Connecting the Physical and Digital Worlds: Sensing

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Intel Developer FORUM

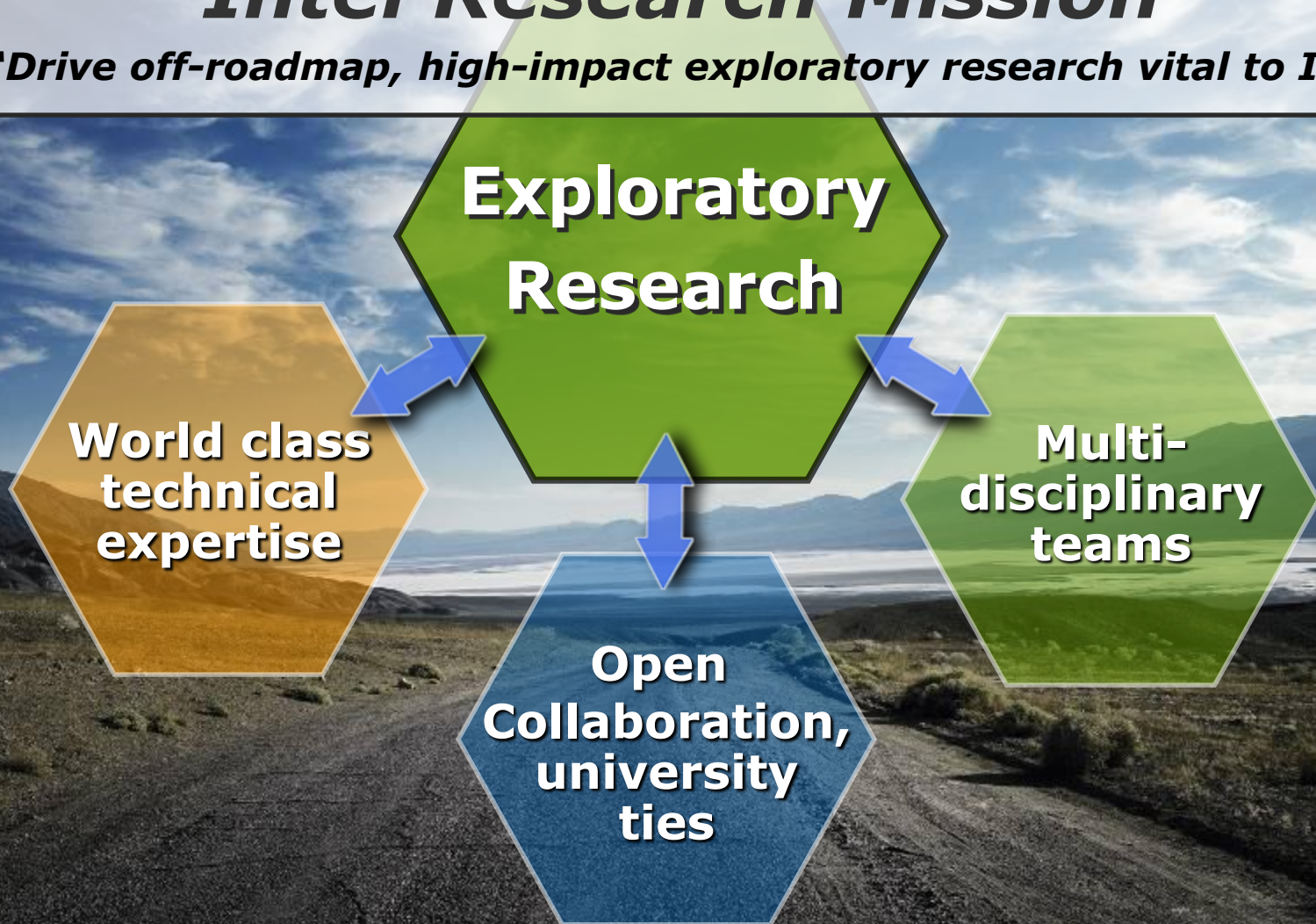Invent the new reality.

