Zotikon

Athlete Analysis System

The Zotikon Team

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Zotikon's Advisor

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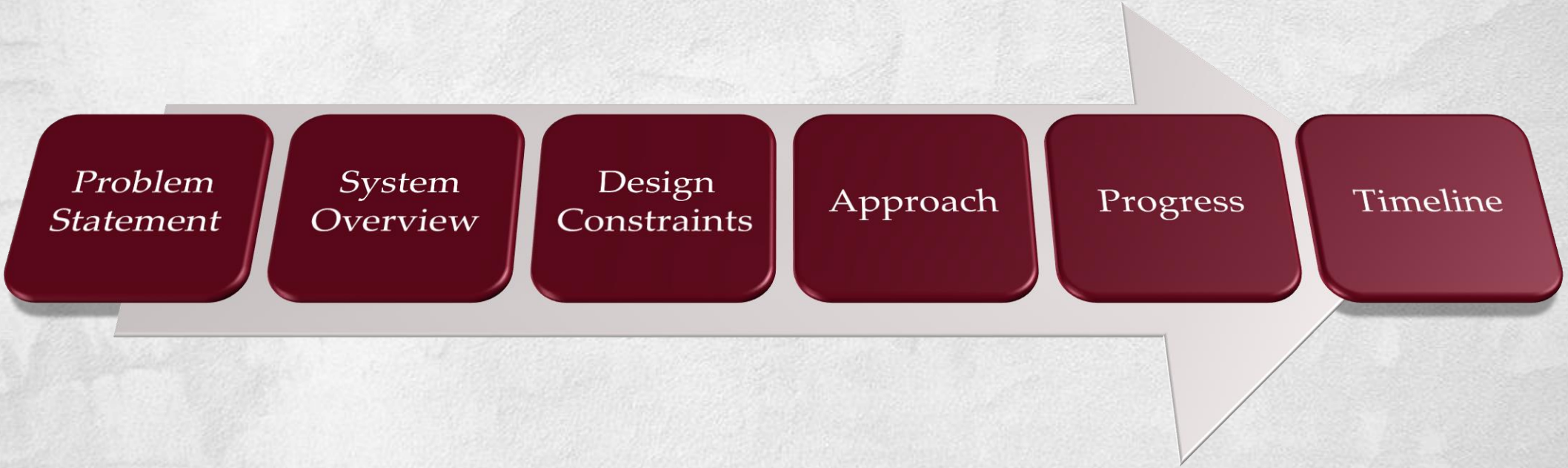
- Assistant Professor
  - PhD, Electrical and Computer Engineering, George Washington University, 2009
- Fields of Interest
  - Microwave and Millimeter-wave Remote Sensing
  - RF Sensors & Systems
  - Radiation and Scattering Theory
  - Antennas & Computational Electromagnetics
  - Subsurface & Subcanopy Sensing and Imaging
  - GNSS Reflectometry

Outline


Problem Statement
System Overview
Design Constraints
Approach
Progress
Timeline

Althlete Analysis System

Zotikon

NOUN: (Greek origin) ***health and vitality***

Applications

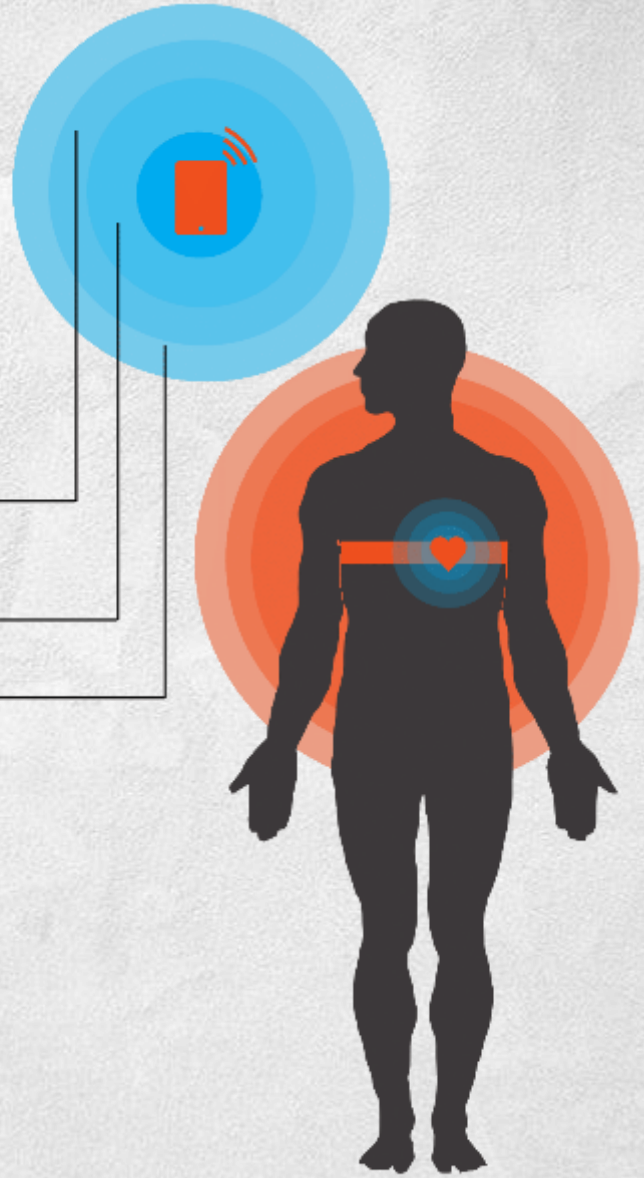
Team-based and individual athlete performance measurement system
AND
Real-time trainer monitoring system to observe athlete performance

