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Deep Learning and Digital Health

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Presented by
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I have no actual or potential conflict of interest in relation to this program/presentation.

Basic Information about Myself (1)

- Prof. Yu Cao, Ph.D.,
  - Associate Professor (06/2016 - present), Assistant Professor (08/13-06/16) of Computer Science, UMass Lowell
  - Co-director, UMass Center for Digital Health (effective from 06/2016)
  - Assistant Professor of Computer Science at University of Tennessee (08/2010-06/2013)
  - Assistant Professor of Computer Science at California State University (07/2007-06/2010)
  - Research Fellow of Biomedical Engineering at Mayo Clinic, Rochester, Minnesota (2006-2007)
  - Ph.D. in Computer Science from Iowa State University (2002-2007)

Basic Information about Myself

- Research interests and expertise
  - Big Data Analytics
    - Scalable machine learning/deep learning algorithms and system for big data analytics
  - Computational Intelligence
    - Learning-based data stream analysis
    - Time series causality analysis
  - Multimedia Computing
    - Content-based image, video, and text retrieval and analysis
  - Biomedical Informatics
    - Digital health

Our Research Focus on Digital Health - Research Focus 1

Designing scalable pervasive healthcare monitoring, rehabilitation, and public health systems

Current Issues in Healthcare

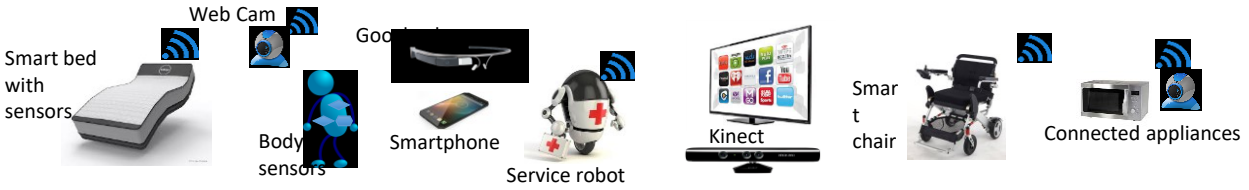
Reactive and hospital-centered healthcare

Our Proposed Approach

Designing new scalable digital models, algorithms, and systems using ubiquitous, Internet of Things (IoT) devices and pervasive computing techniques

Outcomes and Deliverables

Technology-based, computer-aided, proactive and person-centered healthcare



Proposed Internet of Things (IoT) devices, pervasive and ubiquities computing

Our Research Focus on Digital Health - Research Focus 2

Building high performance networking and computing infrastructure for health data transmission and computation

Current Issues in Healthcare

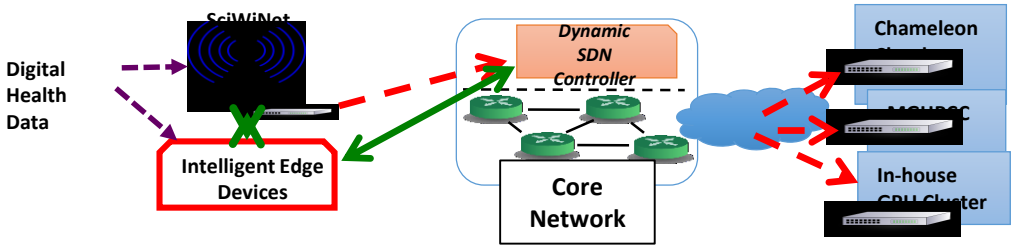
Ever growing health data and unreliable, unsecure networking

Our Proposed Approach

Building high performance, secure networking and computing system using Software Defined Network (SDN), fog and cloud computing, and heterogeneous computing architectures

Outcomes and Deliverables

Reliable and secure networking and computing system for health data sharing and computation with privacy preserving



