Wearable computers in Medicine – New Frontier

New Uses of Internet Technologies in Medicine

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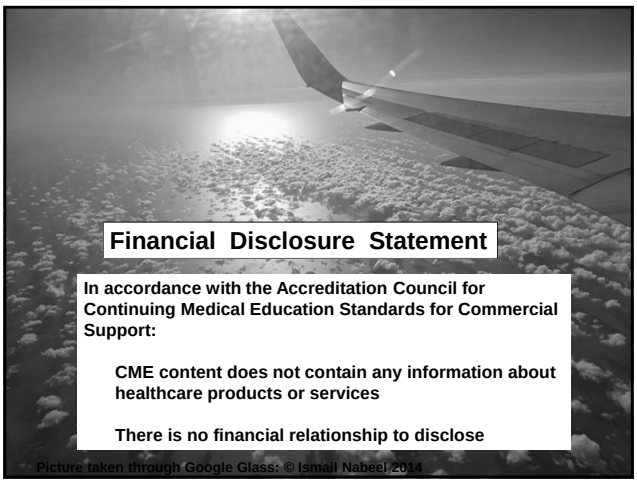
Assistant Professor – Clinical
Division of General Internal Medicine/Occupational Medicine
The Ohio State University Wexner Medical Center



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- **There is no financial relationship to disclose**

Picture taken through Google Glass: © Ismail Nabeel 2014

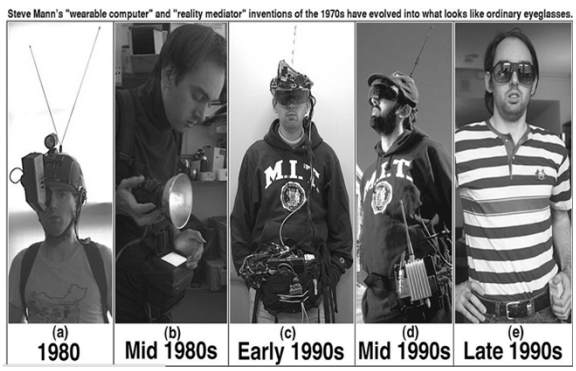
Wearable computers the next Frontier

Image courtesy of Apple

Wearable computers, also known as body-borne computers or wearables are miniature electronic devices that are worn by the bearer under, with or on top of clothing.

Morrison, Jessica. ""Electronic Skin"equipped with Memory." Nature.com. Nature Publishing Group, 03 Mar. 2014. Web. 09 Sept. 2014.

Complete transformation of technology over the years



http://wearcam.org/glass.pdf

Science fiction versus reality

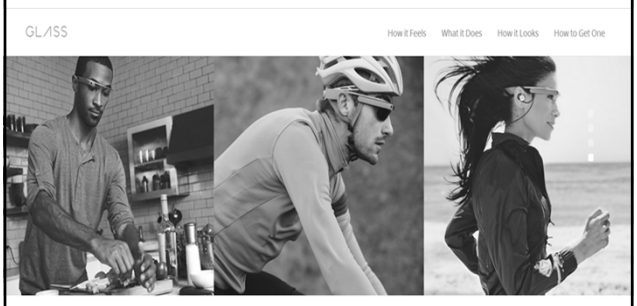
Science fiction versus reality

Source listed on the slide (AFP)

Chapman, Glenn. "Wearable Computers a Smart Fashion Trend." Wearable Computers a Smart Fashion Trend. PHYS.ORG, 27 June 2013. Web. 09 Sept. 2014.

What is Google Glass

https://www.google.com/glass/start/



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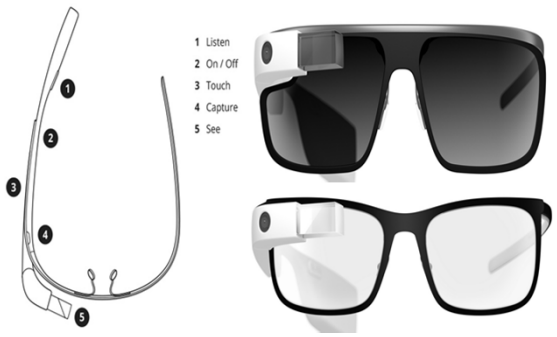
https://www.google.com/glass/start/

