OpenAuto Pro

User guide

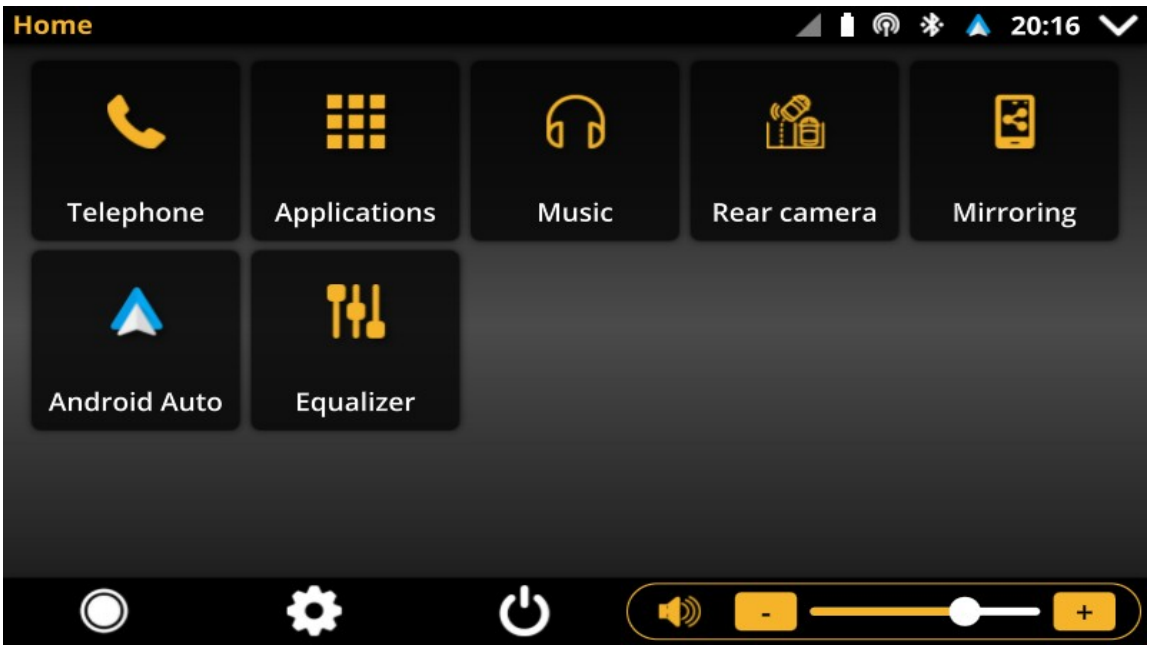


Table of content

1. Overview

OpenAuto Pro is complete head unit software solution. It provides deep integration with the Raspbian OS what allows to turn your Raspberry PI into complete head unit ready to retrofit your vehicle. User can easily extend functionalities of OpenAuto Pro by installing favorite apps and add it to the launcher menu. Many customization options give possibilities to adjust OpenAuto Pro to the user needs. Integration with Android Auto™ software brings access to many voice commands, navigation and communication services like phone calls or messaging.

1.1. Minimal system requirements

- Raspberry PI 3B, 3B+ or 4B
- 8GB SD card
- Touchscreen
- 5V 3A power supply
- External sound card with microphone input
- External Bluetooth adapter

1.2. Functionalities

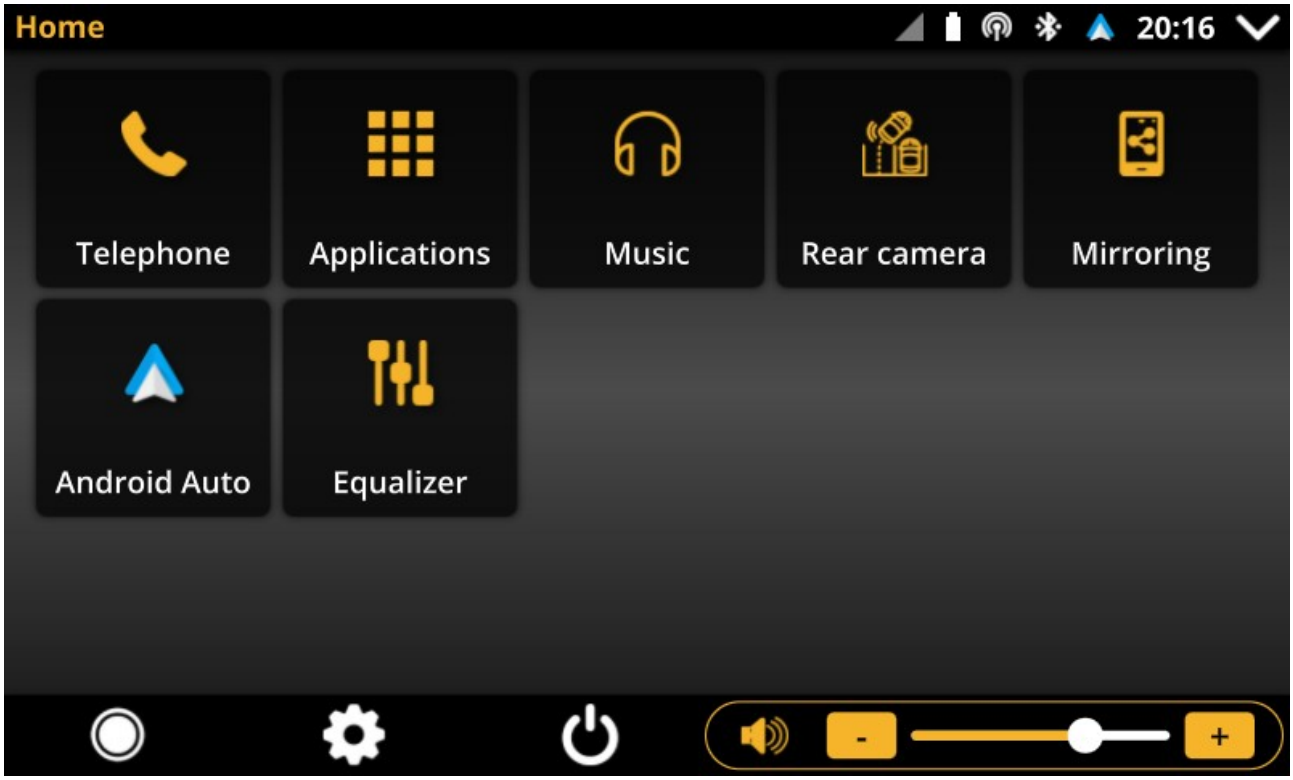
- Bluetooth music and Hands-Free calls
- Integrated music player with streaming support
- Equalizer
- Screen mirroring of Android devices
- Android Auto™ head unit emulation
  - USB connection
  - Wireless connection
  - Suspending/resuming of projection
  - Multi-touch
- Wireless Hotspot mode
- Customizable external applications launcher
- Integrated volume control
- Integrated screen brightness control
- Appearance customization
- Preinstalled Kodi Media Player
- Keyboard controls
- Built-in support of BMW iDrive, IBus and MMI 2G controllers
- Support of TSL2561 light sensor
- Support of GPIO day/night switching
- Support of day/night switching based on day time (clock)
- Support of DS18B20 temperature sensor
- Rear camera
- Custom splash screen

2. Main screen

OpenAuto Pro interface is divided into several sections:

- Top bar
- Bottom bar
- Content area

2.1. Home menu

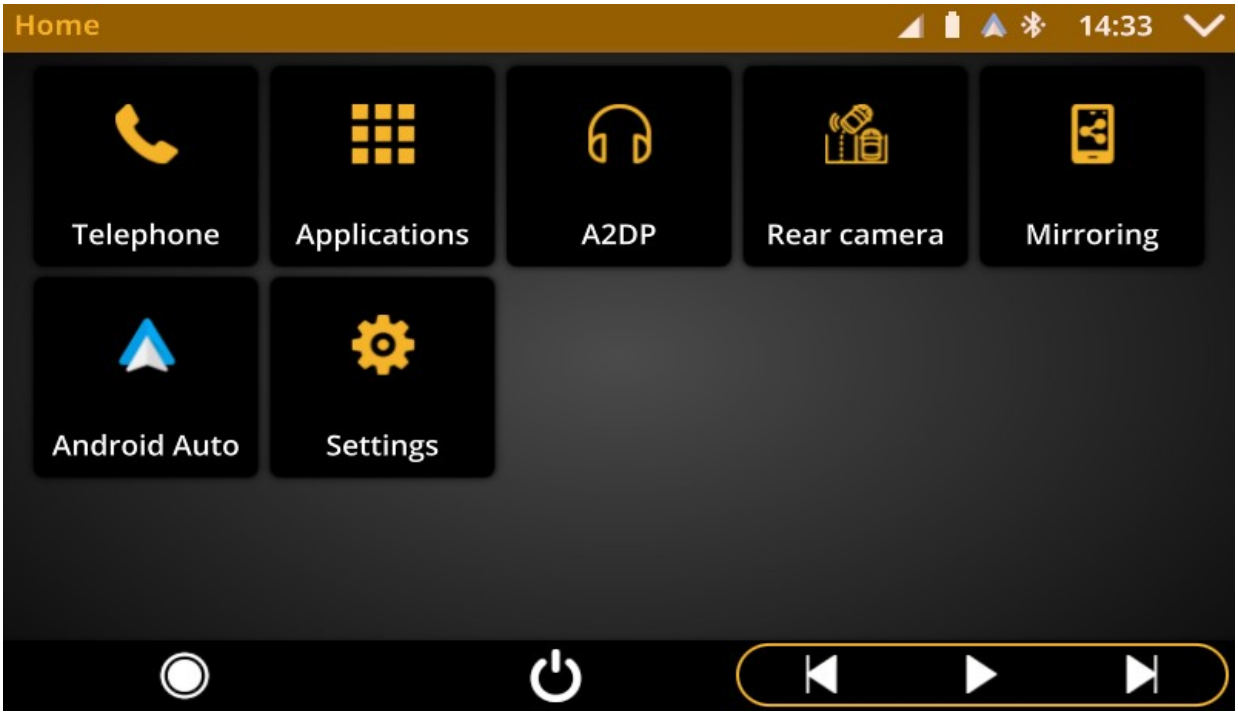


Home menu

Main menu and start screen of OpenAuto Pro where embedded functionalities like Bluetooth Music, Hands-Free calling, Mirroring and others can be accessed.

2.2. Top bar

Expandable control that can be either used to return back to OpenAuto Pro from an external application or (after expansion) for adjustments of system volume and screen brightness levels. In case of active Android Auto session it contains button to switch night/day appearance of the Android Auto interface. Top bar can be also used to stop screen mirroring session.

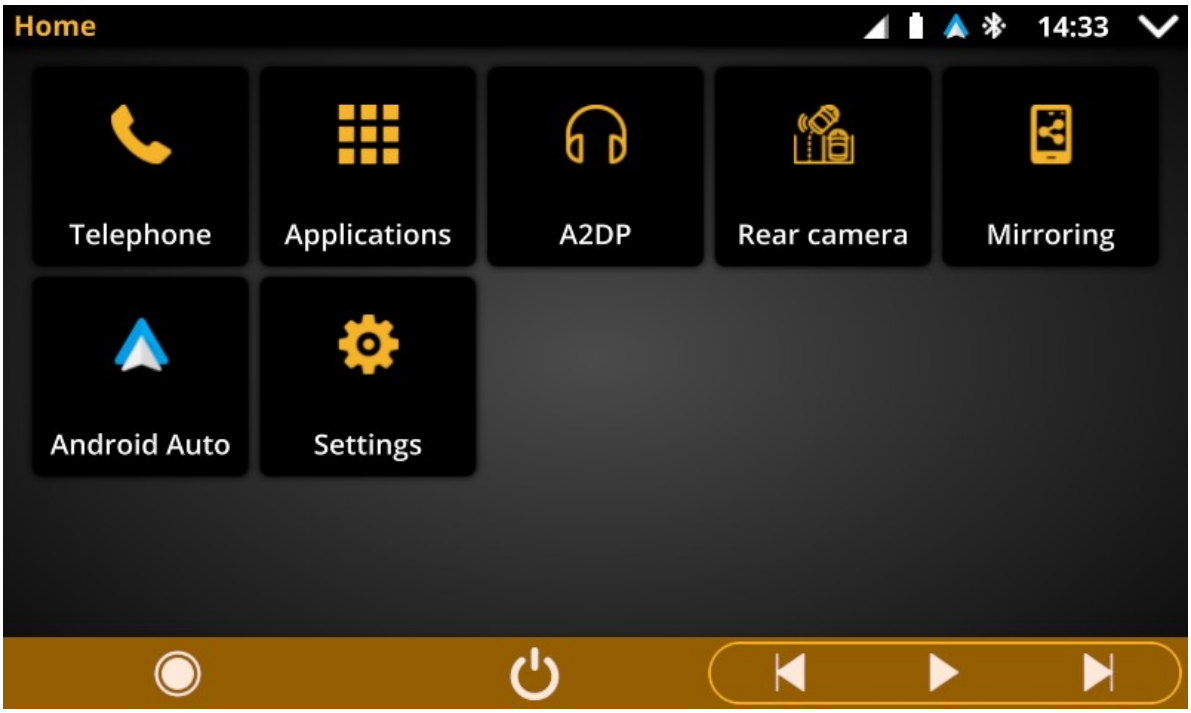


Top bar component is marked by orange color

2.3. Bottom bar

Contains three buttons:

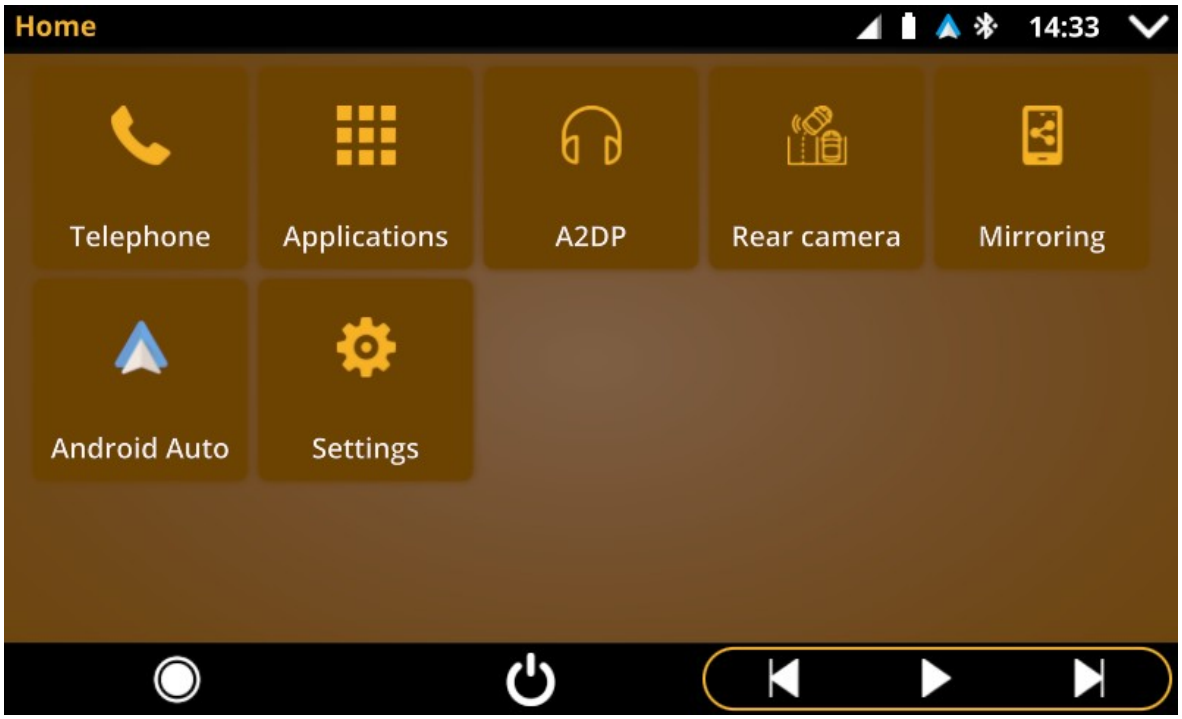
- **Back button** can be used to navigate among screens of sub applications.
- **Home button** activates main screen (launcher menu) from any sub application.
- **Exit button** is used to activate exit menu.



