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Incorporating Google Glass with Emergency Medical Services

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Incorporating Google Glass with Emergency Medical Services

A Capstone Project Submitted in Partial Fulfillment of the
Requirements of the Renée Crown University Honors Program at
Syracuse University

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Science
and Renée Crown University Honors
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Honors Capstone Project in EMSGlass

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Date: 4/22/15

EMS Glass

Incorporating Google Glass with Emergency Medical Services

By: Davis Cho

Abstract

Technology's integration into the Emergency Medical Field has been lifesaving. Quicker response time, treatment, and transport to the hospital have been possible through the help of new technology. Telemedicine is not new, but the way it is communicated is evolving. What is unique about using Google Glass for EMS is it would not restrict the user's mobility or function, which is incredibly important for First Responders who might need two hands to do compressions for CPR. My Capstone Project will give First Responders, such as Paramedics and EMTs, an extra set of hands through utilizing Google Glass.

Executive Summary

A 911 call came through and the dispatcher was simultaneously talking to the 911 caller and using the Computer Aided Dispatch system to get the necessary vital information. It was a priority one call for a "40 year old male, traumatic fall." I used the On-rig touch screen computers to turn on the lights and siren. I radioed in, "A-1 to control, responding priority 1." Adrenaline was rushing through my veins as the traffic spread for our deafening ambulance. Upon arrival, I saw the patient laying face first on the cement sidewalk. The crew jumped out and rolled the battery powered stretcher to his side. The smell of dry blood was circulating inside the rig while we assessed the imminent medical needs and recorded them on our Toughbook laptop for wireless transmission to the hospital. In moments like these, I'm acceutely aware of the importance of technology and medicine working as one.

Working in the Emergency Medical Field as an EMT with Syracuse University, I have noticed the delay in writing a patient care report (PCR). It takes time writing a complete PCR on a call. In the past, most of the reports were written on a PCR document. Even with the recent upgrade to typing on a Toughbook laptop, it still takes too much time. For this reason, most EMTs give a verbal report to the nurses when they arrive at the hospital. When EMTs have multiple calls back to back, which is common on most nights, it can be difficult to finish a PCR before the next call. This reduces the accuracy of the report when the EMT has to write multiple reports at the end of the night. By this time, the hospital would already have taken their own assessment on the patien twice, wastes valuable time that can be better spent on patient care. For instance, time is of essence for stroke patients, and it is important to get the patient to a stroke team under an hour (Golden Hour). For this reason, I wanted a wearable device that can voice

input the “verbal report given to the nurses” and give a patient assessment video to the stroke team prior to arriving at the hospital.

Technology’s integration into the Emergency Medical Field has been lifesaving. Quicker response times, treatment, and transport to the hospital have been possible through the help of new technology. My Capstone Project will give First Responders, such as Paramedics and EMTs, an extra set of hands by utilizing Google Glass. The first stage of the project will be connecting the First Responders with the hospital. For instance, a Paramedic who arrives on scene to a mass casualty bus crash can connect to the hospital to assess the situation. The lead ER doctor or Trauma surgeon can carry a tablet device to stream the emergency scene. This allows the Physician free range to move around the hospital, while interacting with the first responders. Communication with the hospital through use of a live video stream is a great deal more flexible than trying to explain it on the radio. This way, the hospital can prepare for what is to come more efficiently. Telemedicine is not new, but the way in which it is applied are evolving. What is unique about using Google Glass for telemedicine is it would not restrict the user’s mobility or function, which is incredibly important for First Responders who might need two hands to do compressions for CPR.

The second stage of my project will be developing a user interface program (UI) that writes the vital signs for the user. Currently, many EMS services transitioned into using paperless Patient Care Reports by having a Toughbook Laptop as their “paper.” However, the EMS provider must stop what they are doing and physically type the vitals in. The beauty of using Glass is the user can say “Glass, input Pulse: 72 Strong and Regular; Blood Pressure: 130/72; Respiration: 14,” without stopping what they are doing. This vital sign data could be uploaded into the Toughbook report and transmitted to the hospital for patient transfer of care.

The application will be written using Android Studio's integrated development environment (IDE).

The third aspect of the project is to create a website to showcase my capstone project, educate people who may not be familiar of what first responders do, and to show EMS personnels how Google Glass can help benefit their work. The whole process was with the help of my EMS organization, Syracuse University Ambulance. With the help of my friends, peers, and co-workers at SUA, I was able to showcase how Google Glass can help an organization like ours.

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Acknowledgements

I want to first thank my advisor Tim Jorgensen for being a great mentor during my college career and this capstone project. Without him, I would be lost. I want to also thank my reader Chris Kirkegaard for giving me a different perspective on my project. He showed me my project in a different lens, which made my capstone that much stronger. Lastly, I would like to thank the Renee Crown Honors Program for believing in my project and funding the Google Glass.