How the Glass works



https://www.google.com/glass/start/

Picture and images Hovers in front reminiscent of minority report (2002)

http://www.imdb.com

https://www.google.com/glass/start/

Traveling is a breeze with google Glass

https://www.google.com/glass/start/

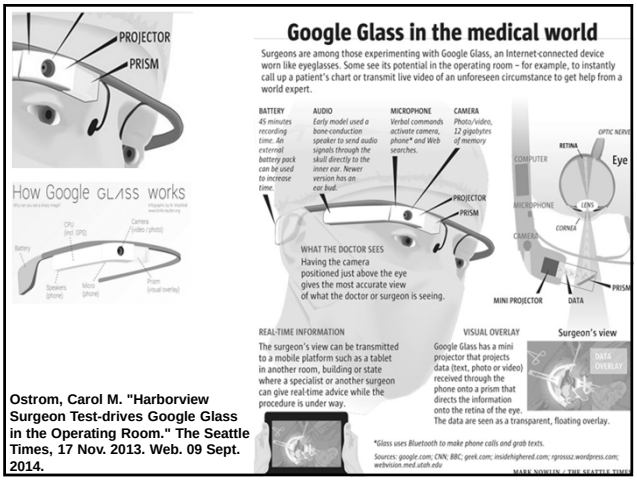
Translation services in real-time

https://www.google.com/glass/start/

1
3

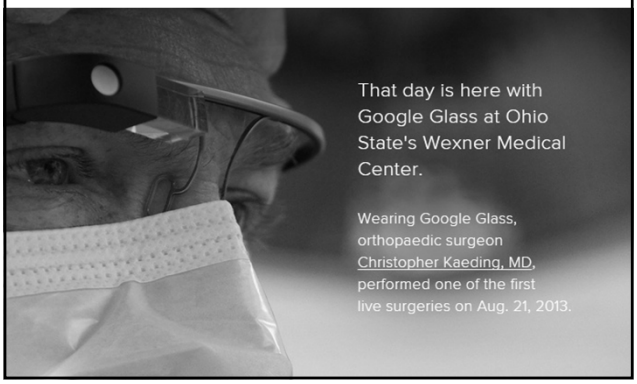
Catching a flight: Using predictive computing

https://www.google.com/glass/start/



Ostrom, Carol M. "Harborview Surgeon Test-drives Google Glass in the Operating Room." The Seattle Times, 17 Nov. 2013. Web. 09 Sept. 2014.

One of kind experiment with Google Glass at Ohio State University, Wexner Medical Center



