Assessment Brief - Group Report

Module Title: Sensors and Networks
Module Code: ELEE1148
Assessment Type: Group Report (**2 Students** per Group)
Weighting: 30% of total module marks (out of a 100-mark scale)
Pass Mark: 40%
Word Count: 1500 words (excluding front page, appendices, and references)
Submission Deadline: 11.30 pm, Thursday 27th March 2025

1. Assessment Overview

In this coursework, each **group** will consist of **two students**. The group will choose one of the following **sensor types** for their project: **Temperature Sensor, Occupancy Sensor, Light Detector, Chemical Sensor, or Acoustic Sensor.**

You are tasked with **designing and implementing** an **IoT-based sensor network** using the selected sensor. The setup will involve creating a **Wired IoT Sensor Network** where **data** is collected by the sensor, passed through an **Arduino module**, and transmitted to a **computer for visualisation**.

The **sensor data** must be displayed on a **live dashboard**, enabling **real-time monitoring**. Each group can choose a preferred approach for creating the **dashboard** using any **programming language** (e.g., **Python, JavaScript**, etc.) or open-source platforms like **ThingSpeak** or **Grafana**.

This project aims to provide **hands-on experience** in implementing **sensor networks**, understanding **IoT communication protocols**, and building **real-time dashboards**.

2. Group Formation

- **Students will form groups of 2 members.**
- **Each group will select one sensor type** from the available options: **Temperature Sensor, Occupancy Sensor, Light Detector, Chemical Sensor, or Acoustic Sensor.**
- The group will focus on designing and implementing an **IoT-based sensor network** using the chosen sensor type.
- There is **no requirement for comparative analysis** between different sensor types, as each group will work independently on their selected sensor project.

3. Learning Outcomes Assessed

This coursework will assess the **following Learning Outcomes**:

- **LO2:** Synthesize a set of core strategic requirements for implementing a range of secure sensor network system problems and issues.
- **LO3:** Develop a range of implementation strategies for secure sensor networks.
- **LO4:** Constructively criticise and evaluate a range of tools and technologies employed in secure sensor networks.

4. Assessment Tasks

The task requires the design and implementation of an **IoT-based wired sensor network**, along with the creation of a **real-time dashboard** to display live sensor data. The general workflow is structured as follows:

Sensor → Arduino → Computer → Dashboard (programming-based or open-source platform)

Students will be provided with a sensor kit box for conducting the coursework, which must be returned by the day after the submission deadline. Any delay in returning the kit box will result in a delay in the marking process.

Key Elements:

A. **Sensor Selection:**
   One sensor must be selected from the following options:
   - Temperature Sensor
   - Occupancy Sensor
   - Light Detector
   - Chemical Sensor
   - Acoustic Sensor

B. **IoT Network:**
   - The selected sensor should be connected to an **Arduino module** using a **wired connection**, such as USB or serial communication.
   - The Arduino must collect data from the sensor and transmit it to a computer.

C. **Data Transmission:**
   - A communication protocol, such as **Serial Communication** (USB/RS-232), should be used to transmit sensor data from the Arduino to the computer.
   - Additional communication methods, such as **HTTP** or **MQTT**, may also be utilised depending on the chosen setup.

D. **Dashboard Development:**
   - A real-time dashboard must be developed to display live sensor data. This dashboard can be created using:
     - **Programming-based solutions** such as **Python**, **JavaScript**, or **C#**, leveraging frameworks and libraries like **Flask**, **Django**, or **Node.js**.
     - **Open-source platforms** such as **ThingSpeak**, **Grafana**, or **Blynk**.
   - The dashboard should include the following elements:
     - Real-time updates of sensor data.
     - Visualisations such as **graphs, charts**, or **indicators** to present sensor readings.
       - Alerts or notifications when certain thresholds are met (e.g., temperature exceeding a limit, occupancy detected).

5. Structure of the Report

The report must follow the structure of a **technical paper or journal article**, adhering to the **ACM CHI publication format**. The content should include the following sections:

A. Introduction

- **Purpose:** A brief description of the selected **sensor** and the **problem** being addressed.

- **Significance:** An explanation of why the sensor and the **IoT network** are important in the given application.
- **Objectives:** A clear outline of the **objectives** for the IoT-based sensor network and the dashboard.

