

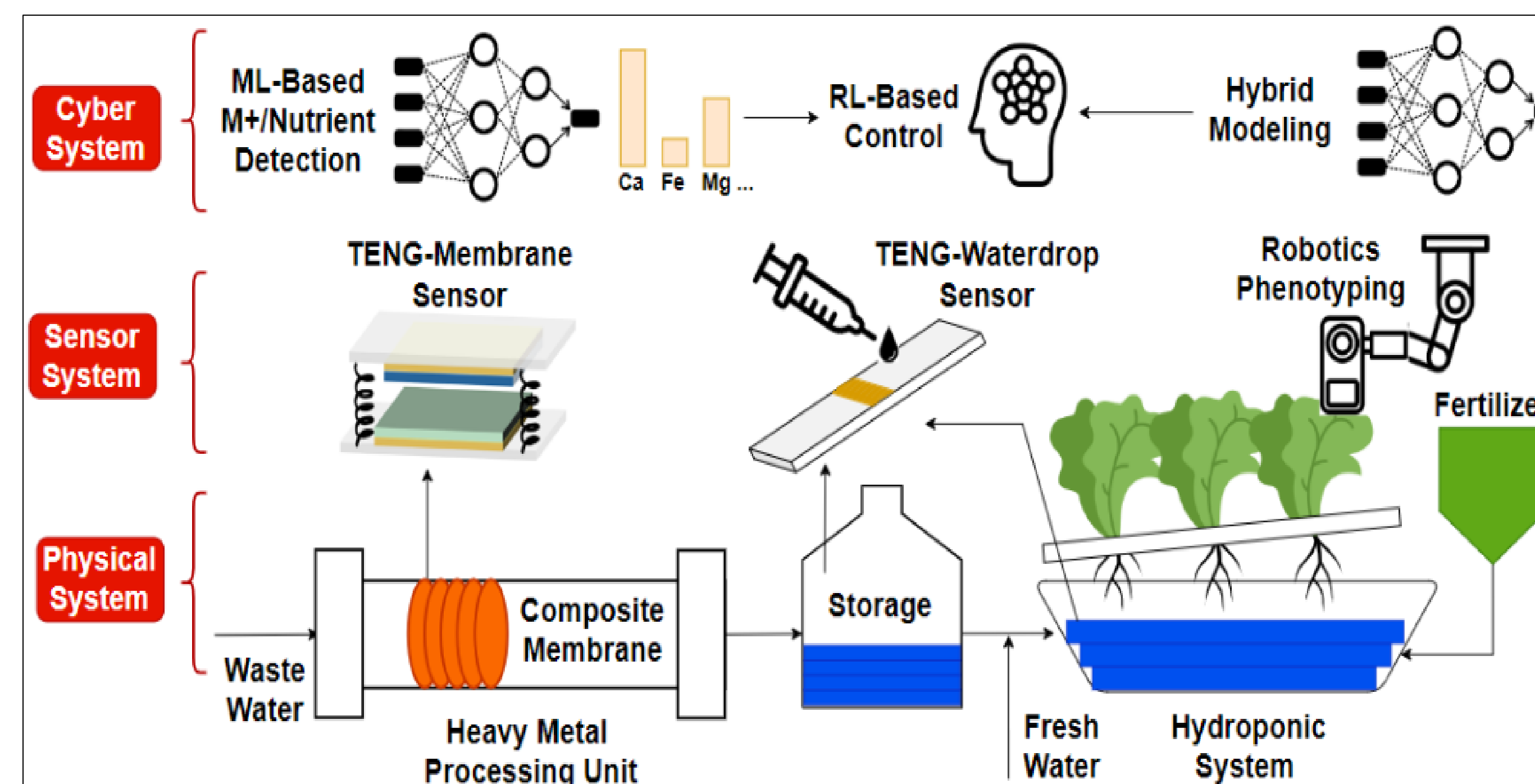
Collaborative Research: CPS: Medium: Controlled Wastewater-Hydroponic Systems for Enhanced Nutrient and Water Efficiency via Coupled Real-time Sensing and Data-Driven Technologies

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Overall Objective: A new decentralized wastewater-hydroponic system to achieve stable and high vegetable production with minimized resource and energy consumption through the development of novel online data acquisition and system control and optimization methodologies.

Key Problems (CEA System):

- Limited data requisition
- Lack of reliable dynamic control
- High overall cost



Scientific Impact:

- **Physical Level:** new hydroponic wastewater system
- **Sensor Level:** New data acquisition devices (membrane sensor devices, and robotic phenotyping technologies)
- **Cyber Level:** Advanced reinforcement learning algorithms

Technical Approaches:

- Wastewater system sensing, modeling, and simulation
- Hydroponic plant growing sensing, modeling, and simulation
- RL-based membrane sequencing and nutrient control

Key Innovations & New Contributions:

- Novel and efficient RL algorithms to train optimal policies for system operations
- Provide abundant, highly accurate, and differentiated nutrient and plant phenotype data

Broad Impact (Society)

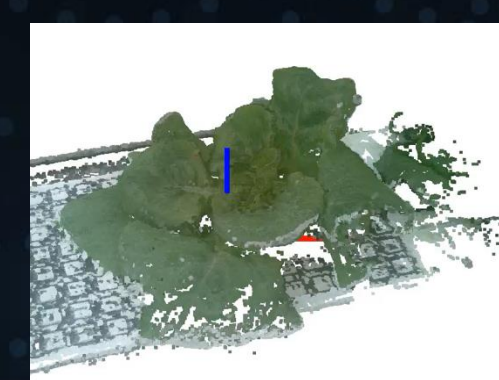
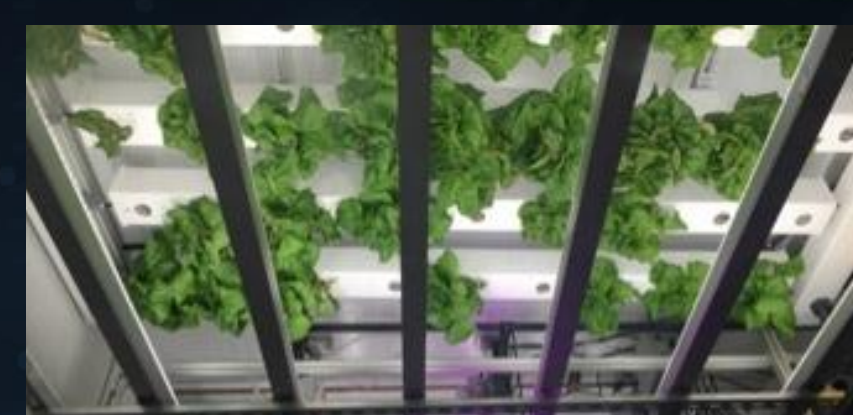
- Addressing the grand challenges
- Fresh and healthier food supply
- Foster employment opportunities
- Positive impact on city/urban planning and increasing employment, healthy diet.

Broad Impact (Education & Outreach)

- Training under and graduate students
- Promoting women and minority
- Extension service in land-grant university: UAS-based sensors for precision water management

Broad Impact (qualify potential impact)

- Training PhDs/UG students and 30 farmers
- New sensor, RL, and ML algorithms for a broader audience
- Low-cost wastewater and nutrient management



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