

CPS5005 - Web Application Development - Assessment Brief

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| Module Code: | CPS5005 |
| Module Title: | Web Application Development |
| Module Convenor: | Prins Butt |
| Module Level: | 5 |

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| Assessment Number: | 1 |
| Assessment Title: | EcoTrack: Energy Consumption |
| Assessment Weight: | 60% |
| Assessment Individual/Group: | Individual |
| Assessment Type: | Web Project |
| Assessment Time/Word Count Restrictions: | 1 software artefact 2400 words report |
| Assessment Time/Word Count Limit Consequences: | It is essential that assignments keep within the time/word count limit stated above. Any work beyond the maximum time/word length permitted will be disregarded and not accounted for in the final grade. |

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| Issue Date: | 12 th November 2024 |
| Hand in Date: | 13 th January 2025 |
| Planned Feedback Date: | Within 3 working weeks |
| Mode of Submission: | Online via Moodle |
| Number of copies to be submitted: | 1 copy of each of the following: <ul style="list-style-type: none">• a report in pdf format• a zip file containing your software artefact |

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| Author: | Prins Butt |
| Internal Moderator: | Harshil Joshi |
| Moderation Date: | 12 th November 2024 |

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Introduction

With the growing importance of sustainability, many households aim to monitor and reduce their energy consumption. In this assessment, you will develop an application called EcoTrack designed to provide real-time insights into household energy usage, track specific appliances, and offer personalised recommendations for reducing carbon footprints. The goal of EcoTrack is to empower households to make data-driven decisions that contribute to environmental sustainability and cost savings.

This project simulates interactions with virtual IoT devices representing household appliances, allowing users to monitor energy usage and receive tailored suggestions for efficiency. Real-time data analysis and visualisations will enhance the user experience, while secure user authentication will ensure data privacy.

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Problem Scenario

EcoTrack's web application requires several key features to help users actively manage their energy usage:

- **User Registration, Authentication, and Profile Management:** Securely manage user accounts and personalised energy goals.
- **Virtual IoT Integration:** Monitor virtual IoT devices to simulate appliance-specific energy consumption data.
- **Real-Time Data Visualisation:** Graphically represent energy usage trends, device-wise consumption, and historical data.
- **Energy-Saving Recommendations:** Offer suggestions for reducing energy consumption based on usage patterns.
- **Analytics and Insights:** Provide data analysis on energy usage, cost estimation, and carbon footprint metrics.

Your role is to develop a MERN stack application that meets these requirements. You will need to carry out both the server-side and client-side development for the web application.

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Requirements

Build a **MERN stack web application** with a RESTful API and a client-side application to meet the following requirements:

1. Server-Side Web Development

Server Architecture: Implement a secure, scalable server with Node.js and Express.js to handle API requests.

Database Integration: Use MongoDB for storing user profiles, appliance data, and consumption records.

Security: Implement JWT-based authentication and ensure secure storage of sensitive data, such as user information and appliance configurations.

2. Server-Side Frameworks

Express API: Build a RESTful API that allows:

- User registration, login, and profile management.
- Retrieval and updating of virtual IoT device data.
- Logging of energy consumption by appliance in real-time.

TypeScript: Apply TypeScript throughout the server-side for type safety and maintainability.

3. Connecting Server-Side and Client-Side Code

API Endpoints and AJAX: Use AJAX to retrieve and update energy data in real-time, providing a responsive user interface.

Client-Side Integration: Ensure that server responses align with client requests for seamless interactions, enabling dynamic data updates on usage patterns and appliance status.

4. Advanced Server-Side Topics

Database Optimisation: Apply indexing and data optimisation techniques in MongoDB to handle historical data efficiently.

Performance Optimisation: Minimise server response times and reduce latency, particularly in managing real-time data streams from virtual IoT devices.

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Emerging Trends: Explore emerging trends such as the potential of Web Sockets for real-time data transfer, improving responsiveness in displaying appliance status changes, or the use of server-side rendering for optimising pages.