http://medicalcenter.osu.edu/mediaroom/features/Pages/Google-Glass.aspx

ACL surgery through Google glass

Video 0:
http://youtu.be/Hf799LKU7TA

http://medicalcenter.osu.edu/mediaroom/features/Pages/Google-Glass.aspx

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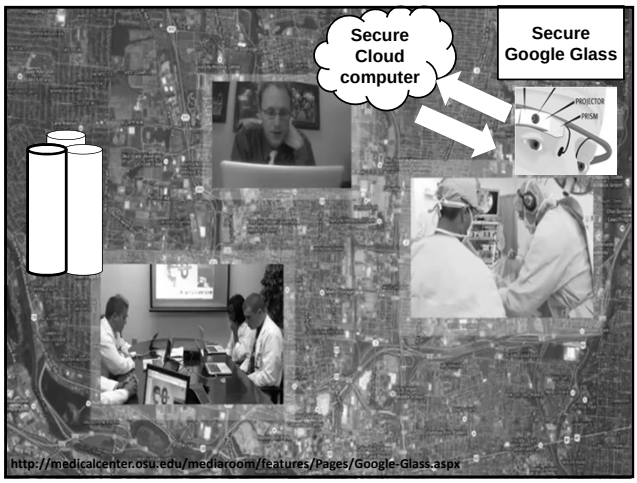
Secure
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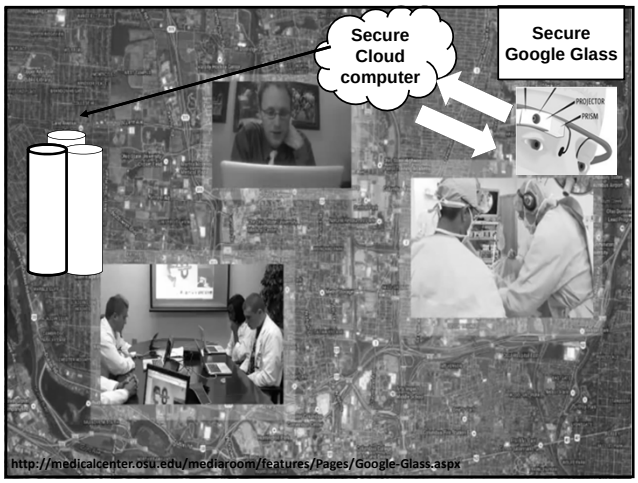
computer
Secure
Google Glass
PROJECTOR
PRISM
http://medicalcenter.osu.edu/mediaroom/features/Pages/Google-Glass.aspx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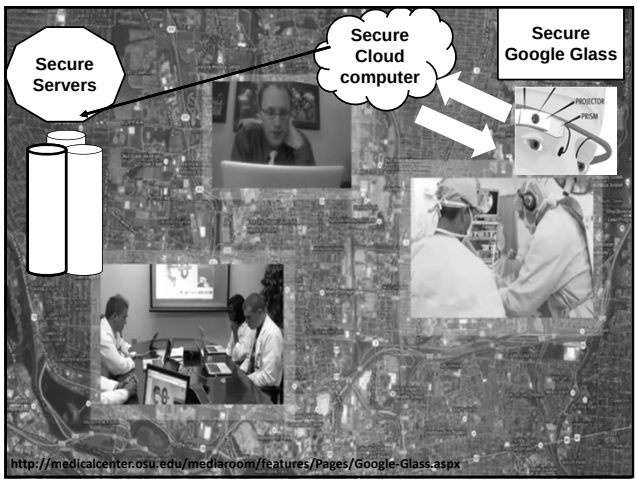
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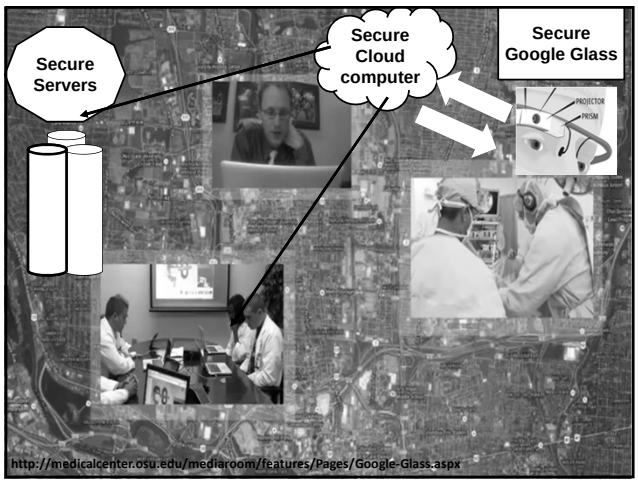
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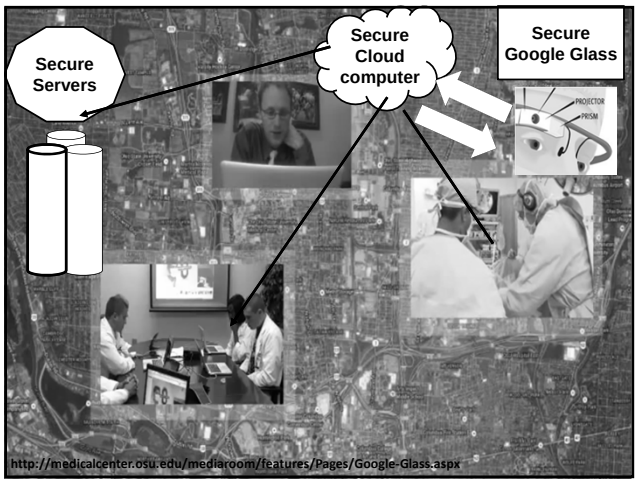

Creating "hangouts" (unfortunately A Tight Google universe integration)
The Health Insurance Portability and Accountability Act of 1996 compliance

Google glass ACL repair surgery

- **Introduction and history about leading up to the experiment with Google Glass at the Ohio State University, Wexner medical center**

Google glass ACL repair surgery

- **Introduction and history about leading up to the experiment with Google Glass at the Ohio State University, Wexner medical center**
  - **Comfort level of the surgeon during the surgery**
  - **Able to transmit real-time data to participants across the room in the OR and around the campus**
  - **Conversation with other surgeon in real time to discuss important aspects of surgery to provide critical feedback**

Google glass ACL repair surgery

- **Lessons learned during the experiment: Multiple steps to improve on our initial experiment**

