Workshop
on

PIC18F MCU based Product Development & Embedded Systems Design

Workshop Highlights:

- Hands-on Experience in Embedded Product Development with PIC18F MCU.

- Programming using Professional Embedded Programming Standards.

- Efficient utilization of PIC18F MCU features for Product Development.

- Interfacing I/O devices, Sensors and Peripherals with PIC18F MCU.

- Understanding Communication Protocols of PIC18 MCU.

- UART based Communication modules Interfacing with PIC18F MCU's.

- Interfacing of DC, Servo and Stepper Motors and their Integration in products.

- Arduino Uno/Nano and ESP32 Programming using Arduino IDE.

- Expert guidance on selecting Mini and Final Year Academic Projects .

- Hands-on training on Kits to be used for self learning of Embedded Systems.

- Career Guidance in Embedded Systems, Automation & Robotics.

- Participation Certificate for attendees.

Workshop Objective

   This workshop provides a comprehensive, hands-on approach to Embedded Product Development using PIC18F MCU, along with insights into Arduino & ESP32. It goes beyond the standard syllabus by covering essential aspects of Embedded System product development through hands-on prototype development of **'Cold Room Controller'** throughout the workshop. The key concepts and implementations demonstrated with PIC18F MCU will be fully applicable to Embedded Product development with other MCUs as well.

Key Topics Covered:
- **Structure of a Professional Embedded Systems Program.**
- **Embedded Programming Standards** - Understanding best practices for variable declaration, operators assignment, memory allocation, conditional loops, etc.
- **State Machine/Process Control Loop Development –** Fundamental programming techniques for embedded product development.
- **Efficient Use of MCU Features –** Using Interrupt Service Routines (ISR), Timers, Counters, EEPROM, PWM and MCU features to it's maximum potential.
- **Practical Hardware Implementations –** Implementing key concepts such as:
  . Debounce-proof switches and using latch ICs for I/O pin expansion.
  . Managing sourcing/sinking current limits effectively.
  . High-frequency switching multiple-Seven Segment Displays for displaying Data
  . Entering Setpoints and multiple other parameters using 4x4 Keypad.
- **Communication Protocols and IoT Applications –**
  . Using UART for communication between PIC18F MCUs and external devices such as Computers, GSM/GPS modules and other UART compitable devices.
  . Introduction to other Serial/UART related protocols such as CAN, LIN, Modbus, etc. and their applications in Automotive, IoT devices, and Industrial Automation.

 Further, along with PIC18F MCU this workshop will also cover below:
  . Hands-on programming on Arduino Uno/Nano and ESP32 for quick prototyping and building IoT based applications.
  . Provides valuable guidance for selecting academic mini and final-year projects, helping participants to select PIC18F-based MCU projects that align with their syllabus and also gives them an opportunity to work on MCUs and Compilers which are professionally used to build Embedded Products.
  . Gives insight into promising careers in the field of Embedded Systems, Industrial Automation and Robotics. And, also convey them that how does learning PIC18F MCU and Embedded Systems thoroughly will make them eligible to pursue careers in the field of Embedded Systems, Industrial Automation and Robotics and excel in them.

Conclusion:
By the end of this workshop, participants will gain the practical skills and confidence to independently implement Embedded Systems concepts, successfully complete their Academic Projects, and pursue self-driven learning in Embedded Systems. This hands-on experience will help students to seek and excel in their careers in Embedded Systems, Industrial Automation and Robotics.

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Workshop Contents

Day 1(6 hrs Approx.):

'Cold Room Controller' Prototype Development with PIC18F MCU.

We will be covering this by undertaking a prototype development of a product **'Cold Room Controller'**. It is Micro-controller based device used to control a single Room or a Chamber in a Cold Storage. This Controller maintains Room Temperature by controlling Coolant Valves and Fans. And, also displays Temp., logs Data and takes care of various other tasks. Below is the sample Picture of **'Cold Room Controller'**.

