

# Ziru User Guide

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Variant: Enter King Dragon

## Health and Safety Warnings

- Anyone who has had a seizure, loss of awareness, or other symptom linked to an epileptic condition should see a doctor before using the headset;
- The headset might distract the user from or partially block the view of actual surroundings. Please remain seated or standing at all times while wearing the headset;
- Exposure to direct sunlight can damage the headset;
- This product has a number of limitations listed in Product Limitations section below;
- By using this device, you agree that you will not modify or adapt the product.

## Core Functionality

Ziru is a device that augments user vision. It captures a scene with a camera and projects onto internal displays a view augmented with additional information. This helps the user make better sense of the scene.

Ziru's key controls are software lenses, zoom levels and focus. Just like with hardware lenses, software lenses have properties that make them suitable for a particular occasion, be that reading, watching TV

or locating an item in a busy room. Zoom for each lens is controlled independently and allows to alter the framing of the scene and magnify a particular part of it in order to see it better and/or to bring it into focus. Focus is controlled implicitly through zoom: once the object of interest becomes dominant in the scene, Ziru brings it into focus automatically. This essential Ziru functionality—switching between lenses and zooming in and out—is accessible through voice commands *or* key presses.

The rest of Ziru’s functionality is accessible through voice commands only. To accommodate a variety of speakers and accents, some actions can be invoked by more than one voice command. When there are alternative commands available they are separated by ‘OR’.

Ziru is calibrated with a combination of voice commands and key presses. Calibration needs to be done relatively infrequently, e.g., during device setup, as part of periodic maintenance or if regular adjustments are required, e.g. to keep up with changes in the vision of the user.

The rest of this chapter details commands and key presses that can be used to control Ziru. Voice commands are given in **bold**, key presses in *italic*, Ziru’s feedback messages in “QUOTED ALL CAPITALS”, lenses in CAPITALS, and Ziru’s states are denoted as State-Name=StateValue.

Ziru has three buttons:

- Zoom In;
- Zoom Out;
- Power.

Zoom In and Zoom out are located at the top right, whereas Power button is located at the bottom right.

## Lens Commands

Software lenses are on a carousel, with

- **Next** - switching to the next lens;
- **Previous** - switching to the previous lens.

Additionally, it is possible to switch to the previous lens by *pressing and holding Zoom Out button for 3 seconds*.

The following software lenses are available:

- **CLEAR**: color lens designed to reproduce true colors and object proportions and sizes;
- **BOOST**: composite lens combining CLEAR lens output with OUTLINE lens;
- **COGNI**: composite lens combining CLEAR lens with a number of other lenses designed to enhance visual cognition;
- **GRAY**: gray scale lens with adaptive brightness and contrast;
- **OUTLINE**: lens that filters out everything but object outlines.

Outlines in OUTLINE and BOOST lenses are supported in six colors. To change color of the outlines one can issue:

- **Black Outlines**;
- **Blue Outlines**;
- **Green Outlines**;
- **Red Outlines**;
- **White Outlines**;
- **Yellow Outlines**.

Additionally, OUTLINE lens supports changing background colors using the same six-color palette. Background color could be changed with the following commands:

- **Black Background**;

- **Blue Background;**
- **Green Background;**
- **Red Background;**
- **White Background;**
- **Yellow Background.**

The color choice will be remembered even if one temporarily switches to another lens.

OUTLINE lens thus has 30 theoretically possible configurations and they span a range of contrast ratios. The table below could be used to look up a pair of colors based on desired contrast ratio:

Table 1: Contrast Ratios for Each Pair of Colors

Color 1	Color 2	Contrast Ratio
Black	White	21.00 : 1
Black	Yellow	19.55 : 1
Black	Green	15.30 : 1
Blue	White	8.59 : 1
Blue	Yellow	8.00 : 1
Blue	Green	6.26 : 1
Black	Red	5.25 : 1
Red	White	3.99 : 1
Red	Yellow	3.72 : 1
Green	Red	2.91 : 1
Blue	Black	2.44 : 1
Blue	Red	2.14 : 1
Green	White	1.37 : 1
Green	Yellow	1.27 : 1
White	Yellow	1.07 : 1

Pairs are given in the order of decreasing contrast, and for each pair both variants are possible, e.g., White Outlines on Black Background, or Black Outlines on White Background. Ziru will not mix colors with contrast ratio less than 2.44 to 1, which rules out 8 combinations (last four rows in the above table); she will display “Low Contrast Mix” message if such mixture is attempted.

## Zoom Commands

Ziru supports up to 8x magnification, and there are 15 magnification levels one can switch between with:

- **Zoom In;**
- **Zoom Out;**
- **Reset Zoom.**

Alternatively, *pressing Zoom In key once* increases current magnification level.

*Pressing Zoom Out key once* decreases current magnification level.

## Flash Commands

- **Flash On;**
- **Flash Off.**

## Brightness Commands

Ziru supports 7 levels of brightness: 2%, 15%, 30%, 50%, 65%, 80% and 100%.

