





Kionix®



3D Accelerometer MEMS in a Context of Gaming and Healthcare

**October 14, 2009
IEEE Meeting**



**Ed Brachocki
Kionix, Inc.**





Kionix is in the business of
silicon micromachining (MEMS)

IC manufacturing techniques
are used to sculpt three-
dimensional silicon devices

Kionix specifically focuses
on inertial sensors

Accelerometers

Gyroscopes

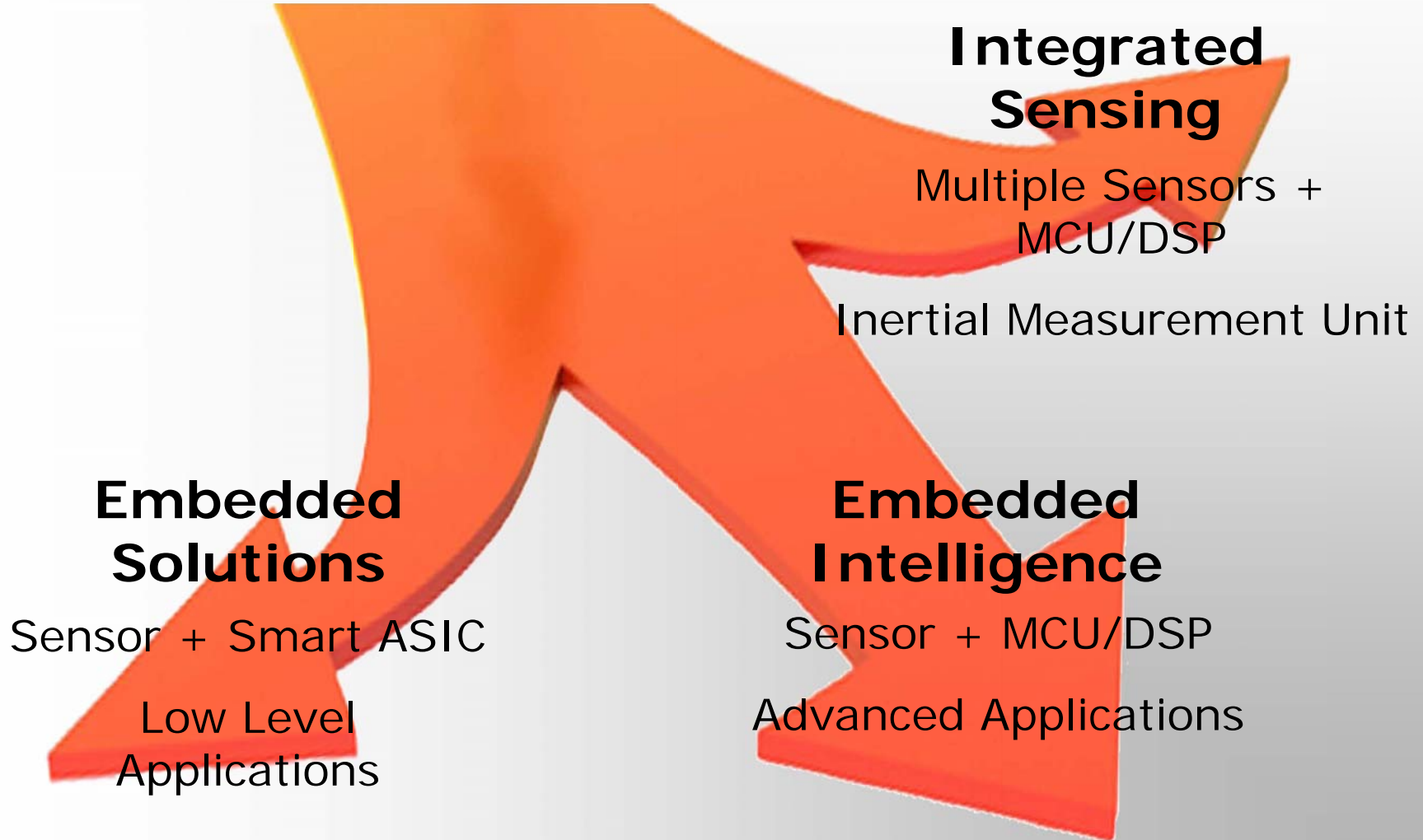
Kionix serves inertial sensor
markets with high volume
and strong underlying demand