Google glass ACL repair surgery

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  - **Quality image capture, focal length in image capture, bright OR lights, simulating the real point of view**

Google glass ACL repair surgery

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    - **Transmission of video feed over a secure network over multiple servers from encrypted Google Glass to other encrypted computers screens**

Google glass ACL repair surgery

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    - **Transmission of on-demand real-time images back to surgeon's the Google Glass for critical decision-making**

Google glass ACL repair surgery

- Lessons learned during the experiment: Multiple steps to improve on our initial experiment
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    - Transmission of video feed over a secure network over multiple servers from encrypted Google Glass to other encrypted computers screens
    - Transmission of on-demand real-time images back to surgeon's the Google Glass for critical decision-making
    - Creating Hangouts for individual participants

Real-time information about traffic patterns

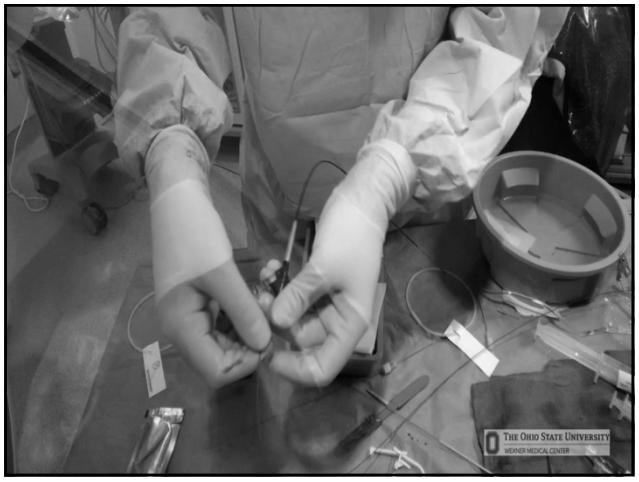
- Google Glass vignette can transmit traffic information in real-time.
- Critical communications during accidents
  - Shared instantly in real time with the Emergency responders, EMS, 911, ED, OR

Google Glass Use in Medical Education

Use of Google Glass in Interventional Nephrology

Procedure:

Angioplasty of the stenosed artery to improved access for Dialysis.



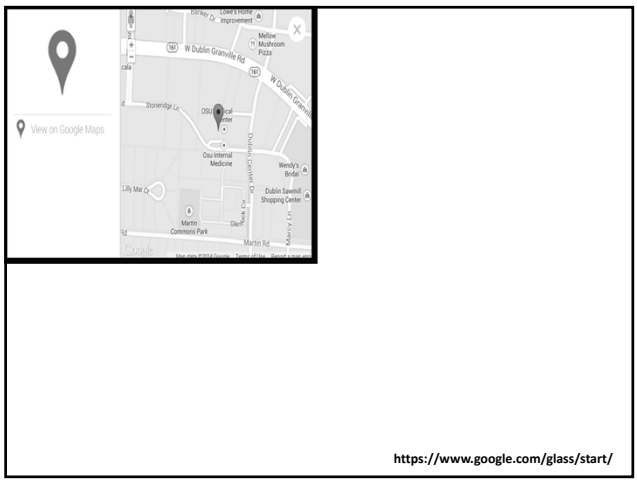
Benefits and shortcomings

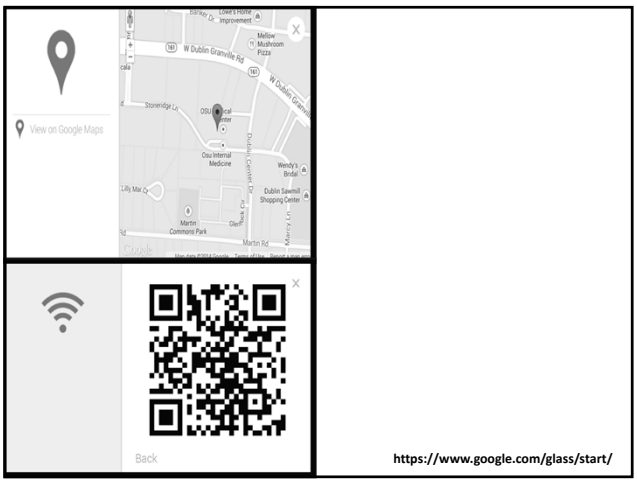
Benefits:

- **1st person view**
- **Original content**
- **Physician/Surgeon able to emphasize on different point during multiple steps of the procedure**

Shortcomings:

