IOT SYSTEM FOR PUBLIC HEALTH AND SAFETY MONITORING WITH UBIQUITOUS LOCATION TRACKING

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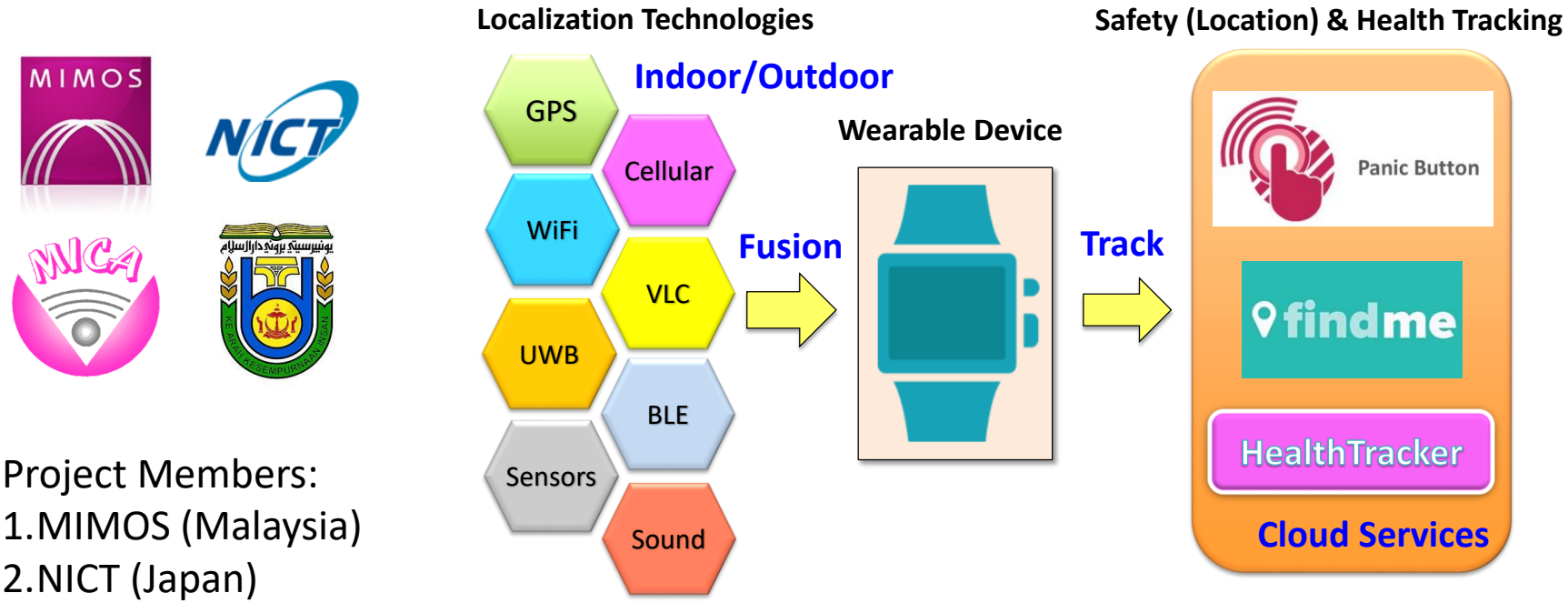
IoT System for Public Health and Safety Monitoring with Ubiquitous Location Tracking

Develop a system which enables tracking of location, lifestyle and health status in promotion of public health and safety in ASEAN countries taking into consideration ASEAN culture, lifestyles, behaviours and infrastructures

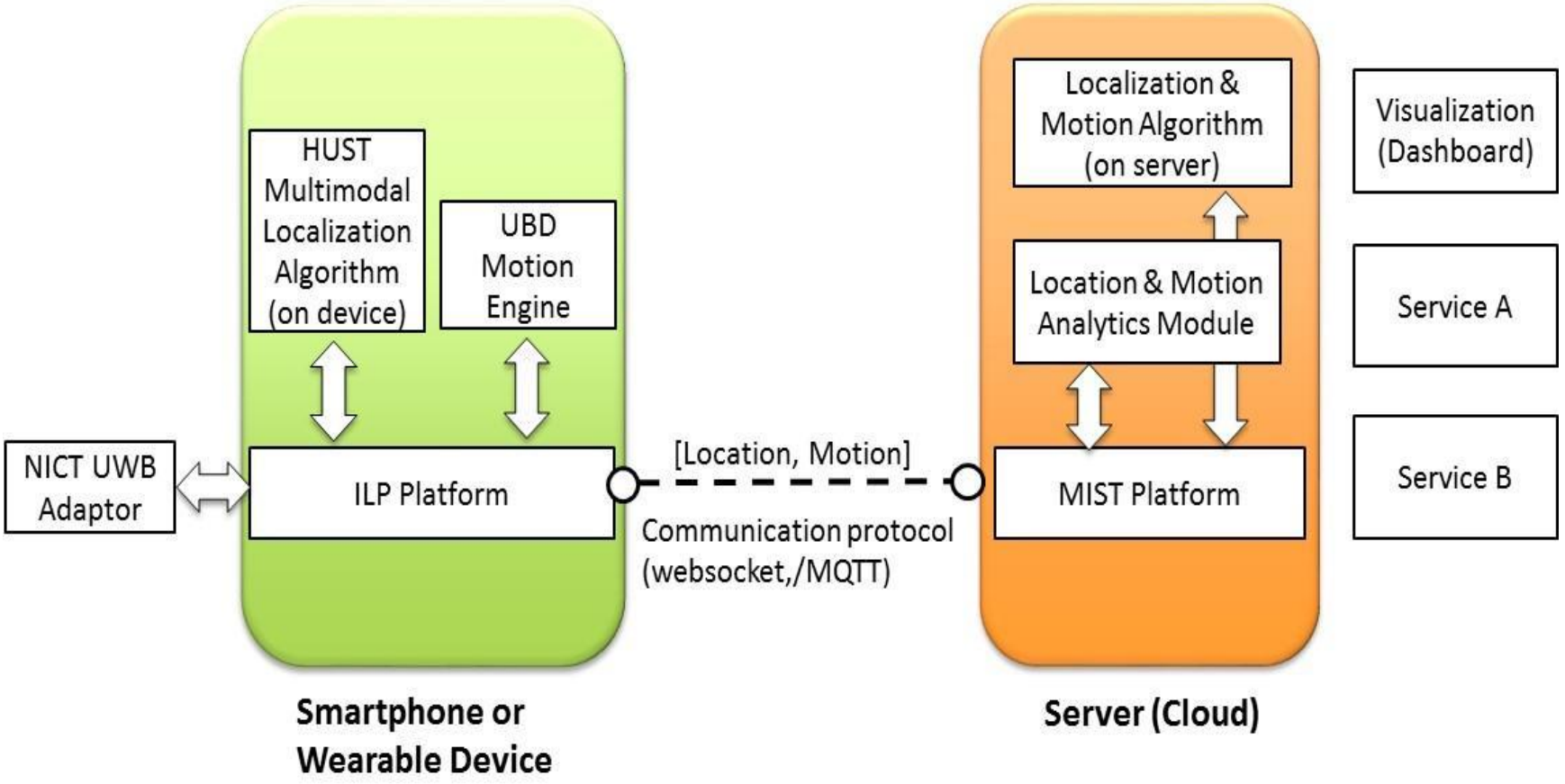


Project Members:

1. MIMOS (Malaysia)
2. NICT (Japan)
3. MICA Institute, Hanoi University of Science & Technology (Vietnam)
4. University of Brunei Darussalam (UBD) (Brunei)

Budget, Timeline and Overall Architecture

- Total budget = USD 77,900
- Duration = 2 years (April 2017 – March 2019)



Work Packages

Work packages	Deliverables	Form of deliverables
1. Mobile/Embedded Platform (Lead: MIMOS/NICT) Design and implementation of embedded platform that supports continuous location tracking and motion reasoning on commercially available smartphones or specially designed, low-cost and energy-efficient wearable devices	• Mobile platform • Embedded device	• Platform SDK, software libraries • Prototypes (hardware, software, testbed)
2. Multimodal Geospatial Localization Module (Lead: MICA) Development and integration new multimodal geospatial localization technologies which opportunistically harvest heterogeneous signals available for localization such as GPS, GSM, WiFi, Bluetooth, UWB, sensors in order to realize ubiquitous location tracking anytime anywhere	• Multimodal localization module/algorithms • UWB, WiFi, BLE, GPS, sensors	• Algorithms, performance results, publications • Prototype demo
3. Motion Reasoning Module (Lead: UBD) Development and integration of Motion Reasoning module based on UBD's hybrid OS architecture	• Motion reasoning module/algorithms	• Algorithms, performance results, publications • Prototype demo

