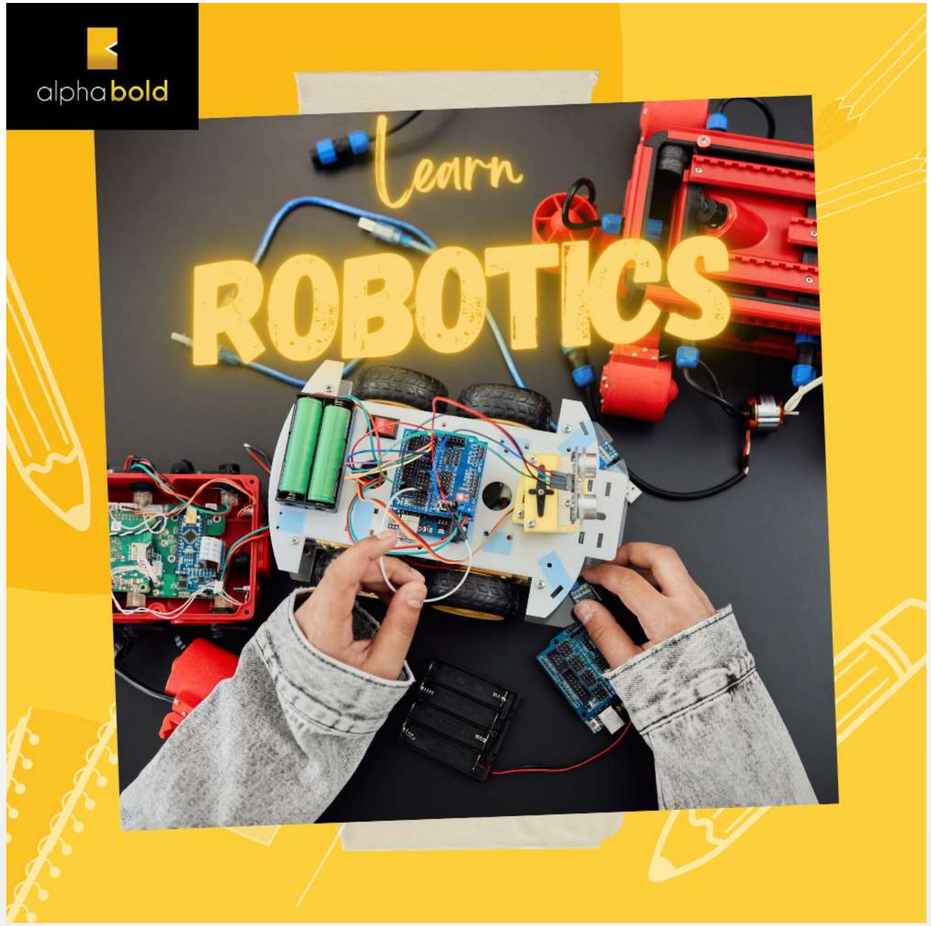
IoT with NodeMCU ESP32 and C++

Internet of Things, NodeMCU ESP32, C++



Learning Pathway: Robotics

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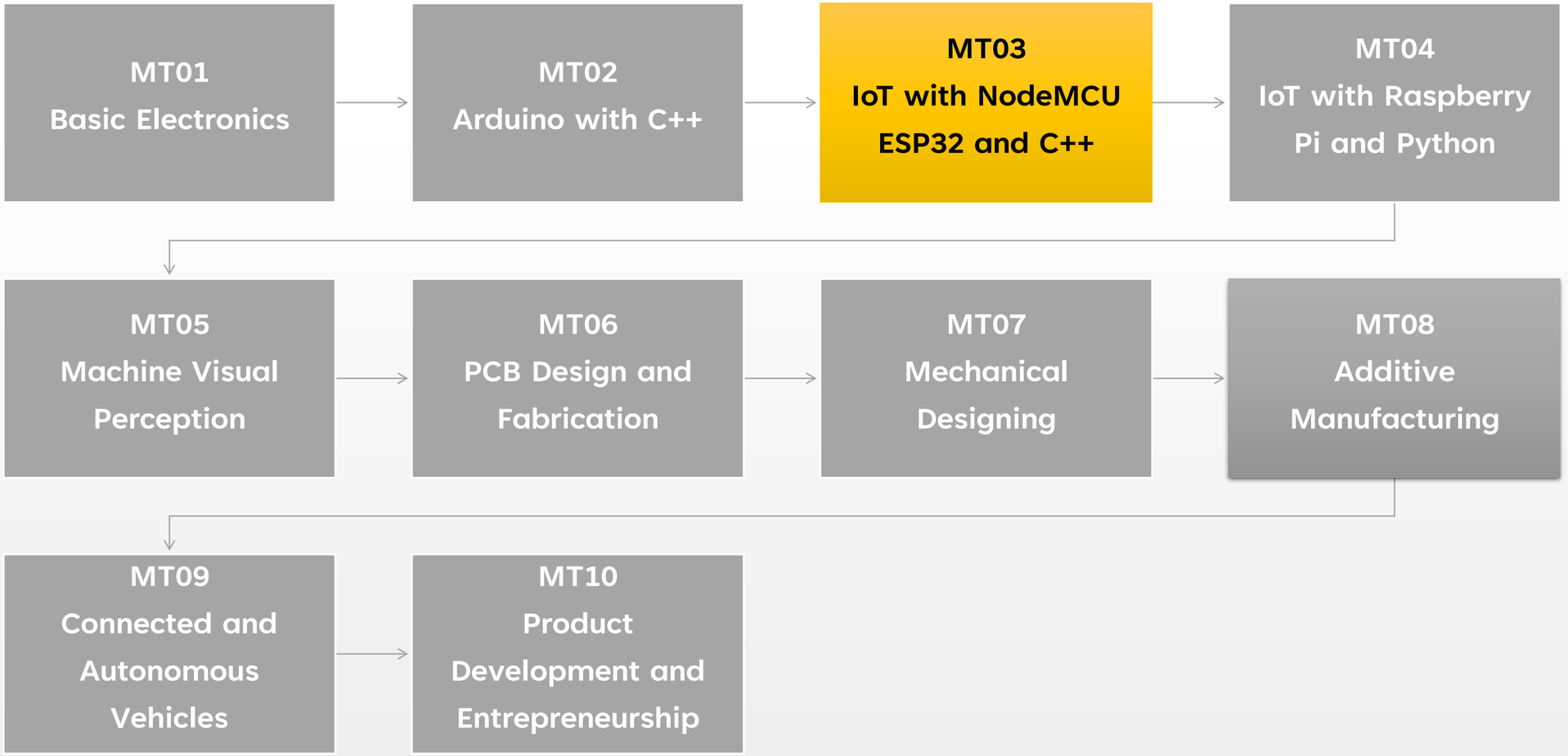

