Panacea’s Cloud:
Intelligent Dashboard for Augmented Reality based Co-ordination for Mass Casualty Disaster Triage

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Mark Vassell and Olivia Apperson
(Computer Science Students)
The Need/Importance

• “Time” and “situational awareness” are critical during disaster relief
• Ingenuity of an intelligent dashboard integrated with Internet of Things (IoT) can drastically improve coordination and communication
  • *Ineffective triage may increase morbidity and mortality*
• Provides an augmented communication system between incident commanders and first responders in a mass casualty disaster incident
  • Substitutes for limited or absent scene infrastructure
Popular Solution from Intermedix ©

- Cluttered and not very user friendly
- No integration of IOT applications or medical systems
- Outdated and limited functionality
Intermedix Review

• Our University of Missouri institution’s protocol named CODE SILVER is based on the hierarchal Incident Command System (ICS), whose technology is provided by Intermedix.

• This system relies on existing operational infrastructure as the communication backbone to coordinate efforts between ICS divisions.

• The Intermedix offering is just a text-based web-application for incident response status notifications, and offers basic synchronous text messaging.
Previous Prototype: Panacea’s Glass

- Identified problems
  - Small network area
  - Simplistic Dashboard
  - Google Glass multi-video co-ordination problem

- Decided to improve communication by creating an Intelligent Dashboard – achieve least manual actions
  - Improving Glass communication
  - Integration of virtual beacons

<table>
<thead>
<tr>
<th>TABLE I: Indoor Range Quality Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (ft)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE II: Outdoor Range Quality Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (ft)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>110</td>
</tr>
</tbody>
</table>
New Solution: Panacea’s Mobile Cloud

- **Responder Theater Dashboard**
  - Provides an effective way for Incident Commanders to communicate with first responders in a medical incident or natural disaster
  - Works without dependence of any scene infrastructure
- **Easy-to-use interactive interface**
  - Incident Management
  - Patient Status Tracking
  - Supplies Replenishment
  - Responder Co-ordination
- Incident Commander can quickly assess any part of the dashboard and give aid to staff on the scene
- Comprised of an Incident Command System (ICS) with integration of Internet of Things (IoT)
Dashboard Brainstorming
Our NEW Responder Theater Dashboard
Add Incident

Add Incidents

Select Type of Incident
- Real Incident
- Exercise/Drill

Incident Description
This notification will be sent out to all specified contacts:

Enter description here

Incident Mission Statement

Enter Mission Statement Here

Select Staff

- Mark Vassell | Developer
- Olivia Apperson | Developer
- John Hampton | Pulmonologist
- Brian Lee | Surgeon
- Ashley White | Clinical nurse specialist
## List of Incidents

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Name</th>
<th>Description</th>
<th>Status</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Exercise/Drill</td>
<td>vehicle accident</td>
<td>Create</td>
<td>In progress</td>
<td>2015-07-22 12:55:37</td>
</tr>
<tr>
<td>20</td>
<td>Exercise/Drill</td>
<td>vehicle accident</td>
<td>This is a test</td>
<td>In progress</td>
<td>2015-07-22 12:14:40</td>
</tr>
</tbody>
</table>
Notifications Page

- Ambulance Arrived to Fire in building 1: 2015-07-22 10:17:56
- This is a test: 2015-07-22 12:14:40
- Situation Resolved: 2015-07-22 10:30:25
- Security Alert Test: 2015-07-22 00:15:05
- Fire in building 1: 2015-07-22 10:11:46

View All Activity
## Supplies

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Number of Blood Bags</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Hospital Building A</td>
<td>24</td>
<td>555-555-55555</td>
</tr>
<tr>
<td>University Hospital Building B</td>
<td>37</td>
<td>555-555-55555</td>
</tr>
<tr>
<td>University Hospital Building C</td>
<td>45</td>
<td>555-555-55555</td>
</tr>
</tbody>
</table>

### Max Amount

- **Supply 1**: Current Level
- **Supply 2**: 88
- **Supply 3**: 85
- **Supply 5**: 86
- **Supply 6**: 87
Map
Google Glass Feed Integration

WebRTC live streaming

Remote Streams

<table>
<thead>
<tr>
<th>Stream</th>
<th>1-way</th>
<th>2-way</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>View</td>
<td>Call</td>
</tr>
<tr>
<td>G1</td>
<td>View</td>
<td>Call</td>
</tr>
</tbody>
</table>

Local Camera

Username: a00

Share this link:
localhost:3000/Wljplk3V0Sk3TwY4h05A
Staff Assignment to Incident

- From the staff page the admin has the ability to search for any staff that is stored in the database.
- All the information about the searched person will be displayed to the incident commander.
Add Staff Page

- The incident commander has the ability to add new staff to the database
  - Handy when there is an Emergency situation that will require outside help
Co-ordination Scheme for Resource Prioritization

- Based on handling the prioritization of personnel and medical supplies between responder stations
- Recommends actionable intelligence for major Incident Commander actions
  - *Active*: orchestration of video feeds between the Incident Commander and First Responders at the scene; ambulance routing tasks
  - *Passive*: Dynamic tracking and replenishment of medical supplies; logging of response activities
By accessing the QR code scanner on the glass, staff can quickly change the status of a patient in the database and enable other micro-location based services.

