User Manual

Weighing System Software version: 3.62

Revision 1

Date: 26/01/2024

Table of Contents

Table of Figures

1   Introduction

The Scrapman PlayStation is a self-contained model of a Heavy-Duty, mobile weighing system but set-up to measure weight, at 1/100,000th scale and, being compact, is ideally suited for use in the laboratory or office environment as a tool to help develop and test software for external monitoring systems. It is also extremely useful as a diagnostic tool for isolating any system problems and as an aid to training. The complete kit comprises the following:

1. ScrapMan Computer Assembly (normally the spare computer, NOT included in price)

2. Model Weighing Platform with Load Cell Cables

3. Set of Test Weights

4. 12V DC Mains Power Supply & Cable (Not Shown)

5. Wi-Fi wireless nano router complete with USB Power Cable.
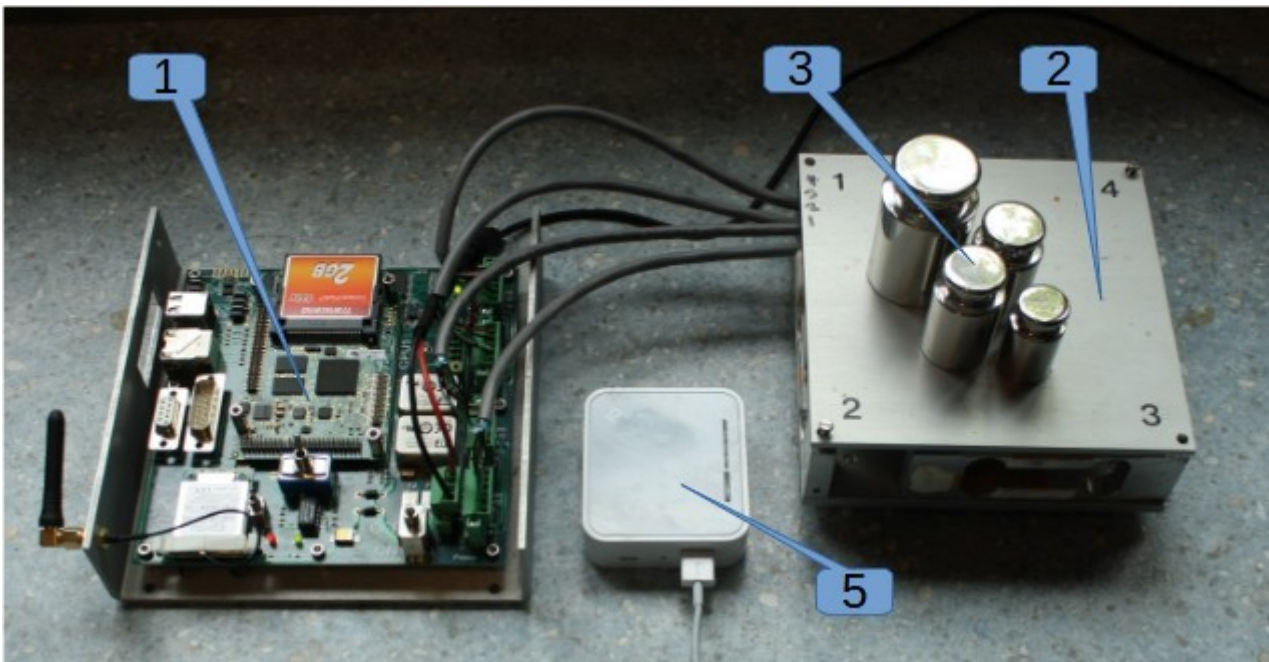

Figure 1: PlayStation Hardware

Like the actual trailer, the load cells are "digital" in that they are laboratory calibrated and scaled and so can be swapped over with simplicity. In the case of the PlayStation, the load cells have been deliberately scaled to read 30,000 with an applied load of 300g thus allowing the system to apparently weigh in Tonnes (30t).

The computer board supplied with the PlayStation equipment would normally be the spare computer and is nominally set to have an identity of Trailer 0 (zero) with a fixed IP address of 123.1.224.213; this can be changed at any time.

2   Getting Started

This section will describe how to connect up the PlayStation and access the pages from the PlayStation web server.

2.1   Connecting The Load Cells

The weighing platform contains 4 load cells which need to be connected to the Scrapman computer Assembly.
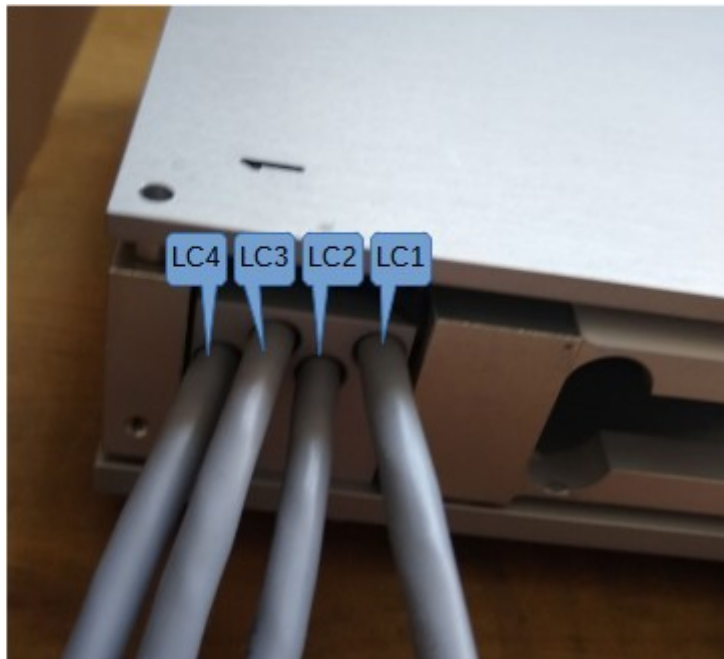
Figure 2: Load Cell Connector Numbering

The load cells are connected to cables which exit from the weighing platform as shown in Figure 2.

