IOT BUILDER

MODEL- IOTBLD100

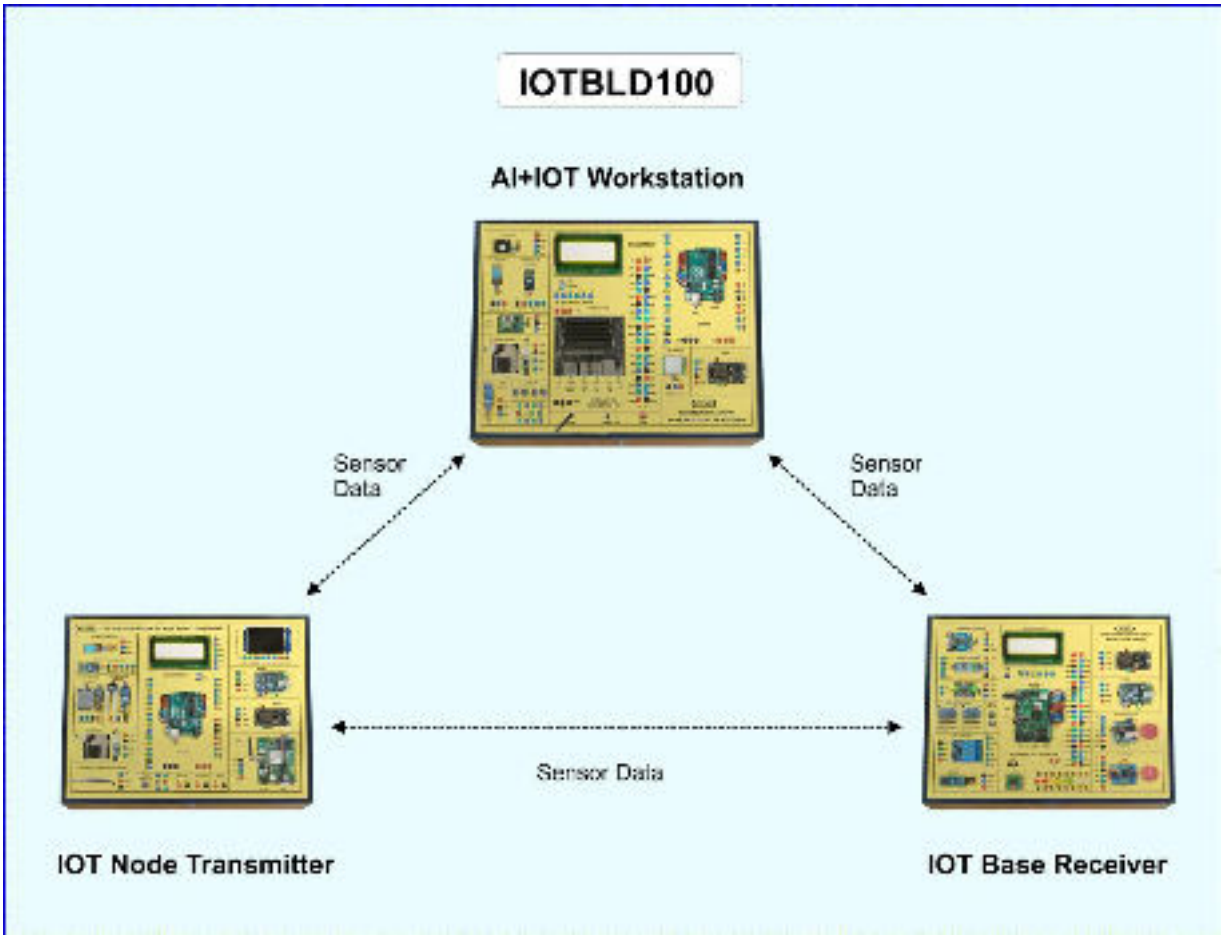
This trainer has been designed with a view to provide practical and experimental knowledge of Internet of Things (IOT) and Artificial Intelligence (AI) with Sensors with hardware and software programing.