Agenda

Introducing Intel Research

Sensing

Many scales of sensing

 - Nanometers to Meters

Questions and Answers

Intel Research Mission

"Drive off-roadmap, high-impact exploratory research vital to Intel"

Exploratory Research

World class technical expertise

Open Collaboration, university ties

Multi-disciplinary teams

(intel)

"Essential"

Things Essence of your life

Essential Computing

Simplifying and enriching all aspects of work and daily life

(intel™)

Connecting the Physical and Digital Worlds

# Marking Stem Cells - Nanometers

Problem

Stem cell research and manufacturing requires tools to track individual cells in cell populations in real time

Research

Track cells in phase contrast microscopy image sequences

Detect mitosis (division) and apoptosis (death) events in image sequences

Best Paper in MICCAI 2007, invited paper in Medical Image Analysis 2008
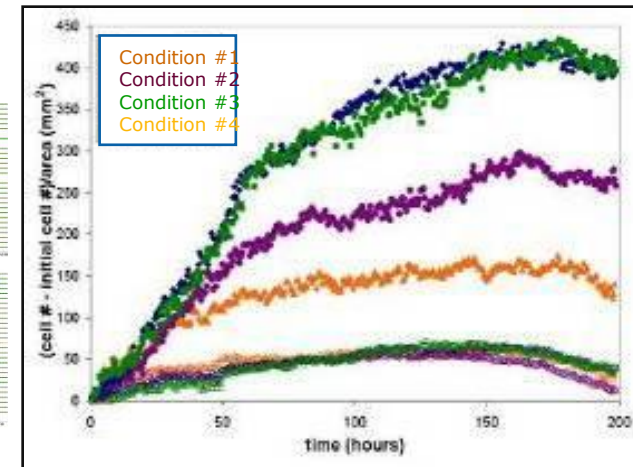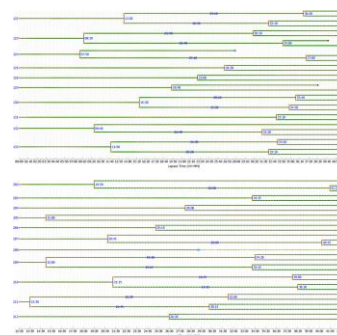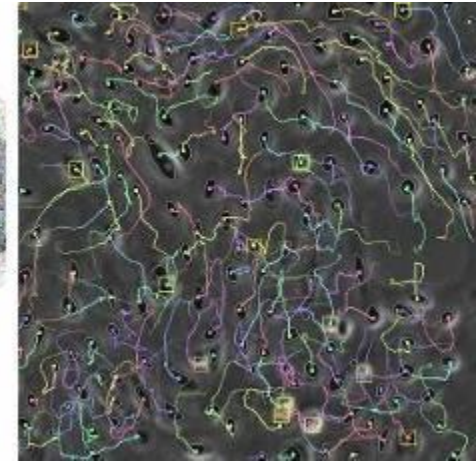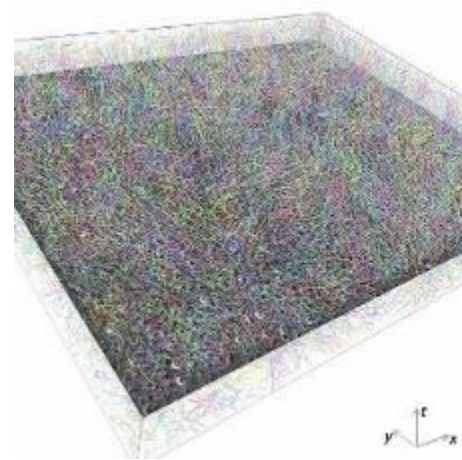
Matching Skin Lesions - Centimeters

Problem

Skin cancer is the most common cancer in U.S. – trained Dermoscopy improves early detection

Research

DermFind: to enable informed diagnosis, provide image-based query with computer vision & machine learning Prototype under pilot study at University of Pittsburgh Medical Center Clinics

