

Independant project proposal

Robbie Herbert

by Robbie Herbert

Submission date: 20-Oct-2025 10:14AM (UTC+0100)

Submission ID: 265716872

File name: 57713_Robbie_Herbert_Independant_project_proposal_Robbie_Herbert_689853_537317053.docx
(353.33K)

Word count: 2244

Character count: 11901



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Independent Project ACCA6020

Independent project proposal

Design and implementation of a test Assembly for monitoring an occupancy sensor during cyclic and vibration testing using a PIC.

By

Robbie Herbert

2405914

Submission Date: 20th October 2025

1	Contents	
2	List of Tables.....	2
3	List of figures.....	2
4	Acronyms, Abbreviations and Units.....	3
5	Introduction.....	4
6	Literature Review/Background	5
7	Project Design	6
7.1.	Risk management	8
7.2.	Ethics.....	9
8	Resources	9
8.1.	Deliverables	9
8.2.	Resources/tools	9
9	Planning.....	10
10	References.....	11

2	List of Tables	
	Table 1 Abbreviations, Acronyms and Units table.....	3
3	List of figures	
	Figure 1 Risk Management Table.....	8
	Figure 2 Gantt Chart.....	10

4 Acronyms, Abbreviations and Units

Hz	Hertz
MS	Microsoft
PIC	Programmable Interface Controller
A	Ampere
SK	Sketch
I/O	Input/Output
RTCA	Radio Technical Commission for Aeronautics
FAA	Federal Aviation Agency

Table 1 Abbreviations, Acronyms and Units table

The working title of this project will be Design and implementation of a test Assembly for monitoring an occupancy sensor during cyclic and vibration testing using a PIC.

Within aerospace and the seats sector of the industry, there is emerging and new technologies constantly. One of the newer technologies is a seat occupancy sensor which will be used for the safety of passengers on an aircraft and for crew knowledge. This project aims to create a way to collect data for testing to ensure the sensor will work within its guaranteed period which is undetermined due to being built in house whilst working in a dusty environment.

The aim of this project is to design and implement a solution for ease of testing/fault finding for an occupancy sensor in production or in service and for qualification.

The objectives of this project are to:

- Analyse the existing test methods for similar sensors to gain information.
- Design a prototype of the test assembly with use of software and hardware.
- Implement a fully built test assembly and test the occupancy sensor.
- To evaluate the performance of the test assembly to allow the assembly to qualify the sensor.

This project holds significance due to the aerospace industry being relatively behind in technology in comparison to other industries such as automotive. Implementing new technologies and engineering ways to test the technology. The project is also very important due to the safety features and convenience that is added because of the seat occupancy sensor. The test assembly will help to qualify the occupancy sensor to be safe for flight with compliance to Boeing, RTCA, FAA and SAFRAN standards and regulations.

To make this project a success, there needs to be risk management, to identify evaluate and minimise any of the potential issues/risks that may pop up during the project. A budget will be created so there will have to be cost saving techniques implemented throughout the project. Communication will also help to make this project a success; this will be communication between many parties including SAFRANs electrical certification engineers to ensure the project is in line with the requirements of the tests. At the end of the project there will be a deliverable which will be the test assembly. The test assembly will include a

harness and a circuit made from electronics within an enclosure, to be able to gather data for the testing.

6 Literature Review/Background

The purpose of this literature review is to thematically justify the purpose of this project.

Through the years there has been many innovations within electronics, one of the main innovations is from the integrated circuit which bases itself on switching signals and amplification[3]. Chae et al. [3] shows that IC usage and technologies have improved throughout the years and will continue to improve for efficiency and data monitoring, the importance of this source is showing the advancements over the years, in this document however there is a gap for testing and aerospace equipment within the paper.

Katalin. [11] shows use case for components to be used in conjunction with a microcontroller to test vibration, this helps design choices for the project which will be carried out. This source as well as Baicu [12], show that vibration analysis is viable, however neither are aerospace-based projects for vibration testing, however the concept is there to create a project to test these things.

