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LECTURER	:	**Dr Aslina Baharum** **ASSIGNMENT DUE DATE**: 13/12/2025 23 50

NO.	NAME	STUDENT ID NO.	SIGNATURE	DATE
1.	MOHAMMAD SHAAN IBNE JAVED SOYFOO	23030935	S.S	13/12/2025
2.	IZZAT ZULQARNAIN BIN IZAIDDIN	23096829	*iz*	13/12/2025
3.	GAVINDRA RAMADHANSYAH FADYL	23059314	GRF	13/12/2025
4.	BEKSULTAN KIRGIZBAEV	22078406	B.K	13/12/2025
5.	DENNIS CHOI YUNG JIN	22054969	D.C	13/12/2025
6.	DARYL TAN YU JUN	22055750	D.T.Y.J	13/12/2025

E-mail Address / Addresses (according to the order of names above):

1. 23030935@imail.sunway.edu.my	5. 22054969@imail.sunway.edu.my
2. 23096829@imail.sunway.edu.my	6. 22055750@imail.sunway.edu.my
3. 23059314@imail.sunway.edu.my	
4. 22078406@imail.sunway.edu.my	

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Team Contribution Statement

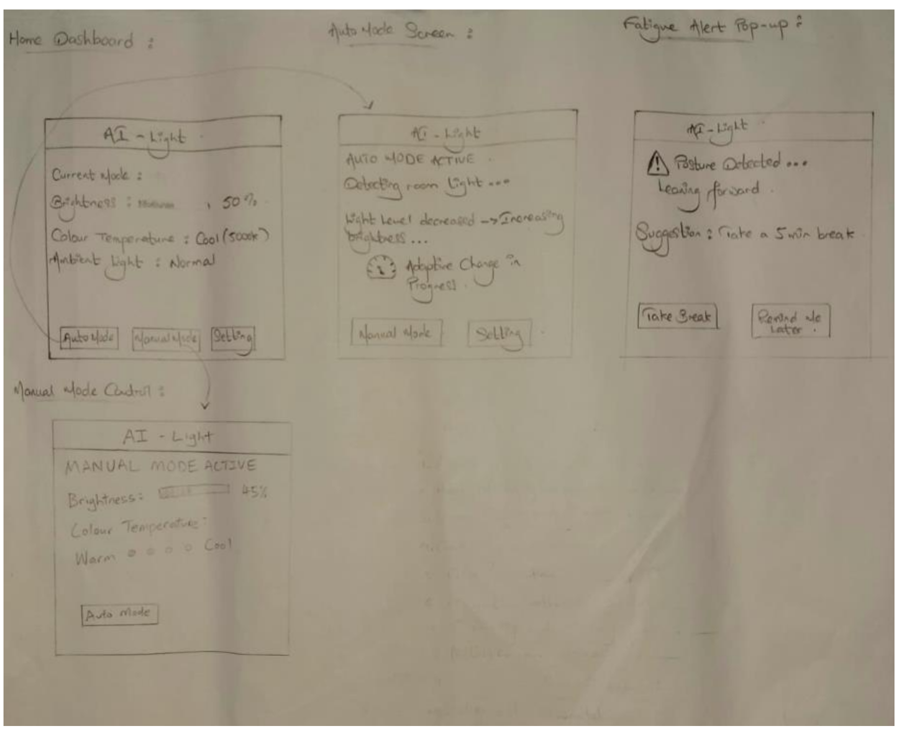
Team Member Name	Contribution %	Roles and Responsibilities
MOHAMMAD SHAAN IBNE JAVED SOYFOO	16	Led heuristic evaluation, refined prototype layout, coordinated design iterations, prepared presentation slides.
IZZAT ZULQARNAIN BIN IZAIDDIN	16	Conducted usability sessions, analyzed critical incidents, documented findings for testing process.
GAVINDRA RAMADHANSYAH FADYL	16	Developed digital mockup in Figma, designed UI components, implemented visual hierarchy and feedback loops.
BEKSULTAN KIRGIZBAEV	16	Performed internal heuristic review, contributed to design research insights, tested AI logic and automation flow.
DENNIS CHOI YUNG JIN	16	Created initial design concepts, iterated paper prototypes, assisted in testing scripts and scenario planning.
DARYL TAN YU JUN	16	Developed user scenarios, managed report writing, structured discussion and reflection sections.

