

# iMask

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sustainable ergonomics

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# Chapter 1: Background

## Inspiration

A very common scene on public transportation in Hong Kong is seeing worker taking a nap. You would think that this is a result after a long hard day at work. But most often this is the case in the morning before the day has even begun. This particular person seems to be sleep deprived.

Figure 2 is a photo taken on The Hong Kong Polytechnic University campus. It shows that there are additional 24-hour studying rooms and shower facilities available for students who need to study overnight on campus during this past semester's finals period. This sign gave us insight into the hard-working nature that is ingrained into Hongkongers from an early age and also shows the institutions expectations of its students.



figure 1

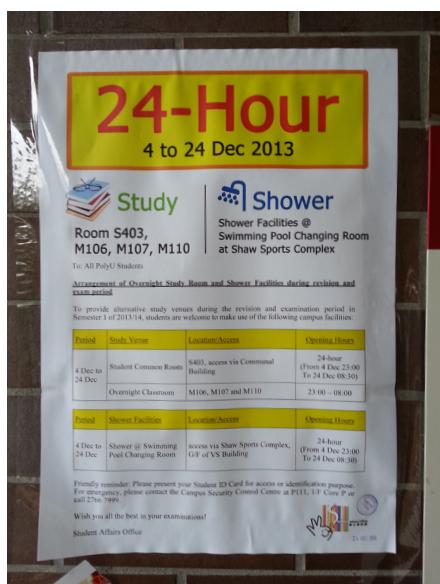


figure 2

Here in Hong Kong, workers and students alike work tirelessly to produce at the expense of a full night's rest. But at what point does a lack of quality sleep effect a person's ability to function efficiently? Most everyone knows the impact on productivity after a good, full night's sleep compared to that of not enough or bad quality sleep. Because of Hong Kong's work-obsessed culture, its workers must be able to work at optimal energy levels that only a good night sleep can provide. Aside from long working hours there are other reasons why workers might not be able to get adequate sleep. Environmental reasons include living in a metropolitan area where outside noises can disrupt uninterrupted sleep, shift work that makes it difficult to sleep during daylight hours or constant traveling across time-zones that makes it difficult to adjust to a normal sleep schedule.

Sleep is a fundamental and essential part of everyone's life no matter age or occupation. Its effect on the body is indisputable but something many people take for granted everyday. We have explored the dynamic relationship of sleep and our body and have come up with a concept that is ergonomic, reusable, sustainable, portable, and most importantly something beneficial to mind and body.

# Chapter 2: Research

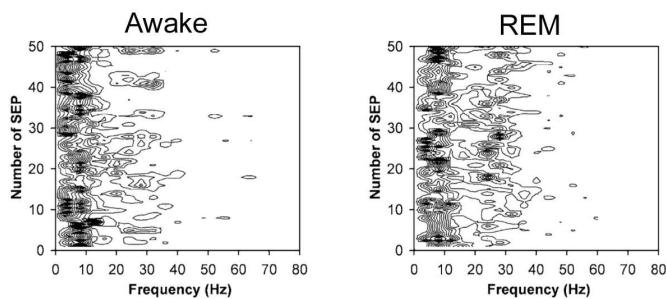


figure 3

and physical performance but also effects our minds ability to communicate with the body. Sleep gives neurons, or the impulses that connects the brain to the spinal cord, a chance to repair itself and replenish its energy supply (NIH, 2011).

Before the 1950's, it was common belief that the mind and body lay inactive during sleep. Since then, studies have shown very active brain activity during slumber. Figure 3 compares brain activity in the awakened state and in dream, or rapid eye-movement (REM), state. Brain activity during the sleep state suggests that dormancy does not correlate with rejuvenation but instead promotes the idea that the mind and body are hard at work providing needed maintenance.

Scientists believe that we are only scratching the surface about information regarding sleep. There is no clear-cut answer to why humans must sleep but there are several generally accepted theories. Pertaining to the concept of repairing neural connectors is the Restorative Theory. During sleep state, restorative function is initiated to help the body repair and grow. For example, restorative function promotes muscle growth, tissue repair and protein synthesis (Why Do We Sleep, 2008).