Advice to Future Honors Students

My first advice to the future honors students is to choose a capstone topic you are truly passionate about. Although I struggled to finish such a massive project, I enjoyed working on it because I chose a topic I was passionated in. My second advice is to share what you are doing with your capstone with anyone who would listen. When I did this, I had the chance to collaborate with and get input from people I never thought I would have gotten from. It also helps with your presentation skills. Lastly, I would advise future students to be proactive with their projects. If you feel stuck on your project and you have gone to your advisor and reader, I would reach out to other professors, friends, or people in your field of topic. Don’t settle with what’s comfortable. Be bold with your Capstone.

Preface

I've worked in Emergency Medical Services (EMS) as an Emergency Medical Technician for almost four years. During my time serving in EMS, I have noticed the positive impact technology has made on patient care, First Responder safety, and advancements in research. However technology's integration into our health care system is still in its infancy. I believe that our health care system is behind and under-utilizing the current technology that is available. I come from a unique background of studying technology and its wide application, while facing problems working in the EMS field. Using what I learned from my technical education, I chose to tackle one piece of problem I encountered in EMS.

Chapter 1

Website (www.emsglass.com)

The current teaching method for first responder is archaic. It has not changed much, although the world has changed enormously with the advent of technology. The purpose of my website is to showcase my capstone project, educate people who may not be familiar of what first responders do, and to people in EMS how Google Glass can help impact them. The whole process was with the help of my EMS organization, Syracuse University Ambulance. With the help of my friends, peers, and co-workers at SUA, I was able to showcase how Google Glass can help an organization like ours.

The website format is a clean single page website with navigation tabs on the top. The logo is “EMS Glass” with the same color as the SU blue and orange and the color of the Google Glass for the project. Syracuse University has taught me a lot and given me a lot of resources to succeed and I wanted to showcase my pride as an Orange.

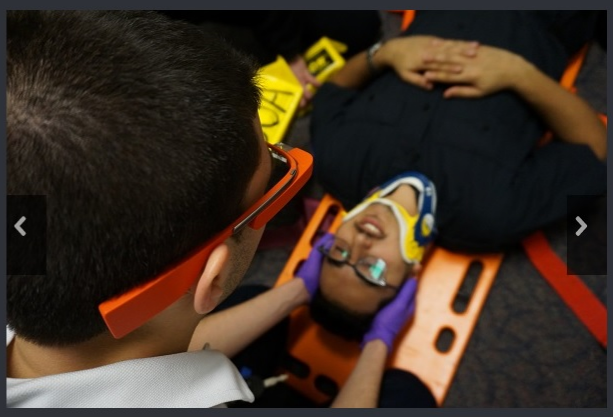
The first page is the home page, where I have an introduction to what the project and website is about. It has a sliderbox to showcase some images that reflect what my project is about. The second page is show cases the application Google Glass can have on EMS through scenario videos. This is where this website is different from others. The benefit of using Google Glass is the ability for the user to be hands free and in the first person view for live steaming events. The first video is a stroke patient assessment that can be sent to the hospital stroke team prior to EMS arrival, which helps transition the patient to a higher level of care. The second video is a Mass Casualty Incident (MCI) where patient triage is given. With this video sent to nearby hospitals, police departments, and fire departments, it will help better coordinate

resources for the MCI. The third page is explain the three aspects of my project. Lastly, the forth page has a contact form that will be sent directly to my project's email address. This is important for viewers that may have questions, critiques, or collaboration interest.

EMS Glass

Home Demos Projects Contact Us

Technology's integration into the Emergency Medical Field has been lifesaving. Quicker response time, treatment, and transport to the hospital have been possible through the help of new technology. Telemedicine is not new, but the way it is communicated is evolving. What is unique about using Google Glass for telemedicine is it would not restrict the user's mobility or function, which is incredibly important for First Responders who might need two hands to do compressions for CPR. My Capstone Project will give First Responders, such as Paramedics and EMTs, an extra set of hands through utilizing Google Glass.



Training Videos

Solutions

Live Stream

A First Responder arrives on scene to a mass casualty bus crash can connect to the hospital to assess the situation and prepare for what is to come quicker and more efficiently. The lead ER doctor or Trauma surgeon can carry a tablet device to stream the emergency scene. This allows the users to be mobile around the hospital, instead of being stuck at a desktop screen. Showing the hospital through a live video stream is a lot easier than trying to explain it on the radio.

Patient Care Report

Timing is key for better patient treatment. Currently, many EMS services transitioned into using paperless Patient Care Reports by utilizing a Toughbook Laptop. However, the EMS provider must stop what they are doing and physically type the vitals in. The beauty of using Glass is the user can say "Glass, input Pulse: 72 Strong and Regular; Blood Pressure: 130/72; Respiration: 14," without stopping what they are doing. This vital sign data can be transmitted to the hospital or doctor faster for more complicated patients.

Training

Many ambulance companies are a training organizations, where constant training is required. Currently, there are videos in a second person point of view to train new members. It is a lot better to learn by doing, but it is not practical for every training. The next best thing is to feel like you are learning in first POV. With Google Glass, new members can learn how to open an oxygen tank, backboard a patient, and take patient assessments.

