



Course Syllabus
ICT 361-Introduction to Robotics
3 Credits (3 Classroom Credit)

AMERICAN UNIVERSITY
OF PHNOM PENH
STUDY LOCALLY. LIVE GLOBALLY.

School Name: *Digital Technologies*
Program Name: *Degree & Major*
Semester: *Fall 2025*
Class Schedule: *Wed/Fri: (001) 8:30-10:00; (002) 10:15-11:45*
Classroom: *Emerging Tech Lab-Robotic and IoT*
Prof.'s Name: *Mr. SENG Theara*
Degree & Major: *Master in Electronics and Robotics*
Contact Info: *Tel: 098 240 840 Email: t.seng@aupp.edu.kh*
Office Location: *B5-Faculty Reception, Emerging Tech Lab-Robotic and IoT*
Office Hours: *8:00AM-5:00PM*

Note: The syllabus is intended to provide guidance as to students' and the professor's obligations for this course. However, the professor reserves the right to modify syllabus items as needs arise, and students will be notified of any modifications.

Course Description

This course introduces students to modern robotics through the lens of computer vision and AI- powered perception. Using the Mobile Robot and Raspberry Pi, students will explore how robots interpret the world through a camera, and how visual data can be used to drive intelligent behavior and decision-making. Students will build hands-on projects where the robot follows objects, recognizes faces and gestures, reacts to QR codes and markers, and even performs tasks based on visual cues, all without traditional range sensors. The course emphasizes practical implementation, creativity, and real-world relevance in smart robotics.

Table 1: Program Learning Outcomes (PLOs)

PLO Ref. #	PLO Statement
	By the end of the program, students will be able to:
1	Demonstrate advanced knowledge in ICT concepts.
2	Acquire expertise in ICT fields, enabling them to address complex ICT challenges effectively.
3	Develop critical thinking and problem-solving skills, applying them to analyze and resolve complex ICT-related issues and challenges
4	Cultivate effective communication and teamwork abilities, facilitating collaboration and knowledge sharing in multidisciplinary ICT environments.
5	Exemplify ethical responsibility and effective interpersonal skills, enabling them to collaborate professionally and make ethically informed decisions.

6	Excel in quantitative analysis, leverage cutting-edge information technology, and communicate effectively, enhancing their ICT problem-solving and communication abilities.
7	Demonstrate proficiency in executing technical tasks, practical applications, or laboratory experiments relevant to their chosen field of study.

Table 2: Course Learning Outcomes (CLOs)

[All sections of the same course must share the same CLOs.]

CLO Ref. #	CLO Statement	CLO Class	PLO Ref. #
	By the end of the course, students will be able to:		
1	Set up and operate a Raspberry Pi-based mobile robot with an integrated camera.	Knowledge, Skill	1,2,3,4
2	Use OpenCV and MediaPipe to process visual input for object detection and tracking.	Knowledge, Skill	1,2,3,4
3	Implement vision-based navigation, line following, face recognition, and gesture control.	Knowledge, Skill	1,2,3,4,5
4	Integrate robot control logic with real-time camera data for autonomous movement.	Knowledge, Skill	1,2,3,4,5
5	Apply visual marker detection (ArUco, QR codes) to control robot tasks.	Knowledge, Skill	4,5,6
6	Build and present a full robotic system driven entirely by camera-based input.	Knowledge, Skill	4,5,6

Statement of relevance to Cambodia: During the course there will be opportunities to relate the subject matter and assessments to the Cambodian context.

Table 3: Course Assessments

[Use multiple types of assessment and provide rubrics for writing work.]

Assessment Task	% of Course, Grade	CLO Ref. #	Due Session #
Assignment	20%	1,2,3,4,5,6	Check Canvas
Quizzes	10%	1,2,3,4,5,6	Check Canvas
Mini Project	25%	1,2,3,4,5,6	Check Canvas
Midterm Exam	10%	1,2,3,4	Check Canvas
Final Project	20%	1,2,3,4,5,6	Check Canvas
Lab	15%	1,2,3,4,5,6	Check Canvas
TOTAL	100%		

Grading Scale: You will receive a letter grade based on the [AUPP grading scale](#).

