UNIVERSITY OF DAR ES SALAAM

COLLEGE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

UNIVERSITY OF DAR ES SALAAM ICT STUDENTS' SOCIETY

Arduino programming for IoT industrial applications

COURSE STRUCTURE

Overview

Have you ever wanted to automate industrial processes? Do you get fascinated by how intelligent traffic lights operate to control movement of vehicles adaptively depending upon the traffic load? Together with many other examples, Arduino provides cost-effective and portable platform to address real-world challenges. The platform contains hundreds of open source libraries that you can easily use to write shorter and efficient codes for different interesting electronics projects. Compared with other platforms in the market, Arduino supports several add-on boards that accelerate development of larger projects, including those suitable for practical industrial applications. This course introduces the Arduino platform and provides core concepts you can apply to develop and implement small and advanced projects. The course, in addition, explores the capabilities of Arduino to design and implement Internet of Things (IoT) industrial applications. You will understand how Arduino can be programmed and interfaced with IoT devices that directly or indirectly interact with the real world. The course provides important fundamentals of Arduino to quickly getting started.

Target audience

The course suits hobbyists and practitioners in electronics, telecommunications, computer science, computer engineering, or other ICT-related disciplines. Undergraduate students undertaking final year projects in these fields are highly encouraged to attend the course.

Prerequisite

Anyone with passion to learn the Arduino programming platform can take this course. Participants with basics of electronics and embedded programming (C or C++) may, however, have an added advantage to experience a gentle learning curve.

Objectives

The goal of this course is to equip you with knowledge and practical skills to address real-world problems using the Arduino platform. We will explore the capabilities of the Arduino microcontroller (ATMEGA 328) to create intelligible solutions for pressing societal problems. Moreover, concepts of Internet of Things (IoT) will be introduced to demonstrate how the Arduino microcontroller, as a central embedded system, can be applied to monitor and control industrial processes.

Expected outcomes

Upon successful completion of the course, you are expected to be able to

1. Describe parts of the Arduino board;
2. Explain the internal structure and operations of the Arduino processor (ATmega 328);
3. Use Arduino IDE (integrated development environment) to write and compile codes;
4. Explain roles of Arduino firmware and bootloader;
5. Upload bootloader into the Arduino target chip;
6. Interface Arduino with peripheral devices;
7. Program the Arduino target chip (microcontroller) in C (or C++) to control peripheral devices;
8. Describe current and future trends of Internet of Things (IoT), and give practical applications of IoT in our daily lives; and
9. Implement simple and advanced projects.

Mode of delivery

The course will be delivered in two modes, namely interactive lectures and laboratory practical, respectively taking 30% and 70% of the course duration. Larger part of the course contains hands-on to equip you with necessary practical skills and experience to apply the Arduino platform in your own electronics projects.

Topics

♦ Architecture, components, and real-world applications of Arduino
- Motivations for using Arduino
- Arduino environment (board, IDE, and compatible devices)
- Simulation of Arduino projects
- Industrial applications of Arduino

♦ Arduino interfacing techniques and industrial considerations
- Industrial processes
- Standard circuits for interfacing Arduino with peripheral devices
- Protection of Arduino against industrial hazards

- ♦ Arduino target processor (ATMEGA 328)
  - Physical structure and pinout diagram
  - Registers (e.g., general & special purpose registers)
  - Interfacing techniques
    - ✓ Switches
    - ✓ Displays (e.g., LEDs, LCD, and Seven Segment)
    - ✓ Motors
    - ✓ Sensors (e.g., temperature, humidity, light, and infrared)
    - ✓ Opto-isolators
  - Switch debouncing techniques
- ♦ Arduino programming in embedded C
  - Basic syntax, variables, and types
  - C-Operators
  - Conditional statements
  - C-Functions
  - Coding styles and rules
  - Libraries
  - Typical Arduino C codes
  - Code debugging techniques
- ♦ Internet of Things with Arduino
  - Definition and applications of IoT
  - Advantages, challenges, and future of IoT
  - IoT Devices
  - RESTClient
  - Interaction of Arduino with IoT devices
- ♦ Development of real-world IoT industrial applications with Arduino
  - Setting up the Project development environment (requirements gathering, block diagram development, components selection, and project design)
  - Arduino programs and hardware implementation
    - ✓ Automatic light control system
    - ✓ Wireless lighting system
    - ✓ Distance measurement system
    - ✓ Temperature and humidity control system
    - ✓ Alphanumeric counter
    - ✓ Accurate angular position controller
    - ✓ Home appliances remote controller

Dates & Time

- ♦ 22nd March – 8th April 2021 | 09:00 HRS – 12:00 HRS

Venue

- ♦ CoICT, Kijitonyama Campus, Room D18