Applicability Evaluation of Mobile Devices for Use within Manufacturing Environments

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Presentation Overview

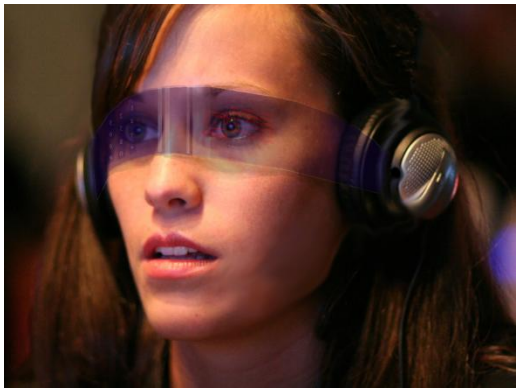
- Introduction
- Mobile Devices
- Objective
- Technology Selected
- Augmented Reality Technology
- Assembly Training
- UMPC Technology
- Pruefcubing
- Discussion

Introduction

- It is hypothesized that the use of mobile devices will lead to more precise and reliable decision making processes, overall increasing efficiency.
- This study presents the initial stages of a project performed by BMW exploring the use of mobile devices within differing manufacturing environments.
  - Assembly Training – Augmented reality
  - Pruefcubing – UMPC Technology
- This paper discusses the analysis performed to identify deficiencies within the processes and how they can be addressed through the use of mobile devices.
- A review of applicable devices will be presented with justification for their selection.

Why Mobile Devices?

- The trend from the traditional local, centralized model to the distributed, dynamic model has resulted in challenges the processing, integration and communication of information between different stakeholders.
- The growth in wireless networks and the increasing trend in the workforce becoming mobile has increased demands for mobile applications.
- Mobile Devices allow for:
  - Broadband communication used for both voice and video based communication.
  - Large data transfers.
  - Wearable mobile device in a production environment is important when hands free operation is needed.



Objective

- This study will investigate the technical maturity and the benefit potential of using mobile devices within a manufacturing environment identified by BMW.
- BMW's preliminary investigation included:
  - Performing an analysis to identify suitable manufacturing processes
  - Evaluation the applicability of mobile devices within manufacturing environments
  - Selection of appropriate mobile devices
- This presentation will present the results of this preliminary work.
- **Proof of concept and data collected cannot be released due to proprietary reasons.**
- The manufacturing processes analyzed are:
  - The use of Augumented reality within assembly training
  - The use of UMPCs within Pruefcubing

Technology Investigated

- The emergence of Augmented Reality and UMPC devices has enabled them to become viable tools within manufacturing.
- The following technology was selected from a list of technologies available for their suitability for use within a manufacturing environment.
- Key Advantages
  - Ubiquity: access from many locations
  - Reach-ability: users can be reached when not in their normal location
  - Convenience: it is not necessary to have access to fixed line connections

Augmented Reality

- Augmented reality, unlike virtual reality, Superimposes information in the form of audio, text, graphics and other sense enhancements over a real world environment.
- Advantages:
  - Flexible, no hand use needed.
  - Real time data transfer
  - Ability to identify where the user is and the orientation of their viewing perspective.
  - Ability to identify the user's location in reference to their surroundings.

Components of Augmented Reality

- 1. Head-mounted display
  - Provides the user with the overlay of information.
- 2. Tracking system
  - Provides the system information as to where the user is located and their perspective.
- 3. Mobile Computer
  - Stores, transfers and processes information

Assembly Training

- As a premium manufacture of high quality vehicles with facilities worldwide, BMW must ensure their training is standardized and effective
- Training is needed for all new associates:
  - Associate understands their duties
  - Minimize waste due to mistakes
  - Manufactured products meet demands
- The trainer explains the process and allows the associate to perform the operation under direct supervision.
  - Over time, the trainer provides the associate with greater freedom until the trainer is confident the associate can perform their assigned tasks and duties.
  - Process is costly. Requires one day of full training and two weeks of monitoring.
- This is performed so that the overall training costs and training throughput time are reduced.

