

ENGINEERING ART

PROBLEM

Educate the public about the contemporary challenges that engineers tackle. More specifically, we were tasked to select one item from the National Academy of Engineering's Grand Challenges for Engineering.

SOLUTION

To do this, we must convey this in an artistic way that demonstrates the use of electrical, computer, software, and/or cybersecurity engineering in our final project.

INTENDED USERS

Mainly, the intended audience of this project is K-12 students for outreach for the National Iowa Space Grant Consortium, but could be for audiences of all ages.

FUNCTIONAL REQUIREMENTS

- Focus on one of the 14 NAE Grand Challenges for Engineering
- Use touch-interactive elements using Disney's Touché
- Display any output onto a tablet provided by the client
- Create a project that combines all of the team's majors

NONFUNCTIONAL REQUIREMENTS

- Portability and ease of setup
- Educational for all ages, not just K-12
- Functionally fun

ENGINEERING STANDARDS

- IEEE P2784: The Guide for the Technology Evaluation of Smart City Projects.
- IEEE 1680 Series: Standard for Environmental Assessment of Electronic Products. Design principles for sustainable and Eco-friendly smart city elements in the art piece.

TECHNICAL DETAILS

The Touch Surface

- The touch surface is the primary medium in which the user interacts with the application
- Uses a conductive fabric instead of a touchscreen
- Enclosed in a laser cut wooden frame painted to match the categories of questions in the game

The Hardware

- Arduino UNO programmed in Arduino IDE with Python
- PCB newly designed to have four separate inputs and outputs to send to the application

The Application

- Written in Java using Android Studio
- Connected to the hardware via USB
- Reads data with the UsbDevice and UsbSerialDriver library
- Displays a question correlating to the section of fabric touched and updates the screen depending if the answer given was correct or incorrect.

CHALLENGES

- Defining the scope of the project
- Soldering the wire to the touch surface
- Getting the application reading 4 inputs instead of 1
- Creating a functional frame that fit together properly and looked good
- Reading data from hardware on the software