Features

Heart rate and jump power monitoring

Reliable mesh network system

Realtime graphical presentation



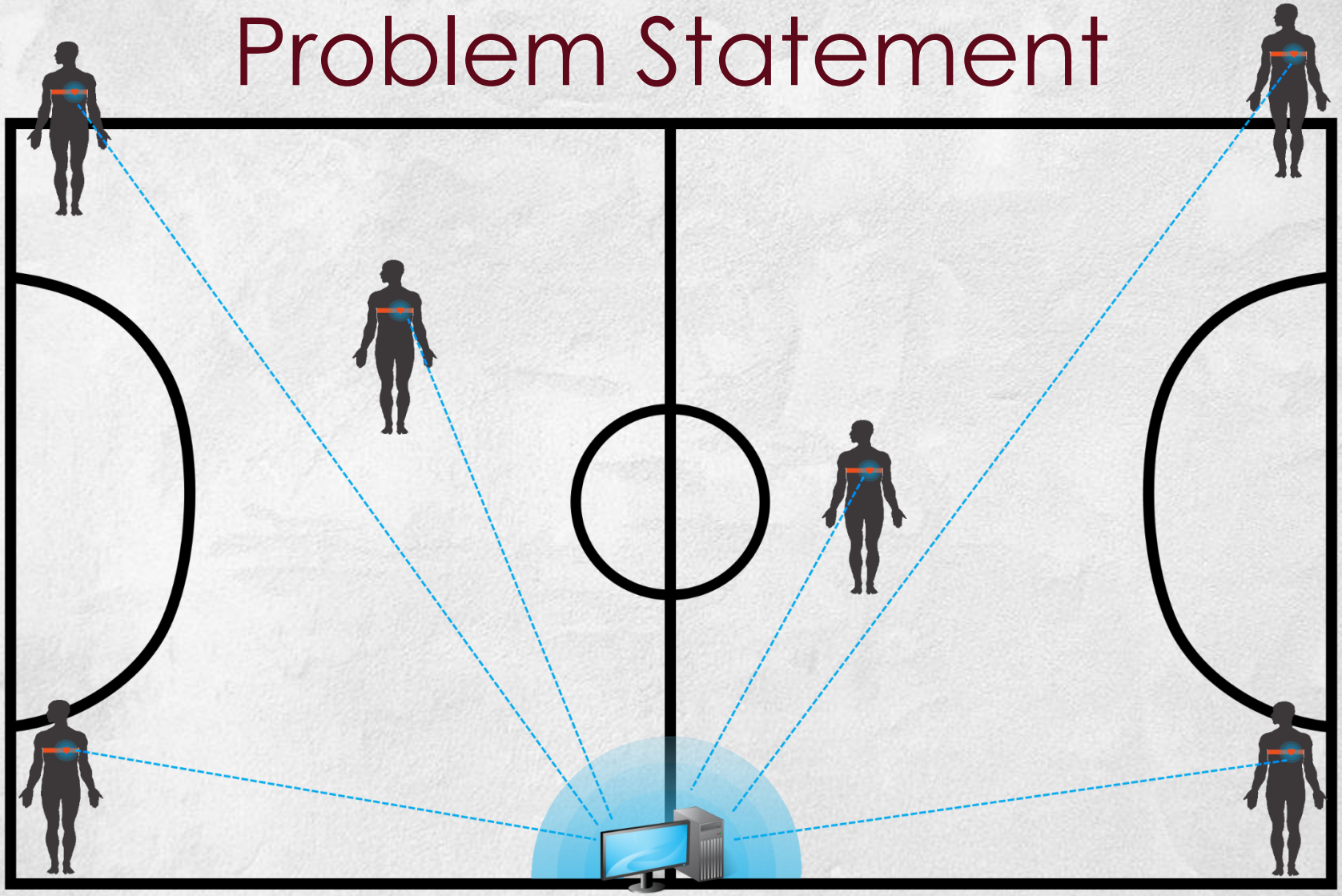
Specifications

2.4GHz Band wireless communication

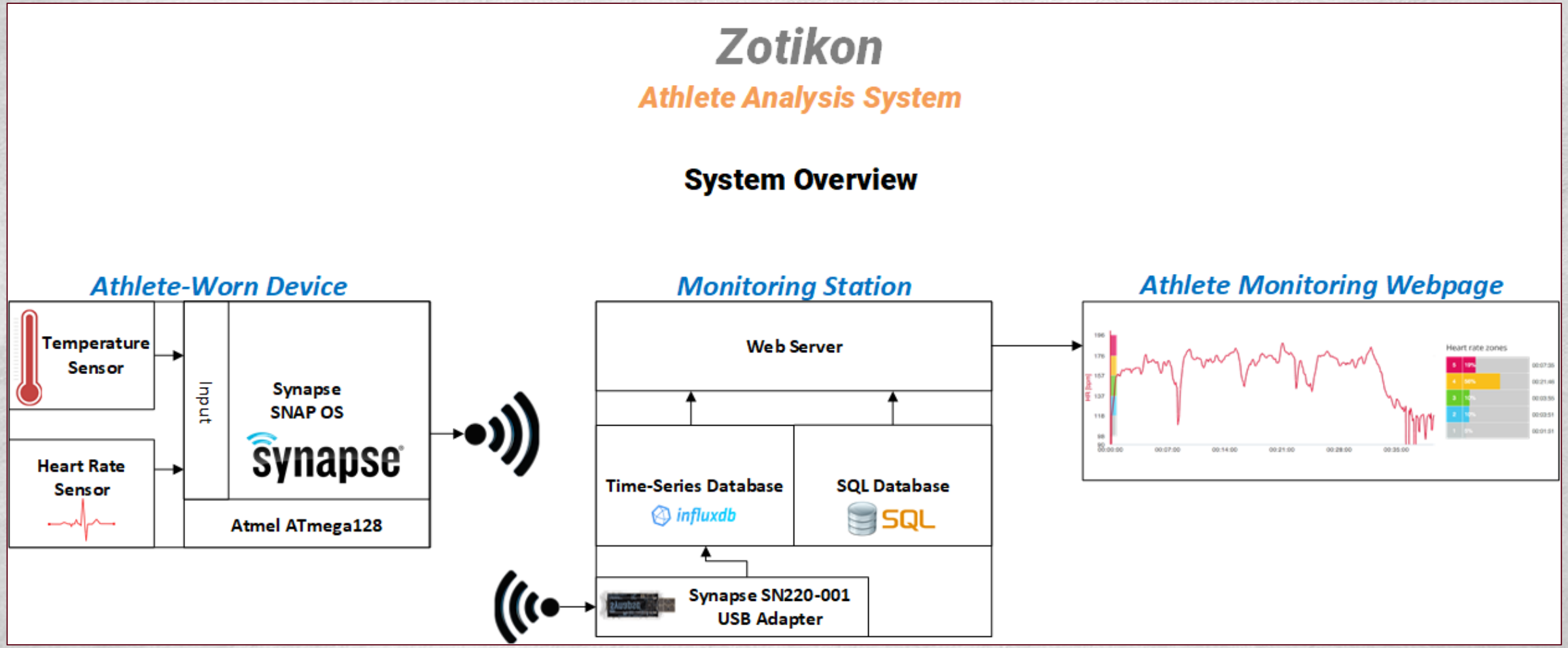
Up to 0.5 mile range

Accurate ECG heart rate monitoring

Problem Statement



System Overview



Design Constraints

Technical

Name	Description
Transmission Range	The Zotikon system must be able to reliably transmit data to at least 70 meters in a noisy environment with radio interference with a success rate of at least 90 percent.
Max Beats per Minute (BPM)	The maximum beats per minute the athlete-worn device must be able to measure is 220 BPM.
Simultaneous Users	The monitoring station must be able to receive data from 11 athlete-worn devices simultaneously.
Runtime	The athlete-worn device must be able to operate continuously for no less than 4 hours.
Skin Temperature Measurable Range	The athlete-worn device must be able to measure temperatures in the range of 15°C - 47°C with 0.25°C accuracy.

