1S-11

Design of an Energy-Autonomous Bio-Sensing System Using a Biofuel Cell and 0.19V 53µW Integrated Supply-Sensing Sensor with a Supply-Insensitive Temperature Sensor and Inductive-Coupling Transmitter

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22nd Asia and South Pacific Design Automation Conference
Jan. 16-19, 2017
Chiba, Japan

Motivation

Energy source of IoT for healthcare

- Conventional approaches
  - ► Battery
  - ► Wireless power delivery
  - ► Energy harvesting

} Technical challenges of healthcare applications

- Biofuel cells

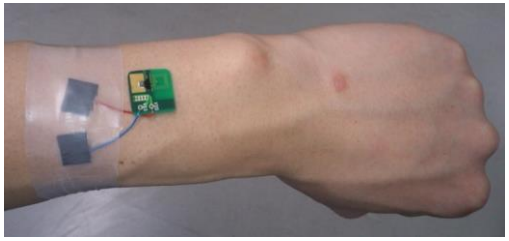
Advantages
- Stable
- Low cost
- Safe
- Biofuel conversion for bio-sensing

Disadvantages
- Temperature sensitive (Enzyme activity)
- Short lifetime
- Low output voltage/power

“Biofuel-cells-friendly sensing system is required”

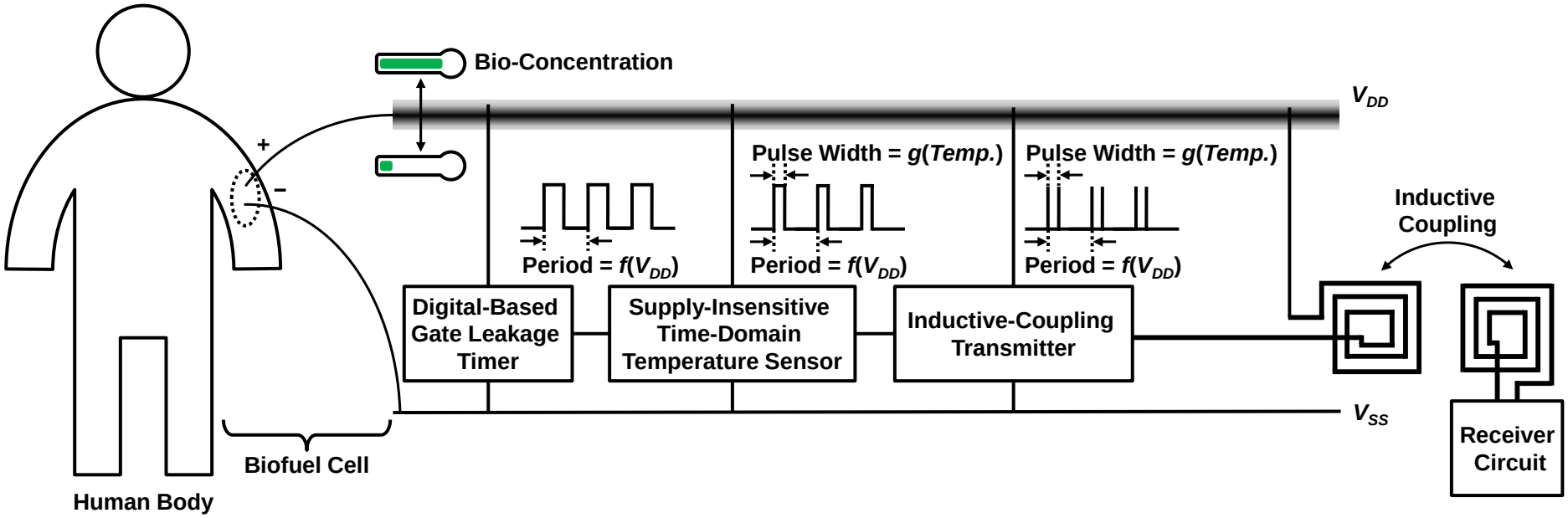
Proposed Bio-sensing System

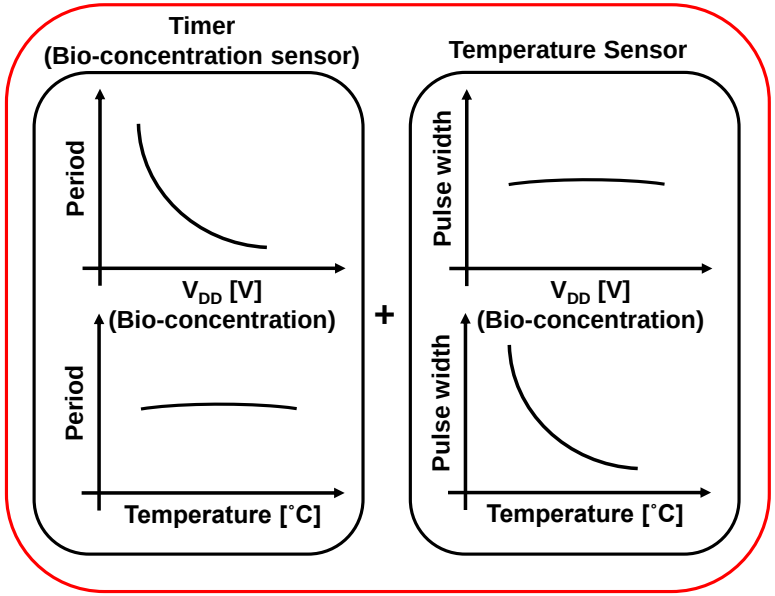
- **Biofuel from the human body: Lactate, glucose, …**
  - **Physical activity monitoring, diabetes monitoring, …**
- **Biofuel cell: Output power is a function of bio-concentration**
  - **Power generation**
  - **Bio-sensing frontend**



- **Design**
  - **Supply sensing → Low-voltage and low-power operation**
  - **Temperature monitoring → Calibrating enzyme activity**

Principles of the Bio-sensing System





- **Unregulated supply voltage operation**
  - ► **Supply sensing:**
    Supply voltage → Bio-concentration
- **Temperature-insensitive timer**
- **Supply-insensitive temperature sensor**
- **Concept feasibility was confirmed**
  - ► **Tx operation: 0.19 V, 53 μW**