Department of Electrical Engineering and Electronics

MEng group project (ELEC450)

Project Specification Form 2025/26

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Supervisor: Valerio Selis Assessor:

Project Title: IoT and AI for Assisted Living

Project Specification

A. Project Aims and Objectives: Provide the overall project's aims and objectives.

Create a smart IoT home assistant with AI integration using a minimum of 8 devices including, 5 sensors and 3 actuators integrated with a Web based central interface also with the ability to learn routines using AI to provide information for caregivers, via an app
Use an AI pipeline to learn users daily routine and flag any anomalies
Create an app to provide caregivers and family members real-time alerts
Implement a privacy first protocol throughout the system to ensure security of users data
Achieve continuous monitoring without a critical system fault

B. Project Rationale and Industrial Relevance. Explain how and why the project was devised. E.g. project sponsored by a company or linked to a research project)

This project is at the forefront of its field with the digitisation of healthcare. This opens the possibility for healthcare assistance utilising improved IoT affordability, advancements in edge computing and improved AI routine learning focusing on a privacy first design . There has also been an increase in smart home adoption for those who require additional healthcare assistance whilst maintaining independence.

Compared to already existing products in the market it will excel by taking a privacy first design, edge-inference design, multisensor fusion and a caregiver app that will provide clarity of the actions of the user, in regular and abnormal routines. The project will be modular and scalable , allowing for additional sensors to be incorporated to meet the needs of the user no matter their living situation.

The Industrial relevance spans disability support, age care agencies and healthcare providers, reducing the need for home visits during the current period of carer shortages. False alarms will be reduced, the time for intervention will be minimised through active monitoring and routine learning will directly impact cost and safety.

(if necessary please attach extension sheets)

C. Roles and Responsibilities. Identify respective role and responsibilities, technical and non-technical, of each team member.

Team member	Assigned Role	Key Responsibilities
Daniel Mitchell	Web-based central interface	- Develop browser-based dashboard, incorporating all pathways of project. (data, ML, Actuator response, displays) - Receive data from sensors over WiFi eg. ESP32/ Pi GPIO pins - Configure data storage solutions - Coordinate actuator response using similar means (over WiFi) - Real time processing in cooperation with app
Alvaro Mesa-Giner	AI sensing system	- Designing, training, and optimisation of machine learning algorithms that can learn day to day routines and detect deviations that can be indicative of abnormal behaviour. - Preprocessing and organising multi-sensor data (motion, temperature, door sensors, etc.) to form credible datasets to train and test. - Measuring the algorithm performance in terms of specific measures (accuracy, false positive rate, response time), and improving the models. - Working closely with Mia to make sensor outputs calibrated and usable in the AI processing, with Daniel to incorporate AI outputs into the central interface, and with Luis to make sure that caregiver alerts are activated successfully.
Luis Guillot	App for Carers	- Develop and deploy a mobile app that has a user-friendly and easy-to-use interface as a caregiver.

		- Implement AI anomaly detection to provide real-time notification and alert capabilities, which will allow caregivers to be notified of possible problems as soon as they occur. - Connect the app to the central web-based interface and gateway to enable the flow of data to be seamless and logs of user activity to be securely synchronised. - Put usability and accessibility first, and make sure that the app is easy to use by non-technical users, such as elderly caregivers or relatives. - Apply the privacy-first design of the system (e.g., encrypted communication, authentication) to data security and privacy. - Give caregivers the option to set alerts, see daily activity summaries, and review detailed event histories. - Work with Alvaro to incorporate AI deliverables (e.g., anomaly flags), with Daniel to make sure that the backend communication is stable, and with Mia to make sure that sensor and actuator states are correctly displayed in the app. - Documentation and presentations of support projects, specifically, the preparation of visual demonstrations of the app.
Mia Hornett	Sensor and Actuation System	- Select sourcing and mounting low-voltage sensors and actuators with discrete enclosures - Implementing and standardising firmware ready for use by Dan - Calibrate, debounce and document sensor outputs

		and define fail safes for actuators - Produce and maintain sensors - Work with Alvaro to ensure sensors are calibrated for use in AI systems, work with Dan to ensure sensors are aligned with web-based central interface requirements and Luis to guarantee alerts are related to correct sensors and actuators. - Build prototype home for testing of sensors on a small scale

D. Project Description and Methodology: Provide an overall view of the project with proposed route/s to realisation i.e. what the project aims and objectives and how you are going to achieve them?