Contact Us

Let us know if you have any questions, concerns, or interest in what we do.

* Required

Name *

Chapter 2

Telemedicine

Google glass can be on the forefront of EMS Telemedicine. When I visited NYC over Thanksgiving break, I had the chance to tour the 911 Memorial. I wanted to pay tribute to the First Reponders that lost their lives to this tragic event. I also wanted to learn more. I got to a section in the museum where recordings of first responders radioing in were saved. It was chaotic and unclear, which is to be expected with such events. Although there are limitations to voice, live stream can tell so much more. For such events as 911, First Responders can wear the Glass and live stream what is going on through a broadcast to Fire Stations, Police Departments, and Hospitals. This allows them to be more prepared when the rush of patients start coming in.

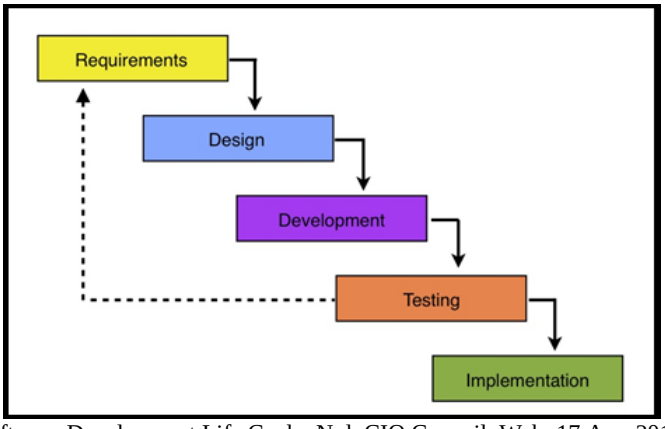
On the micro level, patient care can be improved by this technology. When I went abroad to London last year, I had the chance to ride out with the NHS London Ambulance and their elite Flight Response Team. Through this experience, I learned how transport time can vary immensely. For this reason, if an Emergency Responder's transport time in a rural area takes longer than an hour, higher level of care can not be given. There are two benefits to the patient of using Google Glass during this transport time. The first is the extra information that can be given from a higher level of care provider. There are different scopes for a paramedic versus a neurosurgeon. If the paramedic decided the patient's condition was detteroating due to a neurological problem, a live stream can be connected between the paramedic and neurosurgeon on staff. The neurosurgeon might access the situation and deem the patient needs a certain procedure before getting to the hospital to save the patient's life. Again, telemedicine through a video feed can tell a lot more than radioing in the situation through the radio.

The second benefit is for the neurosurgeon to be prepared when the patient finally arrives at the hospital. Time can be saved since an initial assessment was done through the Glass Telemedicine. For instance, the neurosurgeon might learn the patient is having a stroke and surgery is needed before the golden hour. Time is the essense in Emergency Medicine, and Glass can help expedite the process. My project will test some of these scenarios out by using Google Glass in mock scenarios, which are shown on my emsglass.com website.

