Intellux

Smart Blinds Solution

Presented 2022

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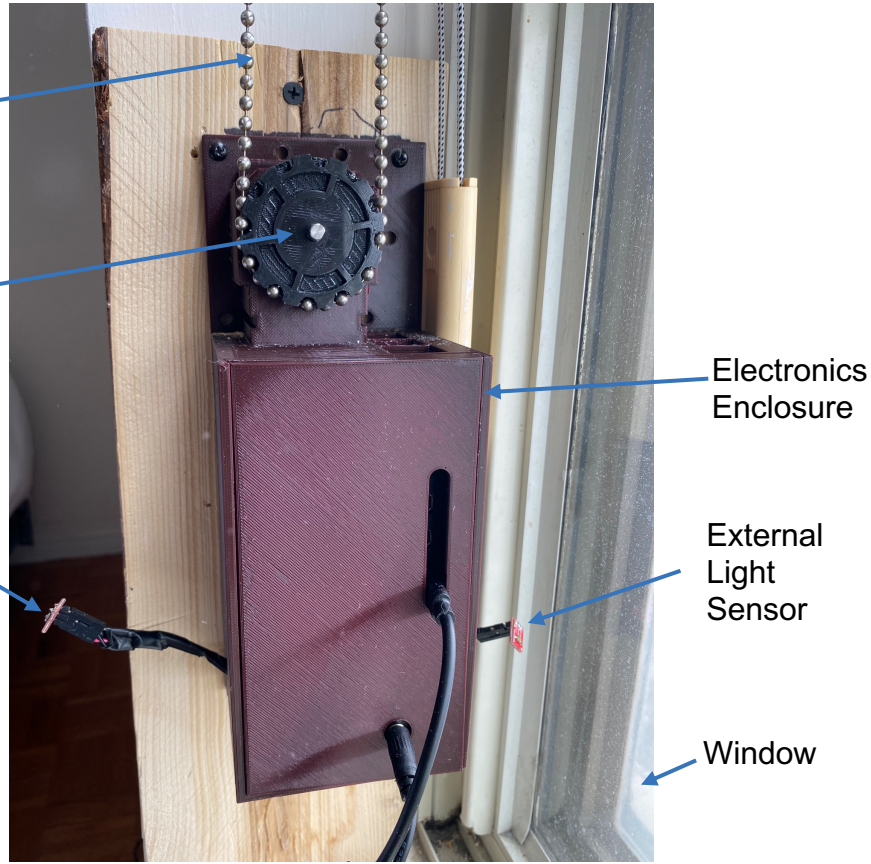
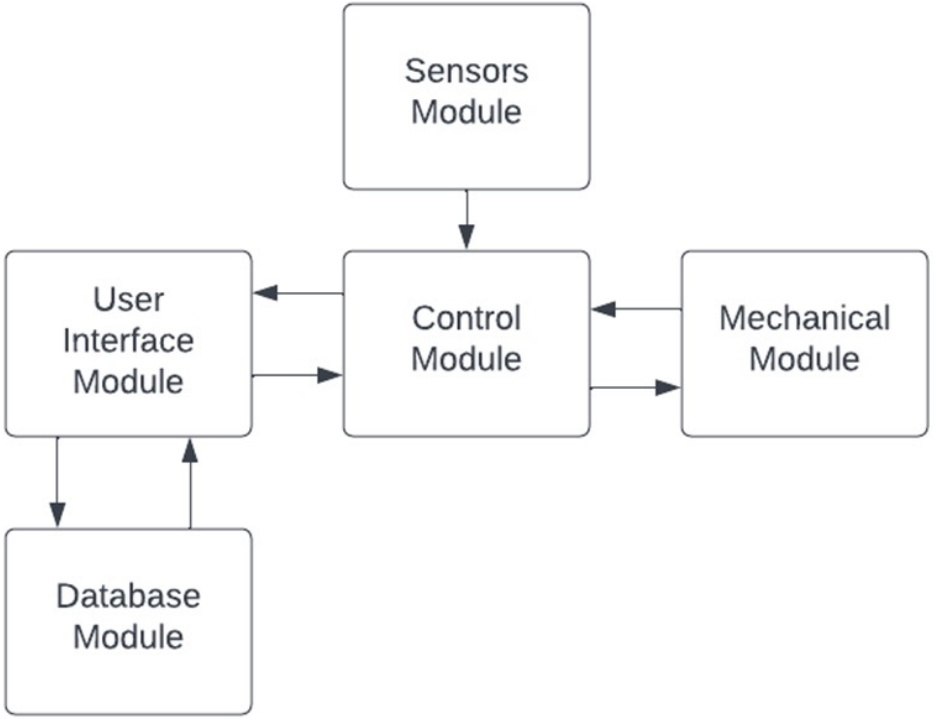
Intellux Overview