Another major theory that directly relates to worker productivity is the Brain Plasticity Theory. Brain Plasticity Theory is the procedure by which the brain processes information in order to learn and re-

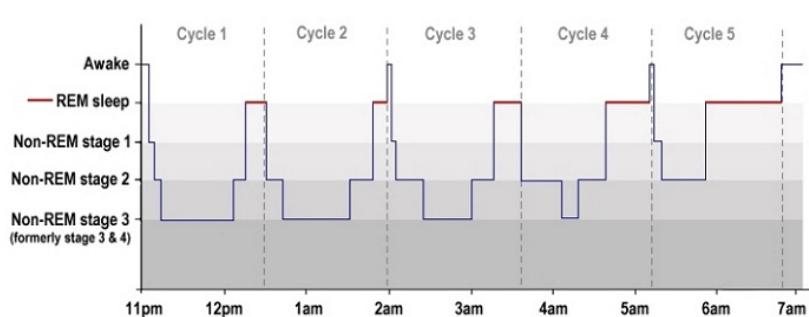


figure 4

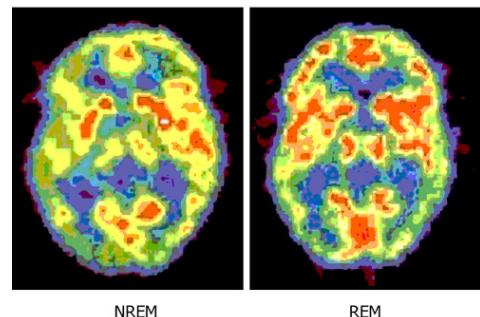


figure 5

member. Acquisition, consolidation and recall are the three stages of how the brain remembers information. The acquisition of new information and recollection of said data occur during the awaken state while consolidation, or memory stabilization, occurs during the sleep state. Consolidation of memory is related to the strengthening of neural connections of the brain during slumber (Sleep, Learning & Memory, 2008).

As mentioned earlier, brain activity during sleep can be just as active as when in the awaken state but most of the time the brain is in a less active state. Humans sleep in a cyclical pattern that is exemplified

by changing brain activity. There are two main types of sleep, rapid-eye-movement (REM) sleep and non-rapid-eye-movement (NREM) sleep. There is one stage of REM sleep and three stages of NREM sleep. The three NREM stages are known as N1, N2, and N3. N1 is the first stage of sleep and accompanied by moderate brain activity and slow eye movements. As N1 progresses to N3, brain activity and eye movement becomes gradually less until the individual reaches deep sleep in N3. A person is most easily awoken during the N1 stage as opposed to deep sleep, where the person becomes less responsive to external stimuli. After N3, the individual will briefly go back to N2 stage for a few minutes before entering the REM stage. Characterized by heightened brain activity and rapid-eye-movement, the REM stage is associated with the stage of sleep when dreams occur.

The stages of sleep throughout the sleep cycle also has a direct influence in how the information is processed and remembered. The consolidation of declarative learning, or fact-based learning, and procedural learning, or the knowing how to do something like playing the piano, occurs during REM sleep. Spatial learning is associated with deep sleep and motor learning is linked to the N1 and N2 stages of sleep.

## 2.2 Sleep Behavior in Hong Kong

With the importance of each stage of sleep and its relationship to key aspects relating to productivity, it is important to examine the common problems that afflict Hongkongers' sleep patterns.

As a major metropolitan city, noise is a factor that can disturb an individual's sleep cycle. Noises at various sound levels effect individuals differently. The most common disturbances in sleep is related to a change in sound frequency outside of the presence of familiar sounds. A city dweller who is accustomed to hearing blaring sirens and car alarms at night might not be able to fall asleep in the countryside where all they can hear is crickets chirping in the background (The National Sleep Foundation).

Due to shift work or frequent travel to different time zones, the body's biological clock can hinder the ability to sleep. For travellers, jet-lag will make it difficult for the body to adjust to the current time-zone which can result in daytime sleepiness. For workers who work night shifts, the ability to sleep in the day is made difficult by the presence of daylight. And for many shift workers, their shift time slots change resulting in a sleep-wake schedule that is constantly in flux. Working a few days during the day and then working a few days during the night taxes the body by not allowing for a consistent sleep schedule. A disruption in the body's biological clock often results in insomnia<sup>1</sup> which effects the amount of hours and quality sleep an individual gets (Jet-lag and Shift Work, 2008).

Although noise and daylight are common culprits, studies have found that stress is the number one cause of sleep deprivation. 2.2 million Hongkongers, or 31% of the total population, suffer from insomnia due to stress. Compared to their Mainland counterparts, Hongkongers sleep almost one and a half hours less, 6.46 hours versus 8.07 hours. Due to the long hours and competitive nature of the workplace combined with the pressures of Hong Kong's escalating cost of living, the cause of most peoples' sleep problems are due to daytime distress (The Hong Kong Institute of Education, 2012).

The relation between stress and insomnia is troubling due to the fact that these two problems directly effect each other and act in a never ending cyclical manner. University of Rochester School of Medicine's Dr. Kathi Heffner states, "associations between sleep and stress-related cognitive, affective,

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<sup>1</sup> Insomnia is a broad term to describe difficulty falling or staying asleep. Severity of condition varies. This problem should occur semi-regularly; at least 3 times per week for at least one month (Roth, T., 2007).