Project Title: AI-Driven Adaptive Lighting System for Ergonomic and Productive Work Environments

1. Problem and Solution Overview

Extended exposure to poorly optimised lighting continues to cause digital eye strain, headaches, and fatigue for students and professionals, reducing productivity and comfort. Our research and usability testing revealed that users rarely adjust lighting manually, even when uncomfortable, due to inconvenience and lack of awareness. To address this, we developed an AI-Driven Adaptive Lighting System that intelligently adjusts brightness and colour temperature based on ambient light, posture, time of day, and signs of fatigue. Through iterative design, we refined the system to balance automation with user control by adding clear status indicators, real-time previews, and a prominent manual override button. The final design also incorporates subtle lighting cues instead of intrusive pop-ups and provides transparent reasoning for adjustments, building trust and usability. This solution promotes ergonomic well-being and productivity by delivering seamless, context-aware lighting adjustments that reduce strain and enhance comfort without disrupting workflow.

2. Initial Paper Prototype



Our initial paper prototype was designed to visualize the core concept of an AI-driven adaptive lighting system before moving to digital mockups. It included three main screens:

Home Dashboard: Displays current lighting mode, brightness level, color temperature, and quick mode buttons.

Auto Mode Screen: Shows when auto mode is active, detects ambient light, and provides a manual override option.

Fatigue Alert Pop-up: Provides posture detection alerts and break reminders to promote ergonomic well-being.

This prototype focused on two primary tasks:

1. Activating and monitoring automatic lighting adjustments.
2. Responding to fatigue alerts and ergonomic suggestions.

The paper prototype allowed us to test navigation flow, layout clarity, and user understanding of AI-driven adjustments before implementing digital features.

3. Testing Process

3.1 Our Approach and Participants

To get a complete picture, we split our testing into two distinct phases: an internal expert review to catch the obvious technical violations, and an external test to see how a fresh user would actually react to the system.

For the External Usability Evaluation, our team member Beksultan Kirgizbaev took the lead. He went through our digital mockup, checking for compliance with Nielsen's heuristics. He checked our digital mockup against Nielsen's heuristics, focusing on finding places where the interface did not match the technical logic.

For the External Usability Evaluation, we recruited Foo Wai Xuan (Student ID: 23022072). We deliberately chose someone outside the immediate design team because we needed to identify the "blind spots" we had developed from staring at the project for too long. We tasked him with interpreting the interface’s feedback mechanisms, specifically, the ergonomic alerts and manual controls, to see if they made sense to someone seeing them for the first time.

3.2 How Our Process Changed

Our testing method changed as we moved from paper to digital prototypes. Initially, we asked questions like "Where would you click to change brightness?" But that approach wasn't enough. A static paper drawing couldn't capture automation.
We pivoted. Instead of just checking button placement, we ran simulated scenarios. We told the tester, "Imagine you've been slouching for 15 minutes, how does the system react?" This shift was important because it helped us catch issues with timing and intrusiveness that we completely missed when we were just looking at static layouts. We also learned that users care about physical hardware, so we added checks for device connectivity status.

4. Testing Results

When we put the prototype in front of testers, we found that the AI communication was often confusing or too aggressive. The main things we learned are listed below, along with exactly how we fixed them based on the feedback from Beksultan and Wai Xuan.

4.1 Fixing the "Invisible" System Status

The external evaluator felt disconnected from the hardware. The app said "System Status," it wasn't clear if the ceiling light and desk lamp were synced or on standby. We also noticed that the dashboard text said "Adjusting lighting..." without telling us how long it would take, which felt stuck and unresponsive.

The Fix: We didn't want users to guess. We updated the Dashboard Status Bar to include a real progress indicator or text like "Adjusting... 5 seconds remaining" so the user knows exactly what is happening. To address the hardware confusion, we added individual status dots (green for devices that are online, red for offline) for each connected device, giving users immediate visual confirmation that their whole setup is working.

4.2 Translating Jargon to Real Language

We overestimated how much users know about lighting technicalities. Testers stumbled over the terminology. The manual sliders used Kelvin values like 4200K. External testers called "technical jargon" hard to visualise. Users hesitated to click the "Focus" and "Relax" buttons because they didn't know what settings were hiding behind those icons.

The Fix: We brought the language down to earth. Next to the technical Kelvin numbers, we added plain labels like "Neutral" or "Daylight" so users can instantly understand the color temperature. We also added descriptive tooltips to the Quick Action buttons—now, hovering over "Focus" tells you it means "Cool Light, High Brightness".

