SiteVisor- Digital Twin Application for Building Monitoring and Asset Management

Project Proposal

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PROGRAMME: HIGHER DIPLOMA IN SCIENCE IN COMPUTER SCIENCE

Project Type
Independent

Project Category
Web App, IoT

Project Overview
The project aims to develop a comprehensive Digital Twin Application for building monitoring and asset management, particularly for offices and industrial sites. The web application will simulate real world objects through a 3D digital twin, enabling users to see the site conditions, manage assets, and streamline maintenance tasks effectively.

The application will allow for sensor integration, employing various protocols like HTTP, MQTT and WebSocket to feed real-time data into the system.

Frontend features
3D environment will be a focal point of the interface and user experience. Most of the interactions will be handled by popup windows over the object in the simulated space. Users will be able to browse through a list of available sensor types and easily add new sensors and devices. Connecting the data streams to the system and configuring the sensor should be done through a set of intuitive settings.

To make the application accessible to non-technical users, they should be able to sketch 2D building plans that automatically generate simple 3D geometries. Additionally, the user can upload their own model in GLTF or OBJ format.

Each user can manage multiple projects, representing different buildings or sites. The platform's asset management capabilities will facilitate maintenance operations by assigning tasks to technicians and setting automatic alerts for equipment issues. Reporting tools will extract data from the 3D environment and sensor data to produce insightful charts and visualizations.

Backend and architecture
The project will incorporate open-source technologies, focus on IoT integration, and utilise Kubernetes for backend deployment, emphasizing security, authentication, and rate-limiting. The system should allow for seamless scaling in terms of the application availability and adding new sensors or devices to the system. To showcase real world integration, a Raspberry Pi 4B with sensors will be used to gather and process the data. RPi 4B will be used as a worker node in Kubernetes cluster.

Technologies, Tools and Frameworks
- IDE: Visual Studio Code
- Version Control: Git, GitHub
- Project Management: GitHub Projects
- Containerisation: Docker, Kubernetes, kind
- Database: MongoDB
- Communication: Kafka, MQTT, HTTP, WebSocket
- Continuous Integration: Jenkins
- Frontend: TypeScript, Three.js, Webpack
- Hardware: Raspberry Pi 4B and sensors/actuators

Project Process

The project will follow an Agile methodology, with sprints planned to deliver iterative and incremental value. The process will involve sprint plannings, reviews, and retrospectives to adapt to changes and continuously improve the project outcome.

GitHub Project board will be created to plan and track your work effectively.

Collaboration and Stakeholders

End-users include environmental engineers, facility managers, and maintenance technicians. Engagement will be through project demos, presentations and a collaborative Git repository.

This Ethics Checklist must be completed for all final year undergraduate, taught postgraduate and research projects in the School of Science and Computing.

View your response(s)

Respondent: **Grzegorz Piotrowski** (Group: CM-HDIPCS) Submitted on: Sunday, 19 November 2023, 5:11 PM

Ethics Checklist for Undergraduate, Taught Postgraduate and Research Projects in the School of Science and Computing

All students in the School of Science and Computing who are either (1) in the final year of an undergraduate/BSc degree, or (2) on a taught postgraduate/MSc programme **must complete this Ethics Checklist before conducting their project** regardless of the project type or discipline. The Checklist should also be completed by anyone (whether staff member or student) conducting a **research project** (whether programmatic or not) within the School.

The purpose of this Ethics Checklist is to **identify projects that will require formal ethical approval** from the School Research Ethics Committee, or the SETU Research Ethics Committee, before they can proceed.

Students/applicants should note that this Ethics Checklist is a **formal declaration**, and great care must be taken to **answer all questions accurately**. Students should consult with their project supervisors/advisors regarding any aspects or questions that they are unsure of before completing and submitting the Ethics Checklist.

Students/applicants must **answer all questions** presented to them until the Checklist questionnaire is completed.

Feedback Report

No human experimentation issues (UG).

No animal experimentation issues (N/A).

No issues regarding the use of human tissues.

No animal tissue or biological fluids issues.

No ionising radiation issues.

No primary data collection issues (N/A).

No underage/vulnerable people issues (UG).

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No issues regarding existing/secondary data use (N/A).

No controversial data issues.

No issues related to the collection of rare or protected plants.

No issues regarding the use of genetically modified (GM) plant material.

Instructions:

1. If the above feedback is **entirely green** then, based on your answers, there is **no need to apply for ethical approval** for your project.
2. If **any** part of the above feedback is **yellow/amber**, then there is at least one issue with your project that needs to be reviewed and **you must apply for ethical approval** to continue your project.
3. If **any** part of the above feedback is **red** then there is a serious ethical issue and **you cannot continue your project** as currently planned.

It is recommended that you print this Feedback Report to a PDF file for your records. You should also forward and discuss this Feedback Report PDF with your project supervisor. They will be able to advise if you have any further questions or if you need to apply for ethical approval.

