



# *Future Me:* Human Augmentics for Sustained Wellbeing

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# electronic visualization laboratory

- Established in 1973 by Tom DeFanti and Dan Sandin
- Jason Leigh is the current director
- All work is Interdisciplinary and Collaborative: Computer Science, Art, Communications, Biomedical, Geoscience, Learning Sciences
- Supporting 16 MS & PhD students, 6 undergrad students
- Research: advanced displays, visualization & visual analytics, high speed networking, interaction and collaboration



# An Early Example of Human Augmentics



- Treats problems (near or far sightedness, etc)
- Same technology improves vision of 'normal' people who need to work on very small mechanisms or details

# 1<sup>st</sup> Tenet of Human Augmentics

- It's not simply about making tasks easier or more convenient for people
- It's about understanding human sensory, cognitive and physical limits and developing technologies that allow you to exceed them
- i.e. Self-controlled Evolution
- Evolving beyond what biology allows you to

# In 1970s We Had TV Shows on this Topic

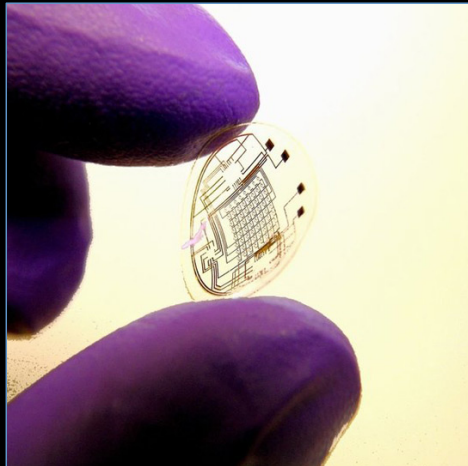


# Today: Prostheses

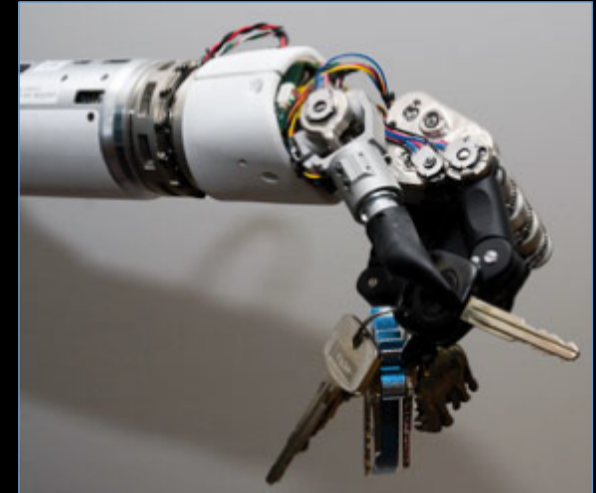
Artificial Heart



Contact Lens display



Dean Kamen – DEKA Research  
RoboHand



Bions – injectable muscle/nerve  
stimulation



Stomach Pace Maker



Ossur Power Knee



# Today: Robotics

Da Vinci



Segway



Rattheon XOS2



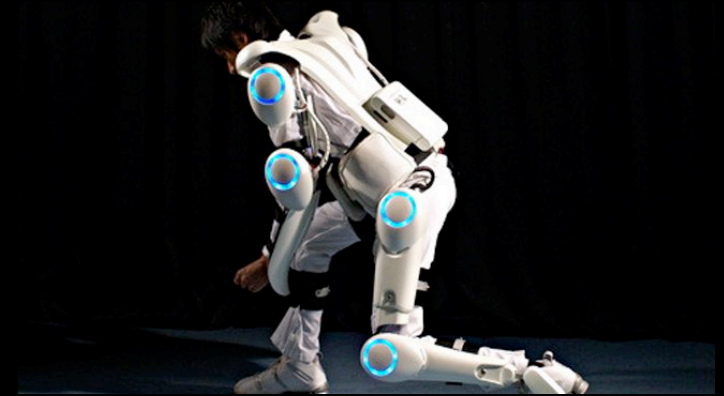
Emovere – Wearable Chariot



Honda Assistive Walker



