**BSc Project Log Book**

**Student Name: Arsenii Khmara**

**Project Name: Cross-Platform Peer-to-Peer Clipboard Synchronization Using mDNS and Bluetooth Low Energy for Seamless Offline Content Transfer**

**Internal Supervisor: Haozhe Wang**

**External Supervisor: (if any)**

**Log of Activities**

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| **Date** | **Key activities** | **Outcomes** | **Comments/Action plans** |
| Oct 1 – 21, 2024 | Identified P2P clipboard concept | Defined project scope and objectives | (Think more about what to do) |
| Oct 22 – Nov 11, 2024 | Started doing Literature Review, checking existing competition | Identified 10 apps that serve the similar function. Created comparison matrix of features and limitations. Found most solutions lacked offline capabilities or required account creation. | Further analyze technical implementations of top 3 competitors. Research Bluetooth LE capabilities and limitations for clipboard data. Investigate how to handle different data types across platforms. |
| Nov 12 – Dec 2, 2024 | Continued literature review | Synthesized main themes and challenges in P2P data synchronization. Identified key technical approaches for clipboard syncing. Outlined potential security vulnerabilities in existing implementations. | Prepare literature review document focusing on: 1) P2P discovery mechanisms, 2) Cross-platform clipboard format compatibility, 3) Security considerations for clipboard data, and 4) Offline connectivity approaches. |
| Dec | Finalized literature review | Completed in-depth analysis of Wi-Fi Direct, Bluetooth LE, and mDNS/DNS-SD technologies. Identified pros/cons of each approach. Created technical comparison table weighing factors like power usage, range, and data transfer rate | Literature review provides good foundation, now need to start technical implementation planning. Focus on creating protocol diagrams for the chosen technologies. |
| Jan 1 – 21, 2025 | Initial implementation planning | Selected technology stack: C++ for Windows client, Swift for macOS/iOS. Created protocol design for clipboard data exchange. Developed initial class diagrams for both platforms. | Need to develop working prototype using chosen technologies. Research third-party libraries for Bluetooth LE and mDNS implementation. Consider using Bonjour SDK for Windows to simplify mDNS. |
| Jan 22 – Feb 11, 2025 | Made a MVP | Successfully connected Windows and macOS via TCP using mDNS for discovery. Implemented one-way clipboard synchronization. | Focus on bidirectional synchronization next. Address large clipboard item handling , focus on challenges to later put it in Final report |
| Feb 12 – Mar 4, 2025 | Improved modularity of the project and achived a working TCP connection in both direction and BLE in 1 | Developed abstracted clipboard APIs for both Windows and Swift platforms. Achieved bidirectional clipboard sync over TCP. Basic BLE discovery implemented | Need to develop comprehensive security model including encryption. Work on conflict resolution when both devices update clipboard simultaneously. Consider challenges around battery optimization for BLE implementation. Plan testing approach for various network condition |
| Mar 5 – Mar 12 | Improved the current functionality of the project | Redesigned BLE protocol to support message fragmentation for larger transfers. Created custom binary protocol for efficient transfer | Start writing report for first draft, at least a general structure |
| Mar 12 – Mar 19 | Integrate UI | Added SwiftUI interface for macOS/iOS. Implemented status indicators for connection state. Created settings panel for configuration options. | Prepare poster design. Decide on key visualization components: architecture diagram, connection flow, and performance metrics. Consider color scheme that highlights key technological innovations. |
| Mar 19- Mar 26 | Finish poster and Start making First draft progress | Created visualization of system architecture. Designed data flow diagrams showing clipboard synchronization process. Optimized color scheme of poster for readability. Added performance comparison charts between different transport methods to the poster. | Initialize project summary for poster presentation. Prepare concise explanation of technical innovations. Begin structuring first draft of final report |
| Mar 26- Apr 4 | Started and sent First Draft | Completed draft outline with all major sections. Included methodology, implementation details, and preliminary results. Added diagrams illustrating protocol design and system architecture. | Need to add more detailed requirements analysis. Improve quality of section headings for clarity. Add more performance metrics and testing results. Consider reorganizing implementation section to better highlight innovations. |
| Apr 4 – Apr 11 | Adding security and Finishing implementation | Implemented end-to-end encryption using CryptoKit/OpenSSL. Created key exchange protocol for secure communications. Completed Windows and Swift implementations with full feature parity. Finalized protocol specifications with error handling. |  |
| April 11- Apr 18 | Manual integration testing and codebase updates | Wrote unit tests , measured throughout, worked out non working UTF formats , changed some code |  |
| Apr 18-Apr 30 | Finishing and submitting Final draft | Finished all graphs and diagrams, corrected style, completed implementation sections mentioning my analysis of choices. | supervisor feedback regarding language clarity in methodology and results sections. Simplify complex technical explanations with better examples. Add more comparative analysis with existing solutions. |
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