INSPIRE - 100

An Emergency Ventilator Device

Web Applications Manual

TekMedika

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Introduction

In addition to the front panel, INSPIRE-100 provides the ability to remotely monitor all ventilation sessions via a WEB dashboard. Doctors and technicians can use the dashboard to connect to any INSPIRE-100 system using a unique system ID embedded in each system. This feature is useful to enable a remote specialist to observe the key system and patient parameters during a session and suggest a course of action for the local practitioners.

Key Concepts

The system captures extensive data during ventilation sessions, including:

- Ventilation modes and settings
- Peak, Plateau, and PEEP pressures
- Tidal and Minute volumes
- Fraction of inspired oxygen (FiO2)
- Mandatory and Spontaneous breaths per minute (BPM)
- Breath pressure and flow waveforms
- Alerts and messages

This data is recorded for each breath, and its utility hinges on effective selection, analysis, and visualization methods. The system supports both online and offline monitoring, as well as local and remote data visualization.

For effective navigation of the reams of ventilator output data, two mechanisms are essential.

1. Easy selection of a range of breaths to be visually inspected.
2. Easy search for breaths that meet a specified, arbitrarily complex condition.

The fundamental premise for data search and selection is as below.

- All data search and selection are with reference to breaths.
- Each breath can be uniquely identified by one of the two parameters below.
    a. BREATH_NUMBER (starting from 1 as the first logged breath).
    b. WALL_TIME (wall clock time as per the local time-zone).

Online, Offline, Local and Remote Monitoring

In the context of this document, the definition of these terms is as below.

- Online: Analysis occurs in real-time during the ventilation session, displaying data as breaths are delivered.
- Offline: Analysis takes place after the session, assuming prior recording of data.

- Local: Data storage and visualization occur on the ventilator itself without external devices.
- Remote: Data is stored externally, requiring communication tools like Wi-Fi and external devices for visualization.

Organizing the four monitoring scenarios (online, offline, local, remote) into a 2x2 grid provides a clear conceptual framework to understand the different possibilities and their unique constraints and opportunities. This structured approach helps in designing effective solutions for each quadrant.

	ONLINE	OFFLINE
LOCAL	Only basic visualization and storage can be provided on the front panel. Otherwise, it adds prohibitively to system cost . Local storage is not enough - no disks. Local compute power is not enough for complex visualization. Local Hardware Graphics Engine is not available. Local Screen area is not enough.	
REMOTE	Ample compute power. (On desktops down to smartphones.) Pre-built Operating Systems by default. Users familiar with Windows, MacOS, iOS, Android. Pre-built, free Software (browsers) by default. Graphics Libraries available by default.	Ample compute power. Ample storage - can store multiple sessions. (On desktops down to smartphones.) Pre-built Operating Systems by default. Users familiar with Windows, MacOS, iOS, Android. Pre-built, free Software (browsers) by default. Graphics Libraries available by default.

Figure 1: Online, Offline, Local and Remote

The grid directly leads to the design principles for the INSPIRE-100 system

1. Locally, i.e. on the physical front panel of every machine, display the key parameters of every breath as it is delivered. The parameters include the peak, plateau and PEEP pressures. These are displayed as big, bold numbers using LED segments so that they are readable from far.

2. In addition, there is a text LCD screen on the physical front panel on every machine to display key messages. The messages are prioritized as there are multiple message sources within the system. The highest priority are errors and warning messages. In the absence of these high priority messages, the LCD display cycles through a periodic display of other parameters of interest such as Minute-Volume, Spontaneous BPM etc.

3. This keeps the front panel of the system simple and user friendly. We submit it is a waste of resources to provide a front panel graphical LCD screen on every system for the following reasons.

    a. For a graphical LCD display screen to be user friendly, it must be of a reasonable size, the bigger the better. Small LCD screens are not user friendly. But big LCD screens (with graphics controllers) add significantly to the cost of each system, which is wasteful.

b. Instead, INSPIRE-100 provides virtual screens that use a single, large common LCD screen. The different views of all systems are constantly updated on their own dedicated virtual screens. So, once set up, it is a simple matter of switching between different virtual screens to monitor different systems on the same physical screen.

c. Instead of graphical LCD screens on every system, INSPIRE-100 equips each system with Wi-Fi functionality, which is a small fraction of the overall cost.

d. Wi-Fi is used to send relevant data to the cloud for every delivered breath (much like IOT devices). A WEB software system receives this data, stores it, organizes it and presents a variety of more complex views of the system.

e. This takes full advantage of ubiquitous laptops and smartphones. Not only do these devices offer ample storage and computing power, they also come with many sophisticated software packages that can be utilized without re-inventing the wheel.

4. Finally, providing local and offline access for past ventilation sessions on every physical system is also wasteful of resources. This would require storage of vast amounts of data storage locally on each machine, which is unnecessary if we provide a remote solution for this quadrant.

Accordingly, the grid below shows the INSPIRE-100 solutions for each quadrant.

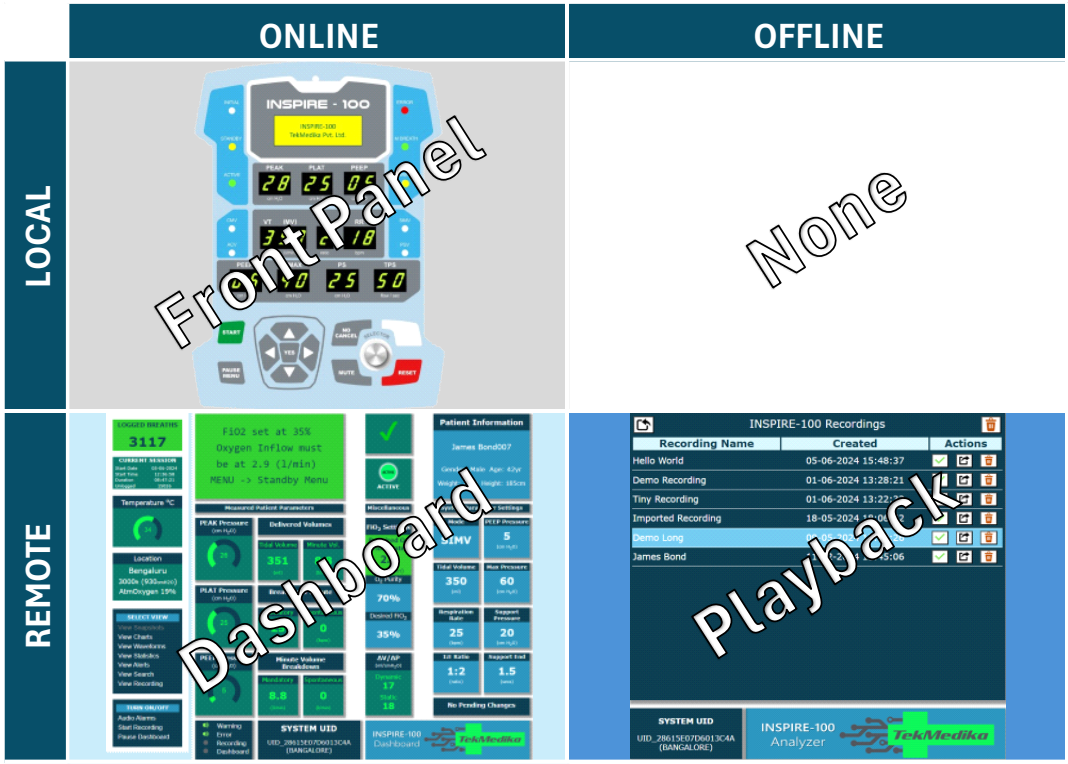


Figure 2: Monitoring Quadrants

INSPIRE-100 System Wi-Fi Login

For the WebApps to function, the target INSPIRE-100 system must login to a Wi-Fi network. A brief overview of the process is as follows.

1. There must be a Wi-Fi network at the site where the INSPIRE-100 system is deployed. If required, use a 4G/5G dongle to establish a Wi-Fi network. One dongle can serve multiple systems at the same site at the same time.
2. There must be Wi-Fi or wired internet at the monitoring site.
3. Enable WEB dashboard monitoring on the INSPIRE-100 system.
4. Allow the INSPIRE-100 system to log on to the Wi-Fi network.
5. Visit the provided URL at the monitoring site.
6. Pair the WEB dashboard at the monitoring site with the INSPIRE-100 at the deployment site using the INSPIRE-100 System Unique ID.
7. WEB Applications allow monitoring only. Remote control of the system is not permitted.

During the start-up sequence, the system gives an option to enable or disable remote monitoring for the system. Once enabled, the system guides the user to set up the remote WEB Apps.

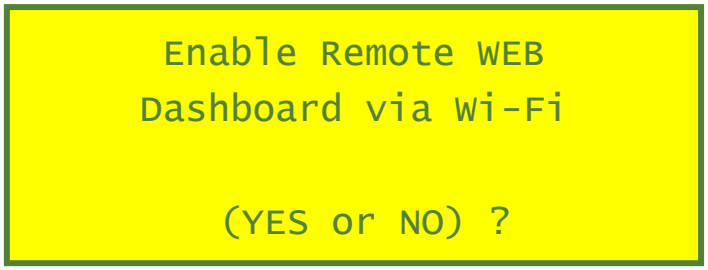


Figure 3: Enable/Disable Wi-Fi login

Setting up Wi-Fi credentials

INSPIRE-100 system remembers the history of prior Wi-Fi networks that have been used by the system. The user is provided with an option to either auto-connect to a previously known Wi-Fi network or to configure a new one. If desired, the recorded Wi-Fi history can be erased at this time.

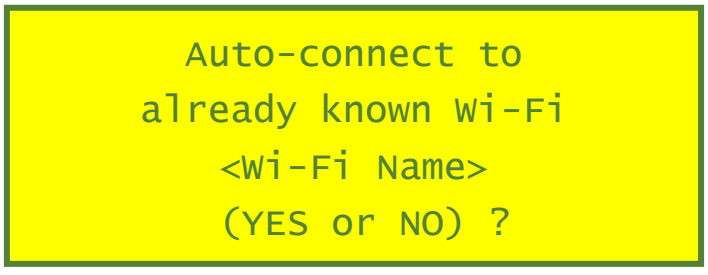


Figure 4: Wi-Fi Autoconnect

If Auto-connect is not enabled or if Auto-connect fails, the next option is to use a configuration portal to setup a new Wi-Fi network for the system to log in to. To enable login through a configuration portal, the system sets up a local, temporary Wi-Fi network named “INSPIRE-100 Wi-Fi”. The user can use either a wifi-enabled laptop or a smartphone to log on to this network.