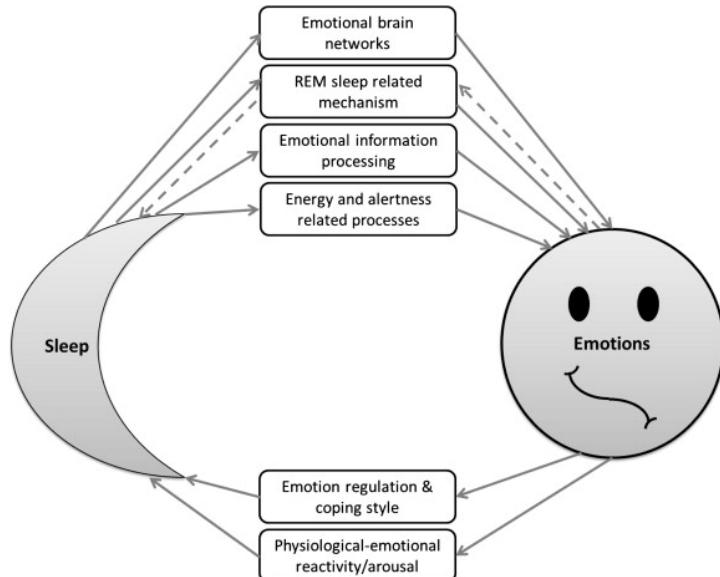


figure 6

has a different ideal amount. Sleep debt is the ideal amount of sleep that is short of what you actually received for a given night. The short term effects are fatigue and irritability. But as the sleep debt accumulates, an individual's overall health also becomes threatened. Weight gain, diabetes, heart disease, stroke, and memory loss are among the long term effects of sleep debt (Repaying your sleep debt, 2007).

The solution is to make up that sleep debt by getting more sleep during the weekend and the following week. Naps are also popular solutions to combat sleep debt and fatigue. Short scheduled naps during the workday have been shown to improve alertness, memory, motor skills, decision-making, and mood. As a result, naps can cut down stress caused by daytime distress (Bloomberg Business Week, 2006).

and physiological disturbances, represents an unhealthy, bidirectional cycle of poor sleep and maladaptive stress responses (Heffner, K.L., 2013)." Simply put, when stress hinders quality sleep, the body cannot properly recharge and as a result is ill equipped to handle the adverse situations that will cause more stress. Figure 6 diagrams this bidirectional process (Kahn, M., Sheps, G., Sadeh, A., 2013).

## 2.3 Sleep Debt

The old adage says that people need eight hours of sleep daily but in reality, everyone

## 2.4 Current products in market

### *Eye Masks & Ear Plugs*

These two kinds of products are some of the most popular ones that people use to get better sleep. They are very cheap, portable and easy to access, and physically help us block unwanted light and noise. However, they are not so comfortable because of cheap materials and fixed size.



Figure 1.4.1 Eye mask & Ear plug

### *Noise Machines*

There are many brands of noise machines in current market, such as Homedics, Marpac, Ecotones, Conair. These products are aimed to create an environment surrounded by the same nature sounds: ocean, summer night, rain, and so on, thus promoting the sleep quality. But it seems a little bit unnecessary to have such a big machine placed in our sleeping rooms and offices, which only provides us with sleep aid sounds.

## Sleep Potion

It is said to be natural ingredients to help people fall asleep, sounds like some magic potions in fairy tale. We probably have reservation about their functions.

## Sunrise Simulator

Philips has a product called Coloured Sunrise Simulation, which can dim light and sound gently, and also has several kinds of natural wake up sounds, thus waking up people naturally by physical environment change. But it is also a little bit dumb, another occupation besides people's bed.

## Sleep Apps

In current apps market, there are a lot of mobile apps that can track people's sleeping behaviors. People can review their sleep statistics, debt and averages, set a reminder to go to sleep or alarm to wake up, and also track sleep motions through some existed sensors in cellphones. But they are just tracking, and subjectively recording, not really improving sleep quality.



Figure 1.4.2 Noise Machine



Figure 1.4.3 Sleep Potion



Figure 1.4.4 Sunrise Simulator



Figure 1.4.5 The App Tracing Sleep Behavior

# Chapter 3: Ideation and Design Concept

## 3.1 Scope and Design Objectives

### Target Demographic

Our target users could be the millions of people from all walks of life who feel the effects of sleep loss, from executives who constantly travel across multiple time zones, to organic farmers who must get up extra early to harvest new crops. We want our product to help them solve their sleeping problems so that they can better adapt to unscheduled biological cycle.

Additionally, for anyone who wants to be a healthier and more productive person, our product can also work for them to make use of their sleeping and napping time sufficiently and efficiently. Thus, they can concentrate on their daily working more efficiently, because better sleep quality makes people get much energetic and fresher.

### Design Objective

Based on our previous research, our final design concept is to create a convenient and sustainable device that will allow users to improve their sleep quality. Moreover, we want our design achieve the following scope:

#### *- Sustainable*

It should be durable in terms of fabrication materials, which extends the life circle of product. And it is better to be self-powered, absorbing external energy automatically to get charged without extra concerns.