- **Surgeons/physician need to know how to stabilize the image**
- **Non zoom able lens**
- **Proper placement of camera in the field**
- **Editing and post production**


View on Google Maps
https://www.google.com/glass/start/


View on Google Maps
Back
https://www.google.com/glass/start/

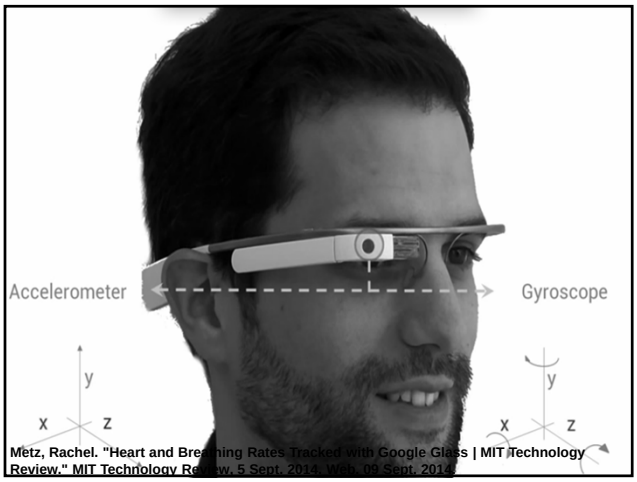

View on Google Maps
Ride with Strava
26:53
Back
https://www.google.com/glass/start/


View on Google Maps
Ride with Strava
26:53
Back
4:30 PM
Check in
Best Western Plus
Yosemite Gateway
Inn

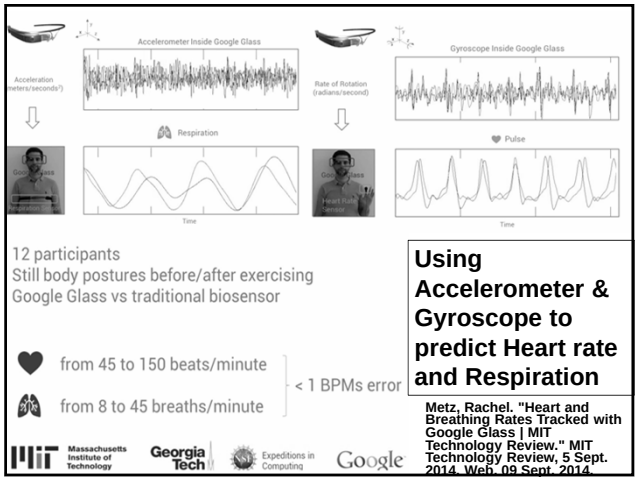
ER doctors use Google Glass and QR codes to identify patients
Custom medical application for Glass keeps data off Google servers.

Hospital in Boston developed a custom information-retrieval system for Google Glass, which lets ER doctors scan a QR code on the wall of each room to call up information about patients.

Kerr, D. "Doctors Testing Google Glass to Get Real-time Patient Data." CNET. 12 Mar. 2014. Web. 24 Mar. 2014.



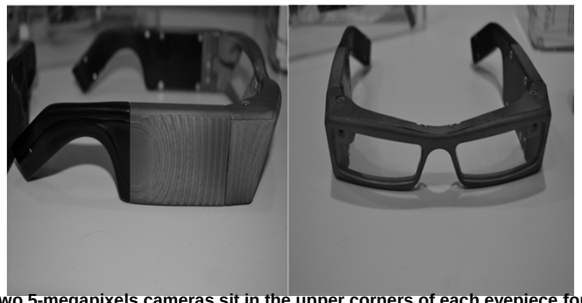
Metz, Rachel. "Heart and Breathing Rates Tracked with Google Glass | MIT Technology Review." MIT Technology Review, 5 Sept. 2014. Web. 09 Sept. 2014.



Using Accelerometer & Gyroscope to predict Heart rate and Respiration

Metz, Rachel. "Heart and Breathing Rates Tracked with Google Glass | MIT Technology Review." MIT Technology Review, 5 Sept. 2014. Web. 09 Sept. 2014.