Cyberdyne Hybrid Assistive Limb

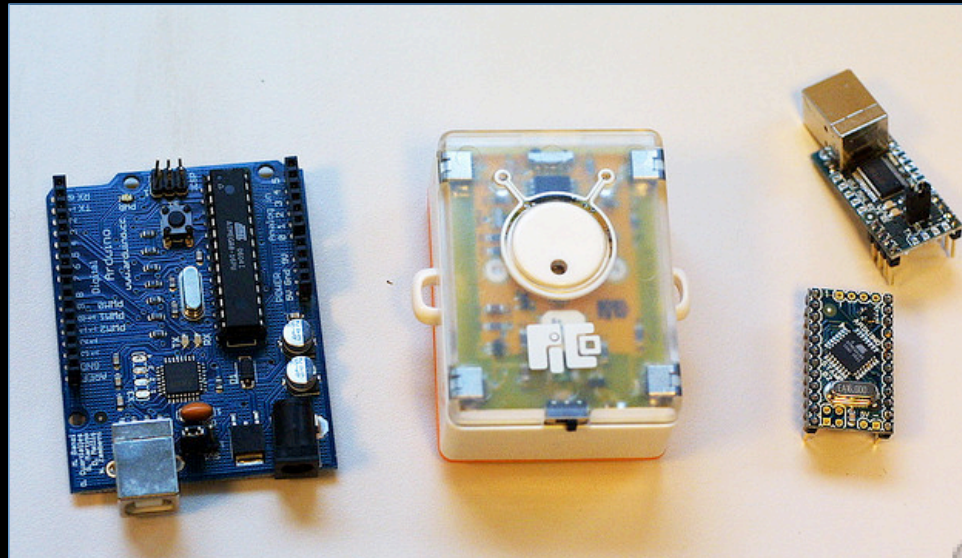


# Miniaturized Computation

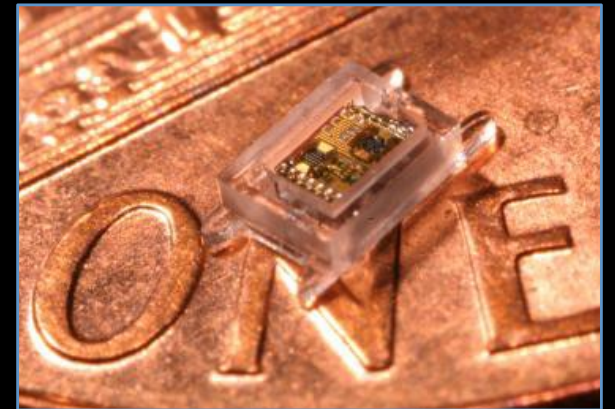
iPhone



Arduino, Pico, STAMP



U of M  
1 cubic mm computer





# Today: Personal Sensors

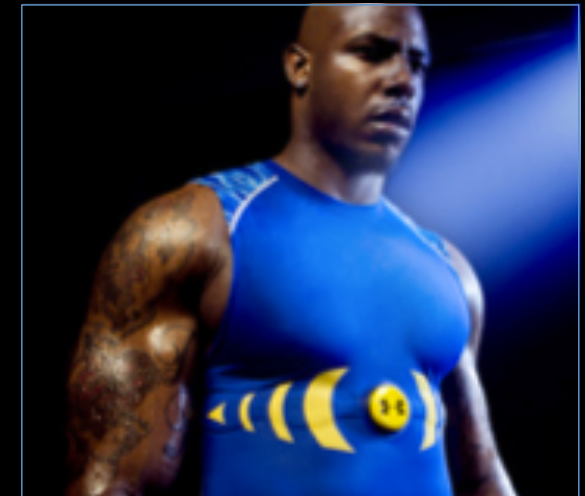
Clemson Bite Counter



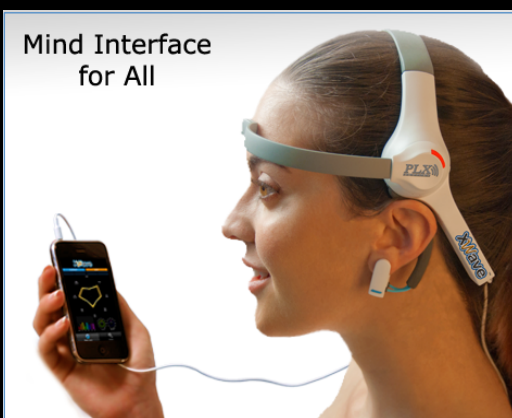
Bodymedia



Under Armor  
Data Gathering Workout Suit



PLX - XWave



Withings Blood Pressure Monitor

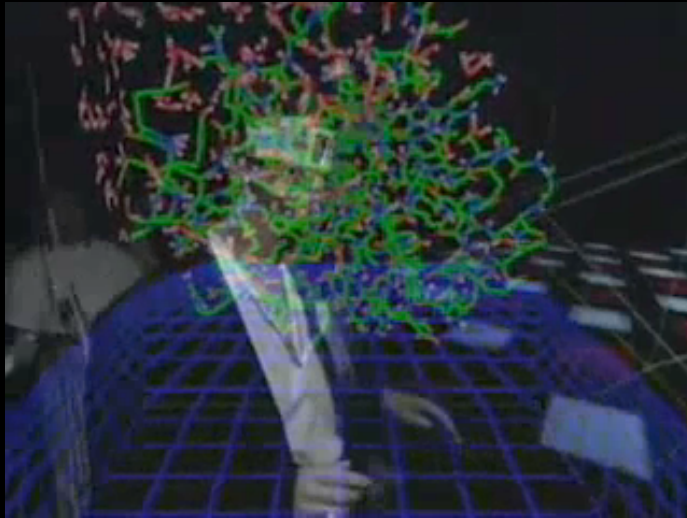


Zephyr Bioharness

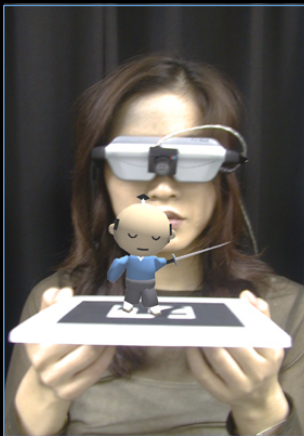


# Today: Virtual & Augmented Reality

CAVE – 90s



Augmented Reality in the 90s



3D TV + Kinect - Today

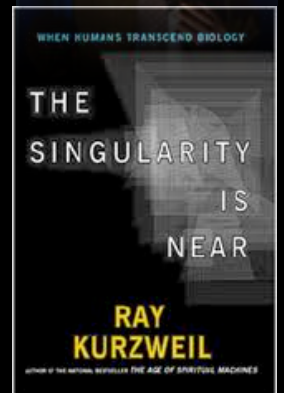
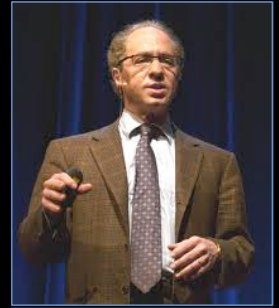
Augmented Reality Today



