SMART: Shipyard Mobile Applications in Real Time Project

March 12-14, 2019
Charleston, SC
SMART

• Enhance workflow by digitizing procedural instructions and implement a location aware markerless Augmented Reality mobile application.
• Develop an application that allows users to scan multiple compartments, recognize the compartments, place object(s) in the virtual environment, and guides user through the compartments.
• Mobile application capable of:
  o Markerless registration
  o Occlusion
  o Object persistence
  o Navigation (without GPS, or Wifi, or Bluetooth)
Project Status Overview

• Developed shipyard mobile applications
  o Turnkey mobile application solution
    ▪ Quality, schedule, technical information
    ▪ Location aware
    ▪ High velocity exchange of information
  o Perform quality inspections, access relevant information
  o Point and tap system for inspection, issue reporting, progressing, documenting change conditions

• Testing application and conducting shipyard pilot and user evaluation
Project Objectives / Goals

• Eliminate “guesswork” out of shipbuilding
• Provide “near” real-time visibility of deckplate activities
• Improve first-time quality of shipyard production
• Capture actions, progress, change conditions (without paper)
• Provide high velocity mobile learning application to workforce
Team Members

• Bollinger Shipyards - Lockport, LLC (Prime)
• D’Angelo Technologies, LLC (D5T)
• Sparkhound, Inc.
• Hepinstall Consulting Group, Inc.
• General Dynamics Electric Boat
• General Dynamics Bath Iron Works
Tasking

• Task 1 – Project Management
• Task 2 – Formalize Current State and Future State (Relevant Shipyard Systems, Practices, Processes)
• Task 3 – Formalize Mobile Security Requirements
• Task 4 – Perform Technology Evaluation
• Task 5 – Finalize SMART System – Performance Specifications
• Task 6 – Capture and Map the System and Process Interfaces
• Task 7 – Develop the Mobile Shipyard SMART Application
• Task 8 – Develop the Shipyard Augmented Reality SMART Application
• Task 9 – Test & Evaluate the Applications
• Task 10 – Train Pilot Participants
• Task 11 – Pilot implementation and Measure
• Task 12 – Demonstrate Shipyard Mobile Application
• Task 13 – Develop Commercialization Strategy for the SMART Shipyard System
• Task 14 – Final Dissemination of Results to Industry
Technology Evaluation
Evaluation

Development

ARKit
ARCore
Wikitude
Unity

Devices

iPad Pro 10.5
ASUS Zenfone AR
Google Pixel 2 XL
Surface Book 2
<table>
<thead>
<tr>
<th>Device</th>
<th>iPad Pro 10.5 inch</th>
<th>Asus Zenfone AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR Capability</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Markerless Registration &amp; Persistent Tracking</td>
<td>✓ (expected)</td>
<td>✓</td>
</tr>
</tbody>
</table>
| Performance     | Chipset: Apple A10X Fusion  
CPU: 6 Core @ 2.38 GHz  
GPU: 12 Core  | Chipset: Qualcomm MSM 8996  
Snapdragon 821  
CPU: Quad-Core (2x2.35 GHz Kryo & 2x1.6 GHz Kryo)  
GPU: Adreno 350 |
| Size            | Dimensions: 9.87 x 6.85 x 0.24 in  
Screen size: 10.5 in                             | Dimensions: 6.25 x 3.06 x 0.35 in  
Screen size: 5.7 inches                              |
| Battery         | Non-removable Li-Ion 8134 mAh                         | Non-removable Li-Ion 3300 mAh                        |
| Cost            | New: $649.00+                                          | Used Like New: $250+                                 |
| SMART Application| Uses newer SLAM algorithms without needing additional hardware | Utilizes Tango hardware to execute SLAM algorithms |
## Requirements