Assembly Training Comparison

Existing

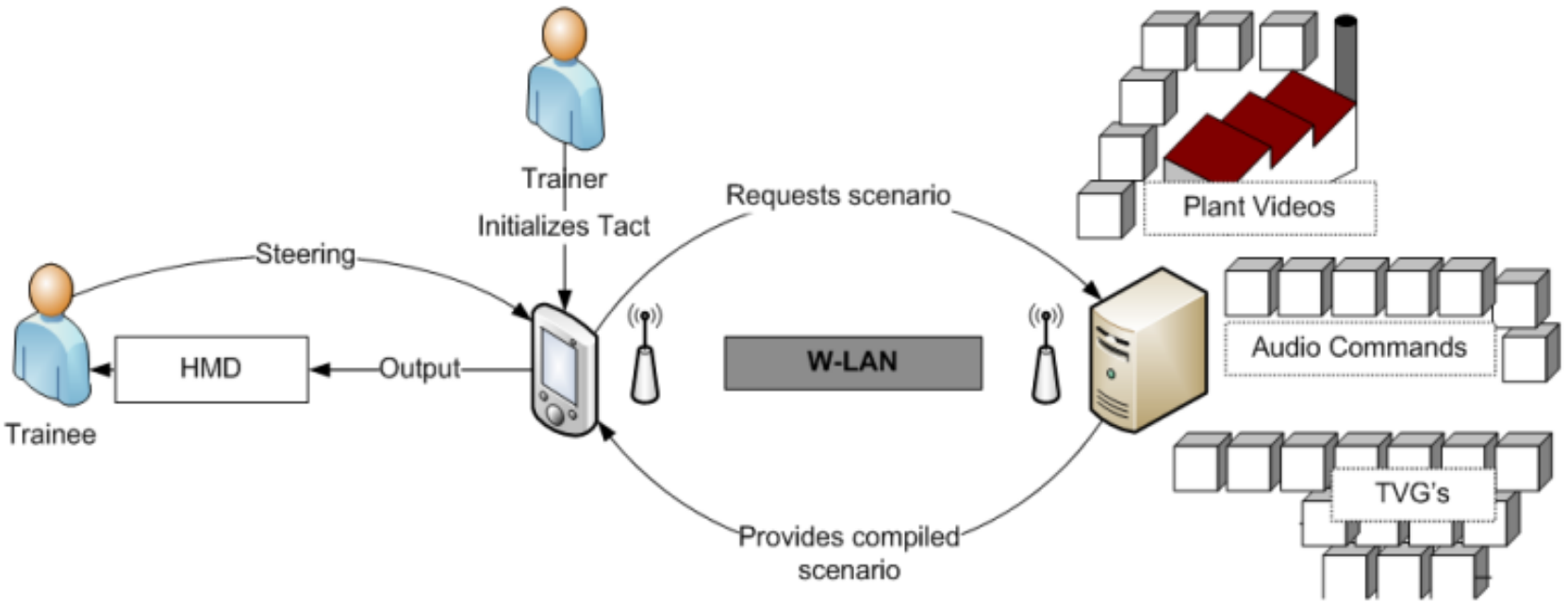
- The associate is provided an orientation process where the basic skills are taught.
- Trainer monitors their work, ensuring to correct any mistakes that occur during their training. Eventually the associate is given full responsibility where they do not communicate with trainer.

Proposed

- Introduction to how their augmented reality device will guide them through the process.
- The HMD retrieves information from a mobile computer connected to a wireless network. This computer will retrieve the necessary training information and feed it into the HMD.
- Information includes training information, procedures, and scenarios. Additionally, the associate can learn the assembly steps autonomously.

Proposed System

- Server holds the relevant information consisting of TVG
  - TVG is a German acronym for “Teilevorgang” - Describes the process steps for assembly.
- TVGs can come in the form of videos and audio instruction.
- Modules can be completed for training certification



Ultra Mobile Personal Computer

- The ultra-mobile PC is a form of computing designed for superior mobility.
- It was developed to fill that need between those who wished to have a computer larger than a Smartphone, yet smaller than a laptop, approximately the size of a paperback book.
- The UMPC is small and light enough to travel with its user while operating it.
- Advantages of a UMPC:
  - Input through physical input (keyboard and touch screen)
  - Audible and video transfer.
  - Information services that are accessible with a mobile device on a network, independent of its location.
  - Small form factor.

Pruefcubing

- Pruefcubing is a process in which an OEM supplier is able to physical test how their part or subsystem fits and mates with the vehicle it is designed for.
  - With the ability to pruefcubing, suppliers and OEMs are able to verify, through testing, new car parts during the development process.
- This starts with the use of a high precision machined vehicle body.
  - This body is machined to “zero tolerance” so that it may have a “perfect shape.”
- To take advantage of this testing capability, hundreds of car parts are handled during the weeks pruefcubing is available.

Pruefcubing

- The manner in which data is collected is inefficient and non-structured.
  - Suppliers are left to gather their own data by their own means.
  - Some suppliers wish to manually insert data on a notebook while others will take pictures and take notes within the photos.
- Using mobile devices:.
  - Suppliers will have a structured process by which they are able to collect and edit their data within the UMPC.
  - BMW may also be able to view this data through this method as the data collected in the mobile device will be shared amongst the supplier and OEM.