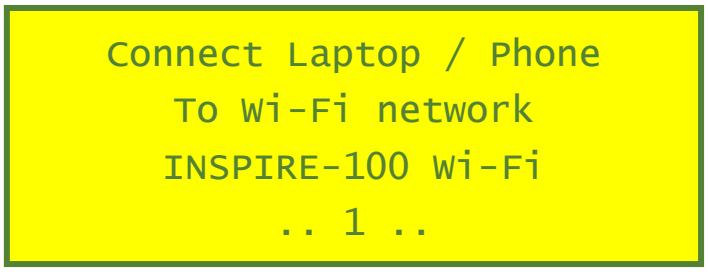


Figure 5: Connect to INSPIRE-100 Wi-Fi network

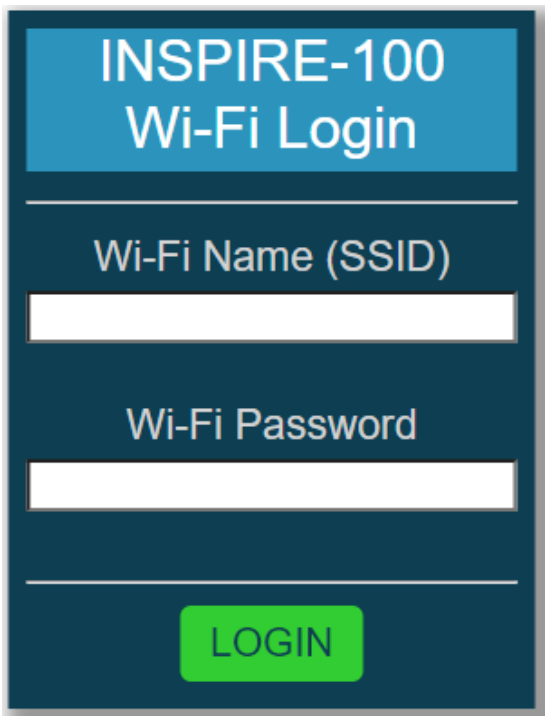


Figure 6: Wi-Fi Configuration Portal

Upon login to this "INSPIRE-100 Wi-Fi" network, a portal screen is automatically presented on the laptop or the smartphone which guides the user step-by-step to enabling system to login to a desired Wi-Fi network. The portal time out in 2 minutes if unable to log on for whatever reason. If the system times out, the user can retry as many times as desired.

WiFi login has two options as below.

1. Anonymous

   No message is sent to the Web Apps portals to announce the login. Only those browsers with prior knowledge of the particular system can connect to it. The "My Systems" page, described later, is the key for a browser to remember a particular INSPIRE-100 system.

2. Broadcast (OTP)

A message is sent to all currently active Web Apps portals to announce the login. An OTP will be generated and displayed on the INSPIRE-100 system's Front-panel. Only those browsers with knowledge of the OTP (One Time Password) system can connect to it.

Upon a successful Wi-Fi login, the system is now ready to be connected to the WEB Apps using the unique system id (SYSUID). The SYSUID is a 20 character string starting with the prefix "UID_" followed by 16 hexadecimal digits. Another option is to connect using the OTP displayed as below. Further details can be found in the next section.

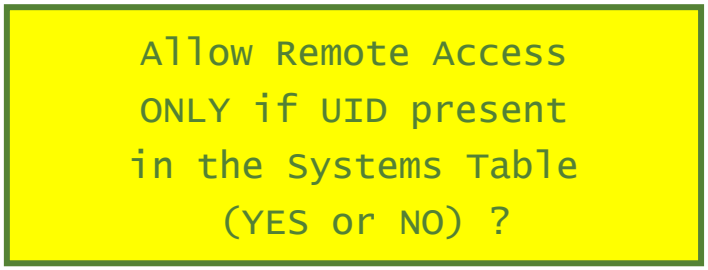


Figure 7: Login Privacy Selection

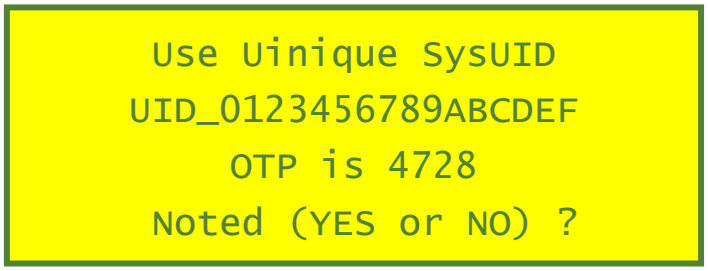


Figure 8: Wi-Fi Login Successful

Main WebApps Portal

The screenshot below is the main portal menu which is accessed via a browser at the URL below. All WebApps are launched using this main menu.

https://www.tekmedika.com/inspire-100

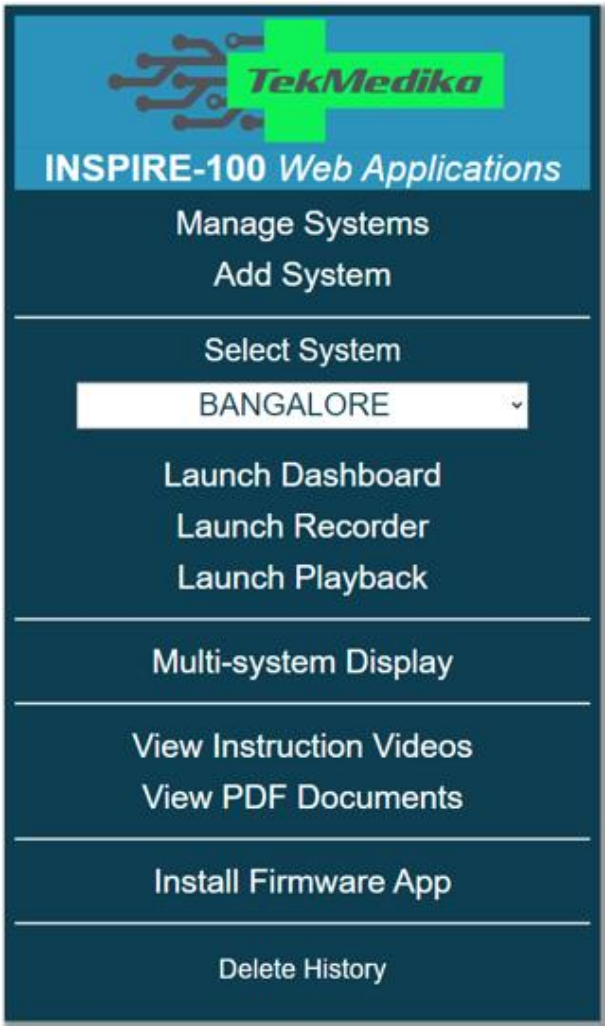


Figure 9: Web Apps Main Menu

For Keyboard Displays

Use CTRL key and +/- keys to zoom in/out
or hold down the CTRL key and use the mouse wheel to zoom in/out
till the content fits well in the browser screen.

For Touch Displays

Use two fingers to zoom in/out

The following WebApps are available via the buttons on the main menu.

- ***Launch Dashboard*** - Monitor a ventilation session remotely. It requires a SysUID to be selected to determine the INSPIRE-100 system to connect to.

- ***Launch Recorder*** – Though a recording can be done through the Dashboard App, the Recorder App is a lightweight app to record a session without all the features of a dashboard. It uses less memory. It requires a SysUID to be selected to determine the INSPIRE-100 system to connect to.

- ***Launch Playback*** - Playback a previously recorded session. It requires a SysUID to be selected to determine the INSPIRE-100 system to connect to.

- ***Multi-system Display –*** Shows the current state of each system in the systems table.

- ***View Instruction Videos –*** Demo videos for each WebApp.

- ***View Documentation –*** All the pdf documents are accessible through this link. If a "PDF Viewer" extension is loaded in your browser the documents can be read online or else, they can be downloaded

- ***Install Firmware App –*** Download and install a WINDOWS or MACOS app on the user's laptop to enable firmware upgrades for the INSPIRE-100 system.

Instruction Videos

The “View Instruction Videos” button on the main portal menu leads to another menu as shown below. This menu provides links to all instruction videos provided. Each instruction video demos the use model for the corresponding WebApp.

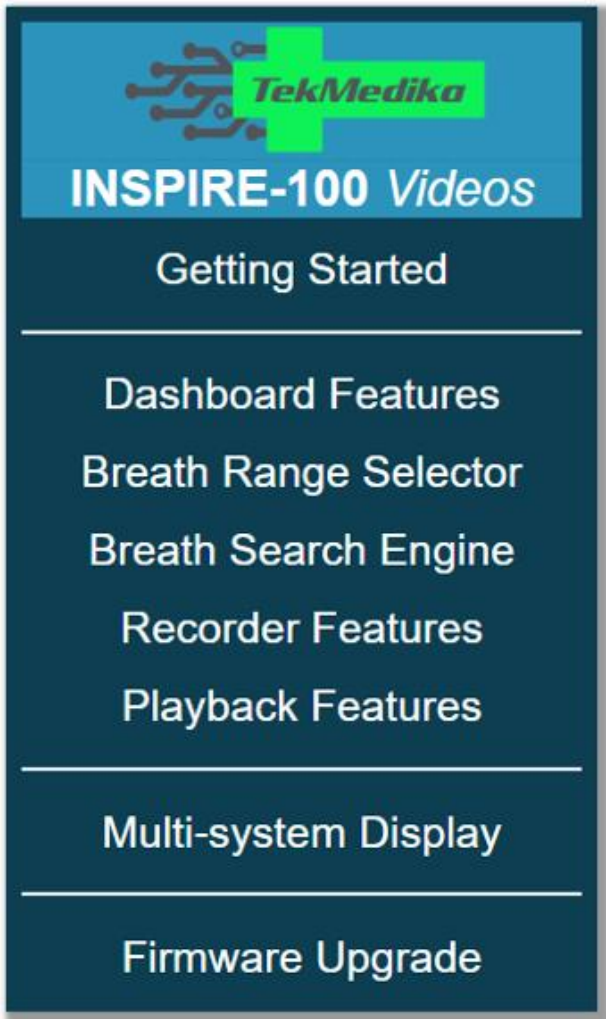


Figure 10: Instruction Videos

It is recommended that the users watch the relevant videos to understand the detailed use model for each WebApp. It is recommended that the videos be watched in the listed order as each video builds on the previous one.

Systems Table

All the Web Apps communicate with a particular INSPIRE-100 system via a Unique System ID (UID). Each INSPIRE-100 system has a built-in UID which is 20 characters long (e.g. UID_AAAABBBBCCCCDDDD). This UID is displayed on the system's front panel upon a Wi-Fi login. It can also be accessed via the STANDBY menu on the system.

Each time a system logs in, the main portal page displays a popup message as below.

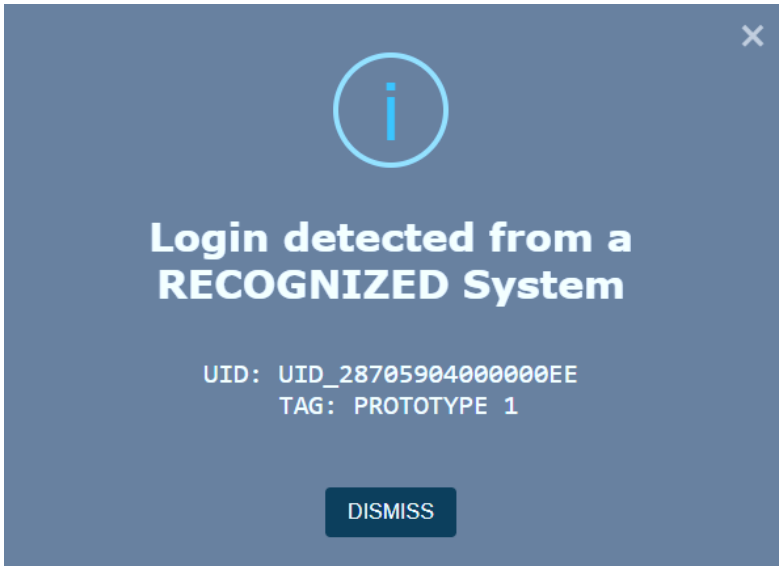


Figure 11: Login Message Popup

The main portal holds a table of the INSPIRE-100 systems it recognizes. Initially this table is empty. Once populated using a browser, it is accessible for all times after that in that browser. The table is accessed via the "Manage My Systems" button.

