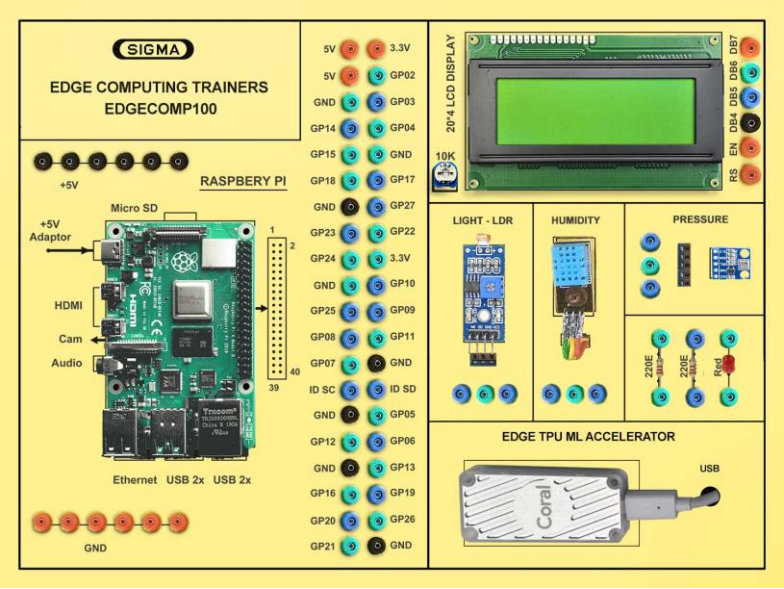
# EDGE COMPUTING TRAINER

## MODEL – EDGECOMP100

This Edge Computing trainer has been designed with a view to provide practical and experimental knowledge of Edge Computing technology used in Internet and Edges and IOT.

## SPECIFICATIONS




## 1. Microcontroller Board

| | | |
|---|---|---|
| 1. | NanoPi Super Raspberry Pi | : Quad-core Cortex-A7 DDR3 RAM 512MB |
| 2. | CPU | : Allwinner H3, Quad-core Cortex-A7, up to 1.2GHz |
| 3. | OS | : u-boot, Ubuntu-Core-Xenial, Debian-Jessie |
| 4. | RAM | : DDR3 RAM : 512MB |
| 5. | Ethernet Connectivity | : 10/100 M Ethernet |
| 6. | USB Connectivity | : USB 2.0 - 3 Nos – Type A |
| 7. | Storage | : microSD – 32 GB |
| 8. | NEO Open Source | : Allwinner H3 Development Board |
| 9. | Debug Serial Port: | : 4 Pin, 2.54 mm pitch pin header |
| 10. | GPIO-1 | : 2.54 mm pitch, 24pin. It includes UART, SPI, I2C, IO |
| 11. | GPIO- 2 | : 2.54 mm pitch, 12pin. It includes USB, IR, SPDIF, and I2S |
| 12. | Power - 5V, 2A DC | |

## 2. Sensors:

1. Temperature and Humidity– DHT11
2. Ambient Light Sensor – LDR
3. Ambient Pressure Sensor – BMP180

## 3. Modules and Hardware:

1. 20 X 4 - LCD Display
2. LEDs and Resistors
3. 2 mm interconnection Sockets

## 4. AI GPU Accelerator

1. Google Edge TPU ML accelerator
2. 4 TOPS total peak performance
3. 2 TOPS per watt
4. USB 3.0 (USB 3.1 Gen 1) Type - C socket

## 5. Accessories:

| | | |
|---|---|---|
| 1. | 2 mm interconnection Sockets | : On Board |
| 2. | 2 mm Banana Jumper Cable | : 20 Nos |
| 3. | 2mm Banana Jack to Single pin jumpers | : 2 Nos |
| 4. | USB to Micro USB Cable | : 2 Nos |
| 5. | USB to TTL RS232 Converter | : 1 No |
| 6. | Ethernet Cable | : 1 No |
| 7. | HDMI to HDMI Cable | : 1 No |
| 8. | VGA 15 pin Male to HDMI Converter | : 1 No |
| 9. | Power Supply Adaptor | : 5V, 4A DC |
| 10. | SD Memory Card with Codes for All Experiments | : 32 GB - 1 No Class 10 |
| 11. | 16 GB Pen Derive | : 1No |
| | with Software, Library, Drivers, Codes, Soft Copy of Manual & Mobile App | |
| 12. | Printed Practical Manual | : 1 No |
| 13. | E-Books for AI Subject | : 10 Nos |
| 14. | Mp4 Video Class for Edge Computing Subjects | : 100 Nos |
| 15. | Power Supply | : 230V AC, 50 Hz |
| 16. | Operating Conditions | : 0-40 °C, 85% RH |
| 17. | Mains Cord | : 1 No – On Board |

## 6. Cabinet and PCB

The complete circuit diagram is screen printed on component side of the PCB with circuit and Parts at the same place. The PCB with components on front side is fitted in elegant wooden box having lock and key arrangement. The acrylic cover is fitted on PCB to safeguard parts. It works on 230 V AC Supply.