Bottom bar component is marked by orange color

2.4. Content area

Section where sub application displays its content.

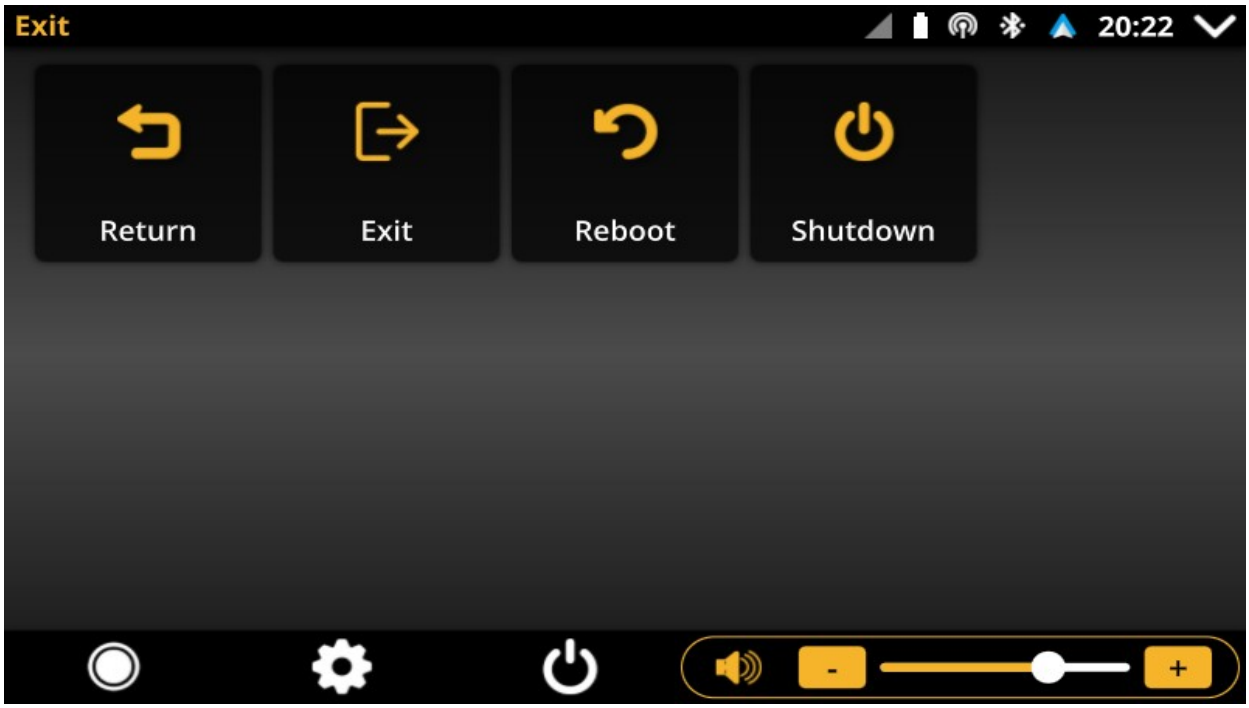


Content area is marked by orange color

2.5. Exit menu

Exit menu contains two buttons:

- **Return to system –** After tapping returns to the system and moves OpenAuto Pro process to the background. All currently active operations (like Android Auto projection or an external application) remain in working state.
- **Exit OpenAuto –** After tapping and confirmation quits OpenAuto Pro. All currently active operations (like Android Auto projection or an external application) will be terminated.
- **Reboot –** After confirmation will reboot entire operating system
- **Shutdown –** After confirmation will shutdown entire system and device

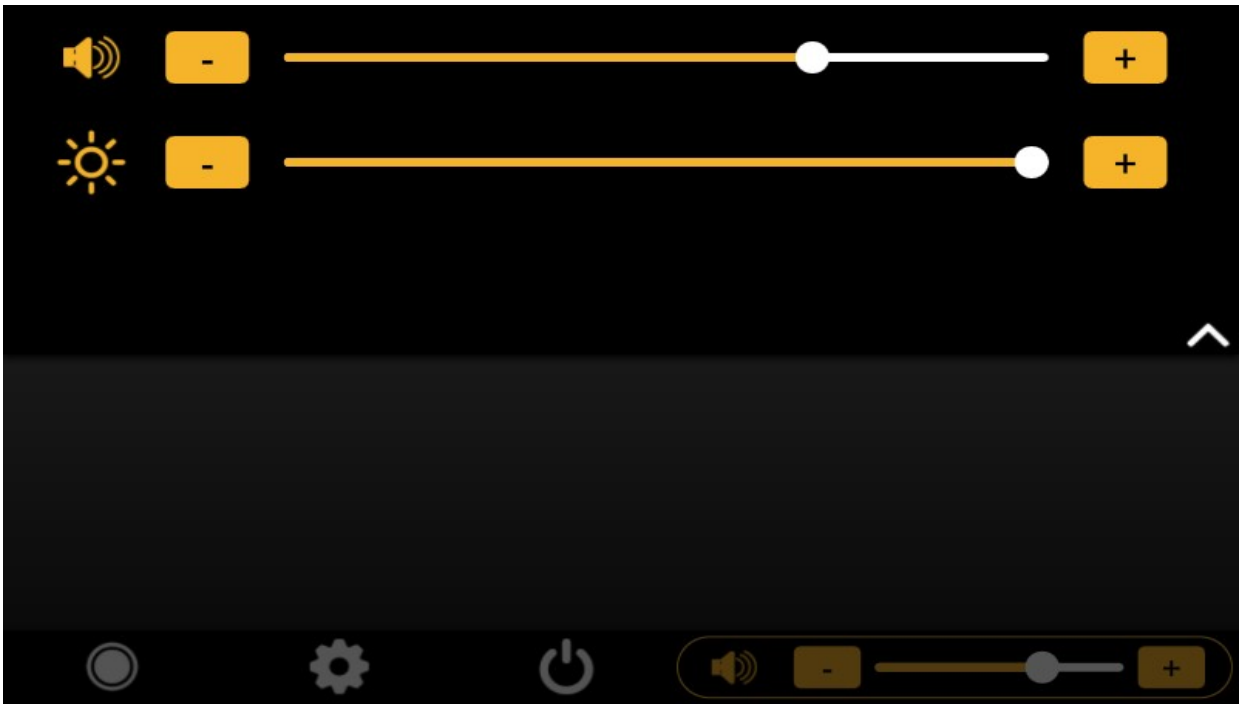


Exit menu

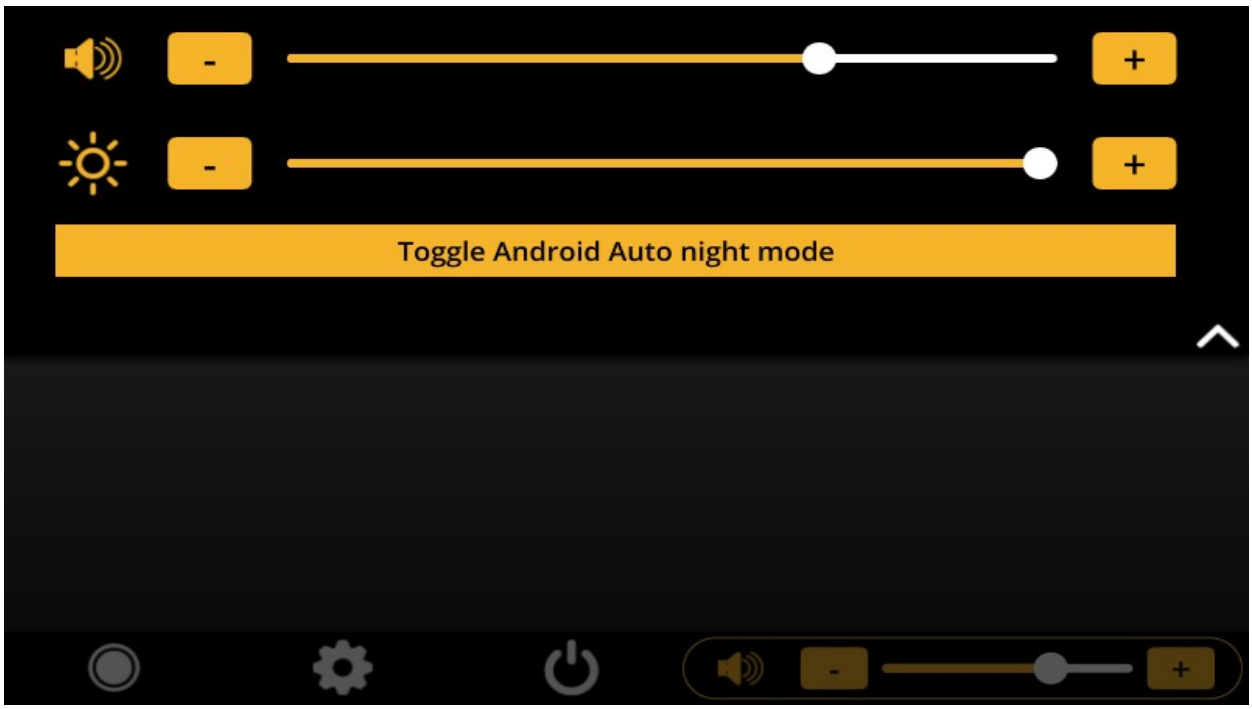
2.6. Top bar functionalities

Expanding the top bar gives possibilities to control levels of volume and brightness. In case of active Android Auto session it can be used to control day/night appearance of Android Auto interface. Another function of top bar is exiting from currently active screen mirroring session.

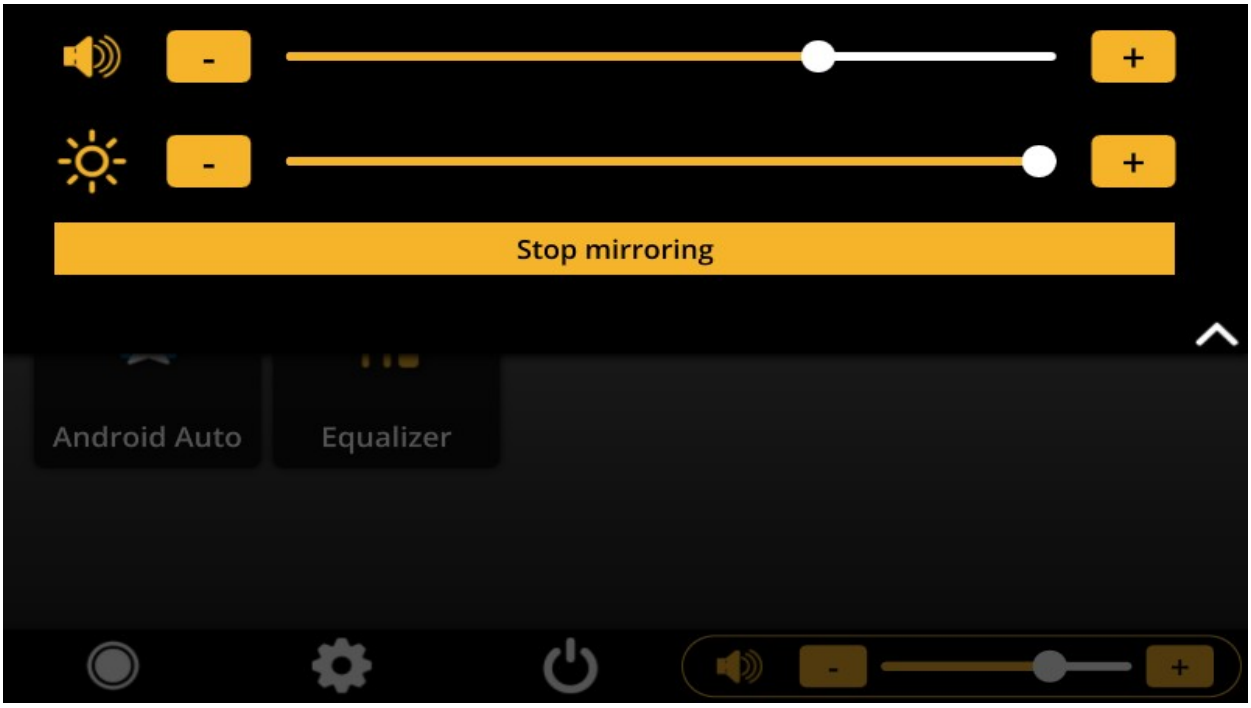
- **In order to expand the top bar** simply tap the expand icon placed at the top right corner. For more convenience, you can also expand the top bar by tapping of the black area between title and expand icon.
- **Hiding the top bar** can be done either by tapping of the hide icon or tapping of the area below expanded top bar.