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Is the device cost effective? – Is it ideal for an enterprise wide scalable approach?</td>
</tr>
<tr>
<td>Risk</td>
<td>During the use of SMART are there any user risks caused by the device or software?</td>
</tr>
<tr>
<td>Ruggedness</td>
<td>Is the device and its accessories ruggedized to withstand the shipyard environment?</td>
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<tr>
<td>User Friendliness / Ease of Use</td>
<td>Is the overall ability to use the SMART system easy to understand?</td>
</tr>
<tr>
<td>Application Appropriate</td>
<td>Does the system benefit the future work load?</td>
</tr>
<tr>
<td>Performance</td>
<td>Does the devices hardware perform every task efficiently?</td>
</tr>
<tr>
<td>Customization</td>
<td>Is the application customized to meet the needs of the operation?</td>
</tr>
<tr>
<td>Software Application</td>
<td>Is the software application efficient enough to complete SMART based efforts and meet necessary requirements?</td>
</tr>
<tr>
<td>Markerless Localization</td>
<td>Does the SMART application support markerless localization?</td>
</tr>
<tr>
<td>Markerless Registration</td>
<td>Does the SMART application support markerless registration?</td>
</tr>
<tr>
<td>Tracking</td>
<td>Does the SMART device support tracking?</td>
</tr>
<tr>
<td>Persistence</td>
<td>Does the SMART application support persistence?</td>
</tr>
<tr>
<td>PDF Viewer</td>
<td>Does the SMART application support a PDF viewer that works with a stylus?</td>
</tr>
<tr>
<td>Low Maintenance</td>
<td>Is the user able to operate the system with minimal maintenance requirements?</td>
</tr>
<tr>
<td>Scalability</td>
<td>Is SMART able to be distributed across multiple devices?</td>
</tr>
</tbody>
</table>

| Size                        | Does the size of the device meet the needs of the project?                  |
| Battery Life                | Does the battery last a shift (recharged between morning and afternoon during lunch)? |
| Features                    | Does the device have all the features needed to meet SMART requirements? (i.e. Stylus, External Battery, etc.) |
| Stylus                      | Does the device have a stylus to allow the user to easily edit internal documents? |
| External Battery            | Does the device have a big enough internal battery to last a complete work day? If not, does the device have an external battery attached? |
| External Case               | Does the device meet the minimum screen size? If not, does the device have an external screen attached? |
| Security Requirements       | Does the SMART application and device meet the shipyard and ship program security requirements? |
| System Weight               | Is the weight of the device ideal to carry throughout an entire work day or task-based effort? |
| Application Learning Curve  | Is the user able to quickly understand and use the device and software?     |
| Internal Storage            | Does the device have enough internal storage? – Can storage be added?       |
| Resolution and Display Quality | Is the application on the device able to be clearly seen? – Can the display settings be changed? |
| Wireless Connectivity       | Is the device able to connect wirelessly via 4G, 3G, Bluetooth, Wi-Fi, etc.? Is this necessary for device functionality? |
| Life-Cycle                  | Is the hardware durable enough to last the longevity of the SMART project?   |
| Graphical User Interface    | Does the SMART application allow for a clean and simple GUI?                 |
Process

Process: Locate Specific Component to be tested

001 Turn on SMART Device
002 Verify Equipment Location is Registered in SMART Device
003 Access Work Site
004 Point SMART System toward equipment
005 From list of components that pop up, Click on the desired component
006 Follow the guide pin on the device to locate the physical equipment

- Other Processes Captured
  - Capture and View Tags/Notes
  - Access Work Instruction
D5T’s SMART Application
Sparkhound’s SMART Application
Enables a System of Dynamic Discovery
- Access to Relevant Information at Point of Use

Enables Collaborative Problem Solving
- Seeing Problems & “Swarming” to Solve

Enables Wide Dissemination of Knowledge
- Share and Sustain the Knowledge Base

Enables Timely Information Exchange
- Provide timely technical feedback and progressing
S.M.A.R.T Use Cases

Red fill = AR driven

Quality Tester (actor)
- Determine Location
- Add Quick Notes by Location
- Access Test Procs
- Access Callout Data
- Access Drawings
- Access Drawing Overlay
- Access Progressing Data
- Update Progressing Data
- Update Callout Data
- Update Test Procs
- Sync Device
- Train Users

Administrator (actor)
- System Configuration
- Troubleshoot Sync Issues
- Review Sync History
- Administer Users
Questions?