

Part A

Creating the Arduino-based parking detection system and integrating cloud services—specifically Google Authentication—were my main contributions to the Smart Parking System project. I concentrated on integrating safe user authentication using Google Sign-In to provide smooth access to the mobile application, even if the main backend was constructed in ASP.NET. To improve security and user experience, I handled token validation and session management while configuring and testing the authentication flow. To determine parking occupancy, I also spent a lot of time working on the hardware side, setting and debugging light and temperature sensors. I experimented with several sensor locations and calibration methods to increase detection precision while maintaining real-time data transfer to the backend. By experimenting with several connecting techniques, such as WiFi, Bluetooth, and USART, I was able to overcome obstacles in experimenting with a variety of connectivity techniques, including WiFi, Bluetooth, and USART, to enable sensor communication, overcoming difficulties in creating dependable and steady data flow. My knowledge of cloud authentication, IoT device integration, and real-time data exchange has grown because of these encounters.

Solving connectivity problems between the Arduino hardware and the backend system was one of the most difficult tasks I had to complete. Interference, erratic connections, and irregular data transmission made it challenging to establish dependable connectivity via WiFi, Bluetooth, and USART. To get a steady connection, I had to experiment with various baud rates, transmission protocols, and device setups. To manage user sessions appropriately while preserving security, integrating Google Sign-In on the authentication side needed careful implementation. It required testing and time to troubleshoot authentication issues and guarantee seamless login/logout processes. Despite these difficulties, I was able to contribute to a dependable sensor-based parking detection system and successfully deploy a functional authentication system. My main achievements were enhancing hardware-to-backend communication, optimizing sensor data accuracy, and incorporating cloud-based authentication.

Part B

As a team, we successfully developed a fully functional Smart Parking System that integrates real-time parking data, an intuitive Flutter mobile application, and a robust backend infrastructure. Our system provides users with secure authentication through Google Sign-In, real-time parking spot detection using Arduino-based temperature and light sensors, and accurate GPS-based parking spot identification. By leveraging sensor technologies, we enabled automated parking status updates, ensuring a responsive and efficient user experience. The system's backend efficiently processes parking availability data and transmits updates to the mobile application, allowing drivers to find available parking spots quickly. This project reinforced the importance of cross-functional collaboration, as we had to synchronize mobile development, backend integration, cloud authentication, and IoT hardware to create a seamless solution.

One of the most successful aspects of our teamwork was our ability to divide tasks based on individual expertise, allowing us to work efficiently despite the complexity of the project. However, we encountered challenges in integrating the various components, especially ensuring smooth communication between the mobile application, backend, and hardware sensors. Debugging connectivity issues with WiFi, Bluetooth, and USART required significant effort, as did aligning real-time sensor data with backend processing and frontend display. Despite these challenges, our team remained adaptable, resolving issues through regular meetings and testing sessions. Overall, our combined efforts resulted in a practical and scalable solution to urban parking challenges, demonstrating our ability to integrate cloud authentication, IoT hardware, and mobile application development into a single, well-functioning system.