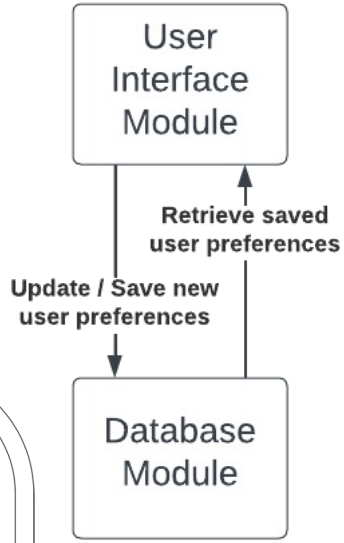
Motivation

1. Current smart blind systems require full removal of the blinds
2. Hassle to keep adjusting blinds manually with varying external light
3. Lack of smart blind solutions for older blinds
4. Existing motorized / autonomous solutions are too expensive

System Modules



System Modules



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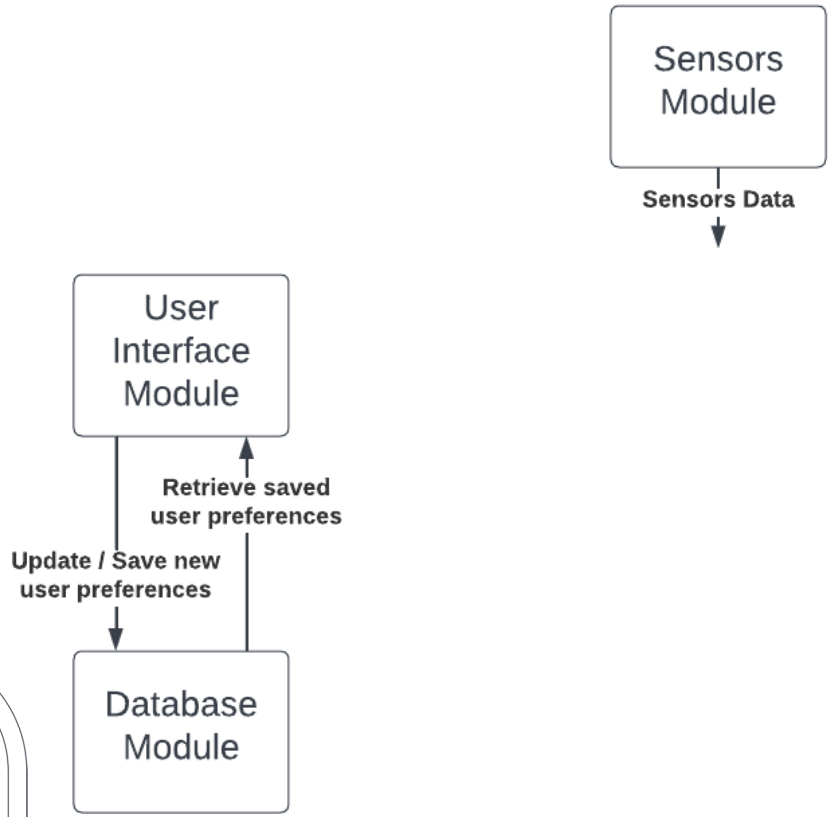

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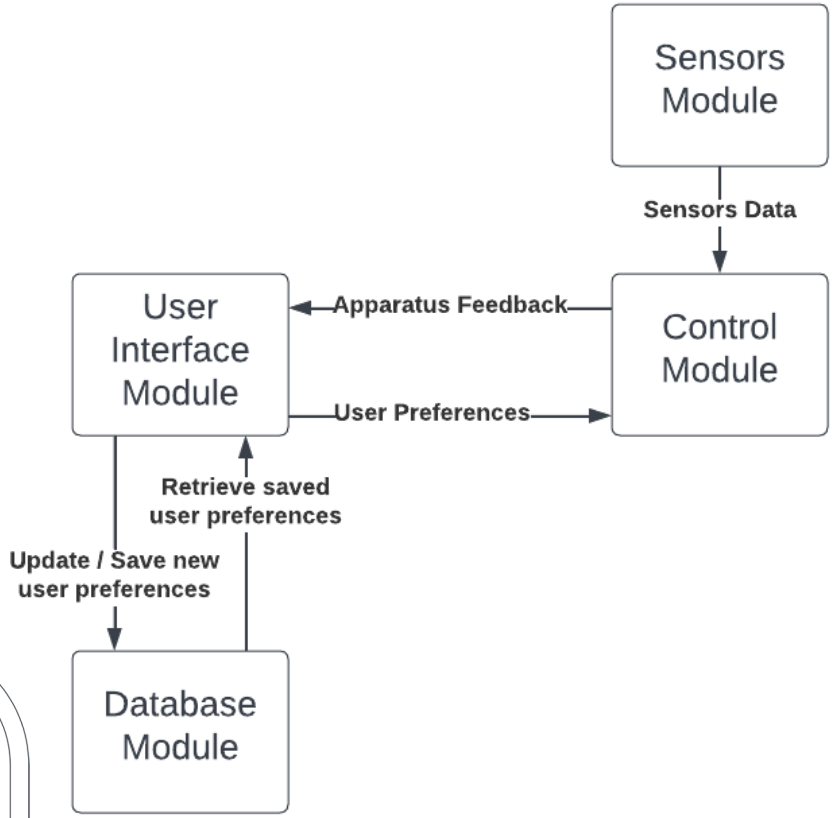