These cables should be connected to the connectors marked LC1 to LC4 on the Scrapman computer assembly. The connectors are polarized and cannot be inserted incorrectly without using undue force.

2.2   Connecting the Power Supply

The PlayStation is supplied with a 12v, 3A power adapter fitted with a 4-way pluggable terminal block. The power supply should be connected to the 4-way socket on the computer assembly situated adjacent to the power switch marked SW1. The connector is polarized and cannot be inserted incorrectly without considerable force.

2.3   Powering Up the Nano Router

The Nano router is powered though it's USB power connector. Any suitable USB port can be used. The Nano router should be powered up and allowed to boot prior to powering up the PlayStation.

Once the nano router is running it should be possible to connect any Wi-Fi enabled computer, phone or tablet to the nano router using the following parameters:

SSID	scrapman
Security	WPA2-PSK
Passphrase	scrapman

The nano router contains a DHCP server and should automatically allocate an IP address to any device connected to it.

The PlayStation is pre-configured to be given an IP address of: 123.1.224.213

2.4   Booting the PlayStation

Before powering up the PlayStation make sure the nano router is up and running and that the network switch on the computer assembly, marked as SW3, is in the '*Wi-Fi*' position.

Turn on the power to the PlayStation by moving SW1 to the '*On*' position

As the PlayStation boots the 4 green and 4 red LEDs will turn on and off, seemingly at random until the system has booted. Once booted the 4 green LEDs will flash together about twice a second. The boot process takes around 20-30 seconds.

3   Communicating with the Weighing System

The weighing system has a web server, through which all communication takes place. The web server provides HTML pages suitable for viewing in a web browser and XML/JSON files suitable for use in application software. The web interface and application programming interface (API) is described in the remainder of this section.

The web server listens on port 5050.