Each unique system id (SYSUID) of the INSPIRE-100 systems can be associated with an easy to remember name tag. The browser remembers the history of all the SYSUIDs that have been used and presents them in the dropdown list in the main menu box above.

The table of name tags and associated SYSUID (Systems Table) is accessed through the "Manage My Systems" button. The + menu button on the Systems Table adds a system. To select a system to communicate with either double click on the appropriate row or use the checkmark button against the row. A system can be removed from the table using the trash menu button in the appropriate row. The trash button on the top right removes all system information. The systems table can also be exported as a JSON file and can be imported from a JSON file by clicking the appropriate icons on the table banner. Finally, the back arrow menu button on the top left can be used to navigate back to the main menu.

Adding System Credentials

There are two ways to populate the systems table.

1. If you know the UID of your system(s), simply add the information using the “Add New System” button. Each system can be assigned a tag name so that it is easy to remember and access. The popup for “Add New System” is shown below.

Figure 12: Add a new system to Systems Table

2. Every time a recognized or unrecognized system logs in, there is a message displayed on the portal web page. In case of an unrecognized system, the portal popup message provides an option to add the unrecognized system to the systems table using an OTP displayed on the system’s front panel.

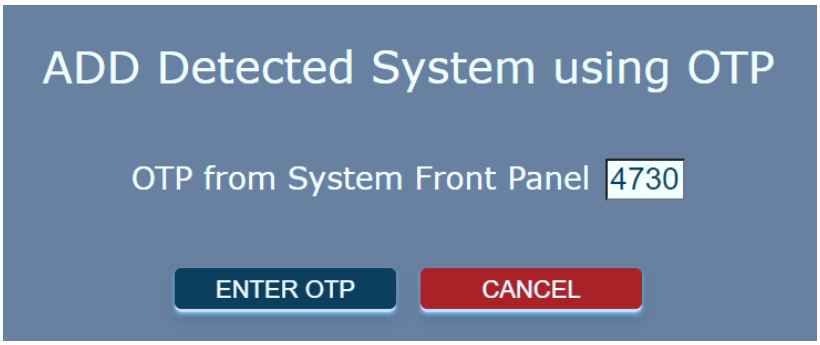
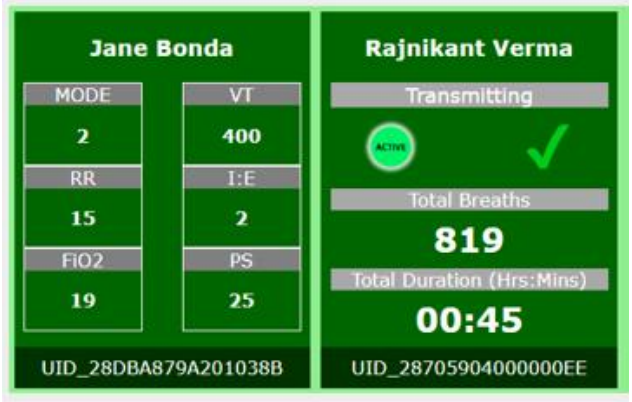


Figure 13: Add a new System using OTP

Multi-System Display

This button presents a bird's eye view of all systems that are entered into the "My Systems" table. The view is composed of live tiles, each showing the current state of the corresponding system. Also, Audio alarms can be turned ON or OFF. Figures below show sample screenshots of this view.



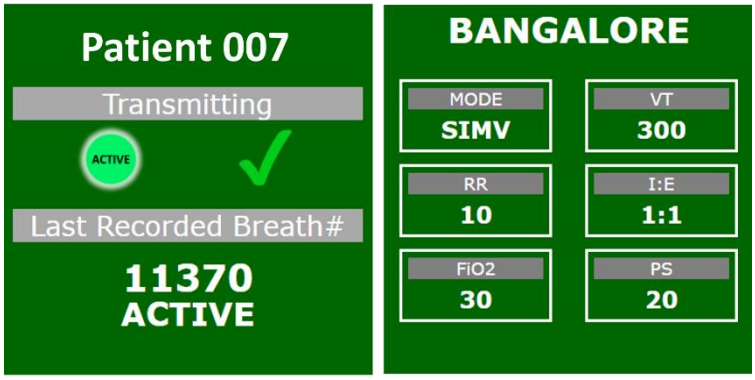


Figure 14: Alternating views of an active System

Figure 16: One System Active, Two Inactive

Hovering on a tile brings up a menu as shown below. The menu can be used to directly launch the dashboard or the recorder for the system.

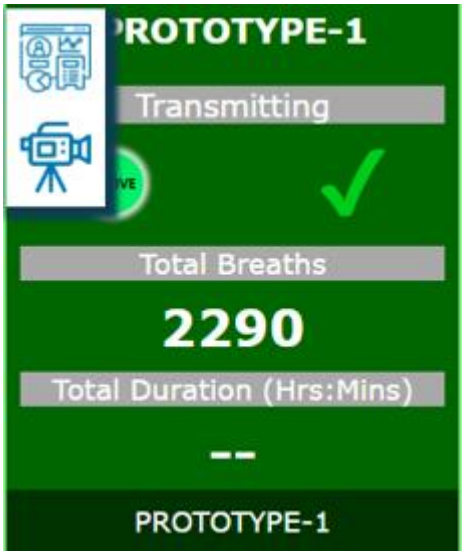


Figure 15: System Tile Menu

WEB Dashboard

The online, live WEB dashboard offers a choice of multiple views of the ventilation session being monitored. The user can switch between these views at any time.

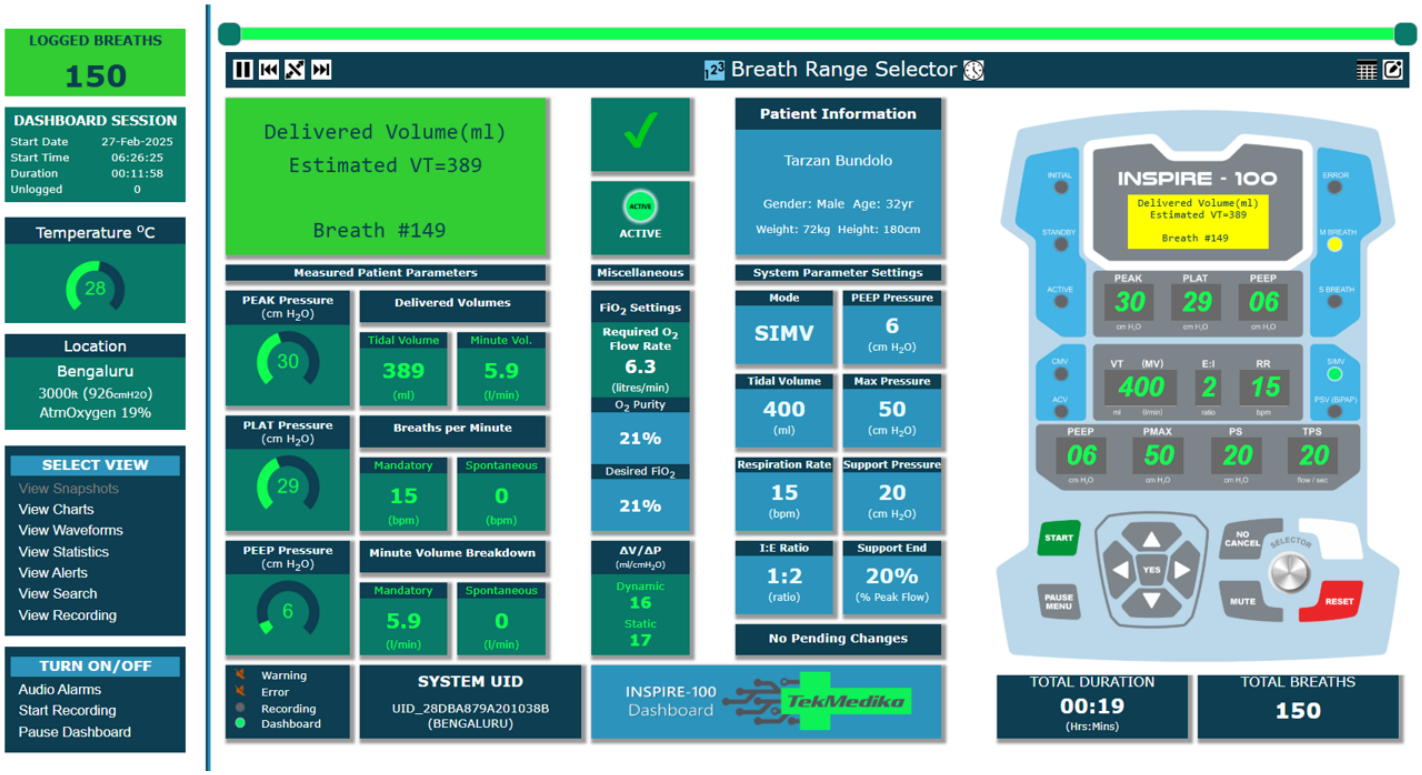


Figure 17: Web Dashboard Home Screen

On the top of the sidebar is a display of the number of breaths that the current dashboard session has logged. In case the dashboard was launched after the ventilation session had been active for some time, it also shows the number of breaths that happened prior to the launch of the dashboard as unlogged breaths.

The next box shows some relevant summary data for the current session. It includes the start time for the Dashboard and the duration for which it has been active.

The next box shows the current operating temperature that the system is at. The following box is the system's deployment altitude.

The next box allows for turning on/off audio alarms, session recording and dashboard updates.

The next box allows for selecting the type of view to display. Available views are as below.

1. Snapshots view
2. Charts view
3. Waveforms View
4. Statistics view
5. Alerts view
6. Search View
7. Recording View

Front Panel Replica

On the right of the Web Dashboard screenshot is a replica of what the actual physical system is currently displaying on its front panel.

Figure 18: Front Panel Replica

Dashboard Audible Alarms

By default, all audible alarms are turned ON. The audio alarms can be selectively turned ON/OFF using the “Control Audio Alarms” button. Below is a screenshot of the Audio alarm settings.

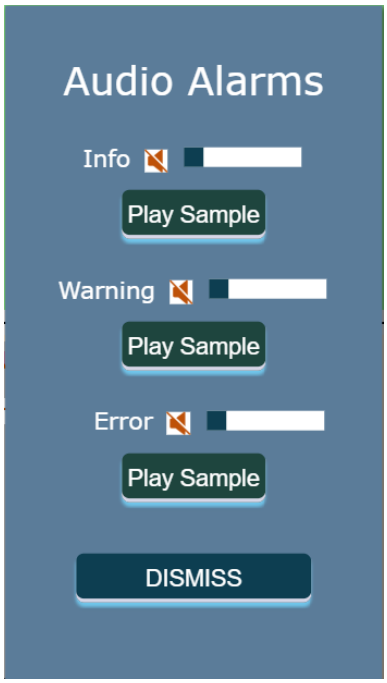


Figure 19: Setting Audio Alarms

Dashboard Snapshots View

Below is a screenshot of the WEB Dashboard “Snapshots View”. All the INSPIRE-100 parameters, both input and output, are presented on the dashboard for easy viewing as a cohesive whole.

