EET-1185: SINGLE BOARD COMPUTERS AND APPLICATIONS

Cuyahoga Community College

Viewing: EET-1185 : Single Board Computers and Applications

Board of Trustees:

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Academic Term:

Fall 2023

Subject Code

EET - Electrical/Electronic Engineer

Course Number:

1185

Title:

Single Board Computers and Applications

Catalog Description:

An introductory course on Single Board Computers (SBC) with an emphasis on embedded applications. Topics include standard interface devices like keyboards, High-Definition Multimedia Interface (HDMI), Universal Serial Bus (USB), General Purpose Input and Output (GPIO) ports, conventional serial communications. Communicating with external sensors, like Global Positioning System (GPS), infrared transmission and detection, accelerometers, etc., are discussed from the aspect of programming. Lab work includes use of circuit simulation software.

Credit Hour(s):

3

Lecture Hour(s):

2

Lab Hour(s):

2

Requisites

Prerequisite and Corequisite

EET-1100 Introduction to Robotics or EET-1150 Basic Robotics with Math or departmental approval.

Outcomes

Course Outcome(s):

Write a report on the advance of technology versus the advance of the human condition in historic and contemporary culture using Word or a similar word processing program and use the program's spell check and grammar check features.

Objective(s):

1. Explain what this means: technology is said to be growing exponentially.
2. Predict where the trend of the human condition (ie: starvation, genocide, terrorism, and torture) will lead in the future since it has not been growing exponentially and has in fact more or less flat lined.
3. Explain how third world countries and the marginalized in the United States can benefit from advancing technology.
4. Explain how computer-based automation is eliminating blue collar jobs and provide thoughts on how gainful employment can result or be restored under these conditions.

Course Outcome(s):

Load and install an operating system on a Single Board Computer (SBC) by a Secure Digital (SD) card or something similar, attach monitor and keyboard/pointing devices, and demonstrate functionality.

Objective(s):

1. Load an operating system using its loader into an SBC, connect a monitor and input devices, and demonstrate that the core of the operating system is functional.

2. Demonstrate the operating system's file management system by loading different programs using Universal Serial Bus (USB). Prove the program is loaded by execution.
3. Create folders and files and demonstrate SBC functionality by reading/writing and/or executing loaded programs.
4. Download and test a compiler that will control an SBC.

Course Outcome(s):

Learn and demonstrate programming using some structured language.

Objective(s):

1. Demonstrate by programming and displaying the results of an iteration control statement like a 'while' loop.
2. Demonstrate by programming and displaying the results of a selector statement like an "if / else" statement.
3. Demonstrate by programming and displaying the results of a process statement like printing to the monitor or any other testable statement that is part of a process.

Course Outcome(s):

Connect simple input/output devices, like switches and LEDs, and write a program that demonstrates they can be read or written to.

Objective(s):

1. Connect simple input/output devices like LEDs and switches using plugs and jacks on an SBC.
2. Explain the concept of current, voltage, and resistance (ohms law) and the electrical properties like LEDs and switches and use mathematics to demonstrate current flow and voltage drop(s). Demonstrate with instrumentation like a digital multimeter.
3. Connect an SD card to an internet-connected computer and download the operating system for an SBC.

Course Outcome(s):

Design a program that uses the single board computer to interface to advance peripherals and demonstrate communication with the peripheral.

Objective(s):

1. Write a program that reads or writes to a simple input/output device. Demonstrate by communication or screen message that the communication was successful.
2. Connect more advanced peripheral devices or a microcontroller board that communicates with peripherals like infrared sensors, etc.
3. Write a program that demonstrates communication with peripheral(s).
4. Write a program that causes an SBC to take some specific action resulting from data obtained from a peripheral.

Course Outcome(s):

Demonstrate mathematical skill in converting English and metric measurements of distance and adding and subtracting distance units using fractions.