4.3 Giving Control Back to the User

The biggest friction came from ergonomic alerts. An external tester told us that while the "Leaning forward" diagnosis was helpful, the pop-up itself was annoying because it appeared in the centre of the screen and couldn't be moved, blocking work or games. We found a critical flaw in the workflow: the system dimmed lights before we even accepted the break.

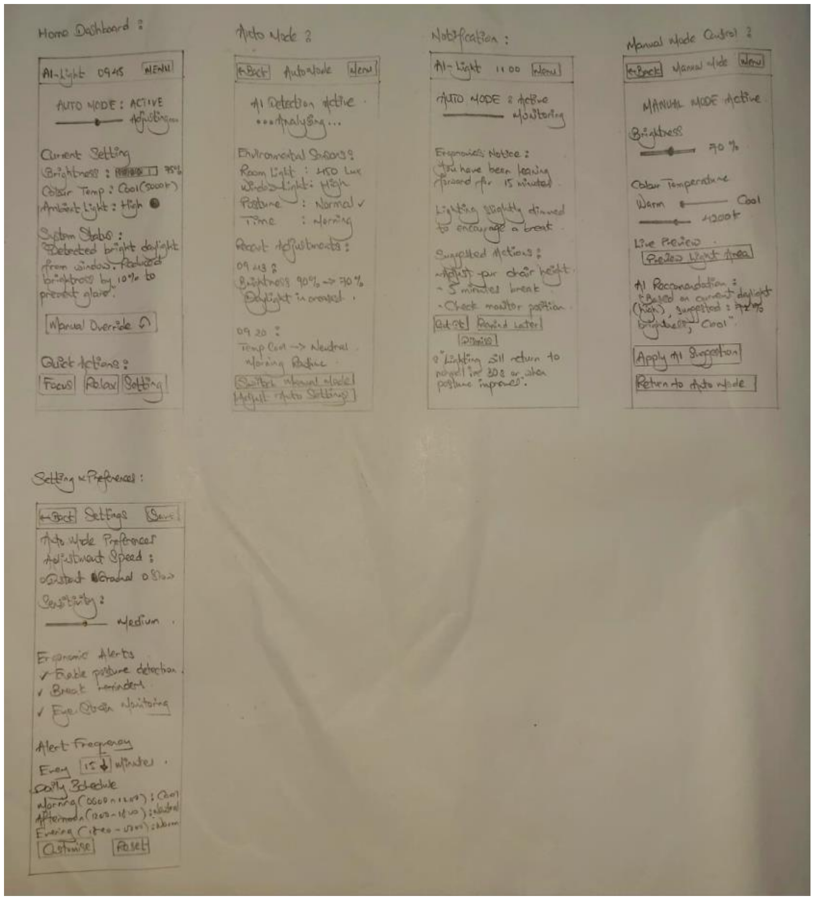
The Fix: We made the notifications less dictatorial. We implemented a "Drag and Drop" feature (or a Pin setting) so users can move that pop-up into a corner where it doesn't interrupt their workflow. More importantly, we added a "Revert Lighting" button directly on the alert. This acts as an "emergency exit," letting users dismiss the advice and instantly snap their lights back to normal.

4.4 Taming the Sensitivity

We realised our AI was a bit too eager. An external user reported getting "false alarms" just for looking away from the screen for a second. We also found that the "Instant" speed setting caused sudden flashes of light, which was actually jarring and uncomfortable.

The Fix: We forced the system to calm down. We added a "Grace Period" delay (around 5 seconds) to the posture detection, so it only bugs you if you're actually slouching, not just moving your head. We also added a warning tooltip to the "Instant" speed setting to warn users that it might be harsh on their eyes.

5. Final Paper Prototype



After incorporating feedback from heuristic evaluation and usability testing, we refined our paper prototype to improve clarity, control, and user trust. The final version introduced several key enhancements:

Clear Status Indicators: The interface now shows when the AI is actively detecting and adjusting lighting, along with progress feedback.

Redesigned Settings Menu: Added visual sliders with real-time previews for brightness and colour temperature adjustments.