Work Packages

Workpackages	Deliverables	Form of deliverables
4. Server Monitor and Analytics (Lead: MIMOS) Development of server-end modules to monitor and analyze citizen's lifestyle, health and location. Using Mi-MIST platform to host data and analytic modules	• Server monitoring/ analytic module • System integration	• Monitoring/analytic platform, prototype software • Use cases/demo apps
5. Pilot Trials (Lead: Depending on location) Pilot trials in selected ASEAN cities such as Hanoi, Kuala Lumpur and Bandar Sri Begawan. Ideally such trials are to be performed with local mobile operators	• Trials • Selected application e.g. people tracking	• Reports • End users' feedbacks

Proposed Timeline

Official project period: April 2017 – Mar 2019

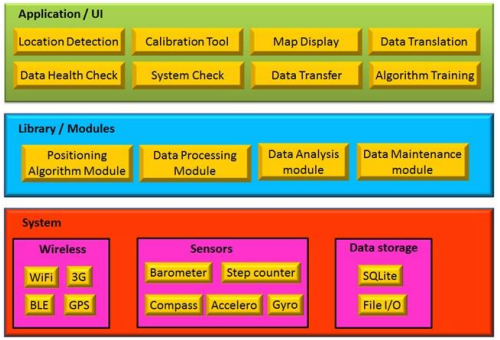
Work package	2017-2018				2018-2019			
	April	July	Oct	Jan	April	July	Oct	Jan
WP1	Platform development							
WP2		Module/algo dev			Integration	Testing & tuning		
WP3		Module/algo dev						
WP4							analysis	
WP5								trial

Progress

WP1: Mobile/Embedded Platform (Lead: MIMOS/NICT)

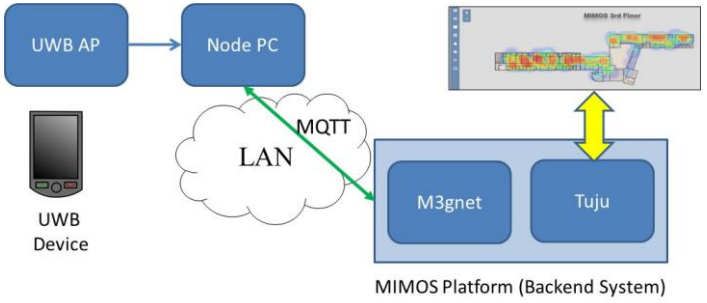
1. Mobile-based Indoor Location Platform supporting WiFi and BLE positioning:

- Android/iOS SDK design
- Algorithm study/evaluation
- Machine learning techniques study



2. UWB Positioning Platform:

- Two-way ranging algorithms (based on propagation time)
- Testbed architecture design (also software interface) in MIMOS
- Compliant design according to Malaysia regulatory

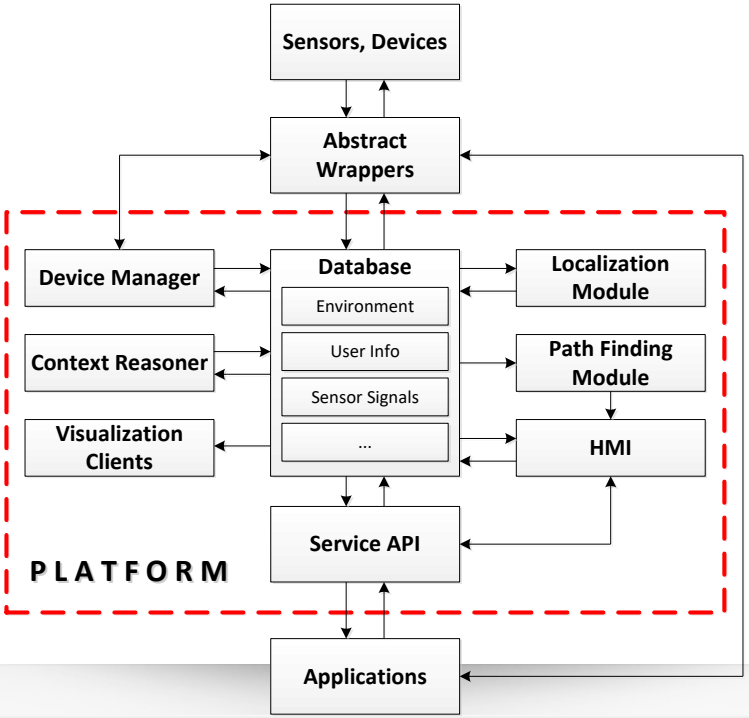


Progress

WP2: Multimodal Geospatial Localization Module (Lead: MICA)

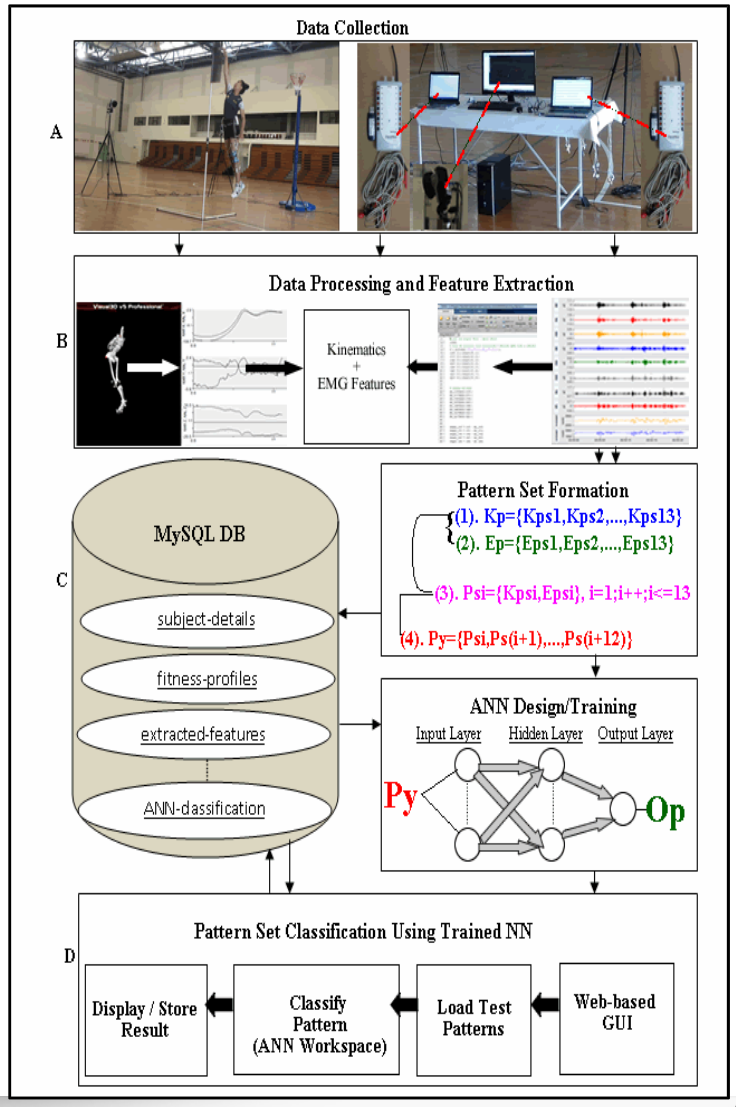
1. Joint-Camera-Mobile-based Localization Module

- Localization system architecture
- Environmental model (XML driven)
- Localization approach (fusion of heterogeneous data)
- Navigation (shortest path, environment-aware, personalize-able)



Progress

- **WP3: Motion Reasoning Module (Lead: UBD)**
  1. Motion Reasoning Module:
     - Motion Engine Laboratory setup
     - Module design:
       - » Signal acquisition
       - » Data processing
       - » Feature extraction, selection
       - » Modelling
       - » Evaluation, Visualization