Chapter 3

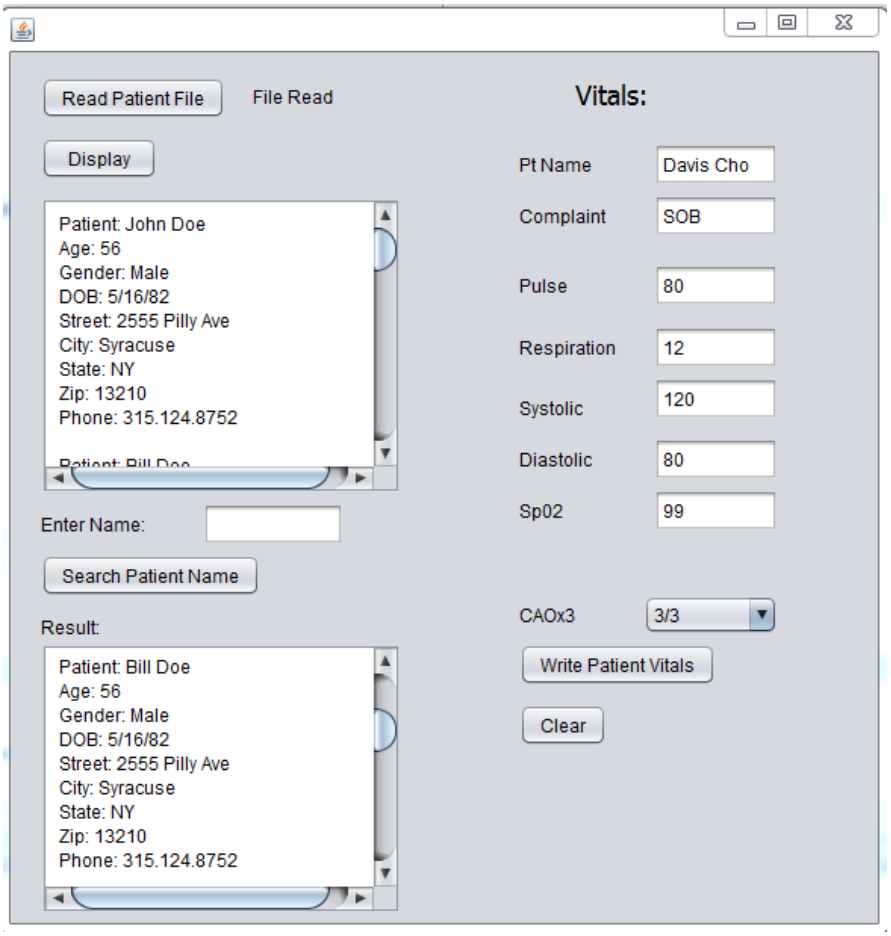
Mobile Application

The third aspect of the project is creating an application to store and bring up patient information. The first responder will be able to tell the glass to input vital signs into the glass, where it will be sent the hospital and patient care report. A prototype application using Java has been coded to input/output patient information. The application will be developed using Android Studio. The environment for Glass Development is a challenge because of the new technology and because it is so different. The screen size is a fraction of a mobile phone and the functionality is limited, yet unique. I am currently working on optimizing the smaller screen size to get the most critical patient information on there. Like any technical project, I am following the System Development Life Cycle to create a user friendly and functional application.

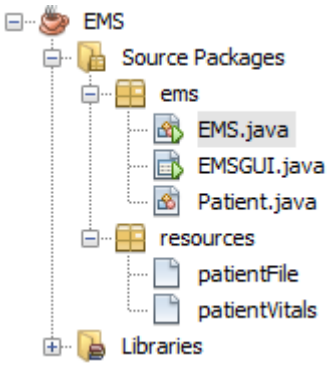


Software Development Life Cycle. N.d. CIO Council. Web. 17 Apr. 2015.

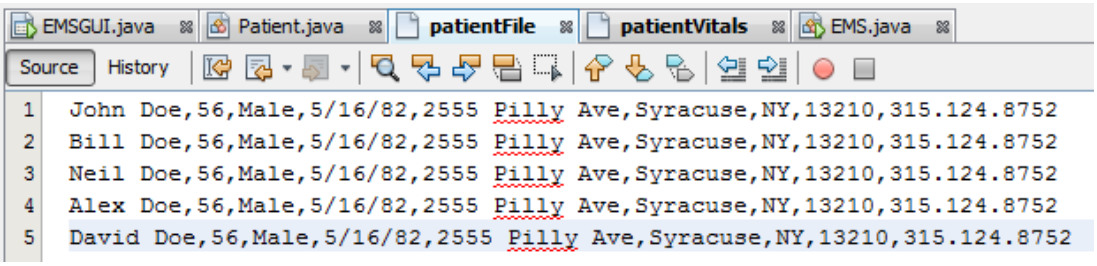
Initial Java Application:



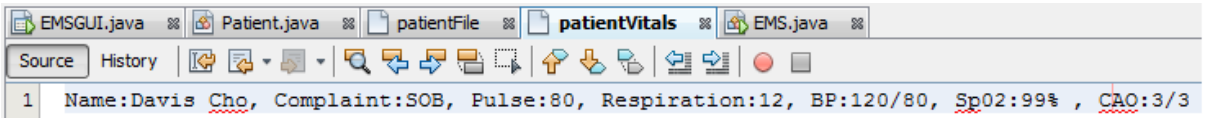
Before I decided to use Google Glass as my platform for my mobile application, I designed and coded a working vital sign application using Java. I wanted to see how the massive data can be organized in a logical sequence. I did not have much restriction on the size of the application because it would be running on a computer monitor. However, I knew I would be limited to the wearable device's screen size. This vital signs application's purpose was for me to build a prototype of my future application. The app can read patient files and display it, input vital signs, and store it to a file.