IOT means Internet of Things, where things are objects, animals, people or Car, AC, Fan, TV, Fridge, Washing machine, Lights etc. IOT is a technology to sense and measure different data and parameters of different things as above and then to control and monitor them automatically as per our requirement. The things are provided with unique ID and their data is transferred on Internet. The things talk with each other with M2M - Machine to Machine communication.

SPECIFICATIONS

This trainer consists of 3 Boards as below.

1. IOT Node Transmitter
2. IOT Base Receiver
3. AI + IOT Workstation

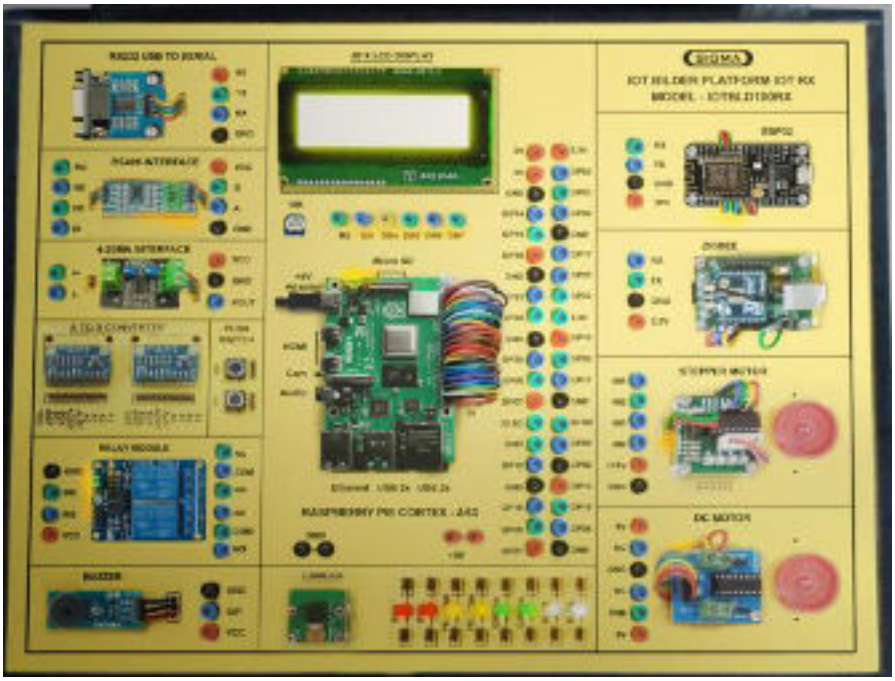


IOT Builder

This trainer consists of 2 Boards as below.

1. IOT Base Receiver
2. IOT Node Transmitter

1. IOT Base Receiver



Hardware

A. Microcontroller

1. Raspberry Microcontroller Board Pi 3.0 B+
2. Processor : Cortex-A53 (ARMv8) 64-bit Soc @ 1.4GHz,
3. Memory : 1 GB RAM
4. SD Card : 32GB SD Card External
5. Operating System : Open Source Linux porting
6. Programming Languages : C, C++ and Python Programming
7. Coding : Qt IDE based GUI development
8. Communication

   Ethernet : Gigabit Ethernet Rj45

   Wifi : 802.11 b/g Wireless LAN (Wifi) Dual-Band 2.4/5.0 GHz, 3G

   Bluetooth : Bluetooth 5.0

   Communication Protocols : I2C interface

   SPI interface

   RS485 interface
9. USB Interface : USB HID and CDC Interface - USB 2.0 – 2 Ports
10. Display and Audio : HDMI Output Interface port

