

# LC - Independent Project Proposal

*by* Louise Caygill

---

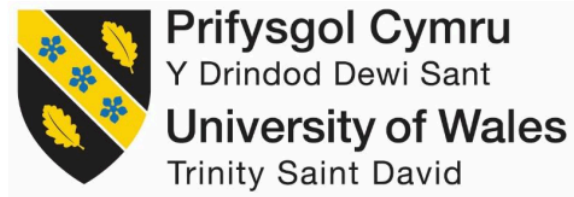
**Submission date:** 23-Oct-2024 02:24PM (UTC+0100)

**Submission ID:** 240884959

**File name:** 32133\_Louise\_Caygill\_LC\_-\_Independent\_Project\_Proposal\_596981\_276610344.docx (553.11K)

**Word count:** 1387

**Character count:** 7816



# **Designing and Building a Tuneable Comb Jammer**

by  
Louise Caygill

Supervisor: NAME HERE

Project submitted as part of the requirements for  
the award of

*BEng (Hons) Embedded Electronic Systems*

October 2024

## Contents

|                              |    |
|------------------------------|----|
| Table of Figures .....       | 2  |
| Project Information .....    | 3  |
| Background Information ..... | 4  |
| Aim .....                    | 5  |
| Objectives .....             | 5  |
| Resources: .....             | 6  |
| Plan: .....                  | 7  |
| Ethics/Morality .....        | 8  |
| References: .....            | 9  |
| Appendix 1 .....             | 10 |

Table of Figures

Figure 1: Project Gantt Chart ..... 7

## Project Information

Proposed Title:

Designing and Building a 30MHz to 600MHz Tunable Comb Jammer

Student Details:

Name: Louise Caygill

Student Number: 2110765

email: 2110765@student.uwtsd.ac.uk

Proposed Supervisor:

Steve Mosey

Start Date:

October 2024

End Date:

May 2025

Deliverables:

- Final Report
- Prototype comb jammer transmitter
- Poster

## Background Information

Trusted communication channels are essential for logistics, personnel movements, and general information transfer. Denial of or interference with these communication channels can result in widespread disruption and misinformation, resulting in the loss of resources and time. Both highly valuable assets.

In Electronic Warfare (EW) it may be pertinent to deny these communication channels through the use of a jammer. A device that generates and transmits interference specifically targeting pre-determined frequencies or frequency ranges [1]. The three most common types of noise generation jammers are spot, sweeping, and barrage jammers. A spot jammer targets a single frequency and concentrates all its power on it, thus making it ineffective against frequency hopping or agile networks. A swept jammer can sweep through multiple frequencies in quick succession, making it more useful against frequency hopping targets. Finally, a barrage jammer will jam multiple frequencies at once, meaning that is not able to be as powerful as a spot or swept jammer due to it spreading its power over these frequencies [2]. A subset of barrage jammer is known as a comb jammer. This type of jammer functions in much the same way as a barrage jammer but consumes less power [3] as it targets multiple frequency points over a given band, rather than the entire frequency range.

Additionally, there are three main types of operation, these are [4], [5]:

- constant
  - once the system is turned on it constantly transmits interference over the selected frequency
- reactive
  - the system is dormant until a target signal is detected, upon which the system will begin to transmit interference to deny the communication channel
- proactive
  - the system sends interference on channels whether there is communication or signals on the channel or not, over multiple nodes

Communication radios may function over a wide range of frequencies and channels, which can make them difficult to deny without a tuneable system. Some radio handsets are capable of Frequency Hopping (FHSS), where the carrier is rapidly switched between different frequency channels [6]. This hopping reduces the likelihood of interference and may be used as a counter jamming technique, as the carrier switches channel from the one targeted by the jammer in rapid order, moving itself away from the noise and interference. In this instance a comb jammer may be used as an effective jamming technique [7], targeting multiple frequency points at once over the FHSS range of the target device.