Proposed high performance, secure, networking and computing infrastructure

Our Research Focus on Digital Health - Research Focus 3

Developing novel algorithms and systems for big data analytics in healthcare

Current Issues in Healthcare

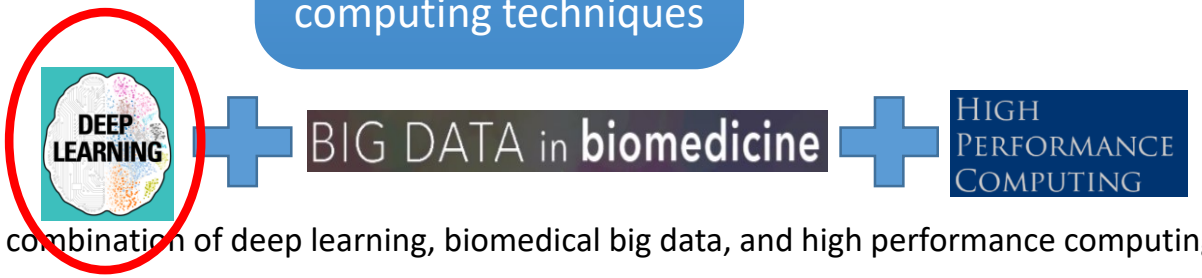
Tremendous amounts healthcare data, *lack of insights from healthcare data*

Our Proposed Approach

Developing novel algorithms and systems using the combination of machine learning (with an emphasize in deep learning), big data in biomedicine, and high performance computing techniques

Outcomes and Deliverables

Analytics tools & techniques for effective and efficient knowledge discovery from healthcare data



Proposed combination of deep learning, biomedical big data, and high performance computing

Our recent results in the field of deep learning with applications to digital health

- (1) Medical imaging informatics for large-scale mining/classification

- (2) Biomedical sensor informatics for scalable behavioral activity profiling

Medical imaging informatics - Sample project 1

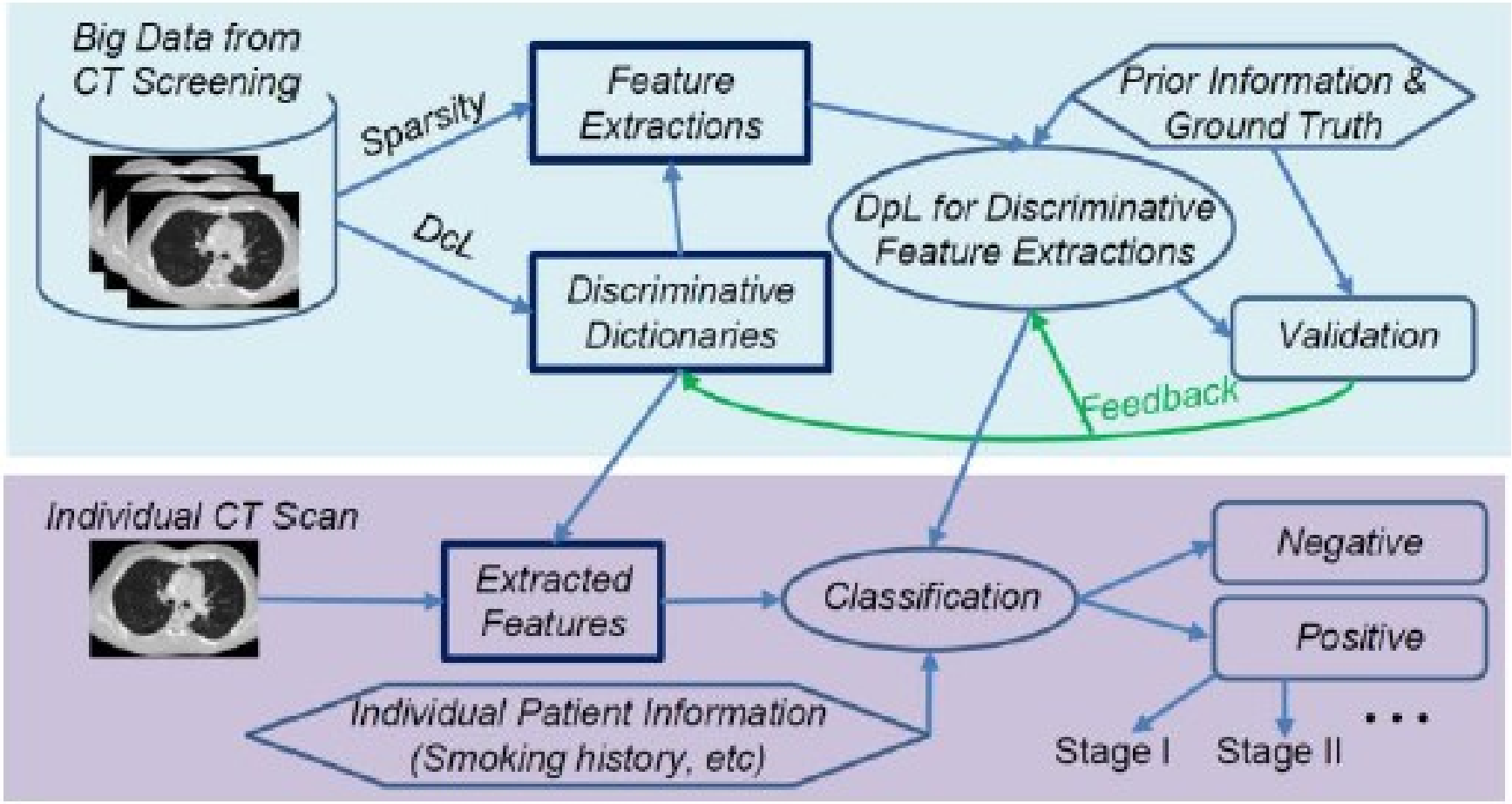
- Project name: Improving Tuberculosis Diagnostics using Deep Learning and Mobile Health Technologies among Resource-poor and Marginalized Communities