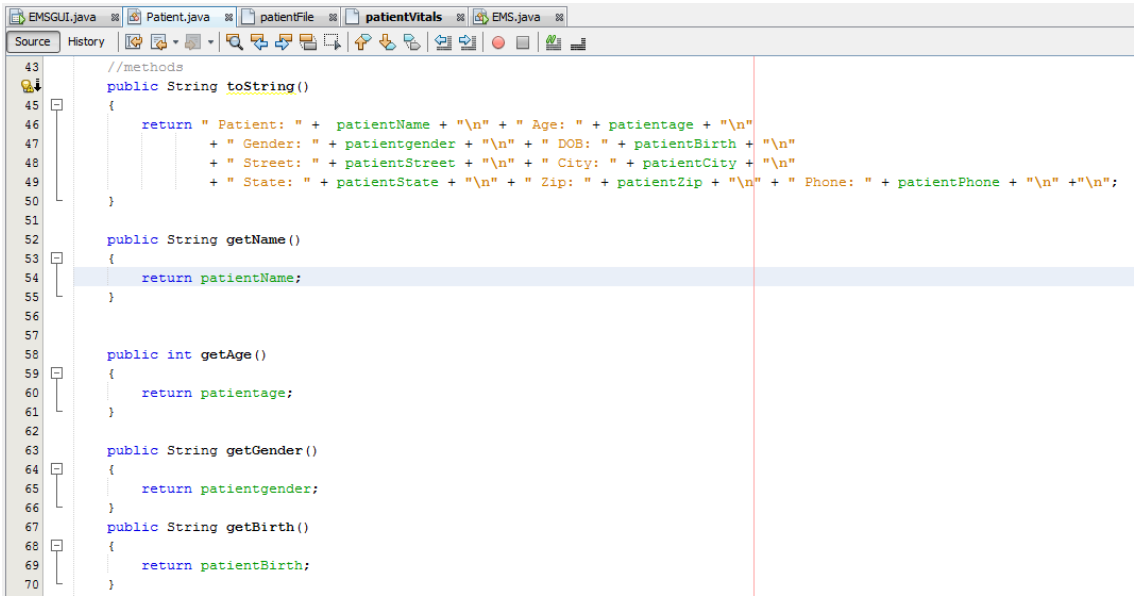
Java Code Structure



Reading compressed patient data and organizing it in the display box



Storing vital signs that were inputed using the application onto a text file



Method code example of application

Scope, Cost, & Risk of Mobile Application:

The purpose of this app is for a proof of concept. For this reason, certain aspects, such as security (HIPPA Regulations), redundancy, and market testing, will not be heavily focused. The limitation to this app is the resources of one developer and short time frame. Currently, the application will not have an input option. With the high learning curve of coding in the Google Glass environment, I created a prototype of the application that show each input option. However, I show in the below diagram what the user interface would be in the future if I implemented the input option. However, once the proof of concept has been achieved, it is possible that this project may be bring on more resources, such as funding and more developers. Lastly, the cost of the Google Glass has been funded by the SU Honors Program, which will be returned to the Honors Program upon completion of the project. The only risk of this project is the testing phase, because of the many regulations in health care systems. For this reason, it will not be tested with live patients and calls, but with simulated scenarios with Syracuse University Ambulance.

Mobile User Analysis (1):

Target Audience:

This app will be used by First Responders and Emergency Medical Personnel. The app will allow certain vital signs to be inputted into the class and sent to a server at the hospital. In the future, the app may support other medical staffs (doctors, nurses, etc) to input patient information or draw out patient information right in front of them.

Target Audience Research:

To better understand how the app should be developed, EMS Providers and IT experts were asked about this project. Both gave great insight from their perspective. The EMS Providers were with Syracuse University Ambulance EMTs. They thought it would be a great way for certain calls, however questioned the cost of the Google Glass. They thought it would be useful for some agencies who have high emergency call volumes, but would not be worth the $1500 price tag for all agencies. The IT experts questioned the hardware and new technology of the Google Glass to be put in the field. Since it is such a new device, it has some flaws to the software and hardware. For instance, it is not very durable, low battery life, and low processor power.

Scenario Analysis (2):

Screen and Interaction Analysis:

The Google Glass software is an add-on to an Android software. It uses Google's Glass Development Kit (GDK), which is built on top of the Software Development Kit (SDK). The GDK and SDK are software tools that help developers make their application. What is unique about the Google Glass GDK to the SDK is the addition of voice, Gesture Detector, and Cards. The Glass will rely on the Android device for all the other aspects, such as GPS, sensors, and 4G.

One big limitation to the Glass is the screen size. Physically, the screen cube of the Glass is a fraction size of an Android S4. However, due to similar technology as a projector, it is projected out as big as a 25-inch screen. The screen resolution is only 640x360 pixel, and it does not project color well under bright sunlight. For this reason, it is not the best for high resolution pictures of videos.

The Glass uses a "card," which is similar to an activity or fragment in an Android Phone. Each card can either be static or dynamic. The way to move around each card is through a touch screen senor on the right side of the Glass or through Voice activation.

Native or Web App:

There are two traditional methods of developing for Google Glass, native or web-based. Here are some thoughts on each, specifically for the Glass.

