Course Description

CTS2466C | Internet of Things (IoT) Development with C# |4.00 credits

This course teaches the principles of Internet of Things applications development using the C# language. The student will learn how to write programs in C# and deploy the applications to devices running Windows IoT Core. The student will also develop advanced working programs that connect the devices to cloud services. Prerequisite: CEN2211.

Course Competencies:

Competency 1: The student will demonstrate an understanding of Windows IoT Core by:
1. Defining Windows IoT Core
2. Installing the IoT development tools and configuring the environments
3. Installing Visual Studio, setting up for Windows IoT Core development and exploring the project templates included with the software
4. Assembling the necessary hardware to run Windows IoT Core (Such as Raspberry Pi, Minnow Board, Qualcomm Dragon Board) and installing the Operating System
5. Configuring the development board, assembly the circuit and study the pins

Competency 2: The student will demonstrate an understanding of the Universal Windows Platform on devices by:
1. Listing the benefits of the Windows 10 IoT Core and Universal Windows Platform
2. Writing a basic UWP app for the Windows IoT device using C#/XAML using the interactive debugger and deploying a debug build
3. Using the Device Portal and the Windows IoT Remote Client to interact with the development board

Competency 3: The student will demonstrate an understanding of how to write IoT applications using C# by:
1. Comparing C, C++, and C# and listing the advantage and disadvantage of using C# for the Internet of Things
2. Researching the .NET Framework and what is an object-oriented programming language
3. Defining Namespaces, classes and explaining how C# programs are structured, the "using" keyword, inheritance, and the Main Page () Method
4. Describing the types of variables available in C#
5. Demonstrating the use of flow control statements (conditionals and loops) to change the execution of the program
6. Explaining the basic data structures, interfaces, delegates and event handlers
7. Handling C# exceptions to avoid program crashes
8. Coding C# indexers and enumerators
9. Writing a C# program that can blink a LED connected to the development board with a user interface

Competency 4: The student will demonstrate an understanding of Windows IoT programing by:
1. Comparing headed and headless modes
2. Writing a headless application in C# for a development board
3. Using the Arduino Wiring Application to use existing Arduino applications directly in the Windows IoT Core applications
4. Describing asynchronous programming, worker threads and thread pool
5. Writing a program that blinks a LED using the Dispatcher Timer class

Competency 5: The student will demonstrate an understanding of user interface design for headed devices by:
1. Researching about Extensible Application Markup Language (XAML), its advantages and UI design of UWP apps
2. Setting up the environment in Visual Studio

3. Studying the XAML – C# Syntax, the rules for object elements, the visual designer, control declaration, properties and attributes
4. Defining objects, resources, styles, templates, animations and transformations in XAML
5. Illustrating the inheritance hierarchy of controls, the grid, and the layouts in XAML
6. Describing the different events that XAML can handle and the event propagation
7. Using the data binding mechanisms in XAML
8. application to display and interact with data

Competency 6: The student will demonstrate an understanding of how to use MySQL to store data by:
1. Defining MySQL and describe how it works
2. Studying the syntax and the commands available to use in the MySQL client and the structure of the MySQL configuration file
3. Researching about Relational Database Management System
4. Illustrating how and where MySQL stores data
5. Installing MySQL and demonstrating that can start and stop MySQL
6. Creating users and granting them access
7. Setting up a database and writing a program in C# that connects to the database using a library (Such as Connector/ Net) and save information collected from the sensors in the development board

Competency 7: The student will demonstrate an understanding of IoT cloud services by:
1. Researching about the different cloud services available for IoT applications
2. Setting up an Azure account and an Azure IoT Hub
3. Creating a new project in Visual Studio with an Azure IoT Hub Connected Service
4. Writing a program that communicates with Azure and using the Device Explorer to monitor the messages
5. Using the Azure Remote Monitoring Solution to host and present the data sent by the development board

Competency 8: The student will demonstrate an understanding of IoT security principles by:
1. Explaining the cybersecurity goals: confidentiality, integrity, availability, authenticity, accountability, non-repudiation, and privacy
2. Defining the principles of cybersecurity (isolation, encapsulation, modularity, simplicity of design, minimization of implementation, open design, complete mediation, layering, defense-in-depth, Least Privilege, Safe Default/Fail Secure, Minimize Trust Surface, usability, trust relationships, separation of duties) ties)
3. Identifying common IoT security risks, threats, vulnerabilities, attacks and countermeasures

Learning Outcomes:
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Use computer and emerging technologies effectively