# 2<sup>nd</sup> Tenet of Human Augmentics

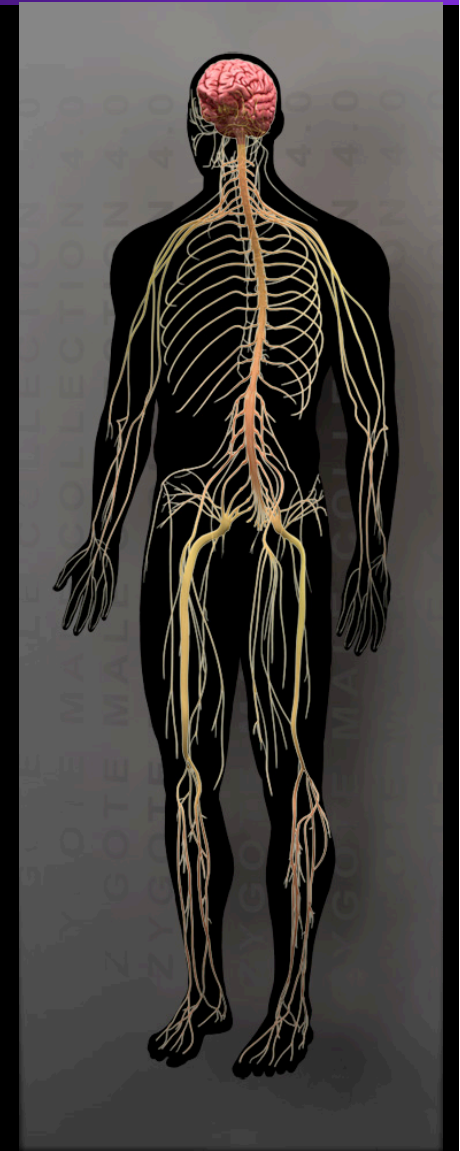
## Exponential Advances in Tech is the enabler

- Ray Kurzweil: “today's smartphone is a million times smaller than the first computer, a million times more affordable and a thousand times more powerful”
- 2020 - Computers equal to the human brain
- 2030 - Brain power of small village
- 2050 - Entire population of US
- 2060 - Trillion human brains by 2060
- 2100 - One personal computer will have more capacity than all humans on earth....
- Humans will merge with machines by 2020
- Man will become immortal by 2045



# Merging Computing & Humans

- Transmission rate of neurons – 25 m/s
- Speed of light – 300,000,000 m/s
- Assume a 6 foot (2 meter) tall human
- It takes 0.08s for your biologic nervous system to send a signal from your brain to your foot
- It takes the speed of light 0.000000007s
- If you imbedded an electronic network connecting your brain to your foot you can react to things 11.5 million times faster
- Theoretically you can create a network of wireless electronic hubs throughout your body