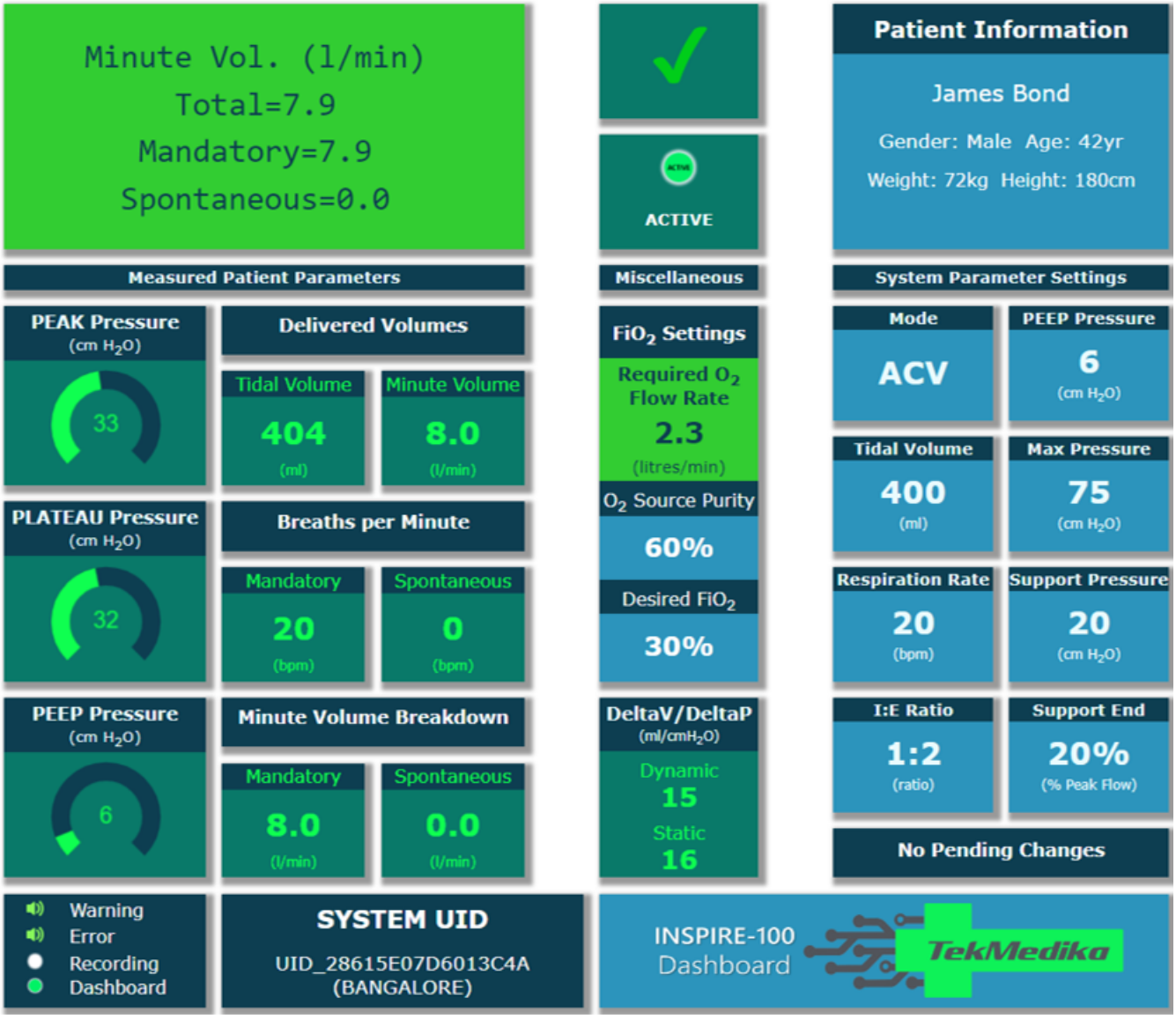


Figure 20: Dashboard Snapshots View

Dashboard Charts View

The Dashboard also provides an option for a “Charts View”. A screenshot of the charts view is shown below. This screenshot shows three chart boxes. A chart box can be added at any time using the + menu button on the top left of the chart box. Use the trash menu button on the top right to delete a chart box.

The parameters to chart can be selected using the checkboxes on the edit menu. The edit menu button is also on the top right of each chart box. The charts are updated after every breath. The X-axis can be selected as breath number or as elapsed time between breaths.

By default, the system charts the selected parameters for the past 60 breaths on a rolling basis, the charts are updated after each breath.

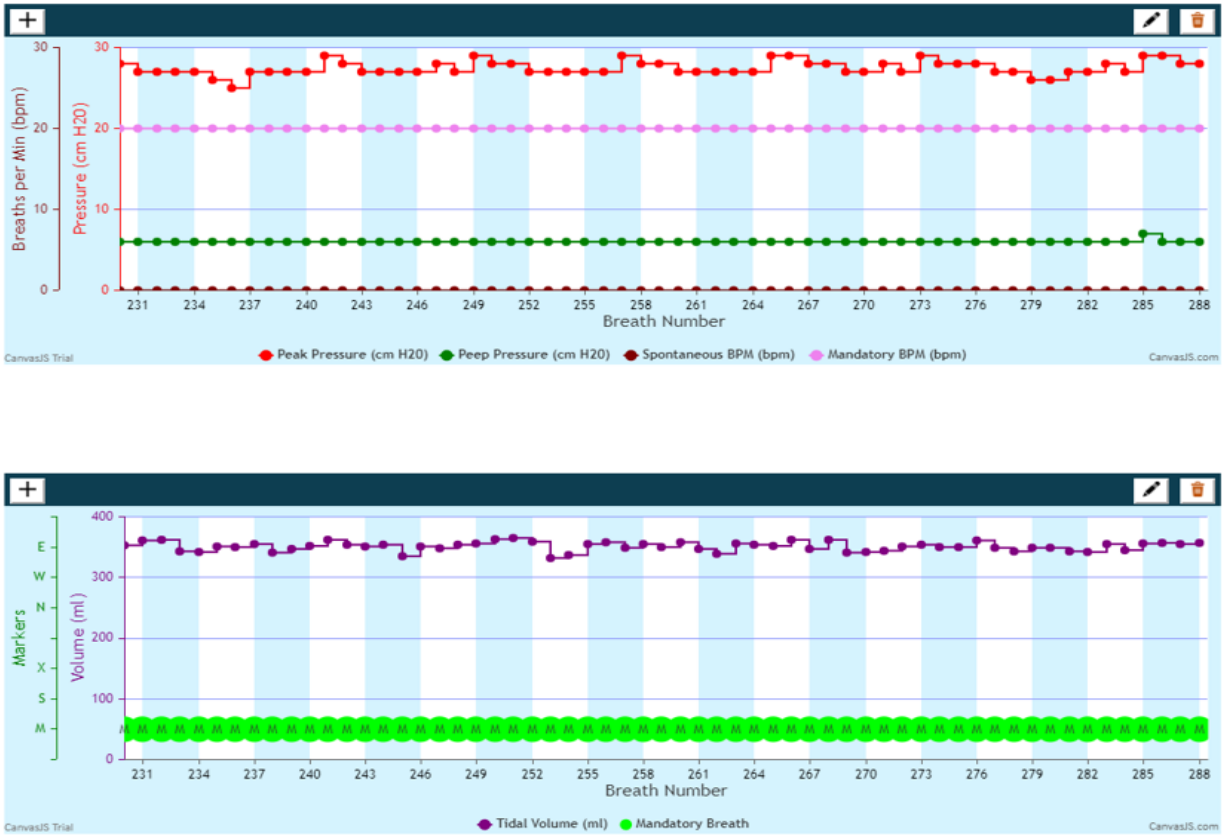


Figure 21: Dashboard Charts View

The chart box edit menu is shown below. Any collection of the shown parameters can be displayed in any chart box or in multiple chart boxes.

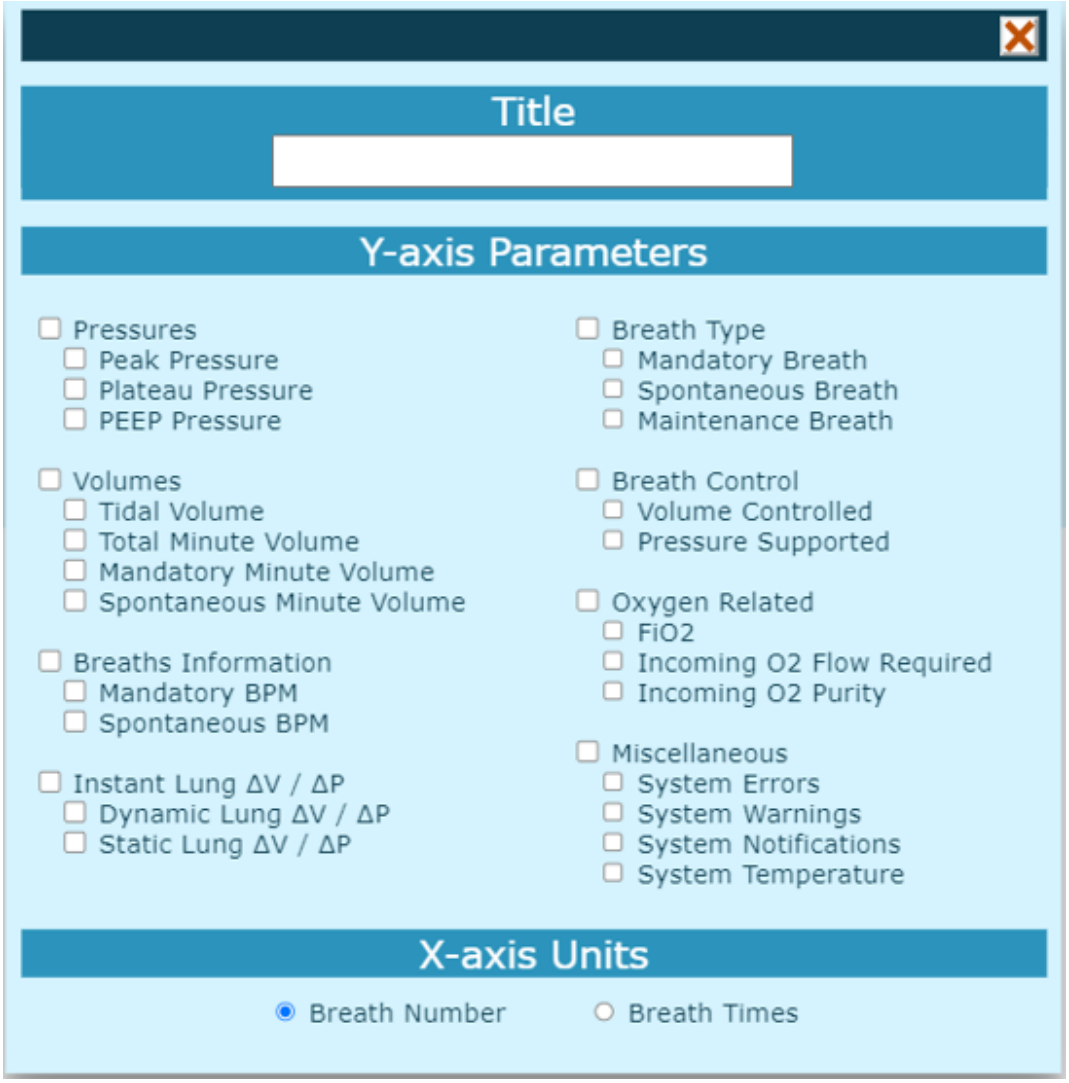


Figure 22: Charts Edit Menu

Dashboard Waveforms View

The Dashboard also provides an option to view the detailed pressure and flow waveforms for selected breaths. Figure below shows a sample of such a view.