Consumer electronics

Automotive



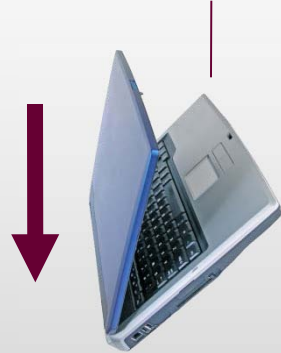
Three Paths of Sensor Integration



Embedded Solutions

- Embed custom engines into ASIC's

- Freefall Detection

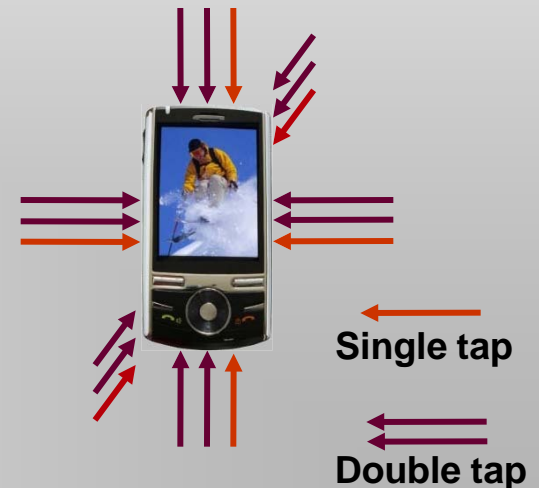


- Pedometer

- Screen Rotation



- Directional Tap/Double-Tap™



Embedded Solutions



■ Advantages

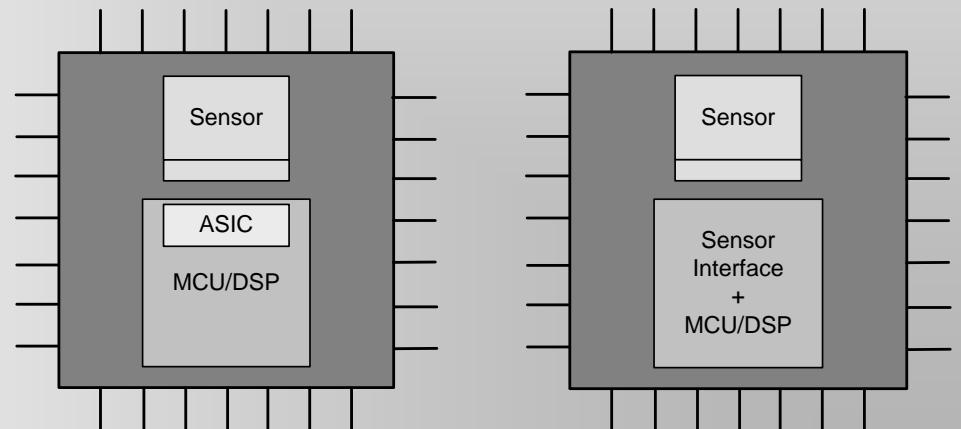
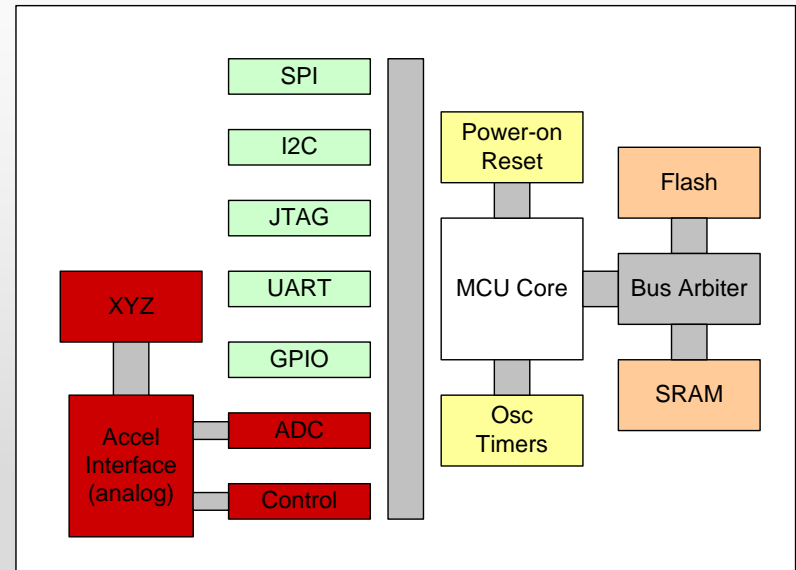
- Simple, easy to use
 - Digital interfaces, such as I²C or SPI, are used for user customization
 - Writing to 8-bit application registers will configure and enable the engines
 - Physical interrupt pins notify the host when an event occurs
 - Reading from the 8-bit status registers inform the results of the engines
- Consume less current
- Smallest size
- Lowest cost

■ Disadvantages

- Computationally limited
 - Simple comparisons and bit shifting

Embedded Intelligence

- Embed MCU cores into same package
 - Pedometer (step counting, distance traveled)
 - Gesture Recognition
 - Digital Image Stabilization
 - 3D Pointer