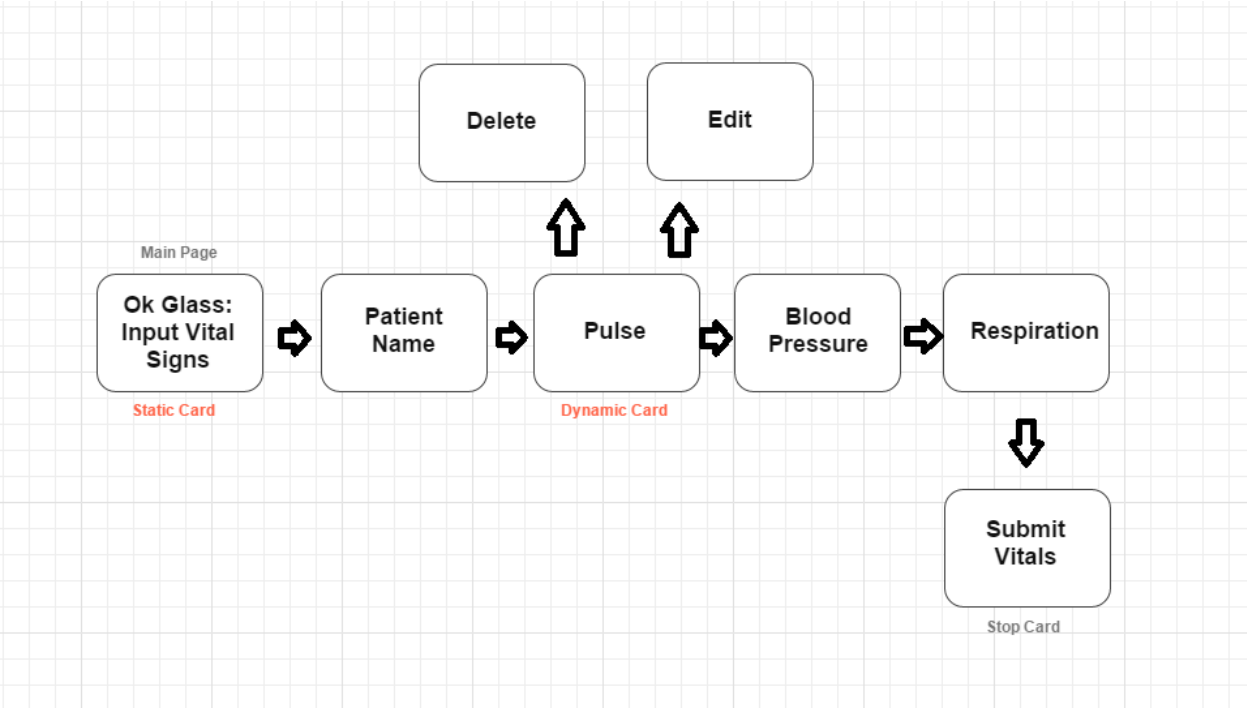
Web-Based: Mirror API Playground

(PRO)	(CON)
• The glass hardware is limited, therefore heavy data processing can be done through a server in the backend. • (PRO) Google has an easy server-client connectivity set up, with step by step instructions. Also, the connectivity uses Google's security measures, connectivity, and performance. • It uses web-based language, such as HTML, CSS, Javascript.	The app will require connection to the Google Cloud service to function.

Native: GDK Android Application Package

(PRO)	(CON)
• Performance will be better in latency, reliability, and speed. • It will be able to perform without a connection to the web.	Usually it has a longer development life cycle time.

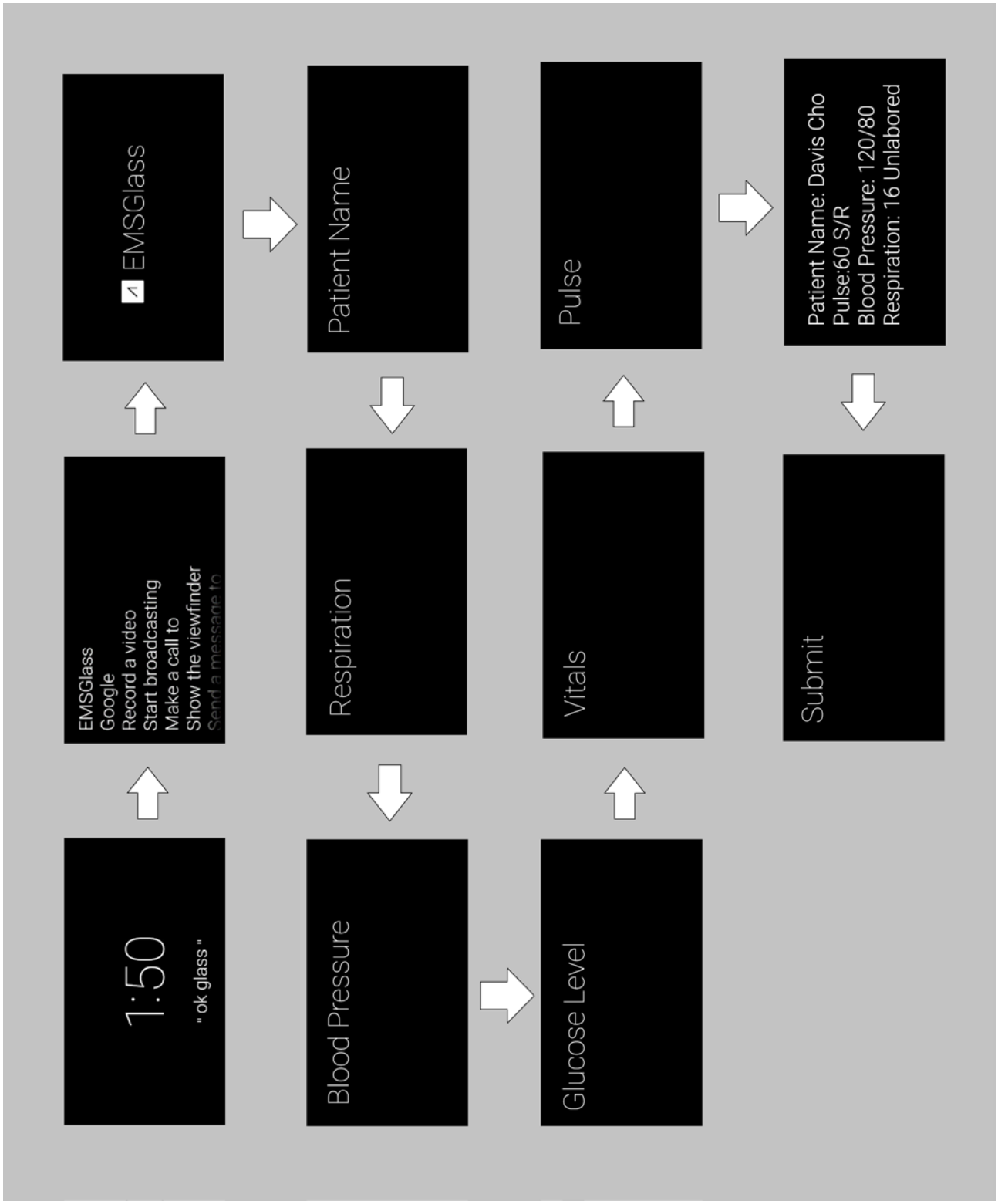
Architectural Design (3):

