



# Panacea's Cloud:

## Intelligent Dashboard for Augmented Reality based Co-ordination for Mass Casualty Disaster Triage

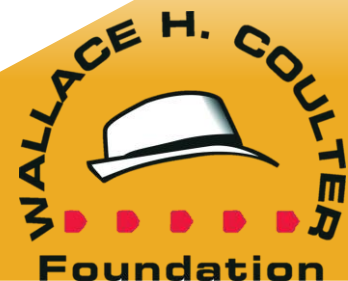
**Salman Ahmad**, MD, FACS, Prof. of Surgery

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**John Gillis** (Computer Engineering Student)

**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- Outdated and limited functionality

The screenshot displays the eICS MHA web interface. At the top, there are navigation tabs for Planning, Response, Recovery, and Settings. The main content area is titled 'Home - Active Incidents' and contains a table with the following data:

Type	Facility	Incident	Start Date	Period
<a href="#">View</a>	University Hospital	Fire	11 Jun 2015 13:20	Immediate
<a href="#">View</a>	University Hospital	Security Alert	08 Jun 2015 11:40	Immediate
<a href="#">View</a>	University Hospital	Fire	08 Jun 2015 09:12	Immediate

Below the incidents table is an 'Improvement Plan' section with a table:

Action	Due Date	Responsible Party	Issue
Ensure pager numbers are entered into eICS profiles for all key management staff		Pat Van Hunnik	Add pager number to profile of all key management staff
Get updated ORG chart for University Healthcare		Rob Loseman	Update ORG Chart

On the right side of the interface, there are 'Quick Links' for 'Create Incident' and 'Update My Information', followed by a 'Missouri Hospital Association Announcement' section with contact information for emergency preparedness staff.

At the bottom of the page, there is a footer with copyright information: © 2014 Intermedix (Terms of Service) (Privacy Policy), eICS® 2.5.1.0, and Mark Vassell | 09 Jul 14:34.



# 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

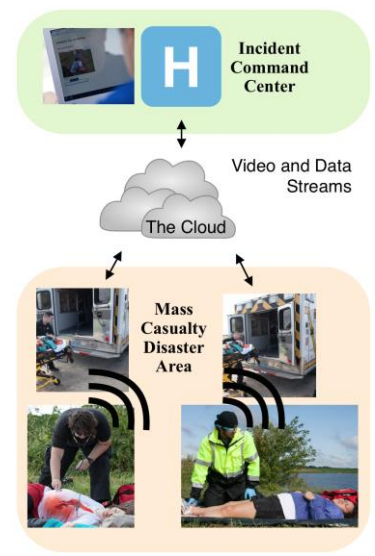
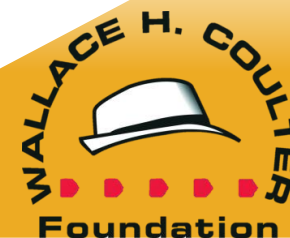


TABLE I: Indoor Range Quality Table

Distance (ft)	Quality	Lag Time Change
1	Great	100%
10	Great	150%
50	Good	300%
80	Good	300%
100	Acceptable	300%
160	Unusable	Infinite (Disconnected)

TABLE II: Outdoor Range Quality Table

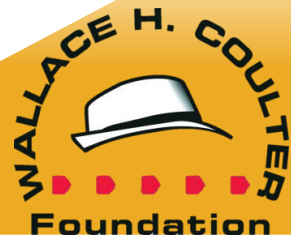
Distance (ft)	Quality	Lag Time Change
1	Great	100%
10	Great	100%
50	Good	100%
80	Acceptable	200%
100	Poor	250%
110	Unusable	Infinite (Disconnected)