Objective(s):

1. Convert fractional inches to decimal inches.
2. Convert decimal inches to fractional inches.
3. Convert yards, feet, and inches to metric measurements in meters, centimeters, and millimeters.
4. Convert meters, centimeters, and millimeters to yards, feet, and inches.
5. Convert between measurements of inches, feet, yards, and miles (for example, feet to miles).
6. Convert between millimeters, centimeters, meters, and kilometers (for example, meters to millimeters).
7. Solve for variables in distance calculations: d = r/t

Course Outcome(s):

Measure and demonstrate electrical properties of voltage, current, resistance, power, and energy. Use algebra to find an unknown quantity using ohms law, power laws, etc.

Objective(s):

1. Demonstrate by solving equations the use of a calculator in engineering notation (can use Windows calculator).
2. Explain voltage, current, and resistance using water pressure, water flow rate, and resistance to water flow.
3. Measure voltage, current, and resistance.

4. Explain ohms law and solve for voltage, current, or resistance when given two of the variables.
5. Explain and solve problems for power in direct current circuits using the three power formulas.
6. Explain the relationship between electrical power and energy. Using a residential electric meter reading, convert power usage over time to energy and then calculate the electric bill based on the cost per kilowatt hour.
7. Measure and calculate the power used by a direct current motor like a small robot wheel motor.
8. Explain the energy rating of a battery in milliampere hours (mAH). Using a given current drain, calculate the service time of the battery (how long it can supply power), and given the desired time, calculate the maximum current drain.

Methods of Evaluation:

1. Written reports
2. Connect a single board computer to peripheral sensors and demonstrate communication
3. Write programs that meet the (solve) the problem statement
4. Tests
5. Quizzes
6. Homework

Course Content Outline:

a. Matters having to do with the advancement of technology versus the advancement of the human condition
   i. The effects of computer-based automation and employment
   ii. The importance of continuous education regarding technological advances
b. Introduction to SBCs
   i. Load an operating system
   ii. Connect various input/output devices, like a keyboard and monitor
   iii. Testing operating system functionality
   iv. Create folders and files
   v. Reading/writing and/or executing loaded programs
   vi. Download and test a compiler
c. Programming using a structured language
   i. Iteration control statement like a "while" loop
   ii. Selector statements like an "if" statement
   iii. Process statements
d. Connect input/output devices (other than the monitor and keyboard) to the SBC
   i. Reading switches or similar binary devices
   ii. Illuminating light emitting diodes
   iii. Current flow in an input/output devices
   iv. Voltage drop in an input/output devices
e. Programming
   i. Display data on a monitor
   ii. Connect advanced peripherals like an Arduino controller or infrared device
   iii. Communicate with peripheral components
   iv. Solve a given problem set by programming a SBC
f. Mathematics
   i. Engineering notation
   ii. Fraction to decimal conversion and decimal to fraction conversion
   iii. English to metric conversion
   iv. Metric to English conversion
   v. Conversion within units of the metric system
   vi. Conversion of units within English system
   vii. Distance equation
g. Electrical/electronic components
   i. Voltage, current and resistance, calculation and measurement
   ii. Ohms law
   iii. Power dissipation and equations
   iv. Energy and its relationship to power
   v. Battery ratings and ability to provide electrical power over time

Resources

Richard Blum. *Python Programming for Raspberry Pi.* 1st ed,. Pearson, 2013.

Richard Wentk. *Teach Yourself VISUALLY Raspberry Pi.* 1st ed,. Wiley, 2014.

Carrioe Anne Philbin. *Adventures in Raspberry Pi.* 1st ed,. Wiley, 2014.

Eben Upton, Gareth Halfacree. *Raspberry Pi User Guide*. 2nd ed,. Wiley, 2019.

Sean McManus, Mike Cook. *Raspberry Pi for Dummies*. 1st ed,. Wiley, 2022.

Andrew Robinson, Mike Cook. *Raspberry Projects*. 1st ed,. Wiley, 2021.

Resources Other
None

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