

# Development of a Wearable Intracranial Pressure Monitoring Device

Computer Integrated Surgery II  
Spring, 2022

Ese Bowry and Marissa Hsu, under the auspices of Joshua Liu, Dr. Chad Gordon, and Dr. Mehran Armand

## Introduction

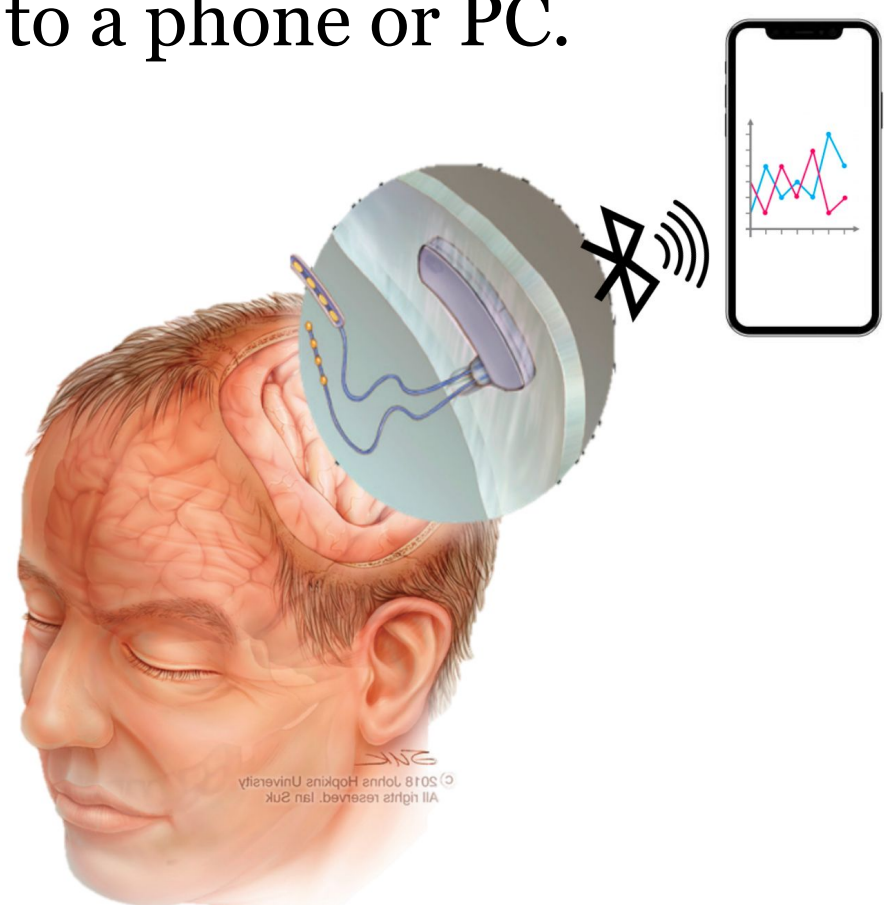
- This project is working on the creation of a wireless, wearable intracranial pressure (ICP) monitoring device for monitoring pressure inside the skull.
- This device will aid patients and physicians in continuously analyzing a connected patient's intracranial pressure levels.
- This project is based as a proof-of-concept design to test the feasibility of a wireless implantable device.

