Product Design Specification

Sunrise Alarm Clock - Team 7
Version 1.1

Version History

Version 1.1 - Removed AC internal components from possibilities. Updated / Removed Requirements.

- Must have easily user-replaceable light. (REMOVED)
- Must be safe. (AC components on separate board) (REMOVED)

Version 1.0 - Initial Document.

Concept of Operations

The sunrise alarm clock wakes you up by gradually increasing the light in your room. Even in the darkness of Winter, waking up early should be a luminous experience that stimulates your natural circadian rhythm. Our device works to gently wake you up with a gradually brightening light and wake up sound. The light rises in brightness for 30 minutes before the alarm. While the alarm gets gradually louder to use the minimal volume needed to stir you from your slumber. The alarm clock will double as a bedside lamp to make a perfect addition to your home.

Night workers, anyone without an established early rise routine, and those hard of hearing will love using the bright light to knock you awake. While anyone with issues getting up in the morning will love the changes to your natural sleep rhythm. Plus a replaceable standard lightbulb to allow for selecting the perfect lightbulb maximum brightness and color temperature for your individual needs.

“Never start your day with darkness again.” - Team 7

Market Analysis

While most have switched to using their phones for alarm clocks and many people use bedside lamps for reading and room lighting. McFarlane of the Royal Melbourne Institute of Technology surveyed people 18-60 and showed that 14% use physical alarm clocks [1 p9]. While 84% use phone alarms to wake-up, the market for physical alarms does still exist; by adding features and doubling as a bedside lamp we can penetrate the market. Further, the data in the study show that 92% wakeup to the same audio each day and preferred volume varies greatly [1 p9]. We can conclude that a large adjustable range of volume is needed for the wakeup sounds to meet user preferences. A gradual increase in volume would probably work best to keep all users happy. Below are some other conditions and users that we consider.

- People who are deaf.
- People who don’t want to disturb their partner.
- People who have trouble waking up in the morning (Philip’s studies confirm).
- Night workers and people who rise before the sun.
- Parents of teenagers.

Existing products don’t cover our listed requirements. Philips is the market leader in the tech offering two dimmable clock options. There are many options available by other manufacturers all copying the main features of the philips solution and adding some additional features such as temperature monitoring. Philips hase listed a clinical study of the effectiveness of their product. Confusingly Philips states their brightness in units of LUX which is area dependent. Alternatively a “Gesture & light alarm clock” app exists for Android and iOS that tries to offer the same features. Gesture controlled alarm clock exists as an Indiegogo campaign but is no longer in production and lacks any dimming features. Philips HUE lights exist and can mimic this wakeup functionality via sync through your phone, but proprietary application and bluetooth protocol is required with little user options and customization and no direct clock features. One product

exists on AliExpress with gesture control and humidity/temperature display; this has no user replaceable bulb.

	Philips SmartSleep HF3520	Philips SmartSleep HF3650	JALL Sunrise Alarm Clock	Ours
Cost	$99.99	$179.95	$45.98	TBD
Features	FM radio, tap snooze and automatic dimmable display	midnight lamp, FM radio, phone charging dock, power back-up, speaker, auto dimming display and smart snooze	2 alarms, FM Radio, 7 Sounds	Gesture Control Auto Dimming Display.
Sounds	5 Sounds, Radio	7 Sounds, Radio	7 Sounds, Radio	User SD Card. Bring your own music, Possible play from phone.
Light, Brightness	300 Lux, 20 steps, Non-replaceable	310 Lux, 25 steps, Non-replaceable	20 steps, Non-replaceable	AC Light bulb. User selectable/ Changeable. Like a lamp.
Power Backup	None	Full	None	Alarm Only

Table 1: Comparison to competition

Requirements

Must

- Must have wall socket AC power power.
- Must attempt to wake the user on time.
- Must have control of brightness.
- Must turn off alarm by user interaction
- Must display time
- Must have user set alarm
- Must have basic clock/alarm interactions: Set time. Set Alarm. Cancel Alarm.
- Must have basic lamp features: On, Off, Dimming.

Should

- Should be intuitive enough to learn controls in 10 minutes.
- Should have backup power (Only for alarm, display)
- Should have physical interaction backup buttons(In case of sensor failure)
- Should keep accurate time within ±5 minutes lost per year
- Should adjust display brightness to light conditions.
- Should have options for light only alarms.
- Should be quiet during operation with suggested lights.