Expanded top bar



Expanded top bar with active Android Auto session



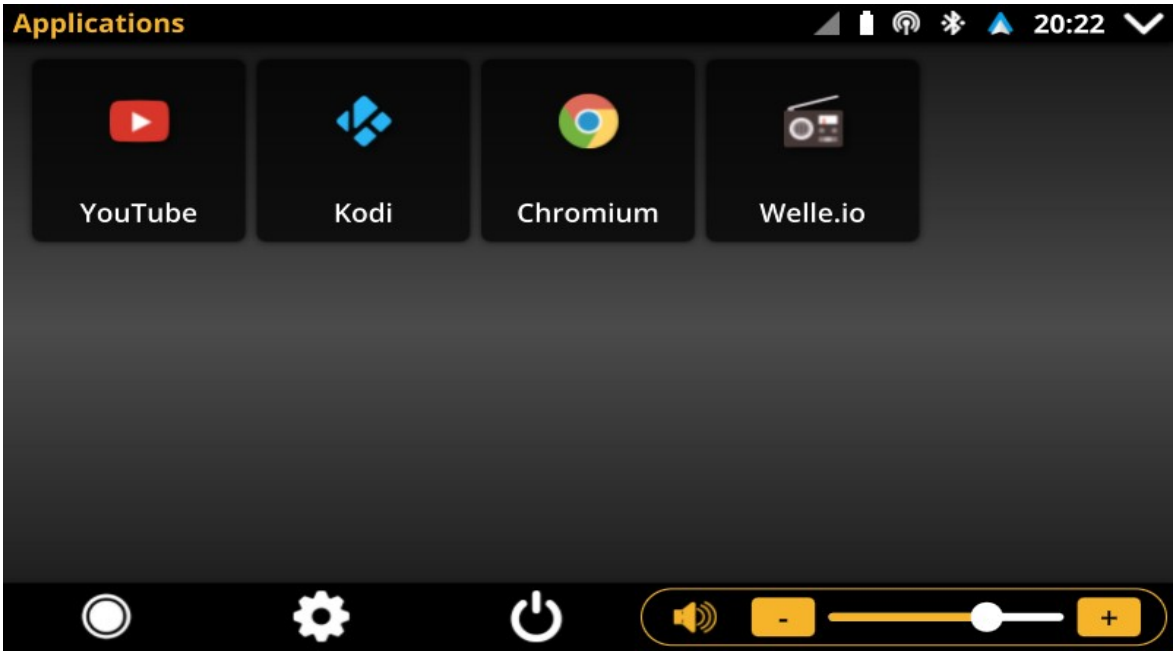
Expanded top bar with active screen mirroring session

3. Applications launcher

One of the OpenAuto Pro functionalities is managing (launching and controlling lifetime) of external applications. In order to launch one of the applications simply tap on it's tile.

In order to return back to OpenAuto Pro and move external application to the background, you must click the "**Applications**" title placed at the OpenAuto Pro top bar.

When application is already launched but was moved to the background, tile will be marked by a red color. Tapping of the tile will bring application to front again.



Kodi application is active in background.

3.1. Configuration of external applications list

List of applications that OpenAuto Pro manages is taken from the configuration file placed in home directory (**openauto_applications.ini**). **Number of configured applications is limited to 8**. Syntax of the configuration file is the same as for any other ini file.

- **Applications count section** indicates how many entries are stored in the configuration file. It is very important to adjust this value respectively.

  [Applications]

  Count=X

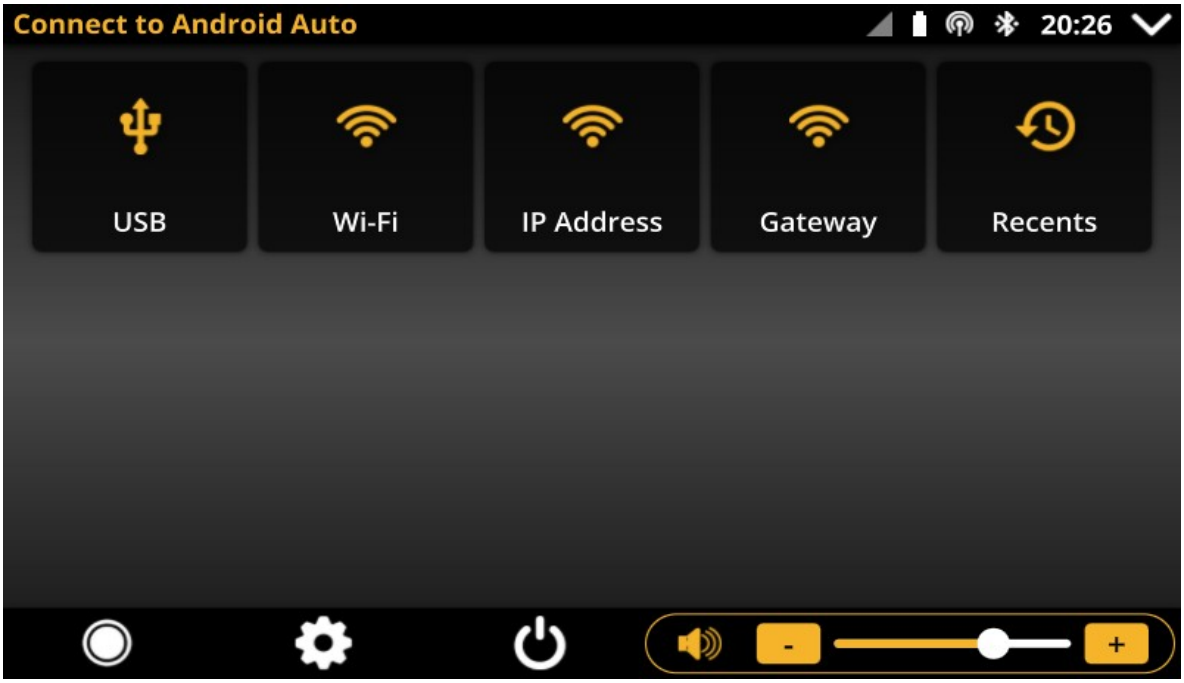
- **Each application** has its own section named Application_X where X is 0 based index incremented for each entry.

  [Application_**X**]

  - **Name –** label displayed on the launcher tile
  - **Path –** absolute path to the executable file
  - **IconPath –** absolute path to the icon displayed on the launcher tile. Supported formats are jpg, jpeg, png, svg and gif.
  - **Arguments –** command line arguments passed to the application
  - **Autostart** – true or false to enable/disable autostart of the application

4. Android Auto

OpenAuto Pro supports emulation of Android Auto head unit protocol. It means that you can connect your Android-based smartphone either via USB or wireless hotspot and enjoy Android Auto functionality.



Android Auto menu

4.1. USB connection

- **Automatic mode** – OpenAuto Pro will start projection of the Android Auto right after Android-based smartphone is plugged in to the USB port. This mode can be enabled/disabled at the system settings (it is enabled by default).
- **Manual mode –** Projection of the Android Auto will be started only by user request.

4.2. Wireless connection

As of version 7.0 OpenAuto Pro supports Wireless Android Auto connection that does not need Head Unit Server enabled on the phone. This feature is now experimental and it is disabled by default. In order to use it below preconditions must be fulfilled:

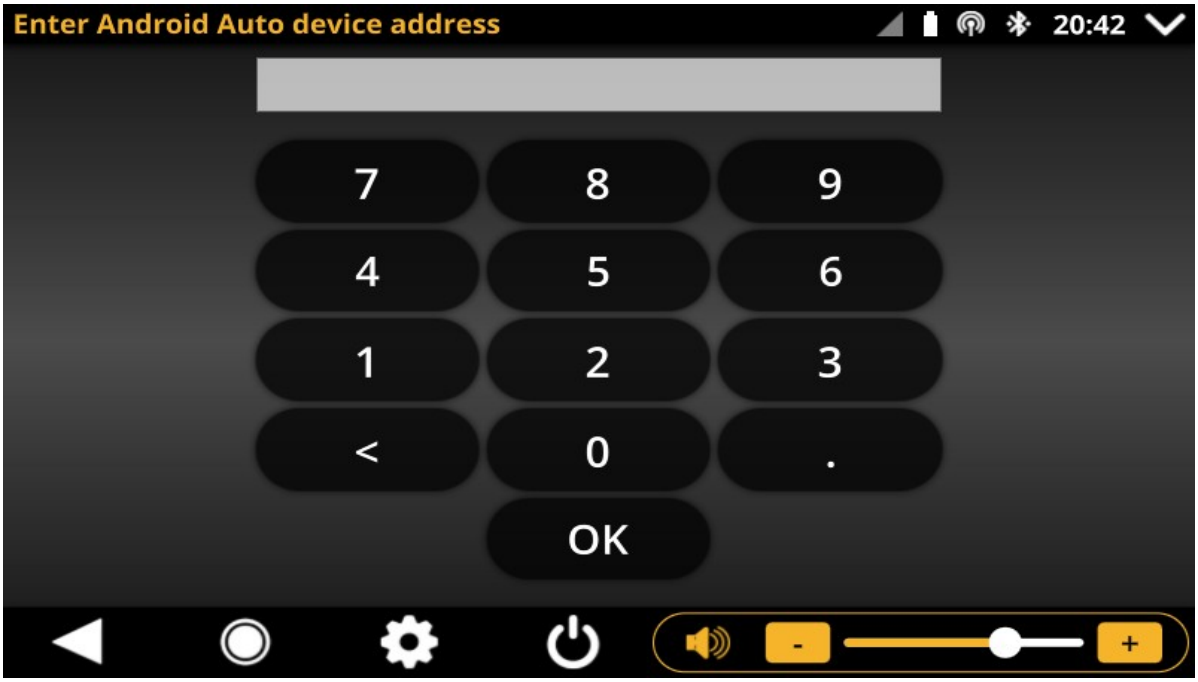
- **Wireless Android Auto** option has to be enabled in Settings → Android Auto → System
- Phone has to have Bluetooth connection established with the Raspberry PI
- Wireless Hotspot mode has to be enabled or external wireless network credentials has to be provided in **openauto_system.ini** file.
- It might be necessary to enable Wireless Projection in Android Auto application settings on the phone

Once all preconditions are fulfilled, Wireless Android Auto connection can be triggered by clicking Wi-Fi tile at Android Auto menu. Also wireless connection will be automatically triggered once Bluetooth connection between phone and Raspberry PI is established (this behavior can be disabled by disabling Start Android Auto automatically option in Settings → Android Auto → System).

There is still possibility to establish wireless connection based on HeadUnit server. In order to use it below preconditions must be fulfilled:

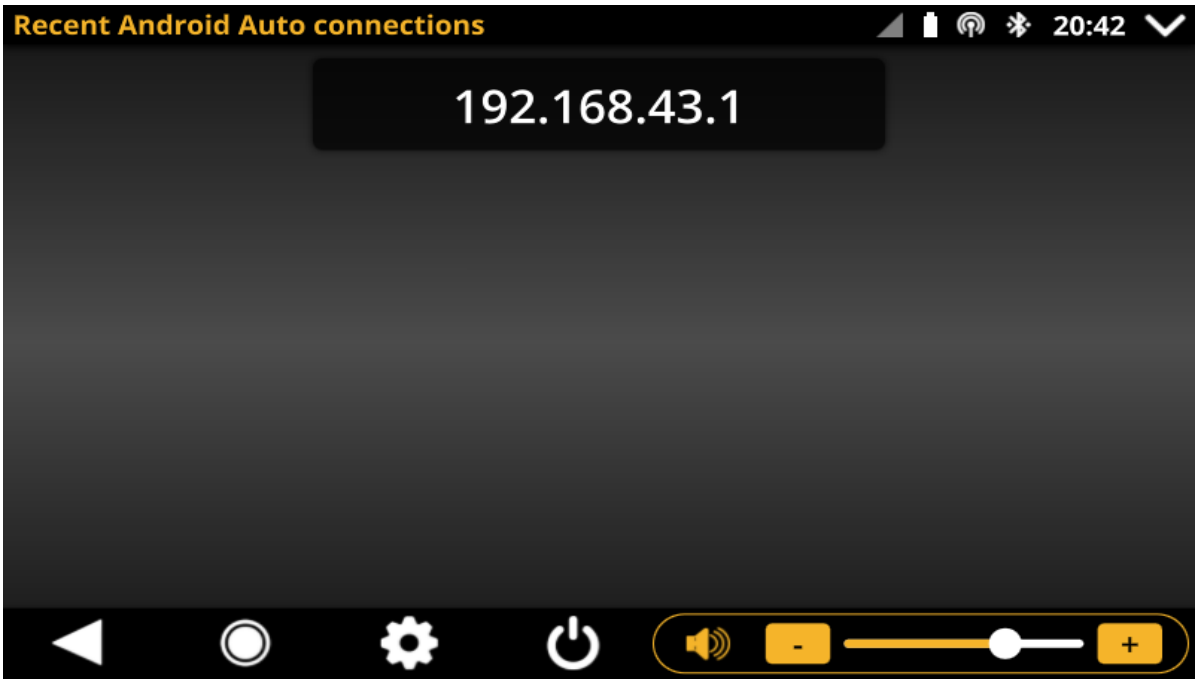
- both Android-based smartphone and the OpenAuto Pro must be connected to the same WiFi network
- Head unit server must be activated at the developer settings of Android Auto application (phone side)
- IP address of the Android-based smartphone must be known

If you are connected to the Phone's Hotspot simply use "Connect to gateway" option that will automatically connect OpenAuto Pro to your phone (after activation of the Head Unit server on the phone).



Entering IP address of the Android-based smartphone

For more convenience, all entered IP addresses will be available at the "recent addresses list".