Embedded Intelligence

■ Advantages

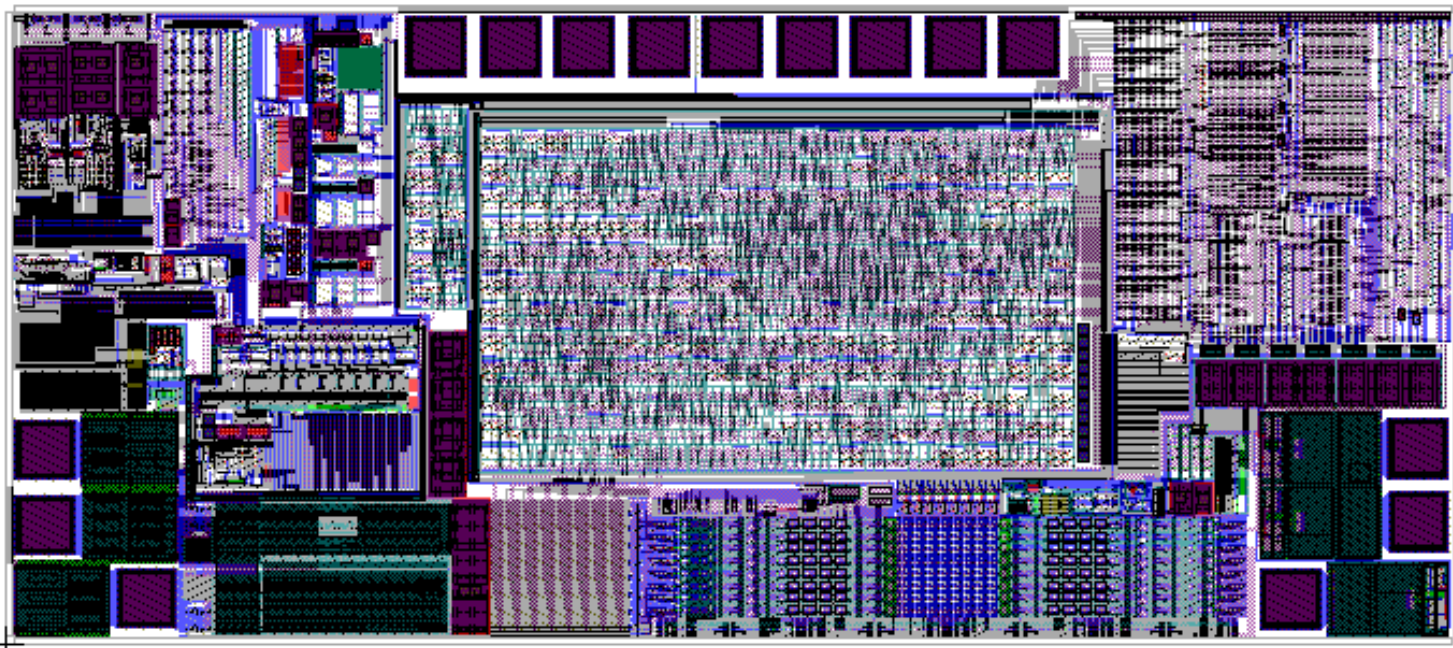
- Increased intelligence
- Opportunity to share computing resources
- Reduced digital bus traffic in system
- Current savings

■ Disadvantages

- Cost
- Packaging challenges
- Yield
- Large size
- Selecting right feature set: speed, memory, instruction set, gpio's

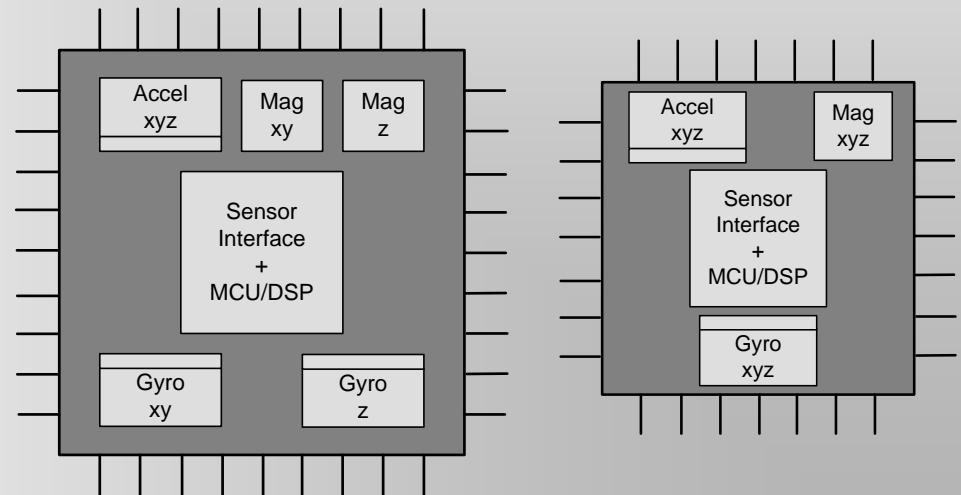
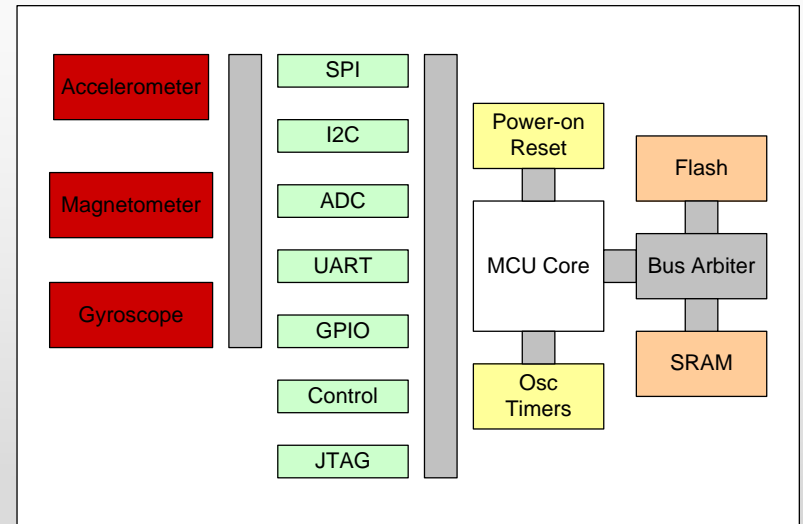
ASIC Technology Migration

