PlantFit: Wearable Sensor Technology for Plants

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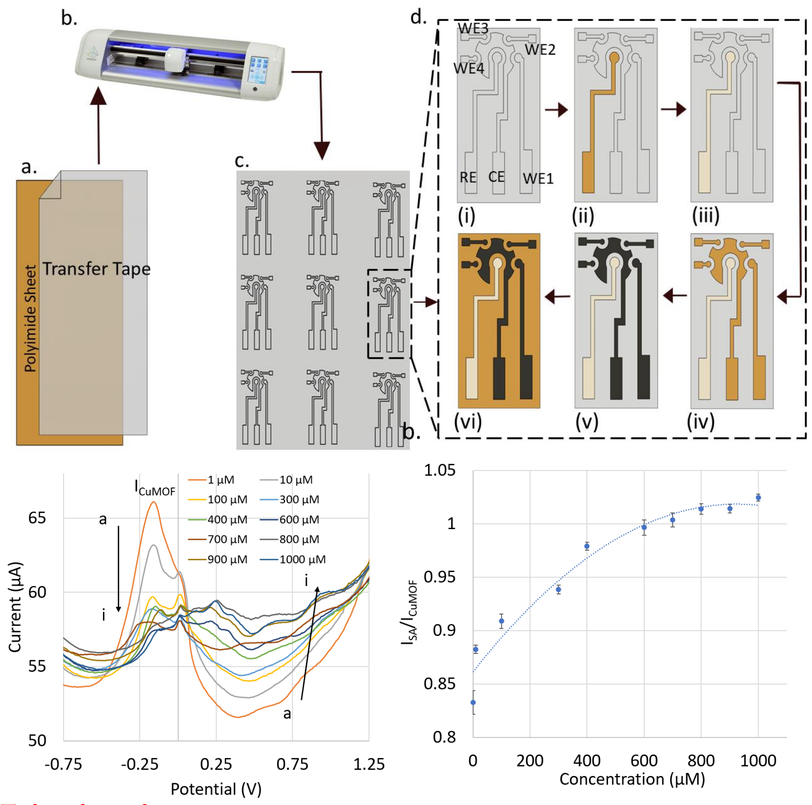
Award No. 2138701

Motivation

- Plant are responsible for providing food, fiber, fuel, and fodder to society.
- When plants are under stress, they release phytohormones which are known as early responders.
- Crop productivity and yield decline under environmental stress conditions.
- We have developed a wearable sensor suite that is cost effective (<$50), provides quantitative measures of stress-related phytohormones (SA, IAA, and ethylene), and early detection of stress (on day 1).
- We envision a wearable technology that monitors plant's fitness under various stress conditions and reports that to existing agricultural equipment to automate precise and efficient use of resources (e.g., nutrients, water, and pesticides).

Initial Investigation



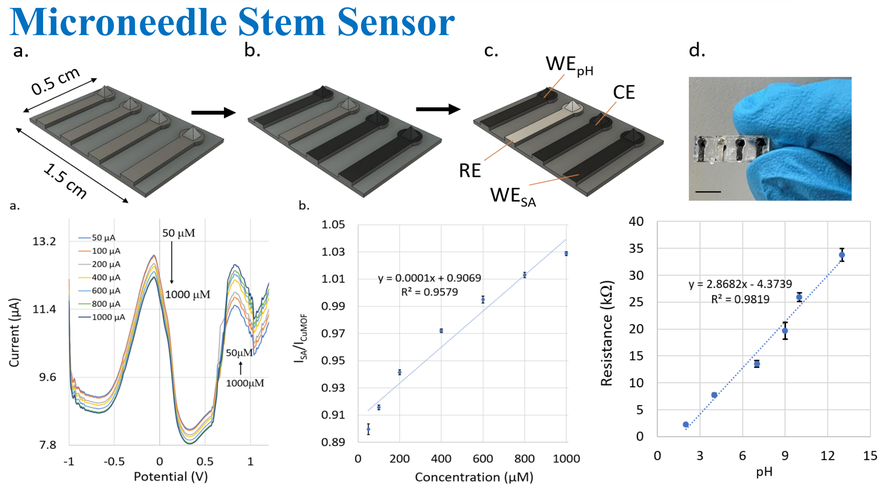
Limitation:

Invasive Process and permanent tissue damage

External buffer is required

Improved Sensor Development

Microneedle Stem Sensor



Major Contribution

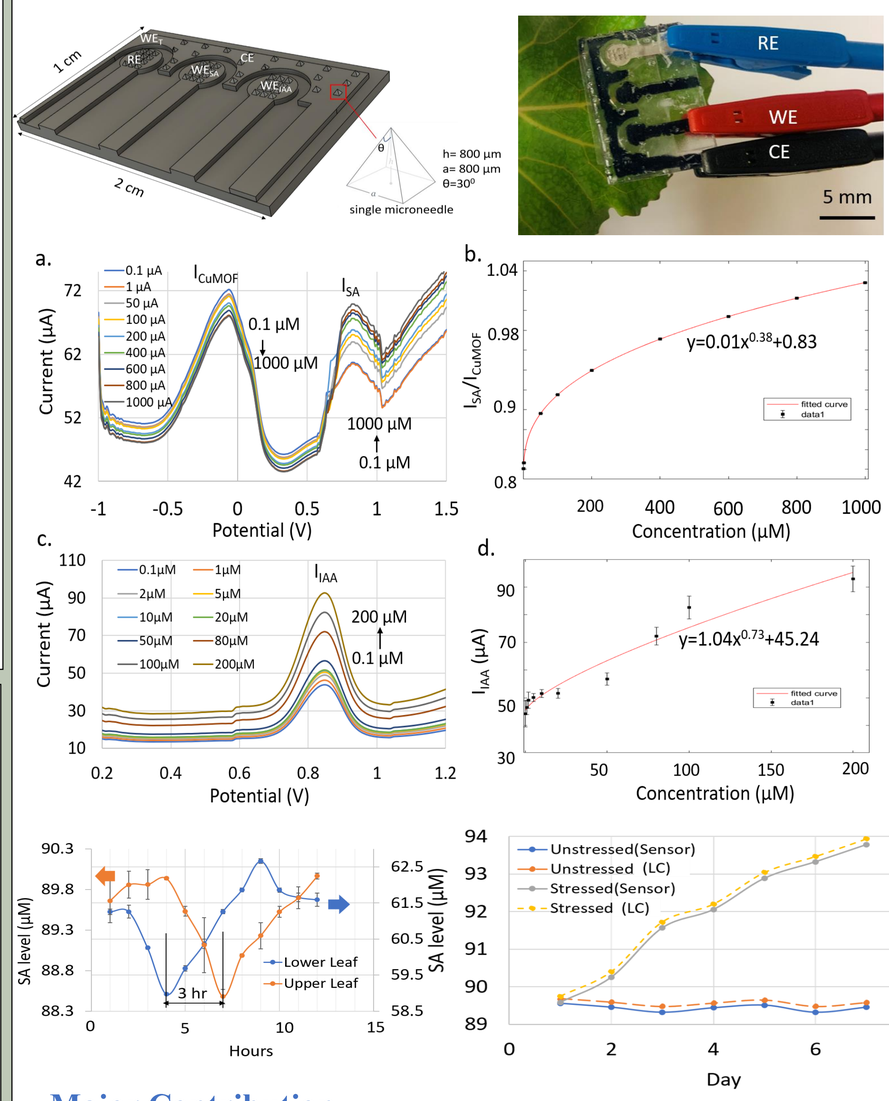
1) This sensor could accurately measure the dynamic variations in SA
2) Temperature Correction of the sensor response
3) Minimal invasive sensor development

IEEE NEMS Best Student Paper Award

N. I. Hossain and S. Tabassum, "Stem-FIT: a microneedle-based multi-parametric sensor for in situ monitoring of salicylic acid and pH levels in live plants," in Proc. IEEE International Conference on Nano/Micro Engineered and Molecular Systems (NEMS), pp. 14-17, April 2022.