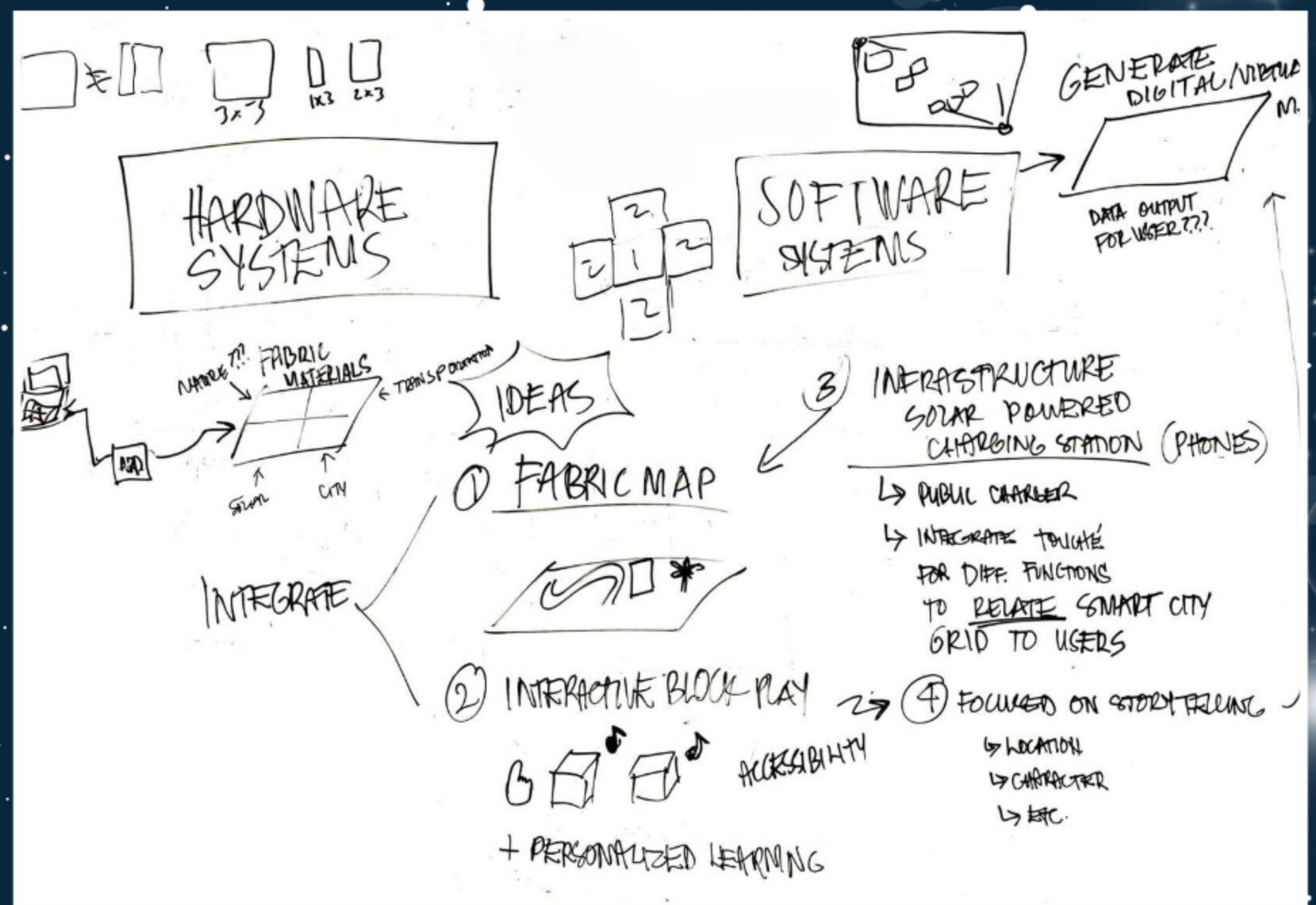


Figure 1: Block Diagram

DESIGN THINKING

We used the Double Diamond design method for iterating through our project. Semester 1 consisted of brainstorming and creating smaller design throughout the iteration. Semester 2 combined the best of those designs along with some adjustments.

