Project Ideation Document

***This document is not to be submitted for a mark**. This is to allow WMG to allocate appropriate project supervision who, along with your Work-Based Manager, will offer advice on identifying and developing your project topic.*

1. Preliminary Information

Working Title:	*Design, Development, Implementation, and Validation of Sensorless DC Motor Control Software in Automotive*	
Student ID	*U1921983*	*Jack.young@warwick.ac.uk // jyoung16@jaguarlandrover.com*
Student Name	*Jack Young*	*Software*
Work Department	*Digital Product Platform (In-House Body Software)*	
Workplace Line Manager	*Dominic Taylor*	*Dtayl169@jaguarlandrover.com*

In addition to the above information, please use the table below to list three key words to describe the topic of your project:

Embedded Software
Digital Signal Processing
Control Systems

2. Explain your Project Idea (200 words)

JLR currently implement seating control software using feedback from hall-effect sensors in the motors to detect positions; per seat, hall-effect sensors add circa £1 of cost. Removing these sensors can save the business a significant amount per unit [CS.5] [CT.9] [CT.10]. I aim to remove the need for hall-effect sensors in the seat motors by using digital signal processing techniques to identify ripples on the trace of current being drawn by a sensorless DC motor. The ripples identified behave in the same manner as a hall-effect sensor so I will be able to count positions in the same way. This removes the need for them and saves the business a cost per seat unit. I will analyse the current implementation to define functional, non-functional and technical requirements to design [CB.7] [SS.2] [ST.3], implement [SS.3] [SS.4] [ST.4] and test [SS.5] [ST.5] a new sensorless DC control solution in the form of C code [CT.3] [SS.1] [SS.5] implemented on a selection of microcontrollers [CS.2] [SS.6]. During the development I will continually perform static and runtime code analysis to ensure my code meets MISRA-C and MAAB guidelines. The project shall be delivered using the agile framework [ST.2], producing small increments over defined sprints to tie in with time constraints of the business [CS.6]. Finally, I will develop a plant model, using Stateflow and

Simulink, of the seat motor to deploy onto a hardware-in-the-loop simulator that will allow me to test independently of hardware.

3. *Resources required to conduct the project (100 words)*

I will require all current documentation for implementation of position counting within the SZM (seat zone module) and requirements for levels of accuracy necessary for accurate position counting and detection. In terms of hardware, I will use my work-provided laptop for all research, design, and development. I will use an Arduino UNO (Or similar, following further research) to deploy the software and test with physical hardware. I will source a seat motor from an existing vehicle or from the test rigs on site. I will ensure I have a motor capable of ripple and hall sensing to benchmark my solution. Once a prototype version of software is complete, I can look to test on an engineering vehicle or labcar (this would need to be booked through the business)

4. *Expected Risks (100 words)*

Risks include the following: Due to the high frequency of ripples within the DC current trace, I will need a high specification microcontroller that has an ADC (Analogue-Digital-Convertor) that operates at a high enough frequency to detect these ripples. This risk can be mitigated by identifying a suitable microcontroller prior to deployment. Furthermore, electrical interference can have a large impact on the quality of the ripple detected on a current trace, this would need to be taken into account when moving to a production vehicle.

5. *Predicted Impact (100 words)*

Success shall be defined as a verified and validated [CS.5] [CT.5] DC motor control solution that recreates or improves the current solution used at JLR. This could be verified by testing that we can still detect pinch scenarios using ripple counting for position detection. I will compare total ripple counts vs hall counts to see how close the new system can get to our existing solution. The production solution will not be identical to our current solution but should behave in a similar manner.

Approved by Work-Based Manager:

Signature D. Taylor

Appendix 1

	Core Skills	Tick the relevant KSB to be covered in your project
CS.1	Information Systems: is able to critically analyse a business domain in order to identify the role of information systems, highlight issues and identify opportunities for improvement through evaluating information systems in relation to their intended purpose and effectiveness.	