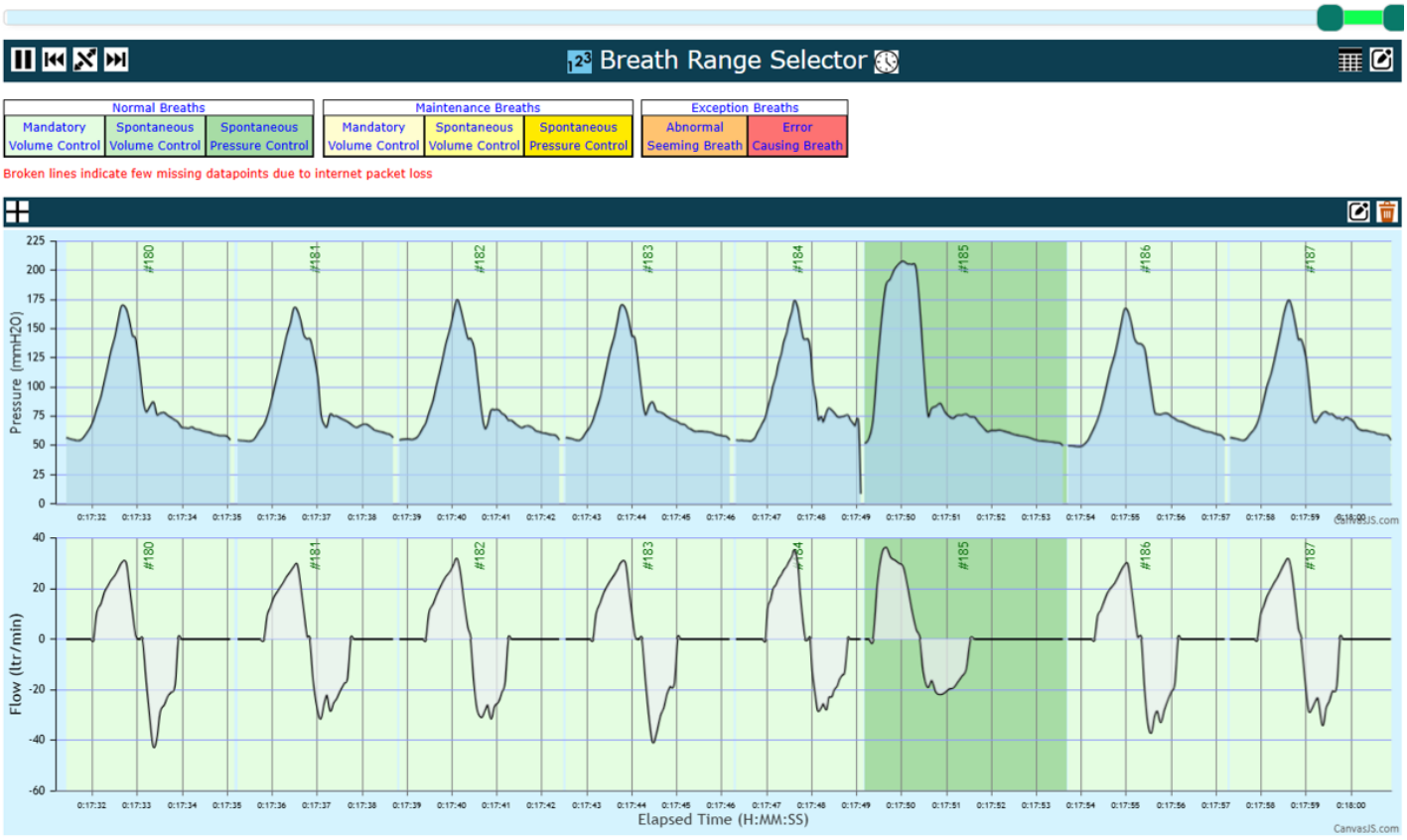


Figure 23: Breath Detailed Pressure and Flow Graphs

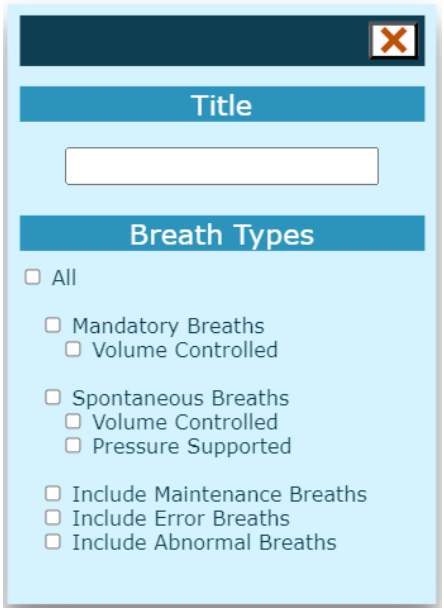


Figure 24: Breath Type Menu

The EDIT icon on each box allows the selection of the kinds of breaths to display. The graphs are color coded as per the legend at the top of the page. The breath selection menu is shown in the Figure below.

Dashboard Statistics View

The Dashboard also provides an option for a “Statistics View”. A screenshot of the statistics view is shown below.

The statistics are collected for the selected range and updated after every breath by default. The range slider can be used to gather statistics for any range of breath numbers.

Parameters Measured

Parameter	Units	Min	Max	Avg
Peak Pressure	cmH20	21	26	25.7
Plateau Pressure	cmH20	19	24	23.7
PEEP Pressure	cmH20	3	6	5.0
Tidal Volume Delivered	ml	284	966	311.9
Total Minute Volume	litres/min	0	5.8	4.3
Mandatory Minute Volume	litres/min	0	4.6	4.1
Spontaneous Minute Volume	litres/min	0	1.9	0.2
Mandatory BPM	bpm	0	15	13.8
Spontaneous BPM	bpm	0	2	0.2
FIO2	%	35	35	35.0
Static ΔV/ΔP	ml/cmH20	0	18	15.9
Dynamic ΔV/ΔP	ml/cmH20	0	16	14.4
System Temperature	degC	35	35	35.0

Miscellaneous Information

Information	Value
Number of Breaths	120
Number of Mandatory Breaths	118
Number of Spontaneous Breaths	2
Number of Maintenance Breaths	0
Number of CMV Spontaneous Breaths	0
Number of Missing Intervals (Packet loss)	0
Number of WiFi Disconnects	0
Number of Notifications	0
Number of Warnings	0
Number of Errors	0

Static Information

Patient Name: James Bond007
Gender: Male Age: 42yr
Weight: 76kg Height: 185cm

System Location: Bengaluru
Location Altitude: 3000 ft
Location Atmospheric Pressure: 930 cmH2O
Location Atmospheric Oxygen: 19%

Parameter Settings Used

Parameter	Units	Values
Ventilation Mode	mode	SIMV
Tidal Volume	ml	300
Minute Volume	l/min	2
Respiration Rate	bpm	15
I:E Ratio	ratio	1:2
PEEP Pressure	cmH20	5
Maximum Pressure	cmH20	85
Support Pressure	cmH20	20
Support Pressure Termination	%flow,secs	1.5
FIO2	%	35

Sequence of Parameter Combinations

MODE	VT/MV	RR	I:E	PEEP	PMAX	PS	TPS	FIO2	#BREATHS	Before#
SIMV	300	15	1:2	5	85	20	1.5	35	119	2

Figure 25: Dashboard Statistics View

Dashboard Alerts View

The Dashboard also provides an option for a “Alerts View”. A screenshot of the alerts view is shown below. By default, it displays the complete history of errors and warnings encountered within the selected range of breaths.

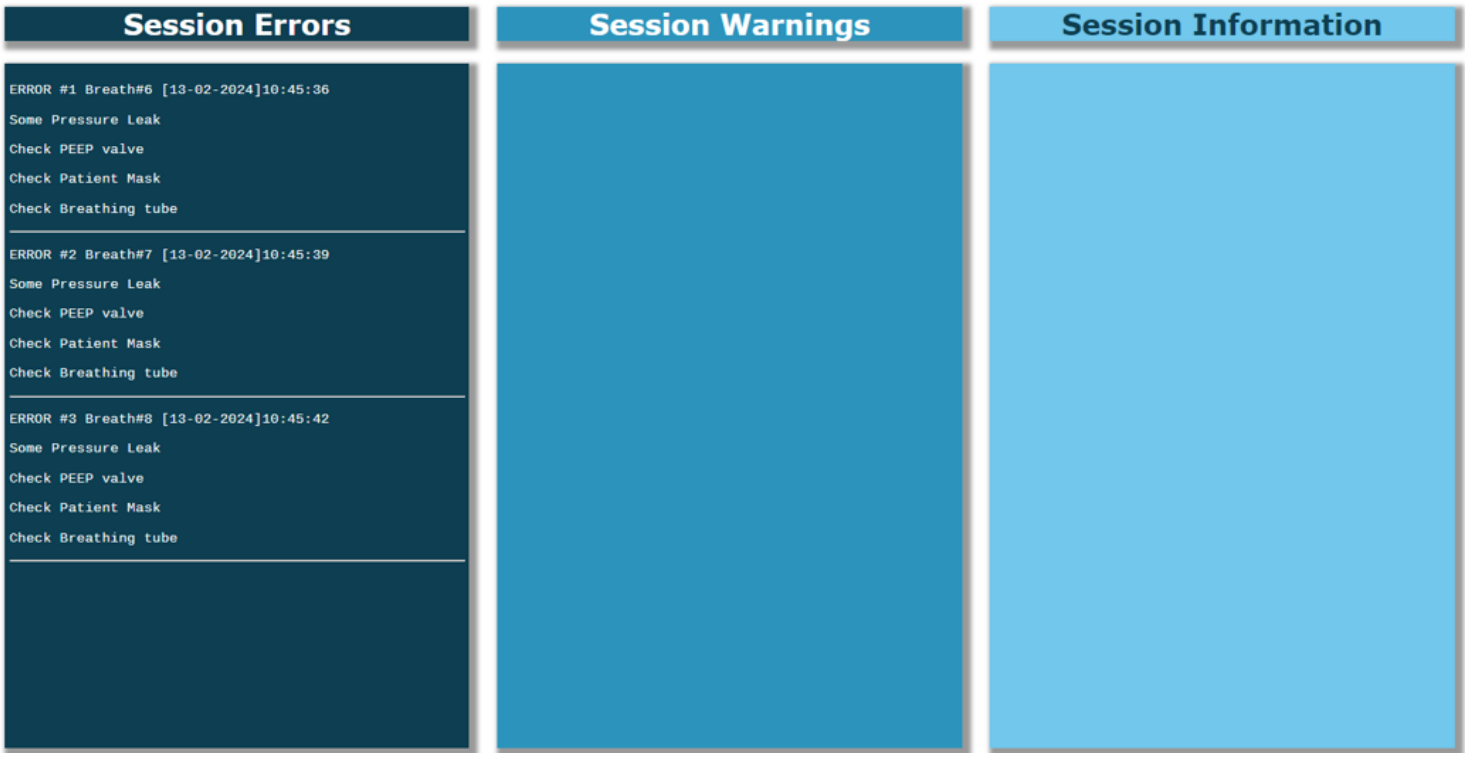


Figure 26: Dashboard Alerts View

Search View

Though the range selector covered in the previous section is a powerful analysis tool, the Search-engine adds to it significantly. The Search-engine enables searching for times where a combination of events is detected. This combination of events is referred to as Search Criteria and can be arbitrarily complex.

