SCIENTEENS LAB
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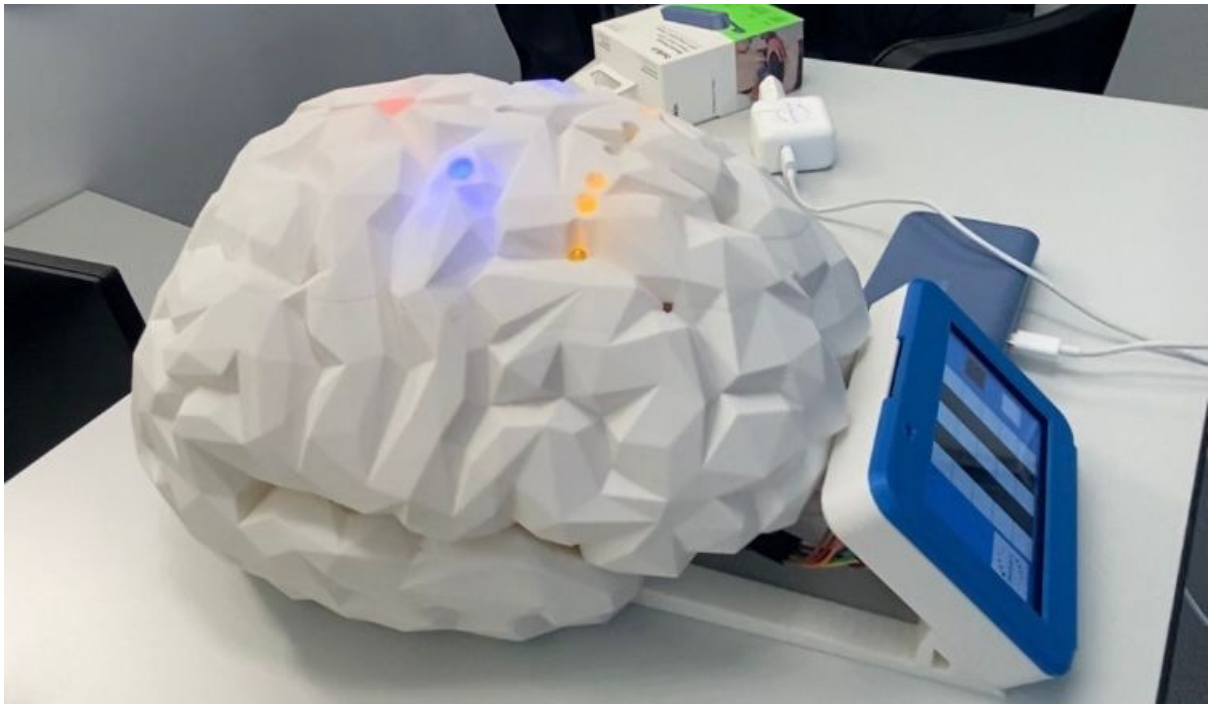
1. Project Overview

This project is a **physical and interactive demonstration of a basic neural network**, designed to explain the fundamental concepts of neural networks in a simple and visual way. It targets both **children and adults**, offering an intuitive understanding of how neurons activate and how information flows through layers.

The system uses:

- A **3D-printed brain model***
- **LEDs representing neurons**
- A **touchscreen interface** allowing the user to "draw" input data
- An **Arduino GIGA R1 WiFi** controlling the neural activation logic / pattern recognition from the interface.

The main goal is to show how **input patterns activate neurons**, and how those activations propagate through a simplified neural network architecture.



2. Physical Setup

A 3D-printed brain model is used as the main visual object. The brain contains holes where LEDs are mounted, representing neurons.
Special Thanks to Dr. Philip Goergen who designed and printed the 3D brain.

The LEDs are arranged in three layers:

2.1 Layer 1 (9 LEDs)

The first layer contains **9 LEDs**, grouped into three sections:

- Group A: 3 LEDs
- Group B: 3 LEDs
- Group C: 3 LEDs

This creates a total of:
Layer 1 = 3 + 3 + 3 = 9 neurons

2.2 Layer 2 (3 LEDs)

The second layer contains **3 LEDs**:

- Neuron H1
- Neuron H2
- Neuron H3

Each Layer 2 neuron is connected to one group of Layer 1 and a neuron in Layer 2 activates only if its corresponding group in Layer 1 is fully activated.

For example:

- Layer 1 Group A → Neuron H1
- Layer 1 Group B → Neuron H2
- Layer 1 Group C → Neuron H3

2.3 Layer 3 – Output Neuron (1 LED)

The third and final layer contains **1 LED**, representing the output neuron.
This neuron activates only when the system detects that at least one Layer 2 neuron is active.

3. User Interaction: Touchscreen Input System

The neural network input is controlled through a touchscreen display connected to the Arduino.

3.1 5x5 Tile Grid Interface

On the display, the user sees a **5x5 grid of tiles**.

Each tile represents an input value:

- **White tile = 0 (inactive)**
- **Black tile = 1 (active)**

Users can interact with the grid by touching tiles to:

- Turn a tile black (activate it)
- Turn a tile white again (deactivate it)

This creates a simple drawing system where the user can "paint" patterns.