Design Constraints

Practical

Type	Name	Description

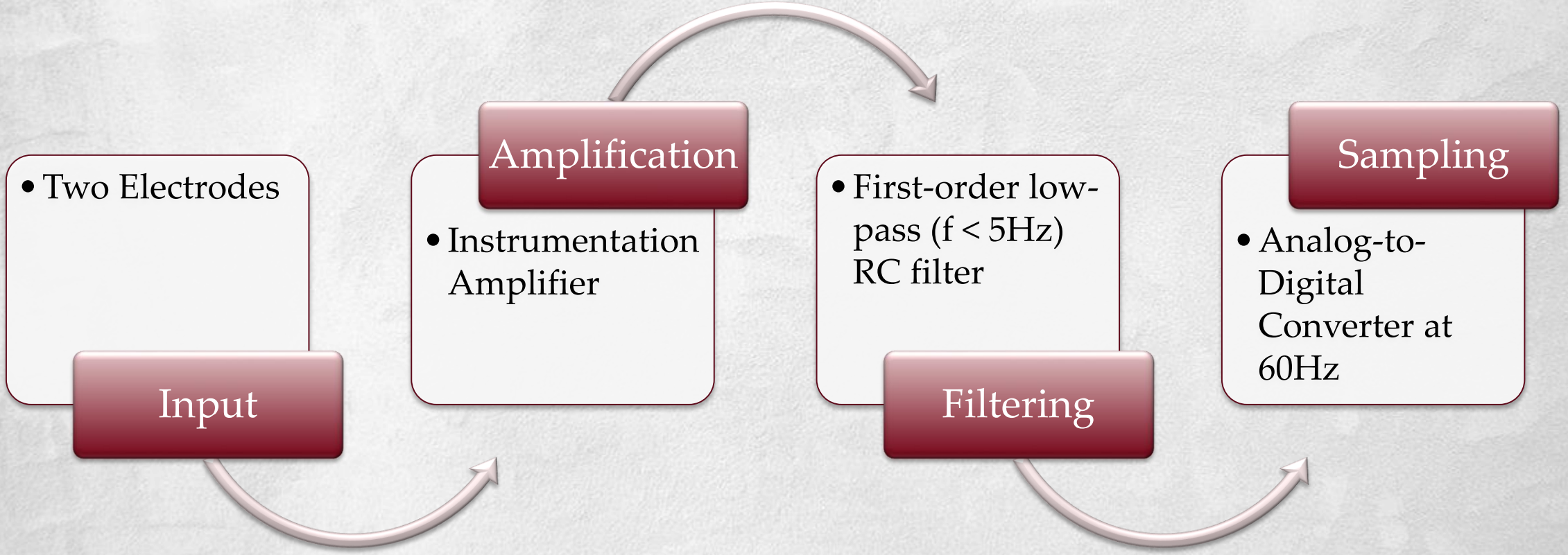
Economic	Cost	• Total System Cost: $3,000
		  • Athlete-Worn Device: $150
		  • Monitoring Station: $1,500

Environmental	Physical	• IP64 Compliant • Temperature Range: -40°C to 85°C

Approach

Hardware

Heart Rate System



Approach

Hardware

Heart Rate System

Component (IA)	Voltage Rail Style	Supply Voltage (V)	Supply Current (μ)	Gain (V/V)	Gain Error (%)	Cost (USD)
Texas Instruments INA126PA	Single or Dual	2.7 - 36	175	10000	0.1	3.15
Analog Devices AD623ANZ	Single or Dual	2.7 - 12	375	1000	0.35	6.31
Texas Instruments INA122P	Single or Dual	2.2 - 36	60	10000	0.1	7.65

Approach

Hardware