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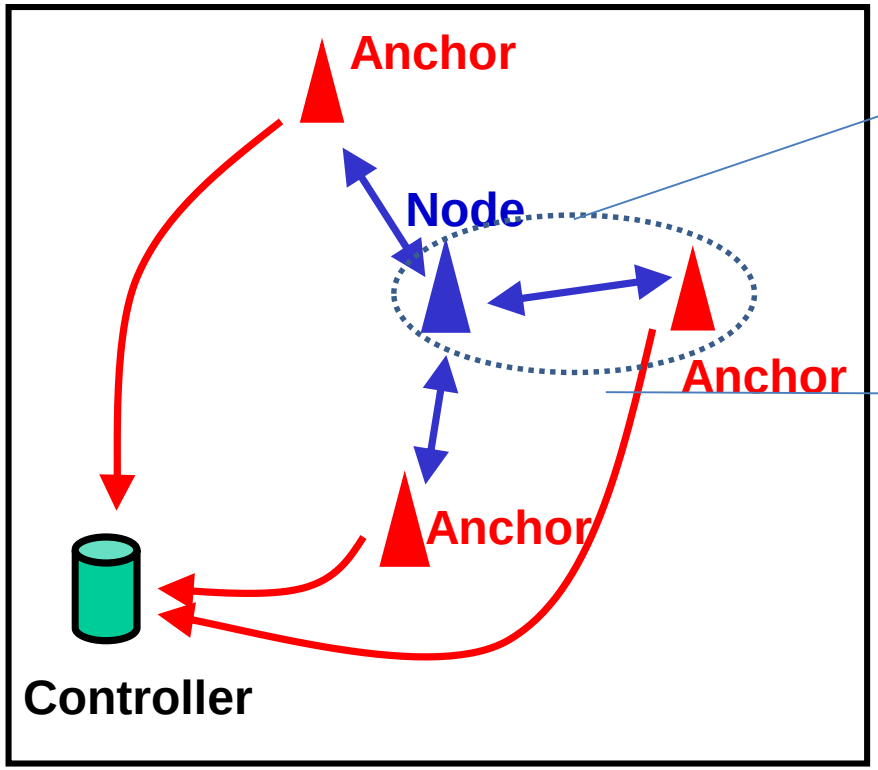
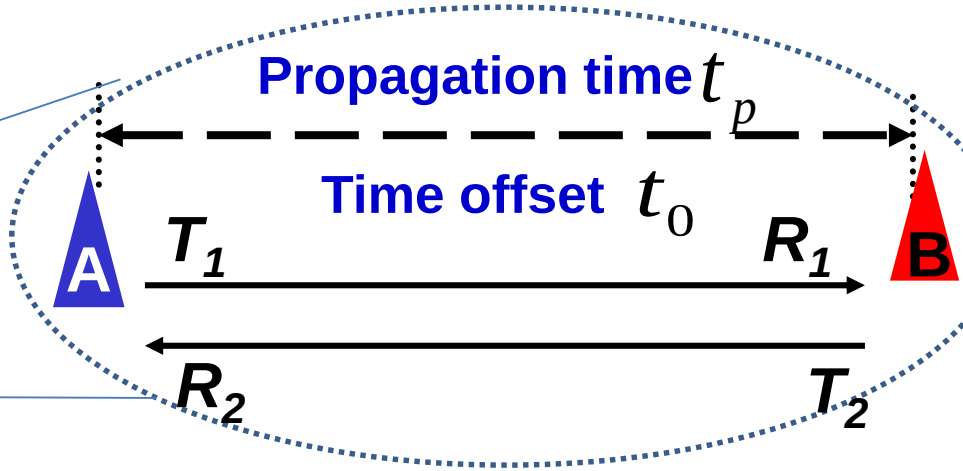
NICT

Two Way Ranging Used in NICT's System





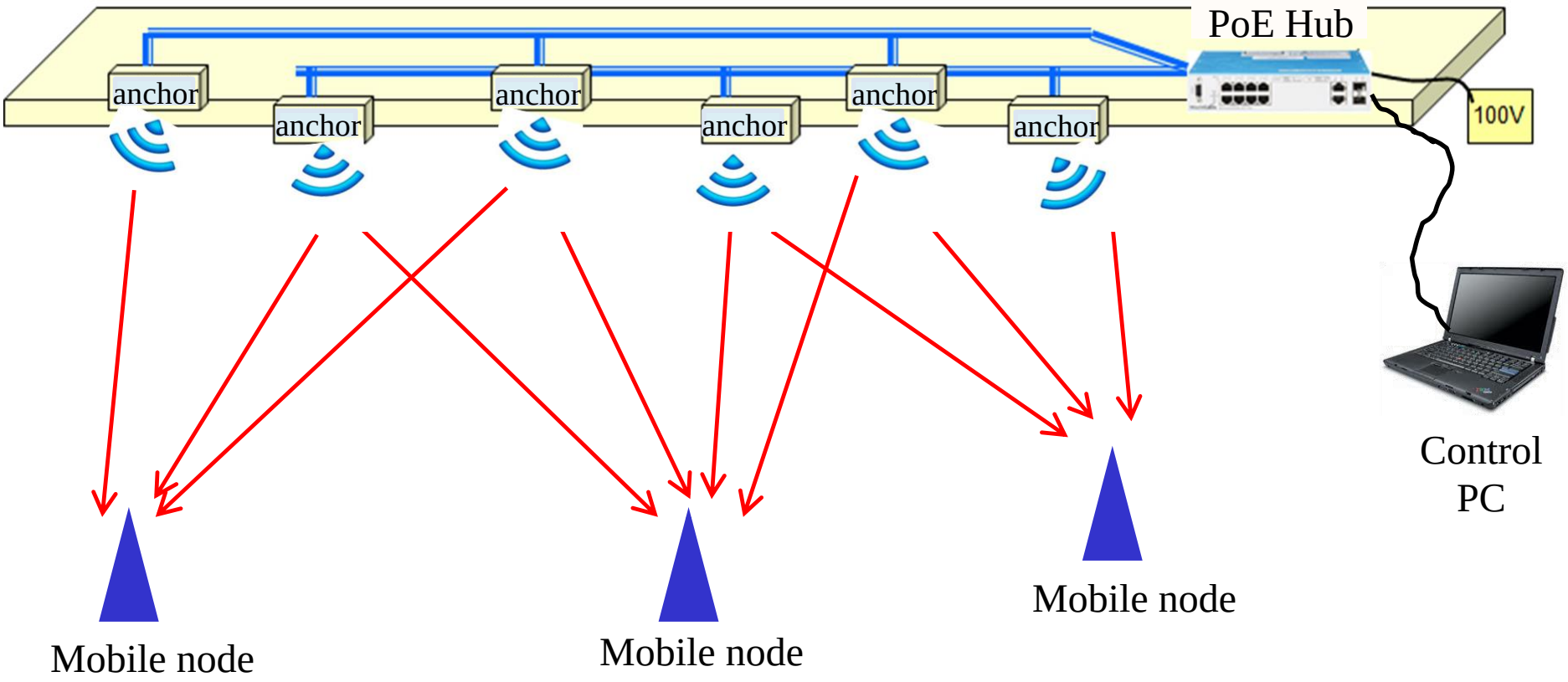
$$T_{2AR} = T_{2BT} - t_o + t_p$$

$$T_{1BR} = T_{1AT} + t_o + t_p$$

- Node transmits and receives
- Round time between anchor and node is measured.

