Digital car switch panel

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1. Project background and purpose

1.1. Introduction

The aim of the project is to give the user a digitized car switch board which will allow them to view digital gauges such as oil pressure, coolant temperature, boost pressure, mass air flow and per cylinder air volume. The user should be able to choose from some default gauges or they can add their own which will include variations on the design and the inputs available. The switch panel will also allow the user to turn on and off certain features just like a physical panel they can turn on accessories such as external lighting, fans, power kill switches and fuel pumps.

1.2. Objectives

The project is useful as it will allow car enthusiasts to gain product which can give them much needed data and a switch panel which doesn't take up much space on the dash and can be connected relatively easily. There currently isn't much else on the market which would do the same and any that do are incredibly expensive or are built for specific cars which makes it hard to have a generalised product which can be used by everyone.

Primary Objectives

The project will allow the user to view digital car gauges which will update in real time.

The project will allow the user to interact with the system via a touchscreen display.

The project will allow the user to click digital buttons which will control various car systems (e.g., fans or lighting)

The project should have large enough buttons that they can be pressed even when the road surface is making the car bumpy.

The project should not be distracting for the driver in any way.

Secondary Objectives

The project will allow the user to change the background of gauges to their own liking.

The project will allow the user to connect to their car and view any errors the system has.

The project should have a fast start up time to ensure the usability of the devices as soon as the car is started.

1.3. Requirements Capture

These are the initial requirements that will be set but further detailed requirements can be found in the requirements document.

- Interactive touchscreen display.
- Easy to use software which can be used by anyone no matter experience.
- Display 3 default gauges: coolant temperature, oil pressure, mass air flow.
- Allow users to change gauges to custom data inputs.
- Allow user to change background of gauges to any image.
- Display any error messages in a clear and easy format to read by the user.
- Keep the system plug and play by using 12v power.

- Display a digital switchboard which can control external systems added by the user. (Will display 3 toggle switches by default)
- Allow the user to upload or change the switch image type to one of their liking.
- System can run without any internet necessary.
- Can be run on main car groups without issues: Volkswagen, Ford, Audi, BMW
- There should be a menu which allow the user to change certain settings such as Bluetooth device connected, language or other accessibility options.

1.4. Scope

The project will include switch control over some basic elements in the car such as fans, external lighting and power kill switches.

The project will display digital gauges such as oil pressure, coolant temperature, boost pressure and mass air flow.

The project will allow the user to customize the gauges with a custom image of their choice to make it personalised.

The project will allow the user to add their own sensors to the gauges.

1.5. Deliverables

The project will deliver a program that can be run on a touchscreen display that will allow the user to control switches and view digital gauges. It will allow the user to quickly and easily control systems such as fans and external lighting. The gauges will update quickly and in real time to ensure the user is kept up to date with the latest data.

1.6. Constraints

The project has a couple of constraints which could pose a problem. One of those issues is the fact that cars only have a 12v power supply and do not have mains voltage and therefore the project will have to keep in mind that the device will have to run off 12v. Another constraint is the Can system that the car uses to communicate with the device, this can be an issue as the Can system can vary between car models and will require specialised coding to ensure it is compatible with all vehicles and will communicate effectively.

1.7. Assumptions

The project is assuming that the end user will have a basic knowledge of cars and will be able to locate a OBD2 port which will be used for the communication of data between the car and software.

2. Project rationale and operation

2.1. Project benefits

A successful project will allow car enthusiasts to have a device that will allow them to view gauges which would otherwise be unavailable to them such as oil pressure, turbo pressure or mass air flow. This extra information that the user will gain could help them to understand their car better and realise when they are at the limit of the car rather than breaking it as its been pushed too hard. The project will also allow car enthusiasts to have a much more compact switch board compared to physical switches which take up a lot of space.

2.2. Project operation

I would use various forms of tracking including something such as a Trello board to monitor progress on specific tasks, gannet charts to make sure that timelines are being met and anything that is taking longer than expected to be monitored and changed on the charts as necessary.

2.3. Risk analysis

Some risks within the project could include Time management, inaccurate estimation of tasks, Hardware failure or software failure. Due to the project being on a tight deadline this could cause it to run over the desired timeframe due to tasks being potentially under or overestimated in their amount of time it would take to complete. The project could also suffer from a few hardware failures such as screens breaking or components shorting out when testing new sensors. The project could also have software failures such as a CAN system authentication or decryption error which would lead to the system being unable to communicate with the car. The OBD device used could be limited in features available which could mean its harder to get the experience needed. The CAN system be different between different car models which could mean that it is incompatible and would require further development to enable to usage of the product.