Open up your favourite browser and type *http://123.1.224.212:5050* into the address bar. The following page should be shown.
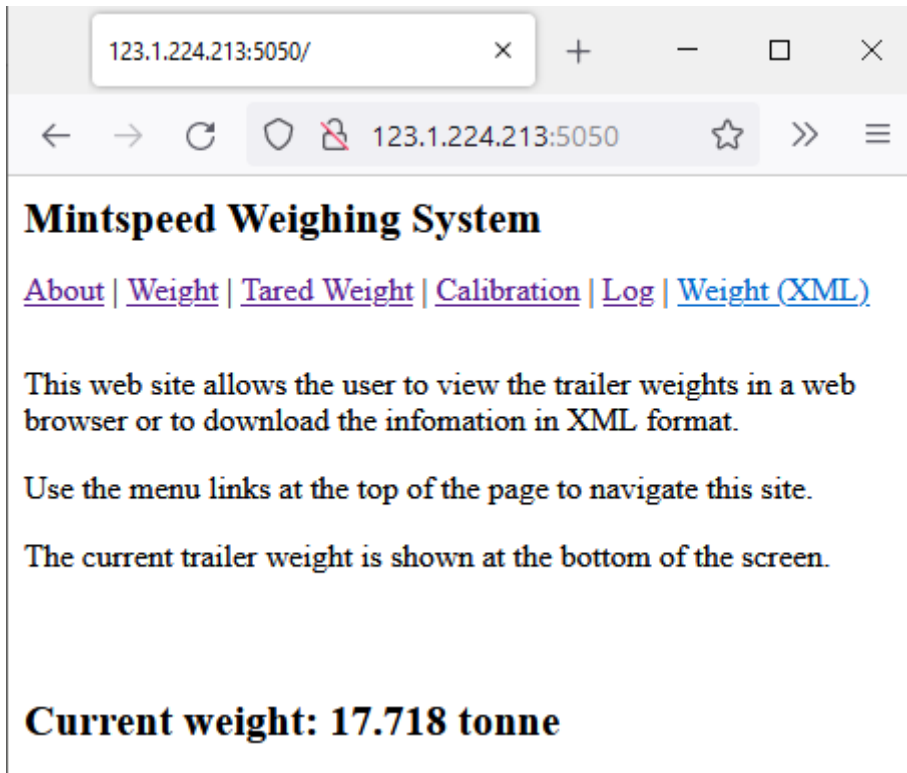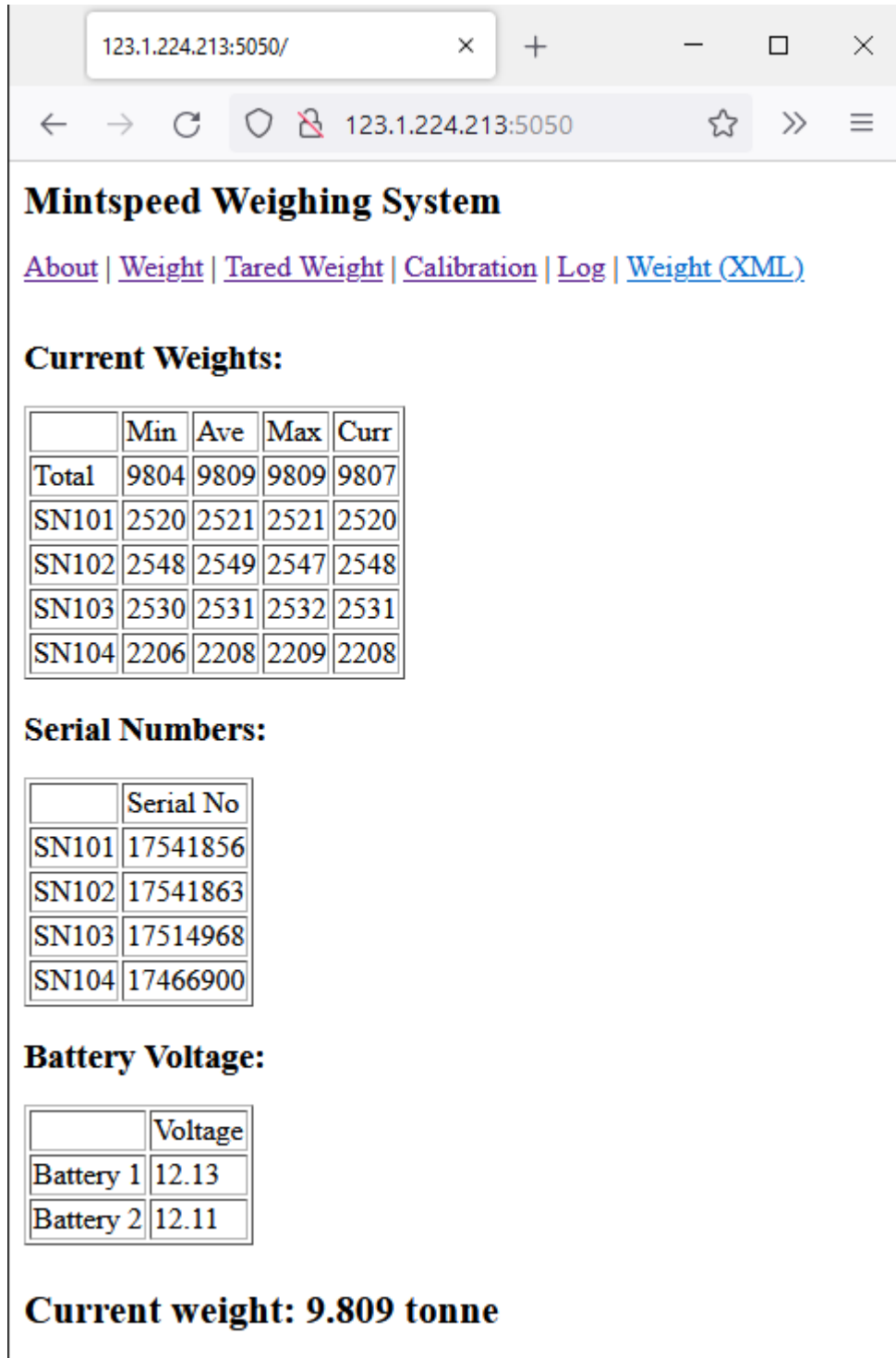

Figure 3: About Page

As you can see in Figure 3, below the title is a menu with links to the various pages available from the web interface, each page will be described in the following sections. The current weight is shown at the bottom of each page.

3.1 Weight Page

Figure 4: Weight Page

The *Weight* page shows tabular information about the current weight, load cell serial numbers and battery voltage.

The *Current Weights* table shows the minimum, average, maximum and current weight for each load cell as well as the total weight. The minimum, maximum and average values are calculated over a 20 sample period which is approximately 700ms. The current battery voltages and load cell serial numbers are also shown.

3.2 Tared Weight Page

On the *Tared Weight* page, shown in Figure 5, the tared weight is displayed as well as 'Tare' and 'Un-Tare' buttons and the gross weight.

Figure 5: Tared Weight Page (Un-Tared)

In the un-tared state the *Tared Weight* and the *Gross Weigh* will show the same value.