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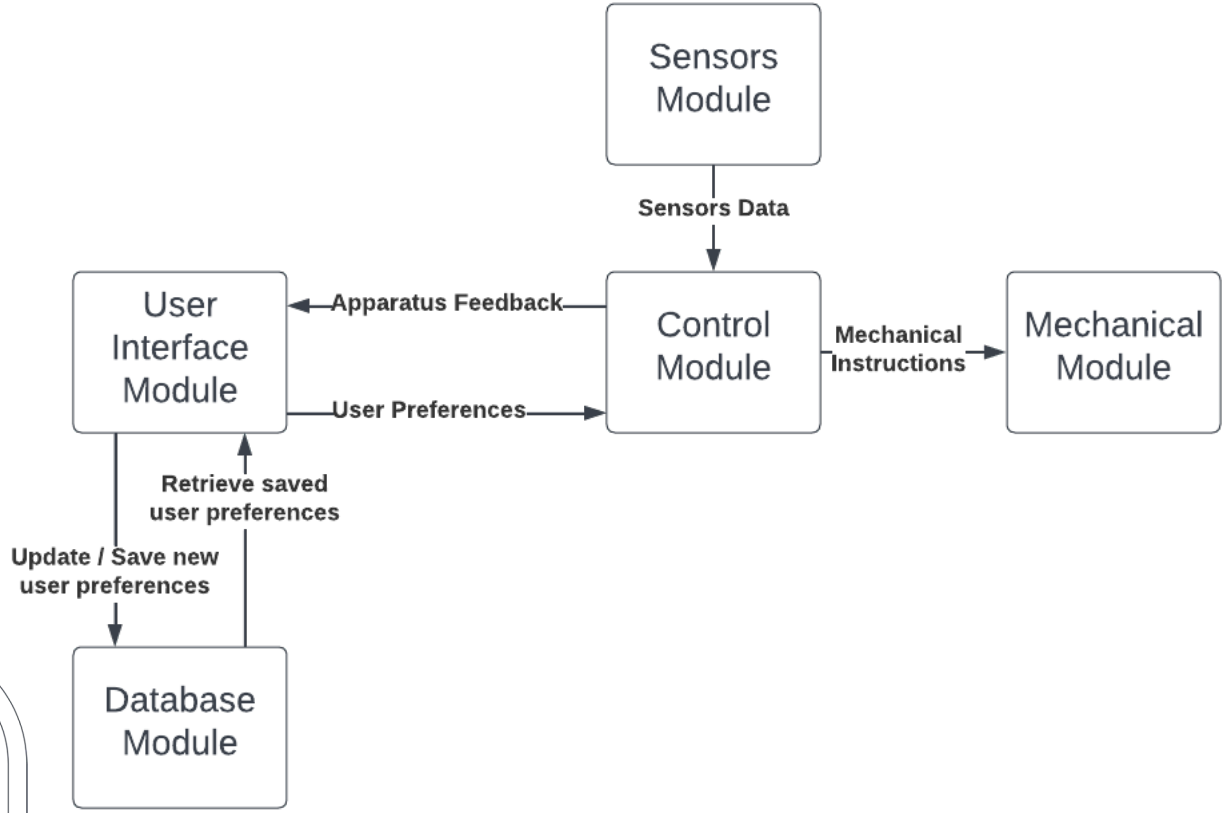
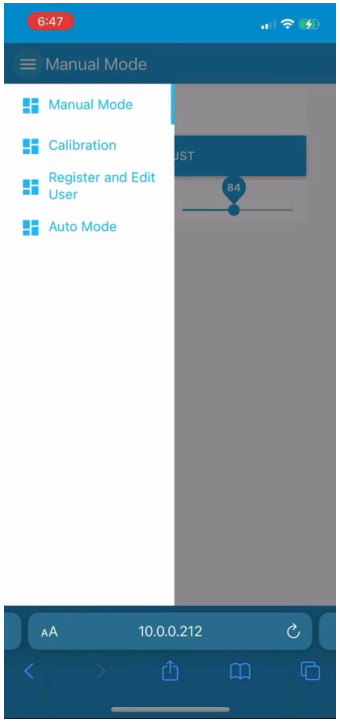