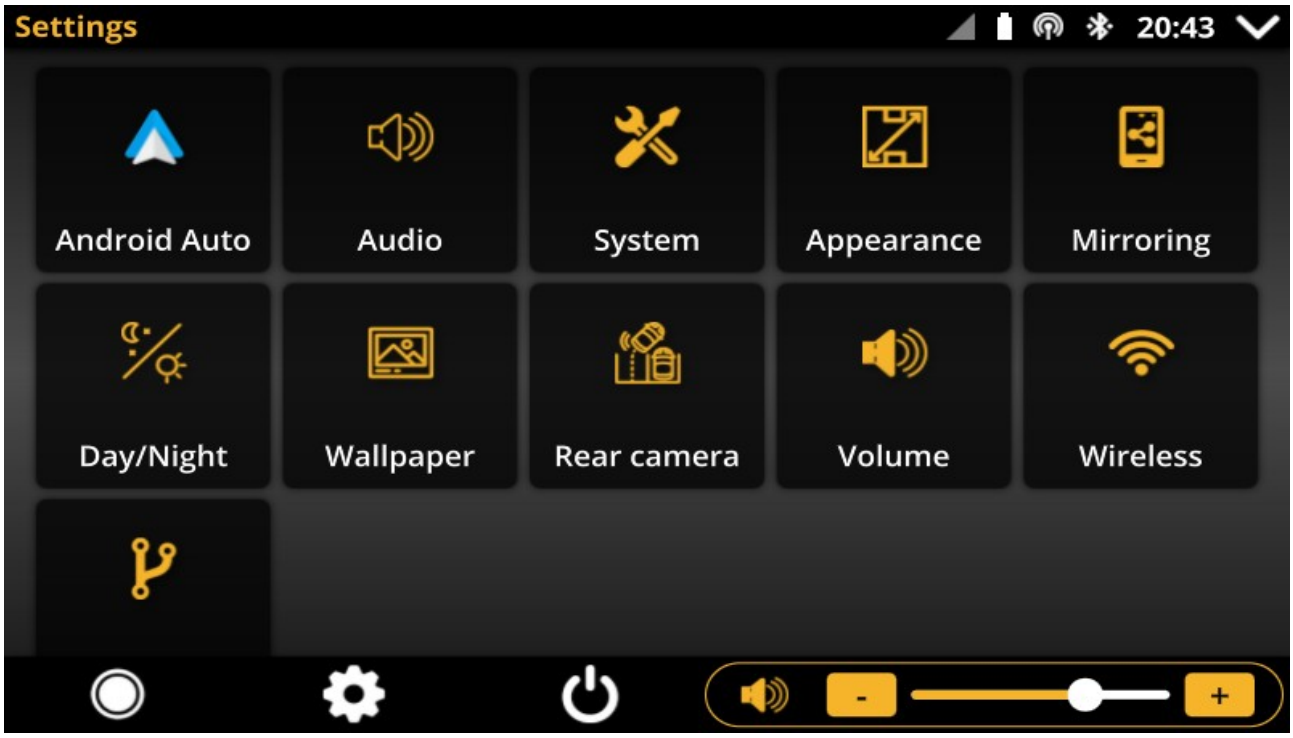


Recent addresses list

5. Settings

Many OpenAuto Pro features can be adjusted to the user needs. Settings menu contains several categories of settings:

- Android Auto settings
- Audio settings
- System settings
- Appearance settings
- Mirroring settings
- Day/Night settings
- Wallpaper settings
- Rear camera settings
- Volume settings
- Wireless settings

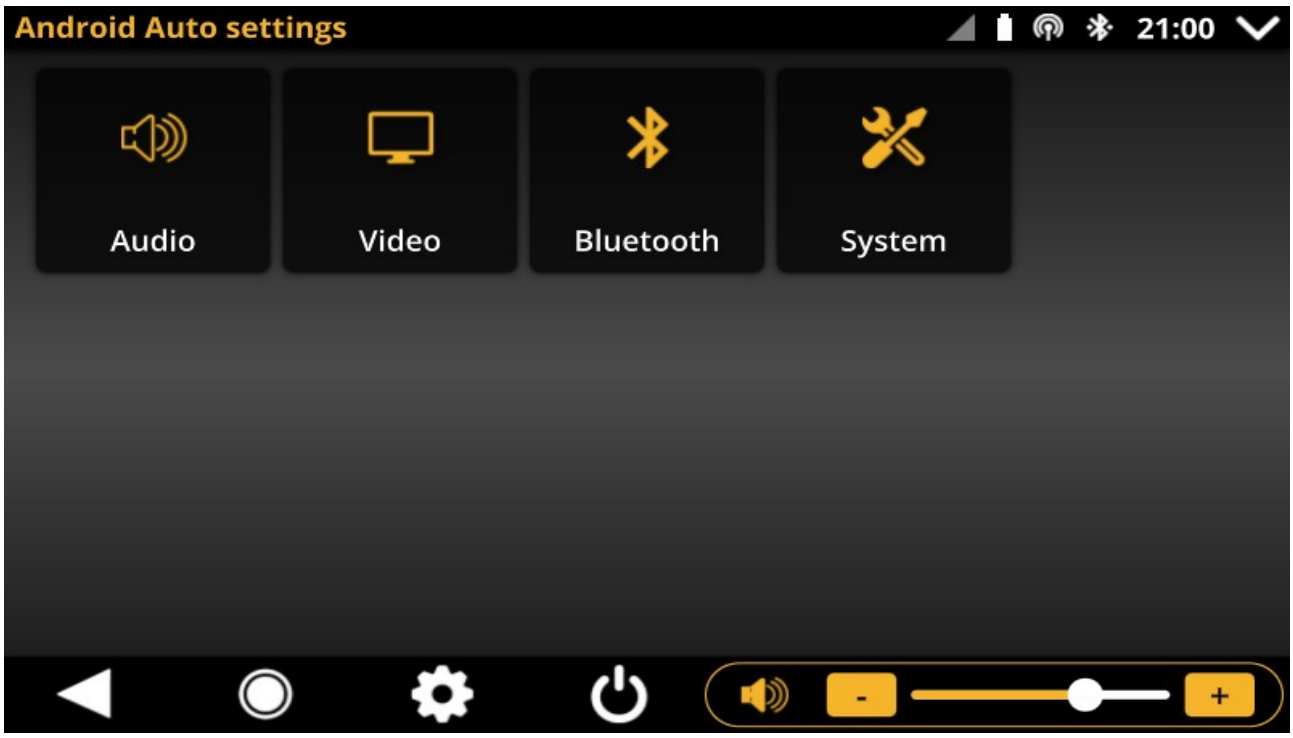


Settings menu

5.1. Android Auto settings

Android Auto settings menu contains several categories of settings:

- Audio settings
- Video settings
- Bluetooth settings
- System settings



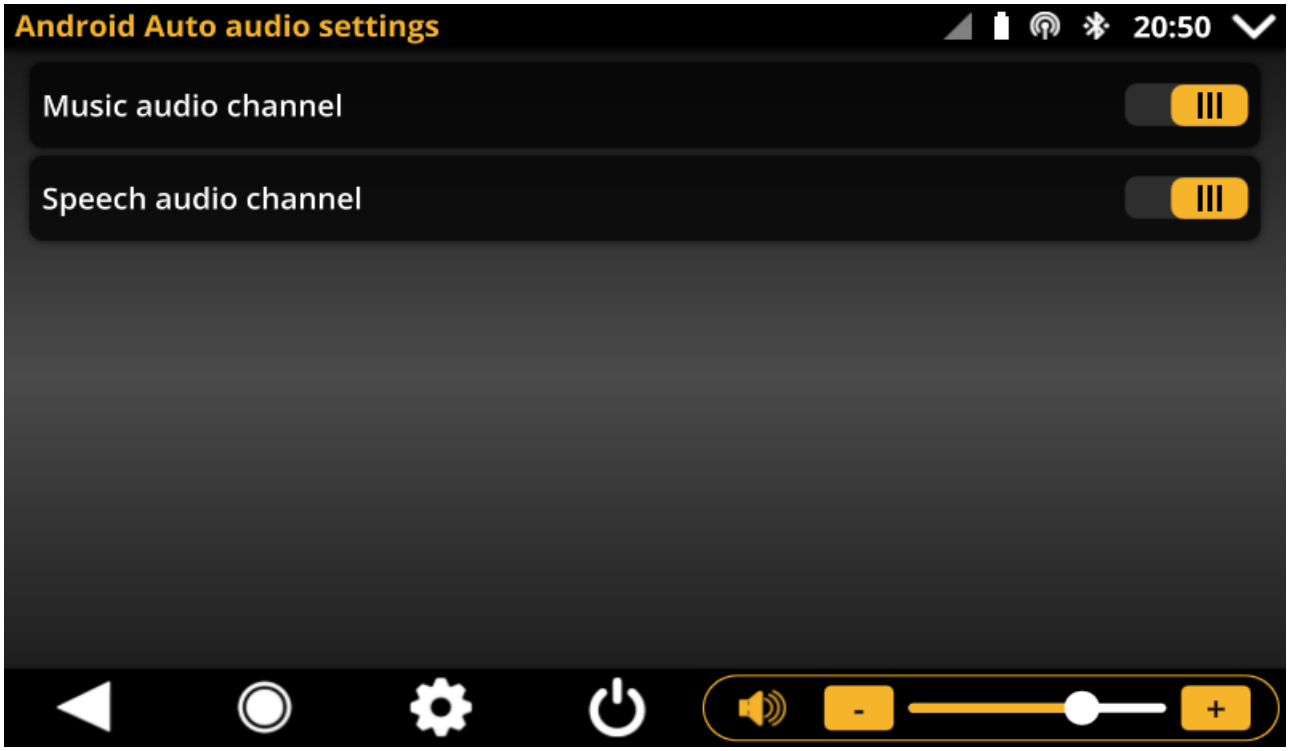
Android Auto Settings menu

5.1.1. Audio settings

- **Music and speech audio channels**

  In audio settings user can adjust behavior of audio channels exposed by Android Auto. If channel is enabled then its playback will be handled by OpenAuto Pro application. Otherwise playback will be handled by the Android-based smartphone like a regular audio stream which means it will be played:

  - **via Bluetooth** - if your Android-based smartphone is connected to the Bluetooth audio output device
  - **via external audio output device -** if any is connected to the headphone socket
  - **via embedded loudspeaker**

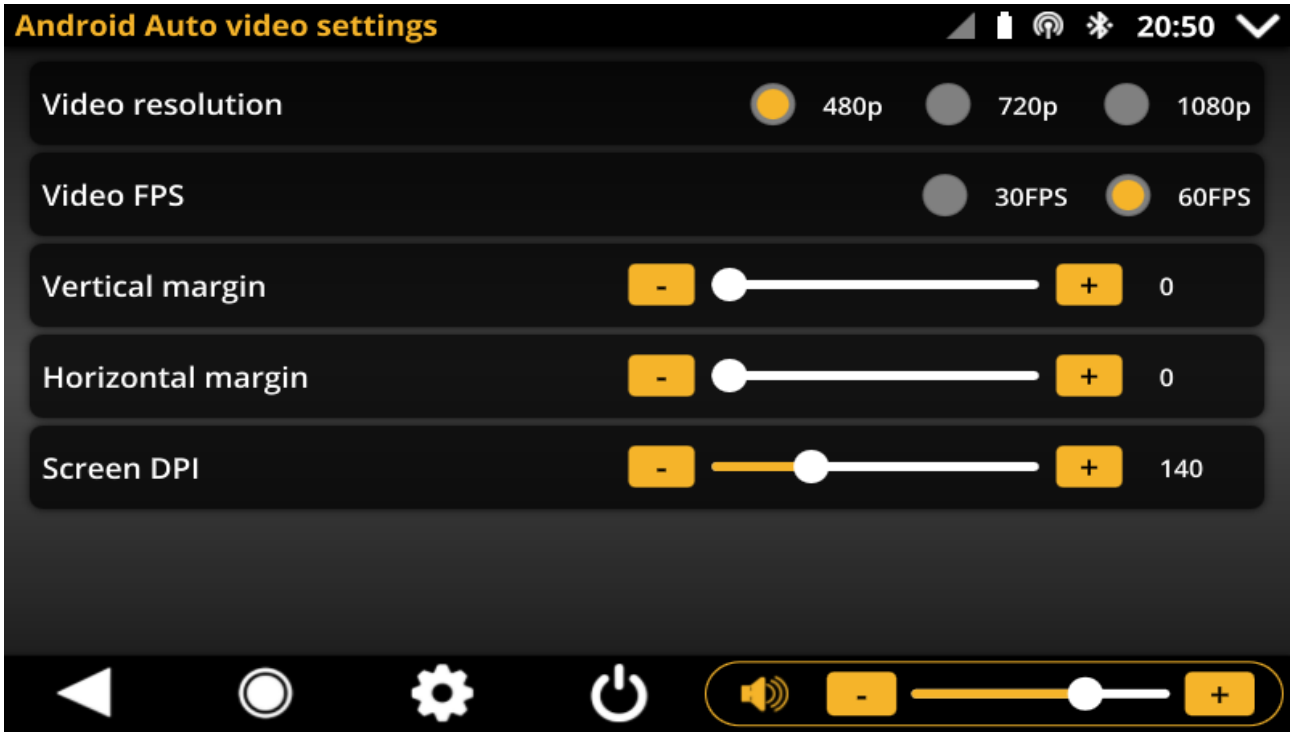


Audio settings menu

5.1.2. Video settings

Video settings allow to adjust video parameters of Android Auto projection:

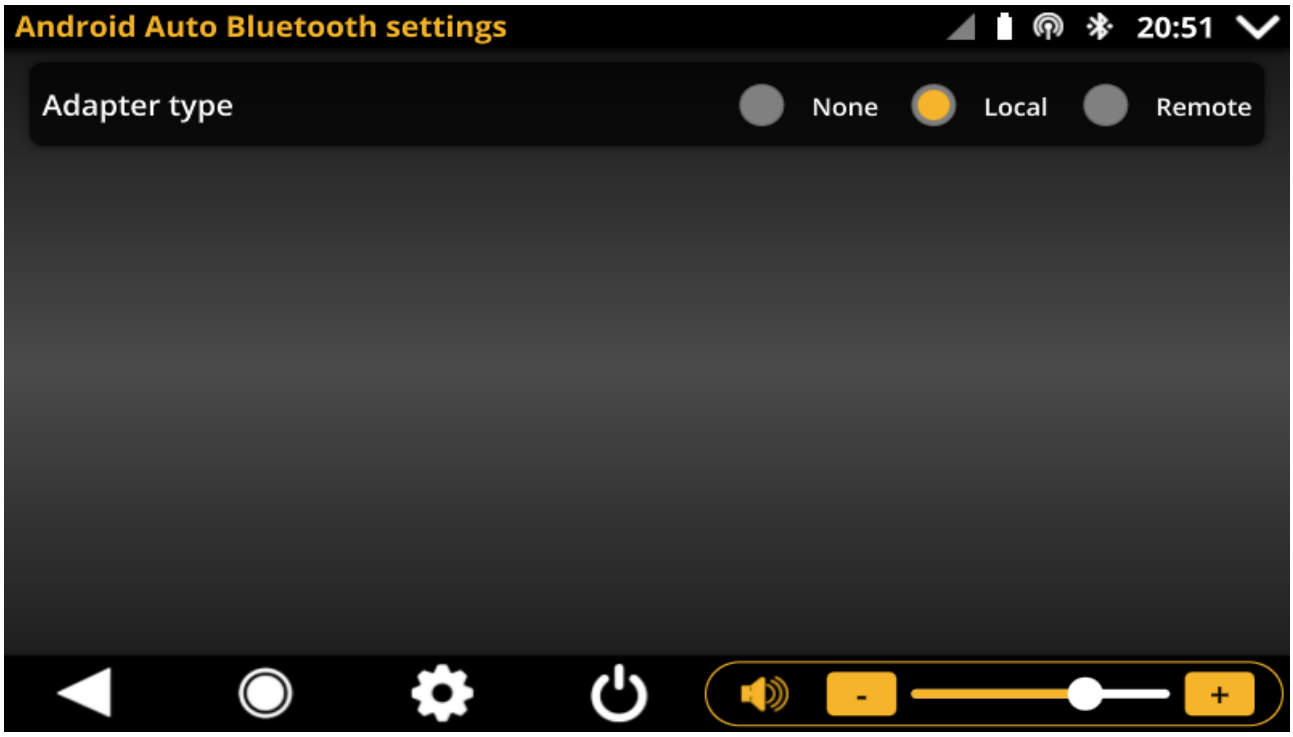
- **Video resolution –** Sets quality of the video stream. 720p and 1080p options must be enabled first in the developer settings of Android Auto application.
- **Video FPS –** Sets frames per second rate of the video stream.
- **Vertical margin –** Allows to adjust top and bottom margins of the video stream (useful in case of enabled over-scan).
- **Horizontal margin –** Allows to adjust left and right margins of the video stream (useful in case of enabled over-scan).
- **Screen DPI –** Controls size of the elements at Android Auto interface



