

Project proposal

by Rhys Jones

Submission date: 20-Oct-2025 03:17AM (UTC+0100)

Submission ID: 265709717

File name: 49553_Rhys_Jones_Project_proposal_689853_1561549409.odt (174.74K)

Word count: 1579

Character count: 8500

ACDA 6

Personal project proposal

Student Number: 2317422

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How can technology be used to design a smart car park system that displays real-time information on available spaces?

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Introduction

The rise of smart cities has led to an increasing use of IoT technology to improve urban mobility. A critical challenge in adapting to a smarter city is how to improve parking efficiency. If people can park efficiently, it will reduce the amount of time spent waiting for spaces, lower emissions and fuel used, ease congestion, and reduce driver frustrations. Many smart car parks use cameras to detect free car parking spots, which can quickly increase the cost of building a smart car park, especially on larger scales, such as multi-story, which are common in cities. This project aims to minimize the cost of turning car parks into smart ones. This will be done by the use of sensors, such as IR or ultrasonic sensors, as they have a much lower cost than cameras for detecting available spaces. The sensors will collect real-time data about each space and display a green LED if the space is empty. There will also be a sensor at the entrance to the car park and the exit to count the total cars in the car park, and it will be able to display the number of empty spaces on an LED before entering to minimize time spent looking for spaces. The information could also be uploaded to allow people to see what spaces are available before entering the car park, allowing them to know where the available spaces are [1] [2].

Aims

- To design and develop a Smart Car Park System that detects and displays real-time parking space availability, helping drivers make informed parking decisions before entering a facility.

Objectives

1. To analyse current smart parking technologies to identify viable sensors, communication methods, and display solutions, and how they can be adapted.
2. To design and develop a technological smart car park using sensors and microcontrollers to detect and relay real-time information.
3. To evaluate the environmental benefits of more efficient parking, with cars idling for less time, reducing the overall CO2 emissions.
4. To compare different sensor technologies, such as ultrasonic and IR, for the detection of vehicles, which can be of different sizes

Literature review

Smart parking systems have emerged as a vital component of smarter city infrastructure, aiming to improve traffic flow and lower parking times through data-driven management. With more people driving and without the necessary space and infrastructure to keep adding additional parking, especially with cars becoming bigger, the demand for parking is continuing to grow. In addition to this, the limited amount of street parking due to yellow lines, permit holder only spaces, and strict rules on how long a car can be parked for, big car parks such as multi-story car parks are getting more traffic than before. Allowing drivers to see the available number of free spaces cuts down the time looking for spaces that don't exist. Currently, a lot of smart car

parks use cameras to help see available spaces, but that can quickly become expensive due to how much cameras cost [3] [4]. There's also the concern of privacy, as collecting information without consent is illegal. By using sensors instead of cameras, not only does it keep costs low, but it also takes away the use of having identifiable information being seen by cameras to see what spaces are free. By using a sensor-based system as opposed to a camera system, it also keeps repairs quick, simple, and cheap. Whilst a vision-based system could provide more information, the core data that's needed will not change, as the sensors can reliably monitor if a space is occupied. Another downside of cameras being used is that they require adequate lighting, which could pose as another cost for those who opt for a camera-based system [5] [6].

Very few car parks offer a display of available spaces before entering, of those that do have a display, a high number of those car parks belong to expensive parking sites such as airports and big tourist attractions such as Disney and Warner Bros. This product addresses the gaps currently out there by providing a compact and affordable smart car park system that uses sensors and provides feedback locally, allowing drivers to make quick and informed decisions. Furthermore, sensor-based systems typically require less complex maintenance because individual sensors can be changed or calibrated without affecting the network as a whole. These systems are now more realistic for long-term usage because of recent developments in wireless communication and low-power electronics, which have further improved their longevity and dependability. Without appreciably raising costs, sensor data integration with straightforward user interfaces—like LED screens or smartphone alerts—can improve accessibility and user satisfaction even more [7] [8].

Project design

This project involves designing, developing, and evaluating a smart car park system that uses sensors to detect which spaces are available and which are taken. It will provide real-time data to drivers, which aims to reduce the waiting times for parking, improve the overall flow of traffic, and lower emissions caused by idling cars. The project will follow a structured design process that includes hardware research and development, ensuring efficient components are selected based on factors such as cost and reliability. Comparison of sensors will be done throughout the design process, allowing the desired sensors to be used as opposed to simply researching, since real-world tests can often provide a much wider range of results. A sensible microcontroller PIC will be chosen based on its size, capabilities, and price. Software integration will be used to provide the data via code using languages such as C to allow efficient and simple understanding of the code. The code will be able to receive the sensor's state and provide readings on the LCD before entering the car park, and be able to change which LED is turned on in each parking space. Sufficient system testing will be done throughout the project to ensure each part is working as expected, and allows errors to be caught early and easily, as opposed to simply testing the final product. As learnt in previous projects, consistent and thorough testing enables the product to be much more refined than testing just at the end, once it's all built together. It also allows you to have sufficient time to change parts if some are faulty or don't work as expected, allowing you to keep on time following your Gantt chart.