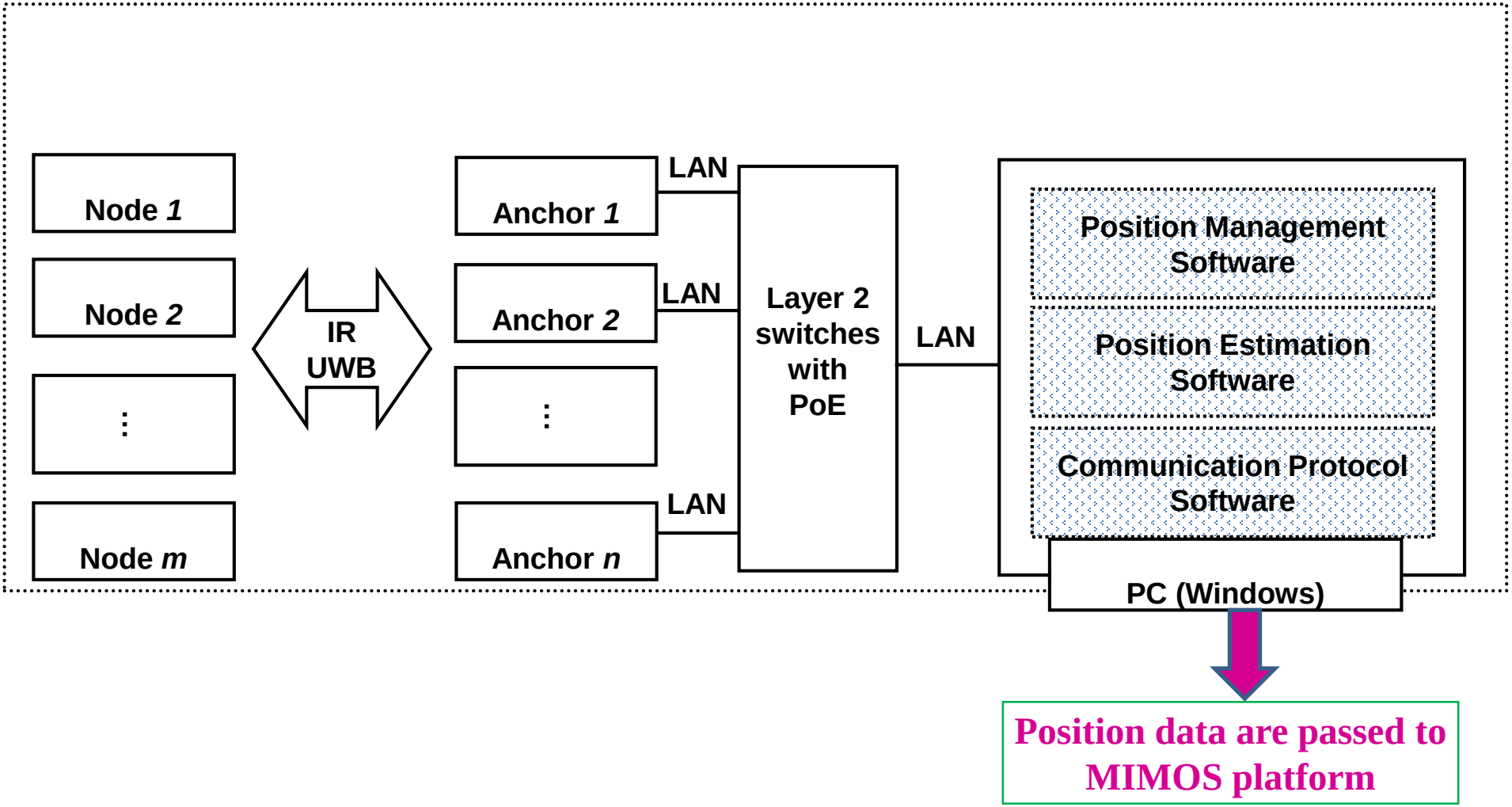
Propagation time is obtained by solving these two equations

Structure of NICT's System



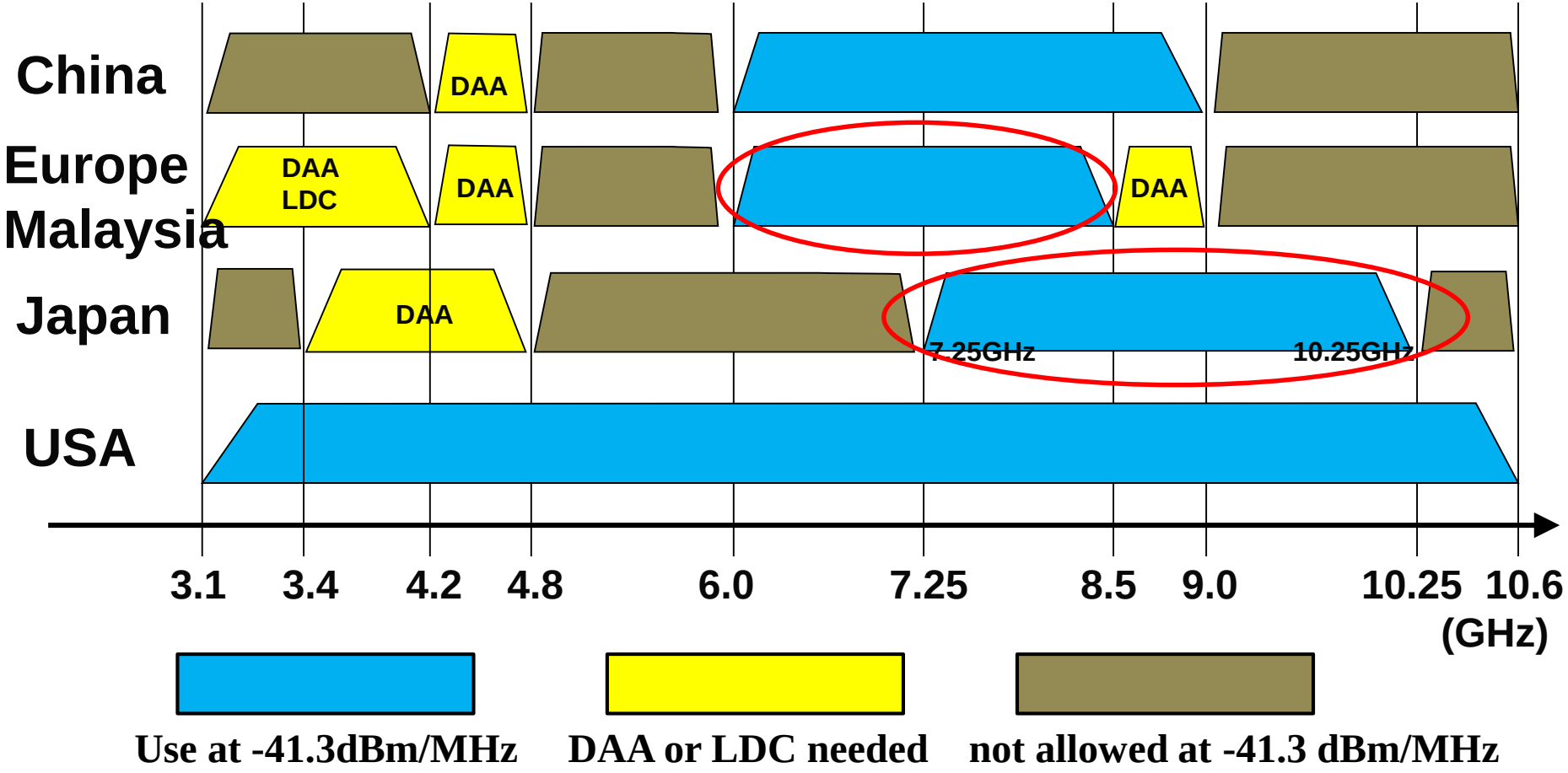
NICT will provide this system for evaluation at MIMOS

