

北京邮电大学 本科毕业设计（论文）任务书

Project Specification Form

Part 2 - Student

学院 School	International School	专业 Programme	e-Commerce Engineering with Law		
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论文题目 Project Title	Design and development of a human-agent collaboration model for situation awareness in cockpit				
论文概述 Project outline Write about 500-800 words Please refer to Project Student Handbook section 3.2	<p>Introduction</p> <p>The rapid advancements in technology have led to new possibilities in the automotive industry, particularly in the development of smart cockpits where human-agent collaboration plays a pivotal role. This project proposes the design and development of a human-agent collaboration model to bolster situation awareness within a cockpit environment for SAE level 2 tasks. It will be grounded in Human-Computer Interaction (HCI) principles, focusing on aspects such as context awareness and implicit interaction to ensure natural and efficacious human-agent teaming.</p> <p>User Requirements Analysis</p> <p>Understanding the needs of drivers is crucial for the design of an effective human-agent collaboration model. We will adopt a user-centered approach to precisely capture the requirements. This process will commence with ethnographic studies and contextual research within the cockpit environment. A critical task analysis will also be facilitated to pinpoint the decision-making pain points during critical stages of vehicle operation.</p> <p>Algorithms, Methodologies, and Techniques</p> <p>The system will leverage various algorithms to ensure efficient human-agent collaboration, including models for recognizing driver's intentions and decision-making (how to help driver), and natural language processing for effective communication between the human and the agent.</p> <p>I will employ adaptive modeling techniques to tailor interaction dynamically based on user physical state and context. A key focus will be on designing an algorithm capable of interpreting implicit cues from the human operator, such as gaze direction or control input patterns, to</p>				

	<p>predict intentions and work as a copilot to adjust system behavior proactively.</p> <p>For situation awareness, multi-sensor data fusion will be essential, integrating inputs from radar, telemetry, environmental sensors, and other available data sources to provide a comprehensive operational picture to the agent for dynamical interaction.</p> <p><i>Note: My preliminary plan is to obtain the above-mentioned data through a simulation platform.</i></p> <p>I will also implement eye-tracking and biometric monitoring through camera as part of the user-system interaction studies.</p> <h3>User Interaction with the System</h3> <p>The interaction framework will emphasize intuitiveness and ease of use. It will include:</p> <ul style="list-style-type: none"> • Voice commands or implicit cues (e.g., gaze) from user, and multimodal feedback (visual, auditory) for communication from system. <p><i>Note: Since the software is only used to demonstrate system performance, the above features will be simplified, and may be changed with consideration of the insights gained from requirements analysis.</i></p> <h3>Experiments</h3> <p>To validate my hypotheses concerning enhanced situation awareness and collaboration efficacy, I will conduct a series of experiments:</p> <ul style="list-style-type: none"> • Simulator-based testing or benchmark datasets to assess system responsiveness and suitability in diverse contextual scenarios. • Usability testing to evaluate the user experience and identify areas for refinement. <h3>Tools, Languages, and Hardware</h3> <p>The software will be developed in Python, given its robust machine learning and data processing libraries and wide acceptance in research communities. For database management, SQL like product will be utilized due to its reliability and performance with complex queries.</p> <p>The choice of hardware will depend on the processing needs identified during the initial prototyping stage but is anticipated to include cameras and microphones to collect data, as well as a computing platform with GPU acceleration.</p>
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	<h2>Background Material</h2> <p>The following is a list of the background material that will guide the initial phase of the research:</p> <ul style="list-style-type: none"> • M. Endsley, “Endsley, M.R.: Toward a Theory of Situation Awareness in Dynamic Systems. Human Factors Journal 37(1), 32-64,” <i>Human Factors: The Journal of the Human Factors and Ergonomics Society</i>, vol. 37, pp. 32–64, Mar. 1995, doi: 10.1518/001872095779049543. • D. A. Norman, <i>The Design of Everyday Things</i>. USA: Basic Books, Inc., 2002. • B. Reeves and C. Nass, “The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Pla,” <i>Bibliovault OAI Repository, the University of Chicago Press</i>, Jan. 1996. • Y. Xing <i>et al.</i>, “Driver Lane Change Intention Inference for Intelligent Vehicles: Framework, Survey, and Challenges,” <i>IEEE Transactions on Vehicular Technology</i>, vol. 68, no. 5, pp. 4377–4390, May 2019, doi: 10.1109/TVT.2019.2903299. • Online HCI resources such as Interaction Design Foundation, Nielsen Norman Group, and ACM Digital Library. • Current standards and guidelines from the Federal Aviation Administration (FAA) and National Highway Traffic Safety Administration (NHTSA). • HCI in automotive contexts from journals like Automotive UI. <p><i>Note: These materials are initial guides, and the list is expected to expand during the literature review stage.</i></p>
<p>道德规范 Ethics</p>	<p>Please confirm by checking the box:</p> <p><input checked="" type="checkbox"/> I confirm that I have discussed ethical issues with my supervisor.</p>

<p>Please discuss ethical issues with your supervisor using the ethics checklist in Project Handbook Appendix 1.</p>	<p>Summary of ethical issues: (write “None” if no ethical issues)</p> <p>None.</p>
<p>中期目标 Mid-term target.</p> <p>It must be tangible outcomes, E.g. software, hardware or simulation.</p> <p>It will be assessed at the mid-term oral.</p>	<p>By February 28, the goal would be to have the design of the intelligent agent system significantly underway with a basic prototype developed. The output by this time should include documentation of the requirements and a well-understood literature background from which to further develop the project. Machine learning integration should be in its initial stages of development, with consideration of the insights gained from the literature review and requirements analysis.</p>

Work Plan (Gantt Chart)

Fill in the sub-tasks and insert a letter X in the cells to show the extent of each task

	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31	Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30
Task 1 Literature review on human-agent collaboration, situation awareness, context awareness, implicit interaction, natural interaction, HCI in cockpit												
1.1 Identify Key Sources	X	X										
1.2 Analyse HCI Principles in Cockpit Context		X										
1.3 Synthesize Implicit & Natural Interaction Insights		X	X									
1.4 Document Review Insights			X									
Task 2 Pain points and requirement analysis												
2.1 Capture the Requirements through Literature Survey			X	X								
2.2 Requirements Documentation				X	X							
Task 3 Design and develop a system with intelligent agent to facilitate the teaming work of human and agent												
3.1 System Architecture Planning					X	X						
3.2 Prototype Development						X	X					
3.3 Integrate Machine Learning Model							X	X				
3.4 Iterative Design & Testing							X	X	X			
Task 4 Conduct experiment to evaluate the system												
4.1 Experiment Design									X	X		
4.2 Simulation & User Testing										X	X	
4.3 Data Collection & Analysis											X	X
4. Refinement & Documentation												X