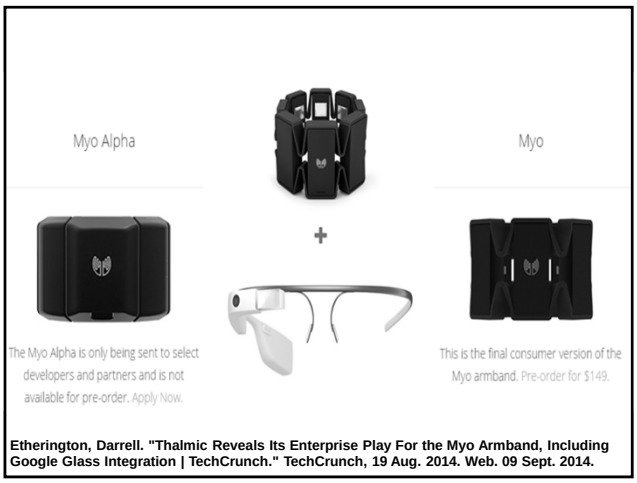
Use of wearable computers in industrial settings



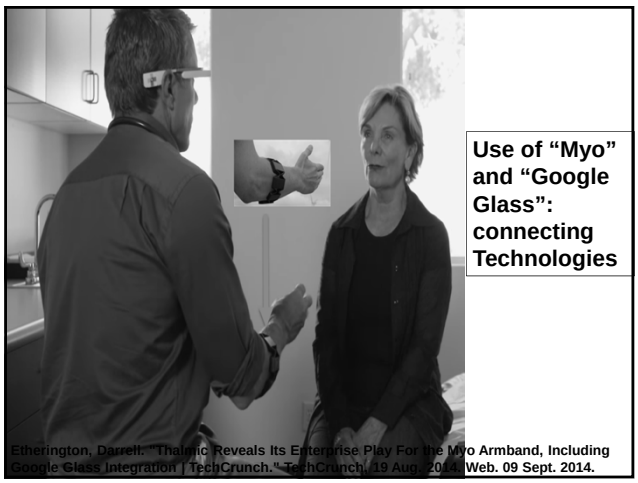
Two 5-megapixels cameras sit in the upper corners of each eyepiece for taking photos, live streaming video in real time, and recording footage. The eyewear looks like a chunkier version of your typical pair of glasses since its accelerometer, gyroscope, processor and other components are housed in its sides.

Franzen, Carl. "XOne Brings Google Glass-like Interactivity to Safety Glasses." Yahoo! News. Yahoo!, 07 Jan. 2014. Web. 09 Sept. 2014.

Lee, David. "Google Glass Controlled by Brainwave." BBC News, 9 July 2014. Web. 09 Sept. 2014.



Etherington, Darrell. "Thalmic Reveals Its Enterprise Play For the Myo Armband, Including Google Glass Integration | TechCrunch." TechCrunch, 19 Aug. 2014. Web. 09 Sept. 2014.



Etherington, Darrell. "Thalmic Reveals Its Enterprise Play For the Myo Armband, Including Google Glass Integration | TechCrunch." TechCrunch, 19 Aug. 2014. Web. 09 Sept. 2014.

Google Glass use in an underserved setting:

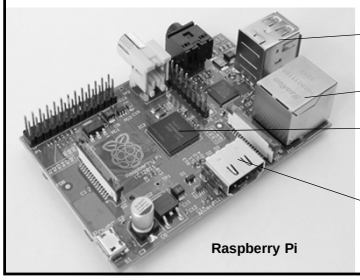
A trip to Cape Town South Africa. Providing a platform to build health solutions in the country's first health hackathon

Stock pictures http://www.raspberrypi.org/

Google Glass

Combining resources:

- **Developing a different solutions for the Glass**
- **Creating different ecosystem for the Glass.**



Connectivity with wired networks

Additional USB ports

Programmable processor on board

HDMI output

Raspberry Pi

Stock pictures http://www.raspberrypi.org/

Transmitting the images back to the surgeon's point of view through Google glass

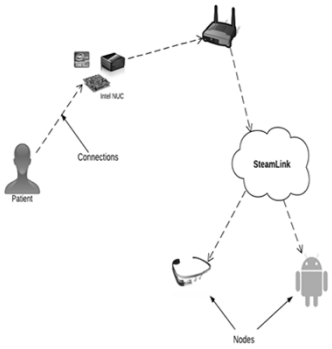
- **Transmit the data back to the surgeon's point**
- **Neurosurgeon Dr. Rezai and his team who are involved in Deep brain stimulation surgery**
- **During the OR surgery, videos were captured and optimized to be seen through Google Glass1**