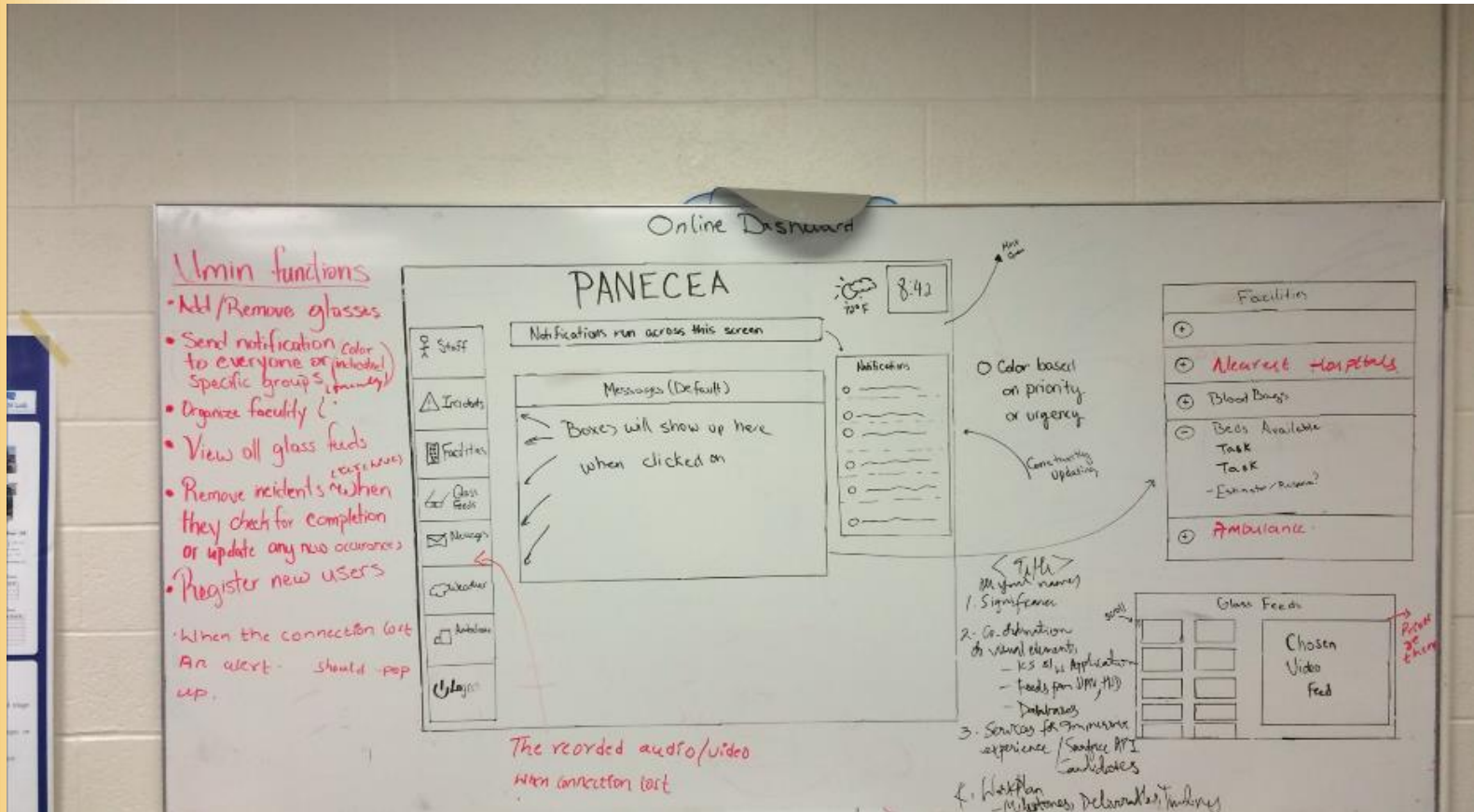
# New Solution: Panacea's Mobile Cloud

- 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



The recorded audio/video when connection lost





# Our NEW Responder Theater Dashboard

PANACEA'S GLASS 📧 🔔 👤 Dennis Vassell

- Dashboard
- Staff
- Incidents
- Facilities
- Video feeds
- Notifications

**6**  
New Incidents  
[View Details](#)

**7**  
Current Staff  
[View Statuses](#)

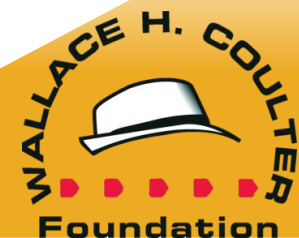
**2**  
Glass Feeds  
[View Feeds](#)

**Half**  
Supplies  
[View Supplies](#)

### Notifications

- Ambulance Arrived to Fire in building 1 **2015-07-22 10:17:56**
- Vehicle accident **2015-07-22 13:26:33**
- Create **2015-07-22 12:55:38**
- Patient in need of help **2015-07-22 12:27:55**
- This is a test **2015-07-22 12:14:40**
- Fire Drill Evacuate **2015-07-22 12:04:23**
- Situation Relsolved **2015-07-22 10:30:25**
- Fire contained **2015-07-22 10:25:53**
- Security Alert Test **2015-07-22 00:15:05**
- Fire in building 1. **2015-07-22 10:11:46**