Tuberculosis(TB)

- A **chronic and infectious** disease
- Affects the **most disadvantaged populations** and involves complex treatment regimes
- More than **9 million** estimated new case and **1.5 million** deaths every year
- Over 80% were in South-East Asia, Western Pacific and African(2013)
- Majority of the infected populations was from **resource-poor** and **marginalized** communities.

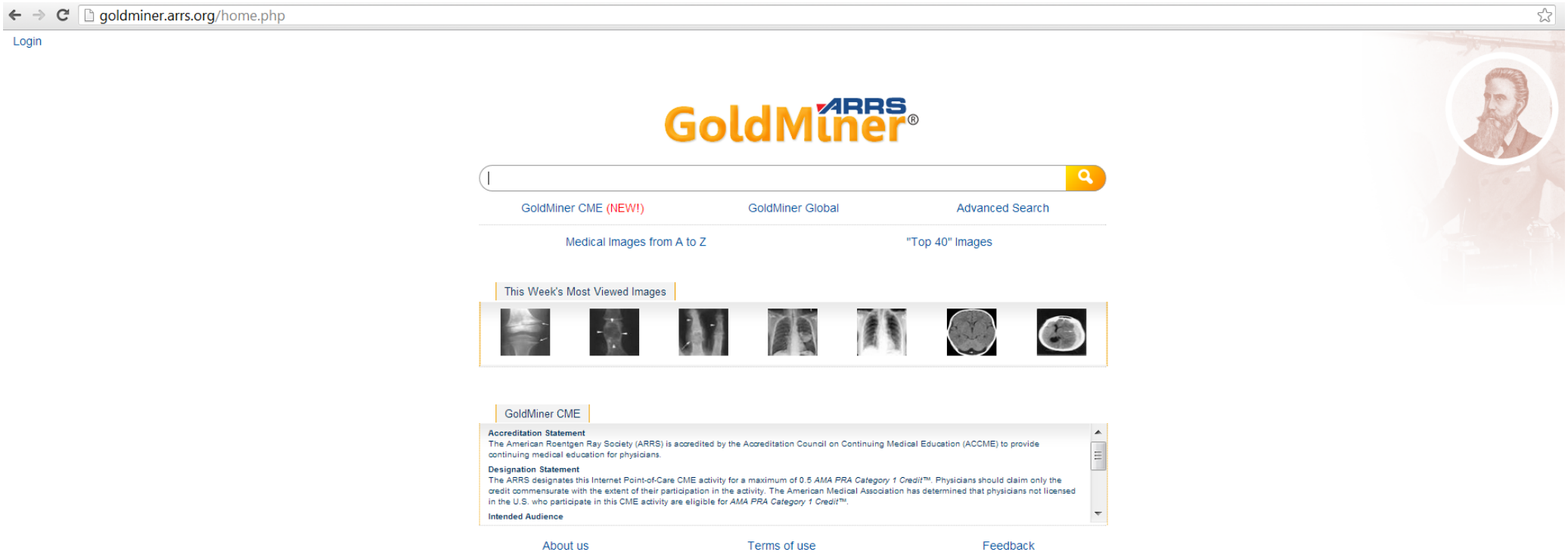
Medical imaging informatics - Sample project 2