Table 4: Course Outline

Session [1.5 hr]	CL O Ref. #	Topic	Lesson Learning Outcome (LLO) The lesson enables students to:	T&L Method	Material
1	1,2	ESP32 Setup	<ul style="list-style-type: none"> - Understand ESP32 hardware architecture - Install and configure ESP32 board support - Set up Arduino IDE environment - Upload and test LED blink program 	Demo + Guided Setup	Canvas, GitHub
2	1,3	Motor & Servo Control	<ul style="list-style-type: none"> - Control DC motors using motor drivers - Operate servo motors - Apply PWM for speed and position control - Test robot basic movements 	Demo + Assignment	Canvas, GitHub
3	1,2, 3	Remote Control (Joystick & Button)	<ul style="list-style-type: none"> - Understand joystick and button interfaces - Read joystick and button inputs - Map inputs to robot motion control - Implement basic navigation logic 	Code-along + Assignment	Canvas, GitHub
4	1,2	Remote Control Lab	<ul style="list-style-type: none"> - Integrate joystick and button for robot control - Test directional movement - Complete LAB 1 tasks - Debug input handling issues 	Mini-lecture + Lab	Canvas, GitHub
5	1,2, 3,5	IR Remote Control	<ul style="list-style-type: none"> - Understand IR remote principles - Interface IR receiver with ESP32 - Decode IR signals - Display IR data via Serial Monitor 	Mini-lecture + Assignment	Canvas, GitHub
6	1,2, 3	IR Remote Control Lab	<ul style="list-style-type: none"> - Use IR remote to control robot movement - Implement command mapping - Complete LAB 2 - Validate robot response 	App Demo + Lab	Canvas, GitHub
7	1,2, 3,5	Dabble Mobile App – Introduction	<ul style="list-style-type: none"> - Understand mobile app control concepts - Interface Dabble app with ESP32 - Read app data via Serial Monitor - Test wireless robot control 	Mini-lecture + Quiz	Canvas, GitHub
8	1,4	Dabble Mobile App – Lab	<ul style="list-style-type: none"> - Control robot using app buttons and joystick - Integrate mobile inputs with motor logic - Complete LAB 3 - Evaluate control responsiveness 	Studio Build	Canvas, GitHub
9	2,3, 4	Radar System – Concept	<ul style="list-style-type: none"> - Understand ultrasonic sensor operation - Control servo motor for scanning - Process distance measurements 	Mini-lecture + Assignment	Canvas, GitHub

			- Explain radar-style visualization concept		
10	3,4,5	Radar System – Lab	- Control servo scanning motion - Read ultrasonic sensor data - Implement radar system logic - Complete LAB 4	Presentation + Lab	Canvas, GitHub
11	2,3,5	Web Server Robotics	- Understand ESP32 web server concepts - Control robot and servo via web interface - Stream ultrasonic data to browser - Test real-time response	Live Config + Lab	Canvas, GitHub
12	1,2,3,5	Web Server Robotics – Lab	- Integrate ultrasonic and servo - Apply color masks for detection - Track moving color objects - Validate system behavior	Demo + Lab + Quiz	Canvas, GitHub
13	2,3,5	Serial Monitor Control	- Use Serial Monitor for data input/output - Parse serial commands - Control robot direction and speed - Debug runtime behavior	Flow Demo + Lab	Canvas, GitHub
14	1,2,3,5	Midterm Assessment	- Evaluate understanding of core concepts - Demonstrate practical implementation - Analyze performance gaps - Reflect on learning progress	Assessment	Canvas, GitHub
15	2,5	Raspberry Pi Setup	- Configure Raspberry Pi OS - Install required libraries - Configure network and IP settings - Prepare Pi for vision tasks	Demo + Assignment	Canvas, GitHub
16	1,2	Finger Count Detection	- Set up camera and web streaming - Use MediaPipe for finger counting - Interpret vision output - Control robot direction using gestures	Mini-lecture + Assignment	Canvas, GitHub
17	2,4,5	Finger Count Detection Lab	- Detect finger count using camera - Map gestures to robot control - Test vision-based navigation - Complete lab tasks	Lab	Canvas, GitHub
18	1,4	Line Detection using HSV	- Understand HSV color space - Detect black line using HSV thresholds - Apply Region of Interest (ROI) - Improve detection robustness	Mini-lecture	Canvas, GitHub
19	3,4,5	Mini Project – Line Following	- Implement line-following logic - Tune sensor parameters - Test robot performance - Document results	Demo	Canvas, GitHub
20	3,4,5	Mini Project – Line Following	- Improve line-following accuracy - Optimize control parameters - Test under different conditions - Record improvements	Demo	Canvas, GitHub
21	3,4,5	Mini Project –	- Validate final line-following system - Demonstrate robustness	Demo	Canvas, GitHub