Pressing the '*Tare*' button will reset the *Tared Weight* to zero and from then on the *Tared Weigh* will show the weight of anything added to the weighing platform since the '*Tare*' button was pressed. The *Tared Weight* can be repeatedly zeroed by pressing the '*Tare*' button again. Figure 6 shows the *Tared Weight* page immediately following a tare.
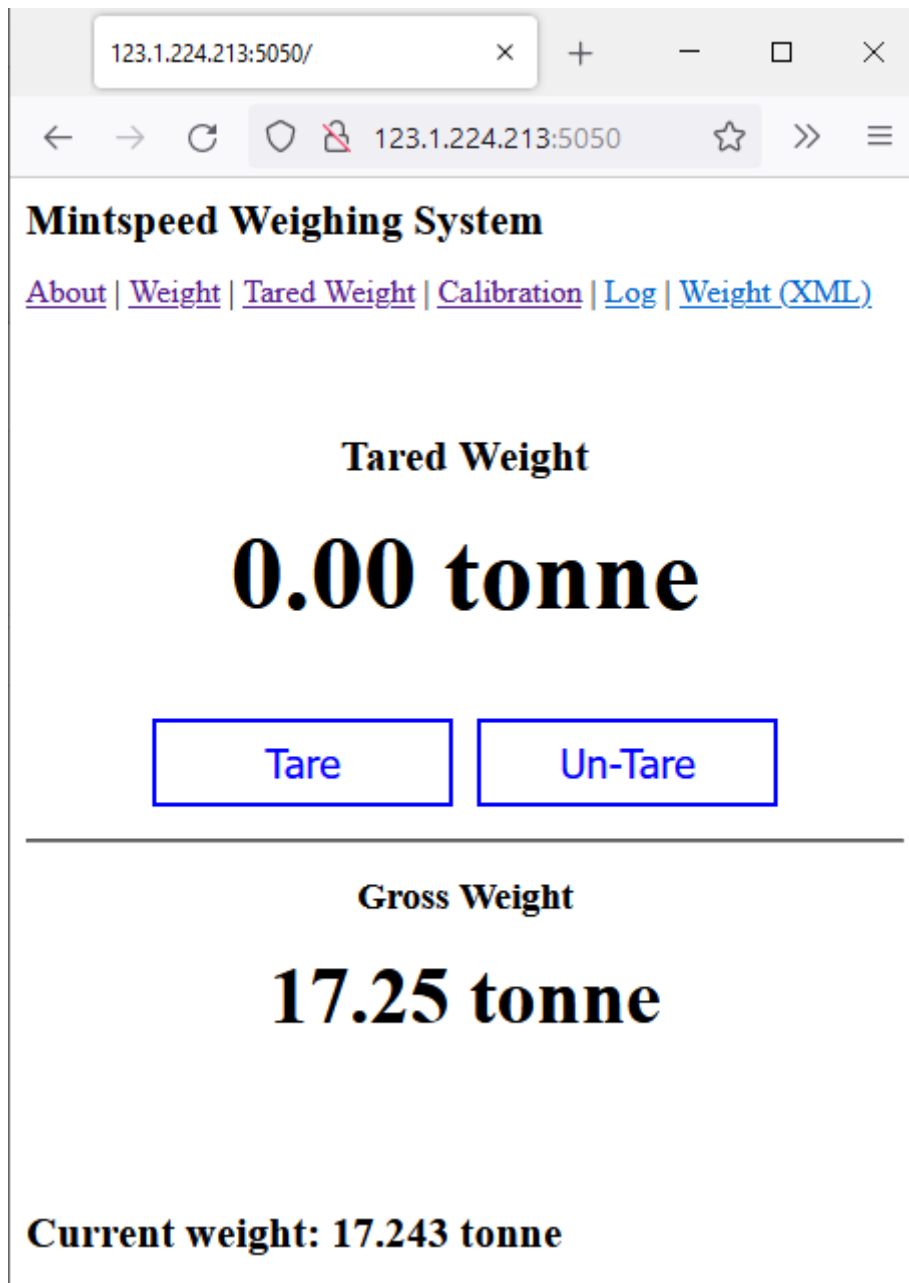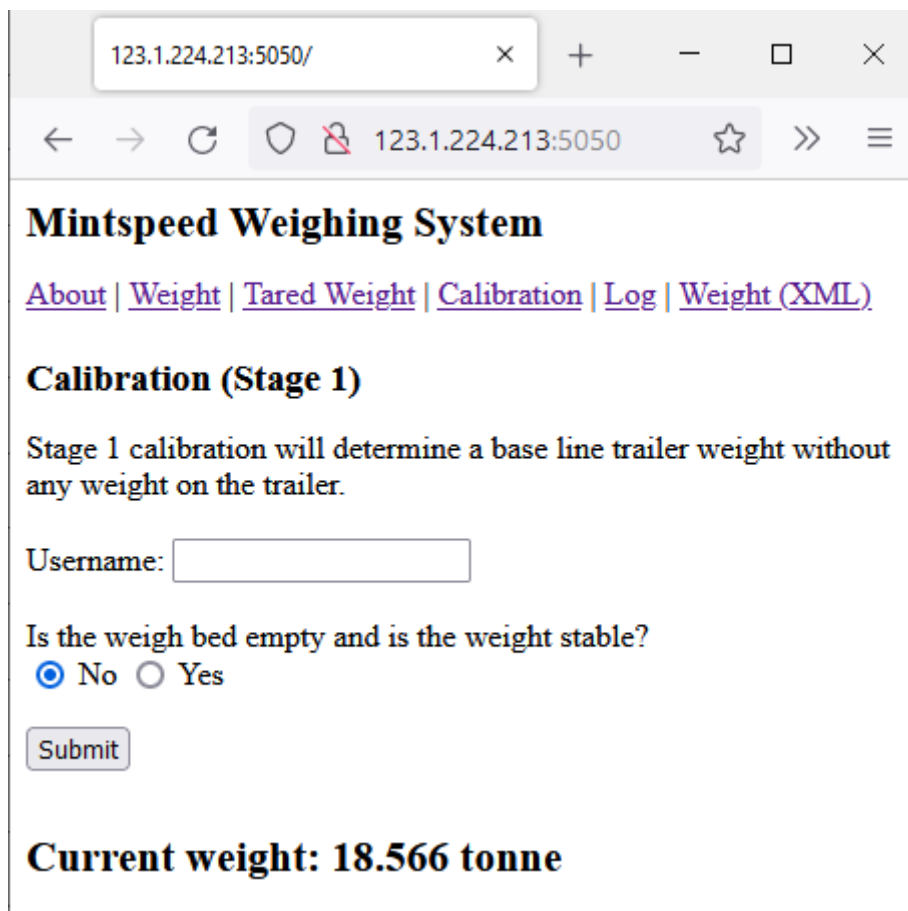

Figure 6: Tared Weight Page (Tared)

Pressing the '*Un-Tare*' button will return the weighing system to the un-tared state where both the Tared and Gross weights will show the same weight.

