

Gareth Davieds - Project Proposal

by Gareth Davies

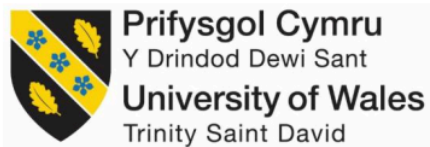
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Project Proposal

Design and Implementation of a Contactless Digital Tachometer

by

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Requested Supervisor: Stephen Mosey

Project submitted as part of the requirements for
the award of

*BEng (Hons) Electrical and Electronics
Engineering*

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Abstract

This project proposes the design and implementation of a contactless digital tachometer utilising a microcontroller, aimed at enhancing measurement accuracy while prioritising health and safety in industrial applications. Traditional contact tachometers, which require physical interaction with rotating machinery, pose significant risks to operators and can lead to equipment wear and inaccuracies. In contrast, the proposed contactless tachometer employs measurement techniques, such as optical or magnetic sensors, to eliminate the need for direct contact, thereby reducing the potential for accidents and equipment damage.

The project encompasses a comprehensive approach, including research and analysis of existing technologies, selection of appropriate components, circuit design, firmware development, and prototype testing. The resulting device will feature an intuitive user interface for real-time revolutions per minute (RPM) display. Rigorous testing and calibration will be conducted to ensure the accuracy and reliability of measurements.

By integrating contactless technology with a focus on safety, this project aims to deliver a robust and efficient solution for rotational speed measurement, ultimately contributing to safer working environments and improved operational efficiency.

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1.0 Introduction

In various industrial applications, accurate measurement of rotational speed is critical for ensuring optimal performance and safety of machinery. Traditional contact tachometers, which rely on physical contact with the rotating object, can pose significant health and safety risks. These devices often require direct interaction with moving parts, increasing the likelihood of accidents, injuries, and equipment damage. Additionally, contact methods can lead to wear on both the tachometer and the machinery being measured, resulting in maintenance challenges and potential inaccuracies over time.

In contrast, contactless tachometers offer a safer and more efficient alternative. By utilising measurement techniques, such as optical or magnetic sensors, contactless tachometers eliminate the need for physical contact, thereby reducing the risk of injury to operators. This technology not only enhances workplace safety but also improves measurement accuracy and reliability, as it is less susceptible to the mechanical wear over time.

This project aims to design and implement a contactless digital tachometer using a microcontroller, leveraging the advantages of contactless technology to provide a safer, more efficient solution for measuring rotational speed. By focusing on health and safety benefits, this project seeks to contribute to a safer working environment while delivering precise and reliable performance in various applications.

2.0 Aim and Objectives

2.1. Project Aim:

The primary aim of this project is to design and implement a contactless digital tachometer using a microcontroller that accurately measures rotational speed while enhancing health and safety in industrial environments.

2.2. Project Objectives:

Research and Analysis:

Conduct a thorough literature review of existing tachometer technologies using Google Scholar and the UWTSD library. Emphasis shall be placed on information regarding contactless measurement techniques and identifying industry best practices.

Define Specifications:

Establish clear technical specifications for the digital tachometer, including measurement range, accuracy, response time, and display requirements.

Select Components:

Choose an appropriate microcontroller and electronic components that meet the project specifications, ensuring compatibility and reliability. The Product Selection Tool [1] by Microchip shall be used for microcontroller selection.

Design Circuitry:

Create a schematic diagram for the tachometer circuit, integrating the microcontroller, sensors, and display components. Proteus [2] and Easy PC [3] software will be used to simulate the circuits for both the prototype and PCB designs.

Develop Software:

Write and test the program c-script for the microcontroller using CCS C Compiler [4] software that will process sensor data, calculate RPM, and manage user interface elements.

Prototype Development:

Build a prototype of the contactless digital tachometer, incorporating all hardware and software components. The initial prototype shall be built using the chosen electronic components on a bread board set-up for proof of concept.

Testing and Calibration:

Conduct rigorous testing of the prototype to ensure accuracy and reliability, followed by calibration to fine-tune measurements. For this, a small motor with a variable speed drive shall be used along with a calibrated market brand tachometer, ensuring accuracy of prototype readings.

PCB Design and Testing:

A PCB shall be designed using Easy-PC software in order to reduce the products overall size and allow for easier integration into some form of protective casing. The PCB shall be purchased, made to specification through JLC-PCB [5].

