

STELLAR VISION v1 — USER MANUAL

Assistive Braille Input Device with AI Integration

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Device Overview

STELLAR VISION is an assistive technology device designed for visually impaired users, featuring:

- **14-key Braille input system** via PCF8575 GPIO expander
- **6-dot Braille pattern recognition** with full character set
- **HID keyboard output** via DigiSpark (USB keyboard emulation)
- **AI integration** (Gemini AI for queries)
- **Notification system** via BLE (ChronosESP32)
- **Audio feedback system** with voice confirmations and mode announcements
- **SD card storage** for notes and files
- **OCR capabilities** (*B-DRIVE mode* for text extraction from images/PDFs)
- **Text-to-speech** for reading files aloud
- **One-hand gesture mode** via MPU6050 accelerometer
- **SOS Emergency Alert** via SMS (Twilio integration)
- **OTA firmware updates** via WiFi
- **SD Upload Mode** for wireless file transfer
- **Audio Player** for WAV file playback
- **Alphabet audio feedback** for typed characters
- **Text auto-correction** system
- **Deep sleep mode** for power saving

Button Layout

Input Keys (14 Total)

Pin	Function	Description
0–5	Braille Dots 1–6	Standard 6-dot Braille input
6	Ctrl Modifier	Toggle Ctrl key (for combos)
7	Backspace	Delete last character
8	Space (Left)	Space bar / Modifier / SOS trigger (long press)
9	Space (Right)	Space bar / Modifier / SOS trigger (long press)
10	Previous	Go back / Long press for gesture mode
14	Up	Navigate up in menus / Long press toggles alphabet audio
12	Select	Confirm / Enter mode
13	Down	Navigate down in menus

Getting Started

Initial Boot

1. Power on the device
2. Wait for initialization (vibration feedback)
3. Device enters **NORMAL MODE** by default
4. Serial Print: *"Stellar Vision v1"*

First-Time Setup

- **SD Card:** Insert before powering on for file storage
 - o Create /AudioFiles/ folder for audio player
 - o Create /Alphabets/ folder for letter pronunciation (optional)
- **BLE Connection:** Pair with mobile device for notifications
- **HID Mode:** Connect DigiSpark for keyboard functionality
- **Twilio SMS:** Configure credentials for SOS emergency alerts

Operating Modes

1. NORMAL MODE

Entry: Device boots into this mode

Purpose: Idle state, ready to enter other modes

Actions:

- **Select (short press)** → Enter *PERKINS MODE*

- **Select (long press)** → Open *MODE OPTIONS*

Power Management:

- Device enters **deep sleep** after 30 seconds of inactivity
- Power cycle to wake from deep sleep

2. PERKINS MODE

Entry: Short press SELECT from NORMAL MODE

Purpose: Braille typing with real-time HID keyboard output

Features:

- Type Braille patterns (dots 1–6)
- Characters appear on connected computer via HID
- **Space** → Add space character
- **Backspace** → Delete last character
- **Ctrl (toggle)** → Hold Ctrl modifier
- **Alphabet Audio** → Announces typed letters (when enabled)

Special Indicators

- **Pattern 60** (dots 3,4,5,6): Number mode
- **Pattern 32** (dot 6): Capital mode

Key Combinations

Combination	Function
Space + Backspace (hold)	Enter key
Space + Ctrl (hold)	Shift + Enter (newline)
Ctrl + Space (hold)	Apply text correction
Space LEFT/RIGHT (1.5s hold)	Send SOS emergency SMS

Exit: Press PREVIOUS to return to MODE OPTIONS

3. MODE OPTIONS

Entry: Long press SELECT from any mode

Purpose: Navigate between device features

Available Modes:

1. NOTIFY
2. GEMINI AI

3. NOTE-MAKER
4. HID SHORTCUT
5. B-DRIVE
6. SD CARD
7. SD UPLOAD
8. SYSTEM UPDATE
9. AUDIO PLAYER

Navigation:

- **Up/Down:** Scroll through options
- **Select:** Choose highlighted option
- **Previous:** Return to PERKINS MODE

4. NOTE-MAKER MODE

Entry: Select "NOTE-MAKER" from MODE OPTIONS

Purpose: Create and save text notes to SD card

Workflow

1. **Naming Phase**
 - o Type desired filename (max 12 characters)
 - o Double-tap SELECT to confirm name
 - o Double-tap SELECT again for auto name (NOTE1.txt, NOTE2.txt...)
1. **Writing Phase**
 - o Type note using Braille input
 - o BACKSPACE → Correct errors
 - o SPACE → Insert space
 - o **Ctrl + Space** → **Apply text correction**
1. **Saving**
 - o **Ctrl + Backspace (hold)** → Save and exit
 - o Audio feedback confirms save