As we develop the prototype we will be covering below topic:

1. Introduction to PIC18F MCU Architecture and it's various features.
2. Revise basic concepts like Digital I/O to control Valves, Buzzers and other I/O devices in the Cold Storage Rooms.
3. Using In-built ADC to interface various sensors used in Cold room to sense Temperature, Humidity, Ammonia and other Coolant Gas Detect sensors.
4. LCD and 4x4 Keypad Interfacing. Using Keypad for entering Temperature and Alarm Setpoints parameters and storing them in EEPROM to retain them.
5. Writing a Main Process Control Program that drives the product to meet it's objectives of maintaining Room Temperature, controlling Fans, Valves and Alarms .
6. Using Timers, Interrupts, ISRs and other MCU features to write robust Embedded Software program to make the Controller more robust. .
7. Interfacing multiple Seven Segment Displays(SSDs) for displaying Temperature and status of various other parameters.
8. Implementing UART based Serial Communication for logging Temperature and other sensors data serially into PC.
9. Interfacing of GSM module to log data and add IoT feature to the Product.
10. Implementing Digital I/O along with PWM to drive DC, Stepper and Servo Motors for precise control of valves and other motion Control Applications.

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Workshop Contents

Day 2(6 hrs Approx.):

Programming Arduino Nano and ESP32 using Arduino IDE .

We will be learning hands-on using of Arduino IDE to program Arduino Nano and ESP32 MCUs.

1. Introduction to Arduino IDE and various MCUs that can be program using it.
2. Interfacing of LED's, 16x2 LCD, Digital Buttons, Buzzer and Potentiometer with Arduino Uno and ESP32.
3. Interfacing of RTC, SD card and GSM module with Arduino Uno and ESP32. for hands-on Implementing of UART, I2C and SPI communication protocols.
4. Interfacing of DC Motors, Servo Motors and Stepper Motors with Arduino Nano/Uno & ESP32.
5. Using Arduino platform for quick Prototyping of various other Embedded products.

Day 3(6 hrs Approx.):

Insight on Embedded Systems role in Industrial Automation.

1. Introduction to PLC/Robot programing and it's foundation in Mico-controllers.
2. Industrial Motion Control Devices such as VFD, Servos and Steppers Motors.
3. Precise control of Motion Control Devices and their similarity with Micro-controller driven small DC, Servo and Stepper Motors.

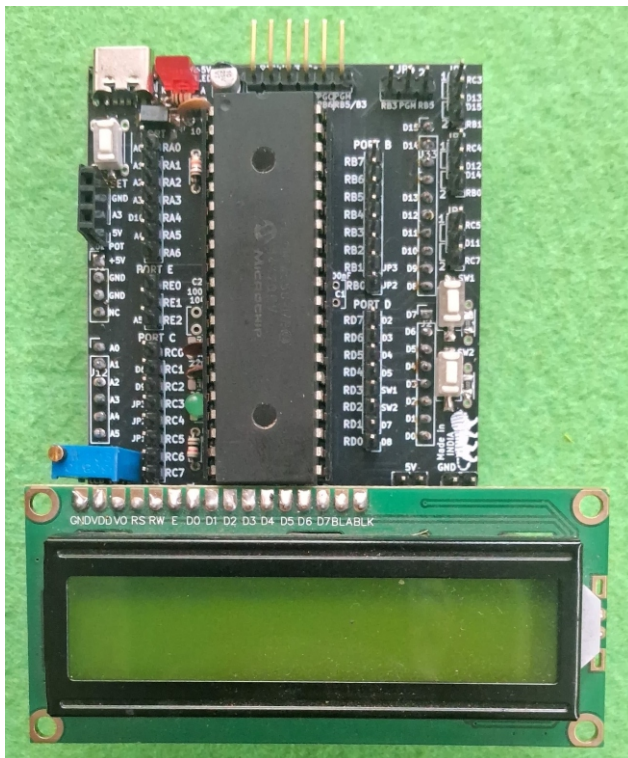### Discussion on Various Project Titles for Mini & Final Year Project.