[View All Activity](#)







# Add Incident

## Add Incidents

[Dashboard](#) / [+ Add Incidents](#)

### Select Type of Incident

- Real Incident
- Exercise/Drill

Select An Incident ▾

### Incident Description

This notification will be sent out to all specified contacts:

Enter description here

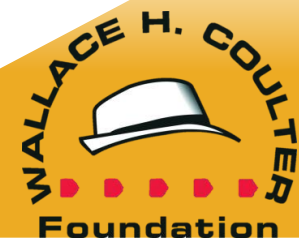
### Incident Mission Statement

Enter Mission Statement Here

## Select Staff

[select all](#) [remove all](#)

Mark Vassell   Developer
Olivia Apperson   Developer
John Hampton   Pulmonologist
Brian Lee   Surgeon
Ashley White   Clinical nurse specialist

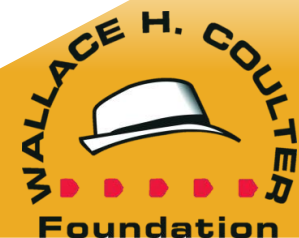




# View Incident

## List of Incidents

Edit	ID	Type	Name	Description	Status	Time
Edit	23	Exercise/Drill	vehicle accident	Vehicle accident  pa	Escalating	2015-07-22 13:26:33
Archive/Remove						
Edit	22	Exercise/Drill	vehicle accident	Create	in progress	2015-07-22 12:55:37
Archive/Remove						
Edit	21	Actual Incident	Patient Surge	Patient in need of help  Solved the incident	Resolved	2015-07-22 12:27:55
Archive/Remove						
Edit	20	Exercise/Drill	vehicle accident	This is a test	in progress	2015-07-22 12:14:40
Archive/Remove						



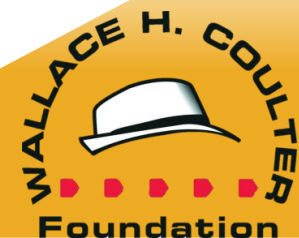


# Notifications Page

## 🕒 Notifications

- 📅 Ambulance Arrived to Fire in building 1 **2015-07-22 10:17:56**
- 📅 Vehicle accident **2015-07-22 13:26:33**
- 📅 Create **2015-07-22 12:55:38**
- 📅 Patient in need of help **2015-07-22 12:27:55**
- 📅 This is a test **2015-07-22 12:14:40**
- 📅 Fire Drill Evacuate **2015-07-22 12:04:23**
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- 📅 Security Alert Test **2015-07-22 00:15:05**
- 📅 Fire in building 1. **2015-07-22 10:11:46**

[View All Activity](#) ➔

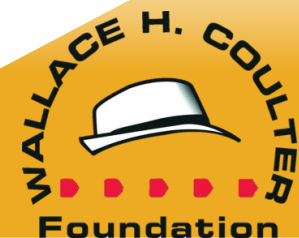
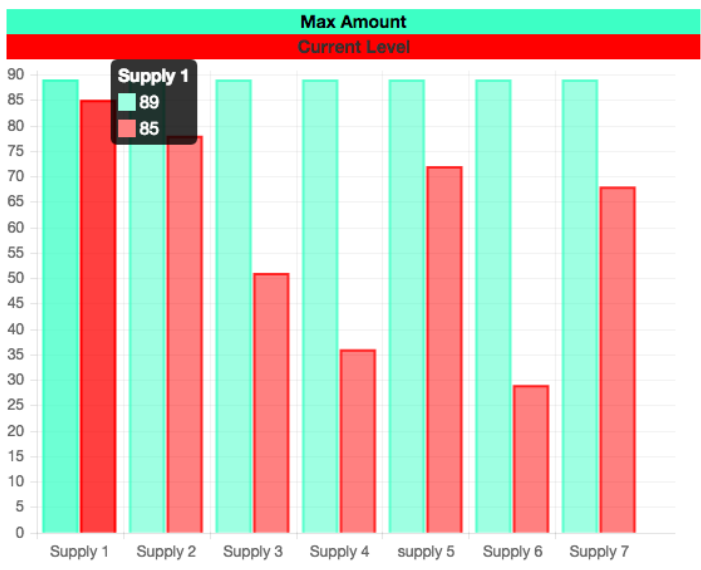