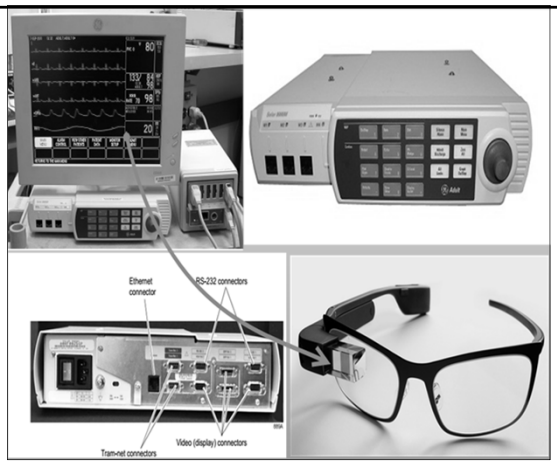
1. http://www.newswise.com/articles/breakthrough-technologies-and-devices-revealed-at-congress-of-neurological-surgeons-annual-meeting

Ohio State University Computer science and engineering capestone project:

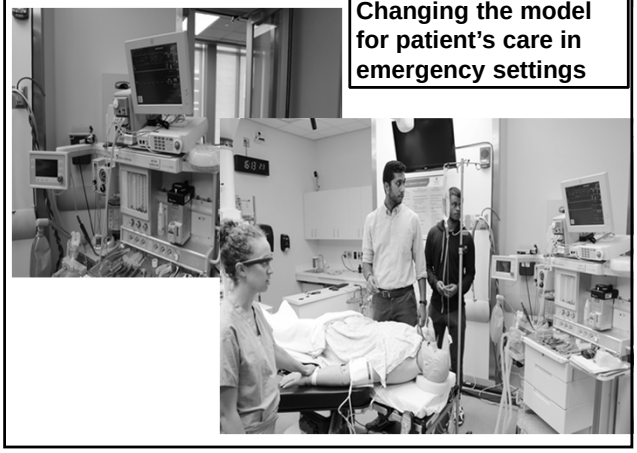
To utilize the Google Glass to display vital patient information

From the legacy medical device





Stock pictures - GEHC-Service-Manual_Solar-8000M-i-Patient-Monitor-v5-2008

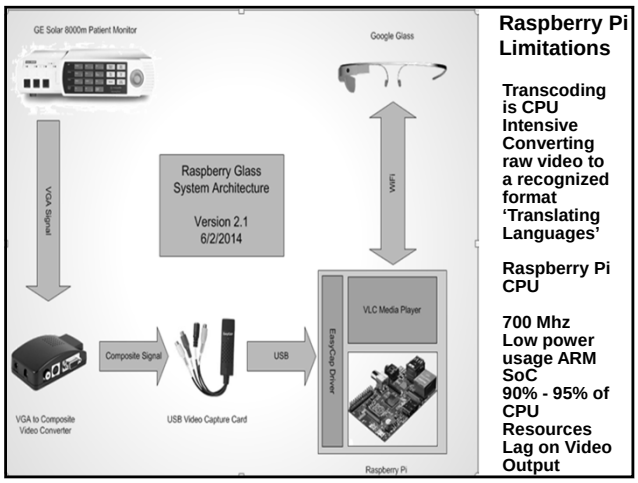


Changing the model for patient's care in emergency settings

High Level Project Plan

Done | In progress | To-do

Tasks \ Week	1 5/5 - 5/11	2 5/12 - 5/18	3 5/19 - 5/25	4 5/26 - 6/1	5 6/2 - 6/8	6 6/9 - 6/15	7 6/16 - 6/22	8 6/23 - 6/29	9 6/30 - 7/6	10 7/7 - 7/13	11 7/14 - 7/20	12 7/21 - 7/27
First Meeting with sponsors												
Project Architecture												
Obtain Hardware												
Hello World Glass App/Mockup												
Finalize Requirements												
Video input/output to NUC												
Develop Glass App												
Finalize Glass App Code												
Test in Sim-OR lab with volunteers												
Freeze Code and finalize project												