Heart Rate System

Component (ADC)	Communication Interface	Max Single-Ended Reference Voltage	Supply Voltage (V)	Resolution (bits)	Cost (USD)
Synapse SM200	On-Chip	1.8V	3.3V	10	30.07
Microchip MCP3002	SPI	2.7 – 5.5	2.7 – 5.5	10	2.30

Approach

Hardware

Temperature System

Component (Thermometer)	Price (USD)	Communication Interface	Sensor Type	Degree Accuracy (°C)	Measurement Resolution (°C)	Max V_{DD} (V)
Melexis MLX90615	13.09	SMBus or PWM	IR	0.5	0.02	3.4
TI TMP20AIDCKR	1.29	Analog Voltage	Contact	2.5	0.05	5.5
Microchip MCP9808T-E/MS	1.19	I2C or SMBus	Contact	0.5	0.05	5.5

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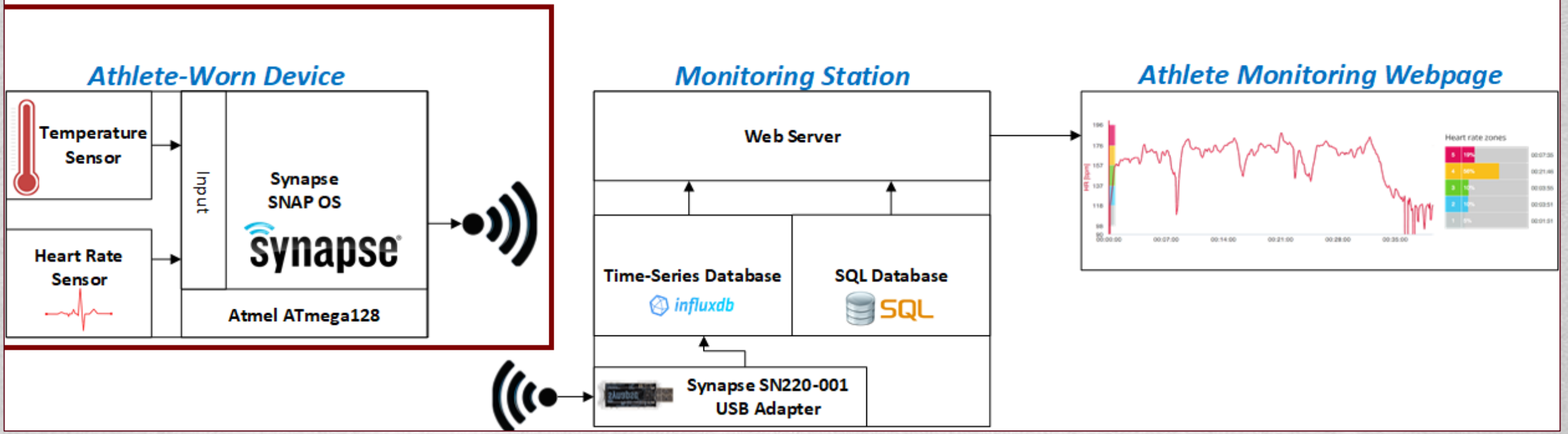
Athlete Analysis System