<table>
<thead>
<tr>
<th>Triage Color</th>
<th>Acuity</th>
<th>Need for Treatment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td>Emergent</td>
<td>Immediate</td>
<td>Threat to life, limb, or organ</td>
</tr>
<tr>
<td>YELLOW</td>
<td>Urgent</td>
<td>Delayed</td>
<td>Significant injury or illness but can tolerate a delay in care</td>
</tr>
<tr>
<td>GREEN</td>
<td>Non-Urgent</td>
<td>Minimal / Non-Urgent</td>
<td>Can safely wait for treatment</td>
</tr>
<tr>
<td>BLACK</td>
<td>Expired or Expected to Expire</td>
<td>No treatment; Treat if resources are available, comfort care</td>
<td>Consider transport and care for expectant patients after initial &quot;Reds&quot; are cleared, if resources exist and it does not delay care for Yellows.</td>
</tr>
</tbody>
</table>
Heat Experiment

- **Heat Study:**
  - Measured temperatures on Google Glass and Recon Jet during video and audio stream processing.
  - Concluded that Recon Jet had a lower temperature and would be more advantageous to use.

<table>
<thead>
<tr>
<th>Wearable Technology</th>
<th>0 Sec.</th>
<th>1 Min.</th>
<th>5 Mins.</th>
<th>10 Mins.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Glass</td>
<td>105° F</td>
<td>115° F</td>
<td>130° F</td>
<td>133° F</td>
</tr>
<tr>
<td>Recon Jet</td>
<td>90° F</td>
<td>97° F</td>
<td>117° F</td>
<td>124° F</td>
</tr>
</tbody>
</table>
Connection Experiment

- Connection Study:
  - Tested length of stream connection with Google Glass and Recon Jet in static and dynamic environments
  - Recon Jet did not disconnect for both static and dynamic situations, but Google Glass disconnected

<table>
<thead>
<tr>
<th>Wearable Technology</th>
<th>Static (minutes)</th>
<th>Dynamic (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Glass</td>
<td>7:59</td>
<td>2:20</td>
</tr>
<tr>
<td>Recon Jet</td>
<td>Did Not Disconnect</td>
<td>Did Not Disconnect</td>
</tr>
</tbody>
</table>
Usability Experiment

- Simulation Study:
  - Incident Scenario: Conducted a two-incident simulation (car crash and building fire) to test co-ordination effectiveness for commander response

- Expert Opinion:
  - Discussed improvements with actual ICS user to provide better communication and co-ordination
  - Test subject concluded that Panacea’s Glass Intelligent Dashboard was ‘Very Effective’ for the claimed purpose!

<table>
<thead>
<tr>
<th>Section of Panacea’s Glass Intelligent Dashboard</th>
<th>Ease of Use (Score 1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup and Customization</td>
<td>5</td>
</tr>
<tr>
<td>Staff Pages</td>
<td>5</td>
</tr>
<tr>
<td>Incident Page</td>
<td>5</td>
</tr>
<tr>
<td>Facilities Page</td>
<td>5</td>
</tr>
<tr>
<td>Video Feeds</td>
<td>3</td>
</tr>
</tbody>
</table>
OKR Update

- OKR 1: Create an Intelligent Dashboard \(0.8\)
- OKR 2: Improve Glass Communication \(0.9\)
- OKR 3: Learn the Advances in Mobile, IoT Apps \(1.0\)
- Total: \(0.9\)
Conclusion

• Successfully created a Responder Theater Dashboard

• Integrated IoT into ICS to create an improved system better than the market offering from Intermedix!
  – In 6 weeks!! 😊

• Results from Usability Study suggest that incident commanders and first responders can successfully augment their triage of patients and resources using Panacea’s Mobile Cloud technologies
Future Work

• Continue to work on project this Fall semester
  – **Will have chance to demo Panacea’s Mobile Cloud to MU Chancellor Bowen Loftin @ Coulter Awards Ceremony in September 2015**

• Work on improving the Responder Theater Dashboard

• Do further work on QR codes
  – Turned out to be very critical based on Task Force 1 meeting

• Continue to work on engineering better video communication quality

• Improve path planning algorithm and use in a large-scale simulation demo

• Many more...