Brightness can be changed up or down with commands:

- **Brightness Up;**

- **Brightness Down.**

and jump to minimum or maximum brightness can be performed with commands:

- **Minimum Brightness.**
- **Maximum Brightness.**

NB: Brightness is set per lens and defaults to 80%. If brightness is changed to e.g. 65% while in Color lens, the brightness will go up to 80% if one switches to a new lens. Brightness values are remembered between invocations of Ziru, so if one returns to Color lens the brightness will return to previously chosen value of 65%.

## **Volume Commands**

Ziru supports 11 volume levels: 0%, 10%, 20%, ..., 90%, 100%.

Volume can be changed up or down with commands:

- **Volume Up;**
- **Volume Down.**

and jump to minimum or maximum volume can be performed with commands:

- **Minimum Volume OR No Volume.**
- **Maximum Volume.**

NB: Volume is set globally and defaults to 80%.

## **Inspection Commands**

- **Display Barrel;**
- **Display Battery;**
- **Display Brightness;**

- **Display Volume;**
- **Display Lens;**
- **Display Scale;**
- **Display Version;**
- **Display Zoom.**

It is possible to use word ‘show’ instead of ‘display’ in the above, e.g., **Show lens** instead of **Display lens**.

## **Calibration Commands**

- **Calibrate View OR Enter Calibration;**
- **Reset View OR Exit Calibration.**

While in Calibration Mode one can issue the following sub-commands:

- **Rescale View;**
- **Barrel Power;**
- **Left Eye Horizontally;**
- **Left Eye Vertically;**
- **Right Eye Horizontally;**
- **Right Eye Vertically.**

and *use Zoom In and Zoom Out buttons* to adjust the setting.

## **State Machines**

### **Operation States**

#### **Description**

Each Operation State has different use:

- On: Ziru is analyzing video scene, listening to voice commands and monitoring movement sensors;
- Standby: Ziru has entered light power-saving mode due to no user activity but she is monitoring movement sensors;
- Sleep: Ziru is in deep power-saving mode: she is not doing audio or video processing and not monitoring movement sensors;
- Off: Ziru is powered down.

## **Battery Life**

Each Operation State has different energy consumption; starting from fully charged state:

- On: battery lasts 3-4 hours, depending on the lens complexity and brightness setting;
- Standby: battery lasts approximately 24 hours;
- Sleep: battery lasts over a week;
- Off: indefinitely.

## **Transitions**

### **Normal Operation**

- Off → On : press and hold power button for 5 seconds; takes 5 seconds;
- On → Sleep : press power button once; transition is instant;
- On → Standby : no physical movement for 5 minutes; takes 5 minutes;
- Standby → On : any physical movement; transition is instant;
- Sleep → On : press power button once; transition is instant;

- Sleep → Off : through eventual battery discharge if not attached to power source; transition takes over a week.
- On → Off,Battery=Discharged : through use under normal operation.

**Standby State** Standby state is entered whenever Ziru is left unattended in On state for more than five minutes. In this state video and audio processing are stopped and the screen is black. Ziru can detect very fine movements and should not enter Standby state while the user is wearing it, and even a very subtle motion will trigger a return to On state.

**Device Reset** If device is on but not responding or in a state where Ziru is not accessible, it can be returned to on state with

- On → Off → On : press and hold zoom out and power button simultaneously for 7 seconds; transition takes 15 seconds.

### **Known Limitations**

- Off → Sleep : not possible directly, but via On state.
- Operation=On → Operation=Off,Battery=Charged : not possible directly, only by fully discharging the device.

NB: theoretically possible by fully discharging the device and charging without turning on.

## **Battery States**

### **Description**

- Charged;

- Partially Charged;
- Discharged.

## **Transitions**

When power cable is not attached transitions are:

- Discharged → Charged : attach power cable; takes 100 minutes;
- Partially Charged → Charged : attach power cable; time varies depending on residual charge;
- Charged → Discharged : through use; time depends on Operation State.

If power cable is attached Charged state can be maintained and Ziru can operate indefinitely.

## **Feedback**

### **When Power Cable is Attached:**

- When in Operation=On state: (1) a spinning circle is shown or there is no feedback (depending on compute hardware installed);
- When in Operation=Sleep,Sound=On state a sound is played and text is shown briefly in the left eye;
- When in Operation=Sleep,Sound=Off state text is shown briefly in the left eye;
- When in Operation=Off,Battery=Discharged there is no feedback;
- When in Operation=Off,Battery={Charged, Partially Charged} there is a spinning circle showing percentage.

NB: if you put Ziru to charge, if it is in Operation=On state it is better to put Ziru into Operation=Sleep state so that it does not continue to operate while charging.

### **As Power Cable is Removed:**

- When in Operation=Sleep state Ziru transitions to Operation=On state and is ready for use;
- When in Operation=On there is no feedback;
- When in Operation=Off there is no feedback.

NB: If you were charging Ziru and are disconnecting it but do not plan to use it immediately, check that Ziru's displays are off:

- if displays are on, press Power button once to transition Ziru into Sleep state. Otherwise Ziru will continue to operate and deplete charge within three hours.
- if displays are off, Ziru was charging in Off state and there is no need to turn it on. If you pressed the Power button, it is necessary to wait for Ziru to complete boot process; once Ziru is in Operation=On state, press Power button once to transition it into Sleep.