11. Color TFT LCD : 1.77 Inch
12. Power : 5V, 2A DC

B. Other Parts

1. A to D Converter - ADC : 8 Nos.
   Voltage inputs : 1 Channel Resistance Input
   1 Channel 4-20mA Input
   6 Analog Voltage inputs,
   4 digital outputs
   I2C Channel – 1 No.
2. Stepper Motor with Driver PCB : 1 No
3. DC Motor with Driver PCB : 1 No
4. RS232 Serial to USB Converter Interface Module - USB and TIL interface
5. RS485 Interface Module : 1 No
6. 4-20mA Interface Module : 1 No
7. Camera Module : CAM Camera
8. Relay Module : 2 Channel
9. Audio Buzzer : 5V, 3 Pins
10. LCD Display : 20 X 4
11. Push Switch Interface : 2 Nos.
12. LED Interface : 8 Nos
13. Bluetooth Module : 1 No
14. IoT Node - Wireless 2.4GHz Zigbee Module
    with USB Port as an End Device, Coordinator and Router with 6 Sensors Input Node
15. IoT Node : Wireless 2.4GHz Wifi Module – ESP32
16. GSM IoT Gateway :
    Quad-Band 850/900/1800/1900 MHz with GPRS multi-slot class
    2G Modem with USB interface and GPRS enabled. Modem can be controlled via AT Commands. The user can make voice call, SMS and send data through Embedded TCP/UDP and HTIP protocol for loT Gateway
17. 2 mm interconnection Sockets and connectors with external module interface
18. Each Sensor Node packed in IP65 box with 6 Analog Voltage inputs, 4 digital outputs and I2C Channel
19. Solar Panel : 6 Watts

20. DC Battery : 3.7V, 4400mAH
21. Solar Charger : USB

C. Server, Software and Programming

1. Cloud/ Server configurations

   It has features of Local server Configuration, Database Management and Web Based application with learning of Html, jQuery, JavaScript and Php applications for local server.

2. Remote parameter update (Over The Air - OTA)

   Over the air (OTA) Node configuration

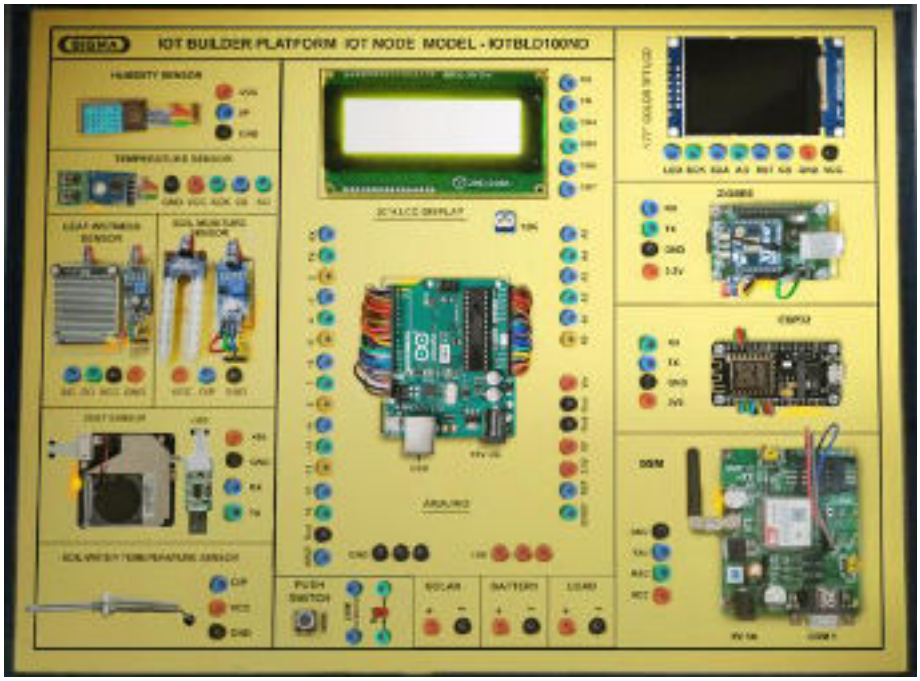
   GUI based parameter configuration

   GUI Base loT application development.

3. Online Cloud/ Server (Optional) :

   We will provide online server along with database, Email, Configuration with one website for one year.

2. IOT Node Transmitter



Hardware

A. Microcontroller

1. Arduino Uno Microcontroller as Wireless Sensor Node with

Analog Inputs	: 6 Nos
Digital Outputs	: 4 Nos.