Video settings menu

5.1.3. Bluetooth settings

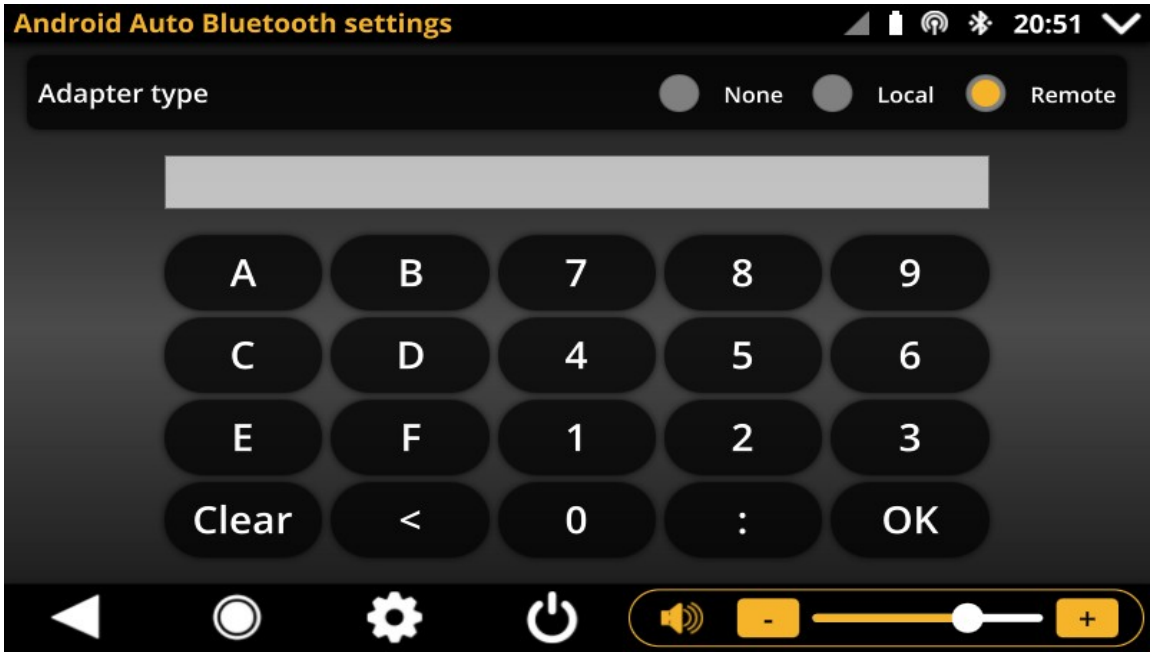
Bluetooth settings can be used to adjust HFP (Hands-Free Profile) parameters of Android Auto projection. HFP profile is used to handle input and output audio streams of voice calls.



Bluetooth settings menu

Adapter type can be set to one of the value:

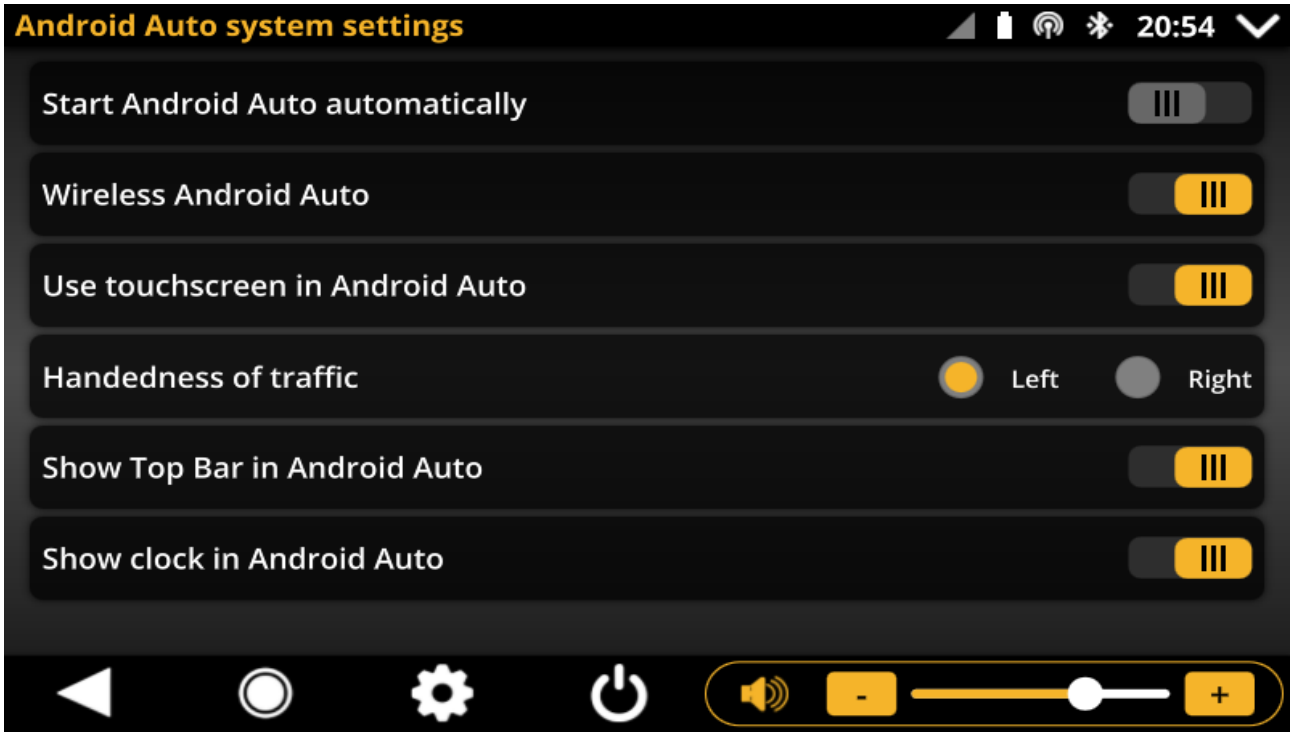
- **None –** voice calls will be handled by Android-based smartphone using embedded microphone and loudspeaker
- **Local –** OpenAuto Pro will request to use Bluetooth adapter connected to the Raspberry PI 3 device. Android-based smartphone must be paired first with the Raspberry PI 3 and also connected Bluetooth adapter must support HFP functionality (embedded Broadcom Bluetooth adapter does not support it).
- **Remote –** OpenAuto Pro will request to use external Bluetooth adapter that address is provided by the user. Android-based smartphone must be paired first with the external adapter. Use this option if you connected your phone with e. g. Car's Bluetooth audio receiver.



Providing address of the remote bluetooth adapter

5.1.4. System settings

System settings contains several entries to control Android Auto projection.



System settings menu

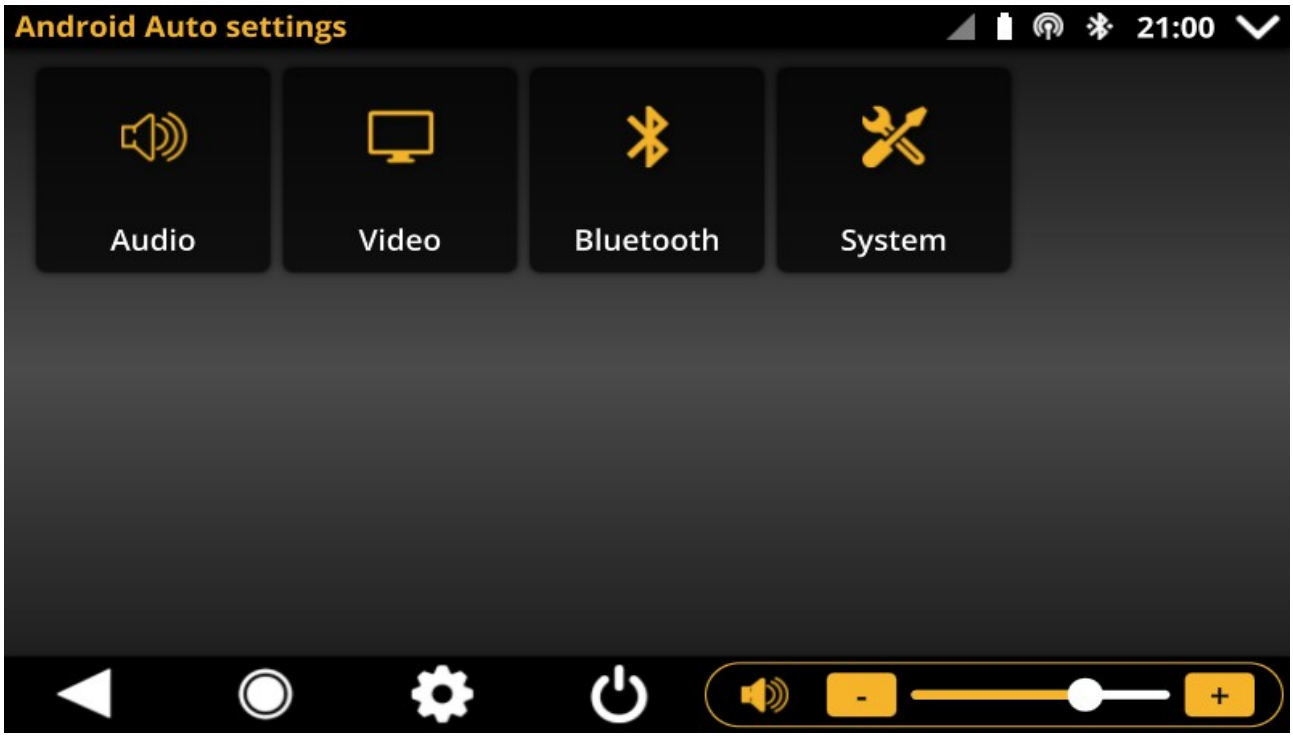
- **Start Android Auto automatically** switch enables starting of Android Auto projection right after Android-based smartphone is plugged in to the USB port. When switch is disabled Android Auto projection will be started only by user request.
- **Wireless Android Auto** switch enables experimental feature that allows establishment wireless connection without Head Unit Server enabled
- **Use touchscreen in Android Auto –** enable or disable touch control of Android Auto interface (useful when only keyboard is used to control Open Auto Pro interface). Disabling this option allows to scroll Maps using keyboard arrows.
- **Handedness of traffic** – optimize Android Auto UI based on handedness of traffic
- **Show Top Bar in Android Auto –** disabling this option will hide the Top Bar during projection of Android Auto and display Android Auto interface in full screen (useful when only keyboard is used to control Open Auto Pro interface)

- **Show clock in Android Auto** – enable or disable displaying clock when Android Auto projection is active

5.2. Android Auto settings

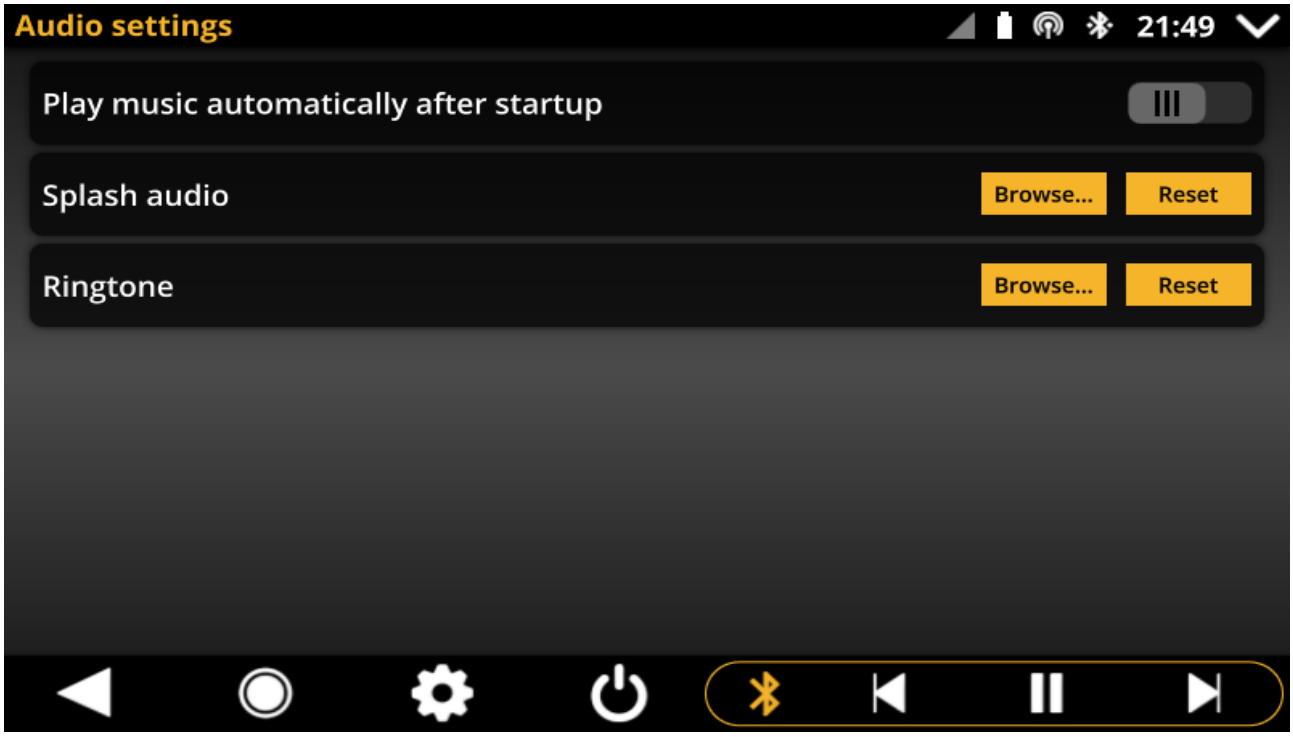
Android Auto settings menu contains several categories of settings:

- Audio settings
- Video settings
- Bluetooth settings
- System settings



Android Auto Settings menu

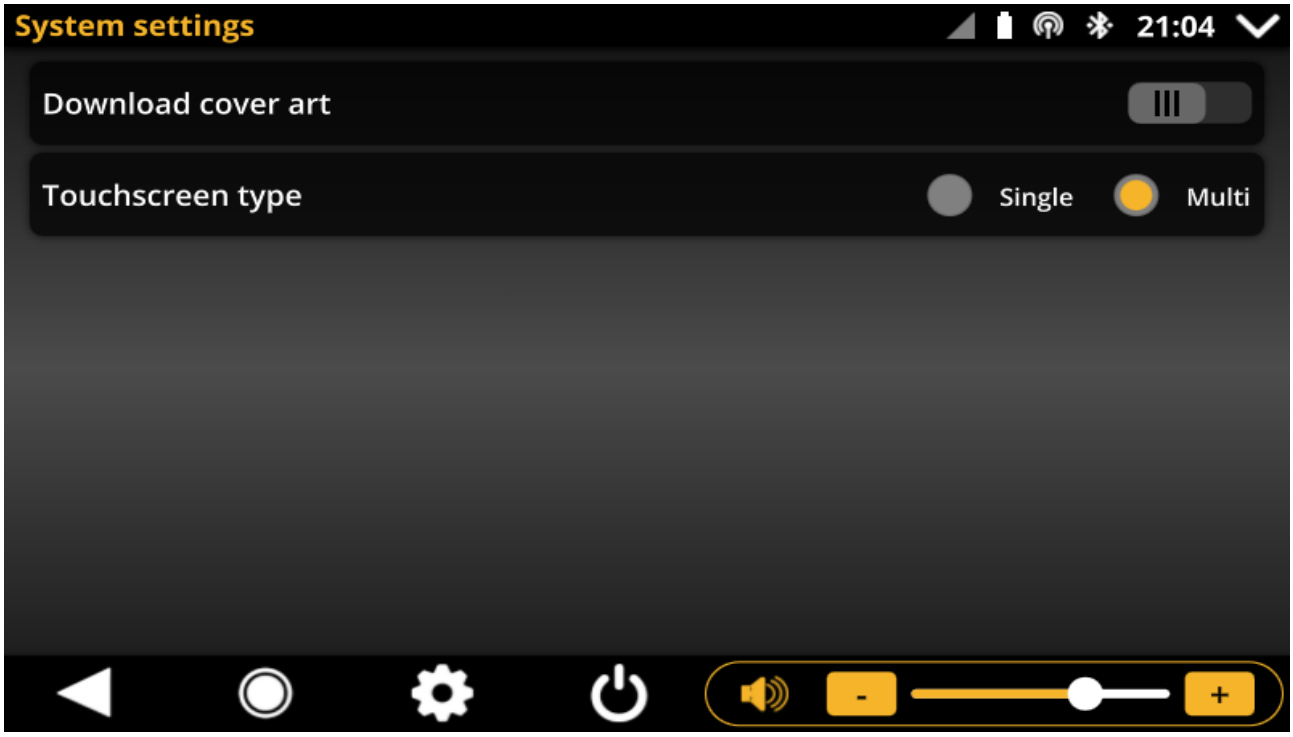
5.3. Audio settings



System settings menu

- **Play music automatically after startup** – Enable or disable resuming playback of last played song by the embedded music player
- **Splash audio** – Audio file that will be played after OpenAuto Pro start
- **Ringtone** – Audio file that will be played during incoming call request

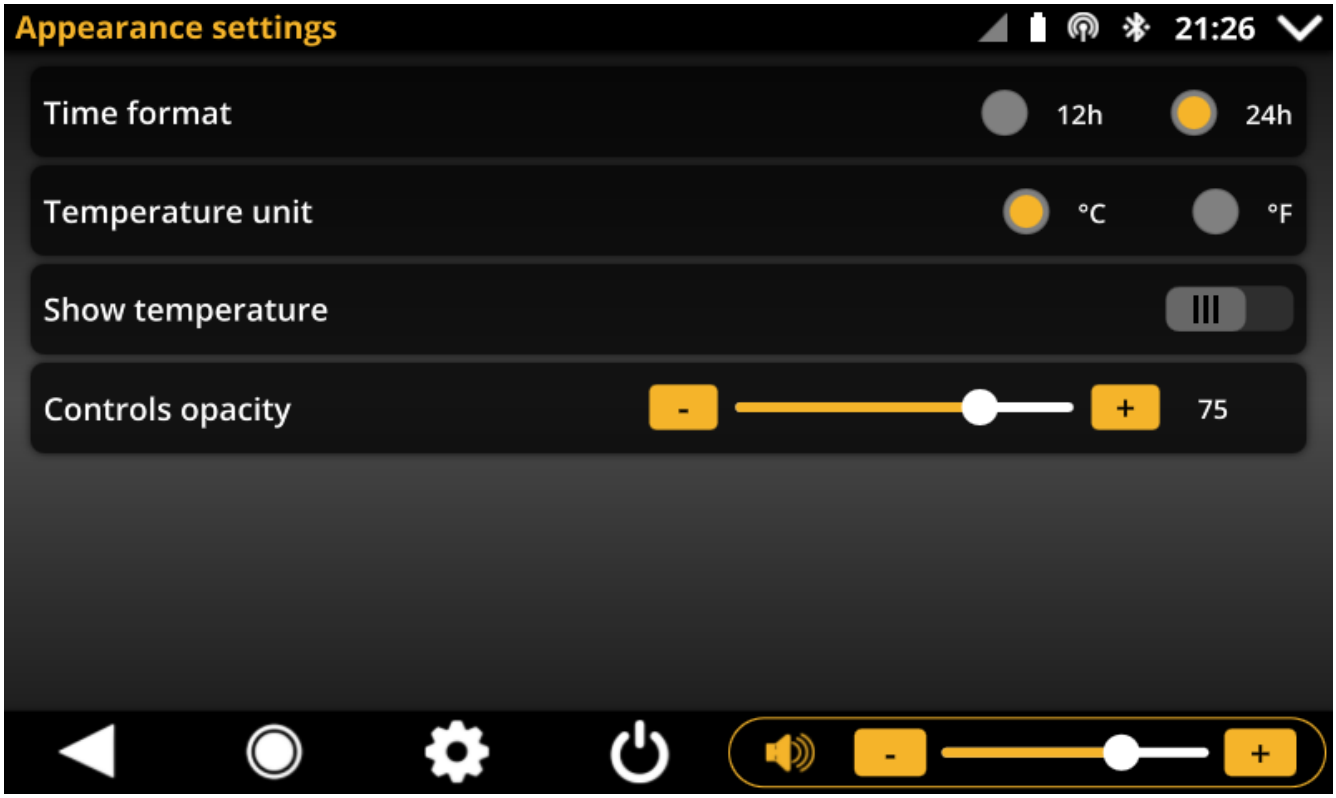
5.4. System settings



System settings menu

- **Download cover art –** enable/disable querying online services to obtain cover art for currently playing song (requires active internet connection)
- **Touchscreen type** – type of touchscreen connected to the OpenAuto Pro

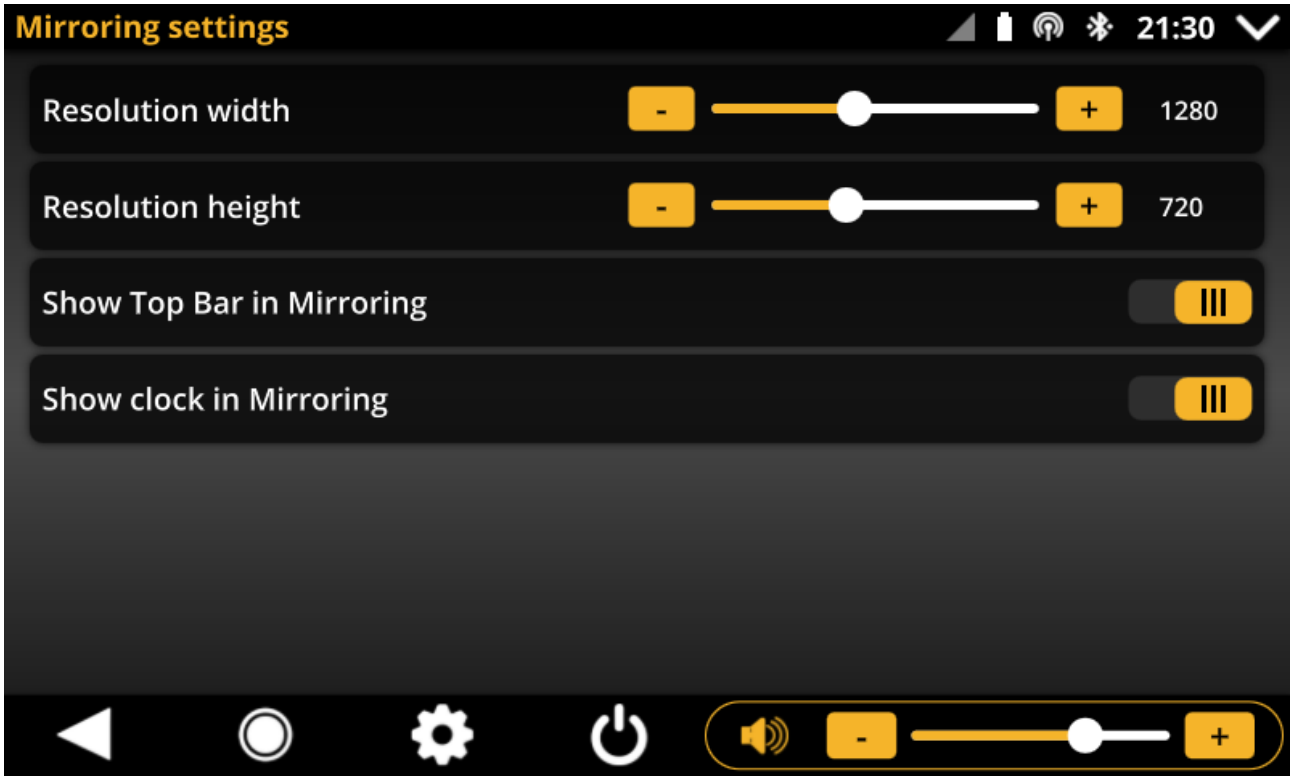
5.5. Appearance settings



Appearance settings menu

- **Time format –** display format of the time
- **Temperature unit –** temperature display unit
- **Show temperature –** Toggle visibility of the temperature
- **Controls opacity –** Opacity of the interface controls

5.6. Mirroring settings



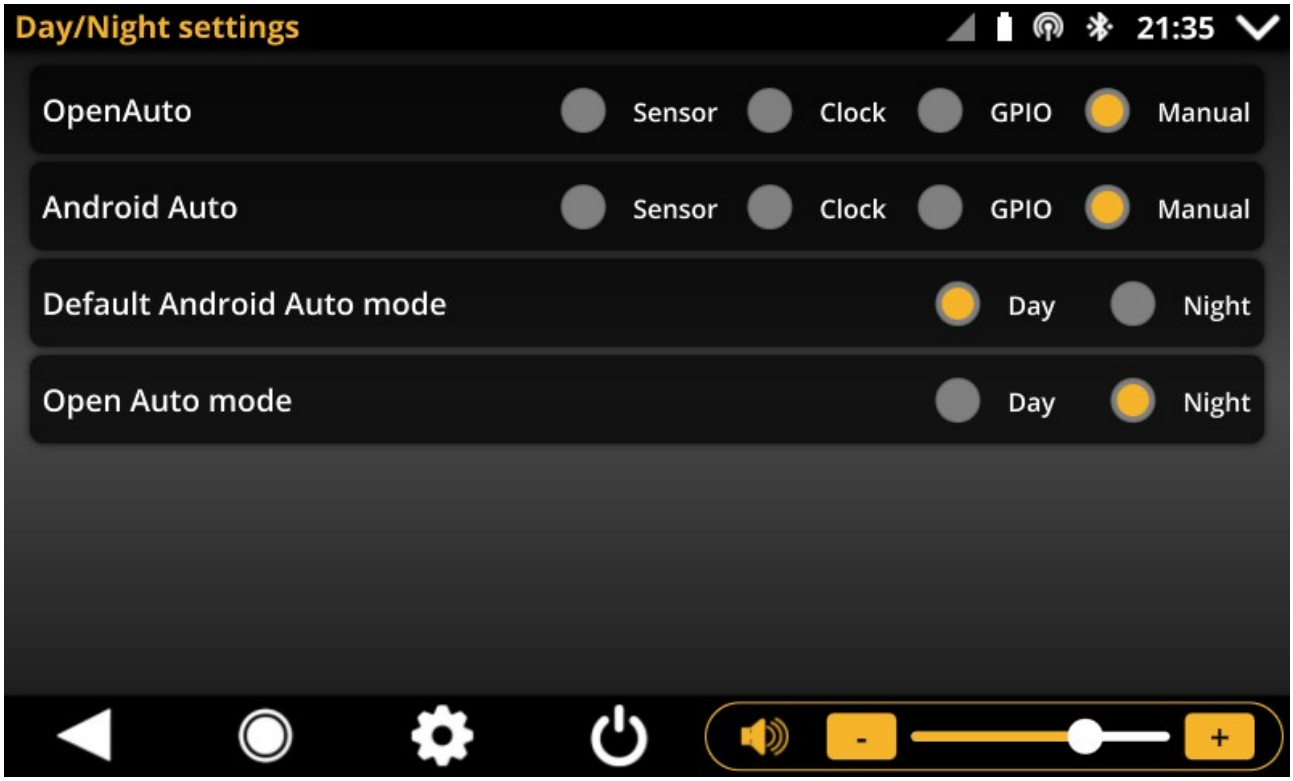
Mirroring settings menu

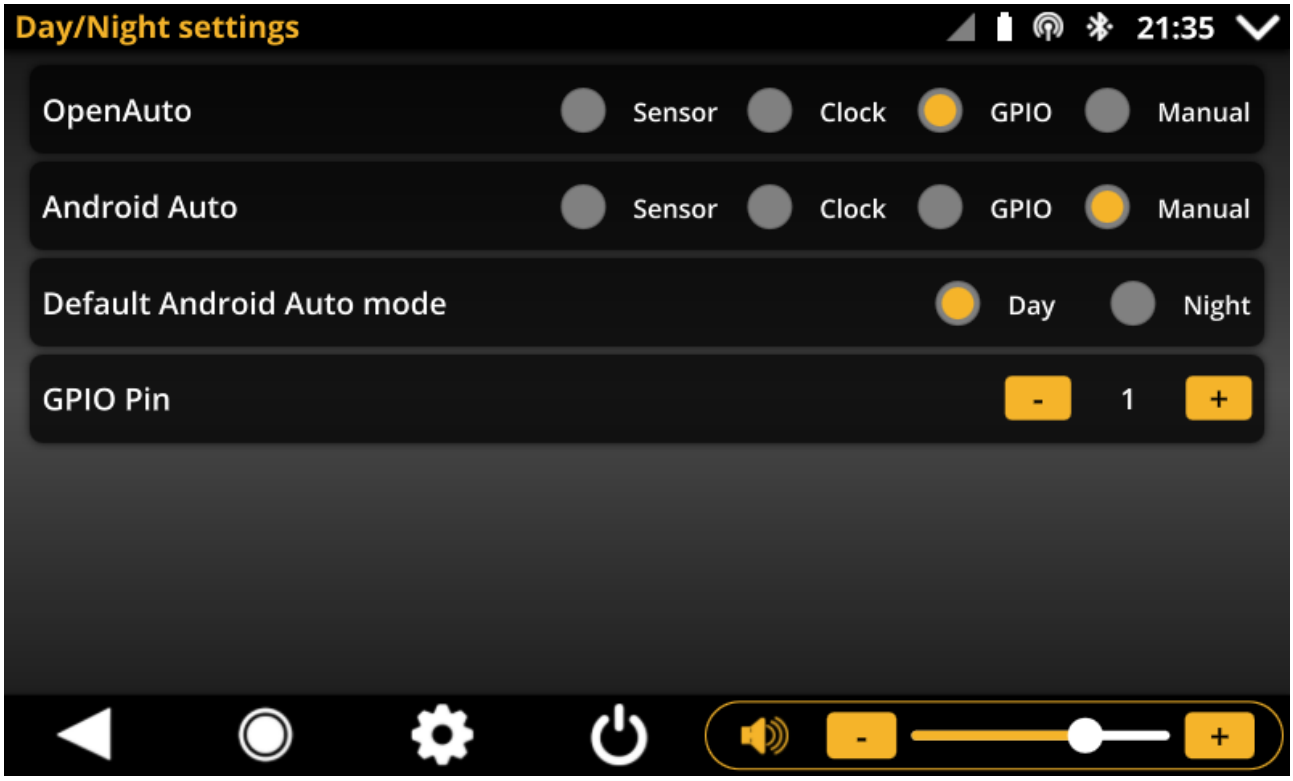
- **Resolution width –** Width of video stream from Android device (should correspond to the Android device aspect ratio)
- **Resolution height –** Height of video stream from Android device ((should correspond to the Android device aspect ratio)
- **Show Top Bar in Mirroring –** disabling this option will hide the Top Bar during Mirroring projection and display it in full screen (useful when only keyboard is used to control Open Auto Pro interface)
- **Show clock in Mirroring –** enable or disable displaying clock when Mirroring projection is active