B. Methodology

- **Sensor Setup:** A detailed description of how the **sensor** was set up and connected to the **Arduino module**.
- **Arduino Configuration:** An explanation of how the **Arduino** collects data from the sensor and communicates with the computer.
- **Data Communication:** A detailed account of how data is transmitted from the **Arduino** to the computer, including the protocols and methods used.
- **Dashboard Implementation:** A discussion of how the **dashboard** was built, specifying the platform or programming language employed.
- **Challenges:** A description of any **challenges** encountered during implementation and the approaches used to overcome them.

C. Implementation & Analysis

- **System Overview:** A detailed description of the complete system, including the **sensor network, data flow**, and **dashboard**.
- **Dashboard Design:**
  - **Screenshot(s)** of the dashboard should be used for explanation in the report, and a **1-minute screen recording** must be submitted along with the final report in a zipped file.
  - An explanation of how the dashboard displays **real-time sensor data**.
- **Results:**
  - An analysis of the **live data** displayed on the dashboard.
  - Evaluation of the **effectiveness of visualisations, data accuracy, and reliability**.
  - Explanation of **signal conditioning techniques** applied, such as filtering, amplification, or noise reduction, to ensure clean and reliable data acquisition.
  - Inclusion of an **Exploratory Data Analysis (EDA)**.

D. Discussion

- **Evaluation:** A critical evaluation of the **system's performance**, including its strengths and weaknesses.
- **Improvements:** Suggestions for potential **improvements** or alternative approaches to enhance the system's robustness.

E. Conclusion

- **Summary:** A summary of the **key points** and outcomes of the sensor network project.
- **Future Work:** Discussion on possible **extensions** or real-world applications of the system.

6. Suggested Topics

Students can choose from the following suggested sensor types for their IoT-based sensor network:

A. Temperature Sensor:

1. **Smart Building Climate Control**
   Design a sensor network to monitor and control indoor temperatures for optimal climate regulation in a smart office or home.
2. **Agricultural Temperature Monitoring**
   Develop a system that tracks temperature variations in agricultural fields and helps farmers maintain ideal growing conditions.

B. Occupancy Sensor:

3. **Office Space Utilisation System**
   Create a sensor network that detects occupancy in office spaces to optimise energy usage and space allocation.
4. **Smart Home Occupancy Detection**
   Design a system that automatically manages lighting, heating, and security systems based on room occupancy.

C. **Light Detector:**

5. **Energy-efficient Smart Lighting**
   Build a lighting system that adjusts brightness based on natural light levels to save energy.
6. **Smart Street Lighting System**
   Develop a smart street lighting network that adapts to surrounding light conditions, improving energy efficiency.

D. **Chemical Sensor:**

7. **Air Quality Monitoring in Industrial Environments**
   Build a system to monitor air quality by detecting harmful gases in industrial environments (e.g., CO, NO2).
8. **Pollution Detection and Reporting System**
   Create a chemical sensing system that detects pollutants in outdoor environments, providing real-time data for environmental monitoring.

E. **Acoustic Sensor:**

9. **Noise Pollution Monitoring**
   Develop an acoustic sensor network that monitors noise levels in urban or industrial areas and alerts users to excessive noise.
10. **Sound-based Home Security System**
    Design a system that uses acoustic sensors to detect sounds indicative of a break-in, triggering alerts in real-time.

Alternatively, students may propose a new topic using the available sensors, subject to approval.

7. Total Marks Breakdown

- **System Design and Architecture:** 30 Marks
- **Implementation (Sensor Network and Dashboard):** 40 Marks
- **Report Structure and Quality:** 20 Marks
- **Presentation and Visuals (Dashboard, Results):** 10 Marks
- **Total: 100 Marks**

8. Marking Criteria (0-100 Marks)

The group report will be assessed across four domains. Marks are distributed within each domain to reflect the expected performance level.

A. Assessment Domain 1: System Design and Architecture (30 Marks)

Marks	Description
0-5	Limited or poorly defined system architecture; lacks key components and design principles.
6-10	Basic design with some key components but lacks proper integration or detail.

11-15	Adequate system architecture with basic integration of components; some important design elements are missing.
16-20	Clear and functional design with well-integrated components and good understanding of architecture.
21-25	Strong system design with careful attention to detail; components are effectively integrated.
26-30	Exceptional system design; advanced understanding and innovative integration of components.