## Aim

This project aims to research, design, develop, build, test and evaluate a comb jammer with modifiable target signals, to improve the understanding and implications of communication channel denial over the 30MHz to 600MHz frequency range. It was decided to undertake this project to produce a portable system that may be taken on trials to assist in the analysing and quantifying of target signals and systems. As it is intended for use on trials, it was decided to create a constant jammer instead of a reactive or proactive as it is not intended to be the system under test, meaning it is more important to know when transmitting, rather than reacting. This comb jammer would need to be tuneable over the stated range so that it may be targeted towards different signals.

## Objectives

The main objective of the project is to research, design, and build a transmitter. This will be *ab initio* (no use of existing systems such as software defined radios (SDR)) and will result in a completely bespoke system. It will be achieved by following the timeline specified in the project Gantt chart (Figure 1 in section 5), where multiple tasks will coincide with one another to save time and ensure that there is no downtime in the project waiting for components or the completion of other dependencies. The objective may be broken down into the following stages and tasks:

1. Research and planning
  - a. Literature review
  - b. Research into existing systems and types of jammers
  - c. Budget creation and approval
  - d. Planning of system design, such as application specification
2. Design
  - a. Designing of Radio Frequency (RF) chain and hardware
  - b. Design of circuit boards – power, RF
  - c. Component and enclosure specification
  - d. Transmitter design
3. Prototype development
  - a. Populate circuit boards
  - b. Build transmitter
  - c. Build RF chain
4. Testing
  - a. Apply for applicable licenses
  - b. Test transmitter over wire
  - c. Integrate into system
  - d. Test system over air
5. Evaluation
  - a. Evaluate and analyze results, identify areas for improvement

## Resources:

The following resources will be used for the project:

- C programming language
- Signal generators
- Spectrum analysers
- Oscilloscope
- Dstl Subject Matter Experts (SMEs)
- KiCad v6.0/v7.0
- Proteus
- CCS
- Microprocessor programming software (Specific microprocessor is as yet undecided)
- Corporate laptop and IT
- Corporate memory sticks
- Lab space
- Soldering iron and extraction

## Plan:

The project may be broken down into 5 stages as previously stated:

1. Stage 1: research and planning stage
  - a. This stage includes research into jammers and existing systems, as well as collating information on the best method, creating a budget and gaining funding.
  - b. It is estimated to take approximately one month to complete
2. Stage 2: Design and development:
  - a. This stage will include the development of the system and initial tests on breadboard and simulation software
  - b. This stage may take up to two months to complete
3. Stage 3: Prototype development:
  - a. This stage will take the lessons learned from the previous stage and collate them into a singular prototype
  - b. This stage may take up to a month to complete
4. Stage 4: Testing:
  - a. This stage will see in depth testing of the prototype against its target signals
  - b. It will take approximately 2 weeks to a month to complete
5. Stage 5: Evaluation and Analysis:
  - a. This final stage will see the results from the testing and prototype stage analysed and any areas for future improvement identified. It also includes finalising the report for the project.
  - b. This stage will take approximately 2 weeks to complete the analysis and a further 2 weeks for finalising the report

Below in Figure 1 is the proposed project Gantt Chart, a larger image may be found in Appendix 1.