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Course Unit Details

Overview

This course unit introduces the fundamental concepts of the Internet of Things (IoT) and equips you with the skills to develop and deploy your own IoT applications using the NodeMCU ESP32 development board and C++ programming language. Through a combination of lectures, hands-on labs, and projects, you will gain a comprehensive understanding of IoT architecture, data management, security considerations, and practical implementation techniques.

Aims

- Provide a foundational understanding of the Internet of Things (IoT) and its core principles.
- Explore various aspects of IoT system design, data storage, and analytics.
- Equip students with the ability to program the NodeMCU ESP32 using C++ for IoT applications.
- Develop practical skills in connecting ESP32 devices to cloud platforms and data visualization tools.

Learning Outcomes

- By the end of this course unit, you will be able to:
  - Define the Internet of Things (IoT) and its applications across different domains.
  - Explain the key components and architecture of an IoT system.
  - Discuss data storage and analytics strategies for IoT data.
  - Identify and address security and privacy concerns in the context of IoT.
  - Set up and program the NodeMCU ESP32 development board using C++.
  - Interface sensors with the ESP32 to collect analog and digital data.
  - Configure the ESP32 for Wi-Fi communication and develop web server applications.
  - Connect the ESP32 to cloud platforms like Arduino IoT Cloud and Blynk.
  - Utilize Blynk for data storage, visualization, and remote control of IoT devices.
  - Integrate the ESP32 with Firebase Realtime Database for data storage and retrieval.
  - Develop basic data analytics and visualization techniques for IoT data collected by ESP32.

Syllabus

Lesson	Learners Activity
1. Introduction to Internet of Things (IoT)	Understanding IoT Concepts and Applications
2. IoT Architecture and System Design	Understanding components of IoT Systems, IoT Architecture
3. IoT Data Storage and Analytics	Understanding data backup and recovery strategies, data retention policies, Understanding IoT data analysis and visualization concepts
4. IoT Security and Privacy	Understanding IoT security issues and measures
5. Introduction to Node MCU ESP32	Introduction to NodeMCU ESP32, Setting up the NodeMCU ESP32 development board
6. Getting Started with NodeMCU ESP32	**Hands-On Exercise:** Writing Your First ESP32 Program (LED Blink)
7. Exploring ESP32 Analog Input Signals and PWM	**Hands-On Exercise:** Exploring ESP32 Built-in Sensors (Hall Effect, Touch), Analog Potentiometer Input, Analog to Digital Conversion (ADC), and LED Control using Pulse Width Modulation (PWM)
8. Wi-Fi Scanning and Web Server Configuration	Scanning and connecting to Wi-Fi networks in NodeMCU ESP32 . Configuring the built-in Wi-Fi in both Station Mode (STA) and Soft Access Point Mode (SAP). **Hands-On Exercise:** Web Pages to Control LEDs with Wi-Fi in Station and Access Point Modes
9. ESP32 with Arduino IoT Cloud	**Hands-On Exercise:** Configuring Arduino IoT Cloud with DHT11 Humidity and Temperature, Relay and DC Motor
10. Data Storage and Management with Blynk	**Hands-On Exercise:** Implementing data storage and management in NodeMCU ESP32-based IoT projects using Blynk and Arduino C++
11. IoT Automation with Blynk	**Hands-On Exercise:** Home Automation system with ESP32 using Blynk 2.0
12. Firebase Realtime Database	**Hands-On Exercise:** How to save sensor data & read data to control devices?
13. Realtime Read and Write with Firebase	**Hands-On Exercise:** Realtime Read and Write with Firebase
14. IoT Data Analytics and Visualization with NodeMCU ESP32	**Hands-On Exercise:** IoT Data Analytics and Visualization with NodeMCU ESP32 and C++

Course Unit Requirements

Prerequisite Course Unit

- MT02

Background Knowledge

- Familiarity with robotics concepts such as integrating microcontrollers with sensors and motors
- Understanding of programming concepts such as function calls, conditional statements, loops and recursion

Prior Programming Skills

- Language: C++

Software and Packages Required

- OS: Windows
- Arduino IDE

Hardware Required

- Electronic Components:
  - Microcontroller: NodeMCU ESP32
  - Necessary Sensors and Motors
- Computing device with internet connectivity
- Android Phone for App Development

Thank you for learning with alpha bold

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