Improved Sensor Development

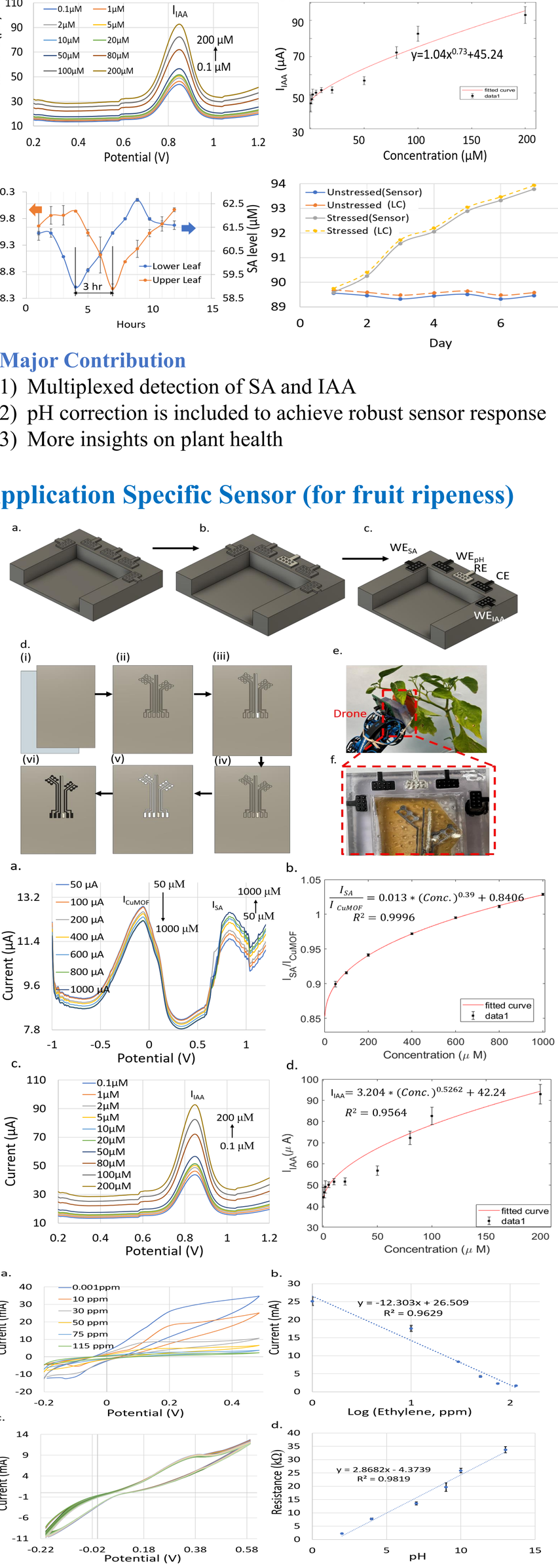
Microneedle Leaf Sensor



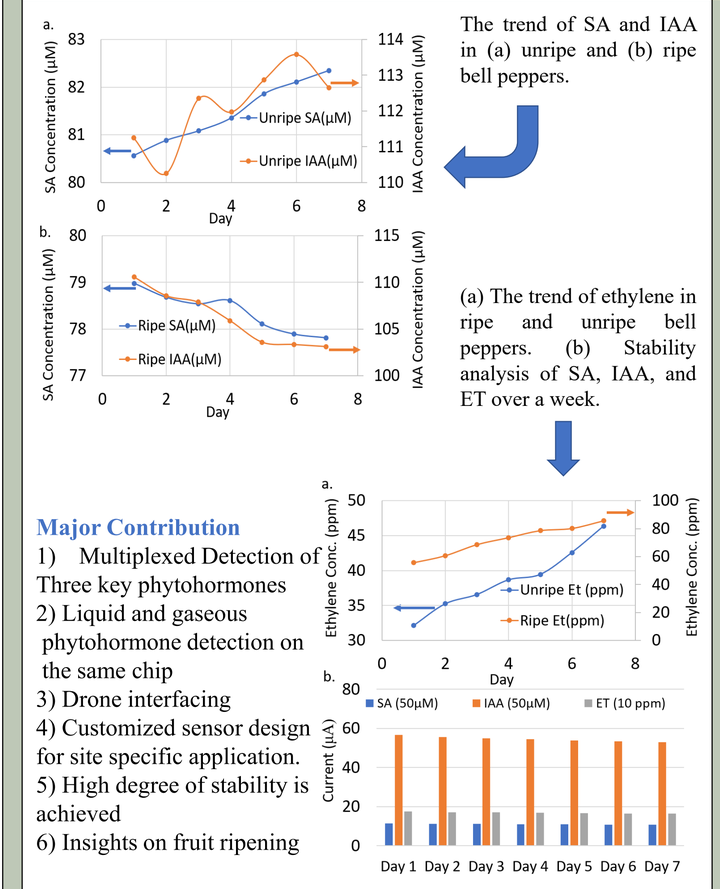
Major Contribution

1) Multiplexed detection of SA and IAA
2) pH correction is included to achieve robust sensor response
3) More insights on plant health

Application Specific Sensor (for fruit ripeness)



Improved Sensor Development



The trend of SA and IAA in (a) unripe and (b) ripe bell peppers.

(a) The trend of ethylene in ripe and unripe bell peppers. (b) Stability analysis of SA, IAA, and ET over a week.

Major Contribution

1) Multiplexed Detection of Three key phytohormones
2) Liquid and gaseous phytohormone detection on the same chip
3) Drone interfacing
4) Customized sensor design for site specific application.
5) High degree of stability is achieved
6) Insights on fruit ripening

Entrepreneurial Activity

Business Model Canvas

Value Propositions
- Environmentally Sustainable
- Reduced Productivity Loss
- Less Spoilage(~80%)
- Internal Stress Monitoring

Customer Relationships
- Traditional methods
  - Websites
  - Newsletters
  - Trade Journals
- YouTube/Facebook
- Account Management Team

Customer Segments
- Farmers
- Insurance Company
- Agro Corporations
