W/D/TY

Reg. No: [redacted]

VIT
Vellore Institute of Technology

Final Assessment Test – April 2025

Course: CSI3032 - Advances in Pervasive Computing
Class NBR(s): 2108/2113/2118 Slot: B1+TB1
Time: Three Hours Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions

(10 X 10 = 100 Marks)

1. A family recently installed a smart home system that includes temperature control, lighting, security cameras, and voice assistants. These devices are interconnected and provide seamless communication and control over various services. **[4+6]**
   a) How does pervasive computing support the structure and functioning of this smart home system?
   b) What are the structural elements of pervasive computing involved in ensuring that the devices communicate and perform their tasks effectively? Explain with neat diagram.

2. A developer is creating a high-performance mobile gaming app that requires real-time graphics rendering and frequent background tasks. However, users report that the game frequently crashes or slows down after extended play sessions. What are the common architectural principles in mobile OS architecture (like Android or iOS) should be incorporated to improve performance?

3. A hiker in a remote mountainous region tries to dial emergency number 112 after a severe injury but receives a "No Network Available" message. However, when he moves a few meters, the emergency call goes through but disconnects after a few seconds. Which 2G technology is used here? Explain its architecture with neat diagram. What technical limitations in this network contribute to call failures in remote areas?

4. A person in distress calls emergency services using a mobile phone. The emergency call is received by three base stations, which measure the signal arrival times as follows: **[4+6]**

   Base Station A (located at (**0,0**)) receives the signal in **2.5** microseconds.
   Base Station B (located at (**1000,0**)) receives the signal in **3.8** microseconds.
   Base Station C (located at (**500,1000**)) receives the signal in **4.2** microseconds.

   a) Calculate the distances of the caller from each base station.
   b) Determine the approximate location of the caller using trilateration.

5. a) A military radar system tracks an incoming enemy aircraft using AoA. Two ground-based radar stations measure the aircraft's signal: **[5+5]**
      Radar A at (0,0) detects an AoA of 30°.
      Radar B at (5000,0) detects an AoA of 50°.
      Determine the aircraft's current coordinates.
   b) A runner uses a smartwatch with GPS to track their running route and speed. How does the smartwatch determine the user's speed and distance traveled using GPS signals? What are the main sources of GPS signal errors in a forested or mountainous area? How does the GPS time synchronization help in calculating position and speed accurately?

6. An e-commerce platform wants to enhance personalization using context modelling techniques across different areas such as product recommendations, customer segmentation, dynamic pricing, and predictive analytics. Given the following use cases, identify the most suitable context modelling technique and explain how it would be represented:

   i. Personalized Product Recommendations: Store user preferences, past purchases, and browsing behaviour to suggest relevant products.
   ii. Fashion Outfit Suggestions: Consider customer preferences, seasonal trends, and fashion categories to recommend outfits.
   iii. Dynamic Pricing Strategy: Adjust product prices based on demand, inventory, and user behavior.

   For each use case model, represent the context using key-value, ontology, and rule-based modelling techniques.

7. Identify and describe various privacy issues in location aware computing system.

8. A student wears a smart ring that tracks their typing speed and accuracy while preparing for an online typing test. **[7+3]**

   a) How does the smart ring use motion sensors (accelerometer, gyroscope) to detect keystrokes? Explain with neat diagram.
   b) What challenges might arise in distinguishing between intentional and accidental finger movements?

9.a) A music streaming app wants to recommend songs based on a user's mood. The system should detect emotions through facial expressions, voice tone, or past listening behavior and suggest playlists accordingly. **[7+3]**

   a) How can affective computing be applied to infer user emotions from facial expressions and voice analysis?
   b) What challenges exist in accurately predicting emotions from user behavior?

OR

9.b) An autonomous vehicle aims to improve driver safety by detecting stress, drowsiness, or distraction using eye-tracking, facial expressions, and heart rate sensors. If the driver appears fatigued or emotionally unstable, the system will suggest taking a break or switch to autonomous mode. **[7+3]**

   a) What affective computing techniques can be used to detect driver emotions in real-time? Explain in detail.
   b) How can computer vision and physiological sensors be combined for accurate emotion recognition?

10.a) A user has multiple smart devices (lights, thermostat, security cameras) from different manufacturers. They want a unified WoT-based dashboard to monitor and control all devices through a web interface, regardless of brand differences. How does WoT architecture enable interoperability between heterogeneous smart home devices?

OR

10.b) Review in detail the challenging issues and solutions in Web of Things(WoT).

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