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Environment and Tools

You are required to use the following tools:

- **Visual Studio Code** for the development.
- **Node.js** and **npm** for server setup and package management.
- **MongoDB** for managing user, appliance, and energy data.
- **Postman** for testing API endpoints.
- **Draw.io** or an equivalent tool for diagrams.
- **Microsoft Word** (or equivalent) for the report, to be exported as a PDF.
- **Git** and **GitHub** for version control to document project progress.

Additionally, you may use any packages or modules covered in class or required for the advanced activities, testing, version control or managing the project.

If you are unsure about any tools or library, please check with the module convenor.

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Submission

The assessment must be completed individually. You must not share, in part or whole, your assessment with another party other than the module convenor and for the purpose of submission to the university. You must ensure that the University's academic misconduct guidelines are followed in their entirety.

You should use the assessment submission link on the module's Moodle page to submit the following files:

- A **PDF** file for your report. This should not be included in the zip file but instead submitted as a separate file. Failure to do so may result in zero being awarded.
- A **Zip** file of your software artefact. This should contain your software solution and any relevant files to open and execute your solution.

You should ensure that you make a timely submission by the deadline stated at the start of this assessment brief.

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Assessment Criteria

Your assessment will be graded according to the following criteria:

| Grading criteria | Functionality (50%) | Documentation (30%) | Professional Practice (20%) |
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| Mark band | | | |
| 80-100 Pass (1st) | Displays exceptional skills with comprehensive implementation and design considerations including strong considerations and implementation for web applications. | Exceptional analysis and evaluation provided, offering deep insights into the software artefact's strengths and weaknesses, supported by evidence and critical reflection. Report is exceptionally well-structured with use of referencing and citations, with thorough and accurate citation of relevant sources to support arguments and analysis. | Demonstrates exceptional adherence to industry and ethical practice with strong usage of version control with a well-structured repository, regular commits, detailed commit messages, and evidence of branching and merging strategies. |
| 70-79 Pass (1st) | Exhibits advanced skills with comprehensive web application development, and in-depth design considerations. Implements significant web application features. | Advanced communication in explaining complex software development concepts. Well-structured report with appropriate citations and captions where relevant. | Advanced adherence to code conventions, ethics, and relevant industry practice with usage of version control with a well-structured repository, regular commits, detailed commit messages, and evidence of branching/merging strategies. |
| 60-69 Pass (2.1) | Good, consistent knowledge and understanding of the material, main concepts, key theories, and practice at this level. Exhibits advanced skills in web application development. | Strong communication in explaining complex programming and problem-solving concepts. | Competent adherence to ethics, code conventions and other relevant industry practice with usage of version control with regular commits and meaningful commit messages that provide clear context for changes. |
| 50-59 Pass (2.2) | Sound, routine knowledge and understanding of the material, main concepts and key theories. Some flaws may be evident. Shows improved skills with refined implementation. | Improved communication skills seen in summarising design and implementation. | Improved adherence to code conventions and other relevant industry practice. Some ethical considerations. Usage of version control with regular commits. Commit messages provide some context but may lack detail or consistency. |
| 40-49 Pass (3rd) <i>(Threshold)</i> | Demonstrates basic skills in developing a functional application | Basic communication evident in summary of implemented solution. | Basic adherence to code conventions and other relevant industry practice with evidence of version control usage. Commits are sporadic and lack meaningful commit messages. |
| 30-39 Fail | Displays limited proficiency, with significant deficiencies in the programming. | Demonstrates inadequate communication skills, struggling to articulate ideas and concepts. | Inadequate adherence to code conventions and other relevant industry practice. Minimal evidence of version control. |

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Additional Guidance

You are required to develop a software system that meets the requirements stated above.

For a passing grade (40 - 59):

2. Comprehensive Solution:

Software Artefact Criteria:

- Develop a basic API covering essential functionalities (user management, basic IoT data retrieval, and energy usage tracking).
- Ensure that the core requirements are met, focusing on correct functionality and RESTful principles.

Report Criteria:

- Provide a summary of your implementation with diagrams and basic code snippets.
- Show evidence of version control through a detailed commit history.