- ASIC-Sensor interface remains analog
- ASIC digital content increasing as algorithms are integrated



Integrated Sensing

- Combine multiple sensors into same package
 - Accelerometer + Gyro + Magnetometer
 - Inertial Measurement Unit



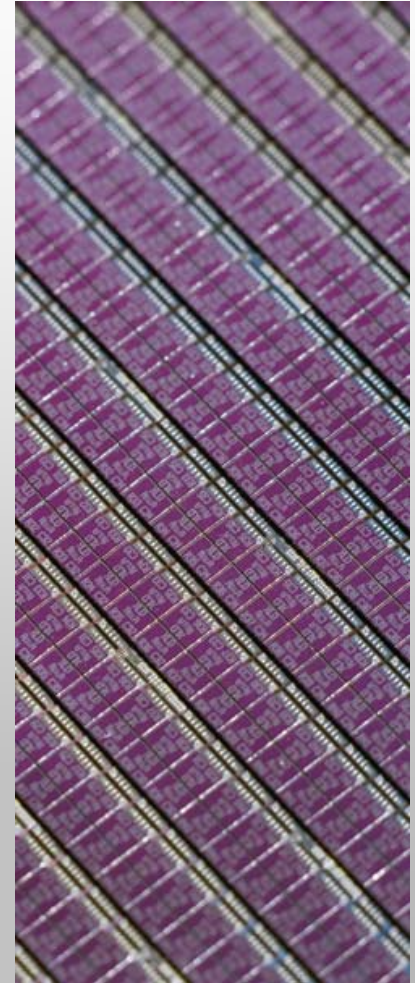
Integrated Sensing

■ Advantages

- Opportunity to share computing resources
- Provide a more complex application solution

■ Disadvantages

- Cost
- Yield
- Packaging challenges
- Loss of flexibility with mounting location



Enabling Applications

■ Consumer Electronics

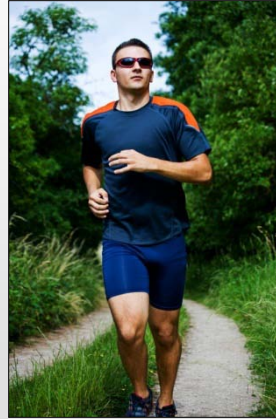
- Mobile phones, Personal Media Players
 - User interface → gaming, navigation
- Gaming
 - User interface → context awareness features
- Digital Still Camera
 - Image stabilization → user interface
- Computer (Netbooks, Notebooks....)
 - Hard Drive Drop Detection → security, navigation
- Personal Navigation Devices
 - E-compass → user interface, meta-data

■ Automotive

- Electronic stability control
- Electronic parking break
- Headlight leveling

Expanding Markets

- Healthcare
- Fitness & activity monitoring
- Education (e-books)
- Toys
- Security/asset management
- Portable Industrial measurement/tools



Coming Age of Sensor Based Health Games

Games are using new generation of sensors

- Movement
- Haptics
- Proximity
- Global Position
- Light & Images
- Brain Waves
- Emotional States
- Physiological States



Mindflex

Health-Related Games Market

16% of the overall game business
\$6.6B Worldwide



Health Games Research program

- **Goal: Advance the innovation, design and effectiveness of health games and game technologies**
- **Improve health behaviors and outcomes**
- **Physical activity games or self-care games**
- Three targeted areas of interest:
 1. Theory-based design principles
 2. Comparative analysis of games versus other health intervention methods
 3. Meeting the needs of specific target populations

\$4M in Research Grants in 2008/09

What Do Games Offer Healthcare?

For Consumers and Patients

- **Engagement**
 - Cognitively focus the user on the task
- **Motivation**
 - Provide an addictive reward structure
- **Improved Compliance**
 - Distract from duration of the task or pain

What Do Games Offer Healthcare?