2.4. Risk Matrix

Risk	Likelihood	Severity	Impact
Time Management	2	3	2 x 3 = **6**
Inaccurate estimation of tasks	2	2	1 x 2 = **4**
Hardware Failure	1	4	1 x 4 = **4**
Software Failure	1	1	1 x 1 = **1**
OBD Features	1	4	1 x 4 = **4**
Incompatibility	2	5	2 x 5 = **10**

2.5. Risk Mitigation Plan

Risk	How it will affect the project	Mitigation
Time Management	If time management is poor, it could affect how long the project will take for completion which could lead to the project being delayed	Multiple mid-way meetings should be held to determine the progress of the project and to see if it's deemed to be behind schedule
Inaccurate estimation of tasks	If task completion time is not accurately recorded, then this could lead to some tasks taking much longer than anticipated or it could do the	Tasks should be revied after to determine if a accurate time was given and then other similar tasks within the project

	opposite and finish the project too early without adding any extra features therefore wasting time.	should be update with a new estimated completion time
Hardware Failure	Hardware failure could include things such as then computer screen being broken or the circuit board being damaged or broken if any sensors short it out	Extra care should be taken when handling the screens and they can be stored in a safe bag which will help prevent any damages when not in use. When adding things such as sensors the system should be shut down and power disconnected to help prevent any short circuits.
Software Failure	Software failure could include decryption failure with the CAN system that could lead to the system not being able to connect to the car and gather data.	There isn't any way to prevent this as it could be a random error that could occur
OBD Features	OBD device could be lacking features which could mean its harder to use and create the intended use case.	OBD research should be taken place to ensure that a device tat will deliver the required features are used.
Incompatibility	The system could be incompatible between different cars which could lead to uses being unable to use the product.	Research should be done into how the system could be make useable for all vehicles. Also have testing on various cars to help determine what cars are compatible and which are not.

2.6. Resources required

There is nothing specialised required to ensure the project runs smoothly and would only need some basic resources such as single board computer, touchscreen display and a OBD reader.

3. Project methodology and outcomes

3.1. Initial project plan

3.1.1. Tasks and milestones

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Start Up

Task	Due Date	Status	Priority	Timeline
Requirements Capture	20 Oct	Working on it	Critical	20 Oct
PDD	26 Oct	Working on it	Critical	1 - 26 Oct
Literature review	27 Apr, 2024	Not Started	Medium	-
+ Add task				
	Oct 20, '23 - Apr 27, '...			1 - 26 Oct

Research 10 Tasks

Task	Due Date	Status	Priority	Timeline
Research Similar Projects	~~15 Sep~~	Done	High	1 - 15 Sep
Research Hardware	~~18 Oct~~	Done	Medium	16 - 18 Oct
Research Software	~~20 Oct~~	Done	Medium	18 - 20 Oct
Research overview	~~20 Oct~~	Done	High	20 Oct
Research Can system	23 Oct	Working on it	Medium	20 - 23 Oct
Digital gauge research	25 Oct	Working on it	Low	23 - 25 Oct
Digital switch board research	27 Oct	Working on it	Low	25 - 27 Oct
Research overview	27 Oct	Not Started	Medium	27 Oct
Research solution for 12v power	30 Dec	Not Started	Low	30 Oct
Switch images to use	23 Feb, 2024	Not Started	Low	Feb 21, '24 - Feb 23, '24
+ Add task				
	Sep 15, '23 - Feb 23, '...			Sep 1, '23 - Feb 23, '24

Project Plan 32 Tasks

Task	Due Date	Status	Priority	Timeline
SCRUM Meeting 1		Not Started	Low	1 Dec
Sprint 1		Not Started	Low	1 - 14 Dec
SCRUM Meeting 2		Not Started	Low	15 Dec
Sprint 2		Not Started	Low	15 - 28 Dec
Alpha Deliverable	28 Dec	Not Started	Low	28 Dec
Alpha Testing	4 Jan, 2024	Not Started	Low	Dec 28, '23 - Jan 4, '24
Alpha Testing Review	12 Jan, 2024	Not Started	Low	Jan 4, '24 - Jan 11, '24