User Interface Module

- Accessed through QR Code
- Can be accessed from phones, tablets, or laptops
- Node Red Diagram Module

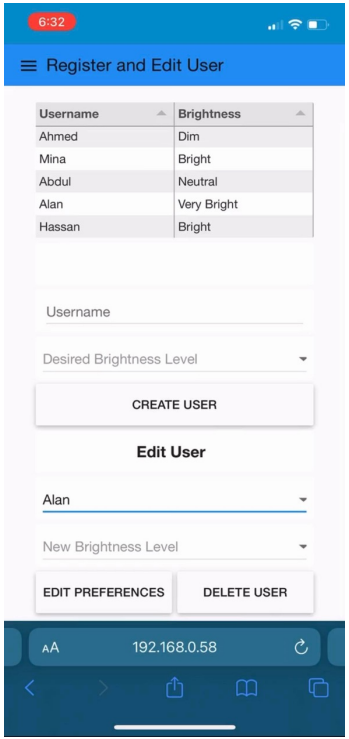
User tabs available:

- Manual Mode
- Calibration
- Register & Edit User
- Auto Mode



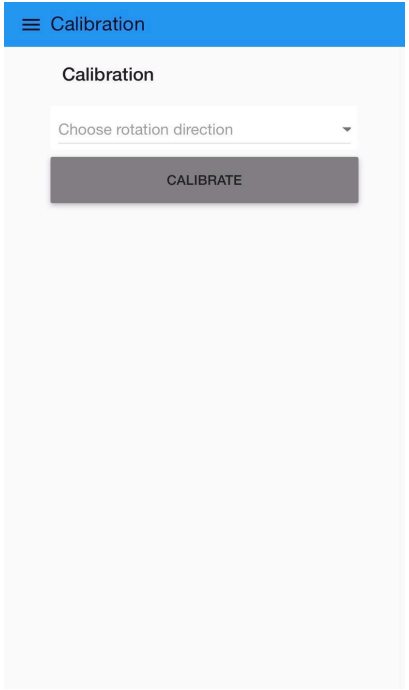
UI – Register & Edit User

- First sections for new users to register
- Table shows currently registered users
- Second section for previously registered users to edit their desired brightness or delete a user



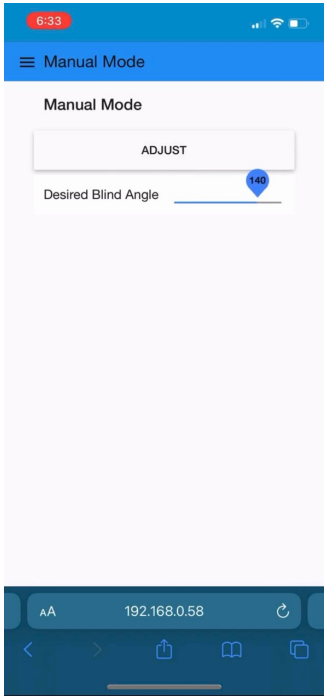
UI – Calibration

- Select rotation direction from drop down (Clockwise / Counter-clockwise)
- User presses "CALIBRATE" Button to start calibration process
- User presses "STOP CALIBRATION" Button to stop calibration process



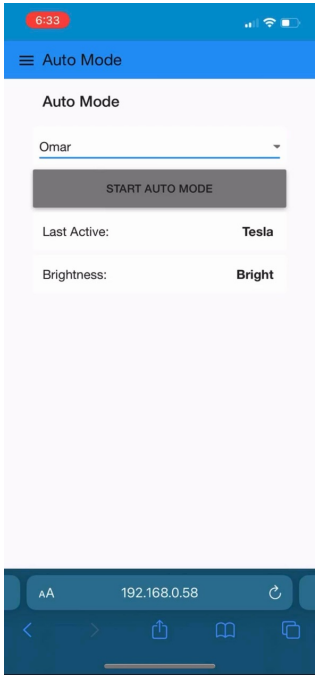
UI – Manual Mode

- Sliding bar for user to adjust blind angle manually
- 0-180 degrees
- Press "ADJUST" button to confirm changes



UI – Auto Mode

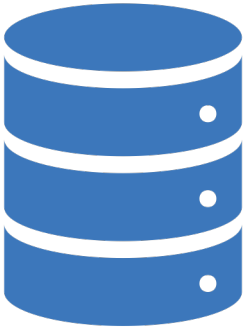
- Drop down menu to select active user profile
- Press "START AUTO MODE" button to activate auto mode
- Press "STOP AUTO MODE" button to stop auto mode