For Healthcare Professionals

- New Provider/Patient Interaction
 - Doctor/Patient
 - Insurance Company/Member
 - Communication and Data Collection
- Better Outcomes
- Lower Costs and New Revenue Opportunities

What Do Games Offer Healthcare?

For Healthcare Professionals

- Realistic Simulations for Training
 - According to a study by the New Scientist, surgeons in training that 'warmed-up' using the Nintendo Wii scored 48% higher on tool control and performance (in subsequent simulated surgery) than those without the Wii warm-up'.

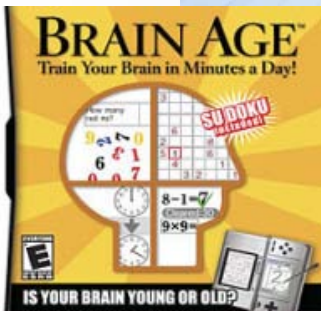
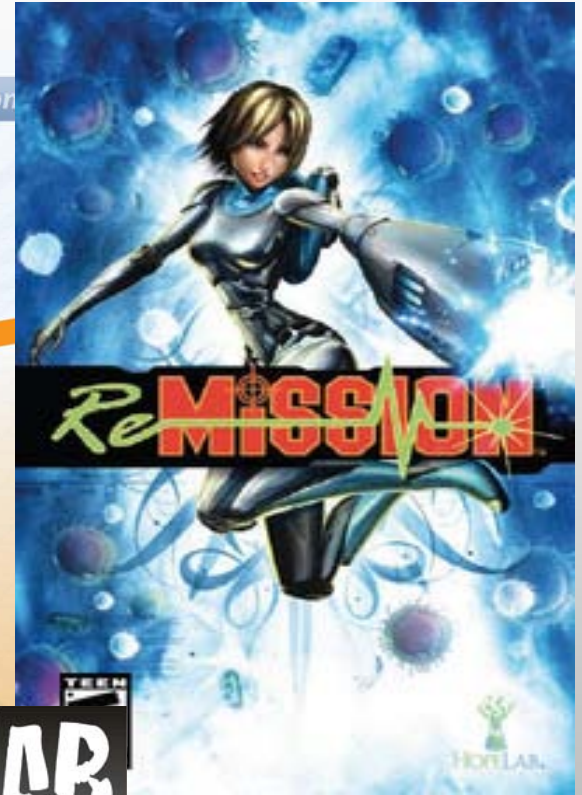
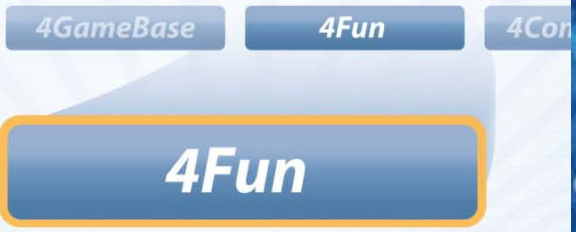


Examples of Health Related Games

- Exergaming
 - WiiFit, WiiSports and others
- Games for rehabilitation and therapy
- Games to raise awareness of health issues
- Cognitive development games
- Games to train practitioners



Exergaming...Condition Management... Healthy Eating & Brain Fitness



Humana Games 4 Health

The screenshot shows a web browser window with the address bar at <http://humanagames.com/#/home/>. The page features the HG4H logo in the top left and navigation links like 'Send To A Friend', 'Register', and 'Contact' in the top right. The main content area is titled 'Make Your Play' and includes a 'Learn More' button. Below this is a 'Latest News' section with several articles. On the right side, there are three game promotion boxes: 'INSERT COIN', 'HAPPY neuron', and 'FREEWHEELIN' CYCLE CHALLENGE'. At the bottom of the main content area, there is a large graphic for 'THE HORSEPOWER CHALLENGE' featuring a cartoon horse and a 'Sign In and Play' button. The footer contains copyright information and a 'beta' badge.

Humana Games for Health

File Edit View History Bookmarks Window Help

http://humanagames.com/#/home/

Search: humana games for health

Nature Pu...formation Family History Track Flig...formation My Yahoo! KJZZ The Huffington Post Politico.com Sciencefriday.com WSJ.com Minyanville Yahoo Finance News (150) Popular

Send To A Friend Register Contact

HG4H

Make Your Play

At Humana games, we believe video games can be more than just fun and entertaining - they can serve as a catalyst to a healthier lifestyle. Join us, as we design, develop and research video games that make people healthier.

[Learn More](#)

Latest News

new outfit to wear to the premiere of Disney's G-Force in Hollywood, CA.
[Watch Video](#)

Ever wonder what happened to Link & Zelda?
[Watch Link: The Later Years](#), and find out.
[Watch Video](#)

Winners of **Operation Planet Savers** selected to walk the red carpet at G-Force movie premiere; HG4H team announced launch of **Operation Planet Savers: Master Series** game.