B. Assessment Domain 2: Implementation (Sensor Network and Dashboard) (40 Marks)

Marks	Description
0-8	Minimal or incomplete implementation; key features are missing.
9-16	Basic implementation; limited functionality and data visualisation.
17-24	Functional implementation with basic data flow and some dashboard features for visualisation.
25-32	Well-executed implementation with efficient data communication and effective dashboard with real-time updates.
33-36	Excellent implementation; fully functional, robust system with innovative features and highly accurate data.
37-40	Outstanding implementation; fully optimised, scalable, and innovative solution, with flawless performance.

C. Assessment Domain 3: Report Structure and Quality (20 Marks)

Marks	Description
0-3	Disorganised report; lacks key sections and clarity, significant issues with structure.
4-6	Basic structure: some important sections missing or unclear, lacks coherence.
7-10	Reasonably well-structured with key sections included some minor issues with clarity or organisation.
11-14	Well-organised and clearly written report; demonstrates good technical writing skills with logical flow.
15-17	Strong, professional report; well-supported analysis and good attention to technical detail and clarity.
18-20	Exceptional report structure, clarity, and technical depth; well-written with strong insights and analysis.

D. Assessment Domain 4: Presentation and Visuals (Dashboard, Results) (10 Marks)

Marks	Description
0-1	Poor presentation; lacks key visuals and meaningful results.
2-3	Basic visuals; limited clarity or no meaningful insights from the dashboard results.
4-5	Adequate visuals; basic clarity and communication of results; some meaningful insights shown on dashboard.
6-7	Strong presentation with clear, effective visuals; results are well communicated and meaningful.
8-9	Excellent presentation; insightful visuals with high engagement, and clear communication of results.
10	Exceptional presentation: highly engaging visuals, effectively communicating key insights and results.

9. Final Grade

Grade Range	Description
0-29	**Fail (Minimal Performance)**: Minimal or weak performance, lacking key competencies.
30-39	**Fail (Basic Understanding)**: Basic understanding but insufficient for a pass.
40-49	**Satisfactory**: Satisfactory performance with basic competency in each domain.
50-59	**Good**: Good understanding and performance across most domains.
60-69	**Very Good**: Very good performance, showing consistent strength and competence.
70-79	**Excellent**: Excellent across all domains, with strong depth and insight.
80-100	**Exceptional**: Outstanding and comprehensive performance, displaying exceptional competency.

*Each group's final score will be out of 100 but will contribute **30%** to the total module mark.*

10. Submission Guidelines

- **Report Format**: PDF or Word document.
- **1-Minute Screen Recording**: A 1-minute screen recording (in video format) of the dashboard should be included to showcase the real-time data visualisation.
- **Submission Deadline**: 11.30 pm, Thursday 27th March 2025
- **File Name**: [Student's Surname]_[Student ID]_Sensor_Network_Report.
- **Submission Instructions**: Submit a zipped file containing:
    - The report document (PDF or Word format)
    - The 1-minute screen recording (in video format)

11. Pass Requirements

To pass this assessment, students must achieve a minimum of **40%** on this report. The marks achieved in this report will contribute **30%** to the overall module grade.

Support

Students can seek additional guidance and feedback during lectures, tutorials, labs or by reaching out via email. For any questions related to hardware components, please contact the module leader.

12. Guidelines on the Use of AI Tools

Students may use AI-powered tools (e.g., ChatGPT, GitHub Copilot, or similar) to assist in software design and implementation. However, the following guidelines must be adhered to:

A. **Transparency & Citation** – If AI tools are used for generating code, debugging, or system design suggestions, students must clearly acknowledge and document their use in the report.

B. **Originality & Understanding** – AI-generated content should not be blindly copied. Students must demonstrate a clear understanding of the implementation and be able to explain all components of their system.
C. **Ethical Use** – AI should be used as a support tool, not as a replacement for independent problem-solving. Over-reliance on AI without critical analysis may impact grading.
D. **Security & Accuracy** – AI-generated code must be reviewed for potential vulnerabilities, inefficiencies, and correctness to ensure a secure and reliable sensor network.
E. **Assessment Integrity** – AI-assisted work must align with the learning outcomes. Direct plagiarism of AI-generated responses without modification or understanding will be treated as academic misconduct.

Failure to adhere to these guidelines may result in penalties or deductions as per the university's academic integrity policy.

13. Final Remarks

This coursework provides students with the opportunity to gain practical experience in designing and implementing an IoT-based sensor network. It is essential that students document their methodology and analysis thoroughly. While various tools and platforms can be used, students should ensure that they demonstrate a clear understanding of the underlying principles and processes involved in building such a system.

Good luck with the project!