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Adapting Multimodal Work Instructions For Augmented Reality:
A Case Study of Hydraulic Fuel Tank Assembly

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ABSTRACT

This thesis investigates the implementation of work instructions to ensure consistency and quality in manufacturing and assembly processes, focusing on a case study of hydraulic fuel tank assembly at Hyster-Yale. In this context, Operational Method Sheets (OMS) serve as standardized work instructions, providing static, multimodal step-by-step, illustrated procedures. The study incorporates an eye-tracking video registration of an experienced Hyster-Yale worker to analyze the practical application of these instructions.

A comprehensive analysis using a text-based method, developed by Dr. I.F. van der Sluis et al., reveals significant differences between the prescribed instructions and the actual actions performed by the worker, both in terms of chronology and detail. This discrepancy underscores the necessity for more flexible and adaptable instructions that can accommodate the efficiencies developed by experienced workers.

The research explores Augmented Reality (AR) as a technologically advanced method for delivering flexible work instructions. AR overlays computer-generated information into the real world, offering the potential to enhance the delivery of work instructions by providing dynamic, contextually relevant guidance.

To further understand the assembly process, the research employs Hierarchical Task Analysis (HTA) to break down the process documented in both the OMS and video into tasks, sub-actions, and elementary actions. This analysis reveals dependencies and allows for flexibility in the order and detail of actions, which can be utilized in application design. The differences between the OMS and video emphasize the importance of the video registration for an accurate HTA analysis.

An extensive literature review on AR-specific interface design guidelines complements these findings, demonstrating the importance of user-centered design and the potential for AR to deliver standardized dynamic work instructions.

These findings together provide a structured foundation for developing an AR application.

This study concludes that AR can significantly improve the efficiency and effectiveness of work instructions, particularly for novice workers who benefit from detailed, step-by-step guidance. Experienced workers require flexibility to adapt instructions based on situational factors and personal optimization strategies. It also highlights the need for further studies to validate the effectiveness of AR-based instructions across different industries and assembly processes, as well as the potential for machine learning to enhance AR systems by adapting to user behavior and preferences.