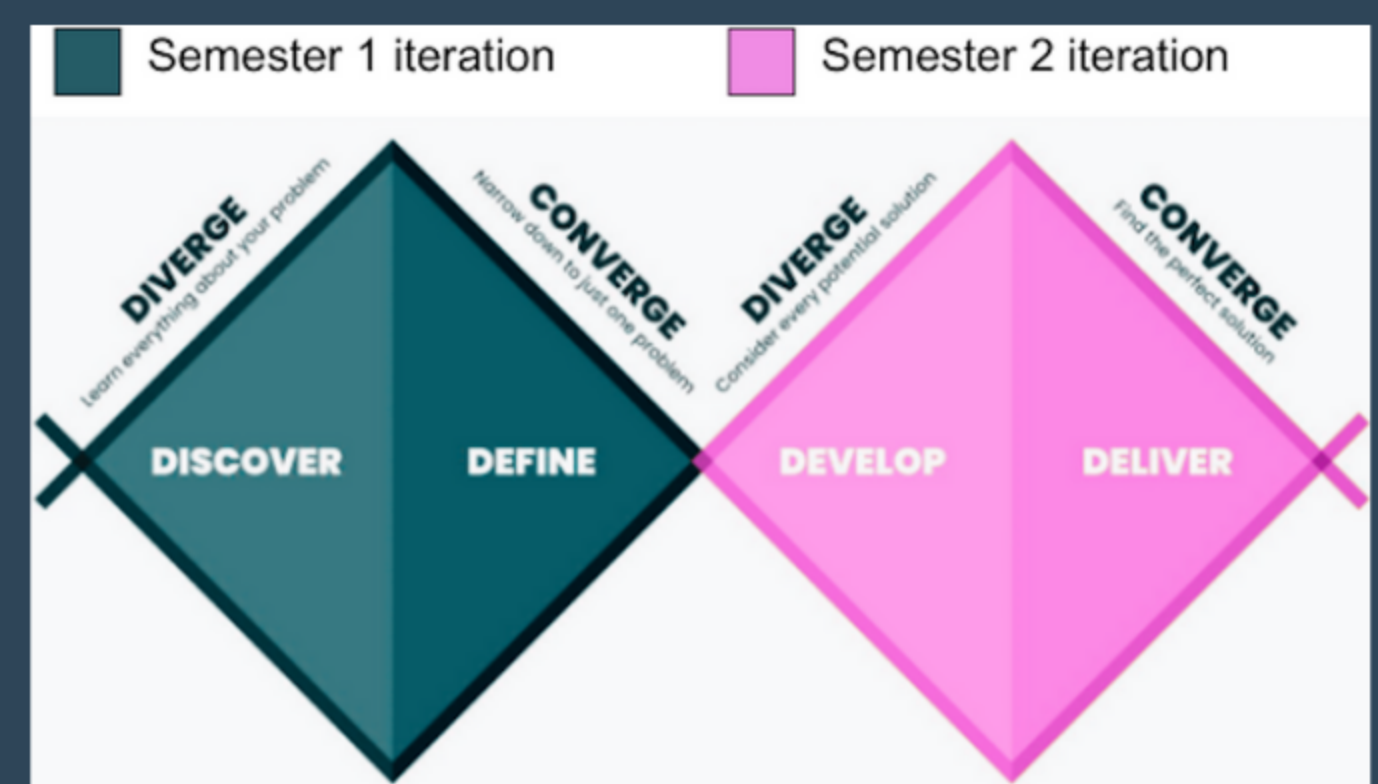


Figure 2: The Double Diamond by the Design Council

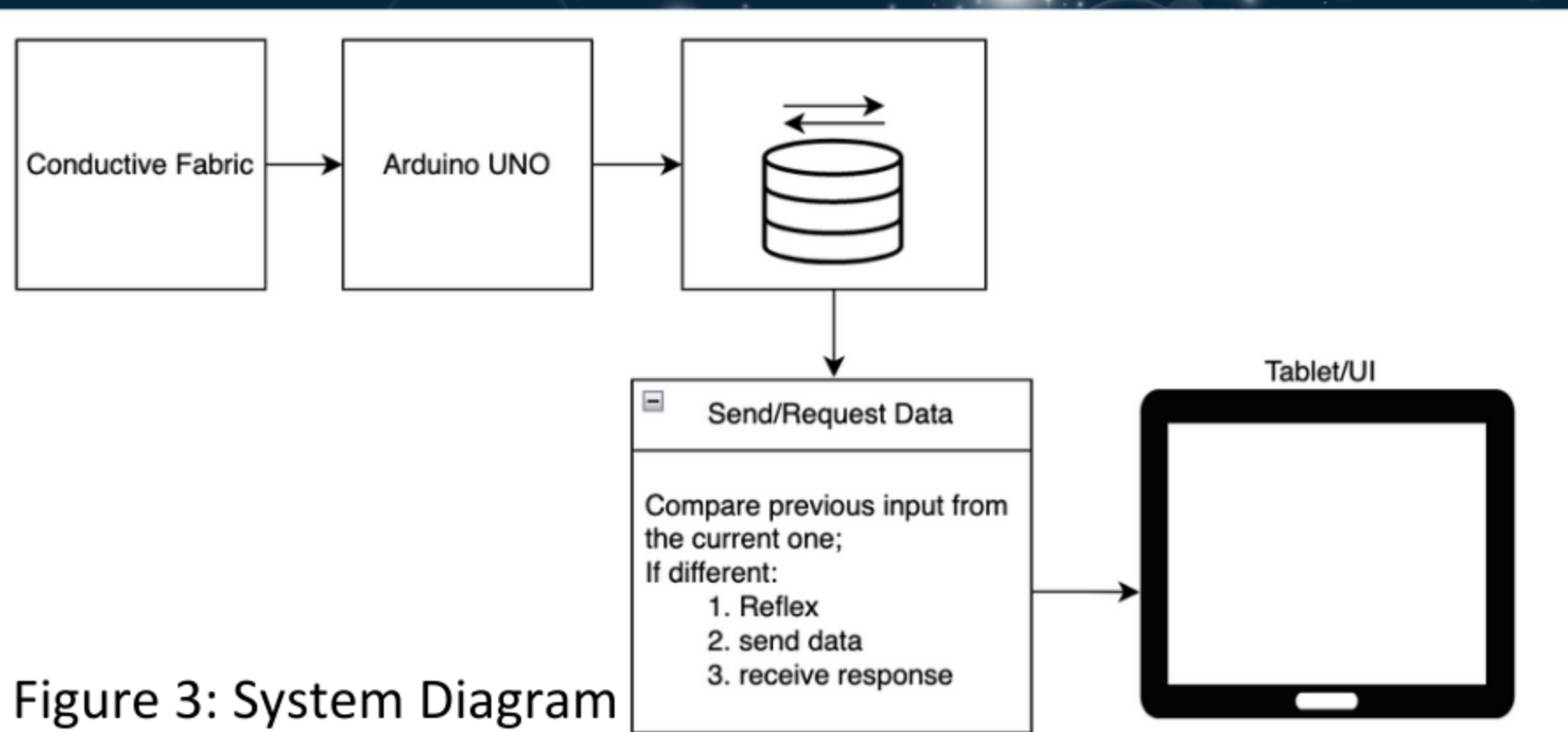


Figure 3: System Diagram

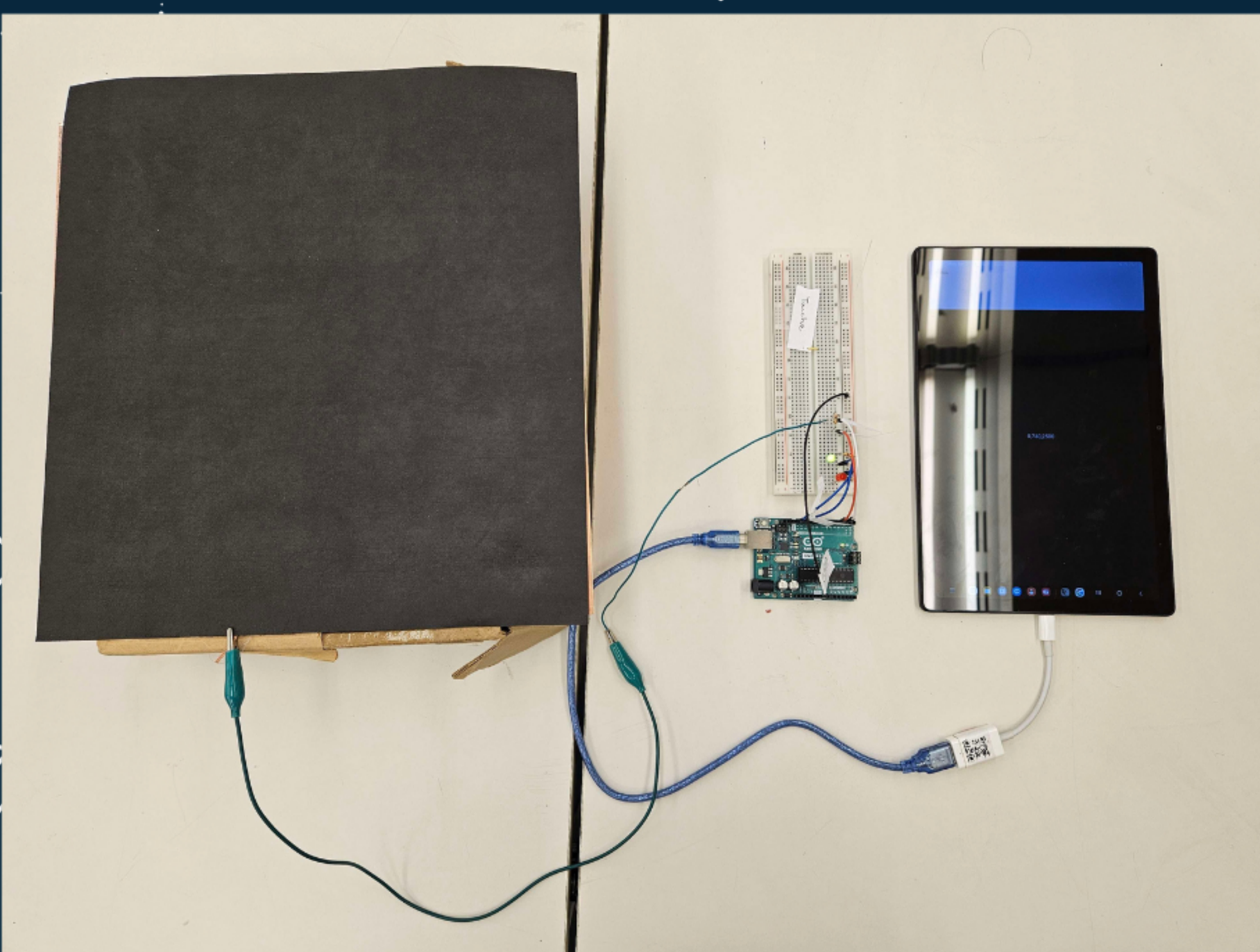


Figure 4: Hardware connected to software

TESTING

The Touch Surface and Hardware

- Scripts used to check the conductivity waveform
- Peaks indicate the surface has been touched
- Multiple types of material were manually tested for effective conductivity (e.a. cooper plates)

The Software

- Software was written with visual cues used to debug if the USB connection was detected
- Once the connection was found, real data was used to test how data was read

The Combination

- code was flashed onto the Arduino and tablet
- real data collection was used to ensure data was being read and collected correctly



Figure 5: Waveform Testing Displays the surface touch