Good luck to everyone who submitted entries to **InsertCoin!** The team is busy judging entries and will announce the finalists in October.
[Learn More](#)

Challenge your brain and keep it in top gear at all times!
[Play Now](#)

Find out if you've got what it takes to cross the finish line in first place!
[Play Now](#)

THE HORSEPOWER CHALLENGE

[Sign In and Play](#)

beta

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Inbox - Microsoft ... ActiGraph - Messa... Humana Games fo... IEEE Games and He... Health_2020-View... ActionXL

1:39 PM



Teams race around the world and pass historic landmarks.



Students track their activity via their individual dashboard.



Students and teams purchase accessories using currency earned through steps.



Why Should the Engineering Community Be Interested in Health Games ?

Because They Require
New Devices and New
Technologies!

Coming Age of Sensor Based Health Games

Games are using new generation of sensors

- Movement
- Haptics
- Proximity
- Global Position
- Light & Images
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- Emotional States
- Physiological States



Mindflex

For Example: Activity Monitors



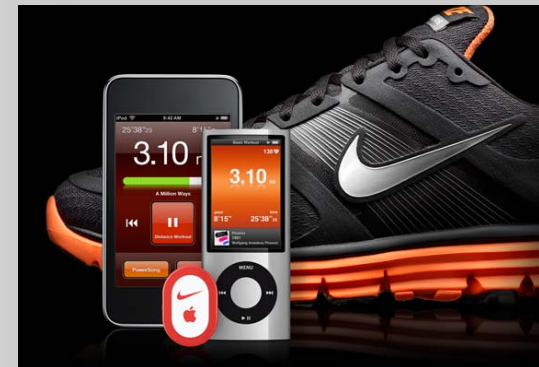
FitLinxx



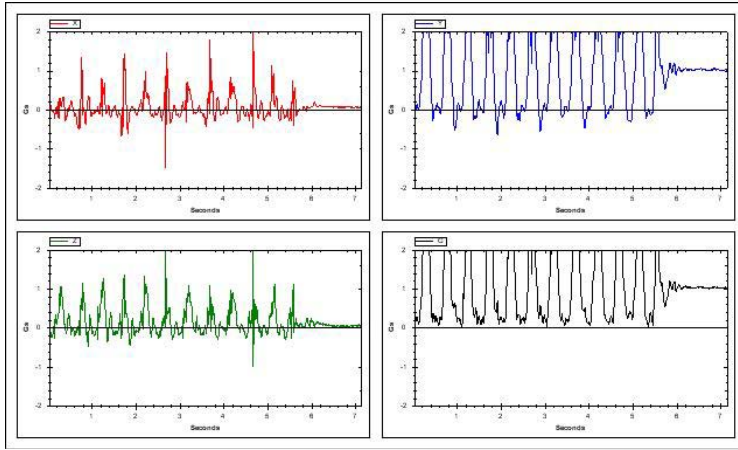
BioMotion



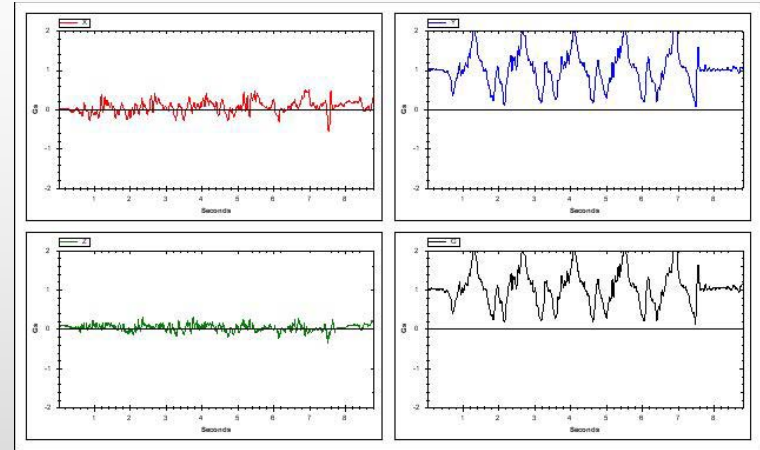
Actigraph



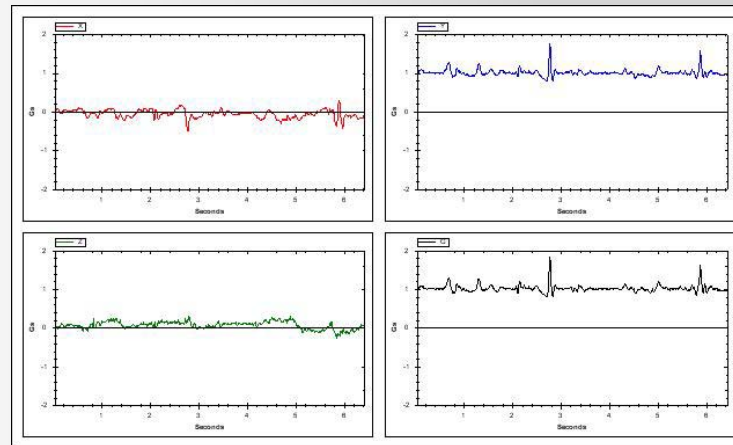
Motion Detection Algorithms



Jumping Jack



Squats



Walking

Ingestible Sensors



Proteus ingestible sensors

Proteus ingestible event markers (IEMs) are tiny, digestible sensors made from food ingredients, which are activated by stomach fluids after swallowing. Once activated, the IEM sends an ultra low-power, private, digital signal through the body to a microelectronic receiver that is either a small bandage style skin patch or a tiny device insert under the skin.