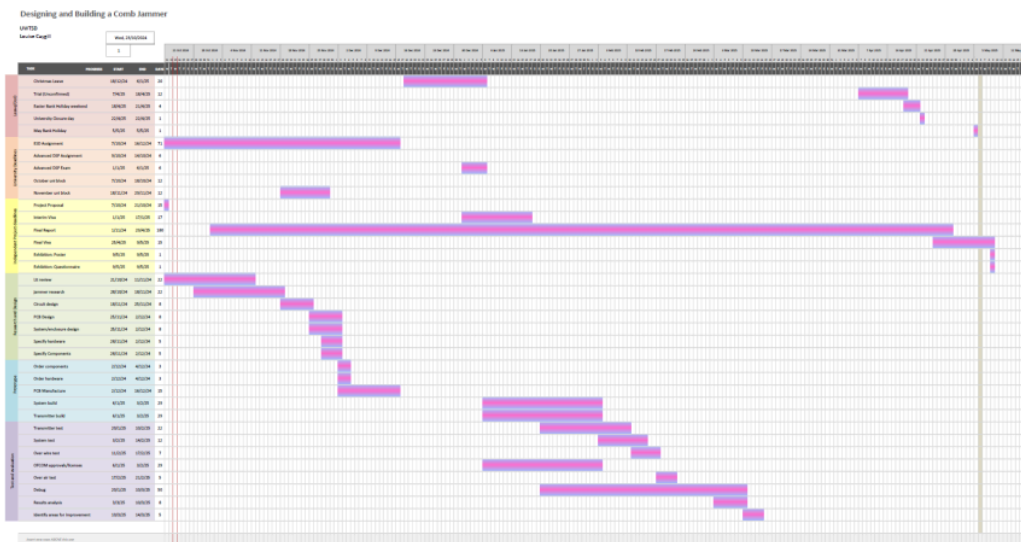


Figure 1: Project Gantt Chart

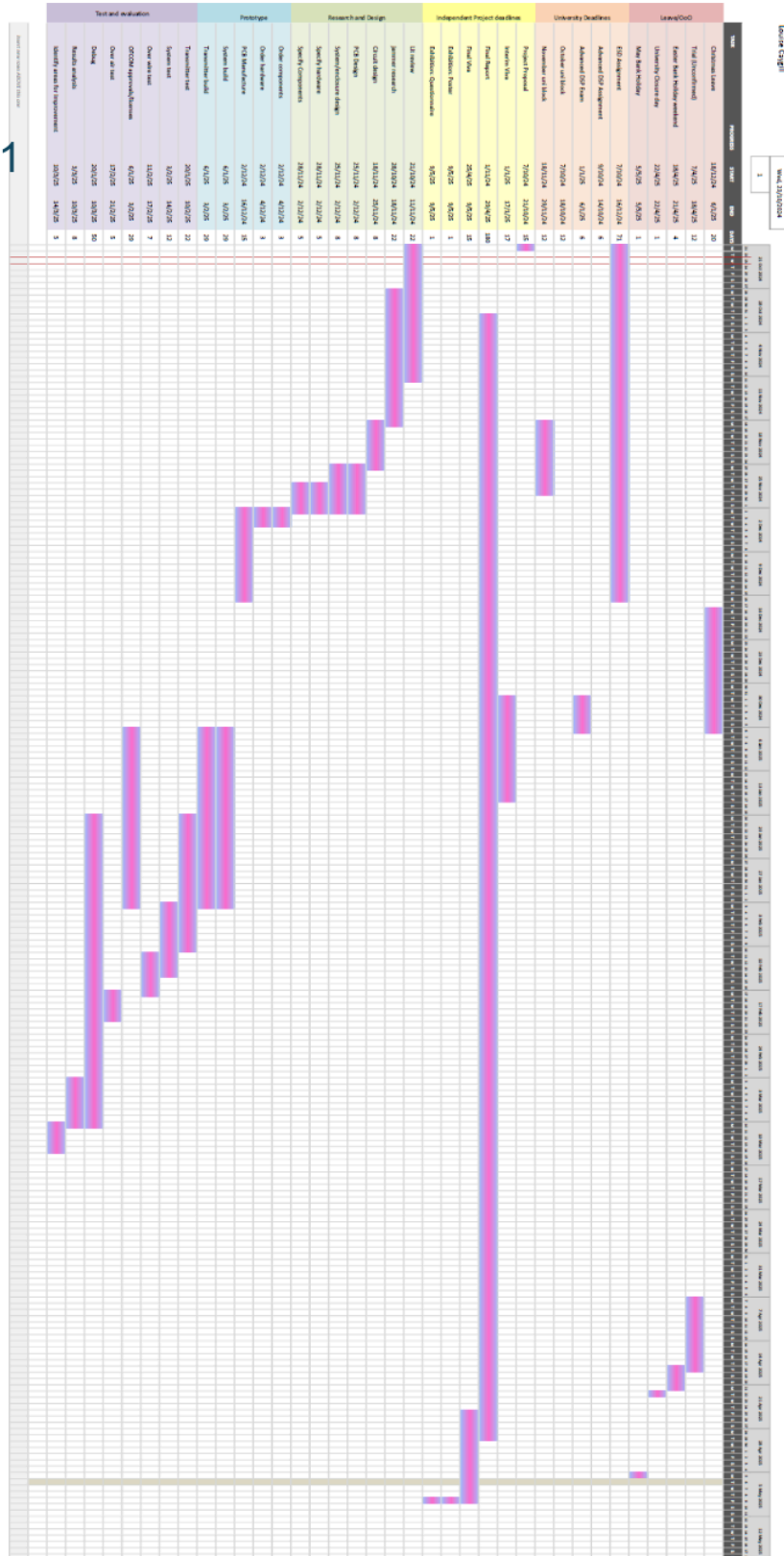
## Ethics/Morality

It is essential to maintain that the jammer is used in accordance with any and all rules and regulations as well as legal restrictions relating to the use of jamming equipment and will only be used in controlled environments where it will not disrupt or deny rightful communication channels. A completed ethics form is submitted alongside this document.

## References:

- [1] Tangreat. *The Basics of Radio Frequency (RF) Jammers* [Online]. Available: <http://www.tangreat.com/en/news-detail-27.html>
- [2] JEM Engineering. (Sep 2019). *An Introduction to Jammers and Jamming Techniques* [Online]. Available: <https://jemengineering.com/blog-an-introduction-to-jammers/>
- [3] J. Radivojevic, M. Mileusnic, A. Lebl and V. Marinkovic-Nedelicki. "Comb Jamming as A Strategy For RCIED Activation Prevention". *Facta Universitatis - Series: Electronics and Energetics Facta Universitatis - Series: Electronics and Energetics* 3535pp. 405–420. pp. 405–420. Sep 2022.
