

WarpMind #4 Assignment Report: The Paths of Refinement Option 1: CSS and JavaScript frameworks

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1 Introduction

For this assignment I decided to rework my WarpMind interface by introducing one CSS framework and one JavaScript client-side framework. I chose **Bootstrap** and **jQuery** because they are well-established, easy to integrate into a small project, and flexible enough to reshape the interface without forcing a full rewrite. My goal was not only to modernise the appearance of the tool, but also to make the code easier to maintain and to improve the experience across different devices.

2 Refactoring Process

2.1 Choosing and Integrating the Frameworks

The first step was simply getting the frameworks into the project. Once I added the Bootstrap and jQuery CDNs to the `index.html`, the entire interface immediately changed character. Bootstrap brought a much more uniform style than my handwritten CSS, and I quickly realised that many of my custom rules were no longer necessary. jQuery, instead, felt like adding a layer of convenience over the functions I had already implemented. Even small changes, like switching to `$(#id)` selectors, made the code feel lighter and more coherent.

2.2 Rebuilding the Layout

What took the most time was reorganising the layout to use Bootstrap's grid system. The original interface worked, but it was rigid and definitely not friendly on smaller screens. With Bootstrap I structured the page into a simple three-column layout: the concept list on the left, the PDF viewer in the centre, and the workspace on the right.

The surprising part was how easy it became to make everything responsive. Once I replaced my fixed widths with Bootstrap's `col-` classes, the interface naturally collapsed into a vertical layout on a phone without further tweaking. Even simple components like buttons and sliders instantly looked cleaner once wrapped in Bootstrap classes.

2.3 Refactoring JavaScript with jQuery

Moving the JavaScript logic to jQuery required more thought. A lot of my code interacted with elements that were created dynamically from a template, and these elements did not respond to event listeners in the same way as static ones. I had to rethink how interactions were triggered and eventually adopted jQuery's event delegation pattern.

Although this initially felt counterintuitive, it ended up simplifying the entire script. Instead of scattering listeners everywhere, I could attach a single listener to a parent element and let jQuery handle the rest. The result was cleaner, more compact, and easier to read.

3 Reflections

3.1 Positive Aspects

What I appreciated most in this refactoring is the immediate sense of order that frameworks bring. Bootstrap removed the visual roughness of the prototype and gave me a layout that behaves well even in edge cases. jQuery, on the other hand, encouraged me to restructure parts of my script in a more thoughtful way, especially regarding dynamic elements.

Another unexpected benefit was how quickly the interface started to feel like a more mature application. Even though the underlying logic did not change dramatically, the combination of better styling and clearer interaction patterns made the tool feel more professional.

3.2 Challenges and Less Positive Experiences

The main difficulty emerged from the combination of old and new code. As soon as Bootstrap's styles became active, several of my previous CSS rules started clashing with it, creating some awkward layouts. It took patience to gradually remove or adapt the conflicting parts without breaking the entire interface.

The switch to jQuery also required learning some habits from scratch. Event delegation in particular took a while to understand, because the behaviour is less explicit than directly attaching event listeners. Debugging dynamic behaviour in the workspace section was the most time-consuming part of the refactor.

4 User Interface Before and After the Refactoring

To better illustrate how Bootstrap and jQuery changed the interface, I compared the previous layout with the refactored version. The screenshots below show both the original state of the tool and the redesigned version.

4.1 Original Interface

The initial interface relied mainly on custom CSS with a fixed layout, which made it less adaptable and visually inconsistent. Figure 1 shows a typical view of the older version.



Figure 1: Original WarpMind interface before refactoring, based entirely on handwritten CSS.

4.2 New Layout with Bootstrap

Figure 2 displays the updated interface after integrating Bootstrap. The three-column layout is now handled by the grid system, making the interface more balanced and immediately more readable.