Database Module

1. Node Red SQLite Module
2. Stored locally on Raspberry Pi
3. Secure; Requires connection to the same WiFi Network
4. Stores username and desired brightness

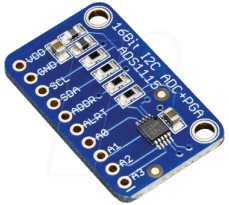
Username (Primary Key)	Desired Brightness
username	d_Brightness



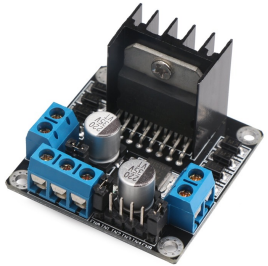
Hardware Overview

Stepper motor (12V)

Raspberry Pi 4



ADC

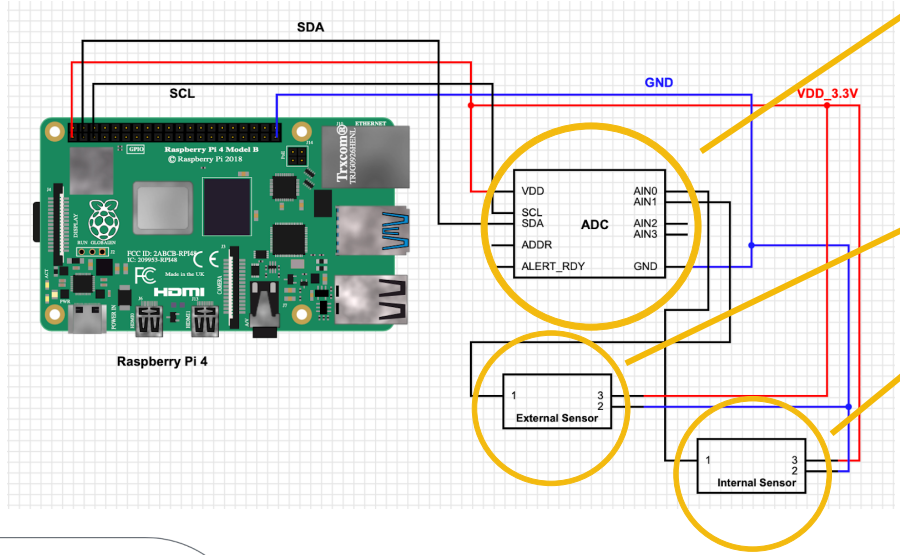


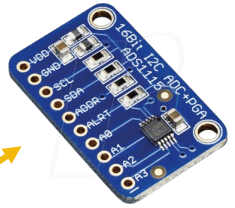
Motor driver

Light sensor (x2)

Sensors Module

- Internal and external light sensors to measure brightness
- Control module receives sensor data and adjusts the blinds if necessary





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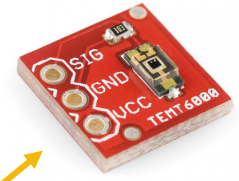


Light sensor

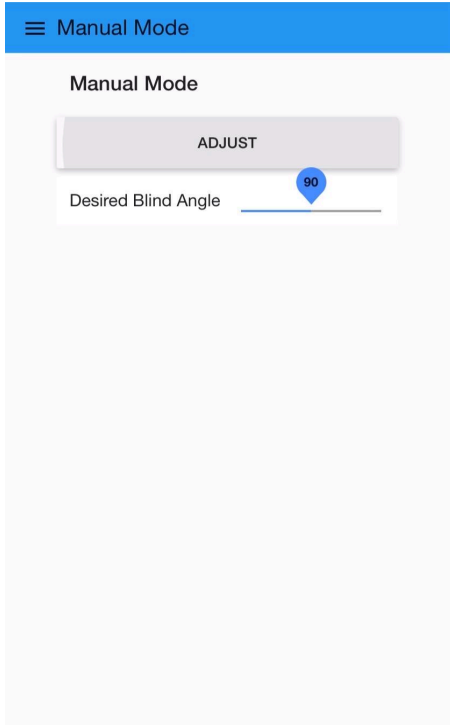
Sensors Module

User Interface Traceability	Volts (V)	Lux Level	Environment
Very Dim	0 – 0.66	0–0.3	Full moon on a clear night
		3.4	Dark twilight under a clear sky
		20–50	Public areas with dark surroundings
Dim	0.67 – 1.32	50	Living room lights
		80	Office building fluorescent lighting
		100	Very dark overcast day
Neutral	1.33 – 1.98	125	Normal indoor lighting
Bright	1.99 – 2.64	150	Train station platforms
		320–500	Office lighting
		400	Sunrise or sunset on a clear day.
Very Bright	2.65 – 3.30	1000	Overcast day
		10,000–25,000	Full daylight (indirect sunlight)
		32,000–100,000	Direct sunlight