3.3 Calibration Pages

The load cells are accurately calibrated prior to being fitted and no further calibration should be required, however it is possible to re-calibrate the weighing system using a known test weight from the Calibration pages.

Important: *Calibration should be carried out using a single test weight that weighs close to the maximum weight that the weighing system can support. Using multiple weights or small weights can (and likely will) result in inaccurate calibration and thereafter inaccurate weight measurements from the system.*
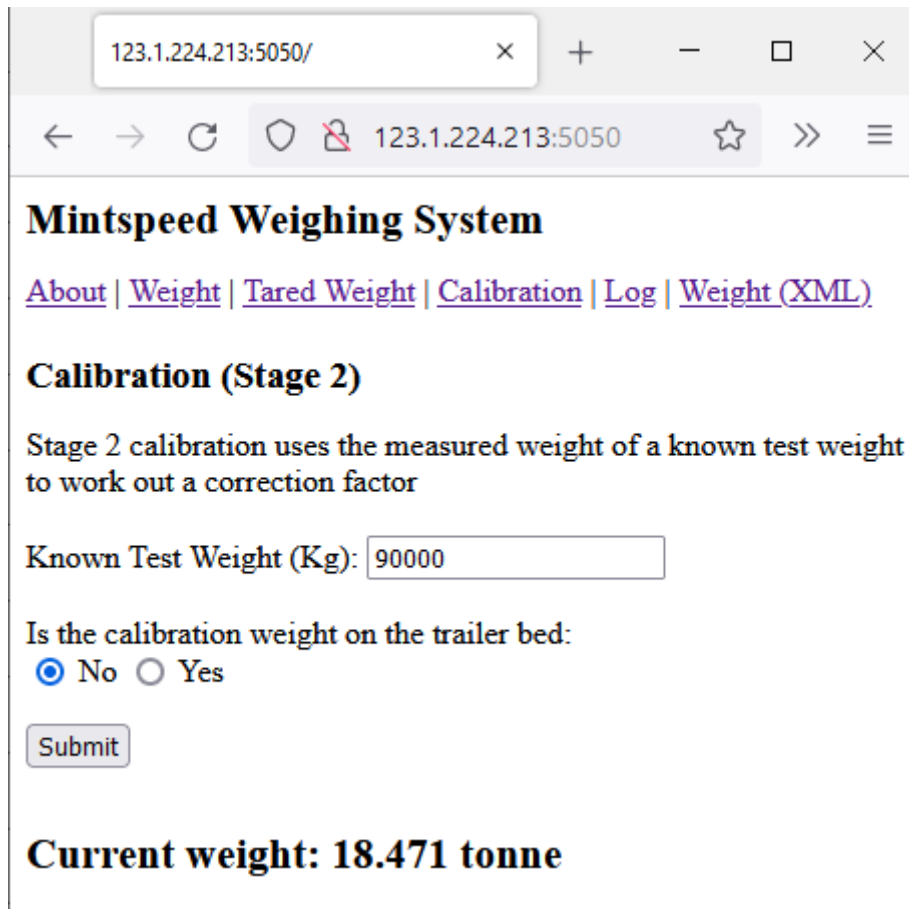
Figure 7: Calibration (Stage 1) Page

Calibration is a 2 stage process, the first stage is accessed by clicking on 'Calibration' on the menu. On the first stage calibration page (shown in Figure 7) the user should enter a 'Username', which is simply used to identify who did the calibration and confirm that the weight bed is empty and that the weight is stable before clicking on the 'Submit' button.

Following submission of stage 1 calibration, the stage 2 calibration page will automatically be loaded. The stage 2 calibration page is shown in Figure 8.

Figure 8: Calibration (stage 2) Page

To complete the 2nd stage calibration the user must insert the weight of the known test weight into the form and confirm that this weight is currently on the weighing platform. Finally clicking on the 'Submit' button to complete the calibration.

The software running on the Scrapman computer with then calculate a correction factor based on the weight of the test weight and the weight being measured by the time. This correction value is stored and applied to all weight measurements there after. The web interface will then instruct the users to power cycle the trailer for the changes to take effect.

3.3.1 Resetting the Calibration Factor

It is not possible to reset the calibration factor from the web interface.

Resetting the calibration factor requires the user to edit a configuration file on the CompactFlash (CF) card. This cannot be done in situ and so the CF card must be removed from the Scrapman computer and connected to a PC using a suitable CF adapter.

Before attempting this it is strongly advised that you back up the supplied CF card and have spare CF cards available in case of mishap.

Procedure for resetting the calibration factor:

1. Ensure the power to the PlayStation is turned off.

2. Carefully remove the CompactFlash card from the Scrapman computer by sliding it towards the edge of the circuit board.

3. Connect the CF card to a PC using a suitable adapter. Be careful when inserting the CF card into the adapter as the pins a fragile and easily bent.