Exit: PREVIOUS before saving → Discard note

5. SD CARD MODE

Entry: Select "SD CARD" from MODE OPTIONS

Purpose: Browse and read files on SD card

Navigation:

- **Up/Down:** Navigate file list
- **Select:** Open file (printed to serial)
- **Ctrl + Backspace (hold):** Text-to-speech (TTS) of current file

File Compatibility:

.txt (UTF-8 text)

Power Note: Deep sleep is disabled in this mode

Exit: Press PREVIOUS

6. GEMINI AI MODE

Entry: Select "GEMINI AI" from MODE OPTIONS

Purpose: Query Google Gemini AI and save responses

Workflow

1. **Query Phase:** Type your question in Braille
2. **Send Query:** Ctrl + Backspace (hold)
3. **Save Response:** Type filename → Double-tap SELECT → Confirm

Requirements:

- WiFi connection (auto-connects on mode entry)
- Internet access
- Pre-configured Gemini API key

Exit: PREVIOUS

7. B-DRIVE MODE

Entry: Select "B-DRIVE" from MODE OPTIONS

Purpose: Extract text from images/PDFs via OCR

Setup

1. Announces local web server IP (port 80)
2. Connect device to same WiFi network
3. Access via browser at `http://[IP_ADDRESS]`

Supported Formats

- Images: JPG, PNG
- PDFs: Text extraction (client-side)

Workflow:

1. Upload file via web interface
2. OCR processes text (OCR.space API)
3. Device vibrates when complete
4. Save: Type filename → Double-tap SELECT → Ctrl + Backspace

Requirements:

- WiFi + OCR.space API key
- SD card

Power Note: Deep sleep is disabled in this mode

Exit: PREVIOUS (stops web server)

8. HID SHORTCUT MODE

Entry: Select "HID SHORTCUT" from MODE OPTIONS

Purpose: Execute predefined keyboard shortcuts

Shortcut	Action
WIFI	Open WiFi settings
CHROME	Launch Chrome
GMAIL	Open Gmail
CHATGPT	Open ChatGPT
PY COMPILER	Open Python IDE
LIBRARY	Open Library app

Navigation:

- **Up/Down:** Browse shortcuts
- **Select:** Execute highlighted shortcut

Requirements: DigiSpark HID connected

Exit: PREVIOUS

9. NOTIFY MODE

Entry: Select "NOTIFY" from MODE OPTIONS

Purpose: Receive and log smartphone notifications

Features:

- BLE connection via ChronosESP32
- Logs notifications to /NOTIFY.txt
- Ring buffer (8 messages)

Log Format:

App: [app_name] [timestamp]

Msg: [title] [message]

Toggle:

- Select "NOTIFY" → ON (vibration feedback)
- Select again → OFF

Note: Old NOTIFY.txt is cleared on each boot

10. SD UPLOAD MODE

Entry: Select "SD UPLOAD" from MODE OPTIONS

Purpose: Upload files and folders wirelessly to SD card

Features

- Web-based file upload interface (port 8080)
- **Folder structure support** with drag-and-drop
- Browse, download, and delete files
- Directory tree visualization

Setup

1. Device announces IP address on port 8080
2. Access `http://[IP_ADDRESS]:8080` in browser
3. Upload individual files or entire folders

File Management:

- View all files with sizes
- Download files to computer
- Delete files remotely
- **Create nested folder structures**

Requirements:

- WiFi connection

- SD card

Power Note: Deep sleep is disabled in this mode

Exit: PREVIOUS (stops server)

11. SYSTEM UPDATE MODE

Entry: Select "SYSTEM UPDATE" from MODE OPTIONS

Purpose: Check for and install firmware updates via OTA

Workflow

1. **Check for Updates**
 - o Device connects to GitHub repository
 - o Compares current firmware (v2.0) with latest version
1. **Update Available**
 - o Device announces new version
 - o Audio confirmation plays
 - o **SELECT:** Confirm and install update
 - o **PREVIOUS:** Cancel update
1. **Installation**
 - o Progress indicators via vibration
 - o **⚠ DO NOT POWER OFF** during update
 - o Device reboots automatically after successful update

Timeout: 15 seconds to confirm update

Power Note: Deep sleep is disabled in this mode

Exit: PREVIOUS (cancels update)

12. AUDIO PLAYER MODE

Entry: Select "AUDIO PLAYER" from MODE OPTIONS

Purpose: Play WAV audio files from SD card

Setup

- Place .wav files in /AudioFiles/ folder on SD card
- Files are automatically sorted alphabetically

Controls

Button	Function
UP	Previous track (or stop if playing)
DOWN	Next track (or stop if playing)
SELECT	Play/Stop current track
PREVIOUS	Exit Audio Player Mode

Features:

- Supports WAV format (22kHz 16-bit mono recommended)
- Audio feedback for track changes
- File list announced on entry

Requirements:

- SD card with /AudioFiles/ folder
- WAV files

Power Note: Deep sleep is disabled in this mode

Exit: PREVIOUS (stops playback and returns to MODE OPTIONS)

Navigation Guide

Global Button Combinations

Combination	Function
Ctrl + Backspace (hold)	Save / Send / TTS
Space + Backspace (hold)	Enter
Space + Ctrl (hold)	Shift + Enter
Ctrl + Space (hold)	Apply text correction
Space LEFT/RIGHT (1.5s hold)	SOS Emergency SMS
SELECT (long press)	Open MODE OPTIONS
PREVIOUS (long press)	Toggle ONE-HAND MODE
UP (long press 1s)	Toggle alphabet audio feedback
All 6 dots pressed	Toggle alphabet audio (alternative)

Mode Transitions

NORMAL MODE

↓ (SELECT short)

PERKINS MODE

↓ (SELECT long)

MODE OPTIONS

↓ (SELECT on option)

[Selected Mode]

↓ (PREVIOUS)

MODE OPTIONS

↓ (PREVIOUS)

PERKINS MODE

Advanced Features

ONE-HAND GESTURE MODE

Activation: Long press PREVIOUS

Purpose: Control device via MPU6050 accelerometer

	Tilt	Action
Right		SELECT
Left		PREVIOUS
Up		UP
Down		DOWN
Long Up (3s)		Disable Gesture Mode

SOS Emergency Alert System

Activation: Long press either SPACE button for **1.5 seconds**

Provider: Twilio SMS API

Features:

- Sends emergency SMS to pre-configured number
- Includes device status and uptime
- **30-second cooldown** between alerts (prevents spam)
- Audio announcement: /TACTI_VISION_WAV/SOS.wav

SMS Content:

SOS TRIGGERED FROM STELLAR VISION

STATUS: Emergency

DEVICE: TACTI-WAVE

UPTIME: [hours]h [minutes]m [seconds]s

IMMEDIATE ASSISTANCE REQUIRED

Requirements:

- WiFi connection (auto-connects if needed)
- Twilio account credentials configured

Cooldown: Cannot send duplicate alerts within 30 seconds

Text Auto-Correction System

Activation: Ctrl + Space (hold 400ms)

Purpose: Correct common typing mistakes

Supported Corrections:

	Typo	Correction
	teh	the
	please	please
	tnanks	thanks
	heelp	help
	cal	call
	fone	phone
	mesage	message
	reed	read
	adio	audio
	braile	braille
	scren	screen
	voise	voice
	setings	settings
	battery	battery
	emergency	emergency

Available In: PERKINS MODE, NOTE-MAKER MODE, GEMINI AI MODE, B-DRIVE naming, GEMINI naming

Feedback: Vibration + serial output showing corrections made

Alphabet Audio Feedback

Toggle: Long press UP (1 second) **OR** press all 6 Braille dots

Audio Source: /Alphabets/A.wav through /Alphabets/Z.wav

Features:

- Announces each letter as you type
- Works with both lowercase and uppercase
- Disabled by default to save processing time
- Available in all typing modes

File Format: WAV files named A.wav, B.wav, etc.

Audio Feedback System

Hardware: MAX98357A I2S amplifier

Features:

- Mode entry notifications
- Action confirmations
- Gesture mode announcements
- **Alphabet pronunciation** (when enabled)
- **Deep sleep announcement**
- **SOS alert sound**

I2C/I2S Conflict Prevention:

- HID keyboard temporarily paused during audio
- I2C bus properly reinitialized after playback
- DigiSpark reconnection handled automatically

Text-to-Speech (TTS)

Trigger: Ctrl + Backspace (in SD CARD MODE)

Provider: VoiceRSS API

Features:

- Reads text aloud in **300-character chunks**
- Detects sentence boundaries for natural pausing
- Natural US English voice (22kHz 16-bit mono)
- Error handling with retry logic

Format: WAV files (temporary /TTS_temp.wav)

Deep Sleep Mode

Activation: Automatic after **30 seconds** of inactivity

Wakeup: Power cycle device

Behavior:

- Audio announcement before sleep
- Vibration feedback
- All resources cleanly shut down
- Servers stopped, BLE disconnected

Exempt Modes (deep sleep disabled):

- B-DRIVE MODE
- SD UPLOAD MODE
- SD NAVIGATION MODE
- SYSTEM UPDATE MODE
- AUDIO PLAYER MODE
- MODE OPTIONS
- BOOT MODE
- NORMAL MODE

Power Saving: Conserves battery during extended idle periods

OTA Firmware Update System

Update Source: GitHub repository

Current Version: v2.0

Update Check: Automatic when entering SYSTEM UPDATE MODE

Features:

- Secure HTTPS download
- Version comparison
- Progress indicators
- Automatic reboot after installation
- 15-second confirmation timeout

Update Process:

1. Fetches latest version info from GitHub
2. Compares with current firmware
3. Downloads .bin file if newer
4. Writes to flash memory
5. Verifies integrity
6. Reboots device

Safety: Cannot power off during update

Braille Character Set

Letters

Pattern	Dots	Char	Pattern	Dots	Char
1	1	a	5	1,3	k
3	1,2	b	7	1,2,3	l
9	1,4	c	13	1,3,4	m
25	1,4,5	d	29	1,3,4,5	n
17	1,5	e	21	1,3,5	o
11	1,2,4	f	15	1,2,3,4	p
27	1,2,4,5	g	31	1,2,3,4,5	q
19	1,2,5	h	23	1,2,3,5	r
10	2,4	i	14	2,3,4	s
26	2,4,5	j	30	2,3,4,5	t
37	1,3,6	u	39	1,2,3,6	v
58	2,4,5,6	w	45	1,3,4,6	x
61	1,3,4,5,6	y	53	1,3,5,6	z

Numbers (after pattern 60)

Pattern	Number
1	1
3	2
9	3
25	4
17	5
11	6
27	7
19	8
10	9
26	0

Punctuation

Pattern	Symbol	Pattern	Symbol
2	,	34	.
6	;	38	!
18	:	36	?
20	-	44	"
8	'	48	=
42	(50)

SD Card File System

Format: FAT32

Organization:

/NOTE1.txt, NOTE2.txt → Notes

/GEMINI1.txt, GEMINI2.txt → AI Responses

/Bdrive1.txt, Bdrive2.txt → OCR Outputs

/NOTIFY.txt → Notifications (cleared on boot)

/TACTI_VISION_WAV/ → Audio Feedback

- |— PERKINS_MODE.wav
- |— MODES.wav
- |— SAVED.wav
- |— SELECTED.wav
- |— PREVIOUS.wav
- |— ONE_HAND_MODE.wav
- |— SOS.wav
- |— Deepsleep.wav
- └— [other system sounds]

/AudioFiles/ → User audio files for Audio Player

/Alphabets/ → Letter pronunciation files (A.wav-Z.wav)

Quick Reference Card

Mode Access

Action	Result
SELECT (short)	PERKINS MODE
SELECT (long)	MODE OPTIONS
PREVIOUS (long)	ONE-HAND MODE
UP (long)	Toggle Alphabet Audio

Common Actions

Function	Input
Type	Dots 1–6
Space	Pin 8 / 9
Delete	Pin 7
Enter	Space + Backspace
Shift + Enter	Space + Ctrl
Save	Ctrl + Backspace
Correct Text	Ctrl + Space
SOS Alert	Space (1.5s hold)
Go Back	Pin 10

Emergency Procedures

Situation	Action
Emergency	Hold Space L/R for 1.5s
Device Frozen	Power cycle (deep sleep)
Update Firmware	MODE OPTIONS → SYSTEM UPDATE

Technical Specifications

Component	Specification
MCU	ESP32C6 (dual-core, 160MHz)
GPIO Expander	PCF8575 (I2C address 0x20)
HID Interface	DigiSpark ATtiny85 (I2C address 0x23)
IMU	MPU6050 (I2C address 0x68)
BLE	ChronosESP32
Audio	MAX98357A I2S amplifier
Storage	SD card (SPI, FAT32)
Power	5V USB / Battery
Deep Sleep	30s timeout, power cycle wakeup
I2C Bus	100kHz for multi-device stability

Pin Configuration

Function	Pin
I2C SDA	GPIO 0
I2C SCL	GPIO 1
Vibration	GPIO 2
SD CS	GPIO 5
I2S BCLK	GPIO 12
I2S LRC	GPIO 13
I2S DIN	GPIO 15
SD MOSI	GPIO 22
SD SCK	GPIO 23
SD MISO	GPIO 21

Support and Resources

API Keys (Pre-configured)

- **Gemini AI:** Google Generative AI API
- **VoiceRSS:** Text-to-speech API
- **OCR.space:** Image text extraction
- **Twilio:** SMS emergency alerts

Firmware Updates

- **Repository:** github.com/MAATHES-THILAK-K/esp32-firmware-updates
- **Update Info:** `Firmware/latest.json`
- **Current Version:** v2.0

About the Author

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Interests & Aspirations

- Embedded Systems Design

- Robotics & Automation
- Assistive Technology Development

Development Philosophy:

"Vibe Coding — Leveraging AI as a collaborative tool to accelerate innovation and create meaningful accessibility solutions."

STELLAR VISION V1 – Making Technology Accessible

Firmware Version: 1.0

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