Control Module

- Control Module is composed of control software for operating the Intellux system in either manual mode or auto mode
- Will run on the Raspberry Pi

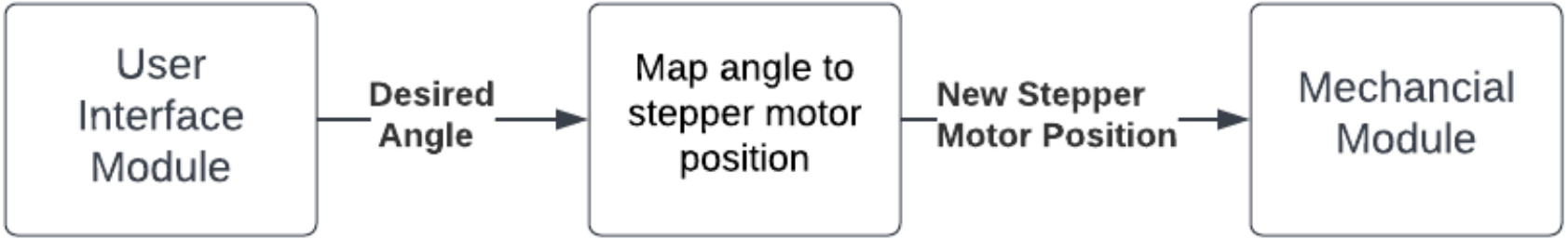
Manual Module



Manual Mode

- User manually inputs a desired blinds angle through the Manual Mode section of the user interface
- Intellux apparatus moves blinds to desired angle

Manual Module



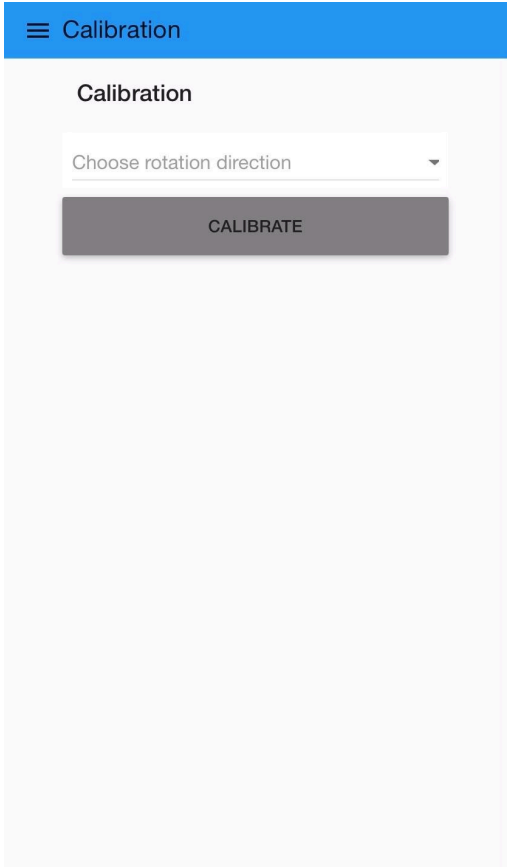
- The blinds angle will be mapped to a specific stepper motor position through the following formula:

$$Stepper\ motor\ position = \frac{Blinds\ angle}{180} * full\ range\ steps$$

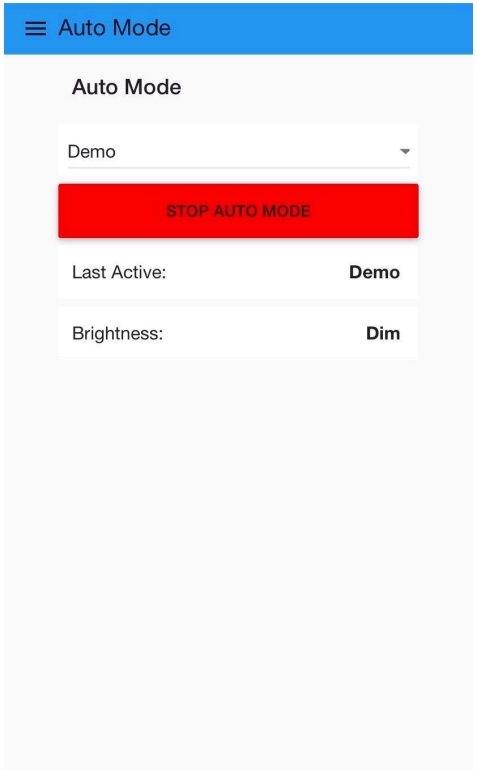
- The full range steps will be determined through the calibration process