Jaber et al. [13] shows that machine monitoring during vibration helps to find issues early on to monitor joints within machinery, the system created helped identify joint problems within the robot, this differs as the occupancy sensor does not have any moving parts, but the concept is similar. The vibration sensor should monitor the occupancy sensor to find early faults within a high frequency vibration range.

Another source [14] shows some of the methods used for testing occupancy sensors, within the source the occupancy sensor has specific tests for detection footprint and pattern, however there is no test method for vibration or cyclic testing. This paper however still misses out on the two tests methods that an assembly will be created to monitor the results.

The final source [15], which is similar to what is wanted in this project with the graphs shows the time that a seat occupancy sensor is activated for, the positive shows the seat is occupied and negative showing unoccupied at different intervals, the sensors however are all different with the same singular test. Labeodan et al [15], shows that energy performance is also

improved through occupancy driven control, which the seat will have if the project can continue and the sensor will be able to be qualified.

Whilst looking at the literature, the monitoring of a sensor during cyclic and vibration testing is lacking in literature which shows there is a gap for this project to continue forward. The design element is not yet defined, so it may change from what is proposed in the project design.

7 Project Design

There are many development methods that can be used. This project will be based on a deductive approach using agile methodology to make sure the project is a success, the reason why the agile approach is appropriate is because of the steps involved being in line with the project. The theory behind the proposal has come about due to there being questions on how to monitor the sensor during its qualification testing. Using software development and an experiment to create the project. These are both appropriate tools, the PIC will need software developed for it to monitor the sensor during its test. The experiments are also justified to make sure that the concept is there to continue with implementing and developing the correct prototype once the experiments are complete.

Data collected will be a collation of two separate tests both of which are quantitative data, the first set of data will be the cyclic test data to see how many times the occupancy sensor can be activated before failing making sure that the test assembly is accurate. The second test will be monitoring the sensor through the vibration test, if the sensor is activated during the vibration test, the assembly should be able to pick up the frequency that the sensor was activated at. The architecture is not yet set in stone however it will include a sensor for vibration, either LEDs for activation indication or an LCD for indication, this may end up being both, one as a visible aid to know when the sensor is indicated and the LCD to show the count and frequency of which the sensor is activated.

Due to the project being work-based, the project has been given a budget of £2000, this will be parts, development and labour included.

This project could impact society positively. Improvements on efficiency and job effectiveness due to the ease of use for the test assembly, the assembly will also positively affect safety on an aircraft due to proving as a knock-on effect.

This project could impact the environment both positively and negatively depending on how the project is created. If created poorly without proper consideration for components and design intent then the environment will be affected by pollution due to waste of components especially if components are not made to regulation. However, if the project is made correctly, the project will be reuseable, through other uses such as upcoming projects with similar sensors that will need to be qualified through similarity.

Below a figure can be seen of some initial risks and how they will affect the project if they are not mitigated and how they will be mitigated.

7.1. Risk management

#	Failure Mode	CAUSE of Failure	LIKELIHOOD	EFFECT of Failure	IMPACT	RISK SCORE	ACTION ITEMS Recommended Actions
1	Code inoperable	poorly written code	2	assembly will not function or function properly	5	10	use sources to create a code which will work correctly and test to ensure code stability
2	harness damage	poor delivery/user error	2	time loss and assembly will not work	5	10	make sure harness is transported/made correctly.
3	lack of parts	slow delivery/lack of delivery	2	lack of ability to complete project on time	4	8	source components when scope of project is complete.
4	testing incomplete	test company unable to complete testing	2	will not be able to qualify the sensor for flight	5	10	find other companies to continue with test or in house test.
5	over budget	poor design choices	4	loss of money possibility of not being able to do similar projects	1	4	make sure to track money spent
6	faulty monitoring components	Faulty wiring or water or dust ingress	3	loss of ability to output correct values	2	6	test all components to ensure they work.
7	interference (EMI)	poorly designed electrical/electronic system	2	poor results	3	6	design the system correctly and find a suitable enclosure
8	reputation impact	poorly managed project lack of commitment	1	customers may not want to continue to work	5	5	make sure the project is managed properly with trackers.
9	unhappy customer	late or lacking in specific components required	2	new customers will not approach	5	10	make sure to keep in contact with customer to ensure they are free from disturbance
10	scope creep	lack of communication between customer and engineer	4	project becomes too much to complete within the timeframe causing incomplete work by the deadline	4	16	keep in contact with customer to make sure what is designed is what is wanted/needed
11	negative economic growth	financial instability	1	project may be cancelled due to concerns of money.	5	5	monitor cash flow and if possible keep reserve.
12	late design changes	new regulations	3	changes to portions or entire design	5	15	regular updates and monitoring to design if there are changes in regulations
13	obsolescence	innovation completed before this project	2	project cannot continue	5	10	monitor the emerging technologies for monitoring
14	infrastructure failures	natural disasters	1	project is likely to be stopped	5	5	ensure locations for test and development can continue anywhere
15	environmental issues	not designing/creating the assembly with the sustainability of the product in mind	2	pollution and fines	5	10	make sure components are sourced with sustainability in mind.
16	discrimination	unfair treatment of members on the project	1	turnover of staff, loss of reputation, loss of skilled persons	5	5	clear policies, training for staff, pay equality.
17	exploitation	poor wages and hours worked.	1	turnover of staff, loss of reputation, loss of skilled persons	5	5	adhere to laws and standards and regular inspections.