Example Behaviors

3.2 Example 1: Strong Pattern (Full Activation)

If the user draws **five black tiles in a vertical line in a coloumn of the grid**, this activates all neurons from a group in Layer 1.

Result:

- A Full Layer 1 group activates
- The corresponding Layer 2 neuron activates
- The Layer 3 output neuron activates

This shows the user:
A strong input pattern activates the full network.

3.3 Example 2: Weak Pattern (Partial Activation)

If the user draws **three black tiles in a vertical line at the top of the grid**, only one neuron in a Layer 1 group activates.

Result:

- Only one neuron in Layer 1 activates
- Layer 2 output does NOT activate
- Layer 3 output does NOT activate

This shows the user:
Some patterns are not enough to trigger a final decision.

4. Hardware Components

This project uses the following hardware:

Main Controller

- **Arduino GIGA R1 WiFi****

Display

- **Arduino Touchscreen Display**
- Used for interactive tile-based input

Output

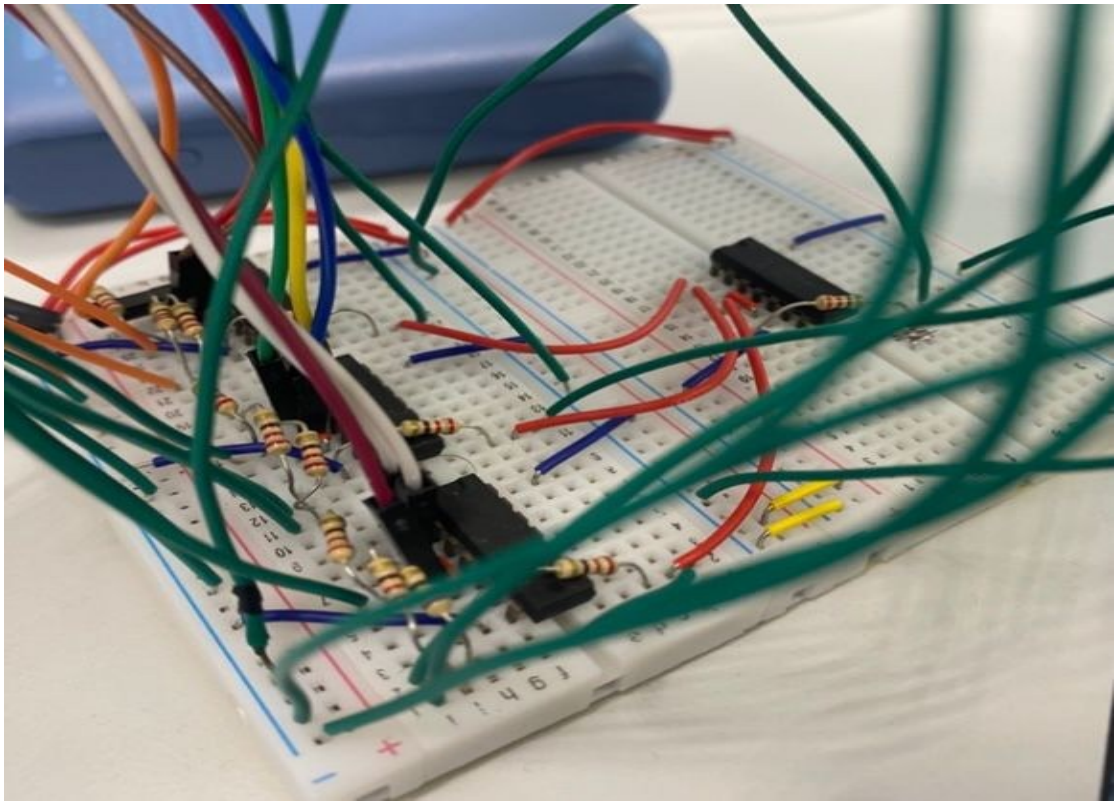
- LEDs installed in the brain model:
  - 9 LEDs (Layer 1)
  - 3 LEDs (Layer 2)
  - 1 LED (Layer 3)

