

ECE140:WORKSHOP ON IOT FOR DIGITAL SOCIETY

L:1 T:0 P:3 Credits:3

Course Outcomes: Through this course students should be able to

- CO1 :: identify Raspberry Pi architecture, GPIO pin out, and interfaces
- CO2 :: explain GPIO, sensors, camera pipeline, and IoT protocols
- CO3 :: develop & Implement OS setup, GPIO control, sensor interfacing, and cloud upload
- CO4 :: analyze sensor data, waveforms, and vision outputs
- CO5 :: evaluate interfacing methods and edge-cloud architectures
- CO6 :: employ and develop integrated Raspberry Pi-based smart systems

Unit I

Setting up the Raspberry Pi : Downloading the Raspberry Pi Imager, Setting and Updating the raspberry pi OS, Installing RealVNC

GPIO Handling of Raspberry Pi : pin configuration of raspberry pi, switch interfacing with raspberry pi, Introduction to Raspberry Pi, understand GPIO header pin functions, Start with first program (LED blinking), PWM concept and switch interfacing, GPIO electrical characteristics and protection

Unit II

Advanced GPIO & Peripheral Control : Python libraries: RPi.GPIO, GPIO Zero etc., Interrupt-driven GPIO programming, Motor control using H-bridge and motor driver ICs, Servo and stepper motor control with acceleration profiles, Real-time GPIO control using DMA

Unit III

Sensor Systems & Data Acquisition : Digital and analog sensor interfacing using ADCs, Analog sensors interfacing (like Gas, temperature, humidity, pressure, proximity sensors etc.), Low-power sensor operation strategies, Data filtering techniques (moving average, Kalman filter)

Unit IV

Camera interfacing & Computer Vision : Raspberry Pi camera architecture, setting up raspberry pi camera, Camera pipeline and ISP fundamentals, OpenCV installation and usage, Image preprocessing and enhancement, Face detection and recognition, Object detection using deep learning models, Video streaming over network

Unit V

Serial Communication & Industrial Interfaces : serial communication protocols (UART, I2C, SPI), Bus arbitration and addressing, Protocol analyzers and debugging, Interfacing industrial modules (Modbus, RS485), I2C LCD and OLED displays interfacing, High-speed data logging systems

Unit VI

IoT Cloud & Edge Integration : IoT architecture and protocols (MQTT, HTTP, CoAP), Cloud platforms: ThingSpeak, AWS IoT, Azure IoT Hub, REST API integration, Real-time dashboards and visualization, Edge computing vs Cloud computing, OTA (Over-the-Air) firmware update

List of Practicals / Experiments:

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- upload sensor data on the thingspeak IOT cloud
- RTC interfacing with raspberry pi
- System Temperature monitoring with raspberry pi
- M2M communication between Raspberry Pi and Arduino
- Camera interfacing and image capture with raspberry pi
- Face detection using OpenCV with raspberry pi
- Google Firebase based IoT application with raspberry pi
- MQTT-based data publishing with raspberry pi

- MQTT based IoT application with raspberry pi
- LCD interfacing using STM32

Text Books: 1. RASPBERRY PI COOKBOOK by SIMON MONK, O'REILLY

References: 1. PYTHON FOR EVERYBODY: EXPLORING DATA USING PYTHON 3 by CHARLES R. SEVERANCE, SHROFF PUBLISHERS & DISTRIBUTORS PVT. LTD
2. FUN WITH RASPBERRY PI by JOAQUÍN SALGADO, BPB Publication, New Delhi