Figure 1 Risk Management Table

7.2. Ethics

Including making sure the test assembly is created ethically, all components needed and work that is completed for the assembly will be done/sourced ethically and include people of all skillsets where needed to complete the project to bring inclusion and diversity into the project. The product created will be made to help with certifying a sensor for an aircraft which in turn helps with public safety and efficiency of crew and be made with help of up-to-date sources [6]. An ethics form will also be made to ensure the project is made safely and correctly.

8 Resources

8.1. Deliverables

- Proteus design
- CATIA Design/s
- Breadboard prototype
- Test assembly

8.2. Resources/tools

Tools to be used throughout the project will be, CATIA V5, MS VISIO, Proteus, PCW/CCS C Compiler. These tools will need to be used as the CATIA V5 model will help to show the prototype and the fully implemented system as a 3D representation for ease of test set up.

The MS VISIO will include a Bill of materials, notes which will state requirements an assembly drawing of the test set up, the test box diagram and finally the in-house harness assembly, with wiring diagram and tolerances.

Proteus and PCW/CCS will be used together to prototype the test set up so that the PIC code (C+) works when moving on to the prototype assembly and the full-service assembly.

Google scholar, Semantic scholar and IEEEExplore will also be of use within the project to include and improve the literature review which will be completed throughout the course of the project. Access should be gained through institutional sign in through the university.