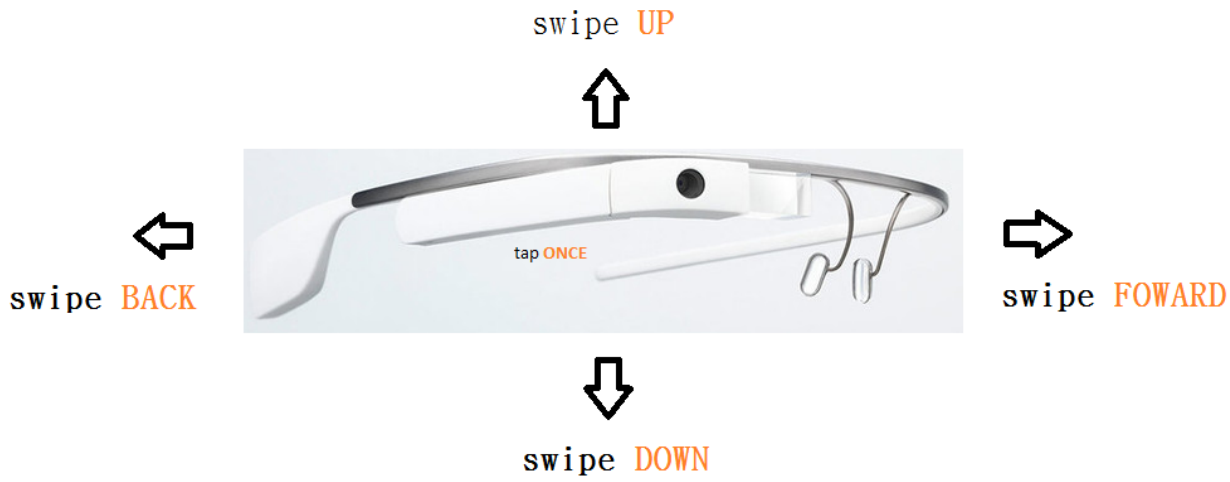


Navigation & User Interface Design (4):

The purpose of using Google's template to build the user interface is the familiarity for our users. Because the Google Glass is such a new technology hardware and software wise, it has a high learning curve for new users. For instance a different android device, such as the smart phone has the familiarity from years of market exposure. For these reasons, I chose to stick with a similar format of the Glass UI.

The home screen for the Glass is the time and "ok glass." Once the user passes to the menu screen (middle picture), the user has the option to choose the "EMSGlass" application, which will take them to the app. My vital signs application will have different cards or screens for each vital sign, such as patient name, pulse, blood pressure, and respirations. The main objective of this application is to keep it simple, concise, and functional. Performance will be critical for an application like this, therefore it will be better to keep out processing time from pictures, fancy fonts, colors, etc.


1:50
" ok glass "
EMSGlass
Google
Record a video
Start broadcasting
Make a call to
Show the viewfinder
Send a message to
EMSGlass
Blood Pressure
Glucose Level
Respiration
Vitals
Patient Name
Pulse
Patient Name: Davis Cho
Pulse:60 S/R
Blood Pressure: 120/80
Respiration: 16 Unlabored
Submit



The control functions for the glass will allow the user to navigate the program:

- Tap ONCE: enter patient information
- Swipe DOWN: Exit the application
- Swipe FORWARD: navigate forward (right) in vital signs application
- Swipe BACK: navigate backward (left) in vital signs application

Implementation (5):

Big Picture: Each Glass Card will have its own vital sign variable. A gesture intent will be used to move between each cards.