Proposed System

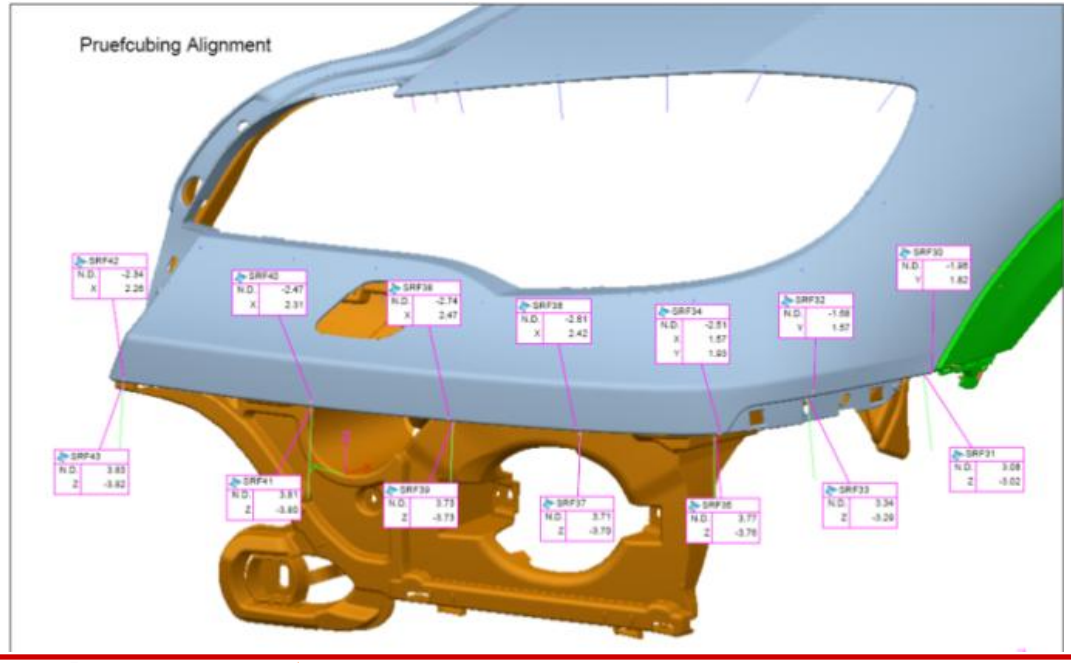
Existing

- Currently there exist no standard pruefcubing process. Suppliers are able to enter the facility and make the needed measurements at their convenience.
- There is a coordinate measuring machine (CMM) that can be used for measurements where suppliers can measure data.

Proposed

- Hand notes are not needed as the supplier associate is able to capture the textual information through the keyboard or screen touchpad.
- Any pictures needed could also be taken with the UMPC. A significant advantage here is the edit or make marks on the photo while on the UMPC.
  - This does not require transferring the photo from one medium to another (camera to a computer) so that editing may take place.
- All CMM information may also be directly transferred to the UMPC.

Proposed System



Limitations

Augmented Reality within Assembly Training

- The use of augmented reality removes the need for human interaction with the associate.
- Tool will introduce technological complexity within the training process.
  - This will require the user to become familiar with the use of augmented reality.
- The trainee is limited in the input they can provide the augmented reality system. Cannot seek help in time of difficulty.

UMPC within the Pruefcubing process

- The willingness of the supplier to record part data on a device that does not belong to them.
- Many suppliers must complete a company specific form that may not be available on the UMPC.
- The transfer of such information will be needed as to ensure the UMPC carry all information needed for the supplier to conduct their pruefcubing test.

Results and Discussion

- Technological solutions that could be used to make a manufacturing process more efficient, less time consuming, and more convenient for the user.
- The use of augmented reality suggests that it would provide the ability for standardized training.

Augmented Reality

- Save money needed for trainers and standardize training.
- The new trainees will be able to work at their own pace.
- The trainee may also attempt to train themselves within different assembly lines.
- Number of trainees not limited by number of trainers available.

Results and Discussion

Pruefcubing

- Many deficiencies were identified within pruefcubing process that related to data recording and documenting existing data.
- This posed a threat as information could potentially be lost or misinterpreted when transferred from one medium to another (from sheet of paper to a computer document).
- Use of mobile devices also allowed the supplier the ability to stay in one centralized location.
  - There was no need to travel from one location to collect data to another location where data may be stored within a computer.
  - With use of a UMPC, which is provided by BMW, all CMM data may be directly transferred to appropriate UMPC based on the need of the supplier.

Mobile Inspection

- Recently completed work motivated by this preliminary study included the testing of augmented reality within vehicle inspection.
- Further technology readiness analysis was performed.
  - Visual Communication: Augmented Reality, Palm, Large screen TVs
  - Oral Communication: Voice Recognition, Oral reading
- Implemented and tested within manufacturing environment for statistical data.

Questions

Thanks you

Questions