#### *- Ergonomic*

It should be both cognitive and physical ergonomic. Based on our research, both internal and external factors have influence on human's sleep quality, and we can try to combine these two. Also, in order to more suitable for Asia people specifically, we should develop our product based on anthropometric concerns.

#### *- Efficient*

It should be convenient and independent, in case that people can use it whenever they are in their bedrooms or during office napping hours. So our product should be tiny and flexible in different situations, rather than a dumb machine, which requires place to be occupied.

## 3.2 Ideation and Design Sketches

As we noticed that people are sensitive to both light and noise (especially volume and frequency change) during the sleep, the design concept should be able to provide the users visual and audio aids to help them sleep better. At the meantime, the design will be capable to monitor user's sleep pattern.

According to the design objectives defined in the previous stage, we have conducted a brainstorming for ideation purpose and the design concept is a eye mask with visual and audio responses to the users' sleep situation. Concept sketches are as following, which describe the basic outlook as well as the location of the technology elements involved.



Figure. Concept Sketch Isometric



Figure. Concept Sketch Front

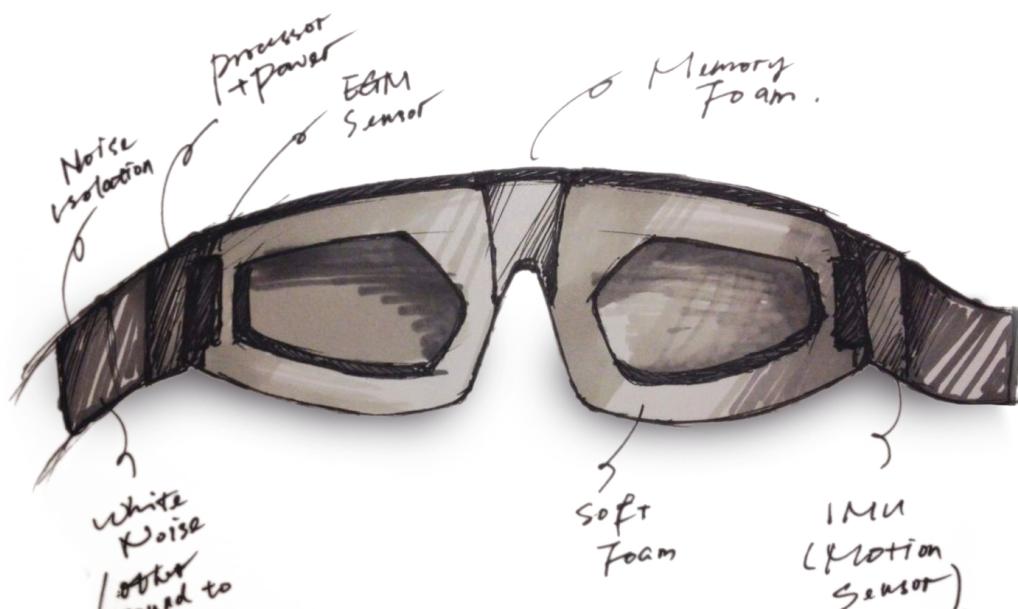


Figure. Concept Sketch Back

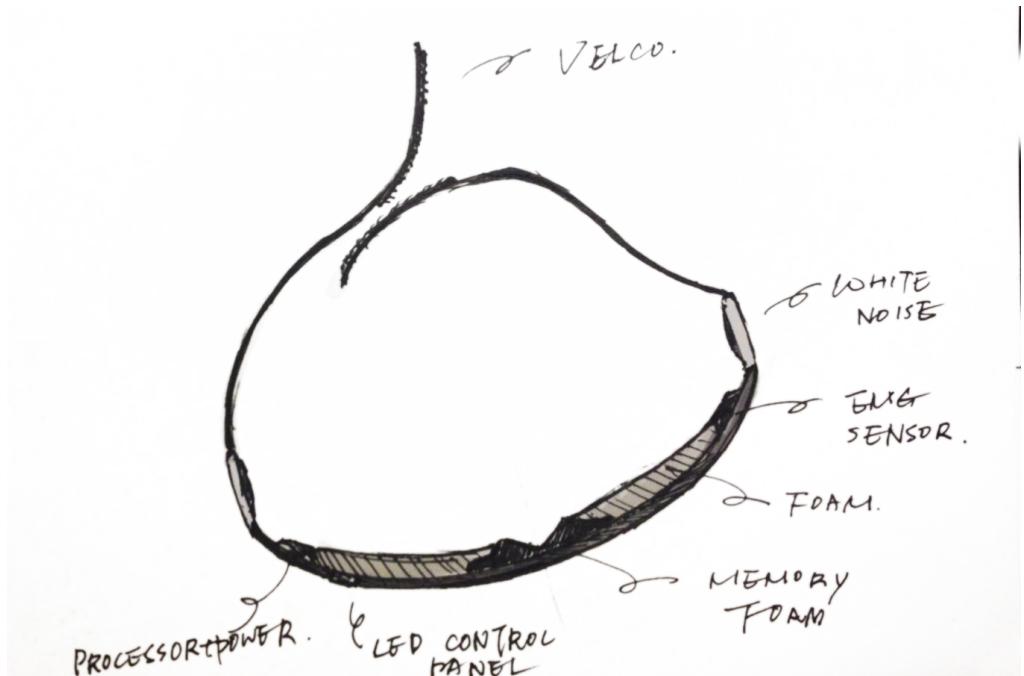


Figure. Concept Sketch Top

### 3.3 Design Concept – iMask

#### 3.3.1 Overview

iMask is an intelligent sleep mask that people can use during their night sleep, daytime short nap and travelling nap on the transportation. The product enables users to enjoy more comfortable sleep even when the sleeping circumstance is not ideal enough.

iMask senses eye movement and body motion to seamlessly interpret your sleep status and process the information to monitor your sleep. With 2 advanced EMG sensors and a nine-axis IMU, iMask has been engineered to recognize the sleep pattern.