4. Open a file browser such as Windows File Explorer and navigate to the root of the CF card.

5. Select all the files and directories and copy them to a back-up location on the PC

6. Back at the root of the CF card identify the file *CalibrationSettings.xml*.

7. Open *CalibrationSettings.xml* in a text editor, any text editor such as notepad will do but don't attempt to use a word processor.

8. Find the line starting with `<Gain>` in the `<weight>` section and change the number between the tags back to 1.0 (be careful as there is also a `<Gain>` section in the `<Battery>` section).

9. Save *CalibrationSettings.xml* back to the CF card.

10. Safely eject the CF card from the PC. Don't just pull it out as it can be corrupted if it's not properly ejected (in Windows: right click on the drive letter for the CF card and select eject from the context menu)

11. Replace the CF card back into the Scrapman computer. Be careful not to bend any of the pins.

12. Turn on the power to the Scrapman computer.

3.4 Log Page

The Log page shows any logged information generated by the weighing system for example: errors, warnings and boot status. A typical Log page is shown in Figure 9.
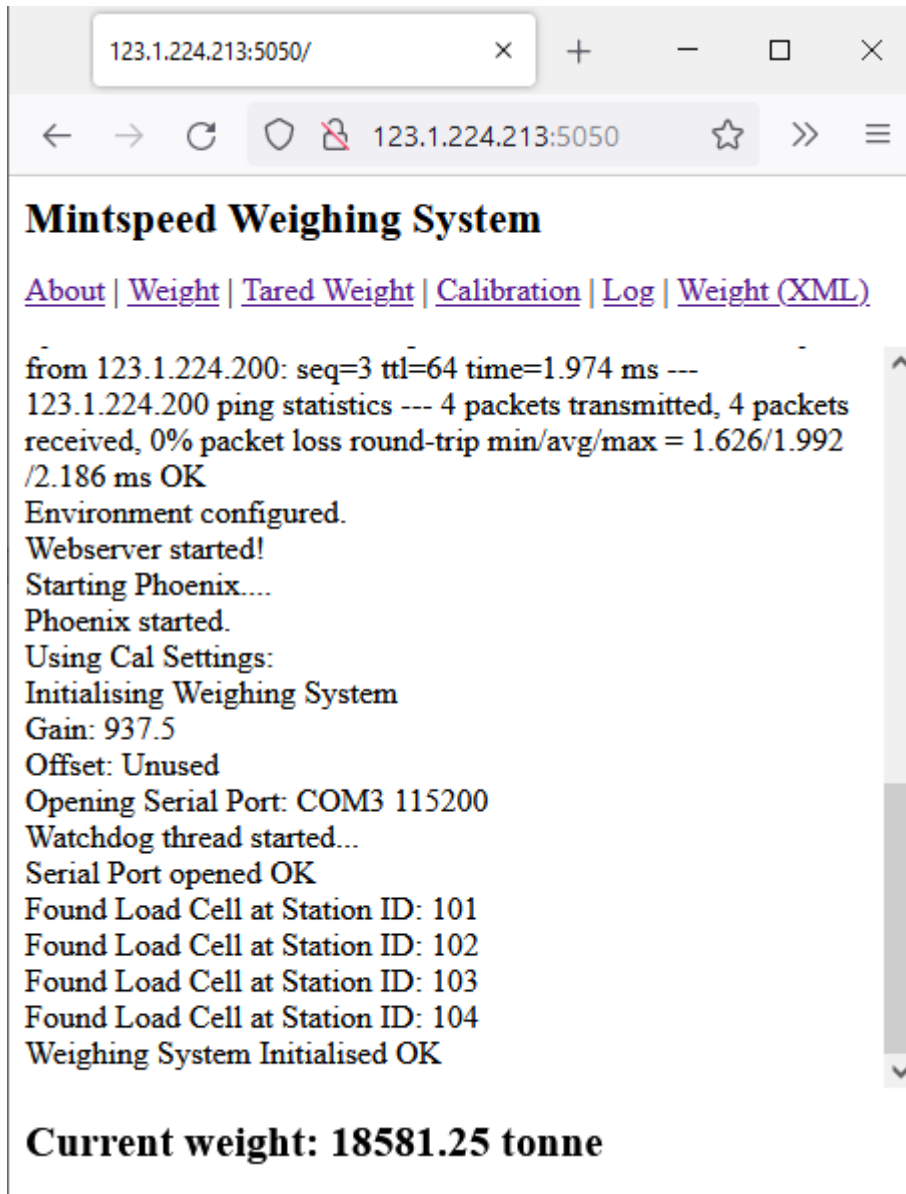
Figure 9: Typical Log Page

3.5   Weight (XML) Page

The Weight (XML) page allows the user to view the contents of the XML page in a browser although more typically the XML data is only used used via the API. The way this page is displayed is browser dependant however the user can usually view or save a copy of the XML file by right clicking in the browser window and selecting 'View Frame Source'.

3.6   Application Programming Interface (API)

The Scrapman weighing system is intended to be used with host software which would typically read the weights from the weighing system for further up stream processing.

To enable such software the Scrapman weighing System provides a simple API. The API is accessed using the same web server, on port 5050, as the HTML pages previously described.

Data from the API can be accessed in XML or JSON format. Both formats contain exactly the same information and user preference would usually dictate which to use.