SCRUM Meeting 3			Not Started	Low	Jan 12, '24
Sprint 3			Not Started	Low	Jan 12, '24 - Jan 25, '24
Project Review		25 Jan, 2024	Not Started	Low	Jan 25, '24
SCRUM Meeting 4			Not Started	Low	Jan 26, '24
Sprint 4			Not Started	Low	Jan 26, '24 - Feb 8, '24
SCRUM Meeting 5			Not Started	Low	Feb 9, '24
Sprint 5			Not Started	Low	Feb 9, '24 - Feb 22, '24
BETA Deliverable		22 Feb, 2024	Not Started	Low	28 Dec
BETA Testing		4 Jan, 2024	Not Started	Low	Feb 23, '24 - Mar 1, '24
BETA Testing Review		12 Jan, 2024	Not Started	Low	Mar 7, '24 - Mar 14, '24
SCRUM Meeting 6			Not Started	Low	Mar 8, '24
Sprint 6			Not Started	Low	Mar 8, '24 - Mar 21, '24
SCRUM Meeting 7			Not Started	Low	Mar 22, '24
Sprint 7			Not Started	Low	Mar 22, '24 - Apr 4, '24
Prototype Released Deliverable		4 Apr, 2024	Not Started	Low	Apr 4, '24
Prototype Released Testing		12 Apr, 2024	Not Started	Low	Apr 5, '24 - Apr 12, '24
Prototype Released Testin... Open		18 Apr, 2024	Not Started	Low	Apr 12, '24 - Apr 18, '24
System Hardware Testing		8 Apr, 2024	Not Started	Low	Apr 4, '24 - Apr 7, '24
System Software Testing		12 Apr, 2024	Not Started	Low	Apr 8, '24 - Apr 11, '24
System User Testing		16 Apr, 2024	Not Started	Low	Apr 12, '24 - Apr 15, '24
Full System Testing		23 Apr, 2024	Not Started	Low	Apr 15, '24 - Apr 23, '24
Released for users to Test System		24 Apr, 2024	Not Started	Low	-
Feedback from Testing		25 Apr, 2024	Not Started	Low	-
Finishing touches to project		27 Apr, 2024	Not Started	Low	Apr 16, '24 - Apr 27, '24
Project completion		28 Apr, 2024	Not Started	Low	Apr 28, '24
+ Add task					
		Dec 28, '23 - Apr 28, ...			Dec 1, '23 - Apr 28, '24

3.1.2. Schedule Gantt chart

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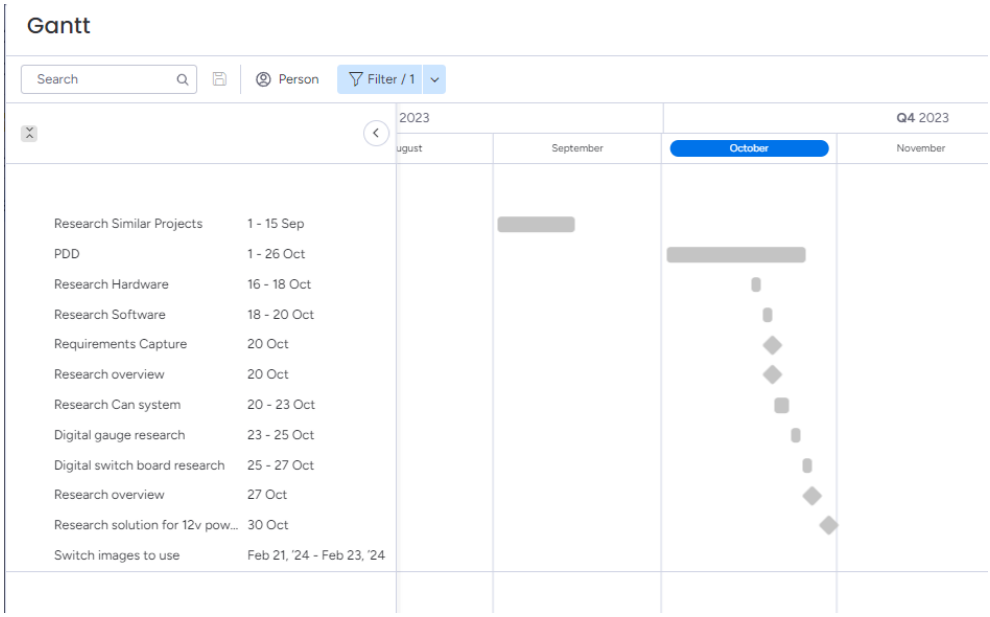