B. Sensors

1. Temperature Sensor – MAX6375

Linear Temperature Slope	: 10mV/°C
Temp. Range (°C)	: -40 to +150-4°C/+6°C Accuracy from -40°C to +150°C
Operates from	: 2.3V to 5.SV

2. Humidity Sensor - DHT22

Accuracy (Best Fit Straight Line)	: ±3.0 %RH
Operates Voltage	: 3.3V
Range	: 0 to 100% RH
Output Signal	: Analog voltage

3. Soil / Water Temperature Sensor – RTD100

Soil/Water Temp. Range (°C)	: 0 to 100

Accuracy : ±2°C

Size : 6 inch

Operating Voltage : 3.3 to 5.0 V

4. Leaf Wetness Sensor

   Grid-like

   Resistance-type sensor

   Moisture on vegetation : From 0 (dry) to 15 (wet).

5. Soil Moisture Sensor

   Operating Voltage : 3.3 to 5.0 V

   Range : 0 to 100% (Need Calibration)

   Output Signal : Analog voltage

6. Dust Sensor – PM2.5-PM10

   Dust Sensor Operating Voltage : 5 V

   Sensitivity : 1.65 V/ 100µg/m3

   Output Signal : Analog voltage

C. Other Parts

1. LCD Display : 20 X 4
2. IoT Node : Wireless 2.4GHz Zigbee Module
3. IoT Node : Wireless 2.4GHz Wifi Module – ESP32
4. Push Switch : 1 No.
5. LED and Resistor : 1 No. Each

D. Accessories:

1.	2 mm interconnection Sockets	: On Board
2.	2 mm Banana Jumper Cable	: 50 Nos
3.	2mm Banana Jack to Single pin jumpers	: 4 Nos
4.	USB to Mini USB Cable for Zigbee	: 2 Nos
5.	USB to Micro USB Cable for ESP32	: 2 Nos
6.	USB to Square USB Cable for Arduino	: 1 Nos
7.	COM1 Cable - Male to Female for GSM	: 1 No
8.	COM1 Male to USB Cable for RS232	: 1 No
9.	Ethernet Cable for Raspberry	: 1 No
10.	HDMI to Micro HDMI Cable for Raspberry	: 1 No
11.	VGA 15 pin Male to HDMI Converter	: 1 No
12.	4 Port USB 3.0 Hub	: 1 No
13.	5V, 3A DC USB-C Adaptor for Raspberry	: 1 No
14.	9V, 1A Adaptor for Arduino	: 2 No
15.	9V, 1A Adaptor for GSM	: 1 No
16.	DIN connector Cable	: 2 No.
17.	SD Memory Card with Codes for All Experiments	: 32 GB - 1 No
18.	Online Cloud/Server Services	: Free for 1 Year
19.	16 GB Pen Derive with Software, Library, Drivers, Codes, Soft Copy of Manual & Mobile App	: 1No
20.	Printed Practical Manual	: 1 No
21.	E-Books for IOT and AI Subjects	: 10 Nos
22.	Mp4 Video Class for IOT and AI Subjects	: 100 Nos
23.	Power Supply	: 230V AC, 50 Hz
24.	Operating Conditions	: 0-40 °C, 85% RH

EXPERIMENTS - IOT Builder - IOT Node Transmitter and Receiver -

A. Theory Experiments

Arduino Micro Controller

1. To understand theory and working of Arduino Operating software.
2. To understand Pin and Connection Diagram of Arduino.
3. To understand USB Interface for Arduino
4. To understand that how to connect 20 x 4 LCD Display to Arduino
5. To understand Libraries and Algorithms used for Arduino