1 * Are you a student on a **final year undergraduate** programme, a **taught postgraduate** programme, or are you conducting a **research project**?

- (•) Final Year Undergraduate
- ( ) Taught Postgraduate
- ( ) Postgraduate Research Project
- ( ) Other Research Project

2 * What is the **working title** of your project?

SiteVisor - Digital Twin Application for Building Monitoring and Asset Management

3 * Who are the project **supervisors/advisors/principal investigators**?

Colm Dunphy / TBC

4 * Does your project involve **human experimentation**?

( ) Yes (•) No

5 * Does your project involve **live animal experimentation**?

( ) Yes (•) No

(6) * Is the planned animal experimentation limited to **non-invasive procedures only** (such as feeding, weighing, or taking naturally voided faecal or hair samples), and does **not** involve any invasive procedures (such as taking rectal faecal samples or blood) from live animals?

( ) Yes ( ) No

7 * Does your project involve the use of **human** remains/cadavers/tissues/cells/biological fluids/embryos/foetuses?

( ) Yes (•) No

(8) * Do you intend to only use established **commercial human cell lines**, and no other **human** remains/cadavers/tissues/cells/biological

fluids/embryos/foetuses in your project?

○ Yes ○ No

9 * Does your project involve the use of **animal cells, tissues** or **biological fluids**?

○ Yes ◉ No

(10) * Do you intend to only use (1) **established commercial animal cell lines**, or (2) **slaughterhouse-derived tissues/fluids**, or (3) **fluids collected as part of routine animal husbandry** (e.g. milk) and no other animal tissues or biological fluids in your project?

○ Yes ○ No

11 * Does your project involve the **collection of rare or protected plants**?

○ Yes ◉ No

12 * Does your project involve the generation or use of **genetically modified (GM) plant material**?

○ Yes ◉ No

(13) * Do you agree to (1) only use **established genetically modified (GM) plant cell lines, seeds, or plant products** in your project, (2) **not generate new plant mutations** using chemical or other means, and (3) follow specified SETU **containment and use protocols** for GM plant materials at all times?

○ Yes ○ No

14 * Does your project involve the use of **ionising radiation**? (e.g. use of gamma ray spectrometry)

○ Yes ◉ No

(15) * Do you agree to carefully **follow the instructions** of the SETU designated **Radiation Protection Officer (RPO)**, and **adhere to all legal requirements** as set out in the Radiological Protection Act 1991 (Ionising Radiation) Regulations (2019), regarding the use of ionising radiation materials and equipment?

○ Yes ○ No

16 * Does your project involve the **collection of any new (or primary) data** from **individual people or groups**?

○ Yes ◉ No

(17) * Does your project involve the **collection of any new (or primary) individual or group data** that is **personally or uniquely identifying**? (e.g. data about people or organisations/companies/groups that could be used to identify those individuals or groups; data collection might take any form, including internet and social media data, etc.)

○ Yes ○ No

(18) * Will you ensure that participants who you are collecting data from are provided with **fair warning** and must provide **explicit informed consent** for any data collected?

○ Yes ○ No

(19) * Will you ensure that any project-related data collection, data storage, and data use is in **full compliance** with the **EU General Data Protection Regulation (GDPR)** and the **Data Protection Act (2018)**?

○ Yes ○ No

(20) * Does any of the data that you intend to collect include **sensitive or private personal information** about individuals, or **commercially sensitive information** about organisations/companies/groups?

○ Yes ○ No

21 * Does your project involve **persons under the age of 18 years** (i.e. minors), or **any vulnerable groups**? (e.g. prisoners, refugees, those in care, addiction service users, etc.)

○ Yes ◉ No

22 * Does your project involve the use of **existing (or secondary) human data**? (i.e. data originally collected for another purpose)

○ Yes ◉ No

(23) * Is the existing or secondary human data you intend to use either (1) **anonymous/non-personally identifying** and in the **public domain**, or (2) available with **explicit and specific informed consent or permission** for the data to be **legally** reused in the way you intend?

○ Yes ○ No

(24) * Are any aspects of the primary/secondary data you intend to use for the project **controversial** in nature?

○ Yes ○ No

25 * Before you submit the Ethics Checklist, you must **confirm all of the following**:

- ☑ I understand that the Ethics Checklist is a formal declaration.
- ☑ I have answered all questions on the Ethics Checklist carefully and truthfully.
- ☑ The supervisor/advisor (or principal investigator) for the project is present as the Ethics Checklist is being submitted, or they have given me explicit permission to submit it in their absence.
- ☑ I have had adequate ethics training and/or instruction prior to completing the Ethics Checklist.
- ☑ I understand, and agree to abide by, the general ethical principle of "do no harm" for this project.
- ☑ I will follow the instructions given in the Feedback Report.

26 * Authentication Code (ask your project supervisor/advisor for this code)

Enter Student Number:

Enter the Authentication Code below and click "Verify Code" Verify Code

Note: If an INVALID authentication code is used then this submission is NULL and VOID

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