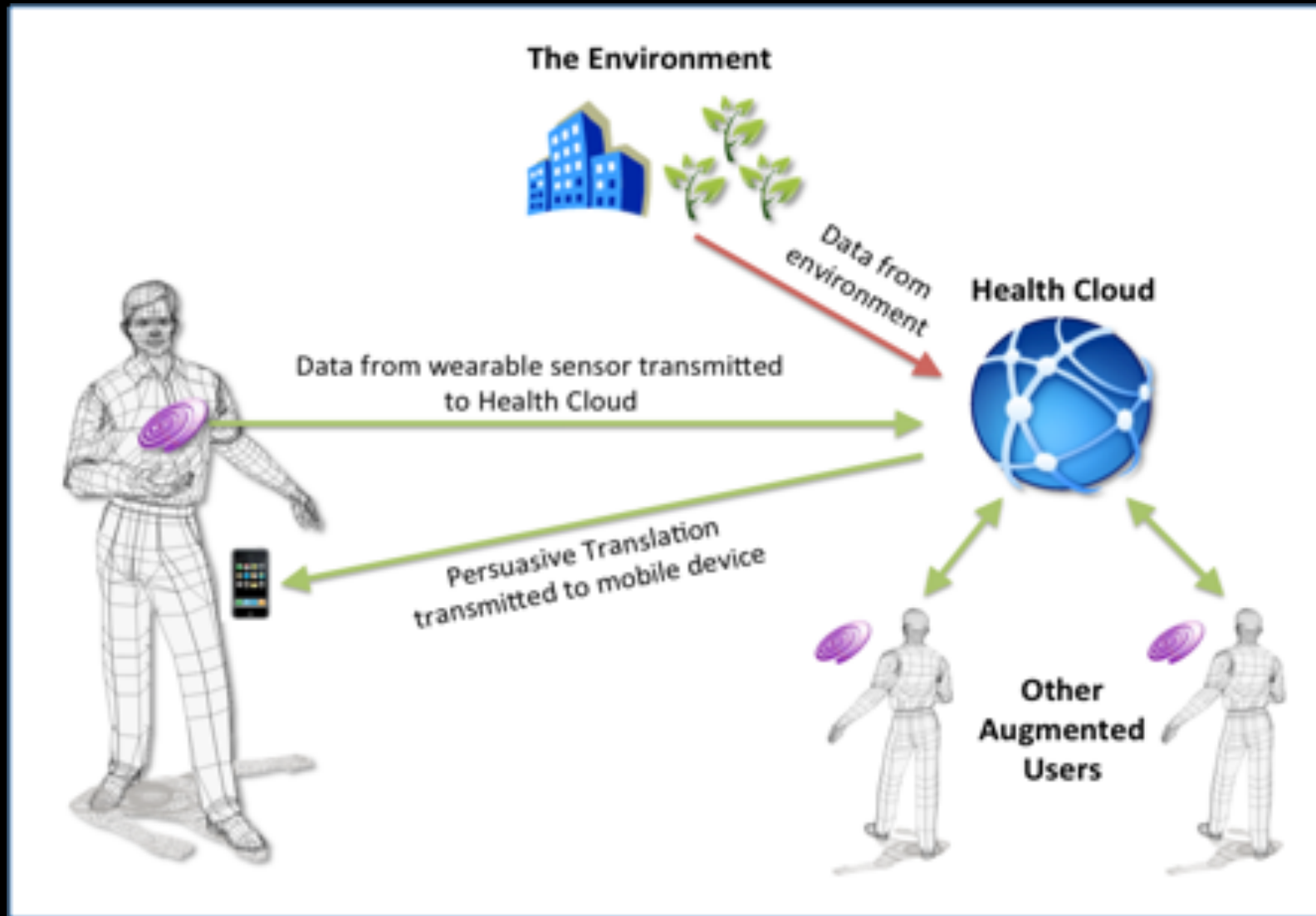


# Not Science Fiction

- 25 year old man became paralyzed in 2006 when struck by a car
- Researchers at U of Louisville & UCLA implanted his spine with electrical pulse generator that mimics brain signals for movement
- Able to regain some voluntary motion - able to stand
- 1<sup>st</sup> time electric stimulation produced this result in a human



# 3<sup>rd</sup> Tenet of Human Augmentics: Human + augmentics + environment + cloud ecosystem is necessary for continual evolution



# An Emerging Area...

- Augmented Human Conference  
[www.augmented-human.com/](http://www.augmented-human.com/)
- 1<sup>st</sup> IEEE EMBS (Biomedical and Health Informatics) workshop on Wearable & Ubiquitous Technology for Health & Wellness  
[embc2011.embs.org/unconference/program](http://embc2011.embs.org/unconference/program)
- Singularity Institute for Artificial Intelligence  
[singinst.org](http://singinst.org)

# 3 Tenets of Human Augmentation

1. It must be based on an understanding of human sensory, cognitive & physical limitations, so that augmentations are applied appropriately, ethically, responsibly
2. Exponential advances in technology is the key enabler
3. Ecosystem of networked humans, human augmentics technology & the environment (in the Cloud) enables human capabilities to expand beyond evolution



