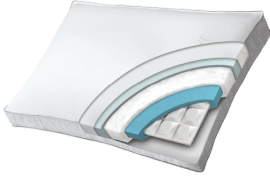
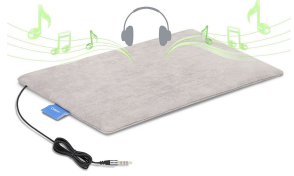




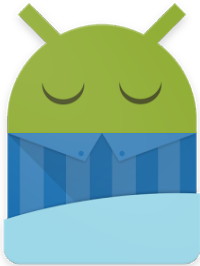
Problem Statement:

The purpose of our project is to create a comfortable device to help educate sleepers of their sleeping habits and gently wake them.

Impact Statement: The device will enable its users to gain valuable information about their posture and respiratory patterns while asleep. This means the user can adjust their sleeping habits by themselves, or give the information to a medical professional for feedback on what could be done to improve quality of sleep. The device may disturb a user's sleep if the wake-up feature is set to an incorrect time.

Benchmarking Related Solutions:

Solution	Description	Pros	Cons
<p>iComfort Hybrid Triple Effects Pillow (\$109)</p> 	<p>The iComfort Pillow solves the problem of poor sleep by providing pressure point relief where needed, supports proper body alignment despite your sleeping angle, and regulates body temperature.</p>	<ul style="list-style-type: none">• Adaptive• Simple• Comfortable	<ul style="list-style-type: none">• Expensive• Doesn't give feedback• Works best with the same brand mattress
<p>Oittm Smart Pillow Mat (\$25.99)</p>  <p>http://www.oittm.com/Oittm-Smart-Pillow-Mat</p>	<p>The Oittm Smart Pillow Mat solves the problem of poor sleeping by playing music to aid sleeping from the user's smartphone, tracking the user's sleep patterns, and coordinating an alarm with the user's sleep patterns to awake them at the ideal time.</p>	<ul style="list-style-type: none">• Numerous features (alarm, music, and tracking)• Integrated sensors and speakers	<ul style="list-style-type: none">• Wired connection to smartphone• Must be placed under existing pillow (separate purchase)

<p>Somnox (499 Euro, 597.73 US)</p> 	<p>Somnox simulates human breathing, is able to identify sleep cycles, play music and gently wake the user.</p>	<ul style="list-style-type: none"> • Eases anxiety • Bluetooth enabled • data collection 	<ul style="list-style-type: none"> • Expensive • Limited quantity release
<p>Sleep Cycle alarm clock App (\$29.99 for 1 year premium)</p> 	<p>This app has your phone track your sleep states by using sound analysis to track movements during sleep. It will wake you up slowly during your lightest sleep phase.</p>	<ul style="list-style-type: none"> • Low risk of harm to the user (no physical contact between phone and user). • Being slowly woken during lightest sleep phase means there is no sudden disturbance. 	<ul style="list-style-type: none"> • Does not have in depth analysis of sleeping behaviors. • Does not have a timer for waking up at specific times.
<p>Sleep as Android (free app)</p>  <p>http://sleep.urbandroid.org</p>	<p>Sleep as Android solves the problem of waking up in the morning by playing an alarm while the user is sleeping lightly and then verifies the user has woken up by making the user complete a short puzzle to disable to alarm.</p>	<ul style="list-style-type: none"> • Free • Verifies wakeup • Smart alarm goes off at optimal time 	<ul style="list-style-type: none"> • Requires placing phone on bed • Additional purchases

Criteria and Constraints:

Criteria	Threshold (Halt & Review)	Target Goal (Plan of Record)	Stretch Goal (Design Stop)	Rationale
Cr-1: Variable audio alarm	>40db, <100db	80 db +/- 30	80db +/-60	Awake user gently (goldilocks)
Cr-2: Measure sleeping	Detect presence/absence of head Sensitivity: +/-10lbs	Detect rolling Sensitivity: +/-5lbs	Detect all movements +/- 0.5lbs	Measure user's soundness of sleeping based on head movement
Cr-3: Battery Life	12 hr battery	24 hr battery	186 hr battery	Stay powered through the night with no cords
Cr-4: Number of pressure sensor collection samples	2 samples	10 samples	100 samples	Track user's sleep cycle
Cr-5: Accuracy of keeping track of time	+/- 1 min	+/- 1 second	+/.1 second	Know how long the user is sleeping and what time it is
Cr-6: Size of entire unit	8" x 10" x 4"	6" x 8" x 3"	6" x 4" x 2"	We don't want the box to be too big and make the user's sleep uncomfortable

Table 3: Example project constraints - marine alarm clock

Constraints	Threshold (Halt & Review)	Target Goal (Plan of Record)	Stretch Goal (Design Stop)	Rationale
Co-1: Stay cool (components)	<110 degrees F	<90 degrees F	<80 degrees F	Project specific
Co-2: Material, (flame retardant)	<50 degrees F	>= 100 degrees F	>= 200 Degrees F	Project specific

Co-3: Pillow Size	28"L x 16"W x 6"H	22"L x 14"W x 4"H	18"L x 12"W x 4"H	Project specific
Co-4: Prototype budget	<\$160	\$80	\$40	Defined by professors
Co-5: Power supply (AC adapter, battery, or solar panel connected to voltage regulator. No USB power packs may be used)	>3.3V	5V	12V	Defined by professors
Co-6: Microcontroller (Cypress Bluetooth® Low Energy (BLE) Pioneer Kit (CY8CKIT-042-BLE-A), PSoC® 4 Pioneer Kit (CY8CKIT-042), and/or Prototyping Kit (CY8CKIT-049-42xx))	>= 1	1	2	Defined by professors
Co-7: Sensor(s) read by a microcontroller	6	2	1	Defined by professors
Co-8: Actuator(s) controlled by a microcontroller	1	2	4	Defined by professors
Co-9: Bluetooth Low Energy communications to a phone, computer, or another device using a Cypress BLE Pioneer Kit	1-way communication with max range 5 ft	1-way communication with max range of 10 ft	2-way communication with max range of 10 ft	Defined by professors
Co-10: Custom printed circuit board <ul style="list-style-type: none"> Must be created in Cadence No commercial boards 	1	2	3	Defined by professors

Co-11: Surface mount components <ul style="list-style-type: none"> • Size 0805 or larger recommended 	0	6	100	Defined by professors
Co-12: Programmed in C or C++	Programmed in C	Programmed in C	Programmed in C	Defined by professors