The XML formatted data can be obtained by sending a standard HTTP request to the weighing system web server requesting *weight.xml* and the JSON formatted data can obtained by requesting *weight.json.*

Example code written in Python can be found on our GitHub page here: Python Demo Code

3.6.1 Example Requests:

To get weight.xml:

http://123.1.224.213:5050/weight.xml

To get weight.json:

http://123.1.224.213:5050/weight.json

3.6.2 Example weight.xml Page

The following is an example *weight.xml* page.

```xml
<?xml version="1.0" encoding="utf-8"?>
<IJMSoftware>
  <MintSpeed>
    <TrailerWeighingSystem>
      <System>
        <SoftwareVersion>03.62</SoftwareVersion>
        <XMLPageVersion>1.0.0</XMLPageVersion>
        <BatteryVoltage1>12.12</BatteryVoltage1>
        <BatteryVoltage2>12.11</BatteryVoltage2>
      </System>
      <Weight>
        <LoadCell1>
          <CurrentWeight>8397</CurrentWeight>
          <AverageWeight>8395</AverageWeight>
        </LoadCell1>
        <LoadCell2>
          <CurrentWeight>8543</CurrentWeight>
          <AverageWeight>8543</AverageWeight>
        </LoadCell2>
        <LoadCell3>
          <CurrentWeight>8360</CurrentWeight>
          <AverageWeight>8361</AverageWeight>
        </LoadCell3>
        <LoadCell4>
          <CurrentWeight>8416</CurrentWeight>
          <AverageWeight>8416</AverageWeight>
        </LoadCell4>
        <Total>
          <CurrentWeight>33716</CurrentWeight>
          <AverageWeight>33715</AverageWeight>
          <MinWeight>33704</MinWeight>
          <MaxWeight>33704</MaxWeight>
          <NetCurrentWeight>33704</NetCurrentWeight>
          <NetAverageWeight>33704</NetAverageWeight>
          <AverageLength>20</AverageLength>
        </Total>
      </Weight>
    </TrailerWeighingSystem>
  </MintSpeed>
</IJMSoftware>
```

Example weight.xml Page

3.6.3 Example weight.json Page

The following is an example *weight.json.*

```json
{"MintSpeed": {
    "TrailerWeighingSystem": {
        "System": {
            "SoftwareVersion": "03.62",
            "JSONPageVersion": "1.0.0",
            "BatteryVoltage1": "12.12",
            "BatteryVoltage2": "12.11"
        },
        "Weight": {
            "LoadCell1": {
                "CurrentWeight": "8397",
                "AverageWeight": "8395"
            },
            "LoadCell2": {
                "CurrentWeight": "8543",
                "AverageWeight": "8543"
            },
            "LoadCell3": {
                "CurrentWeight": "8360",
                "AverageWeight": "8361"
            },
            "LoadCell4": {
                "CurrentWeight": "8416",
                "AverageWeight": "8416"
            },
            "Total": {
                "CurrentWeight": "33716",
                "AverageWeight": "33715",
                "MinWeight": "33704",
                "MaxWeight": "33704",
                "NetCurrentWeight": "0",
                "NetAverageWeight": "3",
                "AverageLength": "20"
            }
        }
    }
}
}
```

Example weight.json Page

3.6.4 Programming Tips

At the outset, it must be clearly stated any mobile weighing system can never be as accurate as a static weighbridge. There are two main reasons, the first being the static weighbridge has substantial, rigid foundations of concrete and steel but the mobile equivalent has a dynamic mechanical structure which can flex, bend, and distort with weight, movement, and terrain. It has been observed (with a 200T trailer with 50T basket) to flex and bounce by up to 75mm when 2T of dense scrap has been dropped into the basket from a height of 10m. Secondly, the static platform is supported by load cells that **only** have to support weight in a vertical plane (compression) but the mobile option requires the load cells to be part of the structure to support the platform laterally as well as vertically. Additionally, scrap movements within the basket when the trailer is moved can also cause a shift in weight with respect to the centre of gravity.

Nevertheless, with correct weight processing, the results from a mobile platform can be nearly as good as a static one. The two Golden Rules for mobile weighing are;

   1   You must NEVER move a trailer when in the middle of loading.

   2   You must always use **relative weight** (or "change in weight") when adding new material.

A number of other factors also need to be considered when writing software for the Scrapman weighing system to get the best out of it.

   1. Do not poll the trailer unnecessarily. It is only essential to get the weight readings at high frequency when the trailer is actually involved in being loaded with material. At other times, for example when parked or being moved, it achieves nothing and wastes battery power.

   2. If the trailer is out of commission (for example being serviced) then as well as switching the trailer computer off, disable the trailer from the network until needed again.

   3. After moving the trailer to a new stock location, the weighing system **must** be tared before starting to load. Moving the trailer around the site may result in large apparent weight errors. These errors are caused by scrap in the basket settling and by how level the trailer is now compared to it's last stop; taring will clear these errors.

   4. Taring should be carried out within your software and host system. Host software should always use the "*Total/CurrentWeight*" or "*Total/AverageWeight*" fields from the XML or JSON files.

5. Check Battery voltages frequently and build in an alarm system if the voltage falls below 12.0V. The batteries may suffer permanent damage if discharged too much.

6. Carry out a "sanity check" when an empty basket is lowered onto the weighing system in the melt shop. This is the only time you may detect an error in the weighing system. You should have an idea what an empty basket weighs, and you should check for this when the empty basket is put down.

3.6.5 Example Loading Procedure

This section describes how an example load should be added to the trailer from multiple locations within a scrap yard.