The Search-engine provides a graphical interface to build the search criteria from pre-defined and menu-driven “primitive queries”.

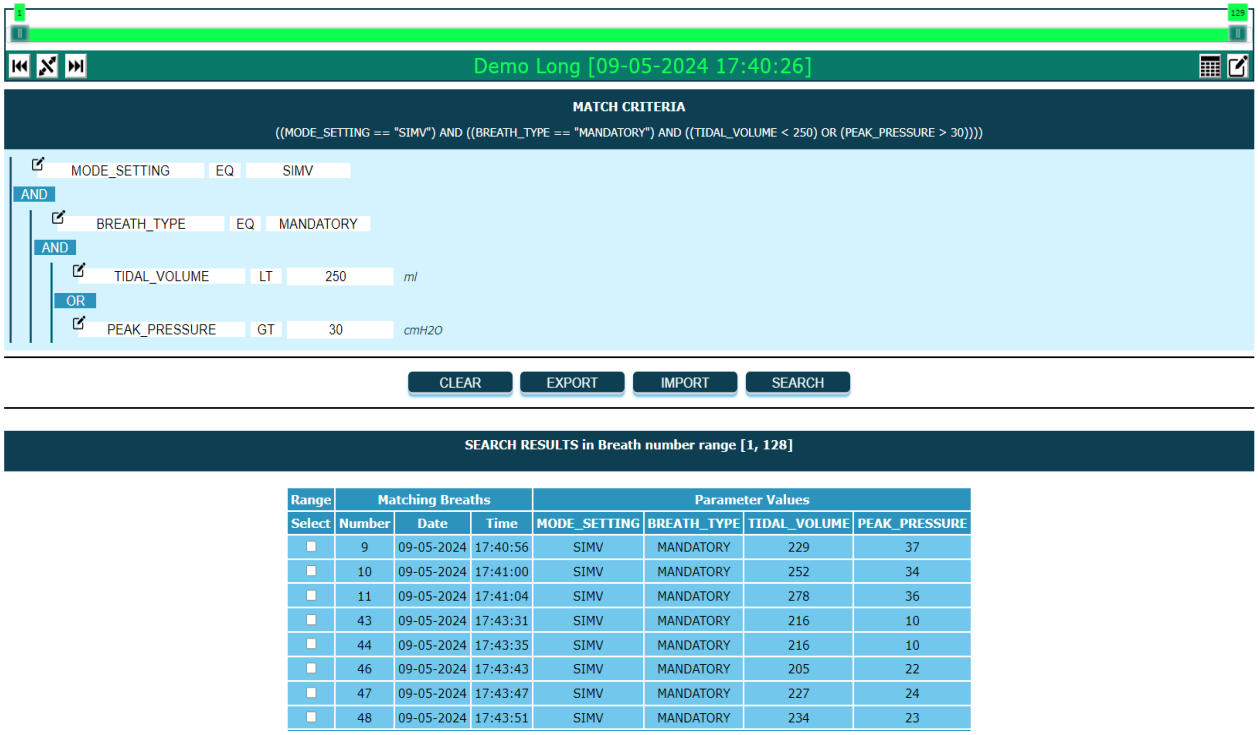
A primitive criterion is composed of three fields. The three fields are a parameter, a value, and the parameter’s relationship to a value.

The parameter field is a set of predefined parameters which can be selected using a drop-down menu of choices. These parameters are pre-defined and include a wide range of ventilation parameters that the system keeps track of.

Depending on the parameter selected, the range of possible values is selectable from another drop-down menu. This drop-down menu changes dynamically as the parameter is selected.

Just like the values that depend upon the parameter type, so do the relationships of the parameter to the value. For instance, numeric parameters can be related to a value using the mathematical operators such as “< , <=, >, >=, ==, !=. On the other hand, the allowed relationships for parameters that can only assume enumerated values are limited to “==, !=”.

More complex compound criteria are built by connecting two or more primitive criterion. The connectors are simple logical operators namely AND, OR and XOR. The connectors can connect both a primitive criterion and a compound criterion. Using this feature, we can build arbitrarily complex criteria.



Range	Matching Breaths			Parameter Values			
Select	Number	Date	Time	MODE_SETTING	BREATH_TYPE	TIDAL_VOLUME	PEAK_PRESSURE
☐	9	09-05-2024	17:40:56	SIMV	MANDATORY	229	37
☐	10	09-05-2024	17:41:00	SIMV	MANDATORY	252	34
☐	11	09-05-2024	17:41:04	SIMV	MANDATORY	278	36
☐	43	09-05-2024	17:43:31	SIMV	MANDATORY	216	10
☐	44	09-05-2024	17:43:35	SIMV	MANDATORY	216	10
☐	46	09-05-2024	17:43:43	SIMV	MANDATORY	205	22
☐	47	09-05-2024	17:43:47	SIMV	MANDATORY	227	24
☐	48	09-05-2024	17:43:51	SIMV	MANDATORY	234	23

Figure 27: Search View

The Figure above is an example of a search criteria that is of practical use. In simple English, it says to search for spontaneous (patient-initiated) breaths while the ventilator is set to SIMV ventilation mode, for which the delivered tidal volume is less than 300ml or the peak pressure is less than 20cm. Note that the indentation on either side of each connector shows the precedence structure of the expression.

A search criterion, once created, can be exported to a file and is available for importing into later sessions too.

The search, just like all other views, is constrained by the range selector. The Search-engine only searches within the bounds of the selected range. If the range selector is in PLAY mode, the search is done after every delivered breath.

The search results appear in the table shown in the Figure above. The table shows the breath number and the wall time for matching breaths. The table also shows the values, at the match time, for the parameters used in the search. Finally, a consecutive range of matches can be selected, and all other views automatically zoomed to the selected range.

Recording View

The Dashboard also provides an option to record any part of the current session using the “Start Recording” menu button on the sidebar menu. The recoding can be paused at any time causing that paused window to not be recorded. The Recording at the bottom left of the Snapshots view indicates whether the recording is currently active.

The recording is stored in a JSON database on the disk of the laptop or the desktop that the browser is running on. This recording can be played back and analysed at any future time using the Playback WebApp. A screenshot of the recording view is shown below.

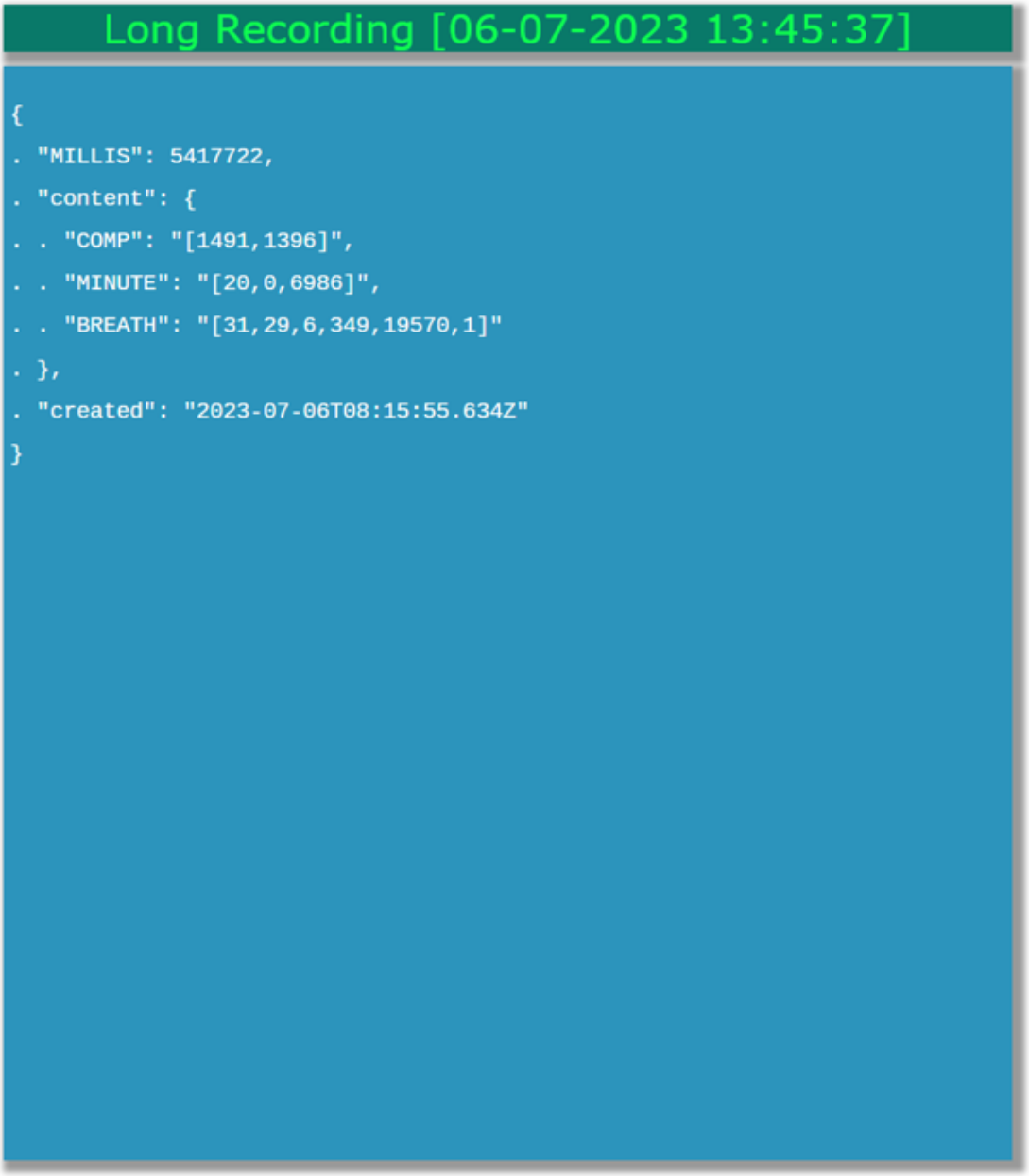


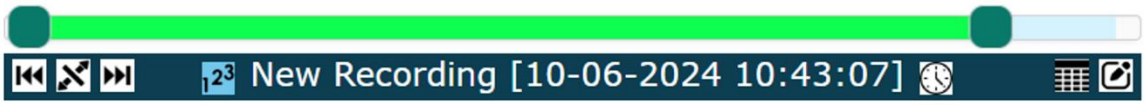
Figure 28: Dashboard Recording View

Data Navigation Tools

Range Selector

The range selector concept is loosely modelled on video players. We conceptualize each snapshot of the ventilator system's state as a frame in a movie. The entire database that is collected is like a movie to either be played from end-to-end or different portions at a time with ability to pause at any time, forward or rewind it etc.