# Facility Supplies Page

## Supplies

Facility Name	Number of Blood Bags	Phone Number
University Hospital Building A	24	555-555-5555
University Hospital Building B	37	555-555-5555
University Hospital Building C	45	555-555-5555





# Map

PANACEA'S GLASS Olivia Apperson

- Dashboard
- Staff
- Incidents
- Facilities
- Video feeds
- Messages
- Notifications
- Patients

**3** New Incidents  
[View Details](#)

**7** Current Staff  
[View Statuses](#)

**2** Glass Feeds  
[View Feeds](#)

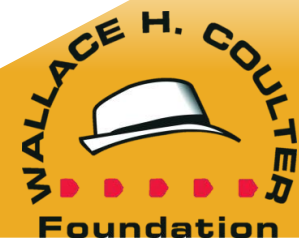
**Half** Supplies  
[View Supplies](#)

Glass User: John Smith  
[View Info](#)

Patient 1: Critical Condition  
[View Info](#)

### Notifications

- Ambulance **2015-07-22 10:17:56**  
Arrived to Fire in building 1
- Ambulance **2015-07-22 10:15:40**  
heading to Fire in building 1
- Fire in building 1. **2015-07-22 10:11:46**
- Security Alert **2015-07-22 00:15:05**  
Test
- Fire contained **2015-07-22 10:25:53**
- Situation **2015-07-22 10:30:25**  
Relsolved
- Car crash with **2015-07-21 23:07:58**






# Google Glass Feed Integration

Panacea's Dashboard

- Dashboard
- Staff
- Incidents
- Facilities
- Glass feeds
- Messages
- Notifications
- Maps

## WebRTC live streaming

### Remote Streams




Stream 1-way 2-way

G1	View	Call
G1	View	Call

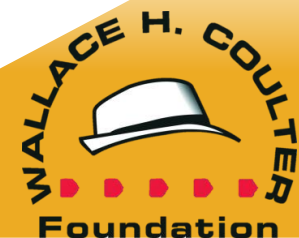
### Local Camera

Username :



Share this link :

<localhost:3000/Wjplk3VO5k3TwY4h05A>

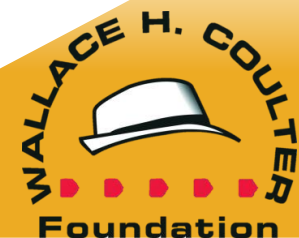




# Staff Assignment to Incident

Edit	Status	ID	First Name	Last Name	Email	Telephone	Job	Glass User
Edit Status	Unavailable	10305	Ashley	White	AWhite@health.com	+1 (314) 475 - 7856	Clinical nurse specialist	Yes
Edit Status	Available	10304	Brian	Lee	BLee@health.com	+1 (314) 376 - 9794	Surgeon	Yes
Edit Status	On Call	10306	Jay	Kelner	JKelner@TheJayKel.bis	+1 (888) 888 - 8888	Life Coach and CEO	Yes
Edit Status	Unavailable	10303	John	Hampton	JHampton@health.com	+1 (314) 576 - 9894	Pulmonologist	Yes
Edit Status	Available	10300	Mark	Vassell	mdvy96@mail.missouri.edu	+1 (314) 546 - 3894	Developer	Yes
Edit Status	Unavailable	10307	Mark	Vassell	dvassell@live.com	+1 (555) 555 - 5555	Developer	Yes

- 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

## Staff

[Dashboard](#) / [Add Staff](#)