The procedure that any controlling software must use is as follows:

1 Load the trailer with an empty basket, the weight recorded by the trailer at this point is unimportant.

2 The trailer is moved to a position where it can be loaded with, for example, 9t of scrap steel.

3 At this point you must be satisfied that the trailer is level.

4 Take a note of the weight that the trailer is reporting. This weight is effectively your zero. Let's call this weight **WT1**

5 Add scrap steel to the basket until the trailer reports a weight of **WT1 + 9t**, you now have 9t of scrap steel in the basket, Let's call this **WT2**

6 If more material from a different location is required, then:

7 Move the trailer to the new location and ensure that it is level.

8 Let's assume that at this new location we are going to add 5.5t to the basket.

9 Take a note of the weight that the trailer is reporting now. Let's call this **WT3**. **WT3** is effectively your new zero for the second load. It is unlikely that **WT3** will be equal to **WT2** (for the reasons described in section 3.6.4).

10 Add material to the basket until the weight reported by the trailer is **WT3 + 5.5t**

11 Repeat steps 6 to 10 until the recipe is complete.

You absolutely must not: turn the trailer on, zero the weight, drive off to first location add material drive to the next location add more material and so on, doing this will result in large errors.

You must make a note of the weight reported by the trailer after it's been moved and before you load more material.

All this usually requires a 3-way interaction between the tractor (trailer tow) driver, crane driver and a steel works computer system. For example:

1   Trailer driver receives instruction to move trailer to required location, usually via a display in his cab.

2   Trailer driver reports to steel works that he is in position and that trailer is level.

3   Steel works (software) takes a note of current weight reported by the trailer.

4   Crane drivers display is now set to zero either automatically from the steel works software or manually by pressing a button on his display.

5   Crane drive now loads steel into the basket until his display reads the required amount.

6   Crane drive reports to the steel works that the required amount has been loaded, usually by pressing a button on his display.

7   Repeat steps 1 to 6 until recipe is complete.

8   Trailer driver to take the trailer to the melt shop.

4   Alternative Networking

As described in section 2.3 the PlayStation is supplied with a nano router which enables the user to set up a pre-configured wireless network. It is possible, however, to connect the PlayStation to an existing network.

4.1   Wired Network.

If a wired, Ethernet network supporting DHCP is available then the PlayStation can be connected to the network as follows:

- Ensure the power to the PlayStation is turned off.

- Move the Wi-Fi/LAN switch (SW3) on the Scrapman computer to LAN position.

- Connect an Ethernet cable between the RJ45 socket on the Scrapman computer and the network.

- Turn on the power to the Scrapman computer.

The Scrapman computer will boot and obtain an IP address through DHCP. It would be wise to allocate a specific IP address to the PlayStation so that it can be found easily on the network.

4.2   Wi-Fi Network

Connecting the PlayStation to a different Wi-Fi network is a little more complicated and will require the user to edit configuration files on the CompactFlash (CF) card. This cannot be done in situ and so the CF card must be removed from the Scrapman computer and connected to a PC using a suitable CF adapter.

Before attempting this it is strongly advised that you back up the supplied CF card and have spare CF cards available in case of mishap.

1. Ensure the power to the PlayStation is turned off.

2. Carefully remove the CompactFlash card from the Scrapman computer by sliding it towards the edge of the circuit board.

3. Connect the CF card to a PC using a suitable adapter. Be careful when inserting the CF card into the adapter as the pins a fragile and easily bent.

4. Open a file browser such as Windows File Explorer and navigate to the root of the CF card.

5. Select all the files and directories and copy them to a back-up location on the PC

6. Back at the root of the CF card identify the files: *CommsSettings.xml* and *local.cfb*.

7. Open *local.cfb* file in a text editor, any text editor such as notepad will do but don't attempt to use a word processor.

8. Edit the following lines:

   - **wl-ssid scrapman** (such that scrapman is replaced with the SSID of the new network)

   - **wl-dhcp 0** (Change it to **wl-dhcp 1** if using DHCP else leave it as is)

   - If not using DHCP change **wl-ip**, **wl-subnet**, **wl-gateway**, **dns-server1** and **dns-server2** to match the requirements of the new network.

   - If using DHCP comment out the lines starting with **wl-ip**, **wl-subnet**, **wl-gateway**, **dns-server1** and **dns-server2** by inserting a '#' character at the start of each line.

   - **pw-wpa-psk scrapman** by replacing scrapman with the pass phrase of the new network.

9. Save *local.cfb* back to the CF card.

10. Open *CommsSettings.xml* in a text editor.

11. Find the line: `<ConfigFile>scrapman.cfb</ConfigFile>` and change scrapman.cfb to local.cfb.

12. Save *CommsSettings.xml* back to the CF card.

13. Safely eject the CF card from the PC. Don't just pull it out as it can be corrupted if it's not properly ejected (in Windows: right click on the drive letter for the CF card and select eject from the context menu)

14. Replace the CF card back into the Scrapman computer. Be careful not to bend any of the pins.

15. Find the Wi-Fi reset switch on the scrapman computer. It labeled SW4.

16. The Wi-Fi reset switch is spring loaded. Switch it over to reset and hold it in that position. Turn on the power to the Scrapman computer and wait for 15 seconds before releasing the switch.

17. Turn the Scrapman computer off and then on again, this will cause the computer to reboot using the new settings.