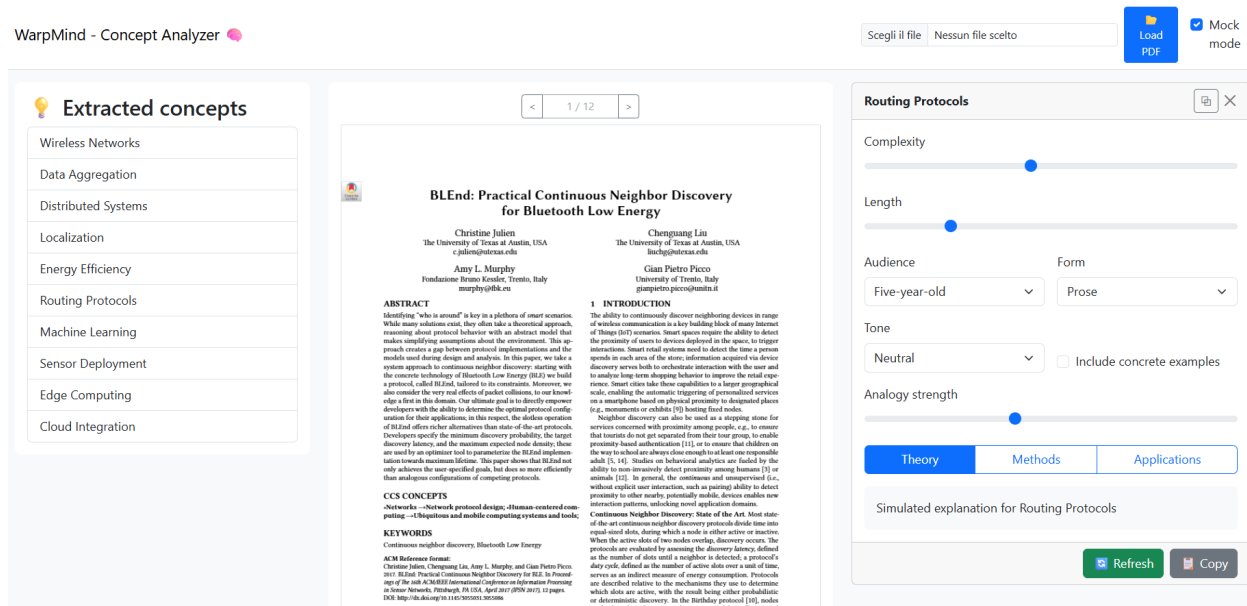


Figure 2: Refactored WarpMind interface using Bootstrap's grid system and improved spacing.

4.3 Concept Extraction and Card Rendering

Bootstrap list-groups and cards allowed for a cleaner and more structured presentation of dynamically generated content. As shown in Figure 3, the extracted concepts appear neatly in the sidebar, and clicking on them produces an interactive card.

WarpMind - Concept Analyzer

Scegli il file RA-015-D4RA08236B.pdf

Load PDF Mock mode

Extracted concepts

- Joule-heated reaction field
- spiral-shaped catalyst
- CO2 methanation
- infrared thermal imaging
- thermal management
- carbon capture utilization
- hydrogenation
- swirl flow
- methane production
- energy efficiency

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e-Methanation with a spiral catalyst: optimized thermal management and long-term stability†

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This study explores the development of a Joule-heated reaction field utilizing an electrically driven spiral-shaped catalyst for efficient CO₂ methanation. Infrared thermal imaging in an unisolated reactor reveals a rapid and uniform temperature rise along the spiral structure. With a 10 W input, CO₂ conversion reached 80%, while 75% conversion was maintained even at 5 W. The catalyst's heat angle played a crucial role in optimizing heat transfer and CO₂ conversion by enhancing swirl flow. Long-term stability tests at 5 W demonstrated sustained methane production over 50 hours at 250 °C, highlighting the catalyst's durability and energy efficiency.

1. Introduction

The CO₂ methanation reaction ($\text{CO}_2 + 4\text{H}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$, $\Delta H_{\text{rxn}} = -165 \text{ kJ mol}^{-1}$) has attracted considerable attention in recent years as a carbon capture utilization (CCU) technology, facilitating the conversion of the greenhouse gas CO₂ into valuable methane (CH₄) resources.^{1–3} This technology enables CO₂ reduction and efficient utilization without reliance on fossil fuels by using hydrogen produced from renewable energy sources, thus contributing to global warming mitigation. Therefore, various catalytic systems for this reaction have been researched both domestically and internationally. CO₂ hydrogenation is a multi-product reaction, potentially yielding not only CH₄ but also methanol (CH₃OH), higher hydrocarbons and alcohols, depending on the catalyst type and reaction conditions. Selective CH₄ production via methanation is a thermodynamically favorable route at relatively low temperatures, whereas methanol synthesis ($\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_3\text{OH} + \text{H}_2\text{O}$) requires precise catalyst design to suppress excessive hydrogenation to methane. Meanwhile, the Fischer-Tropsch synthesis pathway ($\text{CO}_2 + \text{H}_2 \rightarrow \text{hydrocarbons} + \text{H}_2\text{O}$) can produce long-chain hydrocarbons and organics under certain catalytic and reaction conditions. Controlling the selectivity of CO₂ hydrogenation products is therefore a critical factor in optimizing the desired process for energy and chemical production. Tada et al. initiated the selective CO₂ methanation earlier than

while the superior performance of its based catalysts has also been widely reported.^{4–6} The reaction mechanism and catalytic system developments have been extensively investigated. Our research group is focused on the social implementation of the CO₂ methanation system for industrial flue gases.^{6,7} Industrial exhaust gas usually contains oxygen, raising concerns about catalyst degradation from oxidation; however, we found that the presence of oxygen is effective for CO₂ methanation. The coexistence of oxygen in the CO₂ methanation reaction triggers an auto-methanation (AM) phenomenon that does not require external heating.^{8–10} In the AM process, combustion by hydrogen and oxygen causes internal heating in the reactor, which is the driving force for the methanation reaction, thereby achieving efficient CO₂ conversion. This internal heating process is particularly effective in improving the energy efficiency of the reaction system and offers significant advantages over conventional external heating methods, with reported energy savings and simplification of the reactor. Furthermore, reusing the methane produced in this process as fuel could form an energy cycle, thus supporting a sustainable society. There is a major innovation in this technology. Spiral-shaped catalysts are commonly used in catalyst systems,^{11–13} as their configuration enables the thermal energy from hydrogen combustion to be efficiently supplied to the catalytic reaction field via swirl flow within the gas stream. The metallic helical base material facilitates heat transfer through the gas flow and