This project aims to build a multi-sensor and actuator home prototype and full scale model to communicate via a gateway. The gateway will store events, run AI for routine detection and output actionable alerts via a caregiver app. The data flow is based on a privacy first design.

In order to realise the project fully, existing solutions will be identified, looking at the limitations and opportunities of each. Following this the requirements of carers, individuals and family members will be analyzed. Then a technical specification will be created for sensors, AI, application, actuations and gateway will be released.

Following this the system architecture will be created through block diagrams detailing the links between sensors, gateway, AI, app and actuators. In this stage the communication protocol and data storage protocol will also be specified.

At this point the team will divide into their various tasks which are detailed below, updates on each area of focus will be given on a weekly basis to ensure understanding of the project as a whole by all team members.

Sensors and Actuators (Mia)

- Select and integrate sensors and actuators
- Calibration of sensors and actuators
- Validate accuracy and responsiveness

Web based central interface (Daniel)

- Configure web based central interface to receive sensor data
- Manage input and outputs to the system
- Coordinate actuator response
- Ensure real-time performance

AI Sensing System (Alvaro)

- Design and train algorithms for behaviors pattern recognition
- Anomaly detection
- Evaluate performance metrics

Application (Luis)

- Design and implement a mobile app
- Provide care giver integration
- Prioritize usability, accessibility and security

With each section complete the integration and communication phase can begin. Subsystems will be connected and protocols for real-time monitoring, alerts and data storage can be implemented. At this point the system flow for the alert system can be validated.

Testing and validation will then be completed with the testing of all areas of the system by implementing them on a small scale prototype home, creating a controlled environment to evaluate whether the pre-defined specification points have been me to identify strengths and areas for improvement for the system prior to full scale implementation

Following the test from the small scale prototype the hardware and software elements will be refined to address any issues. Once these issues are addressed a full scale model will be implemented allowing for analysis of the modularity and scalability of the project to be analysed.

All of this will be the culmination of a working small scale and full scale prototype. Test results from both implementations will be presented with particular focus on accuracy, reliability and performance metrics. Accompanying this will be documentation for user operation and data sheets. All this will be presented in the bench inspection, dragons den presentation and final report.

(if necessary please attach extension sheets)

E. Project Tasks and Milestones: Indicate the tasks and milestones to be achieved and their expected dates. E.g. Understanding of theory, designs of circuits, construction of circuits, software specifications, working demonstrations etc.

Tasks

- Define project requirements
- Select components
- Design of circuits
- Construction of circuits
- Develop the app
- Home prototype assembly
- Testing of prototype
- Creation of full scale system
- Liking database and the app
- Testing of full scale system
- Define data requirements and collection strategy
- Collect and preprocess training data
- Develop baseline machine learning model
- Train and evaluate model performance on test datasets
- Optimize model
    - Real-time testing of ML predictions with hardware prototype

Milestones

- 3/10 - Project requirements outlined
- 17/10 - Final sensor and actuator list created
- 31/10 - Initial sensor and actuator testing for compatibility
- 10/11 - Building the app baseline
- 14/11 – Baseline ML model trained and initial accuracy achieved
- 28/11 - Complete circuit design
- 12/12 – Model optimized and validated on test dataset
- 30/1 - All sensors and actuators tested prior to fitting into prototype
- 13/2 - System prototype working
- 27/2 – Final ML model version

- 13/3 - Full scale sensors fully calibrated
- 27/3 – Full system integration: ML + sensors + actuators validated
- 10/4 - Testing completed
- 17/4 - Final demonstration

F. Project Deliverables: Indicate what should be completed at the end of the project. E.g. What will be presented / demonstrated at the final Bench inspection and Dragon's Den pitches.

- Model home with sensor and actuator integration
- Full scale working prototype
- Test evidence – accuracy tables, power profiling, videos of testing
- Comprehensive user manual
- Bench Inspection - Poster, comprehensive presentation, working prototype, video of full scale tests
- Dragons Den Pitch - presentation, business plan
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(if necessary please attach extension sheets)

Student Signature: ____ Alvaro Mesa Giner ___ Date: 30/09/2025

Student Signature: _____ Mia Hornet _____ Date: 30/09/2025

Student Signature: __Luis Guillot Lozano_____ Date: 30/09/2025_____

Student Signature: ____Daniel Mitchell_____ Date:__30/09/25_____

Supervisor's Signature:_____ Date:_____

Please scan the completed form and upload it on Canvas or email Dr M Raja (mraja@liv.ac.uk). Retain a copy for your record.