University of Ruhuna- Faculty of Technology

Bachelor of Information and Communication Technology Honours Degree
Level 2 (Semester II) Examination, November/December 2023
Academic year 2021/2022

Course Unit: ICT2223 Internet of Things (Written) **Duration: 2 hours**

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IMPORTANT INSTRUCTIONS:

1. The medium of this examination is English.
2. This is a closed book examination.
3. This question paper contains **six (06) pages** including this instruction page.
4. This examination consists of **four (04) questions** that are given equal marks.
5. You must answer **all four (04) questions** in this examination.

1)

a) What is ***Internet of Things (IoT)***? What are the ***benefits*** of using the IOT in many fields? Explain the contribution of ***Artificial Intelligence*** to the field of IoT with two (02) key points.

[25 marks]

b) Variety of industries use IoT to operate more efficiently.

i. Summarize ***the generic work flow of the IoT*** system with a neat diagram.

[12 marks]

ii. ***"Smart homes are residences equipped with IoT devices and systems which ensures the quality of life."***
Defend the above statement in terms of "***remote access and monitoring***" and "***energy efficiency***" in smart homes.

[14 marks]

iii. Express two (02) ***IoT challenges*** by considering IoT-enabled healthcare systems as the real-world use case example.

[14 marks]

c) IoT ecosystem simply connects devices, systems and stakeholders to enable a seamless exchange of data and information.

i. Illustrate the ***functional block of IoT ecosystem*** with a neat diagram.

[15 marks]

ii. ***"Smart agriculture uses big data analytics in managing its' IoT operations."***
Do you agree with the above statement? Justify your answer.

[20 marks]

2)

a) Embedded systems and IoT are closely related technologies. Recognize the term "***embedded system"*** with two (02) characteristics of it.

[20 marks]

b) Study the given scenario below and answer the following questions.

Live Wire is a simple device: an electric motor connected to an eight-foot long piece of plastic string. The power for the motor is provided by the data transmissions on the Ethernet network to which it is connected, so it twitches whenever a packet of information is sent across the network. Under normal, light network load, the string twitches occasionally. If the network is overloaded, the string whirls madly, accompanied by a distinctive noise from the motor's activity. Conversely, if no network activity is occurring, an unusual stillness comes over the string. Both extremes of activity therefore alert the nearby human (who is used to the normal behavior) that something is amiss and let him investigate further.

i. Briefly discuss the ***design principle*** used in the above case study when connecting devices.

[10 marks]

ii. According to the above given context, how does the ***"Live Wire"*** design, distinguish between the ***normal network activity*** and ***alert states***.

[10 marks]

iii. Beyond the given scenario, identify how the practical use case of ***"Smart Office"*** can deploy and adapt a connected IoT device like ***"Live Wire"***.

[10 marks]

c) Embedded systems are used wide range of applications for real-time operations.

i. Show the ***components of an embedded system*** with a neat diagram. Hence, interpret the functions of ***A-D converter*** and ***processor*** in an embedded system.

[15 marks]

ii. Briefly explain the two (02) ***types of embedded systems*** which are based on performance and functional requirements with one example per each type.

[20 marks]

iii. List three (03) header files for ***Arduino Ethernet Library*** which are included as preprocessor statements in C codes and provide the functions for Ethernet LAN.

[15 marks]

3)

a) Distinguish between ***sensors*** and ***actuators*** with two (02) key points for each. Hence, discuss a practical scenario where sensors and actuators collaborate to achieve a specific outcome.

[20 marks]

b) Sensors and actuators are essential components of IoT systems that serve different functions.

i. What is the ***need for sensors***? Discuss three (03) ***characteristics of sensors***.

[12 marks]

ii. Demonstrate the working process of IoT communication protocol ***MQTT*** by referring to the given Figure 01 below.

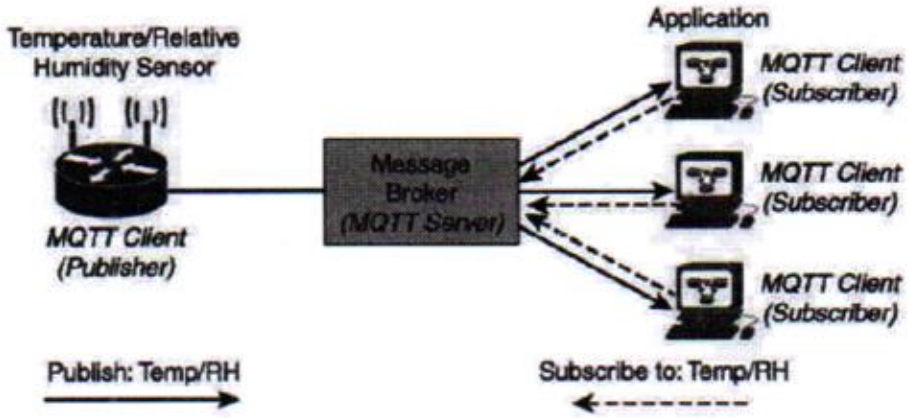

Figure 01

[08 marks]

iii. Differentiate ***pneumatic actuators*** and ***hydraulic actuators*** with two (02) key points and provide one example per each.

[10 marks]

c) Assume that you are going to prototype an IoT-based surveillance camera system for remote construction site that can perform real-time video analytics for security monitoring.

i. Report three (03) ***hardware components*** that can be used to prototype the above-mentioned camera system in 3) c).