# The Health Care Problem in the US

- 40% of Americans (20% of 4 year olds) today are obese
- Half are taking some form of prescription drugs
- Lipator (for high cholesterol) is the most prescribed drug in the world
- 1<sup>st</sup> generation of American children who will live fewer years than their parents
- US spends 2.2 Trillion dollars per year on health care
- Obesity, diabetes, hypertension costs the US \$100B/year
- Every minute 1 person in the US is killed by heart disease
- 1 in 3 people born in US today will end up with diabetes

# The Answer ...

- Getting people to live healthier ALL THE TIME
- Keep them away from hospitals and pills
- Problem is MOTIVATION
- Doctors counsel patients to live healthier lifestyles. Patients are then left alone to achieve these goals
- If individuals could easily monitor their health status 24/7 and received personally tailored, persuasive, and actionable feedback and suggestions at the right times, they would be continuously coached towards healthier living

# Not Just a Technological Solution

- Coping peers are more powerful agents of change than professionals, celebrities, or family members - a coping peer is someone similar to the participant (age, race, comparable socio-economic status, health issues) who is also similar in his/her perceived competence working toward mastering the desired behavior
- Self-efficacy (confidence) is the central agency that determines behavior - new behaviors will be performed if an individual has high confidence of their success

# *Future Me*

- A combination of wearable and ubiquitous Human Augmentics technology that will:
  - Gather real-time anonymized health data from an individual
  - Make use of a Health Cloud to make projections of future wellness outcomes based on health science models and data
  - Present persuasive visualizations to convey these outcomes to motivate better healthy living practices in the individual

# Cars have this Instrumentation

- Our cars are instrumented this way – we get constant feedback as we drive and recorded data to help the mechanic make repairs
- Adding Miles per Gallon (L/100km) displays to hybrids makes drivers conscious of how their driving affects their MPG



# Videogame Characters have this Instrumentation

- In videogames we have health bars and personal radar. Why don't we have these in real life?



# We are Getting Alerts ...

- Weather alerts on my phone for violent weather (tornadoes in Illinois) or ozone action day
- Security alerts on my phone for campus security issues
- News alerts on my phone for City / National / International important news
- But I don't get an alert if I am about to eat something very unhealthy or something I'm allergic to, or an alert about my body temperature or heart rate if I'm outside shoveling lots of snow or running in the heat

# Health 2.0 Cloud Efforts

- PatientsLikeMe ([www.patientslikeme.com](http://www.patientslikeme.com))
- Tracks 100,000+ patients and 500+ conditions
- Data-driven social networking health site
- Enables its members to share condition, treatment, and symptom information
- Data feeds biostatistical algorithms that enable a patient to estimate his/her future health outcome
  
- Gordon Bell's LifeLogging - record and digitize every instance of an individual's life through images and audio



# Potential Impact

- Health Cloud conceptually a merger of PatientsLikeMe and LifeLogging
- Cloud testbed for real-time data collection, processing, and prediction
- Potentially enable health researchers to conduct studies as groundbreaking as the multi-generational Framingham Study on Cardiovascular disease but on an unprecedented scale
- Creating better predictive models for health outcomes
- New lifelong wearable and ubiquitous digital wellness technologies
- New understanding of approaches for health messaging through persuasive visualization and social networking

# Why is evl doing this?

- Working more and more with folks from our Medical Campus for over a decade in training and treatment
- VR + haptic tools for cranial implant design
- Interactive instructional VR models of the Human eye and ear
- Operating Room of the Future with large tiled displays as walls of Operating Theater replacing multiple displays within the room
- Visualizing eye-tracking data to help diagnose ADHD
- Collaborating on large display walls in the simulation center
- Creating new displays for nursing stations to improve nurse hand-offs by comparing a given patient to similar patients and suggesting alternative interventions
- Also meeting with Chicago 911 Emergency Response Center

# Persuasive Visualization

- Focusing on the problem of message delivery
- Data must be translated into a form that is understood by recipients and it must be delivered in a way that can motivate them toward action
- Want personalized messages to be delivered at any time, anywhere, and at low cost
- Want to discover which forms of Persuasive Visualizations (Fogg) are most effective and what factors determine the persuasiveness of the message for various demographic groups (age, sex, race/ethnicity and socio-economic status)