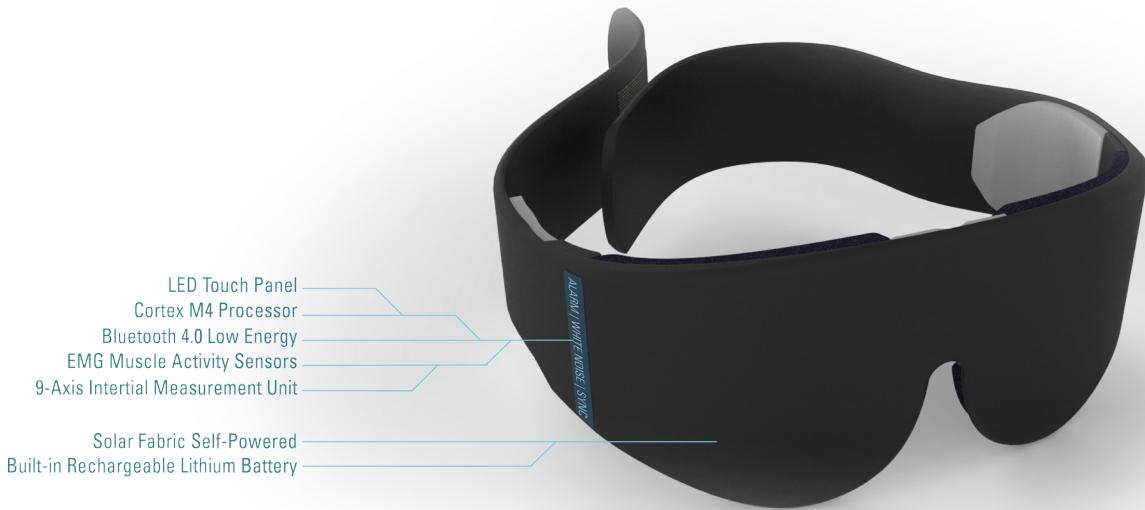


Figure Concept Rendering 1

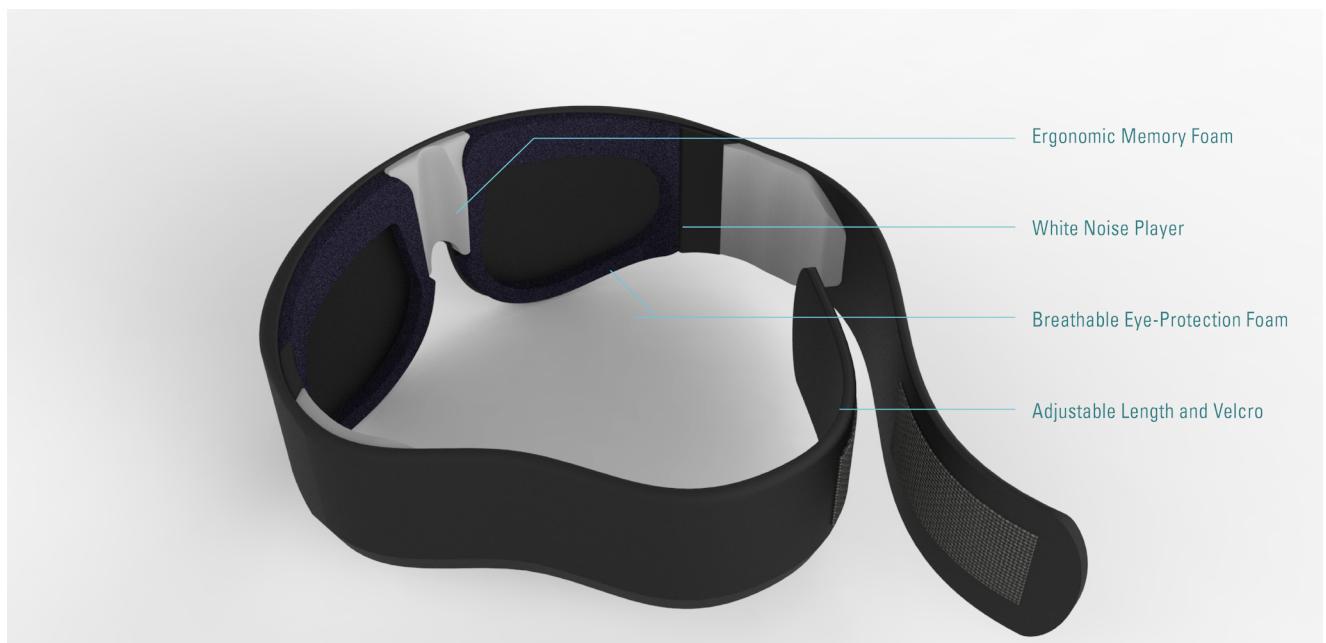


Figure Concept Rendering 2

### 3.3.2 Main Features

#### *Block Light*

iMask is fabricated with light block material, aiming at providing dark and comfortable sleep environment. The inner layer is design with structured ocular support fabricated with breathable soft foam material so that it will give user the optimal comfort.

#### *Block Sound*

Foam material is also adopted around the earpiece and white noise displayer is embedded in the earpiece to seamlessly drown out background environmental sounds.

#### *Integrated Sleep Monitoring*

iMask is equipped with a series sleep sensor for data detection and a tiny process that function as the brain to process the data as well as send sleep monitoring order.