System Overview

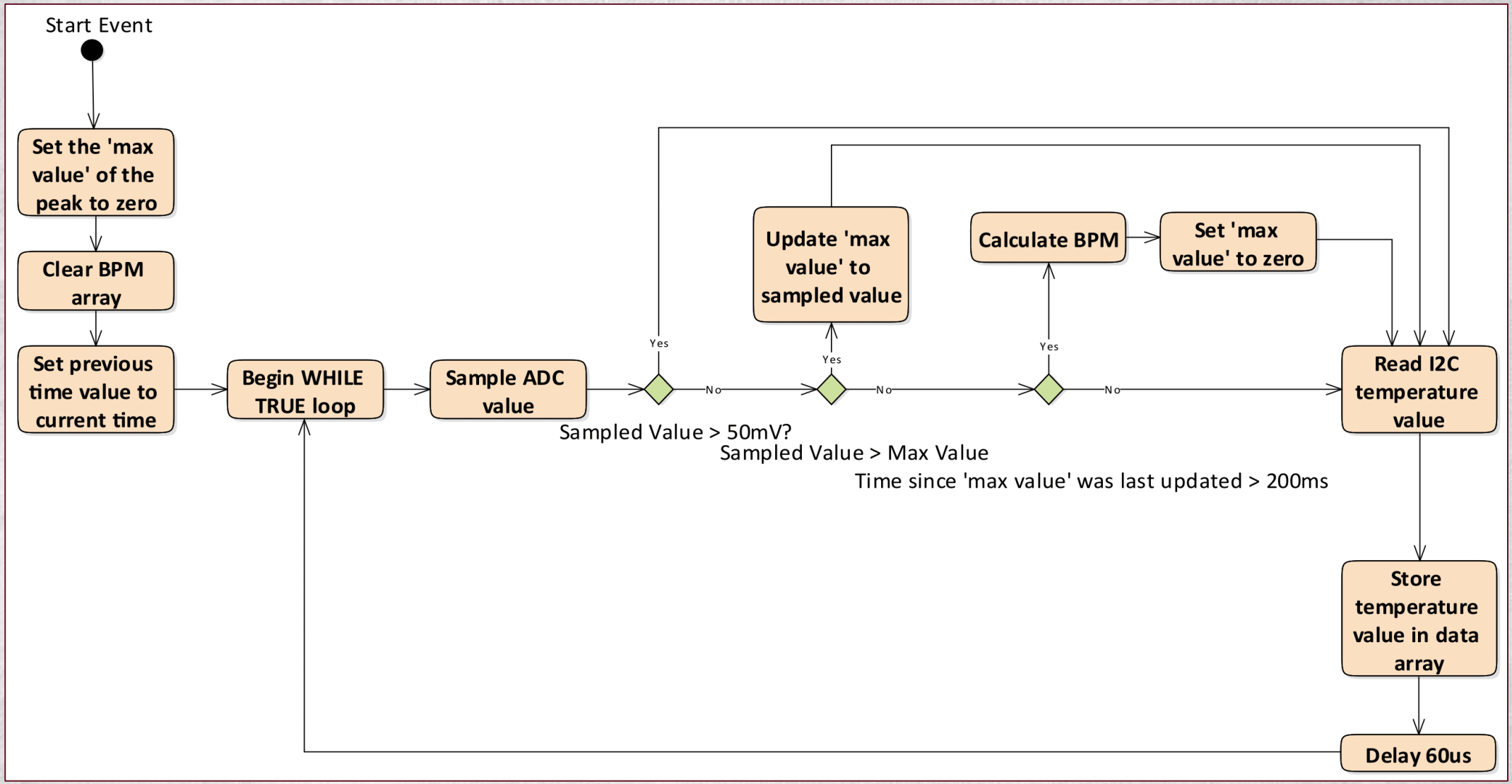


Approach

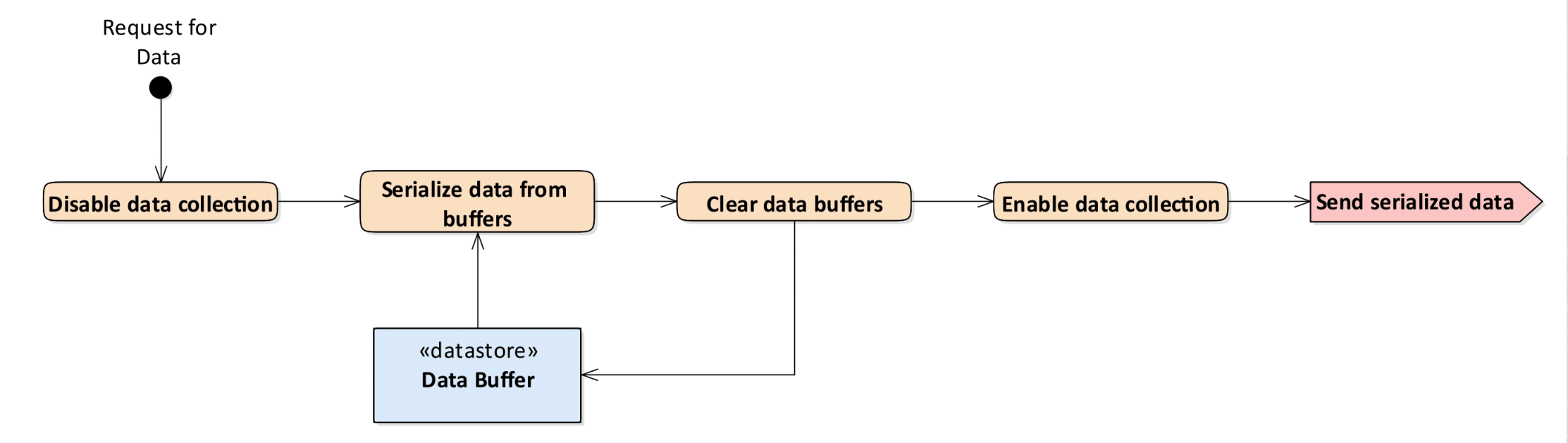
Hardware

Radio

Component (Radio)	Current Draw (mA)	Range (m)	Network Protocol	Cost (USD)	Bandwidth (Kbps)	Noise (dBm)	Encryption
Synapse SM200	22.5	457 - 762	SNAP (mesh)	30.07	250 - 2000	-100	AES 128-bit
Atmel ATmega128RFA1	12.5	457 – 762	IEEE 802.15.4	6.63	250 – 2000	-100	AES 128-bit
Time Domain PulsON330	440	240 - 1000	ALOHA or TDMA	---	19.2 – 612	-113 to -98	Not Implemented
Decawave DW1000	70	100	Not Implemented	15.19	110 - 6800	-106 to -94	Not Implemented