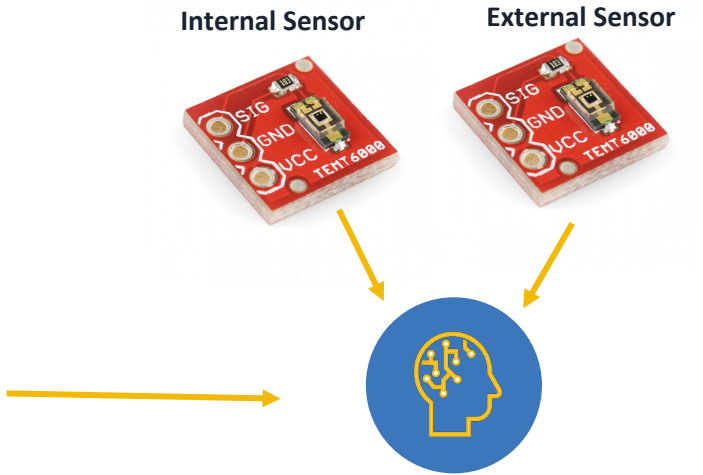
Calibration Setup

1. Set the blinds to the fully closed position (0°)
2. Select the appropriate turning direction and press the “Start Calibration” button on the user interface
3. As soon as the blinds turn to the 180° position, press the “Stop Calibration” button on the user interface
4. The blinds will reset back to the 0° position and the total steps taken by the stepper motor will be returned to the control module where it will be used for future rotation calculations