query

Annotated medical image repository

relevant cases

malignant
biopsy
age: ##
weight: ##
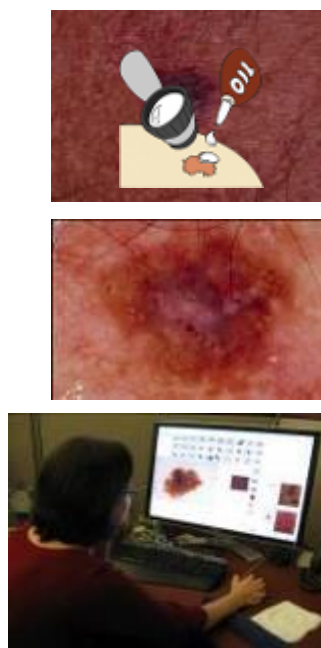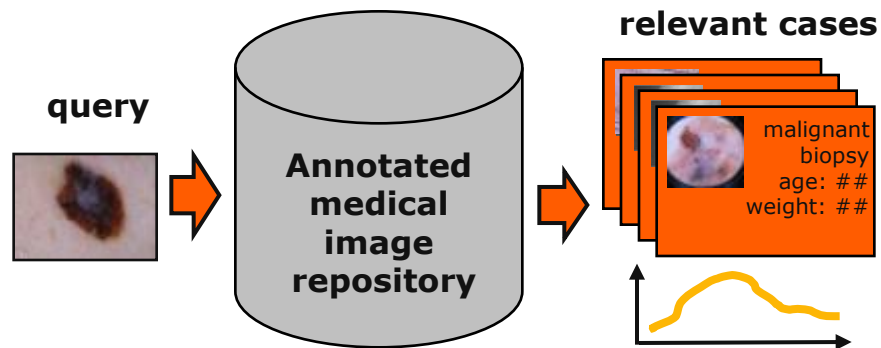
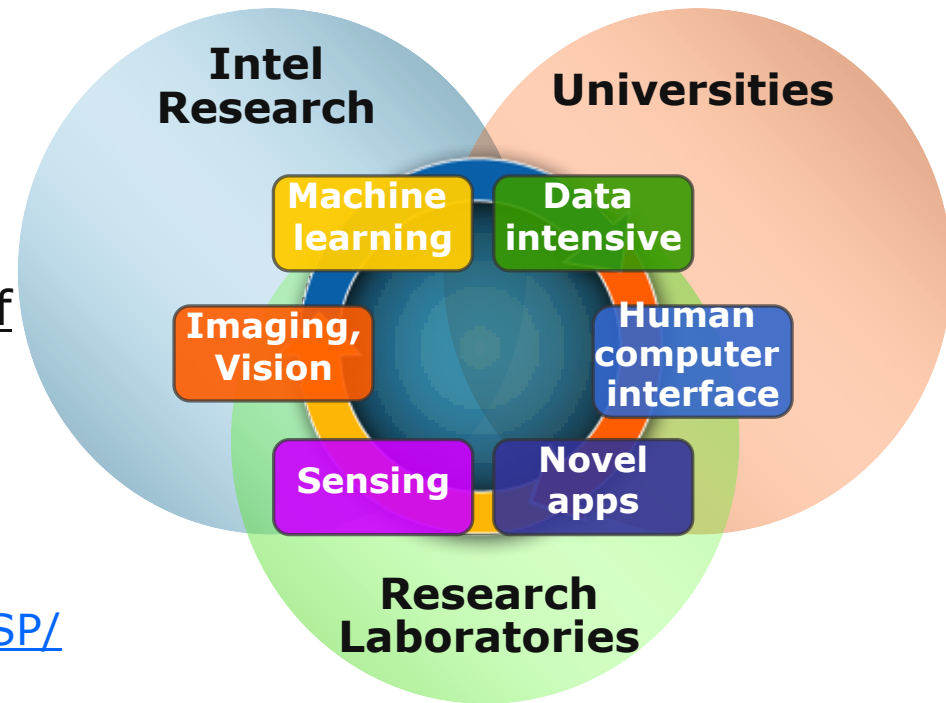# Everyday Sensing and Perception (ESP) - Meters

"**Drive fundamental research advances that enable computing systems to become aware in everyday activities and environments**"

Achieve "<u>90% accuracy for 90% of your day</u>"

Progress

- Launched in Q4 2007, 12+ researchers
- 17+ MSP grants to universities http://seattle.intel-research.net/MSP/

Arizona State, Carnegie Mellon, Darmstadt, Dartmouth, Georgia Tech,

Intel Research

Universities

Machine learning

Data intensive

Imaging, Vision

Human computer interface

Sensing

Novel apps

Research Laboratories

ESP: Making computing systems aware of their users and context in everyday activities and environments

ESP: Low-level sensing to High-level Understanding
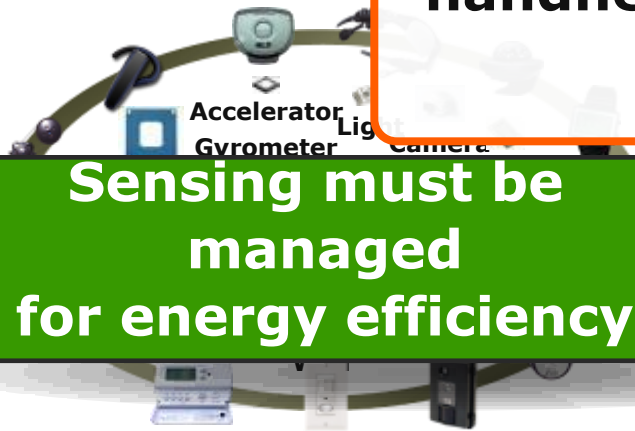
Machine learning of everyday contexts:

With Bayesian Networks today, hundreds of authors.