Athlete-Worn Device – Measurement Collection Flow Diagram

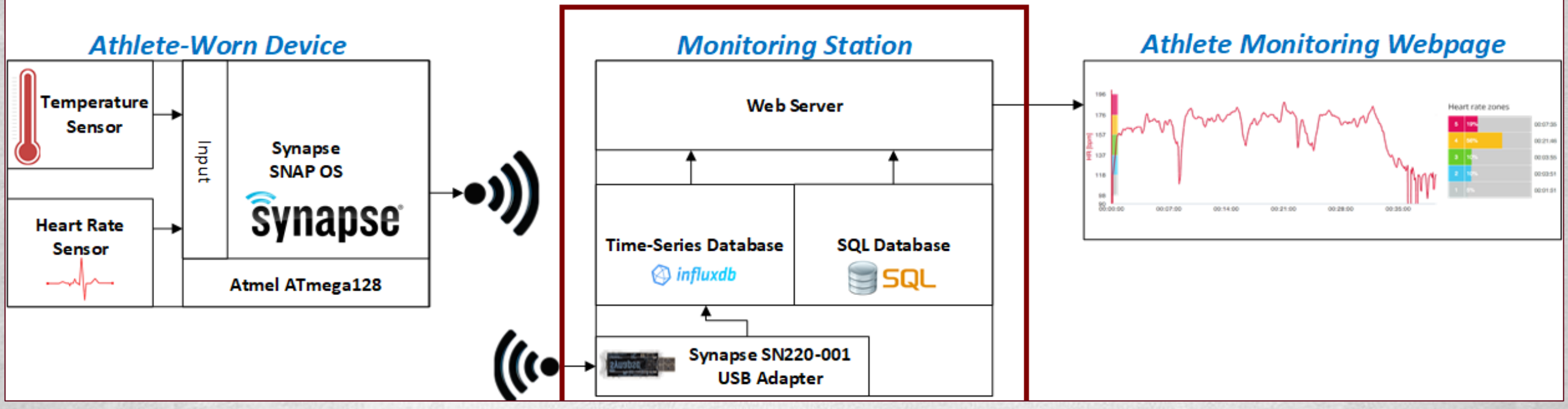


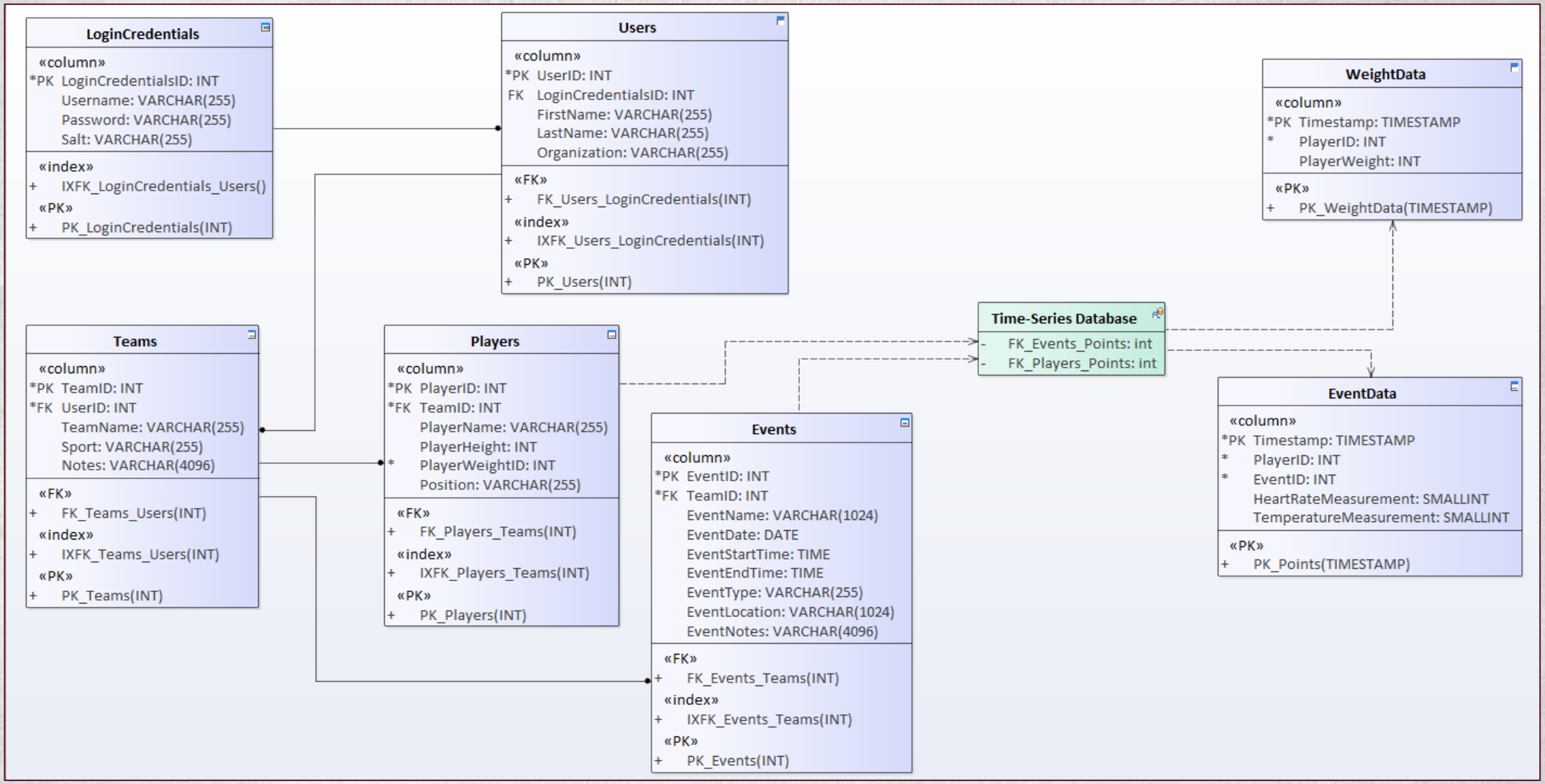
Athlete-Worn Device – Data Transmission Flow Diagram