#### *Smart Alarm*

The smart alarm is integrated with sleep monitoring system that detect the optimal time for wakeup the user.

#### *Self-Powered*

iMask is solar powered with the new solar fabric technology for convenience and environmental concerns. The solar energy collected during the day is stored in a rechargeable lithium battery.

#### *Asian-Specific Fit*

The design considers the specific human factors of Asian people and is designed with the Asian-fit structure. Memory foam is used at the location with complex face contour. Besides, the size is adjustable through Velcro for a wide head conference range.

### 3.3.3 Anthropometry

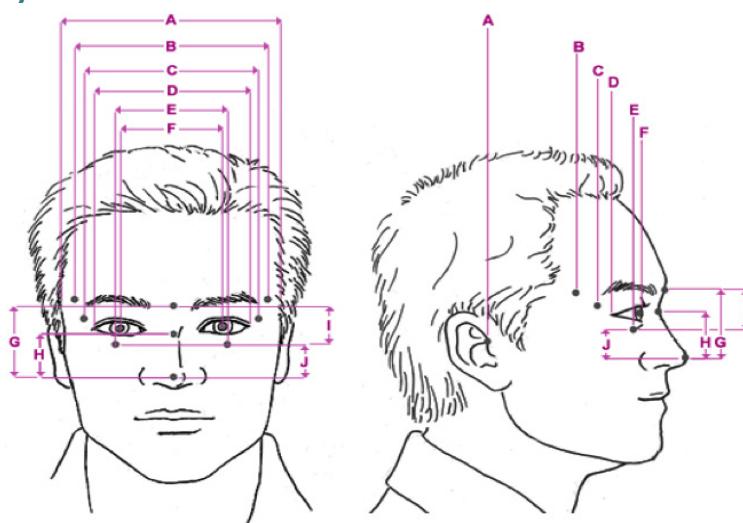


Figure Face Anthropometry (SizeChina,2011)