- Big Data Companies
- State Agencies

Channels
- Website
- Robotics Companies
- Distributors
- Agro Tech Companies
- Insurance Promotion Package

Validated

Validated

Key Partnerships
- Robotics Industry
- Insurance and Finance Industry

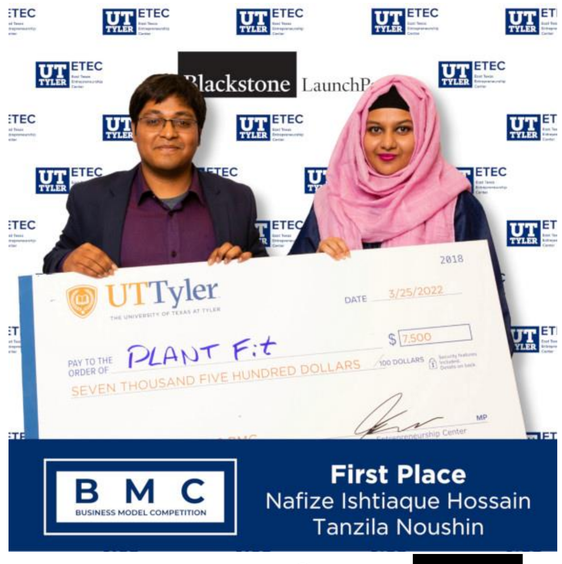
Key Activities
- Technology Development
- Data Analytics and Modeling
- Securing Intellectual Property

Cost Structure
- Product Development
- Manufacturing
- Marketing and Employee salary
- Licensing, Certification and Patenting

Validated

Key Resources
- R&D Team
- Research Facility
- Intellectual Property
- Funding- NSF, DOA and many more.

Revenue Streams
- Device and subscription
- Installation and Maintaince
- Licensing
- Manufacturing Profit Sharing
- Aggregating Data and Data Analytics Service



Courtesy Blackstone LaunchPad

Business Skill Development

- ❑ Serving as The vice president of BIG (Business Innovation Group) at UT Tyler
- ❑ Participated in NSF I-CORPS program
- ❑ Received Bridge Venture Fellowship (To gain knowledge on venture capital)

Future Directions

- ❑ Working on submission of provisional patent to protect intellectual property (IP).
- ❑ Continue entrepreneurship activities during my PhD studies.