Tachometer Evaluation:

The final tachometer design shall be placed into an extended testing period at ERIKS Cardiff motor repair workshop. Throughout this time, data shall be gathered and compared to known calibrated results. The tachometers performance shall then be evaluated to determine design accuracy, sustainability, and areas in which it can be improved through future work.

3.0 Resource Requirements

To complete the outlined objectives, four groups of resources shall be used:

3.1. Human Resources:

For guidance and technical assistance throughout this project, a university supervisor shall be provided. Due to the electronic and software requirements of this project, a request shall be made for Stephen Mosey to oversee this position.

Throughout the testing phase of this project, test engineers at ERIKS Cardiff shall be used to record operational speeds of overhauled motors for analysis using both the project tachometer and traditional methods. All ERIKS engineers utilised will be made fully aware of the project's objectives and will be provided anonymity during documentation.

3.2. Material Resources:

Electronic Components:

Chosen electronic components for this project shall be purchased via suppliers such as Mouser [6] or Farnell [7]. Generic components such as resistors and capacitors may be available within the UWTSD electronic labs. This will include many of the prototyping materials such as bread board and copper wire.

Testing Equipment:

During prototype testing a multimeter, oscilloscope and calibrated tachometer will be required. Both the multimeter and oscilloscope can be found in the university electronics labs, whilst the calibrated tachometer shall be acquired via ERIKS.

3.3. Software Resources:

Project Task	Required Software
Circuit Simulation	Proteus [2]
PCB Design	Easy PC [3]
Software Development	CCS [4]
Software Upload	MPLAB X IDE [8]
Project Documentation	Microsoft Office [9]

Table 1 - Software Resources

3.4. Financial Resources:

Whilst not yet determined, a project budget will be set during the research and planning processes of this design. This budget will be allocated for the purchasing of all project items such as software licences, electrical components and additional items associated with the documentation and presentation of the final product.

4.0 Project Impact

The design and implementation of a contactless digital tachometer will have several environmental impacts, both positive and negative. Understanding these impacts is crucial for ensuring product sustainability and to mitigate negative effects of production.

4.1. Positive Environmental Impacts

Reduction of Workplace Hazards:

A contactless tachometer will enhance safety in industrial environments by eliminating the operator's exposure to rotating machinery. This reduction in workplace hazards will lead to fewer accidents, reportable incidences, and injuries, directly contributing to a healthier workforce.

Minimised Equipment Wear:

As contactless tachometers do not require physical contact with rotating machinery, they are less susceptible to operational wear and tear. This should ensure that the designed tachometer is sustainable, and maintains accuracy over an extended period.

Encouragement of Sustainable Practices:

The project can be used to promote the adoption of advanced and sustainable technologies in industries. By demonstrating the benefits of contactless measurement, it is the hope that this project may inspire further innovations that prioritise safety and environmental considerations.

4.2. Negative Environmental Impacts and Mitigation Strategies:

Electronic Waste (E-Waste):

The production and eventual disposal of the electronic components used in the tachometer can contribute to e-waste. Some components such as batteries, contain toxic substances that if not disposed of correctly, can have negative environmental impacts.

A plan or incentive that encourages the safe disposal and recycling of these materials will have to be considered for this project.

Energy and Chemical use During Production:

The production of electronic components requires the use of chemicals and energy. Similarly to e-waste, chemicals used during production can have serious environmental impacts if not used, and disposed of correctly. Energy required for these processes is typically generated through the use for raw materials such as coal or gas. These methods of energy generation can produce a significant amount of environmental pollution which can lead to poor air quality, soil contamination and a depletion of natural resources.

To mitigate these risks, research into the sustainability practices of suppliers should be conducted. These practices can be tracked through the Global Resources Initiative [10] which is an internationally recognised framework that discloses environmental sustainability of businesses. Environmentally sustainable companies may also be awarded an international standard certificate, ISO 14001 [11], which states that they are operating within environmental regulations.

Transportation Emissions:

The transportation of components and materials for a project can contribute to carbon emissions. Depending on the method of transportation used and distance of travel, these carbon emissions can vary dramatically.

Where possible, this project will look to utilise local suppliers for materials that source their products from within the United Kingdom.