5.6.1 Example of aspect ratio calculation

- Phone's screen resolution: 2880x1440 - aspect ratio is 2 (**width / height**)
- Raspberry Pi's screen resolution: 800x480 – aspect ratio is 1.67 (**width / height**)
- Desired mirroring resolution: 1280x720 (HD)
- Calculated resolution: 1280x640 **[(1280 / 2880) * 1440]**

5.7. Day/Night settings





- **OpenAuto controller –** type of controlling day/night theme for OpenAuto Pro interface
- **Android Auto controller** – type of controlling day/night theme for Android Auto interface
- **Controller types**
  - **Sensor –** Controlling by TSL2561 light sensor
  - **Clock –** Controlling by day time (clock)
  - **GPIO –** Controlling by GPIO pin (**High state** – night, **Low state** – day)
  - **Manual –** Force use of desired theme
- **Default Android Auto mode –** Default day/night theme of Android Auto interface (will be switched at Android Auto startup)
- **Sensor threshold –** Threshold (in percent of sensor range) for switching to the night theme

5.7.1. Day/Night colors

OpenAuto Pro interface gives possibility to use custom color sets for day and night theme. Colors for day and night themes can be adjusted directly in openauto_system.ini file. Below is the set of colors that can be configured separately for day and night themes. Colors must be specified in hexadecimal format e.g. #000000 for black or #ffffff for white.

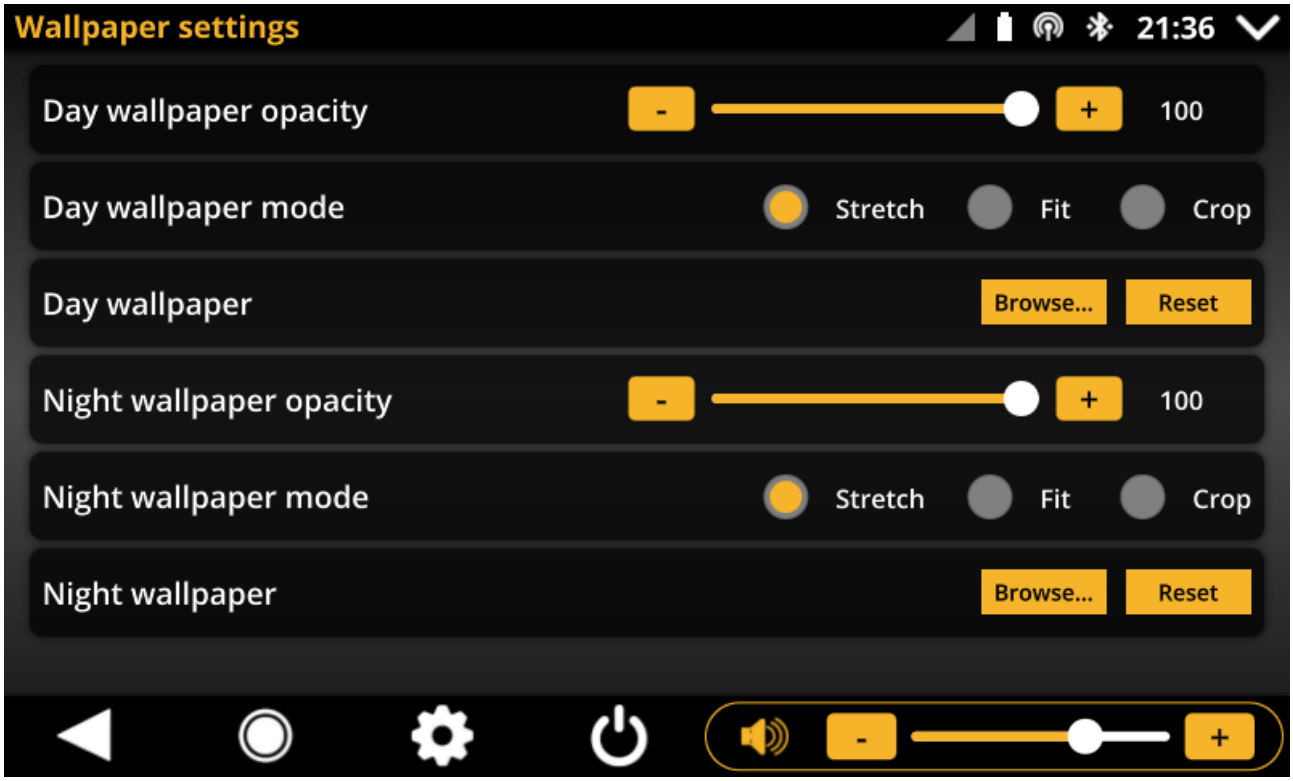
- **HighlightColor –** color of the highlight
- **BackgroundColor –** color of the screen background
- **ControlBackground –** background of a control (e.g. menu tile)
- **NormalFontColor –** color of the normal font (e.g. tile title)
- **MenuFontColor –** color of the menu bar font
- **SpecialFontColor –** color of special text font (e.g. TopBar title)
- **BarBackgroundColor –** background color of bars (TopBar, BottomBar, A2DP player bar)
- **MenuBarBackgroundColor –** background color of the menu bar

5.7.2. TSL2561 sensor configuration

In order to use TSL2561 light sensor for controlling day/night theme, first it must be properly connected and configured in Raspbian OS. If mentioned preconditions are fulfilled, TSL2561 sensor can be activated in OpenAuto Pro by adjustment of below settings in openauto_system.ini file:

- **LightSensorDescriptor** – file system descriptor of the sensor (e.g. /dev/i2c-3)
- **LightSensorAddress –** i2c address of the sensor (e.g. 57)
- **LightSensorMinRange –** Minimum measuring range of the light sensor
- **LightSensorMaxRange –** Maximum measuring range of the light sensor

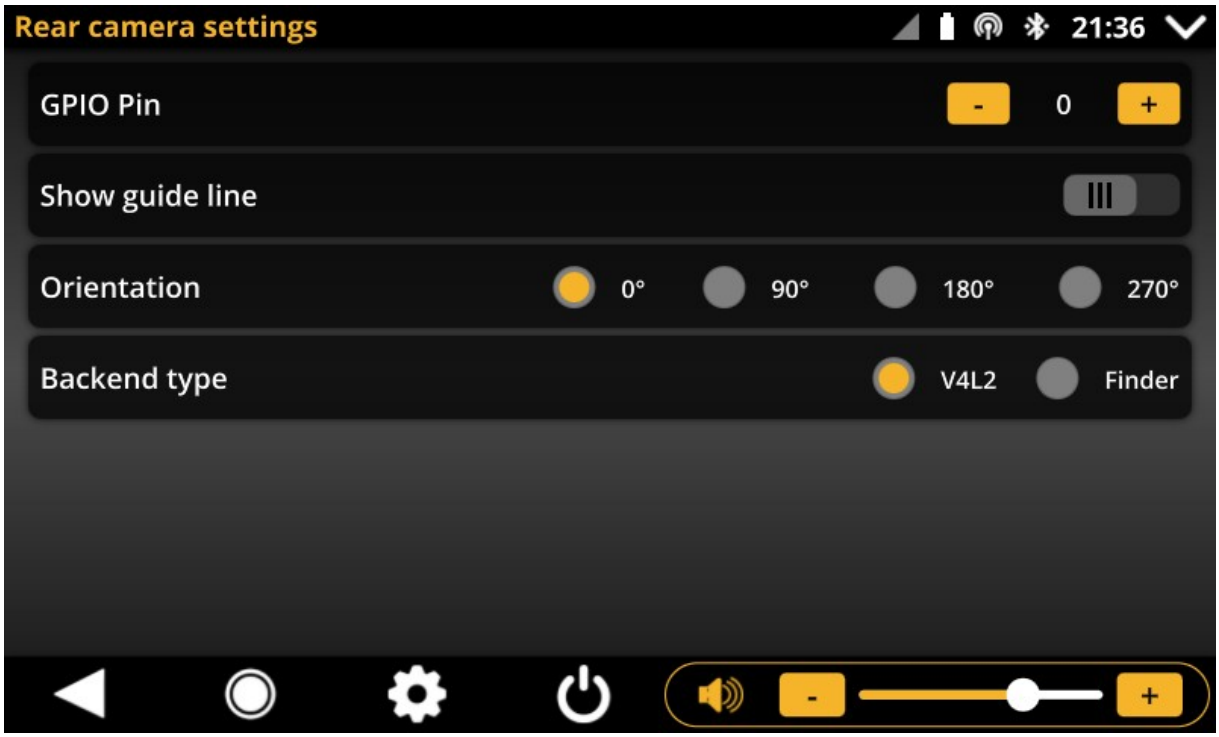
5.8. Wallpaper settings



Wallpaper settings menu

- **Wallpaper opacity** controls opacity of the wallpaper relatively to the default background
- **Wallpaper mode** controls appearance of the wallpaper
  - Stretch - wallpaper is scaled to fit
  - Fit - wallpaper is scaled uniformly to fit without cropping
  - Crop - wallpaper is scaled uniformly to fill, cropping if necessary
- **Wallpaper** can be used to select image file or reset current selection

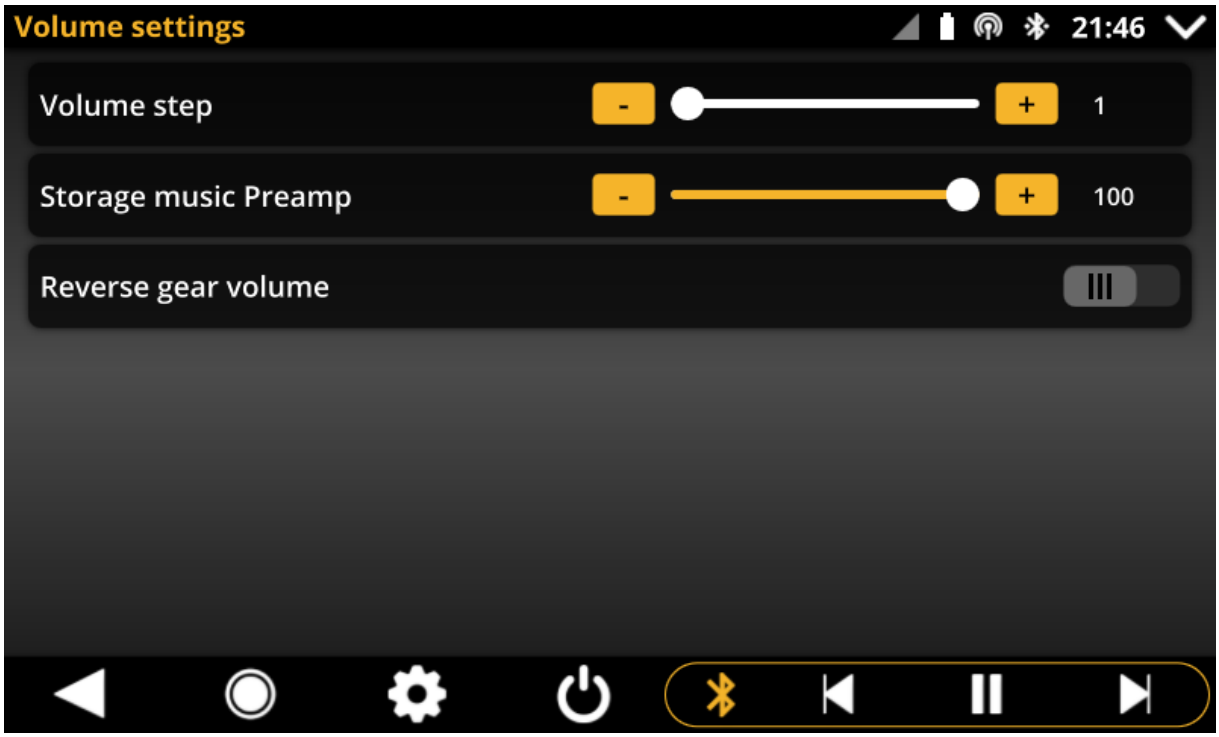
5.9. Rear camera settings



Rear camera settings menu

- **GPIO Pin** – Pin that will be used to trigger rear camera view (Logical HI – camera view is visible, Logical LOW – camera view is hidden)
- **Show guide line –** Enable or disable visibility of guide lines at camera view
- **Orientation** – Change orientation of camera view
- **Backend type** – Change type of the video playback backend (useful when camera does not work with the V4L2 streaming)