Discussion regarding various other similar Project Titles similar to that of **'Cold Room Controller'** that aligns with Industrial Automation and Embedded Product Development.

Workshop Fees and other Details:

- Workshop Fees: 5000 Rs per day.

- Kits needed for the Workshop will be provided and kits in college will be also used.

- 10 set of kits will be provided. Approx. number of students should be 30 forming 10 groups with 3 students per group.

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Development Boards to be used in Workshop.

1. PIC18F/16F Mini Development Board

2. PIC18F/16F Development Board

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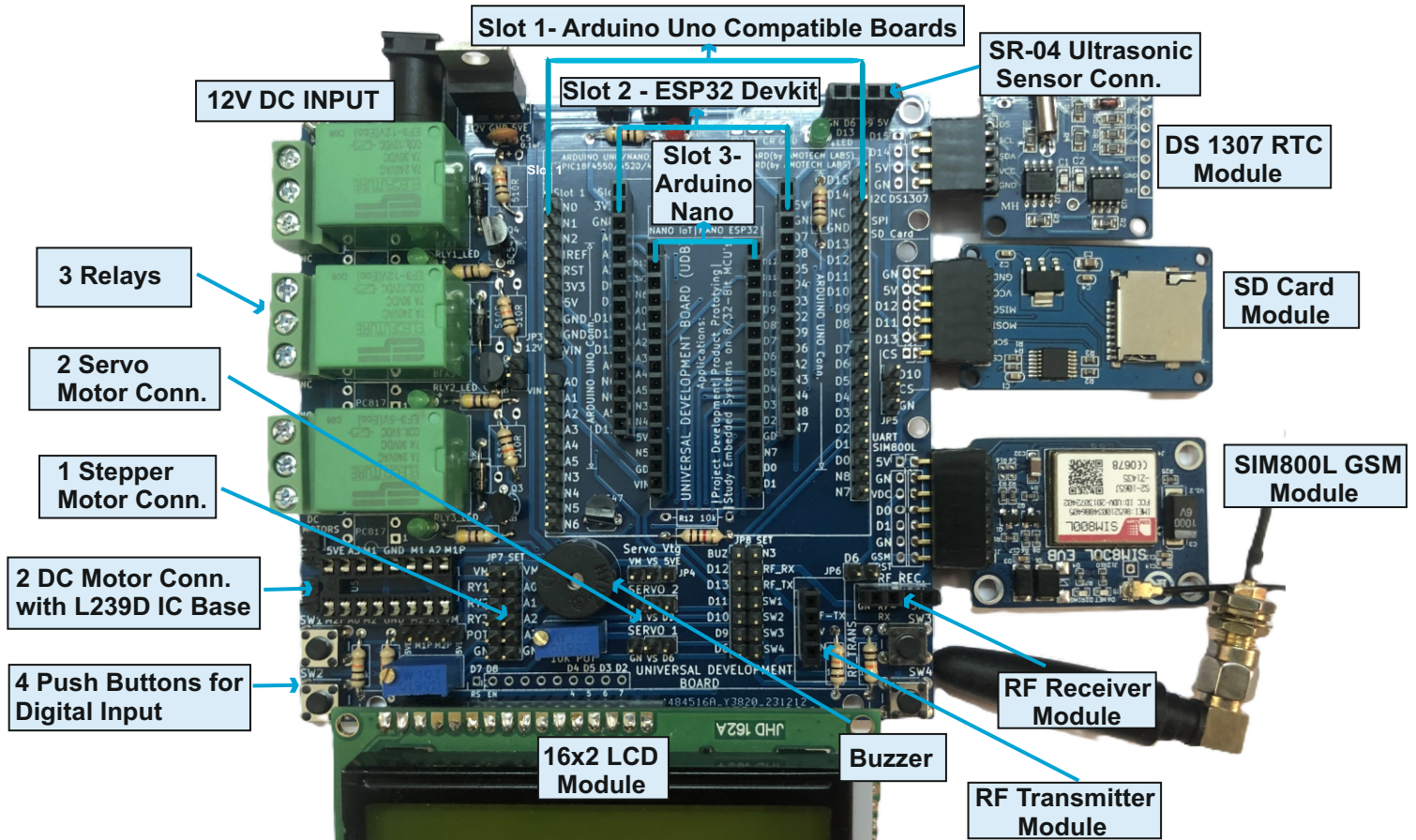www.amotechlabs.com   B +91-8329537565   M amotechlabs@gmail.com
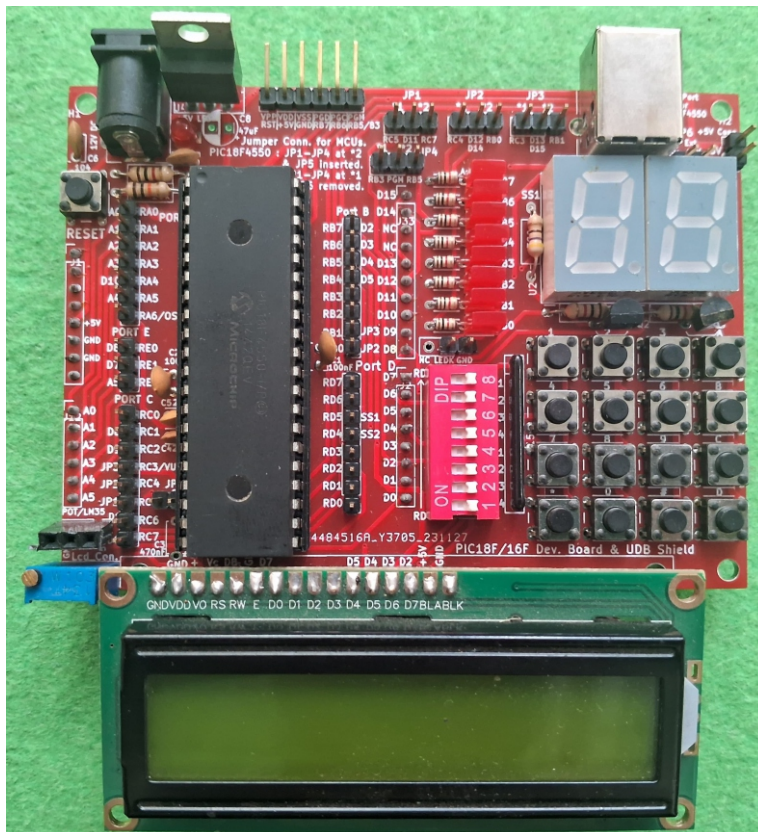
3. Universal Development Board**(UDB) kit**

One Kit for

Studying Embedded Systems | Project Development | Product Prototyping

on below multiple 8 & 32-Bit Microcontrollers

8051 Shield | PIC18F/16F Shield | Arduino Uno | ESP32 Devkit V1 | Arduino/STM32 Nano Boards

Slot 1- Arduino Uno Compatible Boards

Slot 2 - ESP32 Devkit

Slot 3- Arduino Nano

12V DC INPUT

SR-04 Ultrasonic Sensor Conn.

DS 1307 RTC Module

3 Relays

SD Card Module

2 Servo Motor Conn.

1 Stepper Motor Conn.

SIM800L GSM Module

2 DC Motor Conn. with L239D IC Base

4 Push Buttons for Digital Input

RF Receiver Module

16x2 LCD Module

Buzzer

RF Transmitter Module

Develop any Embedded/IoT Project or Product Prototype on UDB by including below Modules & Shields:

UDB + Arduino Uno **UDB + ESP32 DevKit V1** **UDB + ARDUINO/STM32 Nano** **UDB + 8051/PIC Shields**

(All Arduino/STM32 Nano boards) (Made by Amotech Labs)

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