Auto Mode

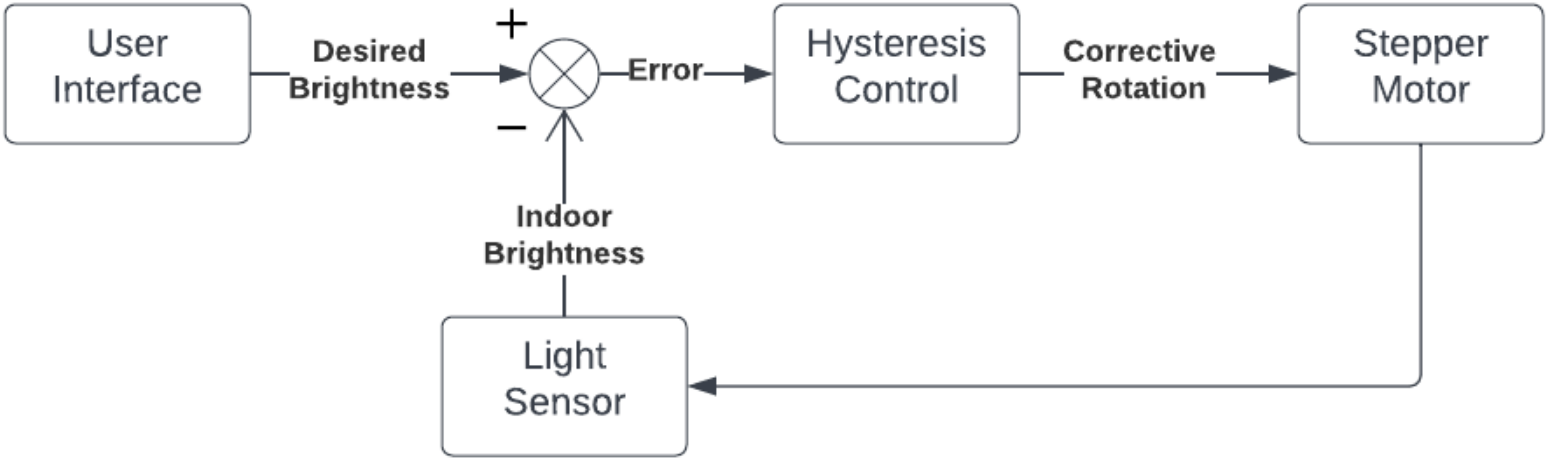




Auto Mode

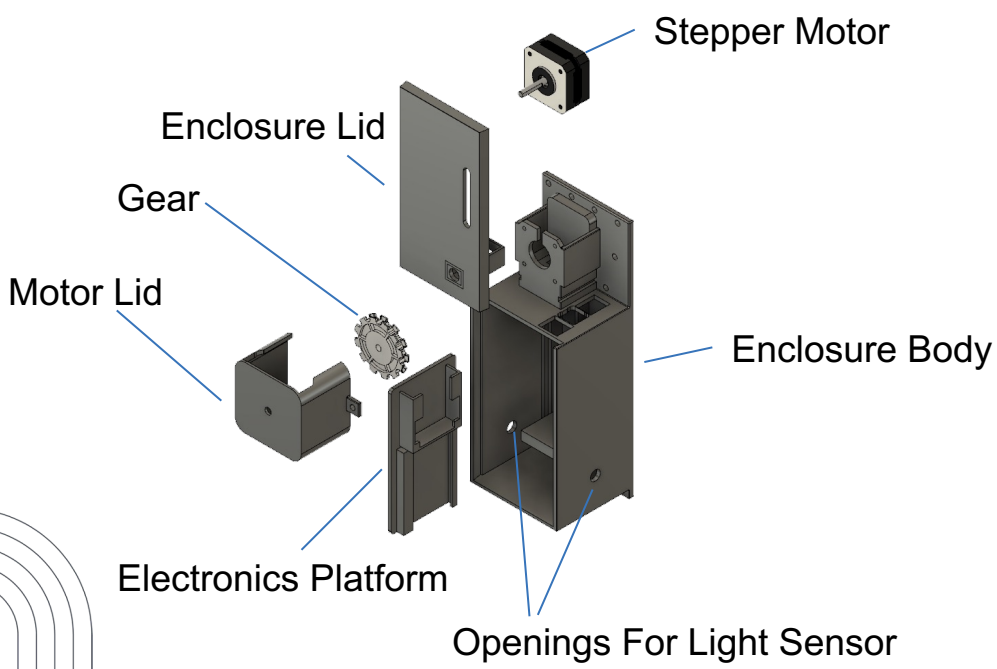
- User sets preferences through the Auto Mode section of the UI
- Intellux apparatus continuously senses brightness internally and externally and blinds angle to maintain brightness

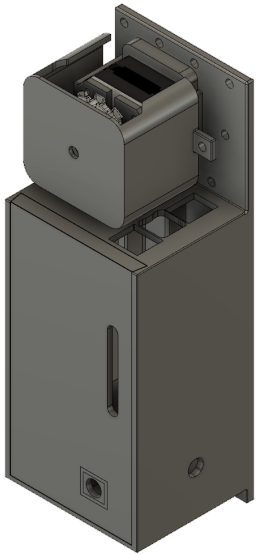
Auto Mode



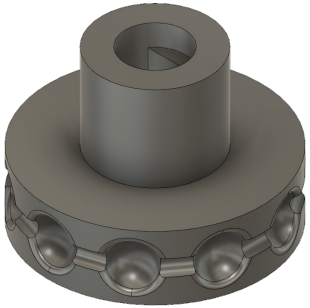
- **Main Requirement:** The Intellux apparatus must be able to adjust the blinds angle to reach the (desired brightness levels ∓ 5%) in the room

Mechanical Module

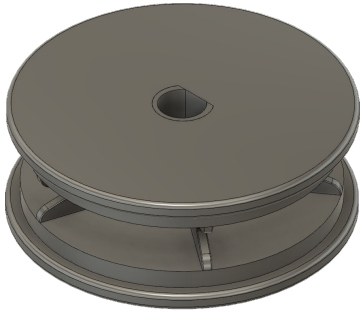




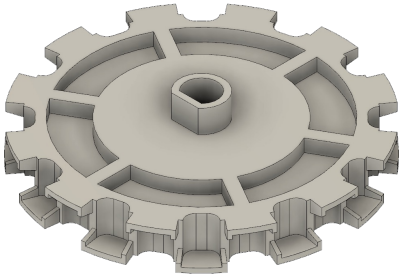
Technical Challenge



First Iteration



Second Iteration



Final Iteration

Hazard Analysis

Hazard	Cause	Mitigation	Comments
Pinching user's skin	Exposed gear	Added a cover to enclose the exposed gear and motor shaft	N/A
Low voltage electric shock	Exposed sensors	A mount was added to cover the exposed sensors	Tube with malleable reinforcement maintains sensor in desired orientation

Market Analysis

- The global smart window market was valued at USD 3.88 billion in 2019 and expected to be worth USD 6.09 billion in 2025
- Intellux is targeting customers with old bead-chain controlled blinds

Competitive Analysis

Competitor	Easy installation	Type of blinds	Motorized	Smart adjustment	Cost
Yoolax Motorized Shades	No (complete change of blinds)	Roller shades	Yes	No	$169 (3x5 ft)
Tuya Blinds	Yes (attach to beads)	Roller Blinds	Yes	No	$70
Lutron Serena Shades	No (complete change of blinds)	Roller shades	Yes	Yes	$797 (3x5 ft)
Intellux Smart Blinds	Yes (attach device to wall and beads to gear)	Beaded vertical blinds	Yes	Yes	Prototype Cost: $150 Optimized Cost: $50

Thank you!