- Project name: Imaging Biomarkers for Lung Cancer Screening



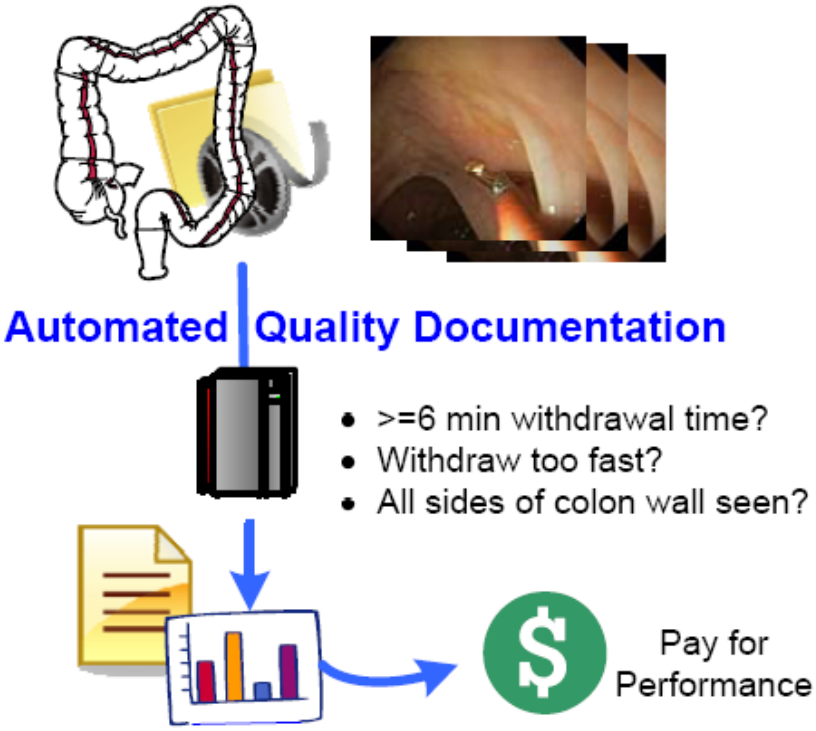
Medical imaging informatics - Sample project 3

- Project Name: Semantic Medical Image Retrieval: A search engine that can understand the medical terms



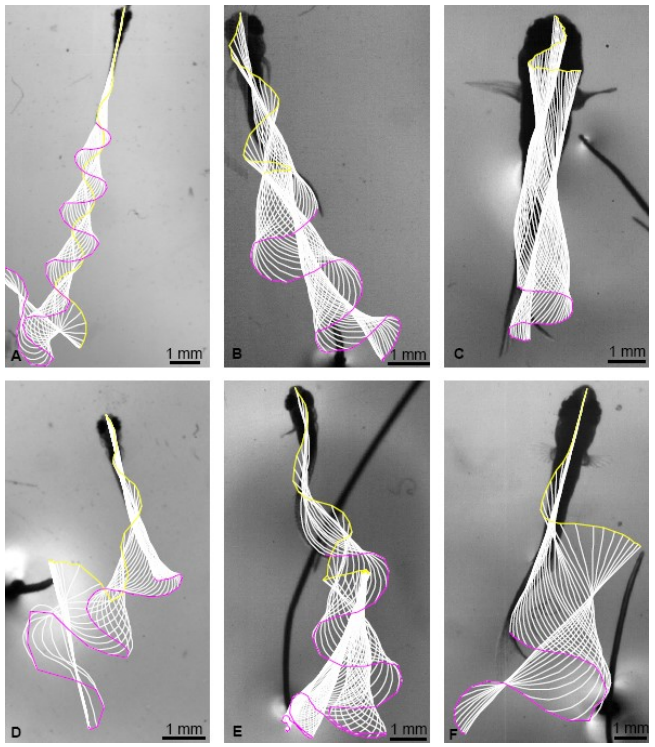
Medical imaging informatics - Sample project 4

