

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4651
Course Title: Data Communication and Networking II

Summer Semester, A. Y. 2022-2023
Time: 3 Hours
Full Marks: 150

There are **6 (six)** questions. Answer all **6 (six)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

Problem Statement: "Real-time smart sensor-based IoT temperature mapping to address Bangladesh's extreme heat alert of 2024 and AI-powered Mitigation."

-Design a real-time smart sensor-based system to address Bangladesh's extreme heat wave of 2024. The system should use smart sensors to create a real-time temperature map across Bangladesh, analyze data with AI to identify hot zones, and deploy drones and robotic vehicles equipped with water sprayers to cool down these areas.



Your goal is to develop a system that achieves the following objectives:

- **Temperature Mapping:** Create a real-time temperature map across Bangladesh using smart sensors.
- **Hot Zone Identification:** Analyze data with AI algorithms to identify areas experiencing extreme heat.
- **Heat Mitigation:** Deploy drones and robotic vehicles equipped with water sprayers to cool down these hot zones.

Considering the above scenario, answer questions 1, 2, and 3.

1. a) Compare and contrast the roles of temperature, humidity, air quality, and solar radiation sensors in creating a comprehensive understanding of heat stress in Bangladesh in 2024. Explain how these variables interact to influence heat mitigation strategies. 5
(CO1, PO1)
 - b) The key to this solution is accurate and timely data. Explain the significance of selecting sensors with high precision and fast response time for the temperature mapping system. Justify how these factors contribute to the effectiveness of the overall system. 5
(CO1, PO1)
 2. a) Develop an AI algorithm capable of analyzing sensor data to accurately identify hot zones effectively for targeted heat mitigation efforts. Describe how this algorithm can inform targeted heat mitigation strategies using drones and robotic vehicles equipped with water sprayers. Describe the role of AI algorithms in analyzing sensor data. 15
(CO2, PO2)
 - b) Discuss the advantages and disadvantages of using drones and robotic vehicles for water spraying in heat mitigation. Suggest potential challenges you might encounter during deployment, and propose solutions to overcome them. 10
(CO1, PO1)
 - c) Imagine a scenario where some sensors experience data transmission delays. Explain how these delays could impact the system's effectiveness and justify strategies you would implement to ensure reliable and timely data transmission. 10
(CO2, PO2)
- Develop a plan for ensuring reliable power sources and implementing backup systems to maintain continuous data monitoring despite power disruptions in the real-time temperature mapping system.
3. a) Illustrate figuratively basic network architecture for the overall system. Identify the key components involved in data collection, transmission, processing, and visualization. 10
(CO2, PO2)
 - b) Explain the importance of choosing appropriate communication protocols for data transmission in this system. Discuss the key factors to consider when selecting a communication protocol. 10
(CO1, PO1)
 - c) Propose an additional functionality you could integrate into this system to enhance its capabilities beyond heat mitigation. Briefly explain how this new feature would benefit the overall project goals. 10
(CO2, PO2)

Problem Statement: "Designing a Secure Smart Home Architecture with Blockchain and Matter Technology"

-Develop a secure communication system for a smart home network that integrates Blockchain technology, the Matter protocol, and readily available hardware platforms such as Arduino, Raspberry Pi, ESP32, and others. The system should ensure data integrity, privacy, and interoperability among various IoT devices within the smart home ecosystem.



Your goal is to develop a system that achieves the following objectives and constraints:

Objectives:

- **Security:** Design a system that ensures the confidentiality, integrity, and authenticity of data transmitted between smart home devices.
- **Interoperability:** Develop a system that allows devices from different manufacturers to communicate seamlessly, regardless of their underlying protocols (e.g., Wi-Fi, Bluetooth, Zigbee, LoRa, Thread, etc.).
- **Scalability:** Ensure the system can handle a large number of devices and data transmissions without compromising performance.
- **Ease of Use:** Design a user-friendly interface that allows homeowners to manage their smart home devices and monitor their security status.

Constraints:

- **Hardware:** Choose from readily available hardware platforms such as Arduino, Raspberry Pi, and ESP32.
- **Software:** Choose from open-source software and libraries to minimize development costs and ensure compatibility.
- **Power Consumption:** Optimize the system to minimize power consumption to reduce energy costs and extend the device lifespan.
- **Cost:** Design a system that is cost-effective and accessible to a wide range of consumers.

Considering the above scenario, answer questions 4, 5, and 6.

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| 4. a) | Explain the main security challenges associated with data transmission in smart home networks. Explain how <i>Blockchain</i> technology can address these challenges. | 5
(CO1,
PO1) |
| b) | The <i>Matter</i> protocol promotes interoperability among smart home devices. Explain how Matter can be integrated with the proposed secure communication system to ensure seamless communication between various devices. | 5
(CO1,
PO1) |
| 5. a) | Considering the constraints of using hardware platforms, develop a system architecture that incorporates Blockchain, Matter, and these hardware platforms. Briefly explain the functionalities of each component. | 15
(CO2,
PO2) |
| b) | Imagine you are developing a user interface for homeowners to manage their smart homes securely. Describe the key features and functionalities this user interface should offer. | 10
(CO1,
PO1) |
| c) | Scalability is crucial for a smart home system. Explain how the designed architecture can be optimized to handle a growing number of devices and data transmissions efficiently. | 10
(CO2,
PO2) |
| 6. a) | Power consumption is a concern for battery-powered devices. Discuss strategies to minimize the power consumption of the secure communication system while maintaining functionality. | 10
(CO2,
PO2) |
| b) | Cost-effectiveness is a major factor in consumer adoption. Explain how open-source software and readily available hardware contribute to achieving a cost-effective, secure communication system design. | 10
(CO1,
PO1) |
| c) | Identify potential trade-offs between security features and other objectives like scalability and ease of use. Discuss how to achieve a balance between these aspects in the design. | 10
(CO2,
PO2) |