Team #23

PURDUE POLYTECHNIC

Augmented Reality

Team #23

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Mentors: James Condron (Purdue), Jason Lipscomb (SIA)

Customer Background

SIA is a leading manufacturer of automobiles in the United States as of 2022 at their Lafayette Indiana plant. Assembly processes at this plant have classically been taught with blueprints and complicated instructions in a day in age where technology is available to streamline this process. Modern automobiles have become more advanced, and their assembly more nuanced. It has become increasingly important to rely on technologies of the future to maintain efficiency. However, such technology has traditionally been too large or expensive to implement on a wide scale within the production line. With the right technology in the hands of the technicians at SIA, their ability to plan and execute critical tasks would be more efficient and less strenuous. The slow adoption of technological optimization within production lines is costing SIA financially in current and future manufacturing and assembly.

Problem Statement / Scope of Work

Subaru at Indiana Automotive (SIA) wants to remain competitive in the automotive industry through the use of new and advanced technology. Team 23's goal was to find ways for SIA to incorporate augmented reality into their company on multiple levels. To accomplish our task, we focused on uses of AR through training, work floor assistance, and instructional guides.

Requirements

Req.#	DESIGN REQUIREMENTS	DESIGN TARGETS	VALIDATION	
	RATIONALE			
1	Must be feasible to use	User friendly and able to work within defined spaces already available at SIA	Feedback from randomly selected employees [51]	
	The software and hardware must fit within the parameters of SIA's facilities and be usable for average workers for ease of integration			
2	Must reduce training time	New employees could be ready to hit the floor in less time	Timed sessions to compare the difference [51]	
	If employees can get to the floor in less time, SIA saves money and becomes more productive			
3	Must reinforce standard work	SIA is successful with their current procedures	Efficiency will be measured [51]	
	SIA is financially successful from their current procedures and AR should only contribute to improving those efforts			
4	Must improve training consistency	Workers must be trained thoroughly	Assessments and observation [51]	
	If everyone has the same program and it is effective, there will be less mistakes, and everyone will know correct procedures			
5	Reduction in overall training/cost	Faster more streamlined onboarding	Tracked by accounting [51]	
	Having one AR training program will make it possible to set the times training takes and measure cost more accurately			
6	Improve knowledge retention rate	Trainees	Tests/assessments [51]	
	Being able to retain information is incredibly important when mistakes can cause injuries or result in extra expenses			
7	Use Microsoft HoloLens 2	All using equipment	Given by Purdue and SIA [51]	
	At the request of Subaru HoloLens is the technology they wish to use regarding AR			
8	Develop a training program for (at least) new employees	Employees in need of training	Possible with Unreal Engine and Dynamics [51]	
	To be able to train with the HoloLens we need to have an effective program			

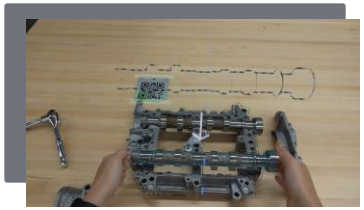
Experimentation and Concepts

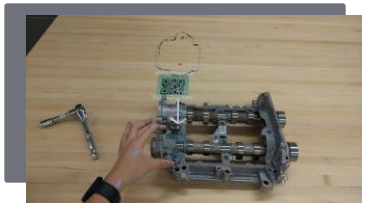
For experimentation we split into teams of two to create short demo's using the Microsoft HoloLens. With these demos we were able to gain a grasp of what the technology was capable as well as give us more experience using the technology.

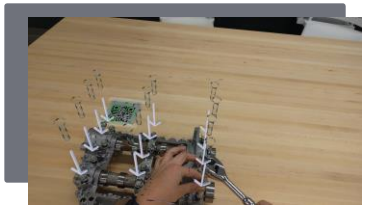
Another requested deliverable was demonstrating the HoloLens's ability to communicate on the internet using Microsoft Teams. Teams allow for engineers across borders to see and diagnose problems in real time.

Final Design

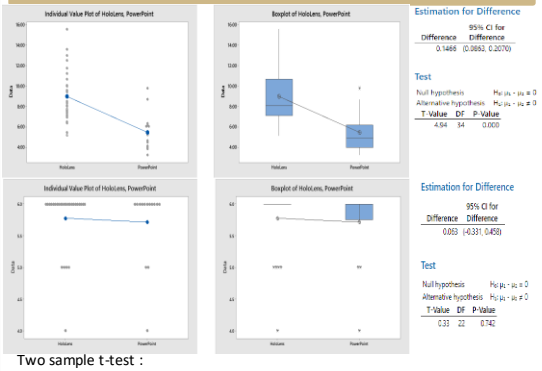
Our final design involved the creation of an interactive tutorial contained within the HoloLens 2 using Microsoft Dynamics Guides that provided step by step instructions on how to assemble a Subaru 2.5L boxer camshaft carrier.
By 3D scanning the camshaft carrier parts we were able to place high-definition 3D models into dynamics and provide instructions for each step of the assembly process.







Results



Two sample t-test :
- Time to complete task: p value > alpha level, there is a significant difference in completion time, the population using HoloLens 2 took longer to complete their guide compared to the Power Point population.
- Satisfaction level: Based on our results there is not a significant difference between the satisfaction levels of associates that completed the guide using the HoloLens 2 and associates that used the Power Point.

Testing

Testing was done at SIA with associates at different levels, just hired individuals and those who have years of manufacturing experience. After a short presentation explaining the project the follow process was preformed:

- Pull random associates
- Randomly assigned to complete the augmented reality tutorial or the PowerPoint tutorial
- Have associate complete tutorial
- Have associate fill out exit survey