EMERTXE TRAINING PROJECT DOCUMENTATION FRAMEWORK
REQUIREMENTS & DESIGN DOCUMENT

Module – Arduino Programming

Industrial Machine State Monitoring System

ΣMERTXE

Contents

1 Abstract

On a factory floor one of the critical work the operators have is to monitor the health of the machine, because if the machine breaks down the over productivity goes done, So it becomes crucial to monitor the health of the machine like how much time does it run in a single shift and find out the performance of it by tracking multiple parameters like temperature, pressure, noise, vibrations etc

The scope of Industrial Machine State Monitoring System (IMSMS) project is to retrofit existing machines and provide a way for data analysis so that corrective action can be taken in order to improve the life and performance of a running machine.

2 Requirements

This project has two sections to be designed

- A server which act as a access point or gateway, would interact with the router

- A client which act a station interacts with access point
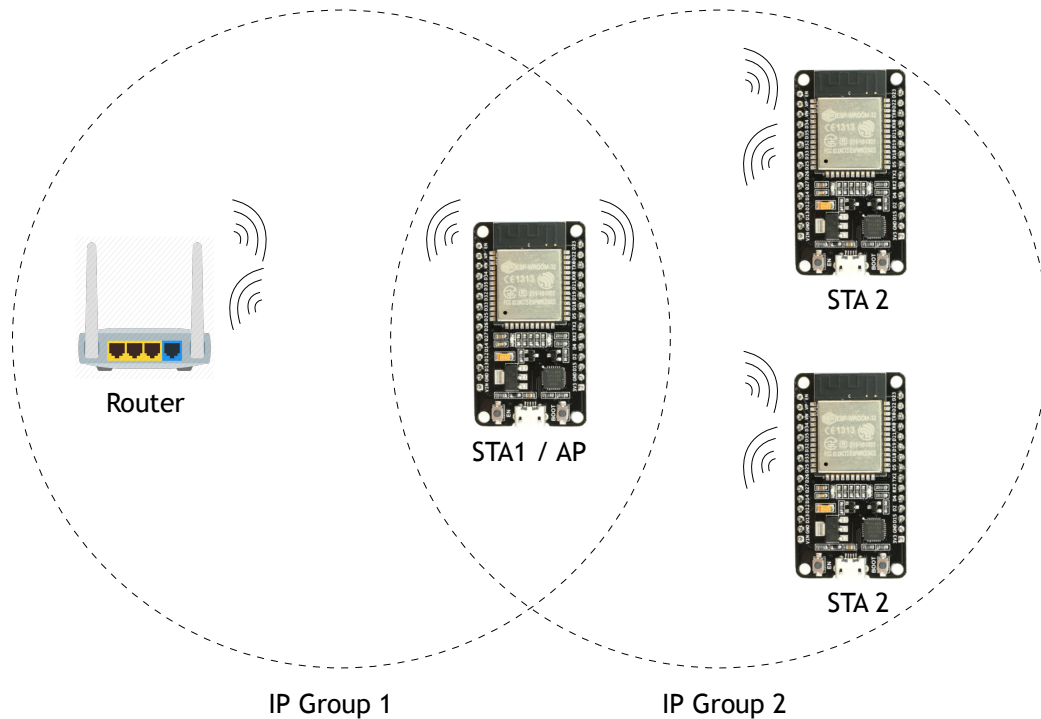
IP Group 1   IP Group 2

- Both the Server and Client should have different IP group

2.1 Gateway Requirements

- The gateway should support both

    ◦ Station Mode

    ◦ Access Point Mode

  Station Mode

    ◦ Should scan for the available networks

    ◦ Show all possible networks so that the user can select a network to connected

    ◦ Make sure the password entered are represented with asterisk

    ◦ Once the connection is established show all the network details like

- The SSID it is connected to

- Stations IP address

- Signal Strength

Once the your gateway as station connected to internet gateway it should configure itself as access point too

Access Point Mode

○ It should generate an SSID with the help of its MAC address (consider 2 lower bytes)

○ Allocate a static IP so that the local stations can connect

○ Display the server status and wait for the nodes to get connected

○ Display the connected node information

2.2 Station Requirements

- Should scan for the available networks

- Show all possible networks including the your access point so that the user can select it

- Make sure the password entered are represented with asterisk

- Once the connection is established show all the network details like

  ○ Server Information

    - The SSID

    - Server IP

  ○ Station Information

    - Name (Generate unique name with the help of MAC id, consider lower 2 bytes)

    - IP Address

    - Signal Strength

    - Connection Status

The above was about the network configuration, apart form all these the station is responsible to sense the environmental parameters and send it to the server so that it can save it, in fact that is the primary goal of this project.