Configuration of NICT's System

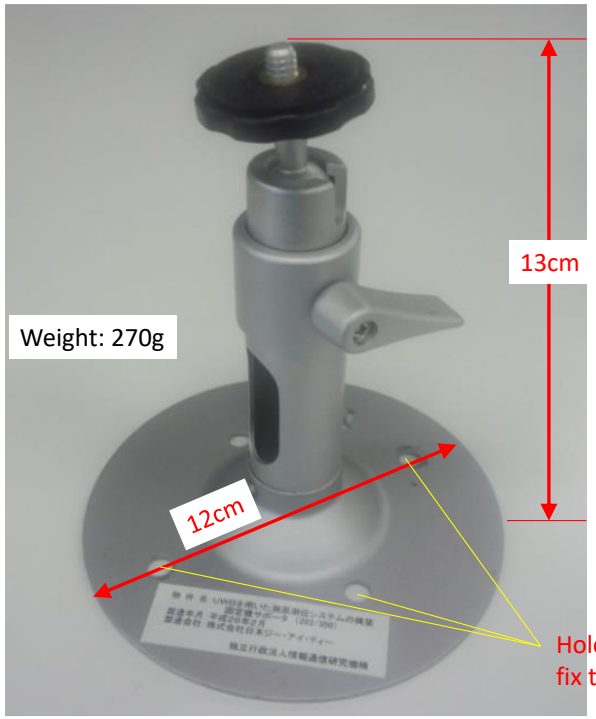


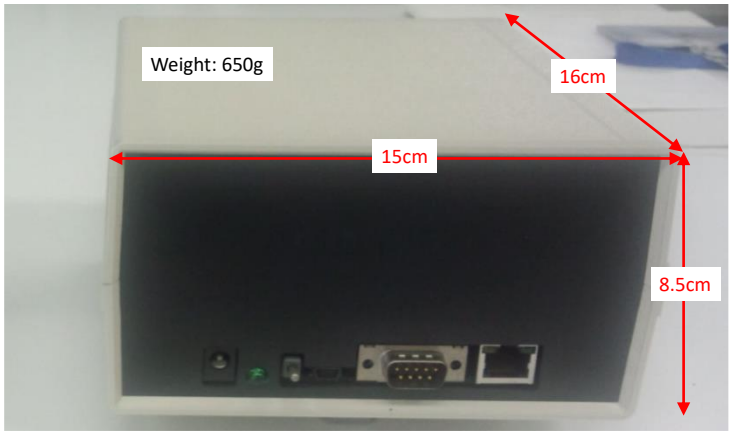
Regulations on UWB

NICT is modifying devices to suit for Malaysia regulation



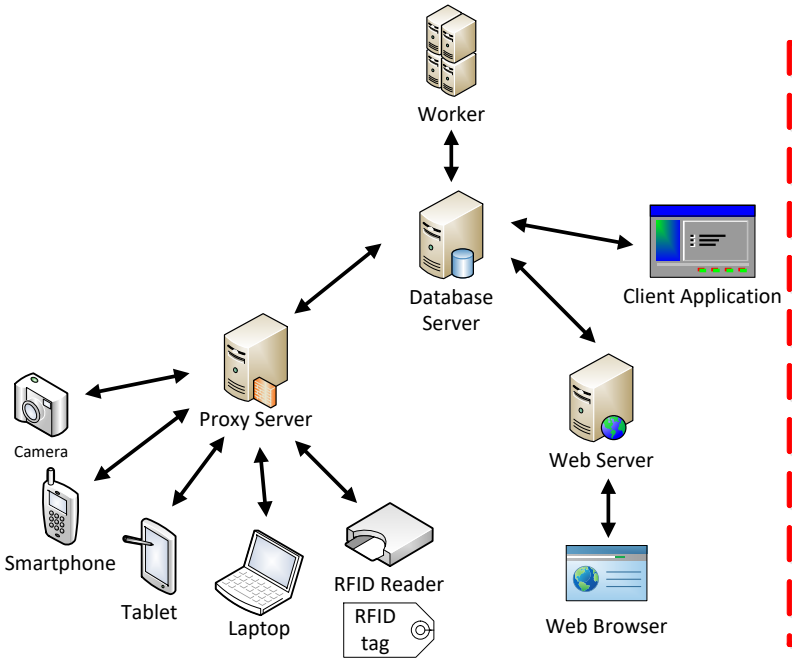
ethod in Discussion to Fix Anchor

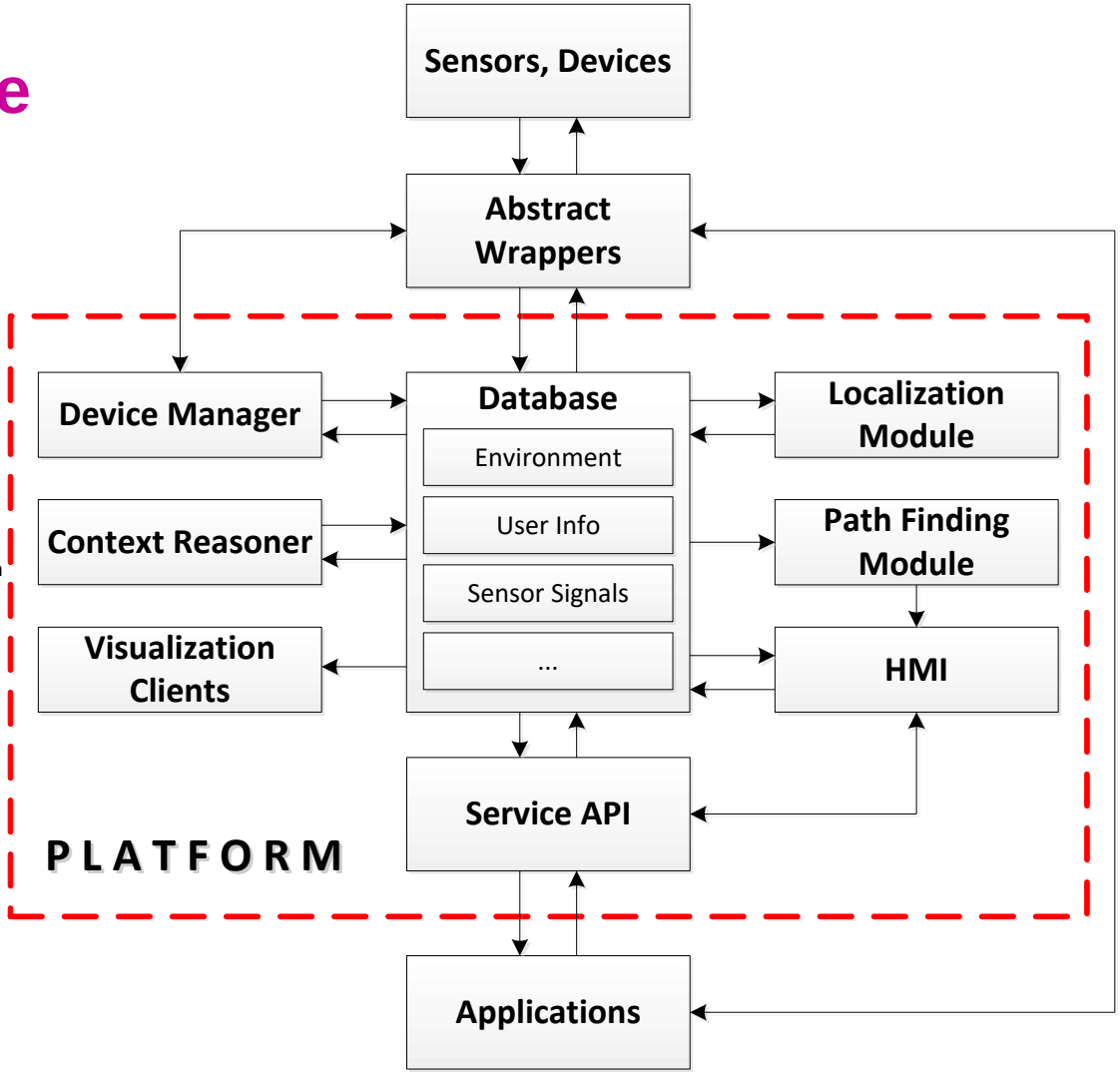




MICA

System Architecture



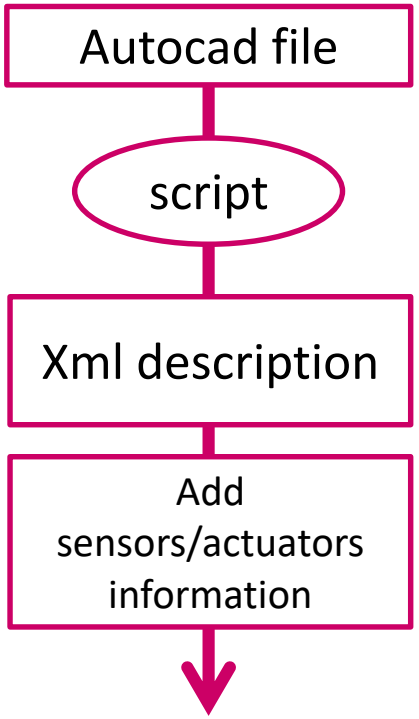


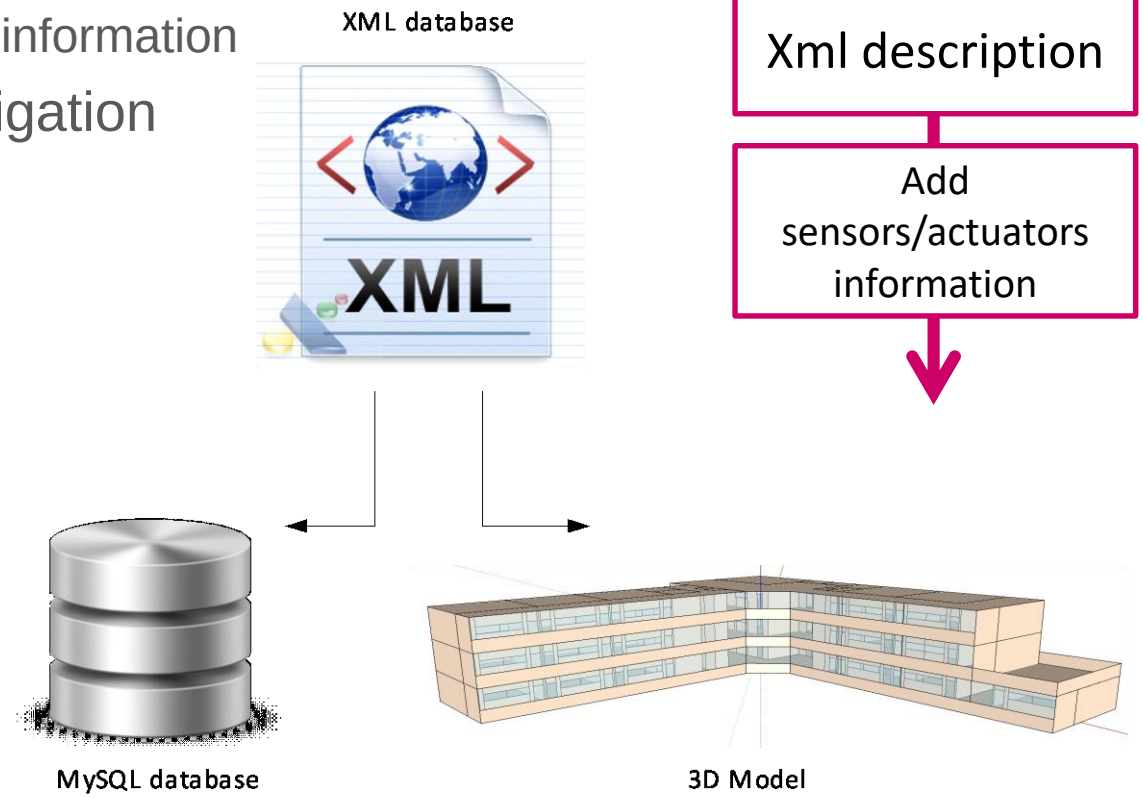
- Environment modeling
- Visualization
- User/robot localization, tracking & navigation
- Device management
- User information collection