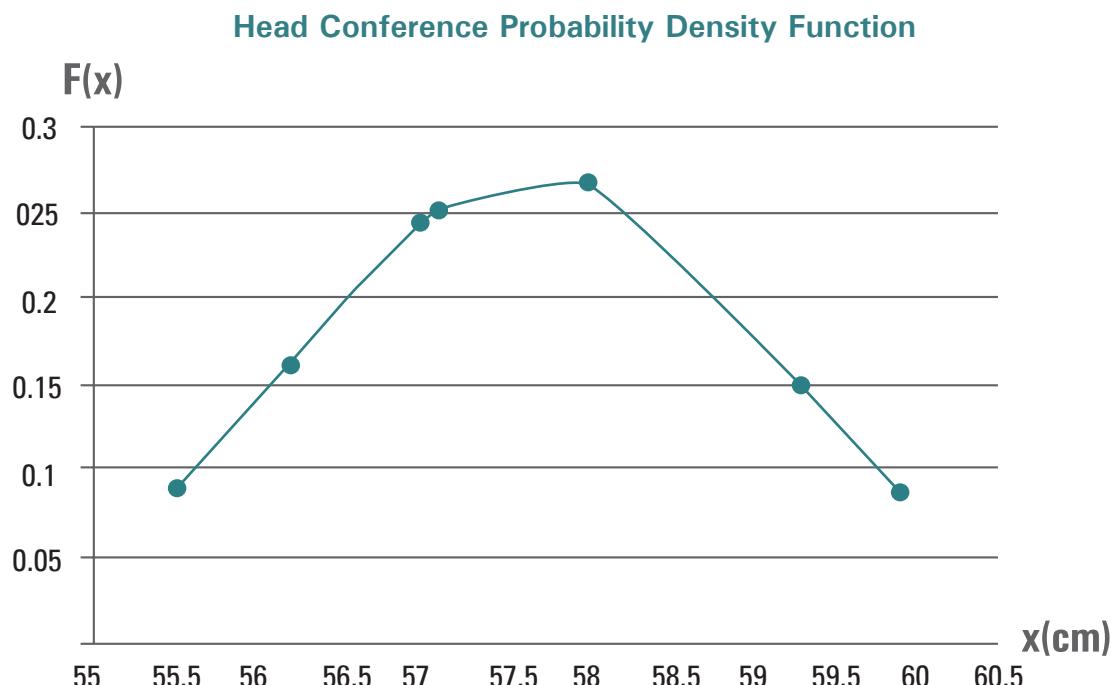
Referring to the customer interviews and online product reviews, considerable amount of the users mentioned that their sleep mask would introduce pressure to their eyeballs and nose bridges. Considering the face contour and shape of Asian people, a structured ocular support made by breathable

foam material has been added around the eye socket area. This design will optimize the comfort for long-time wearing. As to the ears, memory foam is applied to that specific area so that iMask is able to fit the user's ear-shapes.

To fulfill the goal of designing a product with ergonomic concerns and optimal comfort, a small-scaled anthropometry research has been conducted for data collection and analysis. The sample volume is ten people, five of which are males the other five are females.

Five major data has been acquired including intraocular distance, extra ocular distance, curve distance between two ears and the distance from glabella to sellion. The mean value as well as the standard deviation has been calculated as the reference of determining the dimension of the product. To learn more on the detailed data, please refer to the appendices.

The conference of the iMask is adjustable by using the Velcro at the back so that people with difference head confluence will not feel uncomfortable. The size range covers 90 percentile of the Asian users, which is from 54cm up to 61cm.



The product specifications are as following:

	Intraocular	Extraocular	Between ear	Glabella to Sellion	Head Conference
Mean (cm)	4.02	12.00	28.05	1.69	54 - 61

### 3.3.4 Intelligence – Data collection and processing

iMask is equipped with a set of sensitive sensors, enabling the system to capture the user's sleep pattern and conduct backend analysis. There is a nine-degree-of-freedom IMU to detect the body motion of the user and a pair of EMG sensors to sense the eye movement. According to the data analysis, iMask is capable to monitor the current sleep status of the user so that it can provide proper audio aid and ring the alarm when the user is at shallow sleep state around the preset wake-up time. The data obtained can be optionally transmitted to the app installed in the user's smart phone and the app acts as a data display and will also include more accurate long-term sleep pattern analysis. The amount of data obtained will affect the accuracy of the sleep pattern evaluation.

#### Body Motion Capture – IMU

IMU, which stands for inertial measurement unit, is an electronic sensor that had the capability to measure and report the velocity, orientation and gravitational forces. It employs a series of accelerometer and gyroscopes.



The so-called inertial measurement unit functions as a detector of instant rate of velocity change or acceleration through one or several accelerometers. It also detects the change of rotational attributes including pitch, roll and yaw by a set of gyroscopes. (Baluta, S. 2009)

Figure. IMU

During the sleep hour, the user is supposed to stay relatively static in deep sleep state, say in NREM period, while intends to move the body and head in shallow sleep. The body motion is detected by IMU and transmitted to the processor as the reference of sleep pattern analysis and sleep status monitoring.

#### Eye Movement Detection – EMG

Since the eye movement reveals the sleep status of the user, as it has been introduced in previous section that human's sleep pattern is divided into REM (Rapid eye movement) period and NREM (Non-Rapid eye movement) period, the product is designed to acquire data from the eye movement and integrates this set of data to the sleep monitoring.