Raspberry Micro Controller

6. To understand theory and working of Raspberry
7. To understand Operating System for Raspberry
8. To understand Communication Protocols - UART, I2C, SPI, RS232 and RS485.
9. To understand Libraries and Algorithms used for Raspberry
10. To understand USB Interface for Raspberry PI
11. To understand Ethernet Cable Interface for Raspberry PI
12. To understand micro SD Card Interface for Raspberry PI
13. To understand that how to connect 1.77" Color TFT LCD to Raspberry PI.
14. To understand that how to connect 20 x 4 LCD Display to Raspberry PI
15. To understand what is OTA and how to deploy OTA software update on Raspberry Pi
16. To understand theory of I2C Channel
17. To understand theory of Port Forwarding with Static IP
18. To understand theory and working of GSM Module
19. To understand theory and working of Zigbee Module
20. To understand theory and working of ESP32
21. To understand theory of Air Humidity Sensor DHT22
22. To understand theory of Temperature Sensor MAX6375
23. To understand theory of Air Quality Sensor- PM2.5-PM10
24. To understand theory of Soil Moisture Sensor
25. To understand theory of Ambient Light Sensor - LDR
26. To understand theory of Soil/Water temperature Sensor RTD100
27. To understand theory of PIR Sensor

28. To understand theory of Leaf Wetness Sensor
29. To understand theory of Carbon Dioxide CO2 Sensor
30. To understand theory of Oxygen O2 Sensor

B. Practical Experiments

31. To determine Air Humidity using DHT22
32. To determine Air Temperature using Temperature Sensor – MAX6375
33. To measure Air Quality using Dust Sensor – PM2.5-PM10
34. To measure Soil Moisture using Soil Moisture Sensor
35. To measure Soil / Water Temperature using RTD 100
36. To measure wetness of Leaf using Leaf Wetness Sensor
37. To measure CO2 PPM value using CO2 sensor
38. To measure Oxygen range using O2 sensor
39. To detect motion using PIR sensor
40. To detect the presence of Ambient Light using Photo Sensor LDR
41. To control Stepper Motor using Motor Driver
42. To control DC Motor using Motor Driver
43. To record and play Video using Raspberry Pi Camera
44. To control 2 Channel Relay
45. To use Audio Buzzer for output signal alarm experiment
46. To convert Analog voltage into Digital Voltage using ADC - ADS1115S
47. To demonstrate Push Button functionally by toggling LED
48. To charge Battery using Solar Panel
49. To demonstrate 4-20mA input Module
50. To demonstrate RS232 Protocol
51. To demonstrate RS485 Protocol
52. To demonstrate GSM Protocol
53. To demonstrate Ethernet Protocol
54. To demonstrate MQTT Protocol
55. To demonstrate CoAP Protocol
56. To demonstrate HTTP Protocol
57. To demonstrate FTP Protocol

C. Server, Cloud Configuration, IOT Gateway, Nodes and Mobile App Experiments

58. To send Sensors data using Zigbee from IOT Node to IOT Receiver
59. To send Sensors data using Wifi ESP32 from IOT Node to IOT Receiver
60. To send Sensors data by SMS to Mobile using GSM IOT Gateway
61. To send and display Sensors Data in a server Web Page using HTTP, Java and PHP Code
62. To send Sensors data to website webpage and store them into MySQL Server
63. To receive and show Sensors data on Android based Mobile App

2. IOT + AI Work Station – IOT Platform

Hardware – IOT Platform – 1 No

A. Microcontroller

1. NVIDEA Jetson A57 Microcontroller

GPU	: 128-Core - Maxwell
CPU	: Quad-core ARM A57 @ 1.43 GHz
OS	: Linux
RAM	: 4 GB 64-bit LPDDR4 25.6 GB/s
Ethernet Connectivity	: Gigabit Ethernet
Wifi Connectivity	: 802.11 b/g Wireless LAN Dual-Band 2.4/5.0 GHz, 3G
Bluetooth Connectivity	: Bluetooth 5.0
USB Connectivity	: USB 3.0 – 4 Nos. – Micro USB Port

2. Extension interfaces : GPIO, I2C, SPI, UART
3. Power Supply : 5V, 4A DC
4. Arduino Uno Micro Controller : for sending Sensors data