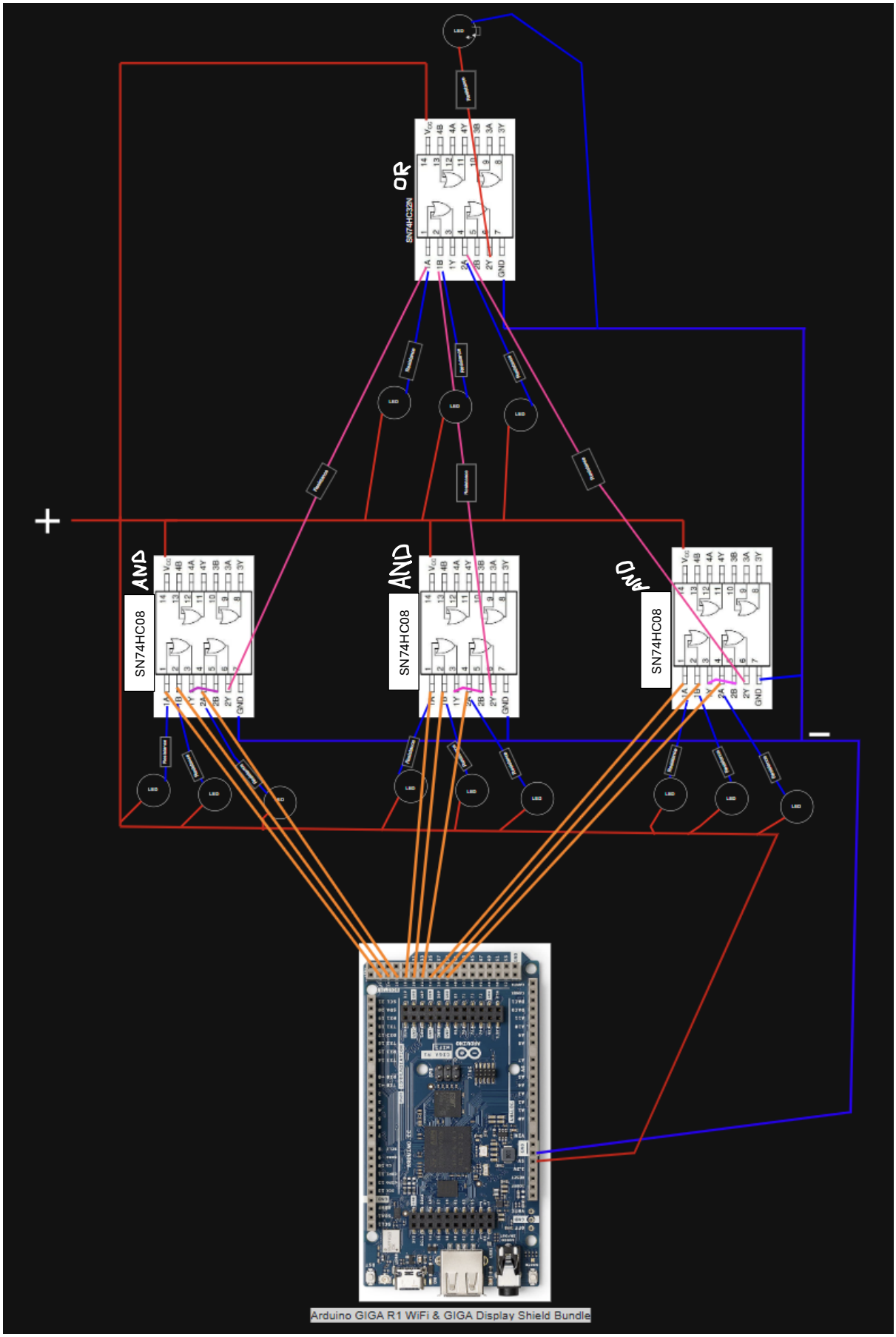
Physical Construction

- 3D-printed brain with LED holes
- Wiring to connect LEDs to Arduino pins

Special thanks to the one and only legend Patrick (surname unknown), who coded this entire project and then vanished into thin air — leaving behind two fully functional Arduinos and zero documentation. It works, and for that, he will be remembered forever.

The Arduino and touchscreen display are connected to the brain LED system using standard electronic components and a breadboard setup. The circuit is documented in the image below, with an additional UML diagram provided underneath.




OR
SN74HC32N
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Arduino GIGA R1 WiFi & GIGA Display Shield Bundle

5. Educational Purpose and Value

This project helps explain AI neural networks in a physical and intuitive way by showing:

- Neurons are "activated" by input signals
- Hidden layers combine simpler signals into more complex decisions
- A final output neuron can represent a classification decision

This is similar to how AI models recognize:

- digits
- shapes
- faces
- objects

And it also reflects how biological brains process:

- vision
- pattern recognition
- decision-making

6. Future Improvements / Roadmap

Possible improvements for future collaborators:

Software Enhancements (If you recode or Patrick reappears)

- Add more patterns (diagonal lines, shapes)
- Add adjustable activation thresholds
- Add "training mode" simulation
- Add animations on the display

Hardware Enhancements

- Add more layers of LEDs or bigger brain or new 3D prints
- Add sound feedback (buzzer)
- Add WiFi dashboard or statistics page to our webserver (contact Christophe
- Change from breadboard to a final soldered copper board.

Educational Additions

- Show explanation text on display – maybe a bigger display
- Display “Layer 1 / Layer 2 / Output” state live
- Add game mode: "Can you activate the output neuron?"

7. Collaboration Notes (For GitHub Contributors)

If you want to work on this project, you might aswell contact me because otherwhise..
EHHHH good luck !

8. Conclusion

This neural network demonstrator successfully transforms an abstract AI concept into a hands-on experience. By allowing users to draw simple patterns and instantly see neuron activations across layers, the project makes neural networks understandable, visual, and fun.

Special Thanks to Dr. Christophe Stammet fand LCSB or being so cool to put me on this project.