[15 marks]

ii. Plan three (03) ***key hardware design considerations*** that can be used for the above scenario in 3) c).

[15 marks]

iii. "***Scalability is a key aspect that needs to be considered in designing IoT devices***". Do you agree with the above statements? Justify your answer.

[20 marks]

4)

a) The Mirai botnet attack happened in 2016. The Mirai botnet attack targeted insecure IoT devices, primarily cameras and routers, and enslaved them into a massive botnet. The botnet was used to launch Distributed Denial of Service (DDoS) attacks, including a notable attack against Dyn, a DNS provider. This resulted in widespread internet outages, affecting major websites and services. The Mirai botnet scanned the internet for IoT devices with known vulnerabilities, such as default usernames and passwords. Once identified, the malware infected the devices and added them to the botnet's network. This happened due to the interconnectivity design of IoT devices which amplifies the impact of breaches. Not only that, but also the attack mainly was launched on unpatched and outdate devices. After the attacks, law enforcement agencies worked to identify and apprehend those responsible for creating and operating the Mirai botnet. The hacker behind the "Anna-senpai" alias later cooperated with law enforcement. IoT

device manufacturers faced scrutiny and pressure to improve security measures, including enforcing unique username and passwords while providing firmware regular updates and patches to address the vulnerabilities. It showed the importance of implementing network segmentations to isolate IoT systems from critical systems.

i. According to the above scenario in 4) a), list three (03) ***IoT security issues*** which caused Mirai botnet attack.

[09 marks]

ii. Give three (03) examples of ***security measures of IoT*** taken to address the risks in above-mentioned attack in 4) a).

[09 marks]

iii. According to the given case study in 4) a), ***security updates*** are of paramount importance in IoT devices and networks. State two (02) reasons why regular security updates are crucial.

[06 marks]

b) In general, machine to machine (M2M) technology plays a vital role in the IoT ecosystem and various industries.

i. Distinguish between ***IoT*** and ***M2M*** technologies with two (02) key points.

[08 marks]

ii. Specify the ***IoT level specification*** for the scenario of deploying the design of the home automation IoT system and model it with a neat diagram.

[12 marks]

iii. Identify which of the following is/are true? In each case, justify your answer.

[06 marks]

a. Time control, meaning data can only be sent or received at specific predetermined periods in M2M networks.

b. Process specification is not the second step to be done in generic IoT design methodology.

c. Controller services are not hosted on device, implemented in Python and they do not run as a native service.

c) The Industrial Internet of Things (IIoT) is the use of sensors and actuators to enhance manufacturing and industrial processes.

i. Briefly outline how ***5G*** can be utilized in ***IIoT*** to enhance industrial process with two (02) key points?

[10 marks]

ii. Consider the following Figure 02:

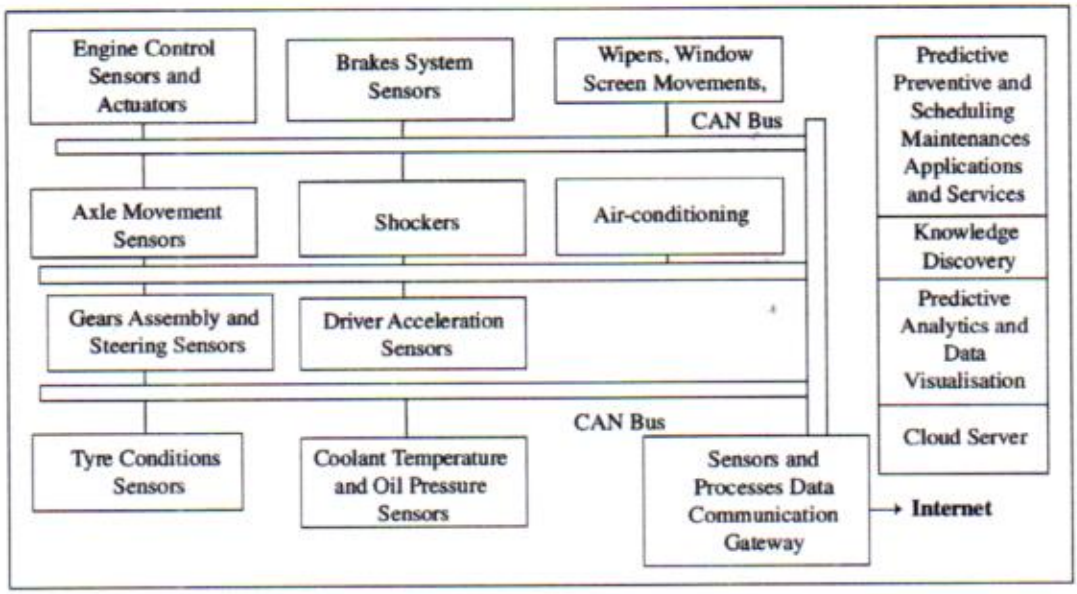

Figure 02: Internet of connected car components for predictive and preventive maintenance of automobile by service center.

According to the Figure 02 given above, briefly cite how automotive IIoT technology is used in ***predictive maintenance of an automobile*** by a service center application.

[20 marks]

iii. ***"IoT isn't just sensors and actuators. It's the power of ideas that delivers useful services."*** Support this statement with two (02) key points and an appropriate example.

[20 marks]

.....End of the paper.....