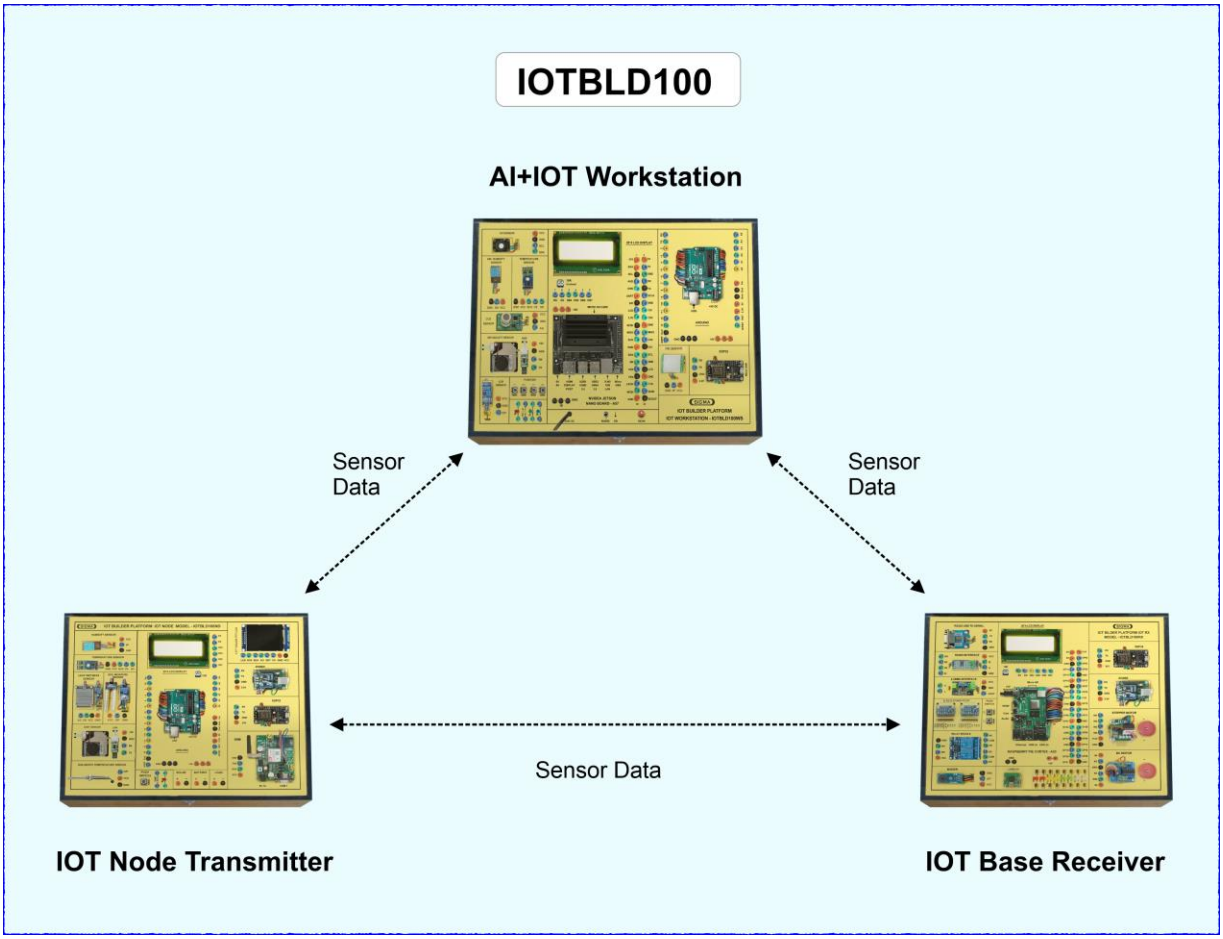
IOT BUILDER PLATFORM 62050
MODEL-IOTBLD100

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 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 : 3 Nos
6. USB to Square USB Cable for Arduino : 2 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 : 2 No
10. HDMI to Micro HDMI Cable : 1 No
11. HDMI to HDMI Cable : 1 No
12. VGA 15 pin Male to HDMI Converter : 1 No
13. 4 Port USB 3.0 Hub : 1 No
14. 5V, 3A DC USB-C Adaptor for Raspberry : 1 No
15. 9V, 1A Adaptor for Arduino : 2 No
16. 9V, 1A Adaptor for GSM : 1 No
17. SD Memory Card with Codes for All Experiments : 32 GB - 2 No
18. Online Cloud/Server Services : Free for 1 Year
19. 16 GB Pen Derive : 1No
    with Software, Library, Drivers, Codes, Soft Copy of Manual & Mobile App
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
25. Mains Cord : 1 No – On Board