Seat Occupancy Sensor Test Assembly

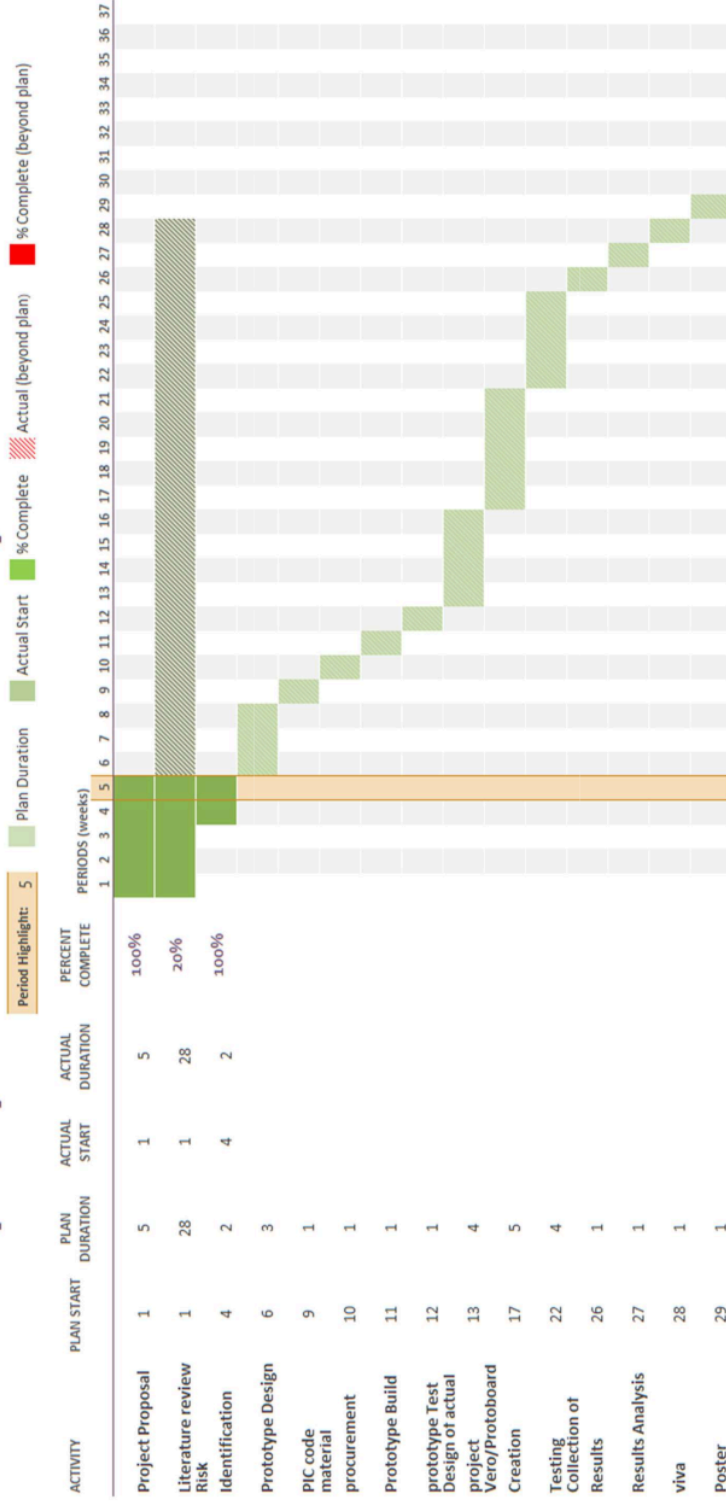


Figure 2 Gantt Chart

- [1] M. R. Ezilarasan, M.-F. Leung, and X. Dai, "Design and implementation of telemedicine system using light fidelity and PIC16F877A microcontroller," *2024 14th International Conference on Information Science and Technology (ICIST)*, pp. 938–943, Dec. 2024. doi:10.1109/icist63249.2024.10805278
- [2] S. A. Pote, D. M. Adat, A. B. More, P. S. Wagh, T. K. Pise, and S. K. Tilekar, "Designing of PIC16F877A based pH node for the development of water quality monitoring system for housing societies," *International Research Journal of Engineering and Technology (IRJET)*, vol. 8, no. 3, pp. 1447–1452, Mar. 2021
- [3] Y. Chae, C. M. Lopez, K. A. A. Makinwa, M. Ortmanns, and W. Sansen, "A glimpse of the history of analog ICS: A tale of amplifiers, Data Converters, and sensor interfaces," *IEEE Solid-State Circuits Magazine*, vol. 15, no. 3, pp. 43–52, 2023. doi:10.1109/mssc.2023.3282557
- [4] H. K. . Setiawan, Rudi Susanto, and Pramono, "Consumer Counting System in Stores Based on Internet of Things (IoT) With ESP 32 Microcontroller and Ultrasonic Distance Sensor", *JAIIT*, vol. 6, no. 2, pp. 93–102, Oct. 2024.
- [5] EERG, "Engineering Ethics: Maintaining society's trust in the engineering profession," <https://www.engc.org.uk/>, <https://www.engc.org.uk/media/2v4ldaqf/engineering-ethics-report-february-2022.pdf> (accessed Oct. 6, 2025).
- [6] M. Susan and J. E. Mitchell, "Ethical issues in electronic and Electrical Engineering," *The Routledge International Handbook of Engineering Ethics Education*, pp. 285–303, Nov. 2024. doi:10.4324/9781003464259-20
- [7] H. Hamil, M. S. Azzaz, S. Sakhi, R. Kaibou, and A. Hamil, "Design of a thermal stabilizer based on USB data acquisition and control using labview and Pic Microcontroller," *2023 International Conference on Advances in Electronics, Control and Communication Systems (ICAEECS)*, pp. 1–6, Mar. 2023. doi:10.1109/icaeecs56710.2023.10104863
- [8] M. Aravind Kumar, K. Madhu Shankar, V. Malleeswaran, and K. G. Dharani, "Development of PIC based CO2 Monitoring System device," *Journal of Physics:*

