ended up taking the delay buffer (for hardware delivery) and improvements time periods. This is perhaps the most glaring shortcoming in the planning section.

3 Independent work

An interesting discovery which is particularly prominent when comparing development plans to the executed procedure, is that at no point were any tasks carried out simultaneously. The Gantt chart in the PFS is particularly rife with tasks occurring simultaneously. While the ‘actual progression’ in fig. 1 lists multiple tasks occurring in a single block (e.g. “Battery found, case designed”), these tasks were carried out exclusively sequentially. In this instance, the step where the battery was found and appropriate modifications made to allow its use (voltage testing, JST connector changing, etc) was only then followed by developing a case once all the substeps were completed.

In short, the project plans created suffered a little from being overly ambitious in how many tasks one person can work on at once, and would have benefitted from parcelling tasks out in an explicitly consecutive manner. The planning was overall reasonable and not excessive. The delay buffer provided in particular was helpful for picking up slack, however the large allotment to it suggests a difficulty in accurately timing tasks. The difficulty here may come down to planning for the project in a isolated manner - in other words, as if the project was being carried out in a vacuum and no other tasks or studies were required to be completed at the same time. Again, this comes to the limits of what an individual can complete when not able to solely focus on the project alone.

Overall, the plan was still reasonably well thought out, and was followed without major deviation.

4 Feasibility and impact

Comparing to the project feasibility study performed prior to the commencement of this project, many of the identified points hold true. The risk register identified health and safety, manufacturing issues, and delays as the most significant project risks. In the case of delays, this was referring to failing to adhere to the project plan, rather than delivery delays as referred to here. However, it ultimately means the project plan could not be followed, so the end result is much the same.

Health and safety was relevant for testing, due to the nature of electronics. Risk assessments were performed before any tests, and overall no issues occurred. Manufacturing issues also occurred, but were minimal and easily corrected for.

A major missed expectation of the PFS was live-testing of the tracker with a cat. The subject of ethical approval for this to be the case was briefly broached, however the conclusion was that far greater detail would be needed in the application, and ultimately it was not carried through in order to save time and complete more critical aspects of the project.

5 Evaluation

The three greatest learning experiences of the project are:

- Account for hardware delays such that issues with delivery cannot hold the entire project development hostage.
- Documentation writing is time-consuming and must be specifically accounted for when creating a development plan.
- Planning cannot be insular, in that other tasks not relevant to the project, but still time consuming, must be accounted for. If they are not, the impression that the plan is poorly thought out or the project went of track may result.