Each dashboard and playback view are navigable using a range selector as shown in the Figure below.



Selection Domains

The slider can be set to work in two different domains, wall-time or breath-number. Note that these two are not necessarily always in sync with each other since there may be periods of time where the ventilator is deliberately set to STANDBY, in which case the wall-time elapses but the breath-number does not change. These two buttons can be found in the middle of the selector bar above.

BREATH_NUMBER

WALL_TIME

Basic Operation

The slider has two handles to manually set the range. The range limits are shown above the handles. Each handle can be grabbed and moved to the required position. In addition, the green bar connected to the handles can be grabbed and moved so that the entire range moves to a different position. All the breaths contained within the range are referred to as range SPAN.

Range Selector Modes

The range selector has two operating modes as described below.

PLAY Mode – In this mode the range selection adjusts automatically as each new breath is recorded. The entire range SPAN scrolls by one breath to the right. By default, the range selector is set to "PLAY" mode.

PAUSE Mode – In this mode, the range selection is frozen to the currently selected range till manually moved.

Range Selector Controls

The range selector provides a set of buttons for control. These buttons are described below.

PLAY/PAUSE: These buttons enable the toggling between PLAY and PAUSE modes. They can be manually toggled. In addition, some other controls also toggle these modes as described below. If in PAUSE mode, the PLAY button blinks orange.

FORWARD/REWIND: Moves the entire range one SPAN forward or backwards.

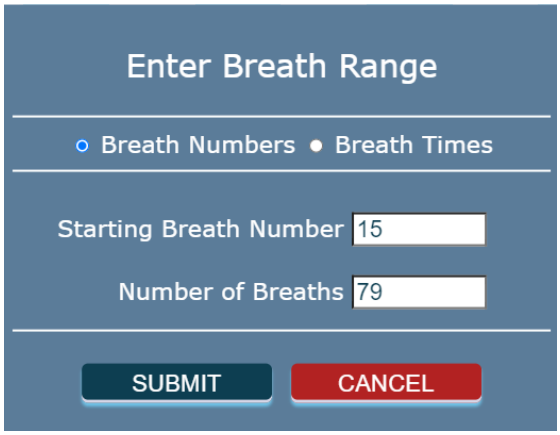
EXPAND: Expands the range selection to the maximum available currently .

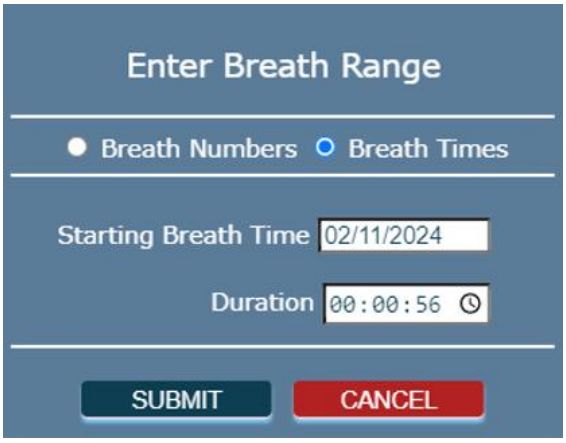
TABLE: Displays the currently selected range as a table shown below.

Selected Breath Range

	Breath Number	Breath Start Time		
		Day	Date	Time
From	520	Fri	26-Apr-2024	12:20:05
Upto	579	Fri	26-Apr-2024	12:22:58
SPAN	60	00:02:53		

EDIT: This button enables a manual entry of range limits. The range limits can be selected using BREATH_NUMBERs or WALL_TIMEs.





Again, appropriate graphical widgets are provided to easily enter this data.

Example Range Selector Usage

The Breath Range Selector is a simple but powerful tool for visualization. Its use is limited only by the user's imagination.

Let's take an example. Let's say you want to check how the patient-initiated (SPONTANEOUS) breaths have progressed over the course of the ventilation session. Below is an example of steps to determine that.

1. Navigate to the "Statistics View"
2. Click on the EDIT button on the Breath Range Selector.
3. Select the "Breath Times" option.
4. Enter the Starting Time as the beginning of the session.
5. Enter the Duration as 1 hour (or whatever is appropriate).
6. Check the "Number of Spontaneous Breaths" or "Spontaneous BPM" in the Statistics tables. These numbers are for the selected range of breaths.
7. Now click on the FORWARD button on the Breath Range Selector. This will move the selector to the next 1 hour of the session.
8. The Statistics table will now show the numbers for the new time range.
9. Or else, you can simply grab the range bar (the green bar connecting the two handles) and slide it back and forth to see the statistical numbers change.

Another way to get a quick look at the trend is as below.

1. Navigate to the "Charts View"
2. Select the "Spontaneous BPM" to plot.
3. Click the "EXPAND" button on the Breath Range Selector.
4. Even if the number of breaths in breath range SPAN might be huge, the Charts view will selectively display the entire range.

Breath Range Selector

1. All data search and selection are with reference to breaths.
2. Each breath can be classified as one of the two below.
    a. MANDATORY (ventilator-initiated). These breaths are always Volume-controlled.
    b. SPONTANEOUS (patient-initiated). SPONTANEOUS breaths could further be classified as one of two below.
        i. Volume-controlled
        ii. Pressure Supported
3. Each breath can be uniquely identified by one of the two parameters below.
    a. BREATH_NUMBER (starting from 1 as the first logged breath).
    b. BREATH_START_TIME (wall clock time as per the local time-zone).

Each dashboard and playback view are controlled by a range selector as shown in the Figure below.

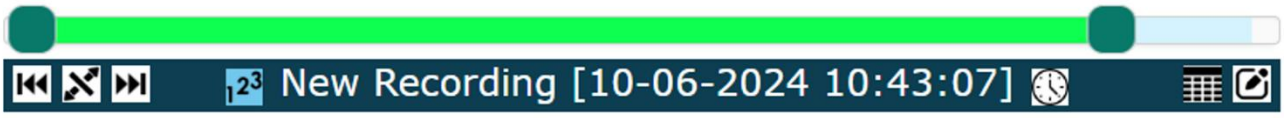


Figure 29: Breath Range Selector

Basic Operation

The slider has two handles to manually set the range. The range limits are shown above the handles. Each handle can be grabbed and moved to the required position. In addition, the green bar connected to the handles can be grabbed and moved so that the entire range moves to a different position. All the breaths contained within the range are referred to as range SPAN.

Range Selector Modes

The range selector has two operating modes as described below.

PLAY Mode – In this mode the range selection adjusts automatically as each new breath is recorded. The entire range SPAN scrolls by one breath to the right. By default, the range selector is set to “PLAY” mode.

PAUSE Mode – In this mode, the range selection is frozen to the currently selected range till manually moved.

Range Selector Controls

The range selector provides a set of buttons for control. These buttons are described below.

▶ ⏸ PLAY/PAUSE: These buttons enable the toggling between PLAY and PAUSE modes. They can be manually toggled. In addition, some other controls also toggle these modes as described below. If in PAUSE mode, the PLAY button blinks orange.

FORWARD/REWIND: These buttons move the entire range one SPAN forward or backwards. The range selector is set to PAUSE mode.

EXPAND: This button expands the range selection to the maximum available at the current time. The range selector is set to PAUSE mode.

TABLE: This button displays the currently selected range as a table shown below. The range selector is set to PAUSE mode.

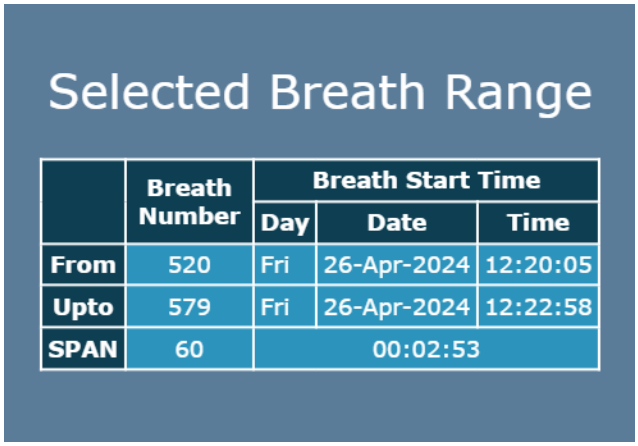


Figure 30: Breath Range Table

EDIT: This button enables a manual entry of range limits. The range limits can be selected using BREATH_NUMBERs or BREATH_START_TIMEs.

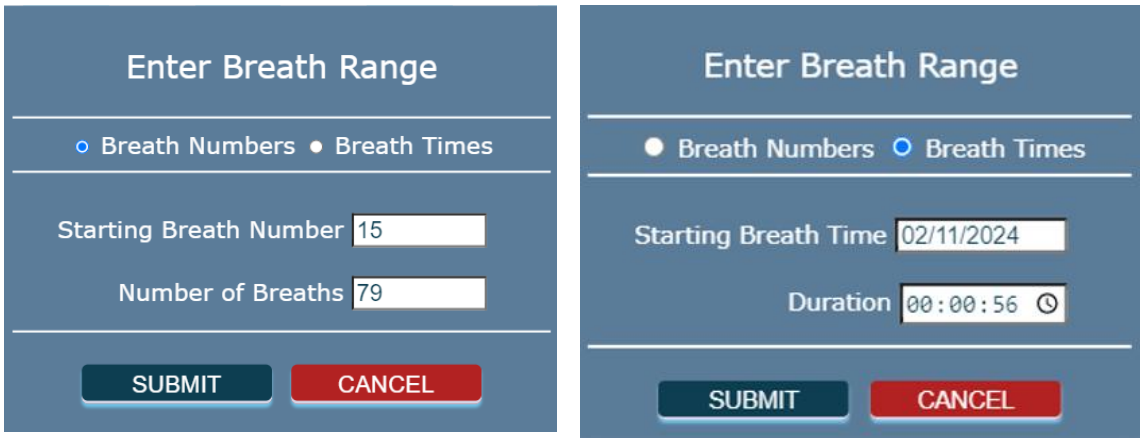


Figure 31: Breath Range Manual Edit

The entry by BREATH_NUMBERs is self-explanatory.

The entry using BREATH_START_TIMEs is slightly more complex because a ventilation session may stretch over multiple days, and the entry necessarily requires entry of both date and time.