B. Sensors

Sensors and Actuator Connector : 7 Nos as below

1. Temperature Sensor – MAX6375
   Temp. Range (°C) : 0 to 1000 °C
2. Air Humidity Sensor - DHT22
   Range : 0 to 100% RH
   Output Signal : Analog voltage
3. Co2 Sensor
   Range : 0 to 2000 ppm
4. O2 Sensor
   Range : 0 to 25%
5. Air Quality Sensor : PM2.5 and PM10
6. Ambient Light Sensor : LDR
   Operating Voltage : 0 to 5.0 V
7. PIR Sensor
   Operating Voltage : 3.3 to 5.0 V

C. Other Parts

1. IoT Node : Wireless 2.4GHz Wifi Module – ESP32
2. LCD Display : 20 X 4
3. LED : 4 Nos.
4. Push Switches : 4 Nos.
5. Display Monitor : 15 Inch LED
6. Storage : External SSD - 128GB
7. Camera : External Logitech – 270 – USB
8. Key Board : External Wireless
9. Mouse : External Wireless

D. Accessories:

1. 2 mm interconnection Sockets : On Board
2. 2 mm Banana Jumper Cable : 30 Nos

3. 2mm Banana Jack to Single pin jumpers : 2 Nos
4. Square USB Cable for Arduino : 1 Nos
5. USB to Micro USB Cable for ESP32 : 1 Nos
6. Ethernet Cable for Jetson Nano : 1 No
7. HDMI to HDMI Cable for Jetson Nano : 1 No
8. Mains Cord : 1 No – On Board
9. DIN connector Cable : 2 No.
10. VGA 15 pin Male to HDMI Converter : 1 No
11. 9V, 1A Adaptor for Arduino : 2 No
12. SD Memory Card with Codes for All Experiments : 32 GB - 1 No
13. 16 GB Pen Derive : 1No
    with Software, Library, Drivers, Codes, Soft Copy of Manual & Mobile App
14. Printed Practical Manual : 1 No
15. E-Books for IOT and AI Subjects : 10 Nos
16. Mp4 Video Class for IOT and AI Subjects : 100 Nos
17. Power Supply : 230V AC, 50 Hz
18. Operating Conditions : 0-40 °C, 85% RH

E. Jetson Nano Micro Controller Experiments

1. To understand theory and working of Jetson Nano
2. To understand Operating System for Jetson Nano
3. To understand Protocols used for Jetson Nano
4. To understand USB, HDMI, Display Port Interface of Jetson Nano
5. To understand Ethernet Cable Interface for Jetson Nano
6. To understand micro SD Card Interface for Jetson Nano
7. To understand that how to connect 20 x 4 LCD Display to Jetson Nano
8. To understand Libraries and Algorithms used for Jetson Nano

Scope of AI + IOT Builder Training consists of following subjects

1. Internet of Things - IOT
2. Artificial Intelligence - AI
3. Machine Learning – ML
4. Deep Learning – DL
5. Natural Language Processing – NLP

1. Internet of Things – IOT - Scope and Experiments

1. Introduction to Internet of Things – IOT - What is Internet of Things
2. Definition of the Internet of Things
3. To understand Fundamentals and Architecture of IOT
4. The Importance of the Internet of Things
5. To understand History of loT, M2M and Web of Things
6. To understand Layering concept
7. To understand loT Communication Pattern
8. To overview loT Builder Hardware Platform
9. To understand loT protocol Architecture and 6LoWPAN protocol
10. To understand loT Market perspective in different segments
11. To understand Operating System used – Linux
12. Operating System - Linux - Operating Commands -
    a. Working with the command line and the Shell
    b. Managing directories and files
    c. Managing user access and security
    d. Setting up a Linux file system]
    e. Connecting a system to the network

13. Shell Scripting Programming for loT
    a. Introduction
    b. Creating Shell Scripts
    c. Flow control in the Shell
    d. Advanced Shell features

14. To understand IOT Programming Language
    a. C
    b. C++,
    c. Python
    d. Java
    e. JavaScript

15. To understand Website and Cloud Programming Language
    a. Html
    b. PHP
    c. SQL

16. To understand IOT Communication Protocols
    a. Ethernet configuration
    b. USB
    c. MQTT Protocol
    d. CoAP
    e. HTTP
    f. FTP
    g. GPIO
    h. I2C Protocol device interfacing
    i. SPI Protocol device interfacing
    j. UART Communication
    k. RS232 Communication
    l. RS485 Communication
    m. Serial-TTL Communication
    n. Bluetooth Communication
    o. Wi-Fi AP and Router interfacing
    p. Zigbee interfacing
    q. GSM module interfacing