# Information Display

- On your phone or your sunglasses as you walk or shop
- Health information on your bathroom mirror
- Nutrition information on your refrigerator
  
- First responders interested in seeing most important pieces of information to prioritize treatment in emergency situations
  
- Others interested in seeing patterns in larger populations on larger display walls

# Collaborators at UIC

- Computer Science
- Mechanical Engineering
- Electrical Engineering
- Bioengineering
- Health Science
- Rehabilitation Sciences
- Dentistry
- Communications
- Psychology
- Learning Science
- Art, Architecture & Design

 <p><b>Jason Leigh</b> Computer Science/Engineering <i>VR, simulation middleware, high-performance networking</i></p>	 <p><b>Robert Kenyon</b> Computer Science/Engineering <i>Human Perception and Motor Coordination</i></p>	
 <p><b>Pat Banerjee</b> Mechanical &amp; Industrial Engineering/Eng <i>Surgical Simulation</i></p>	 <p><b>Maxine Brown</b> Electronic Visualization Lab/Eng <i>High Speed International Networking</i></p>	 <p><b>Michael Colvard</b> Oral Med &amp; Diag Sciences/Dentistry <i>Tactical Medicine</i></p>
 <p><b>Barbara Di Eugenio</b> Computer Science/Engineering <i>Natural Language Processing / Artificial Intelligence</i></p>	 <p><b>Jakob Eriksson</b> Computer Science/Engineering <i>Mobile Computing</i></p>	 <p><b>Andy Johnson</b> Computer Science/Engineering <i>Data Vis and Visual Analytics</i></p>
 <p><b>Steve Jones</b> Communications /LAS <i>Human Computer and Societal Communication</i></p>	 <p><b>Tom Moher</b> Computer Science/Engineering <i>Learning Technologies, Human Computer Interaction</i></p>	 <p><b>Stellan Ohlsson</b> Psychology/LAS <i>Higher/Complex Cognitive Modeling</i></p>
 <p><b>Michael Papka</b> Argonne National Laboratory <i>High Performance Computing &amp; Large-Scale Data Vis</i></p>	 <p><b>James Patton</b> Bioengineering/Engineering <i>Motor Control &amp; Coordination</i></p>	 <p><b>Tom Peterka</b> Computer Science/Engineering <i>Virtual Reality Displays</i></p>
 <p><b>Luc Renambot</b> Computer Science /Engineering <i>High Performance Distributed Middleware</i></p>	 <p><b>James Rimmer</b> Disability and Human Development/AHS <i>Rehabilitation Science</i></p>	 <p><b>Daniel Sauter</b> Art &amp; Design/Architecture &amp; Arts <i>Mobile Interfaces, Responsive Architecture</i></p>
 <p><b>William Schiller</b> Disability and Human Development/AHS <i>Rehabilitation Science</i></p>	 <p><b>Daria Tsoupikova</b> Art &amp; Design/Architecture &amp; the Arts <i>Virtual Reality Art</i></p>	 <p><b>Annette Valenta</b> Health Informatics/AHS <i>Health Informatics &amp; Security</i></p>
 <p><b>Leland Wilkinson</b> Computer Science/Engineering <i>Visual Analytics</i></p>	 <p><b>Milos Zefran</b> Electrical and Computer Engineering/Eng <i>Human-Robot Interaction</i></p>	

# Current Steps

- Testing various personal sensors for over a year
- Building on existing courses in visualization, user interface design, arduino prototyping
- evl is teaching a new cross-disciplinary Human Augmentics graduate course in the Spring
- Starting work on real interventions with a doctor who focuses on asthma in inner-city African American adolescents, and another focusing on rehabilitation

# Questions

- For more information see [augmentics.org](http://augmentics.org)