Environment Model

- Unified environment model for
  - Localization
    - Signal attenuation for WiFi, RFID,…
    - Range information for cameras
    - Result validation
    - Result filter with map information
  - Path-finding and navigation
  - Visualization

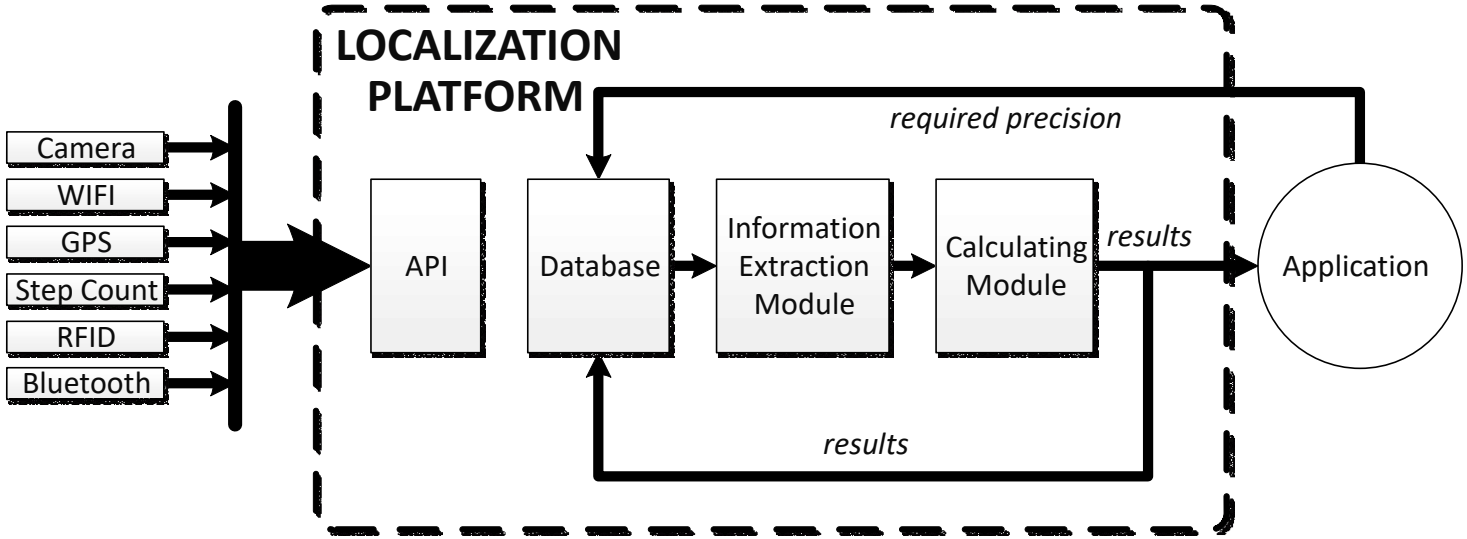
- Using XML





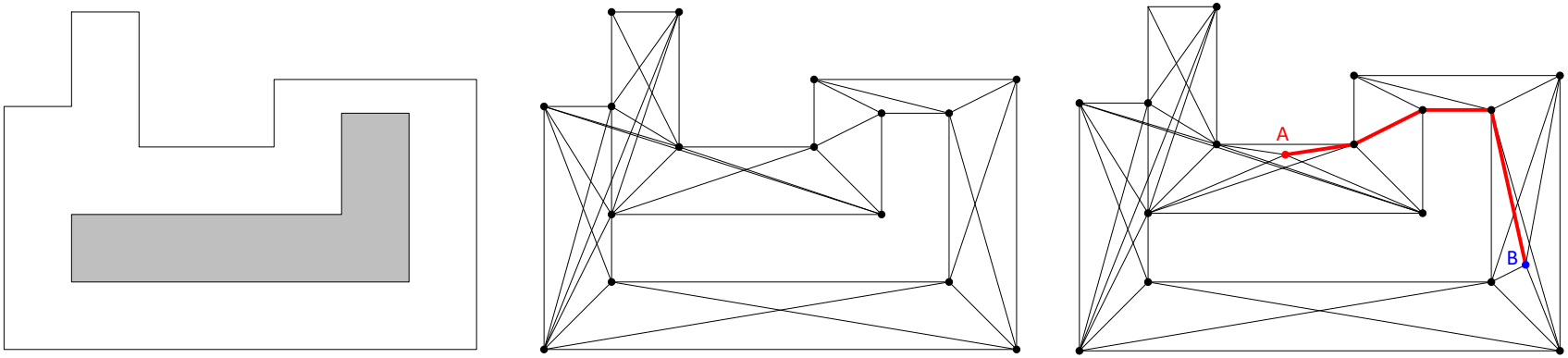
User Localization Approach

- Integration of multiple possible technologies
  - WiFi signals
  - RFID
  - Cameras
  - Bluetooth
  - Step count
  - Multimodal (combination of above technologies)



Indoor Navigation

- Optimal path finding
  - Shortest path
  - Aware of walls, floors, stairs,…
  - Personalized on the basis of user context
  - Collision avoidance in dynamic environments