May

- May support custom audio for wakeup.
- May be configurable via Bluetooth ®
- May have USB power output to charge the phone.
- May have USB data input to connect to the phone for music.
- May have clap on/off sensor.
- May speak with users to guide settings.
- May have a night light feature.

System Architecture

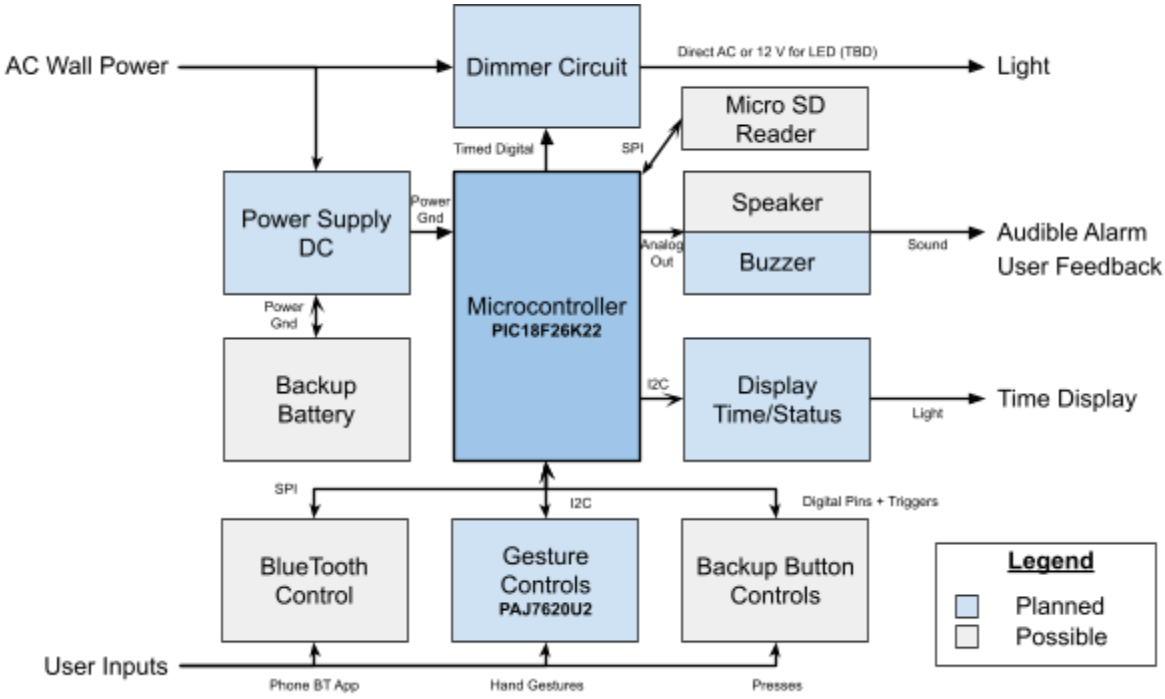

Figure 1: L1 Decomposition Block Diagram

Design Specification

Processor - Microcontroller

PIC18F26K22 can be used as the main controller. It has many pins for the various connections we need and is available in the EPL to start prototyping quickly.

Sensor - Gesture Control

PAJ7620U2 sensor with 9 gestures. Left, Right, Up, Down, Forward, Back, Clockwise, Counterclock wise, and wave. Connect to this by I2C. This is the main control input unit.

Power - AC to DC Supply

Use prefab AC to 5V Power Supply. Check for safety features. Option is HI-LINK HKL-5M05 for 5V power. May be able to use lower voltage.

Actuator - Triac to Light Bulb Socket / DC LED Strip

Used for modulating AC voltage based on microcontroller input. Connects to dimmable LED. We will additionally explore using a DC LED strip to produce the desired brightness.

Actuator - Buzzer/Speaker

Used to create the alarm sound. Controlled with a direct output from the microcontroller.

Actuator - Seven Segment Display

Used to display time and some configuration settings. Should be dimmable to avoid bright light in darkness. May need a separate controller depending on complexity.
https://www.sparkfun.com/products/11441 - With Controller.
https://www.sparkfun.com/products/10931 - No Controller (Picked one)

References

[1] McFarlane SJ, Garcia JE, Verhagen DS, Dyer AG (2020) Alarm tones, music and their elements: Analysis of reported waking sounds to counteract sleep inertia. PLOS ONE 15(1): e0215788. https://doi.org/10.1371/journal.pone.0215788