The data stored in the server can be queried by the central computers for further processing

3 Prerequisites

- Embedded C programming

- Understanding of Wifi Modes

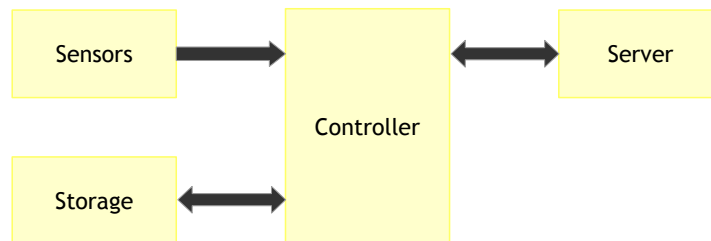ΣMERTXE

4 Design

- Block Diagrams - Stations
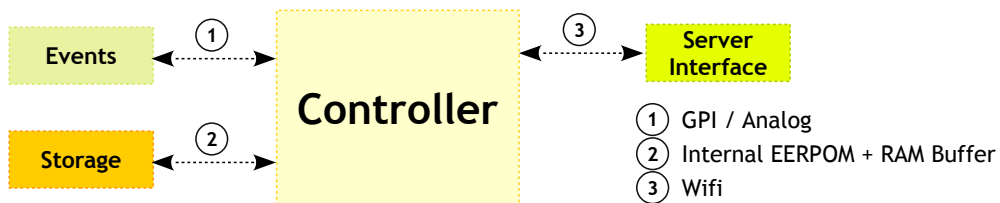

Fig 4 1: Block Diagram - Level 0

1. GPI / Analog
2. Internal EERPOM + RAM Buffer
3. Wifi

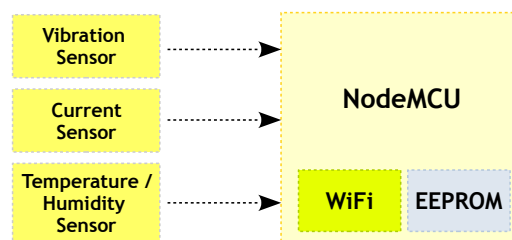*Fig 4 2: B1lock Diagram - Level*

Fig 4 3: Block Diagram - Level 2

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5 Sample Output

5.1 Gateway

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ...
```

Fig 5.1 1: Scan for available network.

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network:
```

Fig 5.1 2: Display available networks and prompt so that the user can select one from the list

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 3
Please enter authentication key:
```

Fig 5.1 3: Once the user select a network, prompt for Password.

Note: In case of unauthenticated network it shouldn't prompt for password

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 3
Please enter authentication key: ********
```

Fig 5.1 4: The entered password should be represented with asterisks

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 3
Please enter authentication key: ********

|--- Attempting to connect Emertxe
...
|--- Connected to Emertxe

|--- Station Information
Station SSID       : Emertxe
Station IP Address : 192.168.43.65
Signal Strength    : -28 dBm
|--- Done
```

Fig 5.1 5: Gateway's station mode information

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 3
Please enter authentication key: ********

|--- Attempting to connect Emertxe
...
|--- Connected to Emertxe

|--- Station Information
Station SSID       : Emertxe
Station IP Address : 192.168.43.65
Signal Strength    : -28 dBm
|--- Done

|--- Access Point Configuration:
|--- Access Point Information
AP SSID            : ESP Server 2E26
AP IP Address      : 192.168.1.1
Server State       : Started
|--- Done
```

Fig 5.1 6: Gateway's Access Point information

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 3
Please enter authentication key: ********

|--- Attempting to connect Emertxe
...
|--- Connected to Emertxe

|--- Station Information
Station SSID       : Emertxe
Station IP Address : 192.168.43.65
Signal Strength    : -28 dBm
|--- Done

|--- Access Point Configuration:
|--- Access Point Information
AP SSID            : ESP Server 2E26
AP IP Address      : 192.168.1.1
Server State       : Started
|--- Done

|--- Waiting for connections ...
```

Fig 5.1 7: Once all the necessary setup is done it should wait for connection

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```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- ESP32 Gateway Configuration:

|--- Station Configuration:
|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 3
Please enter authentication key: ********

|--- Attempting to connect Emertxe
...
|--- Connected to Emertxe

|--- Station Information
Station SSID        : Emertxe
Station IP Address : 192.168.43.65
Signal Strength    : -28 dBm
|--- Done

|--- Access Point Configuration:
|--- Access Point Information
AP SSID            : ESP Server 2E26
AP IP Address      : 192.168.1.1
Server State       : Started
|--- Done

|--- Waiting for connections ...

Client 1 - [Node C21A - Connected]
```

Fig 5.1 8: Information related to the connected Node

5.2 Station

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- Starting the Network Scan ...
```

Fig 5.2 1: Scan for available network


```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network:
```

Fig 5.2 2: Display available networks and prompt for selection so that user can select ESP Server

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 1
Please enter authentication key:
```

Fig 5.2 3: Selecting the server, prompt for password

```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:808
load:0x40078000,len:6084
load:0x40080000,len:6696
entry 0x400802e4

|--- Starting the Network Scan ... Done

|--- Found 3 Networks

1. ESP Server 2E26
2. Wisdom
3. Emertxe

Please select the required Network: 1
Please enter authentication key: ********
|--- Attempting to connect ESP Server 2E26
...
|--- Connected to ESP Server 2E26

|--- Connection Information
Server           : ESP Server 2E26
Server IP Address : 192.168.1.1
Client           : Node C21A
Client IP Address : 192.168.1.2
Signal Strength   : -50 dBm
State            : Connected
|--- Done
```

Fig 5.2 4: Connection information with the server

6 Artifacts

6.1 Skeleton Code

The skeleton code is a very interesting concept used in Emertxe. By looking into the skeleton code, you will get a clear picture into converting the given requirement into a working solution. This will also take care of important aspects like modularity, clean coding practices, re-usability etc.

- TBD

6.2 References

- https://en.wikipedia.org/wiki/Condition_monitoring

- https://evocon.com/kb/what-is-machine-monitoring-in-manufacturing/

- https://tulip.co/ebooks/machine-monitoring/

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