With Web-Mined Descriptions, thousands of authors in future!

Real-time video event detection requires 1 teraflop at 10kW today.

In the future, <1W on handheld?

Accelerator
Gyrometer Light Camera

**Sensing must be managed
for energy efficiency**

ESP: Infer Activities by Visual Object Recognition

ESP camera

LED bracelet

Problem

Recognize activities from shoulder-worn mobile video camera - "Egocentric video" (ECV) solves coverage problem
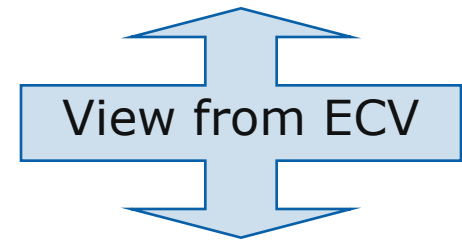
Research

Recognize objects being handled and map objects to activities

Automatic system achieves 70-95% accurate object recognition of 7 objects under varying illumination, locations, usages

Next steps: Scale up to 100s of objects, 10s of activities, 100s of hours

View from ECV

ESP: Identify users by TV Remote Usage

Problem
Use accelerometers to distinguish family members based on the unique way each person wields the shared television remote control

Research
Data: 5 data sets from real families; 30 features including key timing and 3-axis acceleration frequency, magnitude, energy, mean, and variance
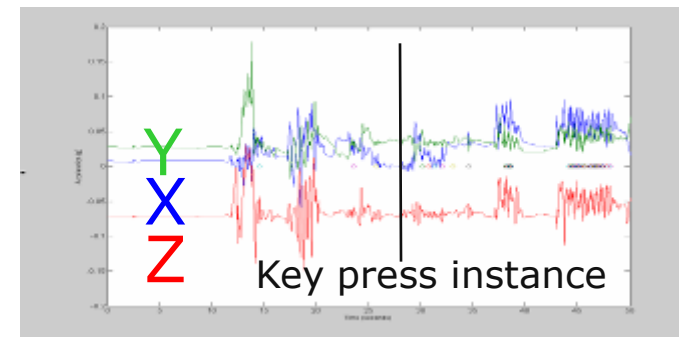Achieved ~85% accuracy using Naïve Bayes with feature selection and time-based filtering
Planned: Semi-supervised learning to bootstrap in real scenarios

Experimental data collection rig

Camera for ground truth (identity)

Remote with 3-axis accelerometer

IR receiver for logging key presses

Y
X
Z
Key press instance

Acceleration during a key-press

Summary

Exploratory Research at Intel

Connecting the Physical and Digital Worlds

Sensing at different scales

  - StemCell Tracking

  - DermFind

  - Everyday Sensing and Perception

Questions and Answers

Intel Research @ IDF

Day 0 Talk: Connecting the Physical and Digital Worlds with Sensing
   Demos: DermFind+Composition, Stem-cell Tracking, Moneyscapes
Days 1-3: Industry Insight, Sessions, ChalkTalks, Demos
   INDS001 Using IT to Meet 21st Century Challenges and Opportunities
   IAIS001 Emerging Media and Education
   IAIS003 Robotics at Intel
   IAIS006 Innovation for Connecting the next Billion Users
   IAIS007 Innovation as a Service
   IAIS008 Biosensors and Solutions for Clinicians
   Innovation in Research Collaboration – UPCRC
   FUTC002 Carry Small Live Large Research
   FUTS003 Context-Aware Applications and Services"
   FUTS004 Composition: A New Paradigm for Building Wireless Systems
   CTG-02 Navigating Future Moneyscapes
   CTG-03 DermFind + Stem-cell Tracking
   CTG-12 Dynamic Composable Computing
   SSG Mashmaker
Academic Program
   SFTS006 Improving Parallel Runtime and Runtime Environment
   SFTS007 Intel Performance Library and Software Tools For Video Surveillance
   SFTS008 Simply Expressing Parallelism in Software
   Academic Community- Multi-core Programming Roundtable

See www.intel.com/research

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Questions?