Conference Series, vol. 1937, no. 1, pp. 1–7, Jun. 2021. doi:10.1088/1742-6596/1937/1/012026

[9] H. Edison, X. Wang, and K. Conboy, “Comparing methods for large-scale agile software development: A systematic literature review,” *IEEE Transactions on Software Engineering*, vol. 48, no. 8, pp. 2709–2731, Aug. 2022. doi:10.1109/tse.2021.3069039

[10] K. Beck, M. Beedle, A. van Bennekum, A. Cockburn, W. Cunningham, M. Fowler, J. Grenning, J. Highsmith, A. Hunt, R. Jeffries, J. Kern, B. Marick, R. C. Martin, S. Mellor, K. Schwaber, J. Sutherland, D. Thomas. “Manifesto for Agile Software Development,” twelve principles of agile software, Feb 2001.

[11] A. Katalin, “Microcontroller based system for vibration analysis,” *2008 IEEE International Conference on Automation, Quality and Testing, Robotics*, pp. 171–174, May 2008. doi:10.1109/aqtr.2008.4588815

[12] L. M. Baicu, M. Andrei, and B. Dumitrascu, “Automotive vibration analysis using ESP8266 microcontroller,” *2023 8th International Symposium on Electrical and Electronics Engineering (ISEEE)*, pp. 54–58, Oct. 2023. doi:10.1109/iseee58596.2023.10310354

[13] A. A. Jaber and R. Bicker, “Design of a wireless sensor node for vibration monitoring of industrial machinery,” *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 6, no. 2, p. 639, Apr. 2016. doi:10.11591/ijece.v6i2.9296

[14] B. Feagin Jr., M. Poplawski, and J. Day, *A review of existing test methods for occupancy sensors*, Aug. 2020. doi:10.2172/1668746

[15] T. Labeodan, K. Aduda, W. Zeiler, and F. Hoving, “Experimental evaluation of the performance of chair sensors in an office space for occupancy detection and occupancy-driven control,” *Energy and Buildings*, vol. 111, pp. 195–206, Jan. 2016. doi:10.1016/j.enbuild.2015.11.054

Independant project proposal Robbie Herbert

GRADEMARK REPORT

FINAL GRADE

73 / 100

GENERAL COMMENTS

1) Introduction / A&O (15.5/20 Marks)

Good project title. Identified an industry relevant problem in the aerospace sector and explained why this project is worth doing. The project aim are clearly stated and well-aligned with the identified problem. SMART Objective is available, although some could be made more measurable. Factors needed for project success such as communication, risk management, and cost control is described. Deliverables are mentioned and appropriate, but they could be grouped and presented more clearly at the end of the introduction.

2) Background to the Project / Literature Review (15/20 Marks)

Engaged with a good range of academic sources, including journal articles and conference papers. The chosen literature is relevant, particularly those focused on vibration monitoring, microcontroller-based systems, and occupancy sensor behaviour. Identify a clear gap in the literature regarding cyclic and vibration testing of occupancy sensors. It would have been better with providing strong connection between each cited work and your project design.

3) Project Design: (21/30 Marks)

Identified that the project will use a deductive approach and agile methodology. The development methods and tools are described well. The description of data collection is good. However, the section could be improved by explaining how the data will be analysed. It would

have been better if a proposed system architecture and more justification for component choices were provided.

4)
Resources /
Planning (11/15 Marks)

Listed the main tools and deliverables. Good Gantt chart showing when each tasks to be completed. Ethics form completed. It would have been better if a brief explanation of how time and resources are distributed and Resource section could be made more concise.

5)
Document
Presentation (10/15 Marks)

The document is well structured and presented. The narrative flows logically, with sections transitioning smoothly from one topic to the next. It would have been better with consistent formatting, fonts, and spacing. Proofread to find minor errors or inconsistencies. It is better to number subheadings appropriately

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9