5.0 Project Gantt Chart

Project Gantt Chart

Design and Implementation of a Digital Stopwatch

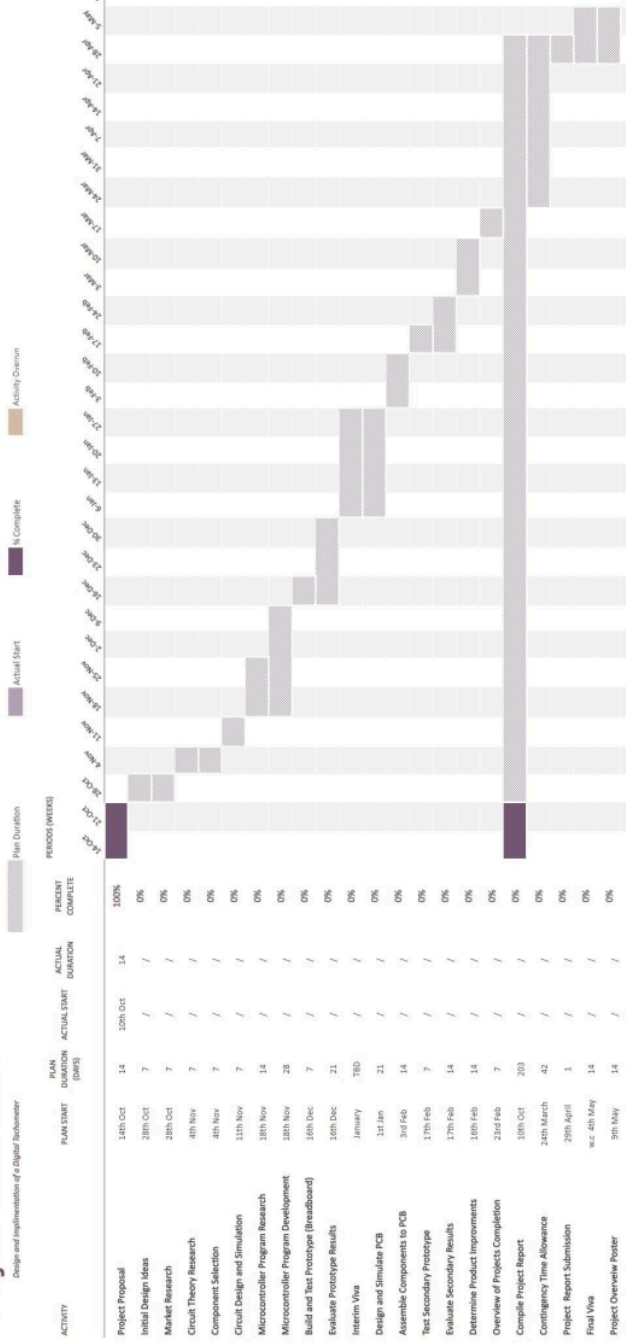


Figure 1 - Project Gantt Chart

6.0 Conclusion

In summary, the proposed project to design and implement a contactless digital tachometer is poised to make a meaningful impact in the field of rotational speed measurement.

By harnessing contactless technologies, this project aims to enhance safety, accuracy, and efficiency in industrial environments, addressing the risks associated with traditional contact-based tachometers.

The structured approach outlined in this proposal encompasses thorough research, precise specification development, careful component selection, and robust software design. An extended testing period will be conducted through a market leading motor repair workshop. Throughout this project, a strong emphasis will be placed on the sustainability of production, as well as the accuracy and safety of the final tachometer.

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Commented [GD1]:

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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

72/100

Intro / A&O (400 words)		
The report effectively highlights challenges, such as the need for physical interaction with rotating machinery, which poses significant risks to operators.	20	17
The aims and objectives are clearly defined and articulated.		
Clearly outlines risks and objectives; concise and effective.		
Background to the Project / Literature Review (400 words)		
It is commendable that the report includes a variety of references. However, there is a need to review more journal papers and incorporate a detailed analysis of	20	12

technical aspects. Including a dedicated section titled "Literature Review" would enhance the structure and allow for a more detailed discussion. Good references, but deeper technical analysis needed.		
Project Design (500 words)		
The design section could be improved by incorporating a design flowchart, which would provide a clear visual representation of the process. Additionally, more emphasis on design methodologies is needed, as the report currently focuses primarily on the technical aspects outlined in the objectives. Needs flowchart and stronger focus on methodologies.	30	20
Resources / Planning (200 words)		
The report clearly mentions key resources, including human, material, software, and financial aspects. The submission of the ethics form is noted, and tasks along with their deadlines are well-presented in the Gantt chart. It is also appreciable that the report covers positive and negative risks along with mitigation strategies. Ethics form submitted.	15	14

Detailed resource planning with clear risk strategies		
Document Presentation		
The document is well-organized and flows logically, with minimal errors. However, some sections, such as the "Literature Review, project design" are missing and should be added for completeness. Well-organized document, but missing key sections.	15	9
TOTAL	100	72

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