Google's card template: <style name="AppTheme" parent="android:**Theme**.DeviceDefault"></style>

Android Manifest:

- Declared the main acivity: android:name=".MainActivity"
- Declared permission to use the Google Voice: <uses-permission android:name="com.google.android.glass.permission.**DEVELOPMENT**" /> <!--name and voice control startup-->

String XML:

<resources>

<string name="app_name">EMSGlass</string>

</resources>

Gesture Intent:

```
private GestureDetector createGestureDetector(Context context)
{
    GestureDetector gestureDetector = new GestureDetector(context);
    //Create a base listener for generic gestures
    gestureDetector.setBaseListener( (gesture) -> {
           // if(Log.I) Log.i("gesture = " + gesture);
            //handleGesture(gesture);

            // LONG_PRESS, SWIPE_DOWN, SWIPE_LEFT, SWIPE_RIGHT, SWIPE_UP,
            // TAP, THREE_LONG_PRESS, THREE_TAP, TWO_LONG_PRESS, TWO_SWIPE_DOWN,
            // TWO_SWIPE_LEFT, TWO_SWIPE_RIGHT, TWO_SWIPE_UP, TWO_TAP;

            if (gesture == Gesture.TAP) {
                handleGestureTap();
                //return true;
            } else if (gesture == Gesture.TWO_TAP) {
                handleGestureTwoTap();
               // return true;
            } else if (gesture == Gesture.THREE_TAP) {
                handleGestureThreeTap();
               // return true;
            } else if (gesture == Gesture.SWIPE_RIGHT) {
                handleGestureSwipeRight();
              //  return true;
            } else if (gesture == Gesture.SWIPE_LEFT) {
                handleGestureSwipeLeft();
             //  return true;
            } // etc...
            return false;
    });
```

Switch Statement for Vital Cards:

```
private void handleGestureTap()
{
    switch (currentView) {
        case 1:
            setContentView(buildVitalsView());
            currentView = 2;
            break;
        case 2:
            setContentView(buildPulseView());
            currentView = 3;
            break;

        case 3:
            setContentView(buildBloodPressureView());
            currentView = 4;   //looping back to 1
            break;
        case 4:
            setContentView(buildRespirationView());
            currentView = 5;   //looping back to 1
            break;
        case 5:
            setContentView(buildGlucoseView());
            currentView = 6;   //looping back to 1
            break;
        case 6:
            setContentView(buildReviewView());
            currentView = 7;   //looping back to 1
            break;

        default:
            setContentView(buildSubmitView());
            currentView = 8;
```

Methods for each card:

```
private View buildGlucoseView() {
    CardBuilder card2 = new CardBuilder(this, CardBuilder.Layout.TEXT);
    card2.setText("Glucose Level");
    return card2.getView();
}

private View buildReviewView() {
    CardBuilder card2 = new CardBuilder(this, CardBuilder.Layout.TEXT);
    card2.setText("Patient Name: Davis Cho" +
            "\r\nPulse:60 S/R" +
            "\r\nBlood Pressure: 120/80" +
            "\r\nRespiration: 16 Unlabored");
    return card2.getView();
}


private View buildSubmitView() {
    CardBuilder card2 = new CardBuilder(this, CardBuilder.Layout.TEXT);
    card2.setText("Submit");
    return card2.getView();
}
```

Testing/Deployment (6):

The testing phase will start with deploying the application onto the device. Android Studio has emulators for most devices, but the Google Glass. For this reason, the application must be deployed directly onto the Glass. The risk of this approach is potentially crashing the application and the device. However, the benefit of compiling the application more quickly outweighs this risk. When an emulator is run on a computer, it is splitting the computer's resources to power the emulator. This is the reason why the emulator is much slower, especially in the testing phase. Also, there are no other options, so a direct connection to the glass is the approach I went with.

Test 1 Notes: 4/8/15

-Device had to be configured to developer settings

-Code in Android Studio had to be compiled and pushed to the Google Glass

-Initial code name "Hello World" was changed to "EMSGlass"

-Voice recognition code was tested and worked correctly

Test 2 Notes: 4/16/15

-Multiple "Vital Signs" cards were tested

-Different Gesture Intents (Tap & Swipe) were tested and worked smoothly

-Application slowed down when the device overheated

-Issues in overheating and battery life was noticed

-Basic functionality of application was tested and worked correctly

Conclusion

There are countless applications for technology's integration into health care systems. I believe our current health care system is behind on utilizing current technological advancements available to them. For this reason, I wanted to show what new cutting edge technology, more specifically Google Glass, can do for medicine. To demonstrate how I am doing this, I created a website to showcase the potentials of technology in medicine. I also wanted a proof of concept on my previous statement in which I created a mobile application for the Google Glass to input vital signs. Lasty, I showed telemedince using the Google Glass can make a huge impact on Mass Casualty incidence.

I have only hit the iceberg on Google Glass's potential in EMS and medicine in general. For example mobile devices, such as tablets and smartphones, have been used to show patient charts. It would be beneficial if these were displayed on the Glass for two reasons. The first reason is the confidential information displayed will be more confidential to the doctor seeing it. The second reason is the Glass is less intrusive than other devices, which will allow the user more freedom with patient care. The Google Glass and technology in general have an endless application to the medical field.

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