UBD

UBD Motion Engine

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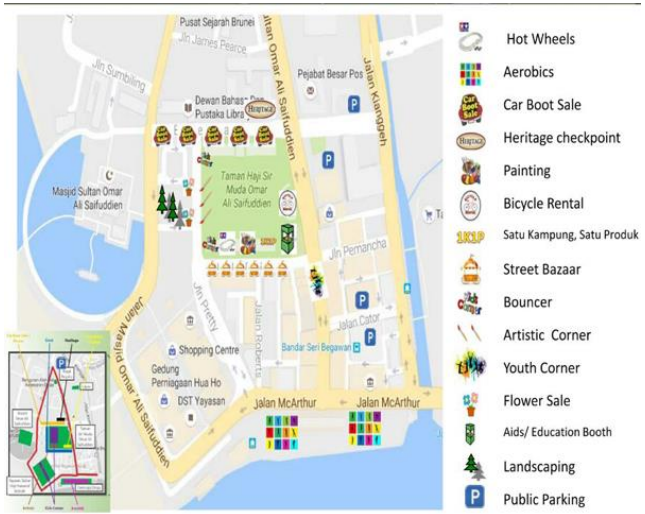
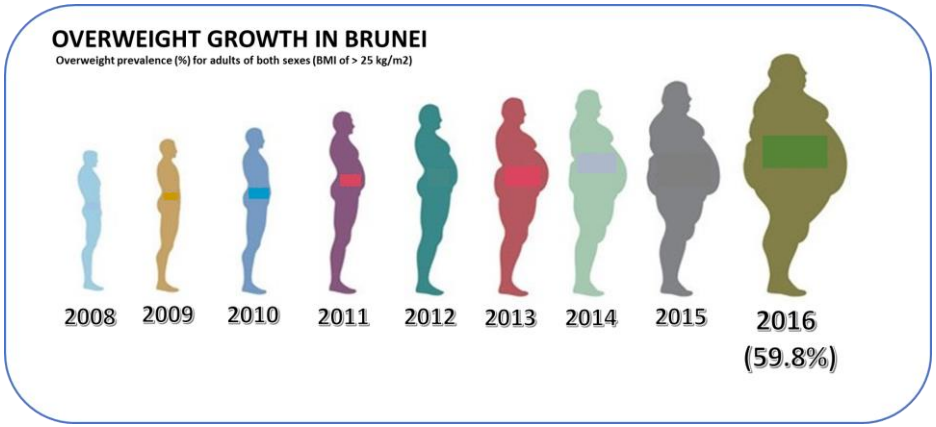
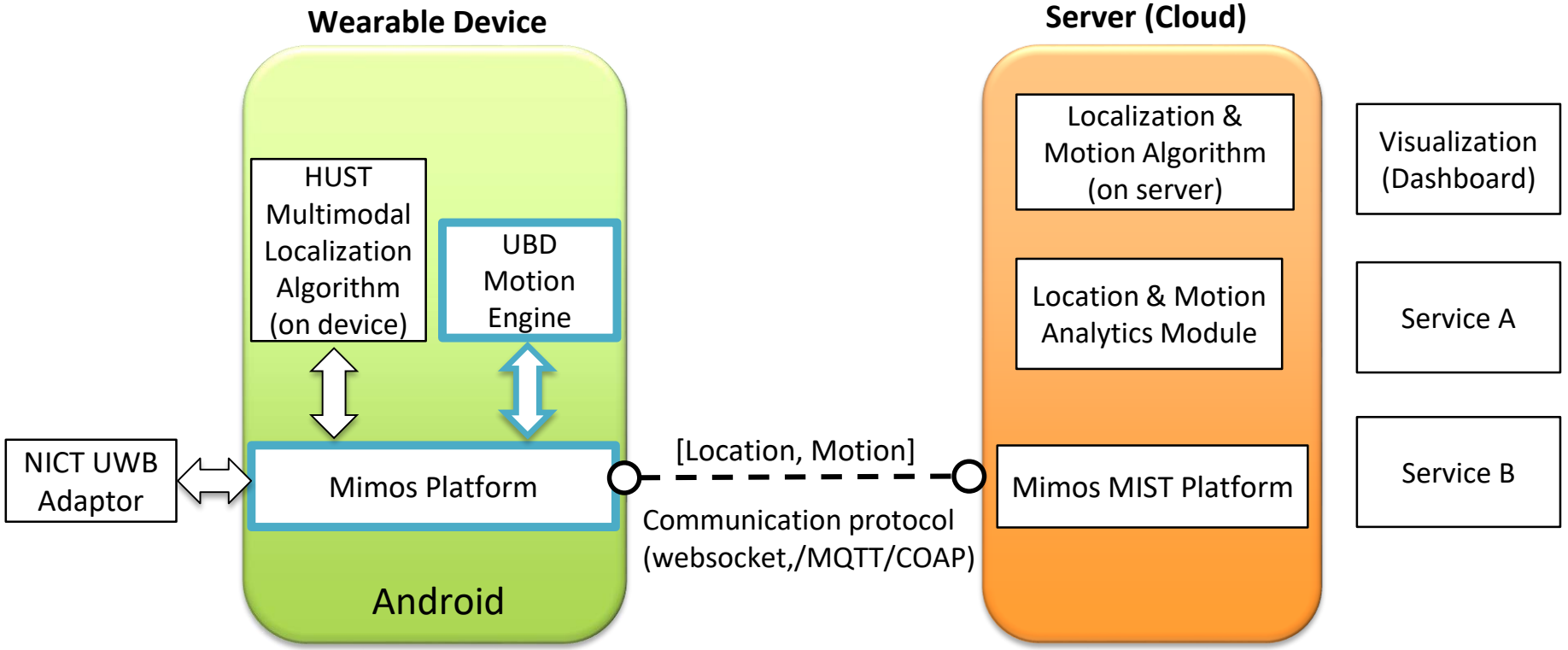
Background Information

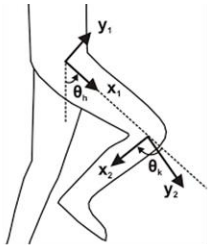


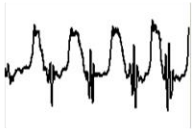


Introduction – UBD Motion Engine



UBD Motion Engine Laboratory Set Up



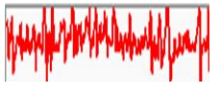


Set up Sensor

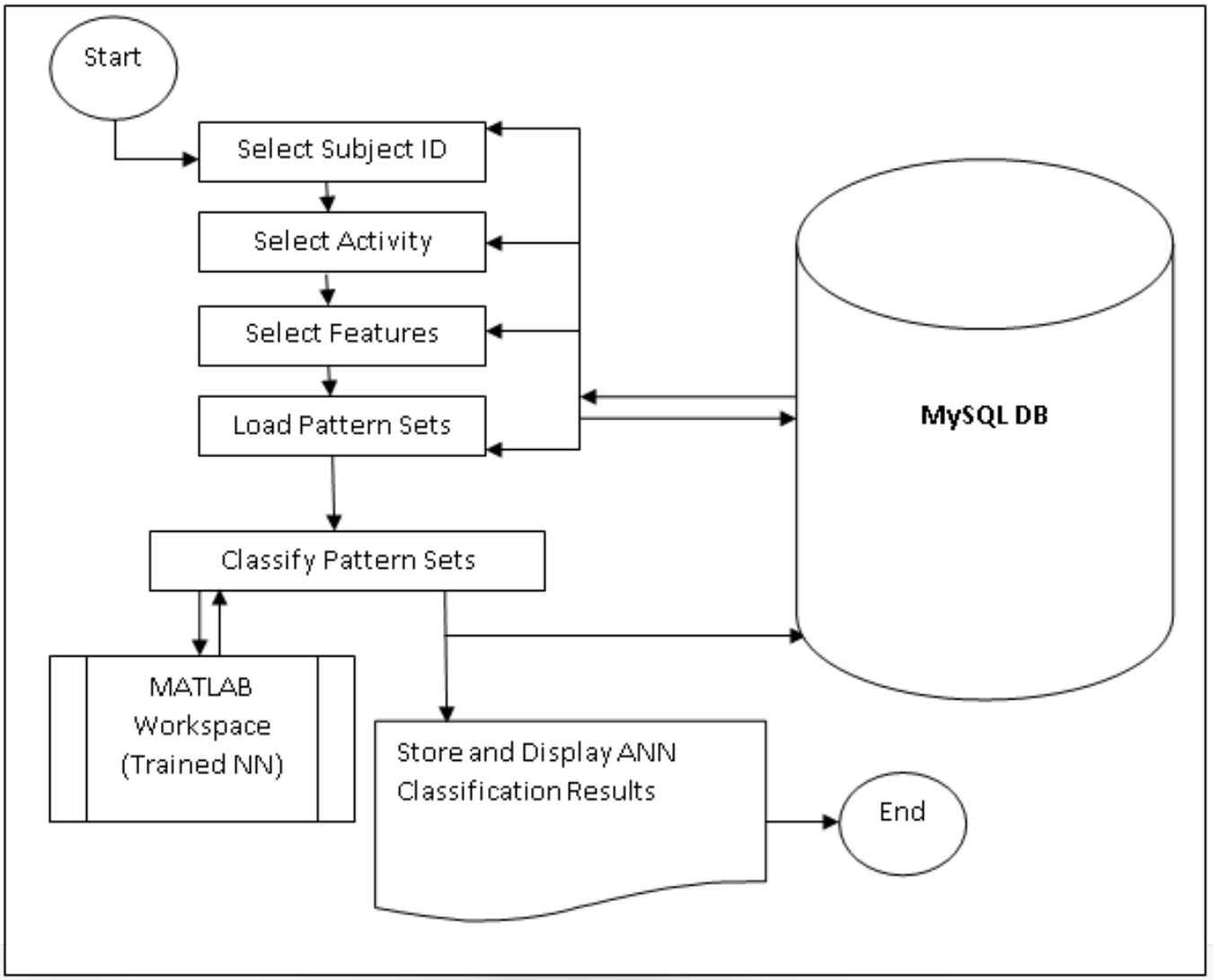
identify 3-D angular rates and neuromuscular data