### **As the Battery Discharges:**

- when battery falls to 15% a system popup is displayed;
- when battery falls to 5% a system popup is displayed and screen is dimmed. Shortly after that Ziru will shut down.

NB: Once battery level falls to 15% we recommend putting Ziru to charge and charge it to 85% or more. This will increase battery life span and health.

## **Sound States**

### **Description**

Ziru optionally plays a notification sound when:

- Power button is pressed and Ziru enters Sleep state (Operation=On → Operation=Sleep) [Sound A];
- Power button is pressed and Ziru leaves Sleep state (Operation=Sleep → Operation=On) [Sound B];
- Charger is connected while Ziru is in On or Sleep state [Sound C];
- Charger is disconnected while in On or Sleep state [Sound D].

NB: Ziru will transition from Operation=Sleep state to Operation=On state if power cable is disconnected, and so she may play either Sound B or Sound D to notify the user.

## Transitions

- On → Off: issue **Volume Down** voice command until 0% volume is reached;
- Off → On: issue **Volume Up** command until desired volume level is reached.

## Voice Recognition States

### Description

- Enabled: Ziru listens and responds to voice instructions;
- Disabled: Ziru does not react to voice instructions.

### Transitions

- Enabled → Disabled: *press and hold Zoom In button for 7 seconds;*
- Disabled → Enabled: *press and hold Zoom In button for 7 seconds.*

## Use Cases

- If user is in an environment where it is inconvenient or inappropriate to use voice to command Ziru, user can change lenses or zoom level silently using buttons only;
- To watch a film or TV program while ensuring Ziru won't erroneously accept a command from a third party (e.g. through accidental match) one could switch Ziru to Voice Recognition=Off;
- To prolong battery life one can decrease brightness, switch to a less complex or more efficient lens and disable voice recognition; here are some example timings that can be used as a guide, starting from 100% battery at hour 0 for Ziru Augmented Vision version 1.0.269, with Voice Recognition=Enabled, as a function of lens:

Table 2: Battery Remaining and Total Runtime for Each Lens

Brightness	Lens	Hour 1	Hour 2	Hour 3	Hour 4	Total Runtime
80%	CLEAR	78%	53%	25%	2%	4 hours
80%	GRAY	77%	52%	26%	5%	over 3.5 hours
80%	OUTLINE	76%	52%	25%	5%	over 3.5 hours
80%	BOOST	75%	49%	18%	-	3.5 hours
80%	COGNI	71%	40%	8%	-	over 3 hours

Screen brightness affects battery life to a lesser extent; as a function of brightness, using CLEAR lens, with Voice Recognition=Enabled:

Table 3: Battery Remaining and Total Runtime for Each Brightness

Brightness	Lens	Hour 1	Hour 2	Hour 3	Hour 4	Total Runtime
100%	CLEAR	77%	52%	26%	-	over 3.5 hours
80%	CLEAR	78%	53%	25%	2%	4 hours
65%	CLEAR	78%	55%	27%	3%	4 hours
50%	CLEAR	78%	56%	32%	5%	over 4 hours
30%	CLEAR	79%	57%	34%	10%	over 4 hours

Using CLEAR lens at 80% brightness with and without Voice Recognition:

Table 4: Battery Remaining and Total Runtime for Each Voice Recognition State

Voice Recognition	Hour 1	Hour 2	Hour 3	Hour 4	Total Runtime
Enabled	78%	53%	25%	2%	4 hours
Disabled	79%	59%	36%	16%	4.5 hours

Tests were conducted on different but typical indoors scenes, with medium number of objects in each, and with battery at the beginning of its life cycle.

## Product Limitations

- Ziru accepts the majority of its commands exclusively by voice, with only the most frequently used functions being also available to control via physical buttons. Ziru’s user thus (1) needs to be

- able to utter the commands and (2) have access to an environment with a relatively low background noise. Even when both of these conditions are met, the recognition success may depend on the stress, voice timbre, intonation and command complexity. It may be necessary to repeat the command or choose an alternative command that has a higher success rate for that user;
- Ziru reduces field of view and presently can only be used while stationary (seated or standing) in order to avoid the danger of falling;
  - Ziru has a magnetic charger cable. If you are using a cochlear implant, heart monitor, pacemaker, continuous glucose monitor or another implantable medical device please consult your doctor or the manufacturer of your medical device. Please contact us if you would prefer a device without a magnetic charger cable;
  - This version of Ziru is not connected to the Internet or any other network. Dodrotu will optionally collect feedback via email or phone survey only.
  - Ziru should be calibrated for each individual user by adjusting lens positions to match their interpupillary distance. We can configure Ziru before shipping if the interpupillary distance is known at the time of purchase. Alternatively, the device could be configured by the user's optician, the user's family member or the user themselves if their condition allows them to learn the calibration process, press the buttons on the device and read and follow instructions in the manual. The calibration is not complex and involves a combination of voice commands and button presses. Calibration operations are detailed in the Calibration section of this guide.