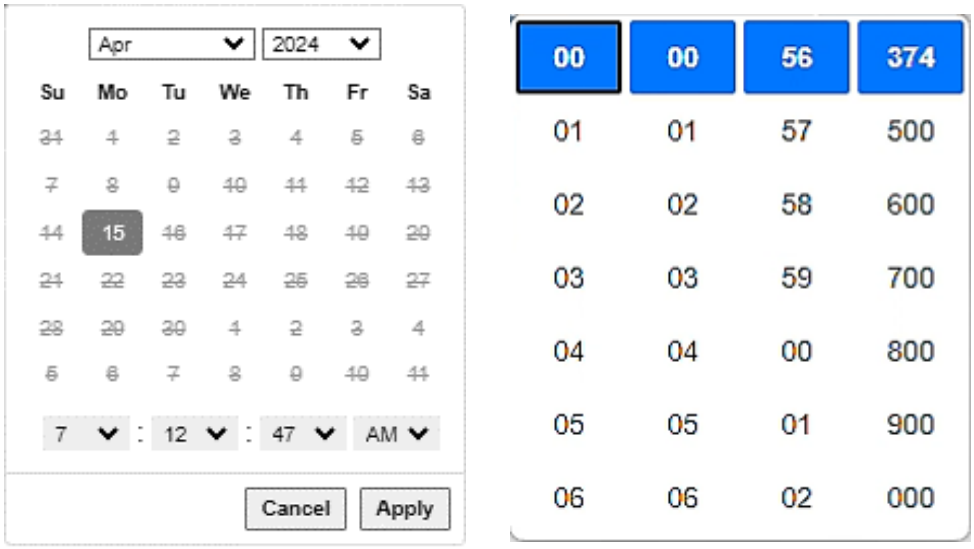


Figure 32: Breath Time Selection

Clicking on “Starting Breath Time” field brings up a calendar which is constrained to the range of date and times for which the breaths have been logged.

The Duration can be entered as hours, minutes, and seconds. Clicking on the clock icon brings up a GUI time selector to do the same.

Example Usage

The Breath Range Selector is a simple but powerful tool for visualization. Its use is limited only by the user's imagination.

Let's take an example. Let's say you want to check how the patient-initiated (SPONTANEOUS) breaths have progressed over the course of the ventilation session. Below is an example of steps to determine that.

10. Navigate to the "Statistics View"
11. Click on the EDIT button on the Breath Range Selector.
12. Select the "Breath Times" option.
13. Enter the Starting Time as the beginning of the session.
14. Enter the Duration as 1 hour (or whatever is appropriate).
15. Check the "Number of Spontaneous Breaths" or "Spontaneous BPM" in the Statistics tables. These numbers are for the selected range of breaths.
16. Now click on the FORWARD button on the Breath Range Selector. This will move the selector to the next 1 hour of the session.
17. The Statistics table will now show the numbers for the new time range.
18. Or else, you can simply grab the range bar (the green bar connecting the two handles) and slide it back and forth to see the statistical numbers change.

Another way to get a quick look at the trend is as below.

5. Navigate to the "Charts View"
6. Select the "Spontaneous BPM" to plot.
7. Click the "EXPAND" button on the Breath Range Selector.
8. Even if the number of breaths in breath range SPAN might be huge, the Charts view will selectively display the entire range.

WEB Recorder

Though the Dashboard also allows recording of the current session being monitored, the stand-alone Recorder allows the same while consuming much less system memory. This is useful if the full-featured Dashboard is not required.

The use interface is very simple – just buttons to START/STOP/PAUSE recording.

Figure 33: Web Recorder

WEB Playback

The Playback App enables the playback and analysis of a previously recorded session with a patient. The process starts with selecting a session recording to playback.

A screenshot of the Playback App is shown below.

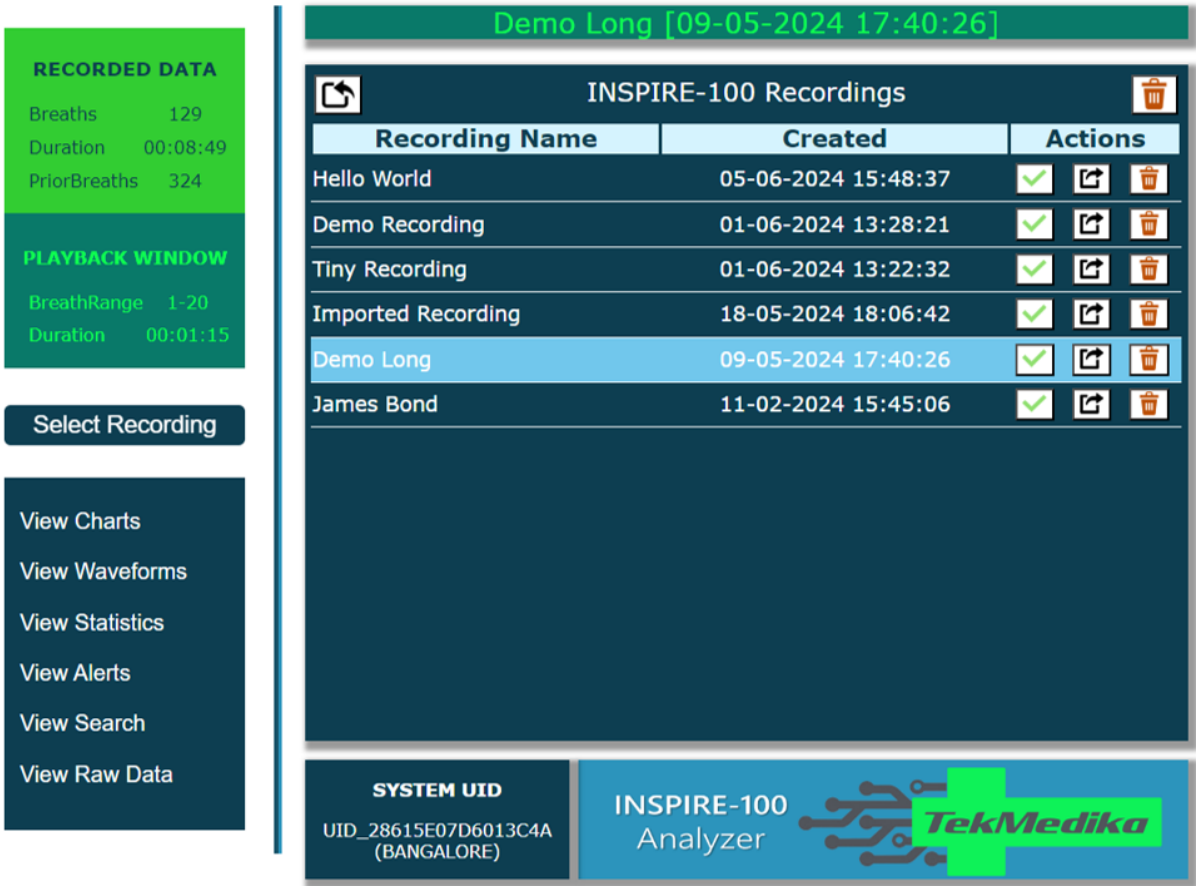


Figure 34: WEB Playback

The box on the top of the sidebar provides a summary of the currently selected recording for playback.

The next box is a button to select a particular recording for playback.

The last box holds all the buttons to do the various types of playback and views. The views are the same as the ones available on the Dashboard and work the same way.

Playback Recording Selector

Each previously recorded session is presented in a Selector table shown on the right of the Figure above. Select a recording for playback either by double-clicking on a row or using the appropriate checkmark menu button.

After a database is selected, a summary of the recording data is displayed in the top box of the sidebar and the selected table row is highlighted.

Playback Recording Import Export

The EXPORT menu button on each row enables the user to export the database to a text file that can be sent to others for playback and analysis. The IMPORT button on the top left allows the user to import a previously exported text file as a new session available for playback. Below is a screenshot of the Import screen.

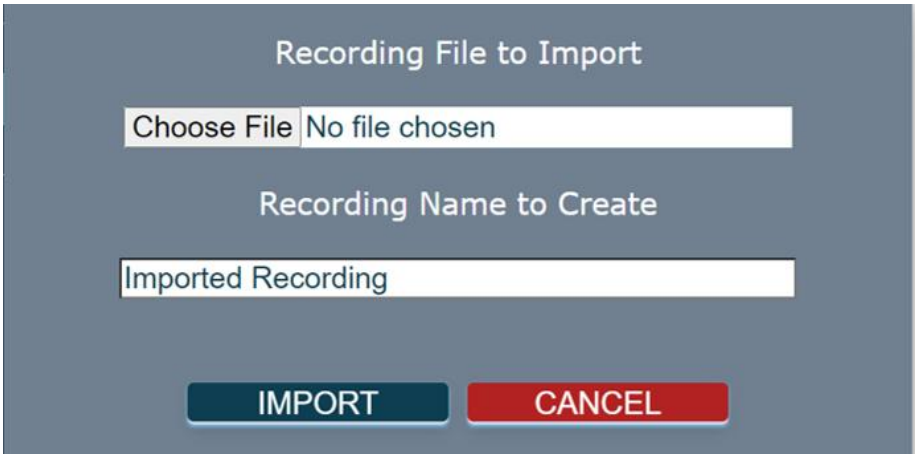


Figure 35: Playback Import View

Playback Charts, Statistics, Breath Waveforms and Alerts Views

Finally, the Charts, Statistics, Breath Shapes and Alerts views work in the same fashion as described in the Dashboard section above. Also, the Breath Range Selector works the same way as described in the Dashboard section.

Install Firmware Upgrade App

Occasionally the system may need to be upgraded in the field for new features or bugs. The new firmware releases are made available on the web for downloading and installing.

A local App must be installed on the user's laptop to enable installation of new firmware for the INSPIRE-100 system. Clicking on this button downloads the appropriate app depending on the operating system of the laptop (WINDOWS or MACOS).

For further details refer to the "Firmware Upgrade Manual".

Mobile Apps

In addition to the Web Apps that are accessed via a browser, a mini dashboard native app is provided for both iOS and Android mobile devices. The app is available for download from Google Playstore and Apple Store for Android and iOS devices respectively. Search for “Tekmedika” on these stores.

The app is designed to provide a quick check on a patient without the extensive features and analysis options that the browser version provides. It provides only two views in real-time as shown in the Figure below.

1. Front Panel view
2. Waveforms view

There are two icon buttons to switch between these two views. In addition, it automatically switches to waveform view if rotated to landscape orientation and to the front panel view if rotated to the portrait orientation.

The app has no menus or switches and is extremely easy to use. For instance, there are no features that allow going back and forth through time, no range selection, no recording, no search etc. Access to these advanced features requires the use of the browser version of the dashboard.

Figure 36: Mobile App Views

Setup requirements

It only requires a one-time setup to enter all the system IDs into the Systems Table. Once done, the setup is used for all future invocations of the app. After that, on every invocation, it is as simple as “select a system and go!”.

Figure below shows the mini portal that is used to select system to monitor. All the buttons on the min-portal work the same way as those on the browser portal.

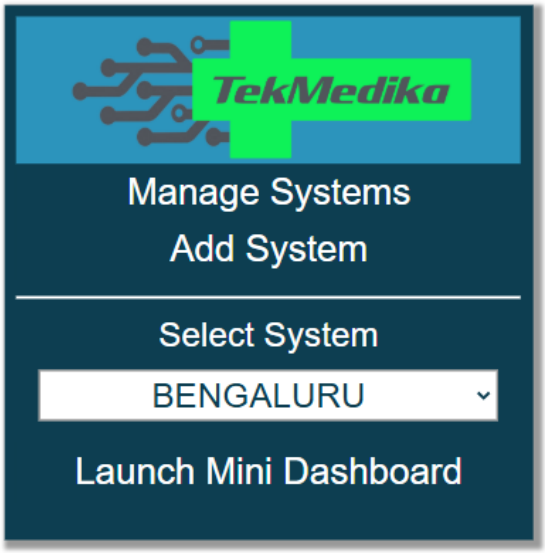


Figure 37: Mini Portal for Mobile App