infrared thermal imaging

Complexity

Length

Audience Five-year-old

Form Prose

Tone Neutral

Include concrete examples

Analogy strength

Theory Methods Applications

Infrared thermal imaging is like having special glasses that let you see heat. Imagine everything around you, like people and animals, glowing in different colors depending on how warm they are. These special glasses don't see regular light, but instead see the warmth that things give off. So, if something is warm, it might look bright, and if it's cold, it might look dark. This helps us know how hot or cold things are just by looking at

Figure 3: Extracted concepts (left) and example of a dynamically generated concept card (right).


4.4 Responsive Behaviour

Bootstrap's responsiveness significantly improved usability on smaller screens. Figures 4 and 5 show how the interface reorganises itself without requiring additional CSS.

WarpMind - Concept Analyzer

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Load
PDF

☒ Mock
mode



Extracted concepts

Edge Computing

Wireless Networks

Data Aggregation

Cloud Integration

Signal Processing

Machine Learning

Routing Protocols

Distributed Systems

Fault Tolerance

Sensor Deployment

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**BLEnd: Practical Continuous Neighbor Discovery
for Bluetooth Low Energy**

Figure 4: Medium-sized view: components reorganise while maintaining clarity.

tation towards maximum lifetime. This paper shows that BLEnd not only achieves the user-specified goals, but does so more efficiently than analogous configurations of competing protocols.

CCS CONCEPTS

•Networks → Network protocol design; •Human-centered computing → Ubiquitous and mobile computing systems and tools;

KEYWORDS

Continuous neighbor discovery, Bluetooth Low Energy

ACM Reference format:

Christine Julien, Chenguang Liu, Amy L. Murphy, and Gian Pietro Picco. 2017. BLEnd: Practical Continuous Neighbor Discovery for BLE. In *Proceedings of The 16th ACM/IEEE International Conference on Information Processing in Sensor Networks*, Pittsburgh, PA USA, April 2017 (IPSN 2017), 12 pages. DOI: <http://dx.doi.org/10.1145/3055031.3055086>

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DOI: <http://dx.doi.org/10.1145/3055031.3055086>

adult [5, 14]. Studies on behavioral analytics are fueled by the ability to non-invasively detect proximity among humans [3] or animals [12]. In general, the continuous and unsupervised (i.e., without explicit user interaction, such as pairing) ability to detect proximity to other nearby, potentially mobile, devices enables new interaction patterns, unlocking novel application domains.

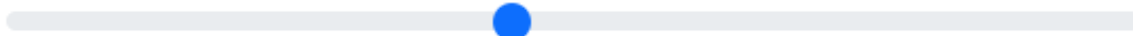
Continuous Neighbor Discovery: State of the Art. Most state-of-the-art continuous neighbor discovery protocols divide time into equal-sized slots, during which a node is either active or inactive. When the active slots of two nodes overlap, discovery occurs. The protocols are evaluated by assessing the *discovery latency*, defined as the number of slots until a neighbor is detected; a protocol's *duty cycle*, defined as the number of active slots over a unit of time, serves as an indirect measure of energy consumption. Protocols are described relative to the mechanisms they use to determine which slots are active, with the result being either probabilistic or deterministic discovery. In the Birthday protocol [10], nodes randomly make a slot active with a given probability, offering good average case performance but not providing guarantees on discovery latency. Instead, Disco [4] and U-Connect [7] space active slots according to prime numbers, relying on the properties of the Chinese Remainder Theorem to guarantee discovery within a tight time bound. Searchlight [1] and BlindDate [17] offer hybrid approaches, placing some active slots for deterministic discovery, then adding more in a pseudo-random manner to improve performance.

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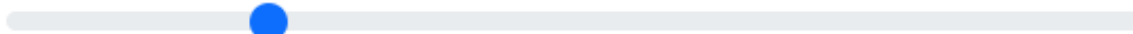
Wireless Networks



Complexity



Length



Audience

Five-year-old



Form

Prose



Tone

Neutral



Figure 5: Mobile-friendly layout where columns stack vertically and buttons adapt.

5 Conclusion

Overall, integrating Bootstrap and jQuery proved to be a very positive experience and gave me a clearer sense of how frontend frameworks can support, rather than complicate, a project. The WarpMind interface is now more polished, more flexible, and easier to extend.

While there were moments where it felt like I was wrestling with the frameworks rather than working with them, the final outcome confirmed that the refactoring effort was worthwhile. The application now behaves more consistently and is better prepared for future improvements, including the possibility of evolving into a full Electron-based desktop tool.