For a 2:1 grade (60 - 69):

2. Comprehensive Solution:

Software Artefact Criteria

- Develop a comprehensive API covering all core functionalities with additional data validation and error handling.
- Integrate TypeScript for clear, type-safe code across both front-end and back-end.
- Show strong version control practice, including branching, detailed commits, and tracking.

Report Criteria

- Include a detailed explanation of architectural and coding decisions, with supportive visual diagrams.
- Demonstrate effective version control practices, showing evidence of feature-based branching.

For a 1st class grade (70 - 100):

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3. Advanced Application:

Software Artefact Criteria

- Implement advanced features such as analytics for carbon footprint metrics, custom energy-saving recommendations, and real-time data visualisation.
- Show clear ownership with well-structured code, TypeScript type-safety across the application, and comprehensive use of version control.
- Focus on secure data handling, optimisation for large data sets, and low-latency real-time data updates.

Report Criteria

- Provide an extensive analysis of the application design, implementation, and testing process, including data security and optimisation techniques.
- Include a comprehensive commit history with detailed comments, showing professional version control practices.

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Learning Outcomes

This assessment will enable students to demonstrate the following learning outcomes as stated in the module outline:

[Module Learning Outcome 2]

- Explain and apply the principles of server-side architecture, including client-server communication, APIs and web services, with ethical data handling and communication.

How is this learning outcome addressed?

The assessment brief meets this learning outcome by requiring students to develop a full-stack web application where the back end implements a RESTful API and front-end utilises the API via web services.

[Module Learning Outcome 4]

- Solve server-side web development challenges with analytical and creative thinking skills, applying suitable debugging and testing techniques, informed by current research in the field.

How is this learning outcome addressed?

The assessment brief aligns with this learning outcome by tasking students with creating, designing, and thoroughly testing a web application to meet a specific real-world scenario. It emphasises the utilisation of advanced problem-solving skills, analytical thinking, appropriate tools, and consideration of ethical and professional practices throughout the development process.

[Module Learning Outcome 5]

- Design, develop, and deploy server-side web applications, using suitable programming languages, frameworks, and tools, while ensuring data privacy and security.

How is this learning outcome addressed?

This assessment addresses the learning outcome by requiring students to employ various frameworks, libraries, and tools to develop a modern and secure software

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solution. Students are required to plan, develop, and deliver a suitable solution for the given problem scenario, ensuring compliance with relevant standards and regulations including those related to data privacy and security.

[Module Learning Outcome 6]

- Manage your own learning, reflect on experiences to identify areas for improvement, and prioritise ethical and professional development.

How is this learning outcome addressed?

The assessment brief supports this learning outcome by requiring students to manage the design and development of the web application and to document key decisions and approaches in the accompanying report and/or design documentation.

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Regulations, Policies, and Guidelines

Guidance for online submissions

<https://www.stmarys.ac.uk/policies/online-submissions.aspx>

Academic Misconduct

Any submission must be students' own work and, where facts or ideas have been used from other sources, these sources must be appropriately referenced. Please find a link to the academic misconduct policy below:

<https://www.stmarys.ac.uk/policies/academic-regulations.aspx>

Ethics Policy

The work being carried out by students must follow the Ethics Policy. Where there is an ethical issue, as specified within the Ethics Policy, then students will need ethical approval prior to the start of the project. Please find a link to the ethics policy below:

<https://www.stmarys.ac.uk/research/students/ethical-review-process.aspx>

Extenuating Circumstances

The University's Extenuating Circumstances procedure helps students facing challenges in assessment submission. To request an extension or deferment, submit an EC application with evidence. Approved cases will not incur academic penalties. For longer-term issues, contact Student Services. Please find a link to the EC policy below:

<https://www.stmarys.ac.uk/policies/extenuating-circumstances.aspx>

Reassessment

If a student fails to meet the assessment criteria, they may be eligible for a reassessment. The reassessment will follow the same guidelines as the original assessment, requiring the student to reattempt the tasks outlined. Students should review any feedback provided and make improvements to meet the expected learning outcomes. In case of reassessment, it is important to consult with the module convenor for clarity on the areas of improvement and ensure compliance with submission deadlines and regulations.