CS.2	Systems Development: analyses business and technical requirements to select and specify appropriate technology solutions. Designs, implements, tests, and debugs software to meet requirements using contemporary methods including agile development. Manages the development and assurance of software artefacts applying secure development practises to ensure system resilience. Configures and deploys solutions to end users.	
CS.3	Data: identifies organisational information requirements and can model data solutions using conceptual data modelling techniques. Is able to implement a database solution using an industry standard database management system (DBMS). Can perform database administration tasks and is cognisant of the key concepts of data quality and data security. Is able to manage data effectively and undertake data analysis.	relevant for data analytics specialism projects
CS.4	Cyber Security: can undertake a security risk assessment for a simple IT system and propose resolution advice. Can identify, analyse and evaluate security threats and hazards to planned and installed information systems or services (e.g. Cloud services).	
CS.5	Business Organisation: can apply organisational theory, change management, marketing, strategic practice, human resource management and IT service management to technology solutions development. Develops well- reasoned investment proposals and provides business insights.	
CS.6	IT Project Management: follows a systematic methodology for initiating, planning, executing, controlling, and closing technology solutions projects. Applies industry standard processes, methods, techniques and tools to execute projects. Is able to manage a project (typically less than six months, no inter-dependency with other projects and no strategic impact) including identifying and resolving deviations and the management of problems and escalation processes.	relevant for all projects
CS.7	Computer and Network Infrastructure: can plan, design and manage computer networks with an overall focus on the services and capabilities that network infrastructure solutions enable in an organisational context. Identifies network security risks and their resolution.	relevant for Network engineering specialism projects
	Core Technical Knowledge	
	Knows and understands:	
CT.1	How business exploits technology solutions for competitive advantage.	

CT.2	The value of technology investments and how to formulate a business case for a new technology solution, including estimation of both costs and benefits.	
CT.3	Contemporary techniques for design, developing, testing, correcting, deploying and documenting software systems from specifications, using agreed standards and tools.	
CT.4	How teams work effectively to produce technology solutions.	
CT.5	The role of data management systems in managing organisational data and information.	relevant for data analytics specialism projects
CT.6	Common vulnerabilities in computer networks including unsecure coding and unprotected networks.	relevant for Network engineering specialism projects
CT.7	The various roles, functions and activities related to technology solutions within an organisation.	
CT.8	How strategic decisions are made concerning acquiring technology solutions resources and capabilities including the ability to evaluate the different sourcing options.	
CT.9	How to deliver a technology solutions project accurately consistent with business needs.	relevant for all projects
CT.10	The issues of quality, cost and time for projects, including contractual obligations and resource constraints.	relevant for all projects
	Core Behavioural Skills	
CB.1	Fluent in written communications and able to articulate complex issues.	relevant for all projects
CB.2	Makes concise, engaging and well-structured verbal presentations, arguments and explanations.	relevant for all projects

CB.3	Able to deal with different, competing interests within and outside the organisation with excellent negotiation skills.	
CB.4	Is able to identify the preferences, motivations, strengths and limitations of other people and apply these insights to work more effectively with and to motivate others.	
CB.5	Competent in active listening and in leading, influencing and persuading others.	
CB.6	Able to give and receive feedback constructively and incorporate it into his/her own development and life-long learning.	
CB.7	Applies analytical and critical thinking skills to Technology Solutions development and to systematically analyse and apply structured problem solving techniques to complex systems and situations.	relevant for all projects
CB.8	Able to put forward, demonstrate value and gain commitment to a moderately complex technology-oriented solution, demonstrating understanding of business need, using open questions and summarising skills and basic negotiating skills.	relevant for all projects
CB.9	·Able to conduct effective research, using literature and other media, into IT and business-related topics.	relevant for all projects
CB.10	Have demonstrated that they have mastered basic business disciplines, ethics and courtesies, demonstrating timeliness and focus when faced with distractions and the ability to complete tasks to a deadline with high quality.	relevant for all projects
CB.11	Flexible attitude.	
CB.12	Ability to perform under pressure.	
CB.13	A thorough approach to work.	relevant for all projects
CB.14	Logical thinking and creative approach to problem solving	relevant for all projects
	Software Engineering Specialism	
	Skills	