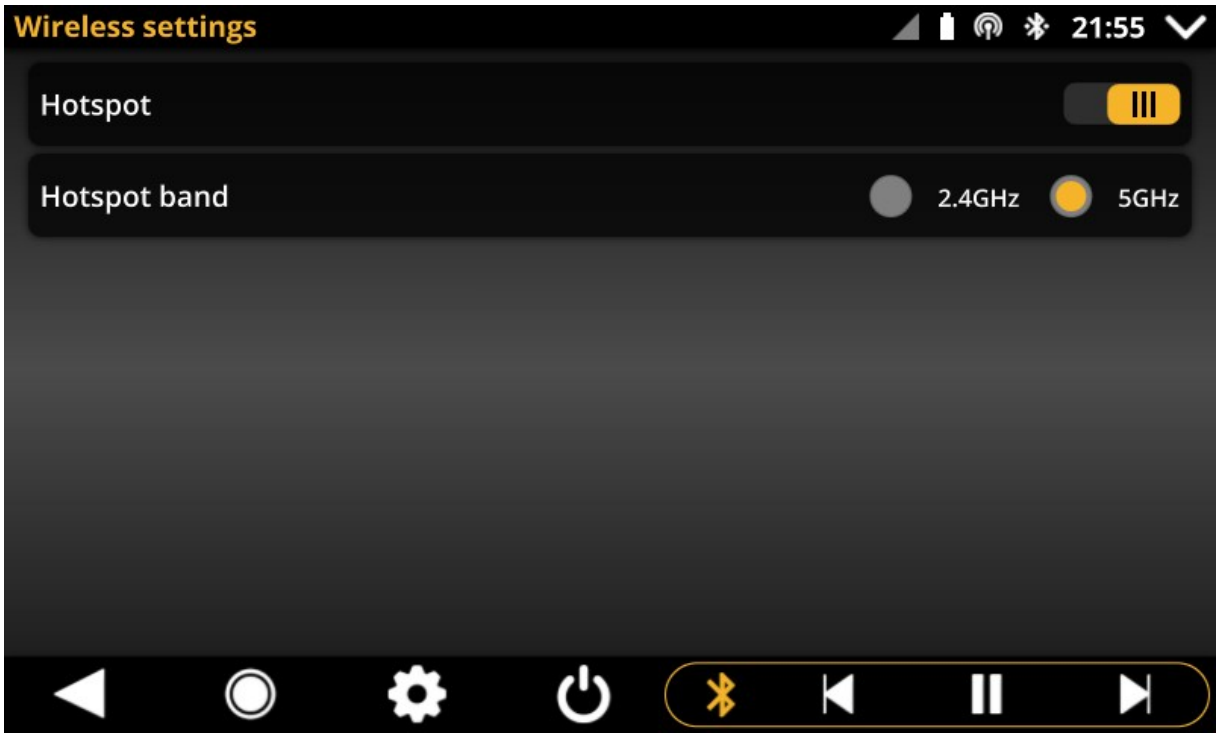
5.10. Volume settings



Volume settings menu

- **Volume step** – Size of a step that volume level will increase by single adjustment
- **Storage music Preamp –** Control preamp of the embedded music player
- **Reverse gear volume** – Enable or disable separated volume level when reverse gear is active

5.11. Wireless settings



Volume settings menu

- **Hotspot** – Enable or disable Hotspot mode
- **Hotspot band –** Control band of the Hotspot. **Please note that 5GHz is not supported by the Raspberry PI 3B.**

Parameters like hotspot name and password can be adjusted directly in **openauto_system.ini** file. **Please note that only alphanumeric strings are valid values.**

6. Keyboard controls

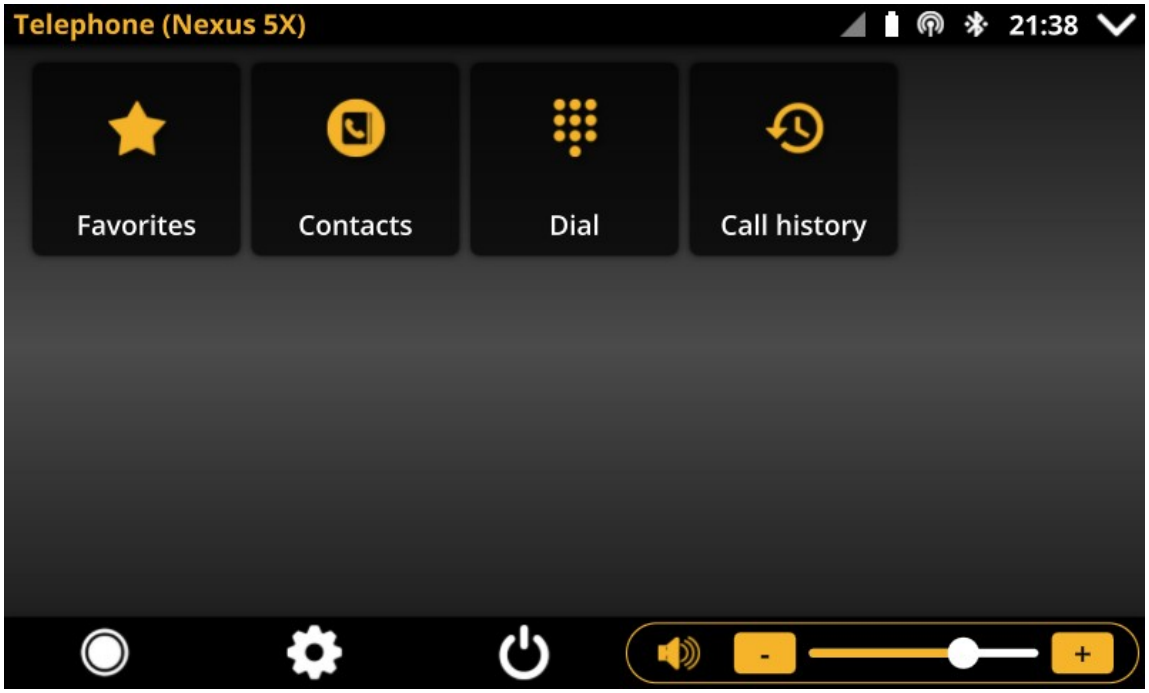
OpenAuto Pro interface can be controller either by touchscreen or keyboard. Below is the list of buttons and their functions in OpenAuto Pro and Android Auto.

Button	OpenAuto Pro function	Android Auto function
Up arrow	Navigate up	Navigate up
Down arrow	Navigate down	Navigate down
Right Arrow	Navigate right	Navigate right / Voice command
Left arrow	Navigate left	Navigate left
1	Scroll left	Scroll left
2	Scroll right	Scroll right
Enter	Select	Select
Escape	Back	Back
H	Home	Home
P	Answer call	Phone menu
O		End phone call
X	Play	Play
C	Pause	Pause
V	Previous track	Previous track
B	Toggle play	Toggle play
N	Next track	Next track
M		Voice command
F		Launch navigation
G		Launch telephone
J		Launch media
F2 (Global Hotkey)	Toggle Android Auto night mode	
F6 (Global Hotkey)	Toggle Top Bar	
F7 (Global Hotkey)	Volume down	
F8 (Global Hotkey)	Volume up	
F9 (Global Hotkey)	Brightness down	
F10 (Global Hotkey)	Brightness up	
F12 (Global Hotkey)	Bring OpenAuto Pro to front	
Ctrl + F3 (Global Hotkey)	Toggle active application	

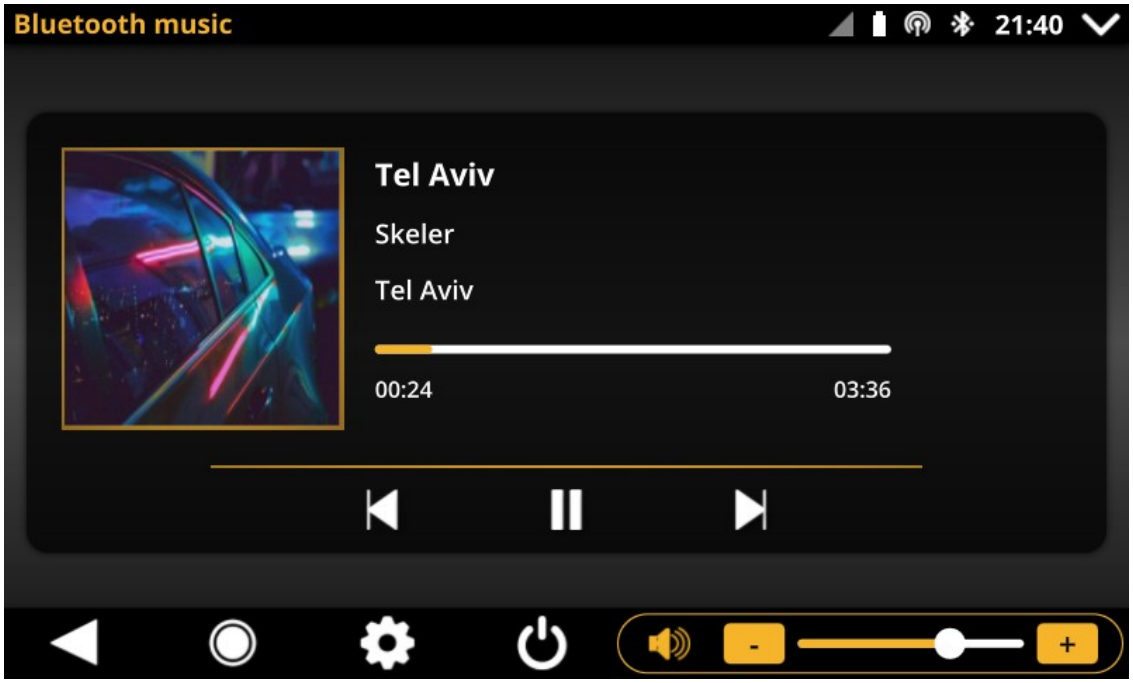
7. Bluetooth

OpenAuto Pro provides support of Bluetooth functions like Hands-Free calling (HFP) with access to the phonebook and calls history (PBAP), music streaming (A2DP) and Networking (BNEP, PAN). Pairing with a phone device is done via Raspbian Desktop interface.

In order to use Bluetooth features an external (USB) Bluetooth adapter based on CSR (Cambridge Silicon Radio) chip is required.



Telephone menu



Bluetooth music (A2DP) menu

8. Mirroring

OpenAuto Pro supports screen mirroring of an Android device connected via USB interface. In order to use it, USB Debugging must be activated on the device that screen will be mirrored. USB Debugging can be activated in Developer Settings that are hidden by default. In order to make it visible please follow instructions at https://developer.android.com/studio/debug/dev-options. Also on some devices (e.g. Xiaomi) it might be needed to enable additional developer settings regarding access to the input device.

Note: Huawei devices are not supported due to incompatibility with Android deployment rules.

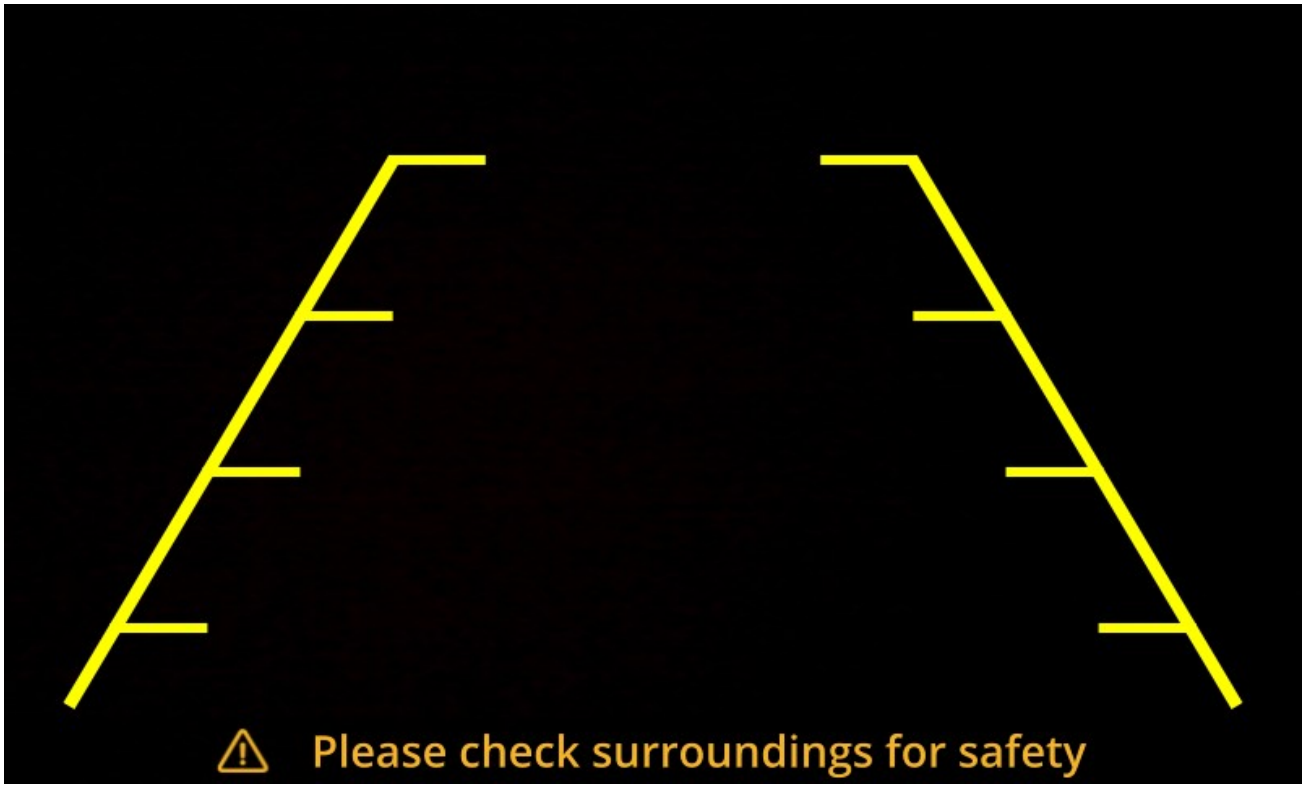
9. DS18B20 temperature sensor configuration

In order to use DS18B20 temperature sensor, first it must be properly connected and configured in Raspbian OS. If mentioned preconditions are fulfilled, DS18B20 sensor can be activated in OpenAuto Pro by adjustment of below settings in openauto_system.ini file:

- **TemperatureSensorDescriptor** – file system descriptor of the sensor e.g. /sys/bus/w1/devices/28-031731045aff/w1_slave

10. Rear camera

OpenAuto Pro currently supports only official Raspberry PI camera hardware. Nevertheless, video capturing service is based on the V4L2 driver that supports almost each camera hardware. Unfortunately, we were able to test rear camera functionality only with official Raspberry PI camera and cannot guarantee that different hardware will work properly.



Example rear camera view

11. About the project

Author and maintainer of this software is **BlueWave Studio**. In case of updates, support or any other queries contact us at *contact@bluewavestudio.io* or visit our web page at *www.bluewavestudio.io*.

If you are interested in purchasing OpenAuto Pro, visit our online store at *www.bluewavestudio.io/index.php/bluewave-shop*

11.1. Used software

- **Boost libraries**
  - *www.boost.org*
- **Qt libraries**
  - *www.qt.io*
- **RtAudio library**
  - *www.music.mcgill.ca/~gary/rtaudio/playback.html*
- **xdo library**
  - *www.semicomplete.com/projects/xdotool*
- **Kodi**
  - *www.kodi.tv*
- **Raspbian**
  - *www.raspberrypi.org/downloads/raspbian*
- **Icons**
  - *www.flaticon.com*