Industrial Applications of Microcontrollers – A Practice Based Approach

TASK – 1

Assume you are an embedded engineer tasked with designing a smart environmental monitoring system. To ensure the project is well organized and all components are accounted for, prepare a table listing the components, their functions, estimated costs, and the microcontroller(MCU) to be used.

Submitted By – Kumkum Shadangi

Roll No. – 23BEEN0024

Department of Electronics and Communication Engineering

JECRC University

SMART ENVIRONMENTAL MONITORING SYSTEM

A smart environmental monitoring system (SEMS) is a network that typically include sensors, data processing units, and communication networks to collect, analyse, and transmit data on various environmental parameters such as air quality, temperature, humidity, water quality, noise levels, and more. It uses advanced technology to track and manage environmental conditions in real time.

The system typically consists of:

1. Sensors and data loggers to collect environmental data
2. Communication networks (wireless or wired) to transmit data to a central hub
3. Data analytics software to process, visualize, and interpret the data
4. Decision-support systems to provide recommendations for environmental management

SEMS can be used at a lot of places like industries for monitoring emissions and waste and disposal management; agricultural sector for monitoring humidity, temperature, soil moisture content; natural reserves for monitoring weather, etc.

With the use of advanced technologies, SEMS can help create a more sustainable and environmentally conscious future along with being cost efficient and making management easier.

COMPONENTS FOR THE SMART ENVIRONMENTAL MONITORING SYSTEM

Below is the list of essential components, their functions , estimated costs , communication interface and power supply requirements.

Component	Function	Communication Interface	Power Supply Requirements	Estimated Costs
MCU (ESP32)	It is the central unit for processing data and managing the network.	UART, I2C, SPI, GPIO, WiFi, Bluetooth	3.3V – 5V	$3 - $10
Temperature Sensor (DHT22)	Measures temperature	Digital [1 Wire]	3.3V – 5V	$1 - $3
Air Quality Sensor (MQ-135)	Check quality of air and detects particulate matter and pollutants.	Analog	5V	$10 - $ 50
Water Quality Sensor(pH and TDS)	It checks Ph, Turbidity, etc.	Analog	5V	$10 - $50

Humidity Sensor (DHT22)	It measures relative humidity	Digital [1-wire]	3.3V -5V	$1-$3
Light Sensor (TSL2591)	Measures light intensity	I2C	3.3V	$1- $2
Noise Sensor (MAX4466)	Measures sound levels (decibels)	Analog	3.3V – 5V	$5 - $10
Display	For showing information	I2C, SPI	3.3V- 5V	$5 - $15
GPS Module (NEO – 6M)	Provides location and help in mapping	UART	3.3V- 5V	$10- $20
Data Storage (SD Card Module)	Store data	SPI	3.3V-5V	$5-$10
Miscellaneous (Resistors, Capacitors, etc.)	Extra components	N/A	N/A	$2-$5
Power Supply	Provide power to the system	N/A	5V	$5-$20

- **MCU – ESP32** is a microcontroller that is powerful because it is integrated with Wi – Fi and Bluetooth and it supports multiple sensor inputs and has sufficient processing power (dual- core 32-bit processor and clock speeds up to 240MHz).
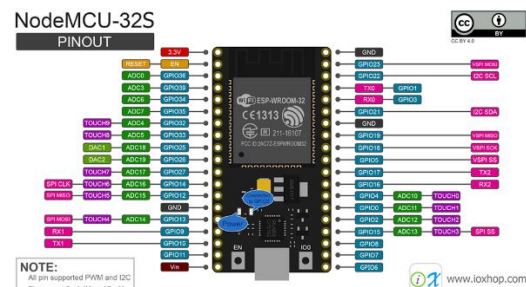
- It consumes less power thus is suitable for battery operated or solar operated systems.

- It has multiple Analog to Digital Converters Channels which are essential for reading various analog signals from environmental sensors.