A risk management process will be implemented to ensure the product can still be delivered on time. These risks will include:

- Hardware malfunction – Researching reliable and readily available parts will minimize the chance of damaged components, and they will be able to get replaced easily.
- Data errors – Minimized by error-checking systems, use of a reliable and easy-to-understand code, and various test environments.
- Time constraints – A Gant chart allowing for internal and external errors will minimize the risk of delays, along with keeping the project on track.

There are some ethical concerns, such as identifiable information, which will not be recorded. A full list of the ethical concerns and considerations will be available in the ethics form.

Planning

An effective project plan is vital for anything to be developed efficiently. It is used to ensure that all key points, such as research, development, testing, evaluation, and any key dates, are easily identifiable for anyone working on a project. This project will follow a Gantt chart pictured below.

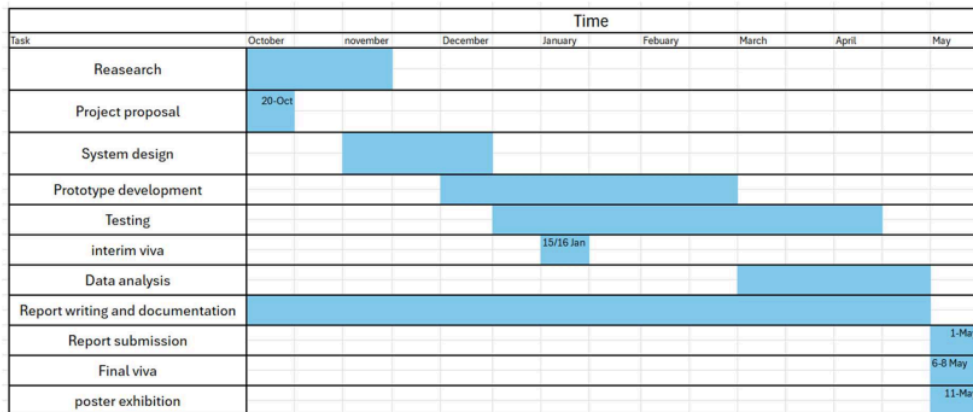


Figure 1 Gantt chart

This Gantt chart provides a clear view of all key dates, including Viva dates, poster exhibition, and report submission. It also clearly outlines how long each task should take and how to keep organized. By looking at the chart, it is easy to see that documentation is required throughout the entire project, as this makes the workload much more manageable than trying to remember everything you've learned and done across the project. Having an easy-to-read chart helps with efficiency of work and allows for less stress due to an outlined work plan to avoid burnout later. Pictured below is proof of completion of the ethics form. The full document has been uploaded and is available to be seen.

APPLICATION FOR ETHICAL APPROVAL

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

This form must be completed and approved prior to undertaking any research activity.

SECTION A: About You (Principal Researcher)

1	Full Name:	Rhys Jones
2	Student Number:	2317422
3	Email address:	2317422@student.uwtsd.ac.uk
4	Programme of Study:	Beng Electrical and Electronic Engineering

SECTION B: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.	
1	UWTSO Research Ethics & Integrity Code of Practice	☒
2	UWTSO Research Data Management Policy	☒
3		☐

SECTION C: Details of Research Activity

1	Indicative title:	How can technology be used to design a smart car park system that displays real-time information on available spaces?		
2	Proposed start date:	October 2025	Proposed end date:	May 2026
	Introduction to the Research (maximum 300 words in each section) Ensure that you write for a Non-Specialist Audience when outlining your response to the points below: • Purpose of Research Activity • Proposed Research Question or Hypothesis • Aim of Research Activity • Objectives of Research Activity • How the research activity will be of use to your industrial partner/employer			
3	Purpose of Research Activity			

Figure 2 Proof of ethics form

References

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Project proposal

GRADEMARK REPORT

FINAL GRADE

66/100

GENERAL COMMENTS

Project Proposal – ACCA6020 Independent Project
Rhys Jones
Intro / Aims & Objectives: 12/20
The introduction, aims and objectives are reasonable statements desires more quantitative justification:
Clear, but could be enhanced with brief objective c
Background to the Project / Literature Review : 14/20
The background provides a good overview of exist
Project Design : 20/30
The project design is reasonably outlined, structural choice of software is desirable.
Resources / Planning :11/15
The Gantt chart is very satisfactory and suit for pu project evaluation.
More detailed and complete clearer milestones fo
Document Presentation:09/15
The proposal is satisfactorily presented, structured
Neat presentation!
TOTAL:66/100

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