**First Name**

**Last Name**

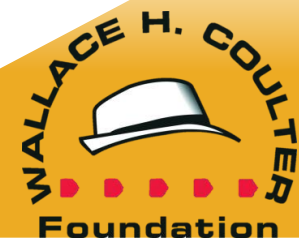
**Telephone**

Only enter numeric values and 10 digits values

**Email**

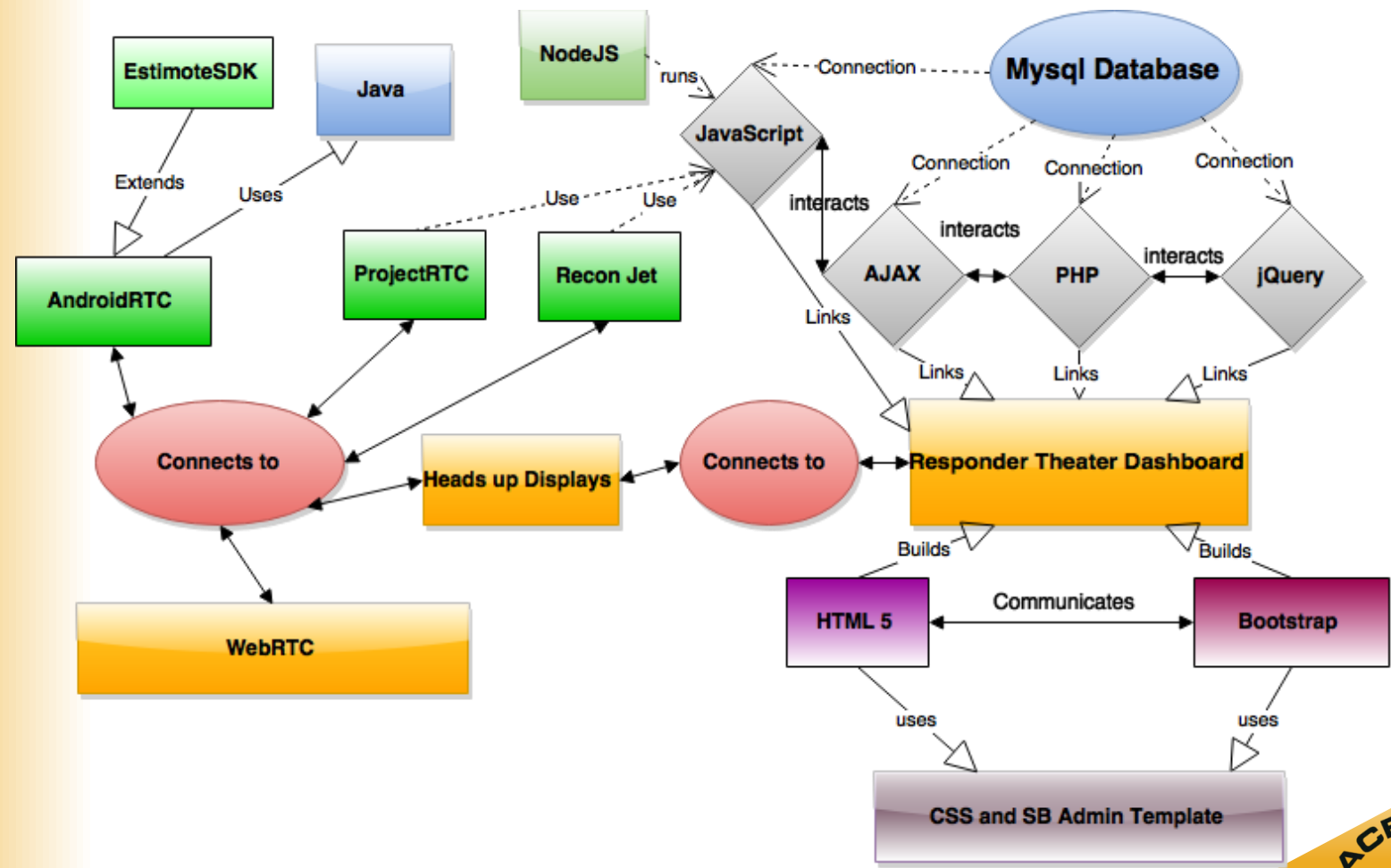
**Job**

**Glass User**  Yes  No





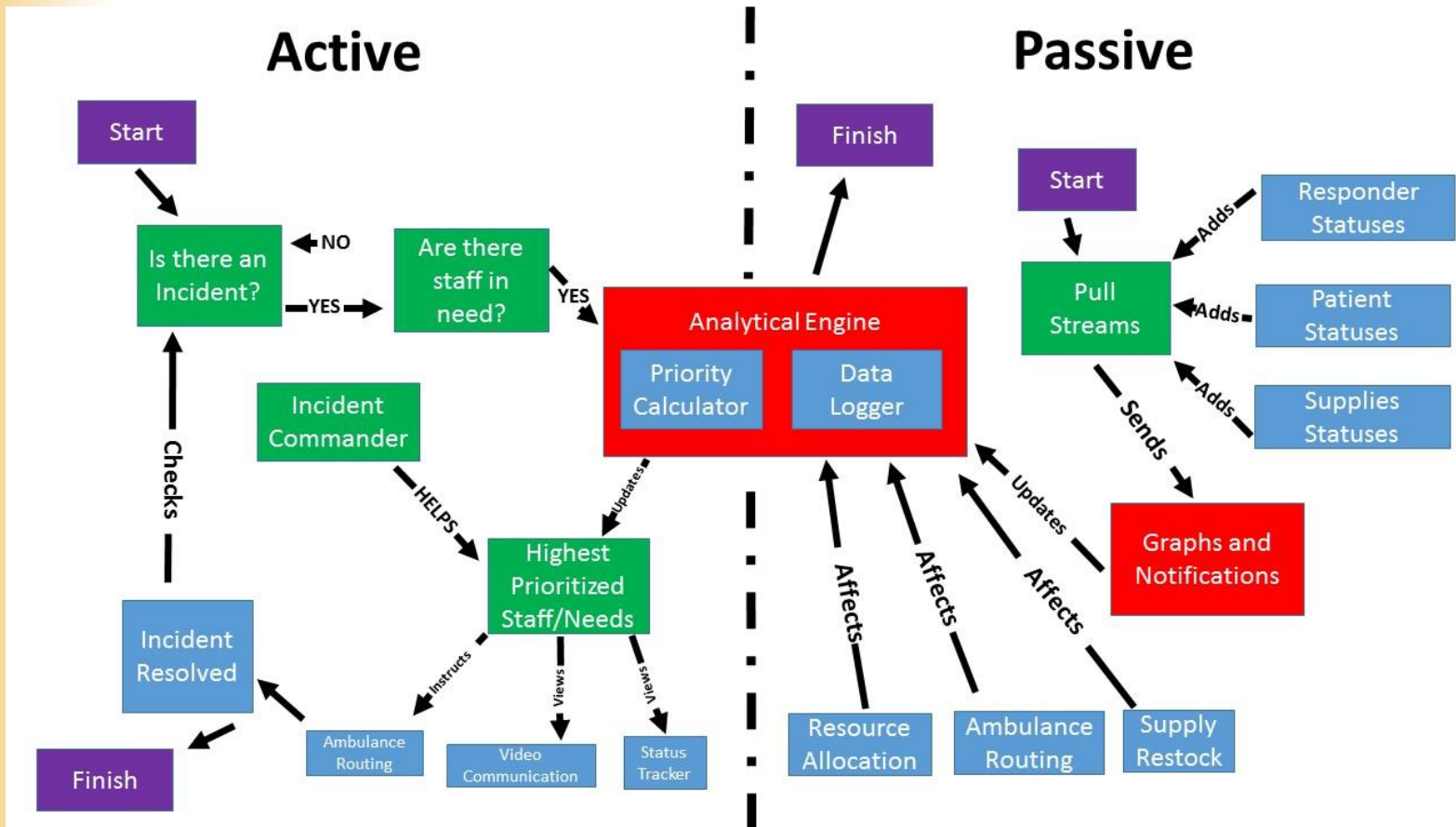
# Overall Software Architecture





# 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





# Status Trackers/QR Codes



- 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

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

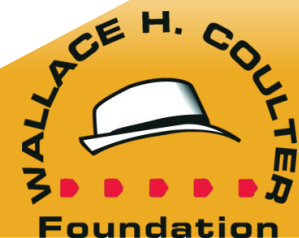




# Heat Experiment

- 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

Wearable Technology	0 Sec.	1 Min.	5 Mins.	10 Mins.
Google Glass	105° F	115° F	130° F	133° F
Recon Jet	90° F	97° F	117° F	124° F





# 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

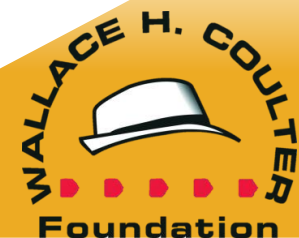
Wearable Technology	Static (minutes)	Dynamic (minutes)
Google Glass	7:59	2:20
Recon Jet	Did Not Disconnect	Did Not Disconnect



# 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!

Section of Panacea's Glass Intelligent Dashboard	Ease of Use (Score 1-5)
Setup and Customization	5
Staff Pages	5
Incident Page	5
Facilities Page	5
Video Feeds	3







# OKR Update

- OKR 1: Create an Intelligent Dashboard .8
- OKR 2: Improve Glass Communication .9
- OKR 3: Learn the Advances in Mobile, IoT Apps 1.0
- Total: .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...