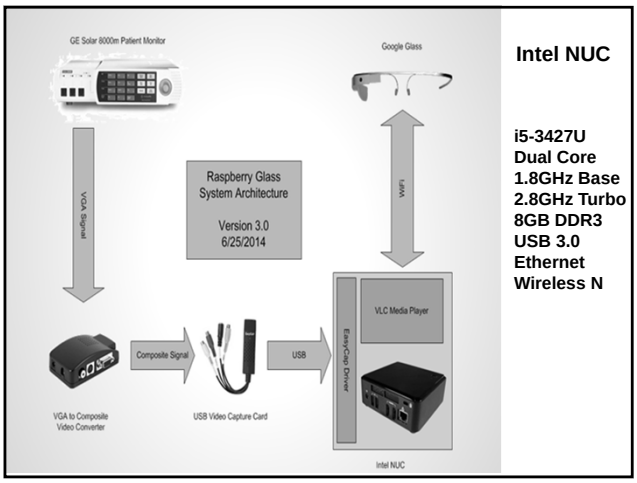


Raspberry Pi Limitations

Transcoding is CPU Intensive
Converting raw video to a recognized format 'Translating Languages'

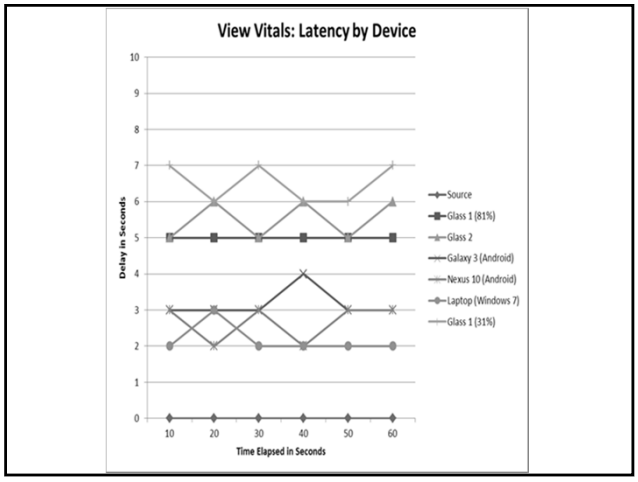
Raspberry Pi CPU

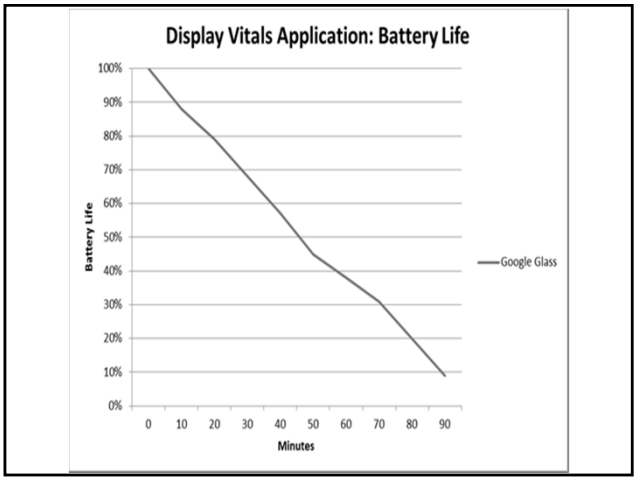
700 Mhz
Low power usage ARM SoC
90% - 95% of CPU Resources
Lag on Video Output

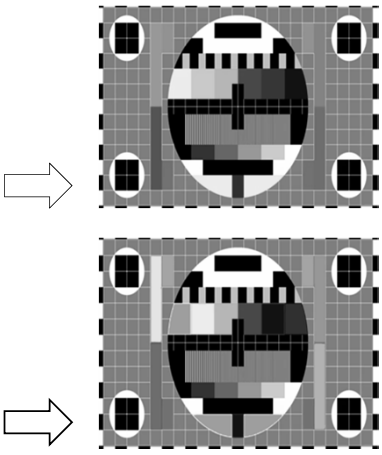


Intel NUC

i5-3427U
Dual Core
1.8GHz Base
2.8GHz Turbo
8GB DDR3
USB 3.0
Ethernet
Wireless N







Google Glass projection of the virtual screen

Real time transmission of visual data.

Furture development of wearable technologies in medicine

Furture development of wearable technologies in medicine

- **Enhancing the delivery of care, diagnosis of patterns in Healthcare**

Furture development of wearable technologies in medicine

- Enhancing the delivery of care, diagnosis of patterns in Healthcare
- Excellent teaching tool with real case senarios for Medical Education

Furture development of wearable technologies in medicine

- Enhancing the delivery of care, diagnosis of patterns in Healthcare
- Excellent teaching tool with real case senarios for Medical Education
- Lead, Innovate and deliver disruptive solutions on demand produce a paradigm shift in the status quo

Capstone Project Video:
http://youtu.be/YfNTITV5TRo