## THEORY EXPERIMENTS

### A. Introduction to Edge Computing

1. What is Edge Computing?
2. Introducing and Defining Edge Computing
3. The Fundamentals of Edge Computing
4. Getting Inside the Edge
5. Developing Your Edge Strategy
6. Edge Computing Vs Cloud Computing
7. How does Edge Computing Work
8. Architecture for Edge Computing
9. Forms of Edge Computing
10. Benefits of Edge Computing
11. Challenges in Edge Computing

### B. Implementing Edge computing

12. Systems for Edge Computing
13. Edge Servers and Devices
14. Edge Messaging Protocols -MQTT
15. Edge Analytics
16. Security in Edge Computing
17. Privacy in Edge Computing
18. Edge computing Platforms
19. Technologies for Implementing Edge Computing
20. Edge computing and 5G
21. IOT Development using Edge Computing
22. Kubernetes Networking
23. Multi-Cluster Networking
24. Kubernetes Distributions
25. Distributed File systems

## PRACTICAL EXPERIMENTS

### A. Configure NanoPi as Edge Computing Node

1. Download NanoPi Neo Plus2 OS image from Raspberry Website
2. To flash NanoPi Neo Plus2 OS image into its eMMC.
3. To connect USB to TTL converter to NanoPi as shown below
4. Connect TTL adapter pins to NanoPi board pins in below order
5. GND <-> GND, TX <-> RX, RX <-> TX
6. Flash official OS image on SD Card with flashing tool balenaEtcher.
7. Insert the TF card into NanoPi board TF socket,
8. Connect USB-TTL adapter to PC USB port
9. Connect +5V Vcc to NanoPi board to power on and boot from TF card.
10. NanoPi Neo Plus2 provides a micro-USB port and Vcc pin for power supply.
11. To avoid data loss, a Li-Ion battery UPS board is used.
12. Prepare a bootable TF card with OS image
13. On PC end, use terminal tool to interact with NanoPi.
14. First, determine the USB device
15. Then use screen tool to connect this device, baud rate 115200
16. Once terminal is connected, and OS boots up successfully, start to login and run eflasher to flash OS from TF card to eMMC.
17. Switch to root
18. Run eflasher, be sure to disable Overlayfs
19. After eflasher finishes its work, remove TF card and reboot NanoPi from eMMC. From terminal we can see the newly installed OS login interface
20. At the first-time boot, login is automatic as default user pi, connect Ethernet cable and start update
21. Run util npi-config to do initial setup
22. By using npi-config, change the default password for default user pi, set the hostname, disable auto login at start-up, set the time zone, and enable ssh server.
23. After initial setting, connect to NanoPi via ssh from PC without USB-TTL adapter.
24. The first NanoPi Edge device hostname is npi-edge-01
25. When this screen is shown, the edge device setup is done
26. When the initial setup is done, the NanoPi board can be packaged into an aluminum alloy case to prevent it from dust and disassembly.
27. Now your edge Node is ready.

## 2. Setting WireGuard Virtual Private Network

### Setup Lan ips

28. Choose a class B private network IP range.
29. Decide IP address, Subnet, IP range
30. Decide WireGuard Server and Client IP
31. Decide Edges IP
32. Decide One cloud VM as WireGuard server
33. Decide One cloud VM as K3S server
34. Set one Edge Computing device as K3S agent

### Setup WireGuard server

35. Update APT (Advanced Package Tool)
36. Install WireGuard server
37. Configuring WireGuard server
38. Generate private and public keys for WireGuard tunnel
39. Enable IP forwarding
40. Enable and start WireGuard service

### Setup WireGuard client on K3S server

41. Update APT (Advanced Package Tool)
42. Install WireGuard server
43. Configuring WireGuard server
44. Generate private and public keys for WireGuard tunnel
45. Set Up WG server by creating /etc/wireguard/wg0.conf File
46. Enable and start WireGuard service

### Setup WireGuard client on K3S agent

47. Update APT (Advanced Package Tool)
48. Install WireGuard server
49. Configuring WireGuard server
50. Generate private and public keys for WireGuard tunnel
51. Set Up WG server by creating /etc/wireguard/wg0.conf File

52. Enable and start WireGuard service

### Add peers on WireGuard server

53. add peer for K3S server
54. add peer for K3S agent
55. save to config

### Install K3S server

56. For experiment purpose, we choose to use one-line installation
57. Verify the service running status
58. Configure the flannel overlay by creating the following systemd drop in
59. Restart K3S service

### Install K3S agent

60. Same as server, we use K3S official one-line online installation script
61. Specify the same K3S version
62. Get the token from K3S server
63. Verify the service running status
64. Configure the flannel overlay by creating the following systemd drop in

### Restart K3S agent service

65. Verify agent connection on K3S server
66. Now this minimum edge cluster is ready for use

### Conclusion

67. To meet certain business use cases, we extend Kubernetes cluster from cloud to edge. This article intends to explain the feasibility with viable opensource software and hardware.

## 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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