3. AI Work Station

Hardware – IOT Platform – 1 No

A. Microcontroller

1.	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

IOT NODE TRANSMITTER AND RECEIVER EXPERIMENTS

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

ARM 57 Micro Controller Experiments

31. To understand theory and working of ARM57 Micro Controller
32. To understand Operating System for ARM57 Micro Controller
33. To understand Protocols used for ARM57 Micro Controller
34. To understand USB, HDMI, Display Port Interface of ARM57 Micro Controller
35. To understand Ethernet Cable Interface for ARM57 Micro Controller
36. To understand micro SD Card Interface for ARM57 Micro Controller
37. To understand that how to connect 20 x 4 LCD Display to ARM57 Micro Controller
38. To understand Libraries and Algorithms used for ARM57 Micro Controller

B. Practical Experiments

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

61. To demonstrate Ethernet Protocol
62. To demonstrate MQTT Protocol
63. To demonstrate CoAP Protocol
64. To demonstrate HTTP Protocol
65. To demonstrate FTP Protocol

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

66. To send Sensors data using Zigbee from IOT Node to IOT Receiver
67. To send Sensors data using Wifi ESP32 from IOT Node to IOT Receiver
68. To send Sensors data by SMS to Mobile using GSM IOT Gateway
69. To send and display Sensors Data in a server Web Page using HTTP, Java and PHP Code
70. To send Sensors data to website webpage and store them into MySQL Server
71. To receive and show Sensors data on Android based Mobile App

AI WORK STATION EXPERIMENTS

AI work station experimets are devided in five categories as below

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 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 loT
18. To understand Qt based GUI and C++ Programming for loT
19. To understand Web and Application Development Tools for loT

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 - Experiments

30. Introduction to Artificial Intelligence - What is Artificial Intelligence
31. To understand theory of Block diagram and its internal Structure of AI
32. To understand History of Artificial Intelligence
33. To understand Fundamentals of Artificial Intelligence
34. To understand theory of Basic of AI and its architecture
35. To understand AI Programming Language – C, C++, Python and R
36. To understand AI Protocols
37. 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

38. 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

39. 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

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

41. 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

42. To understand realtime image processing applications using Computer Vision – CV
43. To understand Minimax Algorithm in Artificial Intelligence
44. To understand Generative AI
45. To understand ChatGPT Applications
46. To understand Virtual Reality – VR and Augmented Reality AR
47. To understand OpenAI - Speech To Text converter
48. To understand LangChain
49. To understand Hill Climbing Algorithm in Artificial Intelligence
50. To demonstrate OpenAI
51. To demonstrate Virtual Reality – VR and Augmented Reality AR

3. Machine Learning - ML – Experiments

52. 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

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

54. To install and understand Anaconda Dashboard
55. To demonstrate Machine Learning Framework Experiment using TensorFlow
56. To demonstrate Machine Learning Framework Experiment using PyTorch
57. To demonstrate Machine Learning Framework Experiment using Keras
58. To demonstrate Supervised Learning for
    a. Linear Regression
59. Logistic Regression

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

61. 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

62. To understand theory of Real Time Sensors Interface using Machine Learning
63. To understand theory of Reinforcement Learning
64. To understand theory of Ensemble Learning
65. To understand theory of Gaussian Mixture Model – GMM
66. To understand theory of Support Vector Machine - SMM
67. To understand theory of MLOps – Machine Learning Operations
68. To understand theory of DevOps - Developments and Operations
69. To understand theory of PCA - Principal Component Analysis
70. To understand theory of Cost Function
71. To understand theory of Text Classification Using Naive
72. To understand theory of Back propagation and Gradient Descent

4. Deep Learning - DL – Experiments

73. To understand theory of Neural Networks - Overview and Representation
74. To understand theory of Convolutional Neural Networks - CNN
75. To understand theory of Recurrent Neural Networks
76. To understand theory of Deep Neural Networks - DNNs
77. To understand theory of Multiple Neural Networks in parallel for applications
78. To understand theory of Preventive Maintenance
79. To understand theory of Activation Function
80. To understand theory of Loss Function
81. To understand theory of Real Time Image Processing Application using computer vision.
82. To understand theory of Real Time Speech Processing and Audio Segmentation
83. To demonstrate Neural Networks
84. To demonstrate Convolutional Neural Networks

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

85. To understand theory of audio processing
86. To understand theory of AI Voice Assistance
87. To understand theory of AI Chatbot
88. To understand theory of Audio Fingerprinting
89. To understand theory of Music Recommendation
90. To understand theory of Speech Recognition
91. To understand theory of Sentiment Analysis
92. To understand theory of Dialog Flow – Chatbot
93. To understand theory of Text Classification
94. To understand theory of Machine Translation
95. To understand theory of Named Entity Recognition
96. To demonstrate AI Voice Assistance using NLP
97. To demonstrate AI Chatbot using NLP
98. To demonstrate Speech Recognition using NLP
99. To demonstrate Text Classification using NLP
100. To demonstrate Computer Vision
101. To demonstrate ChatGPT Applications

CLASS ROOM TRAINING – ONLINE AND OFFLINE

The training includes Single user Classroom / laboratory teaching, learning and simulation software module. The content has easy explanation of various complex topics with animation and simulation for ease of student learning. It also supports learning through videos, graphs, charts, along with mandatory rich content and theory to understand fundamental concepts, interactive learning objects, FAQ, MCQ etc. The content is supplied in digital online access or license protection.

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