- [4] A. Ali, M. Baddeley, L. Bariah, M. Andreoni, W. T. Lunardi, J. Giacalone and S. Muhaidat. "JamRF: Performance Analysis, Evaluation, and Implementation of RF Jamming Over Wi-Fi" [Online]. June 2022. Available: [https://www.researchgate.net/publication/363006038\\_JamRF\\_Performance\\_Analysis\\_Evaluation\\_and\\_Implementation\\_of\\_RF\\_Jamming\\_over\\_Wi-Fi](https://www.researchgate.net/publication/363006038_JamRF_Performance_Analysis_Evaluation_and_Implementation_of_RF_Jamming_over_Wi-Fi)
- [5] Chopra, R. Kumar Jha and S. Jain. "A Survey on Ultra-Dense Network and Emerging Technologies: Security Challenges and Possible Solutions," *Journal of Network and Computer Applications*, vol. 9595, pp. 54–78. pp. 54–78. 2017. DOI: 10.1016/j.jnca.2017.07.007.
- [6] Rohde & Schwarz. *Technology Fundamentals of Hopper Signals* [Online]. Available: [https://www.rohde-schwarz.com/us/knowledge-center/technology-fundamentals/hopper-signals/hopper-signals\\_256050.html](https://www.rohde-schwarz.com/us/knowledge-center/technology-fundamentals/hopper-signals/hopper-signals_256050.html)
- [7] Y. Zhang, Z. Yun, J. Zheng and F. Sun, "Comb Jamming Mitigation in Frequency Hopping Spread Spectrum Communications Via Aid Block Sparse Bayesian Learning," *2021 14th International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI)*, Shanghai, China, 2021, pp. 1-6, doi: 10.1109/CISP-BMEI53629.2021.9624412.