17. To understand Database and Cloud Configuration for IoT
18. To understand Qt based GUI and C++ Programming for IoT
19. To understand Web and Application Development Tools for IoT
20. To understand importance of Wireless Sensor Network – WSN

21. Web and Application Development Tools for IoT
22. To understand configuration of Zigbee Router, End device and Coordinator
23. To understand Hardware Interfacing for loT for Sensors and Actuators interfacing
24. To understand IOT applications in following Areas :
    a. Smart Home Building Automation
    b. Smart City Applications
    c. Smart Agriculture Applications
    d. Smart Energy Monitoring & control
    e. Smart Health care and Telemedicine
    f. Security & Surveillance
    g. Embedded Mobile
    h. Vehicle, Asset, Person & Pet monitoring & controlling
    i. M2M wireless Sensor Network

25. To understand Interacting of Sensors and Actuators with Micro Controllers
    a. Smart Agriculture Sensors
    b. Smart Environment Sensors
    c. Smart Industrial Sensors
    d. Smart Water Sensors
    e. Smart Home Automation
    f. Smart Security Solutions

26. To interface following Sensors and Actuators and measure their parameter
    a. Temperature Sensor - MAX6375
    b. Air Humidity Sensor - DHT22
    c. Co2 Sensor
    d. O2 Sensor
    e. Air Quality Sensor - PM2.5 and PM10
    f. Ambient Light Sensor - LDR
    g. PIR Sensor

27. To send IoT Sensors data to Cloud for Cloud Application
28. To interface LED and Switches
29. To monitor Sensor Data using PC and Mobile

2. Artificial Intelligence –AI - Scope and Experiments

1. Introduction to Artificial Intelligence - What is Artificial Intelligence
2. To understand theory of Block diagram and its internal Structure of AI
3. To understand History of Artificial Intelligence
4. To understand Fundamentals of Artificial Intelligence
5. To understand theory of Basic of AI and its architecture
6. To understand AI Programming Language – C, C++, Python and R
7. To understand AI Protocols
8. To understand AI Applications in following Areas :
    a. Natural Language Processing – NLP
    b. Internet of Things – IOT
    c. Preventive Maintenance
    d. Cyber Security
    e. Agriculture and Food Industry
    f. Remote Healthcare Monitoring and Telemedicine
    g. Environment Monitoring and Forecast
    h. Warehouse and Logistics Monitoring
    i. Retail Analysis
    j. Intelligent Traffic Management
    k. Energy Monitoring and Control
    l. Home and Building Automation

9. To understand algorithms used for applications in AI :
    a. TensorFlow – To make AI Frame work
    b. Keras - For High Performance Numerical Computation
    c. PyTorch
    d. GoogleAI
    e. Amazon web services - AWS
    f. Caffe
    g. Anaconda Navigator

10. To understand software used for AI :
    a. Linux OS
    b. NVIDIA JetPack having Board support package - BSP
    c. NVIDIA CUDA
    d. cuDNN
    e. TensorRT
    f. Anaconda Navigator
    g. Jupyter Notebook
    h. Computer Vision
    i. GPU computing
    j. Multimedia Processing

11. To understand Libraries for applications in AI :
    a. numpy
    b. pandas
    c. scikit-learn
    d. matplotlib
    e. seaborn

12. To understand Mathematics used for AI :
    a. Linear Algebra – Linear Equations, Matrixs, Vectors
    b. Calculus – Differentiation, Integration, Gradient Descent,
    c. Statistics – Population, Parameter, Sample, Variable, Probability