		Line Following	- Review team performance - Prepare for evaluation		
22	2,3,4	Target Detection	- Detect and track custom objects - Apply bounding boxes - Perform localization - Analyze detection accuracy	Guided Lab	Canvas, GitHub
23	2,3,4	YOLOv8-lite on Raspberry Pi	- Understand YOLO architecture - Run YOLOv8-lite on Raspberry Pi - Interpret detection outputs - Evaluate performance trade-offs	Studio Lab	Canvas, GitHub
24	2,3,4	Mini Project 2 – Vision Robot	- Integrate line following and object detection - Implement QR code recognition - Test system integration - Demonstrate prototype	Demo	Canvas, GitHub
25	2,3,4	Mini Project 2 – Vision Robot	- Refine object detection logic - Improve navigation behavior - Validate QR-based actions - Prepare final demo	Demo	Canvas, GitHub
26	2,3,5	Prototype Verification	- Perform system integration testing - Evaluate performance and reliability - Debug hardware-software interaction - Document test results	Experiment	Canvas, GitHub
27	2,3,5	Prototype Verification	- Conduct end-to-end testing - Analyze failure cases - Improve robustness - Validate design objectives	Experiment	Canvas, GitHub
28	2,3,5	Prototype Verification	- Finalize prototype testing - Confirm system stability - Prepare final presentation - Review design trade-offs	Experiment	Canvas, GitHub
29	1,4,5	Final Project Testing	- Integrate camera, sensors, and motors - Perform unit and system testing - Optimize algorithms - Finalize system behavior	Design Studio	Canvas, GitHub
30	2,3,4,5	Final Project Presentation	- Present final robotic system - Explain design and implementation - Demonstrate functionality - Reflect on learning outcomes	Presentation	Canvas, GitHub

Materials

Required Textbook

- ***Yahboom Education (2023)***. Raspbot V2 Robot: Python and ROS-based Smart Robot Learning Guide. *Yahboom Official Documentation*.

Supplementary References

- ***Wyatt Newman (2017)***. A Systematic Approach to Learning Robot Programming with ROS. *CRC Press*.

- ***Yahboom Education (2024)***. ROS and Computer Vision Tutorials for Raspbot V2. (Available online through *Yahboom Wiki & GitHub*).
- ***Lentin Joseph (2020)***. Robot Operating System (ROS) for Absolute Beginners. *Apress*.

Class Policy

Preparation

While we will have lectures, you are encouraged to be active in your learning and engage your classmates. The required reading may be demanding, challenging, and rigorous. However, we will devote class time to discussion and in-class activities. This will ensure that you maximize your opportunities to ask questions and engage your classmates through group activities. As such, *it is important you do the reading before each class and come prepared to discuss the material.*

Behavior

Professional courtesy and etiquette are required at all times in the classroom. Please respect the right of other students not to be disturbed, distracted, or interrupted in their learning by your behavior. This includes:

- Punctuality reflects that you are respectful of everyone in class.
- Interruptions, private conversation, note passing, and texting are not allowed.
- Cell phones should be turned off or on silent mode.
- Electronic devices will be exclusively used for course related work.
- Participation in class discussion is an essential part of the class.

At the discretion of the professor, violations of the above may result in a penalty such as a grade reduction, being asked to leave class for the day, withdrawal from the course, and/or disciplinary action under the Student Code of Conduct.

Communication

It is essential for students to communicate to the instructor any needs, concerns, or questions as early as possible. I have posted certain office hours when I will be available to meet. If you need to meet outside of those times, you can always contact me for an appointment. Please note that any pertinent issues **MUST** be addressed early in the course before they become a serious hindrance to your coursework. Please do not hesitate to contact me if you have any concerns.

Attendance

Student attendance is essential for maximizing the value of the academic experience. Any student who is absent for 25% or more of class time will fail the class automatically.

Academic Integrity

Academic dishonesty will not be tolerated and is considered a serious offense. Academic integrity is a basic principle that requires all students to take credit only for the ideas and efforts that are their own. For incidents of plagiarism, the student will receive a warning, failure on the assignment, failure of the course, suspension, or expulsion—as determined by the professor and school dean. The professor may set up Turnitin for plagiarism check on specific Canvas assignments.

Students with Disability

AUPP is committed to making reasonable accommodations for students with disabilities. Students with any type of impairment that may make it difficult to succeed in this course are encouraged to inform the teacher as soon as possible in writing or through a private meeting. Any information will be kept confidential. Please note, however, that accommodation can only be granted in cases of a documented disability, and that you must request an accommodation before it can be given on any assignment, exam, or in-class activity.

More policies can be found in the [AUPP Academic and Student Policies & Regulations](#).