**Worksheet 3**

**IoT Applications**

**CPSC 3555 - Spring 2018**

Section 1: Read Chapter 15 from the textbook and answer the following questions

1. What was the sample IoT Application the authors were building?

The author’s aim for this example IoT was to design, build and test an environmental-sensing IoT architecture for weather monitoring.

1. What key requirements did the author say was required for the proposed architecture (there are 5)? 1. Hardware must be commodity and available. 2. The software and hardware must be low cost. 3. It must provide enterprise scalability. 4. A minimal level of electronics and computing experience is required. 5. Higher-level programming languages are preferred.
2. What are the objectives when building a prototype? 1. To demonstrate that the scenario concept is viable; to ensure the data collected is appropriate to validate a hypothesis. 2. To test that the hardware will perform as expected; ensuring the data precision and that all the hardware can coexist.
3. What are the three components to the IoT architecture? Briefly explain each. The *sensors* and *actuators* are application-specific and will require some thought to ensure that the data collected meets the accuracy and sampling frequency required for analysis. The *gateway* is responsible for communicating with the sensors and actuators as well as the backend systems. It basically adds TCP/IP capability to sensors, and, although it could be part of a sensor, we separate the gateway to allow a many-to-one mapping with sensors. The *backend* *services* are predominantly used to store the IoT device data but can include additional functionality such as individual device configuration and analysis algorithms.
4. What were the wired gateway interfaces mentioned in the chapter?
5. Inter-Integrated Circuit or Two Wire Interface
6. Serial Peripheral Interface
7. Pulse-Width Modulation
8. Universal Asynchronous Receiver/Transmitter
9. Controller Area Network
10. Analog to Digital-Converter
11. General Purpose Input Output
12. 1-Wire
13. X10
14. What were the wireless gateway interfaces mentioned in the chapter?

Bluetooth Low Energy

1. Ipv6 Low-Power Wireless Personal Area Networks
2. INSTEON
3. Infrared
4. Z-Wave
5. ZigBee
6. Xbee
7. Briefly describe the gateway hardware and software used in the prototype.

The hardware sensors demonstrate a range of common electronic interfaces, and the software stack is chosen to provide maximum flexibility and scalability. Although cloud-based technologies are used, only software which can run both in the cloud and on-site are considered. This provides not only the cost and scalability benefits of a cloud-based architecture, but also the freedom to move between cloud provider and on-site solutions.

Section 2: Read Chapter 16 from the textbook and answer the following questions.

1. What are the characteristics of IoV? Briefly explain each.
   1. Highly dynamic topology – Vehicles move at rapid speeds therefore the topology changes often and this causes network topology to be carefully considered in the development stage
   2. Variable network density – If the network traffic is either very high or extremely slow it may cause the network to disconnect.
   3. Large-scale network – The network expands in larger areas such as cities and highways.
   4. Geographical Communication – Vehicular networks have communication that address where the packets need to be forwarded.
   5. Predictable Mobility – Vehicles must abide by road laws so therefore their mobility is very predictable.
   6. Sufficient Energy and Storage – Nodes in vehicle networks are extremely powerful since they are cars instead of a handheld device.
   7. Various Communication Environments – The two ways networks operate are high traffic scenarios and in the city where they are more complexed compared to the highways.
2. What are the challenges of IoV? Briefly explain each.
   1. Poor Network Connectivity and Stability – With the high mobility, there are frequent network disconnections and many messages are loss
   2. Hard Delay Constraints – There is a delay between when a brake event happens and when the data is sent.
   3. High Reliability Requirements – It is difficult to have high reliability in IoV because of complex network architecture and poor stability of a network.
   4. High Scalability Requirements – Very large nodes and deployment territory would be too much for low scalability which means it would be too much for a low capacity.
   5. Security and Privacy – Security and privacy is not guaranteed in IoV
   6. Service Sustainability – Difficult to have all vehicles adjust to be able to have sustainable services for networks in real-time.
3. Briefly explain at least two applications for IoV.
   1. Driving Safety Related: This application of IoV is for avoid collisions with CCAS(cooperative collision avoidance systems).  This system aids the driver and can hopefully avoid a collision with warning messages of objects nearby.
   2. Transportation Efficiency Related: This application is used for traffic control.  This is done so that waiting time can be reduced and that fairness at traffic stops can be issued.  This is done by a complex algorithm.

Section 3: Read Chapter 17 from the textbook and answer the following questions

1. What are the three steps to management of a smart facility?
   1. Collecting the sensor data that reflects the current state/health of the facility.
   2. Analyzing the sensor data.
   3. Making decisions regarding its management/maintenance.
2. What is a smart facility?
   1. A facility that is equipped with sensors that are connected to the internet and internet passes message and all that data is collected. These sensors can detect failures in the facility as well as prevent them.
3. Briefly explain both case studies mentioned in the chapter.

Case Study Management of sensor-based bridges: In this case study the infrastructure of bridges and keeping up with their maintenance.  In 2009 it was discovered that in the United States over a quarter of the bridges were “deficient or functionally obsolete”.  Therefore, now bridges must be watched constantly and that is what the sensors are for.  A cloud is used to collect data about the bridges and the data is then analyzed using data analysis tools.  To key services are provided and they are on demand which means it is satisfied on a best-effort basis.

Case Study Research Collaboration Platform for Management of Smart Machinery: This case study refers to how resources are located at different geographic locations.  This makes it difficult to do research because the research is collaborative, and the institutions are far from one another.  Therefore, a cloud based platform was created so that the research is easily done and the geographically differences do not hinder the research.