Designing and Building a Comb Hammer  
UWTD  
Don't Forget!



# LC - Independent Project Proposal

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

71 /100

|                                                                                                                                                                                                                                                                                                                                                      |                                |                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------|
| Module Code/ Module Name                                                                                                                                                                                                                                                                                                                             | ACCA6020 / INDEPENDENT PROJECT |                       |
| Student Name                                                                                                                                                                                                                                                                                                                                         | Louise Caygill                 |                       |
| Student Number                                                                                                                                                                                                                                                                                                                                       | 2110765                        |                       |
| PROJECT PROPOSAL FEEDBACK                                                                                                                                                                                                                                                                                                                            |                                |                       |
| <b>Introduction / A&amp;O:</b><br><br>Project title; Identification of a specific problem to be investigated; Well-defined aims and SMART objectives; Explaining why this project is worth doing; Discussion of what the project needs to do in order to be a success; Description any deliverables that will be produced at the end of the project. | <b>Max. Marks</b>              | <b>Marks Obtained</b> |
| Good project title. The aims of the project is well-defined and the rationale is clear and provides a valid justification for the work.<br><br>It would have been better with a SMART Objective, as few components are missing.                                                                                                                      | <b>20</b>                      | 14                    |
| <b>Background to the Project / Literature Review:</b>                                                                                                                                                                                                                                                                                                | <b>20</b>                      | 15                    |

|                                                                                                                                                                                                                                                                                                                                                                                                                             |    |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| <p>Description of how the work to be done by in the project relates to the work identified in the literature review; Discussion of any ethical issues raised by the project Identifying what has already been done within the field; Topic familiarity; Brief literature review using appropriate sources – 6-8 journal papers and book chapters rather than just websites; Selection of relevant models &amp; concepts</p> |    |    |
| <p>The background demonstrates a strong understanding of the problem. Use of more peer reviewed research article would have strengthen the document. The connection between previous work and the project could be made more explicit to emphasise the research gap being addressed.</p>                                                                                                                                    |    |    |
| <p><b>Project Design:</b></p> <p>Clear statement of which development methods are to be used and why they are appropriate;<br/> Clear statement of which tools are to be used and why they are appropriate;<br/> Clear description of how data collected will be analysed.</p>                                                                                                                                              | 30 | 20 |

|                                                                                                                                                                                                                                                                                   |    |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| <p>The development methods and tools are described well. However, the methods could be further detailed by explicitly stating how these tools will contribute to achieving each project objective. It would have been better to include a proper specification of components.</p> |    |    |
| <p><b>Resources / Planning:</b></p> <p>List of any deliverables;<br/>Clear diagram showing both timing and resource use;<br/>Completed ethics form;<br/>Limited and relevant appendices.</p>                                                                                      | 15 | 11 |
| <p>Good clear Gantt chart showing each tasks to be completed. Ethics form completed. It would have been better with clear listing of deliverables.</p>                                                                                                                            |    |    |
| <p><b>Document Presentation:</b></p> <p>Correct spelling, grammar and punctuation; Flow of narrative/fluency; Coherence; Word processed ; Correct use of referencing with bibliography; Strict word limit</p>                                                                     | 15 | 11 |
| <p>The document is well structured and well-presented with good spelling, grammar, and flow.</p>                                                                                                                                                                                  |    |    |

|                                                                                                          |            |    |
|----------------------------------------------------------------------------------------------------------|------------|----|
| It would have been better with equivalent word count and numbering the headings for better organisation. |            |    |
| <b>TOTAL</b>                                                                                             | <b>100</b> | 71 |

|         |
|---------|
| PAGE 1  |
| PAGE 2  |
| PAGE 3  |
| PAGE 4  |
| PAGE 5  |
| PAGE 6  |
| PAGE 7  |
| PAGE 8  |
| PAGE 9  |
| PAGE 10 |
| PAGE 11 |