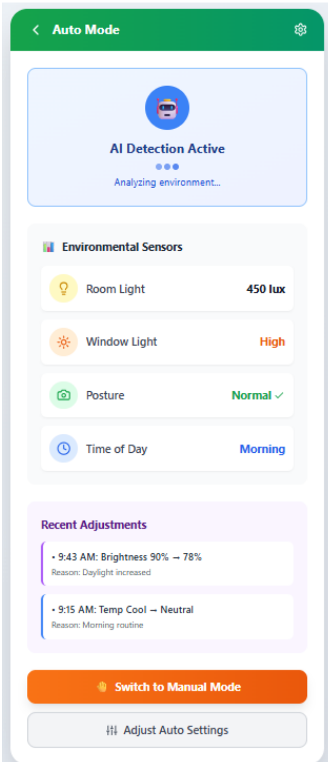
Prominent Manual Override: A dedicated override button is accessible from all screens, ensuring users can regain control instantly.
Consistent Navigation: Standardised button placement and navigation flow across screens for better usability.

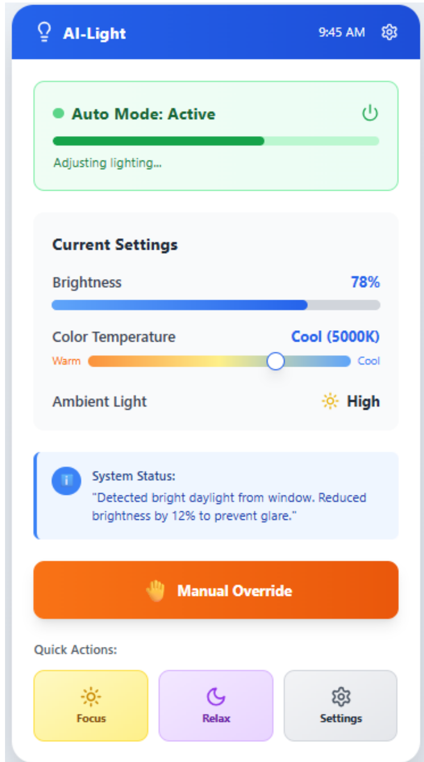
Gentle Ergonomic Alerts: Replaced intrusive pop-ups with subtle lighting cues and optional notifications to reduce disruption.

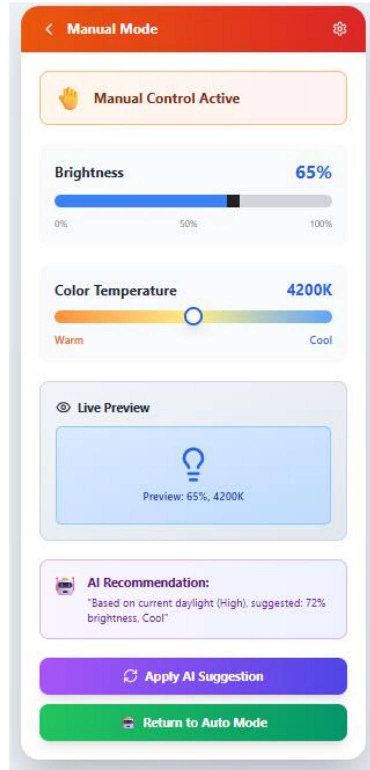
Transparent AI Reasoning: The system explains adjustments (e.g., "Light decreased → 5% more ambient daylight") to build trust and understanding.

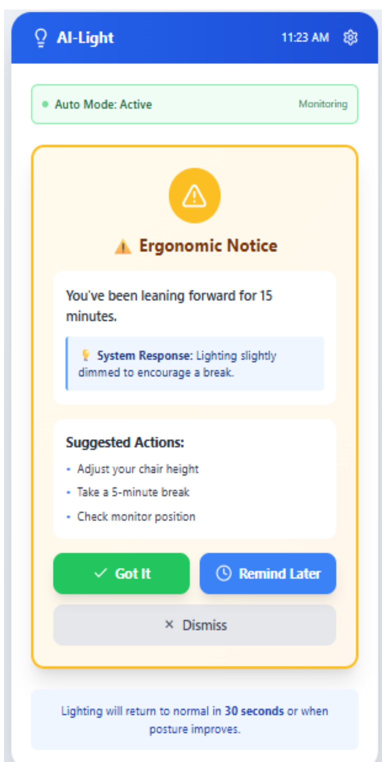
This final prototype reflects a balance between automation and user control, ensuring ergonomic comfort while maintaining transparency and ease of use.

