Enhancing AR Remote Assistance in Manufacturing: Integrating Object Detection via 3D Model Training

Augmented Reality (AR) remote assistance has become increasingly popular across various industries, significantly improving productivity and efficiency. Notable examples include Xerox’s CareAR software for troubleshooting and Microsoft’s HoloLens for mixed reality applications. Despite the growing adoption, challenges in AR remote assistance persist, particularly in accurately identifying specific components in complex machinery.

This project proposes an enhancement to AR remote assistance platforms by integrating object detection capabilities using machine learning. The focus is on developing a system that can accurately identify and classify individual parts of industrial machines, thereby improving communication accuracy and user experience. The innovation lies in the use of 3D renders of manufacturing parts as training data for the object detection model. This approach addresses the challenge of limited real-world data and allows for a scalable, cost-effective solution.

The project will entail the development of a pipeline for generating training data from 3D models, training a machine learning model for object detection, and integrating this model into an AR remote assistance platform. The platform will feature functionalities such as AR annotations, zoom, freeze frame, screenshot capabilities, image and screen sharing, and recording options, with a focus on user experience.

A prototype demonstrating the core functionalities will be developed, showcasing the feasibility and effectiveness of using 3D model-based training for object detection in AR remote assistance. This project aims not only to enhance the current capabilities of AR in field service but also to explore new possibilities in remote assistance technologies.

Project Timeline:

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| Week | Project Goals | Notes | What is needed |
| 1 (1/21/24 - 1/27/24) | - Literature review on AR/MR technologies in manufacturing  - Select objects and renders for object detection  - Begin developing training generator pipeline | -Will have to use open source renders, may reach out to companies later in process  - Importing models in Blender  - Python for rendering automation | -Esp32  -Raspberry Pi 4  -Raspberry Pi 5  -Arduino Uno  -MSI X370 Gaming Pro Carbon Motherboard  -Logitech G27 wheel |
| 2 (1/28/24 - 2/3/24) | - Finish developing training generator output  - Begin working on object detection model |  |  |
| 3 (2/4/24 - 2/10/24) | - Continue working on object detection, classification, tracking  - Test and record results of model  - 3D tracking model over actual object |  |  |
| 4 (2/11/24 - 2/17/24) | - Begin developing AR remote assistance platform |  |  |
| 5 (2/18/24 - 2/24/24) | - AR remote assistance development |  |  |
| 6 (2/25/24 - 3/2/24) | - AR remote assistance development |  |  |
| 7 (3/3/24 - 3/9/24) | - AR remote assistance development |  |  |
| 8 (3/10/24 - 3/16/24) | - Preliminary testing and feedback  - Implement object detection model in AR remote assistance platform |  |  |
| 9 (3/17/24 - 3/23/24) | - AR remote assistance development |  |  |
| 10 (3/24/24 - 3/30/24) | - AR remote assistance development  - First round of testing  - Begin VR implementation |  |  |
| 11 (3/31/24 - 4/6/24) | - AR remote assistance development |  |  |
| 12 (4/7/24 - 4/13/24) | - AR remote assistance development |  |  |
| 13 (4/14/24 - 4/20/24) | - AR remote assistance development |  |  |
| 14 (4/21/24 - 4/27/24) | - Second round of testing and refinement |  |  |
| 15 (4/28/24 - 5/3/24) | - Final evaluation and preparation for thesis defense |  |  |
| 16 (5/4/24 - 5/11/24) | - Thesis defense and live demo |  |  |