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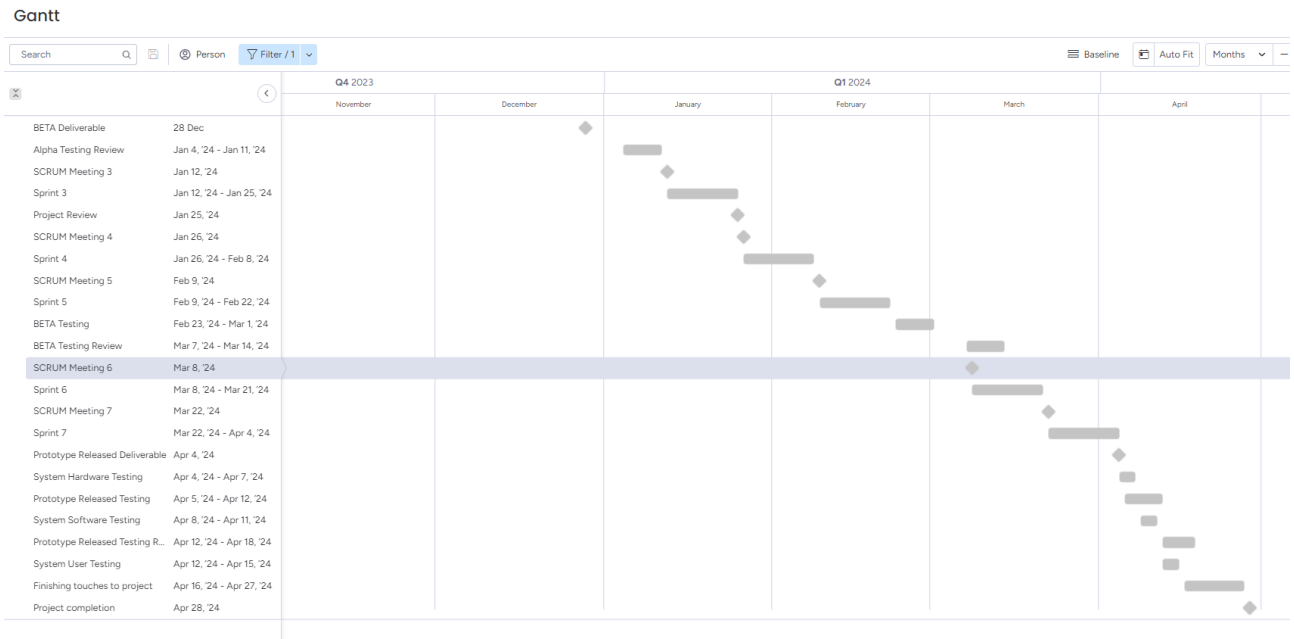

3.2. Project control

I will be using Trello to monitor the progress of tasks and keep track of what needs doing and how the project is progressing. By using Trello, it allows me to keep track of exactly what is going on in each sprint and what tasks are left in the backlog. I will be using a sprint system which will allow me to choose features from the backlog then work on them for a set amount of time then review what's been done the repeat the process over and over. There wouldn't be any real way of measuring progress other than seeing the physical prototype develop and become a much more useable object each time.

3.3. Project evaluation

I will evaluate the success of the project in a few different ways; usability, user feedback and features delivered.

For the usability I will set up some test scenarios which would see the product being used such as how would it perform when going over a bumpy road, this will allow me to have a better understanding of how the delivered project works in the real world.

For the user feedback I would ask testers to fill in a questionnaire which will give them the opportunity to offer feedback on how the project has helped them and based off this I can compare it to what the project aimed to do and see if they match if so then it's very likely that the project has succeeded.

For the features delivered evaluation I would look into what the project has been able to deliver compared to what the vison was and see if there are any big changes or features missing which would indicate success level of the project.

4. References

https://www.youtube.com/watch?v=SVn9uYfEQrA - While researching for my project I found this very informative video of someone creating similar but instead of a switch panel it was being used purely just for a speed/tachometer.

https://www.hackster.io/news/build-a-custom-dashboard-for-your-car-with-raspberry-pi-e66fbd46bb78 - This person used a raspberry pie which is relatively simple and inexpensive, and this helped to prove that a project of this would be possible and not just theory.