SS.1	Create effective and secure software solutions using contemporary software development languages to deliver the full range of functional and non-functional requirements using relevant development methodologies.	
SS.2	Undertake analysis and design to create artefacts, such as use cases to produce robust software designs.	
SS.3	Produce high quality code with sound syntax in at least one language following best practices and standards.	
SS.4	Perform code reviews, debugging and refactoring to improve code quality and efficiency.	
SS.5	Test code to ensure that the functional and non-functional requirements have been met.	
SS.6	Deliver software solutions using industry standard build processes, and tools for configuration management, version control and software build, release and deployment into enterprise environments.	
	Technical Knowledge	
	Knows and understands	
ST.1	How to operate at all stages of the software development lifecycle.	
ST.2	How teams work effectively to develop software solutions embracing agile and other development approaches.	
ST.3	How to apply software analysis and design approaches.	
ST.4	How to interpret and implement a design, compliant with functional, non-functional and security requirements.	
ST.5	How to perform functional and unit testing.	
ST.6	How to use and apply the range of software tools used in Software engineering.	
	Data Analytics Specialism	
	Skills	
	Be able to:	
DS.1	Import, cleanse, transform, and validate data with the purpose of understanding or making conclusions from the data for business decision making purposes.	

DS.2	Present data visualisation using charts, graphs, tables, and more sophisticated visualisation tools.	
DS.3	Perform routine statistical analyses and ad-hoc queries.	
DS.4	Use a range of analytical techniques such as data mining, time series forecasting and modelling techniques to identify and predict trends and patterns in data.	
DS.5	Report on conclusions gained from analysing data using a range of statistical software tools.	
DS.7	Summarise and present results to a range of stakeholders making recommendations.	
	Technical Knowledge	
	Knows and understands:	
DT.1	The quality issues that can arise with data and how to avoid and/or resolve these.	
DT.2	The processes involved in carrying out data analysis projects.	
DT.3	How to use and apply industry standard tools and methods for data analysis.	
DT.4	The range of data protection and legal issues.	
DT.5	The fundamentals of data structures, database system design, implementation and maintenance.	
DT.6	The organisation's data architecture.	
	Network Engineering Specialism	
	Skills	
	Be able to:	
NS.1	Plan, design, build and test a simple network to a requirement specification that includes hubs, switches, routers and wireless user devices, applying appropriate security products and processes.	
NS.2	Identify the key characteristics of a new network service and develop estimates of the expected traffic intensity and traffic load that the network must support.	
NS.3	Determine the minimum network capacity of planned networks to meet network requirements.	

NS.4	Design, build, test, configure and optimise a distributed network (more than 1 sub- net), including switches, routers and firewalls to meet given requirements.	
NS.5	Analyse network performance and troubleshoot typical problems in networks.	
NS.6	Identify and evaluate network security risks and incorporate appropriate security products and processes into network designs to increase security, resilience and dependability.	
	Technical Knowledge	
	Knows and understands:	
NT.1	The fundamental building blocks (e.g. routers, switches, hubs, storage, transmission) and typical architectures (e.g. server/client, hub/spoke) of computers, networks and the Internet.	
NT.2	The main features of routing and Internet network protocols in use, their purpose and relationship to each other, including the physical and data link layer (e.g. https, HTTP, SMTP, SNMP, TCP, IP, etc.).	
NT.3	The main factors that affect network performance (e.g. the relationship between bandwidth, number of users, nature of traffic, contention).	
NT.4	Failure modes in protocols (e.g. why a protocol may 'hang' and the effect of data communication errors).	
NT.5	The ways to improve performance (e.g. application of traffic shaping, changes to architecture to avoid bottlenecks, network policy that prohibit streaming protocols).	
NT.6	The issues that may arise in the day to day operation of networks and how to resolve them.	