“Take two digital pills and they’ll call me in the morning”

The Hand Mentor Pro™ from Kinetic Muscles



Air Muscle Actuator

An air muscle is attached to the proximal forearm.

Activation of the air muscle rotates a bar about a pivot point positioned inline with the flexion axis of the wrist.

This action extends the wrist and fingers

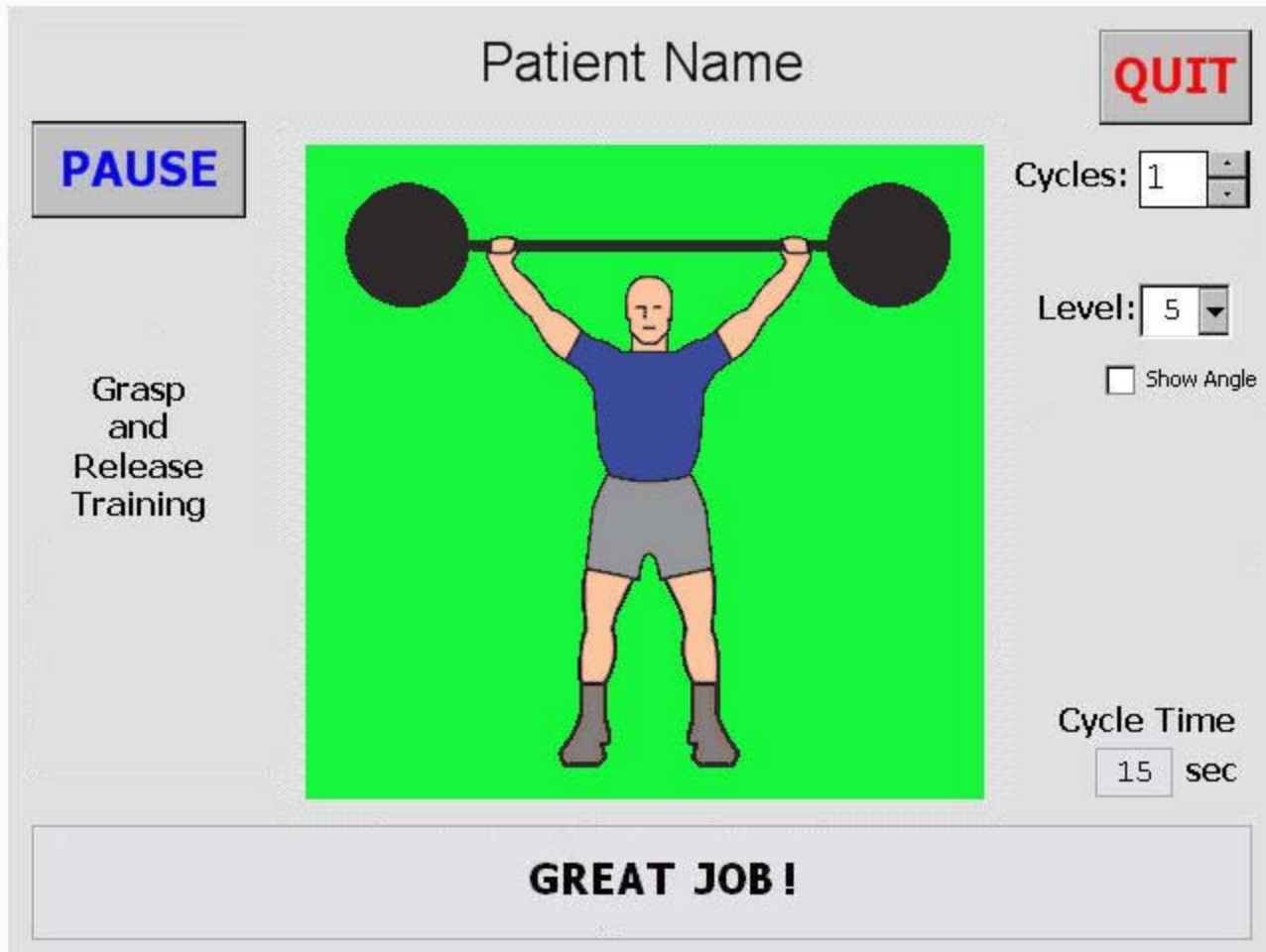


Sensors

Wrist extension position is measured by an angle sensor

Force is calculated from air pressure and air muscle length

Basic Motor Control

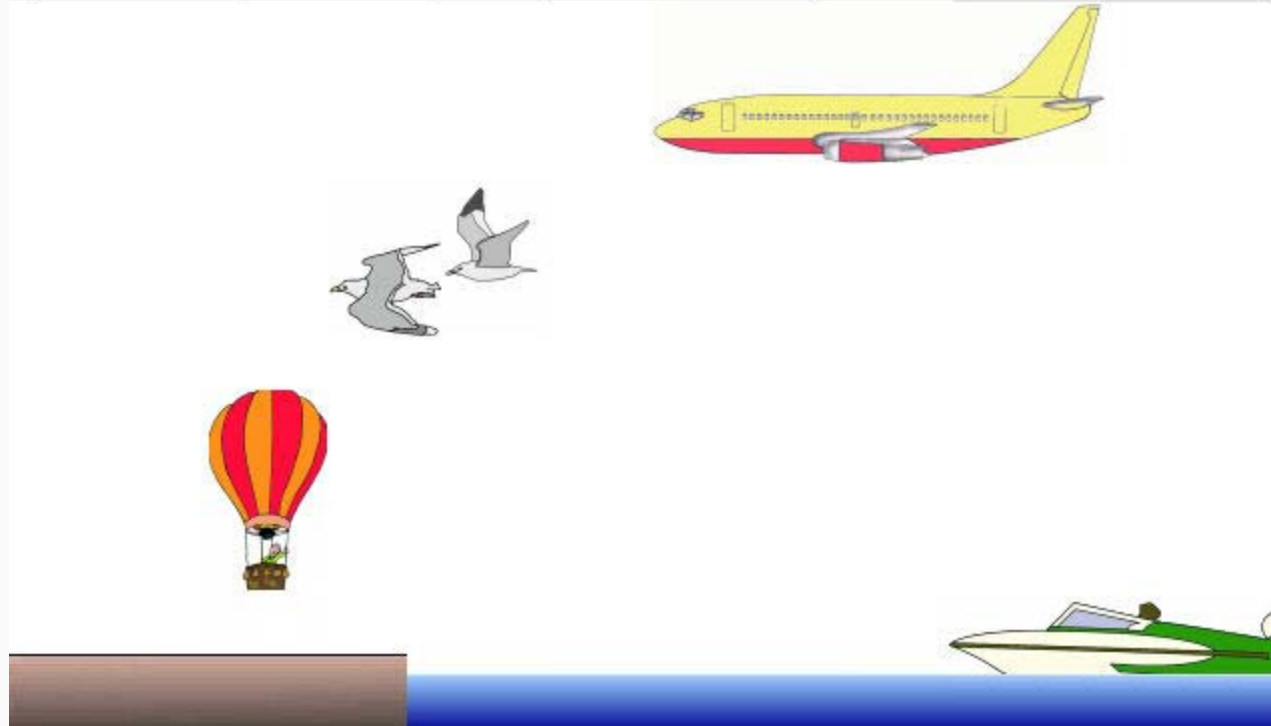


The system uses game concepts to provide feedback and to monitor patient progress.

Advanced Motor Control Balloon Game

Patient Name **QUIT**

PAUSE Play Time: Level: Prev. High Score:
 Speed: Show Angle Score:



The game area features a yellow airplane with red accents flying in the upper right. A hot air balloon with red and orange vertical stripes is positioned in the lower left. Two grey birds are flying in the center. At the bottom, a green boat is on a blue sea, and a brown landmass is visible on the left.

The Hand Mentor Pro™ Games

Spasticity Reduction

Thermometer Gauge

Basic Motor Control Programs

Motor Control Down

Strongman – Grasp and Release Training

Motor Control Up

Strongman – Wrist/Finger Extension Training

The Hand Mentor Pro™ Games

Advanced Motor Control Programs

Balloon

Preset pattern of flexion and extension
Adds timing element to movement

TheraPong™

Random training of flexion extension position
Adds timing element to movement

EMG

Strongman – played with muscle activity only

Gesture Designer

The Made-for-Motion Gesture Designer is a development platform that allows developers to create a gesture library that can be embedded within gaming, healthcare, or user-interface applications. Features include:

- Real-time analysis of design and test gestures
- Gesture detection in-progress for animation syncing
- Adjustable tolerance per signature
- Multiple signatures per gesture for a wider range of detection without 'sloppiness'
- Minimum of storage space for gesture information
- High-speed watch for dozens of gestures composed of hundreds of signatures
- Automatic detection of gesture beginnings and endings, no button presses required

Advanced Development Tools

Gesture Designer

- Motion application development tool
- Gesture recording
- Gesture testing and validation
- Accelerometer testing

USB Development Kit

- Test multiple accelerometers
- Sensor Scope (waveforms)
- Sensor Calc (math)
- Sensor Map (registers)
- Gesture Designer compatible