- Improving Colonoscopy Quality through Automated Monitoring
  - A software-based system that **produces objective quality related indicators** through analysis of the video of a colonoscopy procedure;
  - To provide ***objective evidence for clinical practice***



Medical imaging informatics - Sample project 5

- Animal Motion Capturing, Uploading, Analyzing, and Tracking Software for Biological Science
  - A ***fully automated visual tracking software***
  - Has been used by a few leading biological labs (California Institute of Technology, University of Groningen (Netherlands))

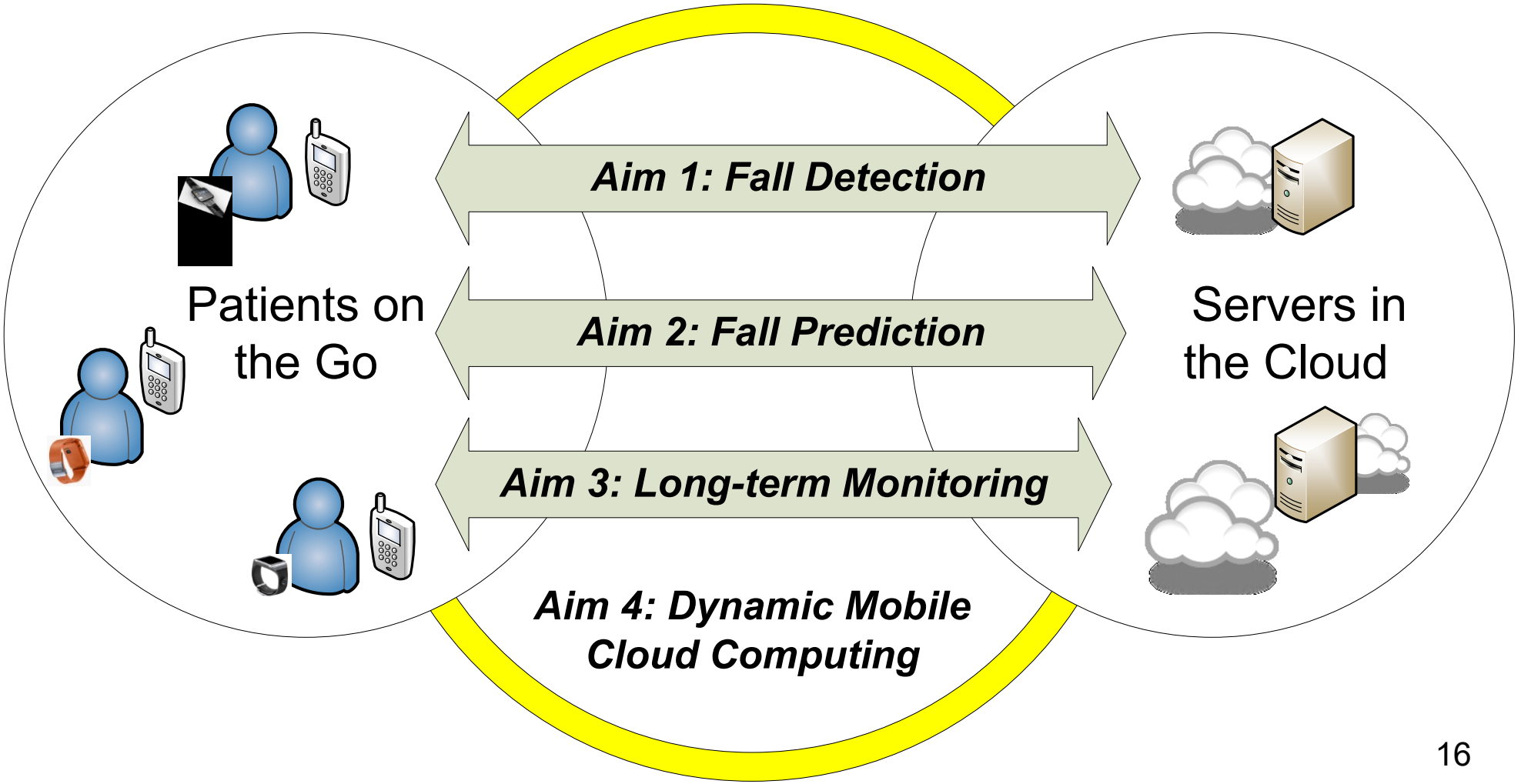


Medical imaging informatics - Sample project 6

- Xbox 360 and Kinect-based motion sensing for in-home rehabilitation

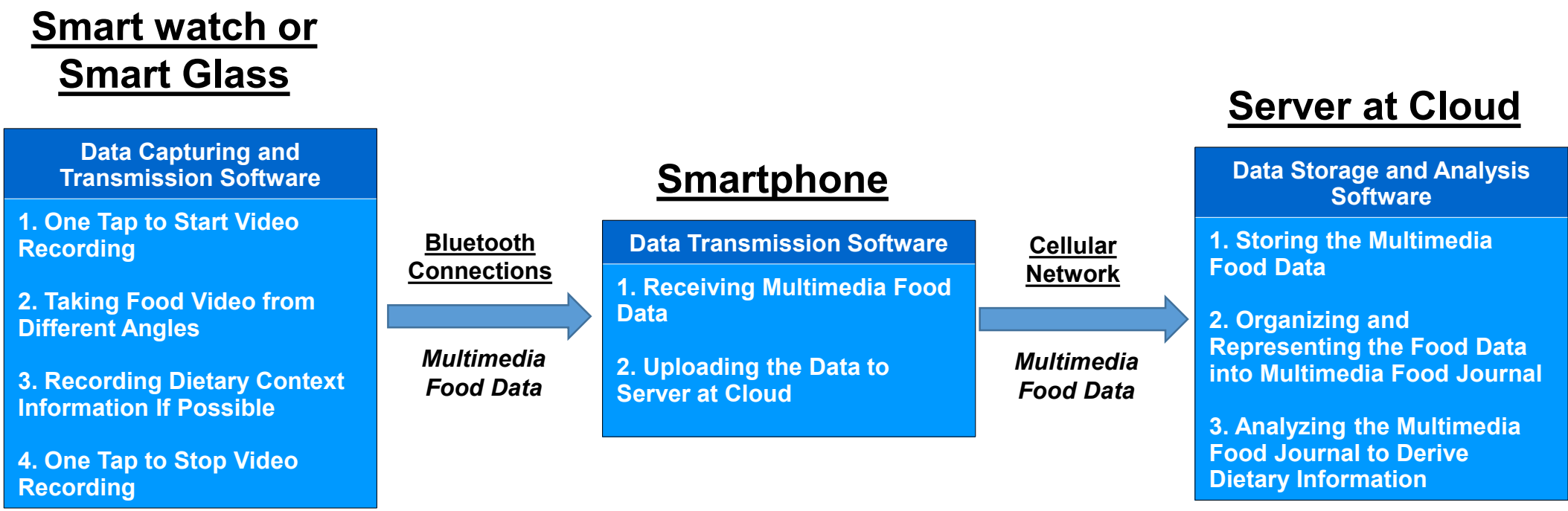
Biomedical sensor informatics - Sample project 1

- Project Name: Pervasive fall detection for stroke mitigation



Biomedical sensor informatics - Sample project 2

- Project name: Wearable device-based Multimedia Computing Platform for Computer-aided Dietary Monitoring



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