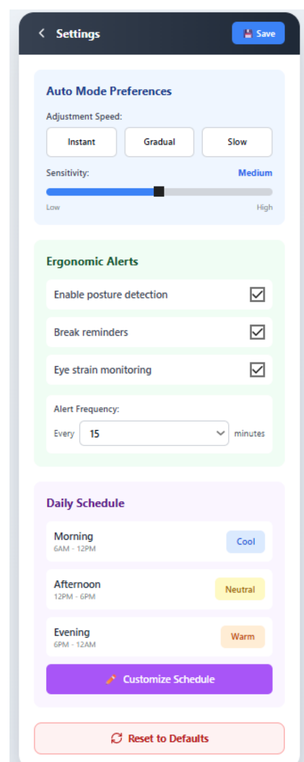
6. Digital Mockup











The digital mockup represents the realisation of our design, translating the mechanics of the paper prototype into a functional and visually refined interface. Built using Figma, it incorporates visual hierarchy, colour psychology, and feedback loops essential for an AI-powered adaptive lighting system.

6.1 Transition from Paper to Digital

Moving from paper to digital introduced both constraints and opportunities that shaped our final design:

Visualising Automation: In the paper prototype, lighting changes had to be explained verbally. In the digital mockup, dynamic background gradients now represent automation, shifting from cool blue for Focus Mode to warm amber for Relax Mode. This provides immediate visual feedback without requiring manual checks.

Prioritising Automation: Manual sliders were deprioritized and made smaller, while the AI Auto Adapt toggle became the most prominent element. This guides users toward the intended “set-and-forget” experience while still allowing manual control when needed.

Sensor Transparency: We added a Sensor Status pill to display real-time data such as webcam activity and ambient light levels (e.g., Webcam: Active, Ambient Light: 400 lux). This reinforces trust and aligns with our research theme of “Simplicity and Transparency.”

6.2 Response to Critique

Feedback from heuristic evaluation and usability testing directly influenced the digital iteration:

- **Privacy Concerns:** Users expressed discomfort with webcam usage. We addressed this by adding a Camera Privacy Mode button on the home screen, giving users full control over fatigue detection features.
- **Notification Overload:** Pop-up alerts in the paper prototype were considered intrusive. We replaced them with toast notifications-small, temporary messages at the bottom of the screen that disappear automatically. This ensures users receive updates without workflow disruption.

6.3 Task Walkthroughs

Task 1: Automated Focus Enhancement (Early Afternoon)

Keyframe A (Dashboard): At 1:30 PM, the app displays Daytime Mode with a cool white theme. The dashboard indicates that Glare Reduction is active.

Keyframe B (Adjustment): As sunlight shifts, the app updates its status to Compensating for Sunlight. The brightness slider moves slightly upward, visually confirming the adjustment.

Task 2: Fatigue Detection and Evening Relaxation (Late Night)

Keyframe A (Fatigue Alert): At 11 PM, the background transitions to warm Night Mode. The webcam icon pulses gently, signalling posture detection.

Keyframe B (Intervention): A soft overlay appears: “You’ve been focused for 2 hours. Dimming lights to rest your eyes.” Users can choose Snooze or Rest, promoting proactive health without being intrusive.

7. Discussion

7.1 Reflections on the Iterative Design Process

The iterative design process highlighted that user trust depends on transparency rather than "black box" automation. Early testing revealed that users felt disconnected when the system acted without explanation or visible feedback. To address this, we introduced device status indicators and real-time progress text on the dashboard. These changes validated that users accept automation more readily when they understand what the system is doing and why.

7.2 Impact on Final Design

Transitioning to digital tools fundamentally changed how we approached feedback and interaction. Dynamic colour gradients replaced static text to communicate lighting states, making automation more intuitive. Testing also showed that Auto Mode needed to be the primary focus. Large manual sliders caused confusion due to technical jargon, so we reduced their size and prioritized the AI Auto Adapt toggle, guiding users toward automation while keeping manual controls as a backup.

7.3 Evolution of Tasks

Our core goals remained consistent, but execution evolved significantly based on user feedback. Initially, fatigue detection relied on intrusive pop-up alerts that interrupted workflow. Testing revealed this was disruptive, so we implemented toast notifications and a "Grace Period" delay to prevent false alarms from minor movements. We also added a "Revert Lighting" option, ensuring users maintain control while still benefiting from proactive health prompts.

7.4 Number of Iterations

The number of iterations was sufficient to uncover critical blind spots, particularly around privacy. External reviews flagged concerns about webcam usage early, prompting us to add a Camera Privacy Mode before finalising the design. These iterative refinements ensured the system balanced automation, transparency, and user control.