Zotikon

Athlete Analysis System

System Overview



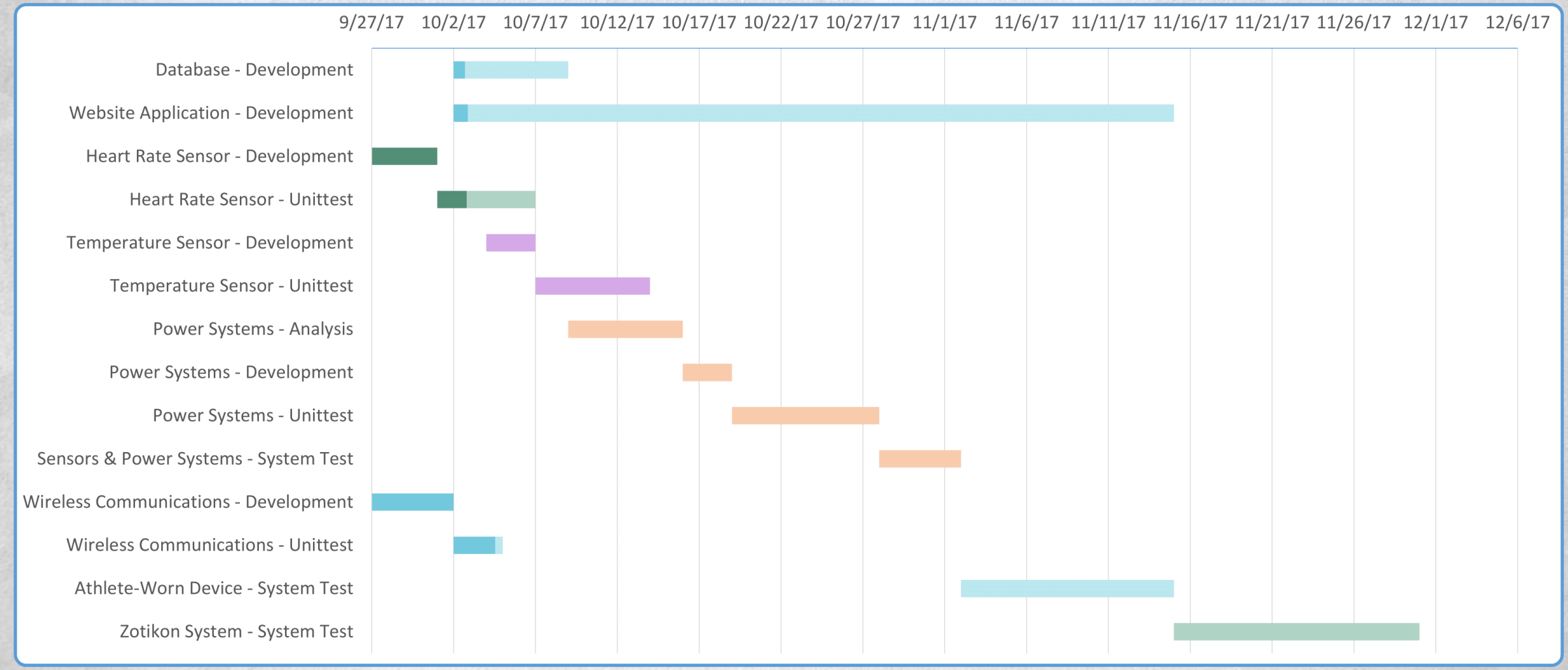


Monitoring Station – Database Design

Progress

Test Number	Parameters	Signal Strength (%)	Ping Successful	Data Sent
1	Device A facing monitoring station	35	Good	Good
2	Device A facing basketball goal	28	Good	Good
3	Device A facing monitoring station on opposite side in the middle of the court. Device B facing the basketball goal	41	Good	Good

Project Timeline



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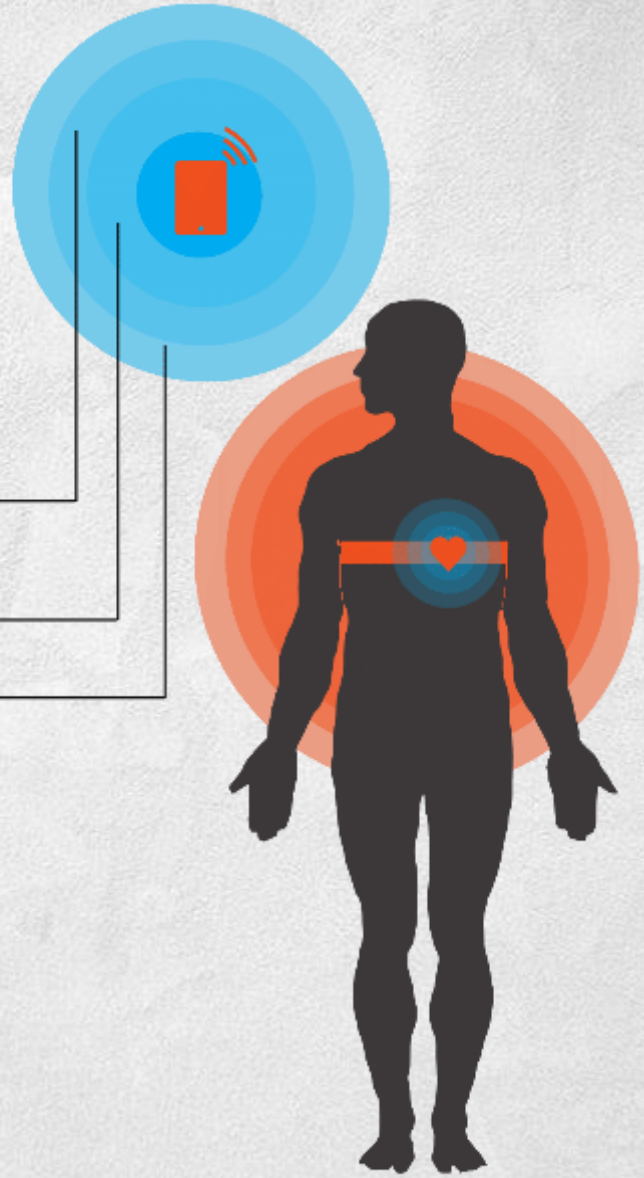

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