Transfer Signal

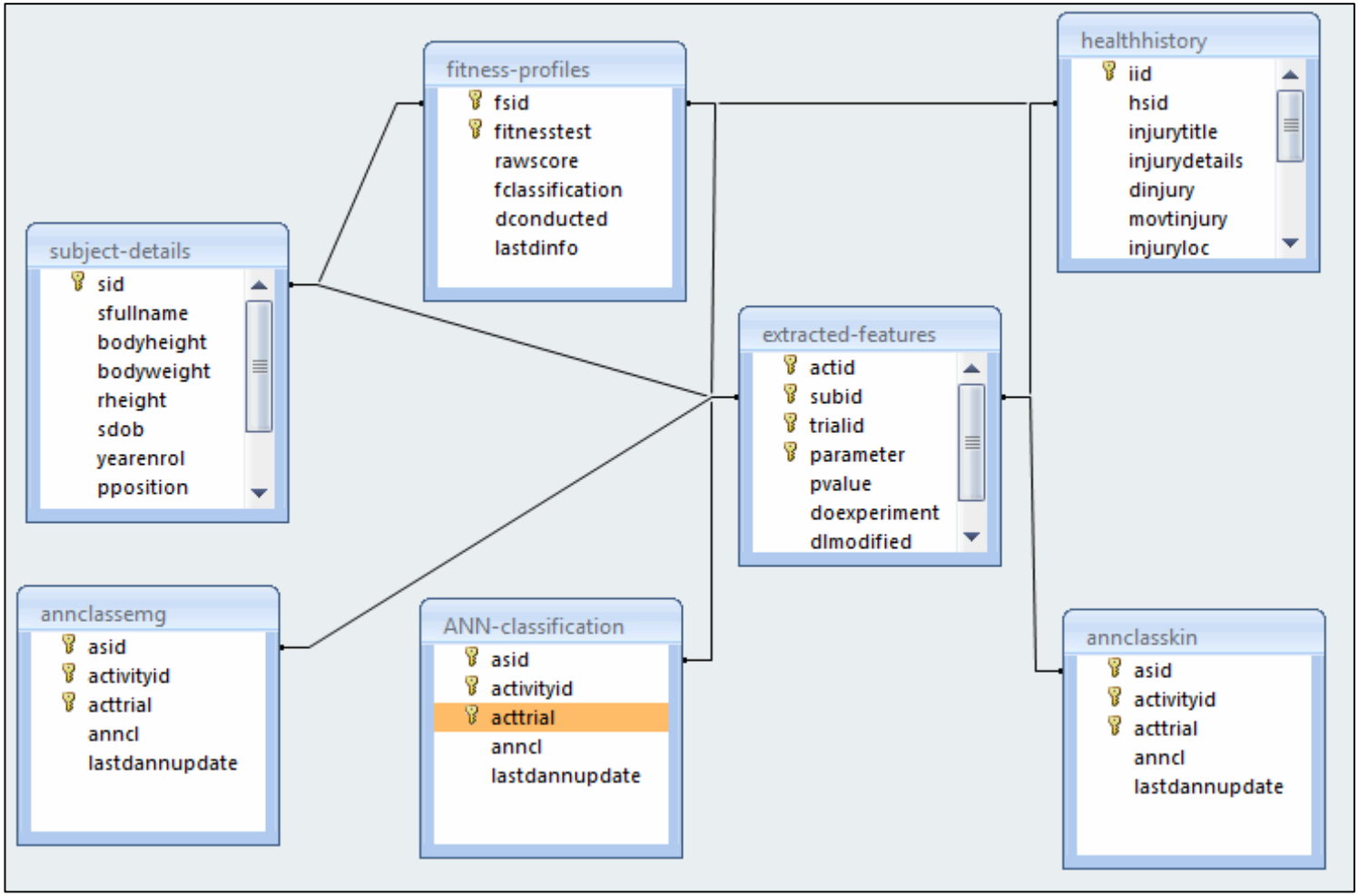
IGUI Acquisition



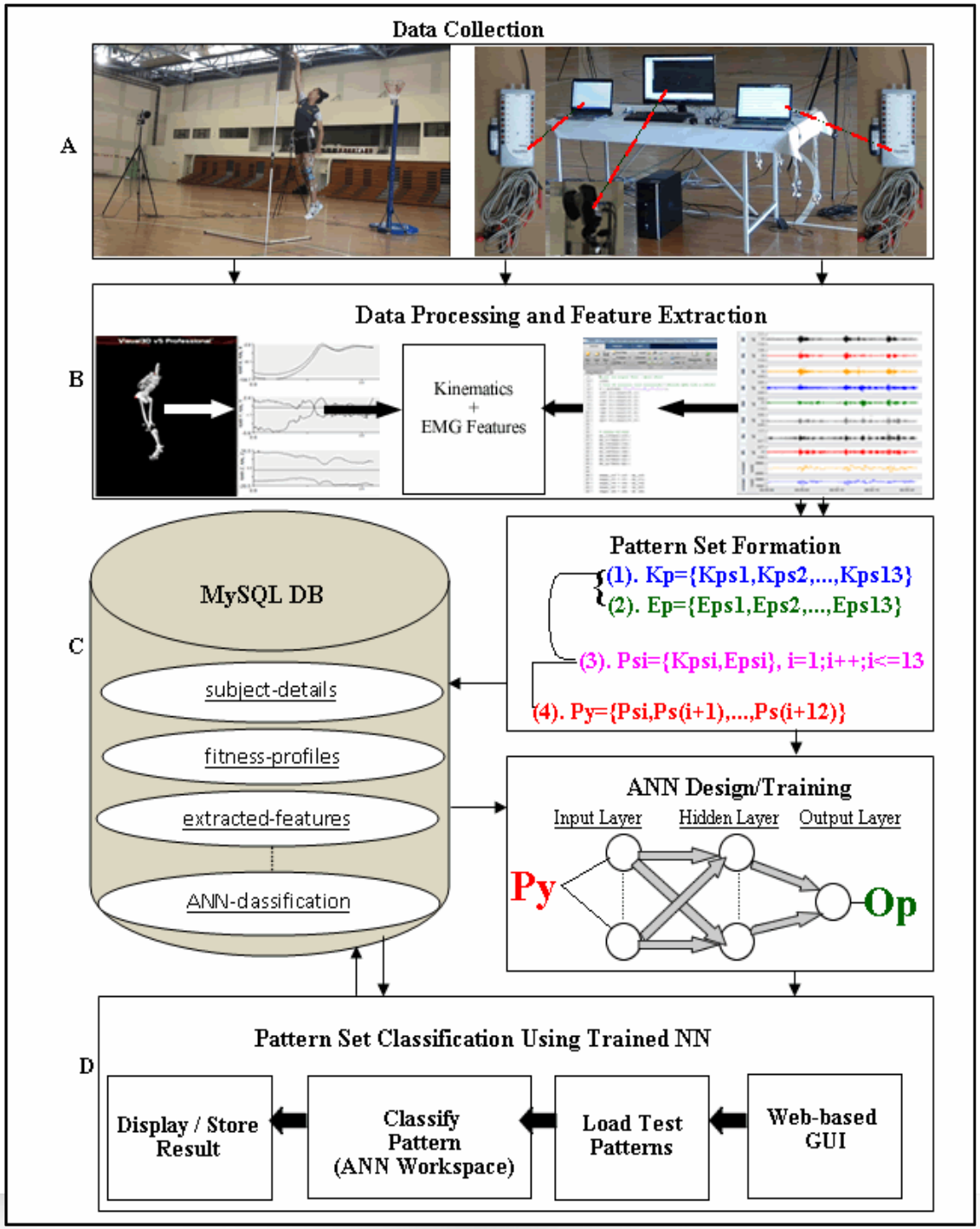
Transient Pattern Storage



Resident Pattern Storage



Prototype Testing: Active Healthy Lifestyle



National Netball Players: Defined Tasks by Coach

Data Visualization: Class A

X			
Class	THS	AHS	
A	55%	33%	
A	67%	44%	
A	88%	67%	
A	77%	54%	
A	97%	77%	
A	68%	43%	
A	89%	66%	
A	88%	34%	
A	62%	61%	
A	59%	49%	
Average	75%	53%	

Class A: Outstanding Player

Data Visualization: Class B

X			
Class	THS	AHS	
B	77%	44%	
B	89%	56%	
B	94%	67%	
B	57%	43%	
B	82%	77%	
B	66%	55%	
B	89%	66%	
B	90%	78%	
B	57%	55%	
B	59%	50%	
Average	76%	59%	

Class B: Very Good Player

Data Visualization: Class C

X			
Class	THS	AHS	
C	88%	66%	
C	76%	45%	
C	66%	59%	
C	67%	34%	
C	89%	55%	
C	90%	67%	
C	55%	45%	
C	78%	43%	
C	88%	23%	
C	90%	44%	
Average	79%	48%	

Class C: Average Player

Data Visualization: Class D

X			
Class	THS	AHS	
D	98%	67%	
D	78%	77%	
D	66%	54%	
D	60%	44%	
D	54%	66%	
D	59%	34%	
D	88%	66%	
D	78%	78%	
D	77%	68%	
D	90%	66%	
Average	75%	62%	

Class D: Below Average