## The Problem

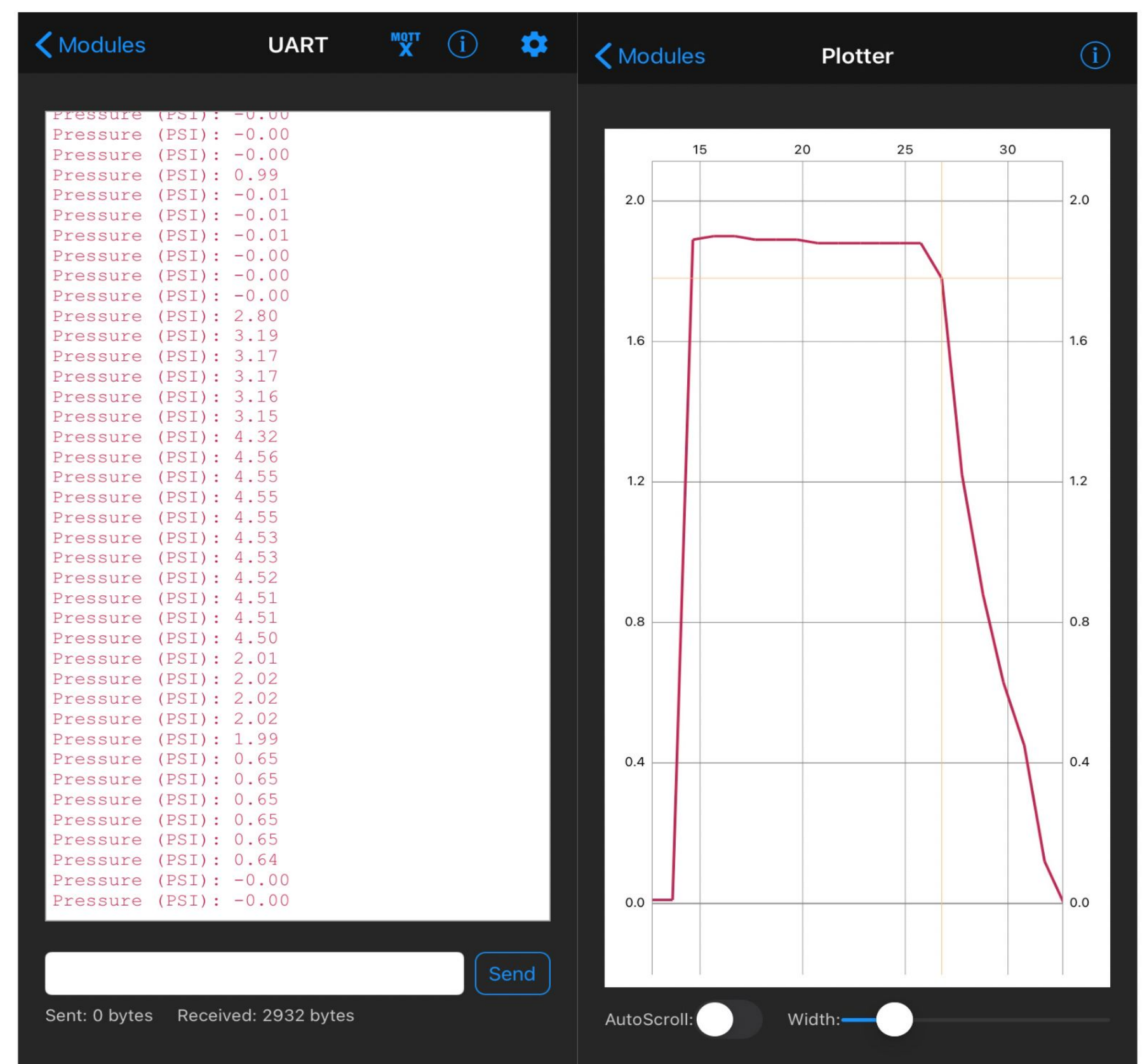
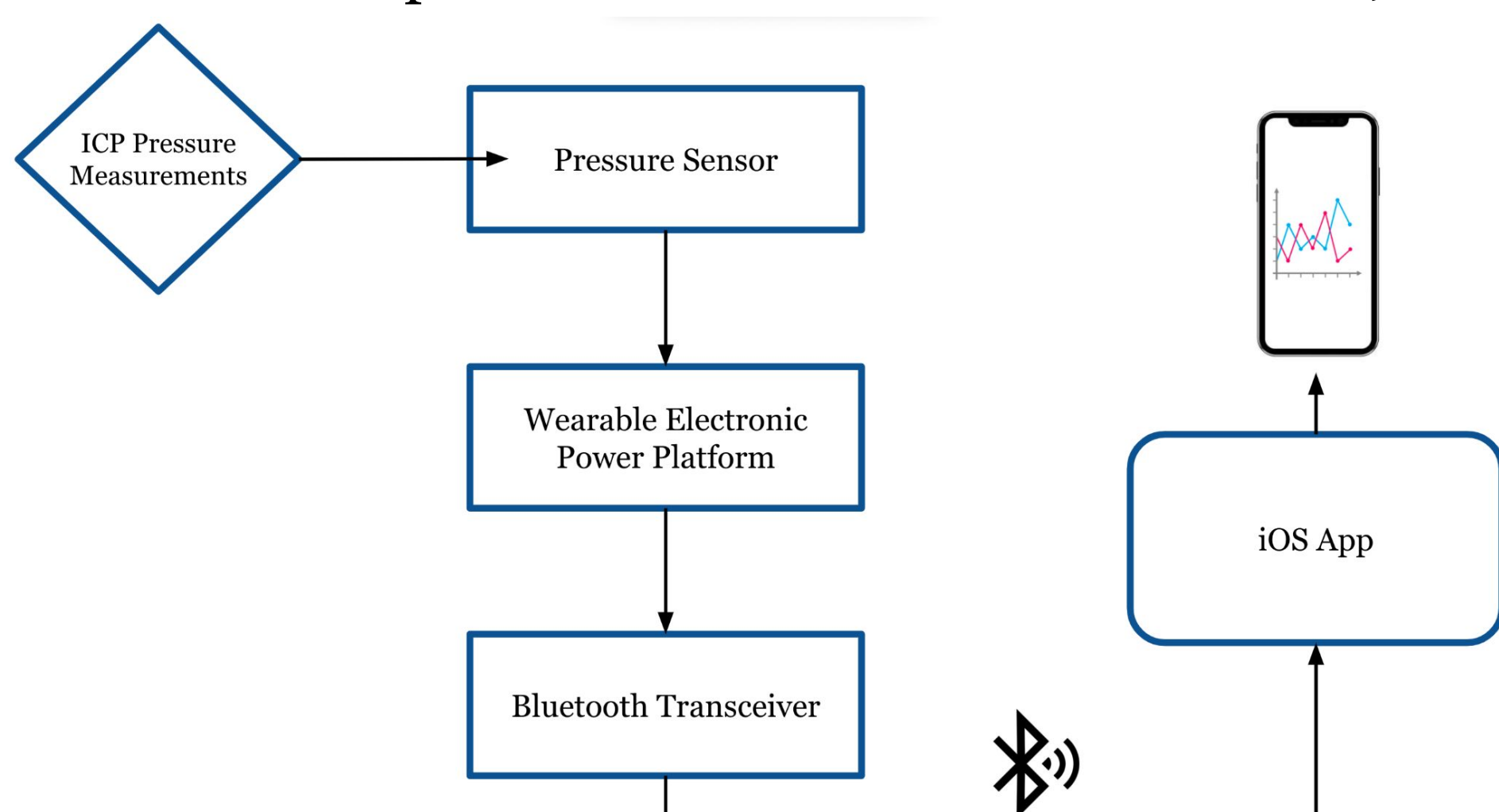
- ICP monitoring methods usually involve the placement of a catheter through the skull that monitors the patient's intracranial pressure for a limited period of time.
- Monitoring is commonly done at the hospital or clinic and must be overseen by trained professionals.
- Modern ICP devices have worked to create a more compact design consisting of an implantable sensor and a connected monitor that can aid in long-term ICP measurements.