13. To understand realtime image processing applications using Computer Vision – CV
14. To understand Minimax Algorithm in Artificial Intelligence
15. To understand Generative AI
16. To understand ChatGPT Applications
17. To understand Virtual Reality – VR and Augmented Reality AR
18. To understand OpenAI - Speech To Text converter
19. To understand LangChain
20. To understand Hill Climbing Algorithm in Artificial Intelligence
21. To demonstrate OpenAI
22. To demonstrate Virtual Reality – VR and Augmented Reality AR

3. Machine Learning - ML – Scope and Experiments

1. To understand theory of Supervised Learning
    a. Linear Regression
    b. Logistic Regression
    c. Gradient Descent
    d. Decision Tree
    e. Random Forest
    f. Bagging & Boosting
    g. K Nearest Neighbors – KNN
    h. Bayesian Linear Regression
    i. Non-Linear Regression
    j. Support Vector Machine

2. To understand theory of Unsupervised Learning
    a. K-Means
    b. Hierarchal Clustering

3. To install and understand Anaconda Dashboard
4. To demonstrate Machine Learning Framework Experiment using TensorFlow
5. To demonstrate Machine Learning Framework Experiment using PyTorch
6. To demonstrate Machine Learning Framework Experiment using Keras
7. To demonstrate Supervised Learning for
    a. Linear Regression
    b. Logistic Regression

8. To demonstrate Unsupervised Learning for
    a. Hierarchal Clustering
    b. K-Means

9. To understand theory of following Applications using OpenCV and Machine Learning
    a. Face Detection and Tracking
    b. Face Recognition
    c. Emotion Recognition

d. Gesture Recognition
e. Smile Detection
f. Vehicle Detection
g. Object Detection using Yolo algorithm
h. Drowsiness Detection
i. License Plate Detection
j. Fingerprint Recognition
k. Text identification
l. Traffic Sign Recognition
m. Motion Detection
n. Character Recognition
o. Edge Detection through Image processing
p. Handwritten Digit Classification using CNN
q. Leaf Disease Detection and Classification
r. Pattern Recognition
s. Fire Detection
t. Weather Forecasting

10. To understand theory of Real Time Sensors Interface using Machine Learning
11. To understand theory of Reinforcement Learning
12. To understand theory of Ensemble Learning
13. To understand theory of Gaussian Mixture Model – GMM
14. To understand theory of Support Vector Machine - SMM
15. To understand theory of MLOps – Machine Learning Operations
16. To understand theory of DevOps - Developments and Operations
17. To understand theory of PCA - Principal Component Analysis
18. To understand theory of Cost Function
19. To understand theory of Text Classification Using Naive
20. To understand theory of Back propagation and Gradient Descent

4. Deep Learning - DL – Scope and Experiments

1. To understand theory of Neural Networks - Overview and Representation
2. To understand theory of Convolutional Neural Networks - CNN
3. To understand theory of Recurrent Neural Networks
4. To understand theory of Deep Neural Networks - DNNs
5. To understand theory of Multiple Neural Networks in parallel for applications
6. To understand theory of Preventive Maintenance
7. To understand theory of Activation Function
8. To understand theory of Loss Function
9. To understand theory of Real Time Image Processing Application using computer vision.
10. To understand theory of Real Time Speech Processing and Audio Segmentation
11. To demonstrate Neural Networks
12. To demonstrate Convolutional Neural Networks

5. Natural Language Processing – NLP – Scope and Experiments using Deep Learning

Theory of Applications using audio processing and deep learning

1. To understand theory of AI Voice Assistance
2. To understand theory of AI Chatbot
3. To understand theory of Audio Fingerprinting
4. To understand theory of Music Recommendation
5. To understand theory of Speech Recognition
6. To understand theory of Sentiment Analysis
7. To understand theory of Dialog Flow – Chatbot
8. To understand theory of Text Classification
9. To understand theory of Machine Translation
10. To understand theory of Named Entity Recognition

11. To demonstrate AI Voice Assistance using NLP
12. To demonstrate AI Chatbot using NLP
13. To demonstrate Speech Recognition using NLP
14. To demonstrate Text Classification using NLP
15. To demonstrate Computer Vision
16. To demonstrate ChatGPT Applications

Contact us

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