## The Solution

- Our project aims to advance ICP telemedicine techniques by creating a more compact design with an implantable pressure sensor that can wirelessly transfer ICP measurements to a phone or PC.



- The designed ICP monitoring device will have three central components:
  1. Prototype a wearable monitoring device that can be embedded in a cranial implant for measuring a patient's intracranial pressure.
  2. Incorporate wireless data transfer using a Bluetooth Transceiver.
  3. Develop an iOS software application to provide live-tracking and feedback analysis capabilities for the patient and physician.
- Proposed hardware and software integration workflow: (all hardware components are from Adafruit Industries)



**Wireless implementation.** To verify a working wireless bluetooth transfer of pressure sensor data, Adafruit's Bluefruit Connect Application was used. This figure shows pressure data being read (units PSI) on the UART display monitor as well as being plotted on a graph plotter.

## Outcomes and Results

- Hardware:
  - Successful prototype implementation of a pressure sensor device.
  - A manual pressure pump was used to verify the behavior of the pressure sensor.
  - Wired implementation with Arduino IDE.
  - Wireless implementation with Adafruit Bluefruit Connect.
- Software:
  - Sign-in/Sign-up screens for patient data security.

## Future Work

- Establishing a stable connection between the Swift code and Adafruit Bluefruit.
- Designing the cranial implant.
- Perform feasibility trials on the system as a whole.

## Lessons Learned

- Workflow for establishing hardware and software connections.
- Progress of modern ICP monitoring systems.

## Credits

- Marissa Hsu was responsible for hardware components.
- Ese Bowry was responsible for developing the software application.
- Both worked on software and hardware integration.

## Acknowledgements

- Thank you to our mentor Joshua Liu for the continued support!