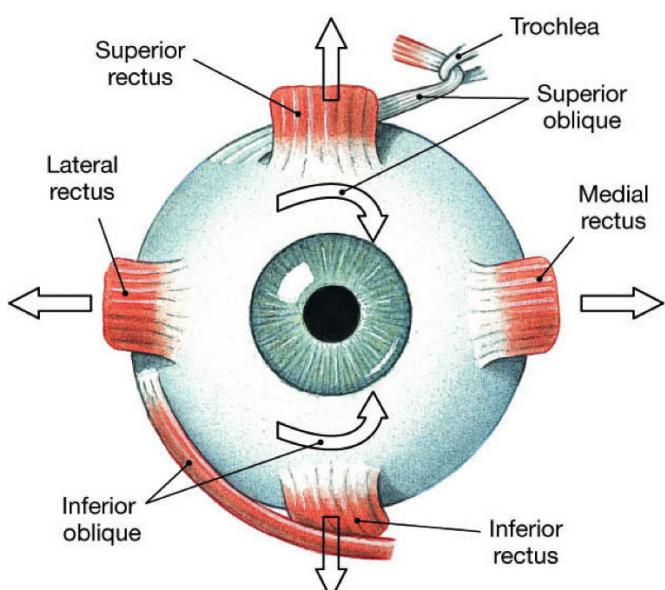


Figure. Eye muscles front view (Droual, R. (2013)

As it is shown in the following figure, there are mainly 6 muscles that control the eye movement, 4 of which are for linear movement and the other 2 are for rotation.

Electromyography (EMG) is a mature technology for detecting and reflecting the bioelectrical signal generated by skeletal muscles. EMG functions through using an appliance called electromyograph, to produce a signal data that is de-

fined as electromyogram. The electromyograph measures the electrical potential produced by muscle cells during the time when these specific cells are electrically or neurologically activated. It can be used to evaluate biomechanics of humans' movement and in this case the device will serve as the eye movement sensor. (Kamen, G. 2004)

### ***Data Processing - Cortex M4 Processor***

iMask is embedded with a latest processor with the module of ARM Cortex™-M4. It is specifically developed for digital signal control, which requires high efficiency, easy-to-use plus control and signal processing capabilities. The processor is a low-power (0.9-1.8V, 8-157µW/MHz), low cost type with professional performance and functionality. (Arm, 2012)

The analog data will be converted to digital signal and reported to the processor for data analysis. The processor will evaluate the sleep pattern and make proper judgments for sleep monitoring, which includes provide audio aid with certain volume, ring the smart alarm during the last NREM sleep period right before the preset alarm, etc.

### **3.3.5 User control and sleep pattern tracking**

#### ***In device Control – LED Control Panel***

There is a low-power LED touch panel located on the right side of the outer layer. The touch panel employed vertical swipe gesture to switch on and off. The menu of smart alarm as well as preference settings can be accessed with it.

The LED panel is also a status indicator, which can show the battery condition and while iMask is in data sync status and is connected to the APP in smart phone, there will be a display showing updating data.



Figure LED Panel - Menu



Figure LED Panel - Updating Data

- Data Tracking and Display - Integrating the Smart phone APP



Figure. App Interface

For more accurate sleep monitoring, an optional app is provided for long-term data analysis, sleep pattern evaluation, and intelligence sleep monitoring feedbacks.

The app will record the sleep time for each day, the data of eye movement and body motions detected by the sensors, and display those data with graphs. The user can rate their sleep quality and take notes on the display page.

### 3.3.6 Audio Aids - White Noise Player

#### *White Noise*

In signal processing, white noise is defined as a random signal with a flat, constant power spectral density. White noise can be regarded as sound signal used to mask background and also blend the external sounds (barking dog, traffic etc.) into the overall background noise, so human's brain pays less attention on unexpected sound. It sounds similar to TV or radio 'static', staying in constant amplitude throughout the audible frequency range.

According to sound masking theory, human ears can only sense the louder one, when the volume of one sound is 15 dB and above larger than others. It is functional where it is not so noisy to help people get rid of the disruption, such as offices, bedrooms and classrooms. If it is too noisy, white noise turns into another new noise rather than to mask others. Therefore, in our design, we put a simple and tiny player near human's ears, playing white noise with adjustable volume, which can help users adapt to environments in different volumes.

#### *Smart Alarm*

According to the sleep data analysis, iMask will be capable to evaluate user's sleep cycles and determine a proper ringing time. The user can preset an alarm before going to sleep, and iMask will wake the user up when he/she is in light sleep before the preset time so that the user will feel more refreshed.

### 3.3.7 Sustainability – Solar Fabric

Sustainability is the most discussed topic in recent decades and is what we always pursue as a design objective. To minimize the environmental footprint, reduce energy consumption, and be environmental friendly, the outer layer of iMask will be manufactured by solar fabric.

Solar textile is an ultra-light, low-cost, flexible material with high-efficiency solar energy harvester. Basically, the solar cells collect photons' energy and convert it into electricity, storing in a rechargeable lithium battery. The presence of light is generally found with every human activity. The solar fabric will not only make the product more energy independent, but will also bring convenience to the users because it is automatically recharged by light during the daytime and is ready to use at night. (Kalyanaraman, R. 2013)

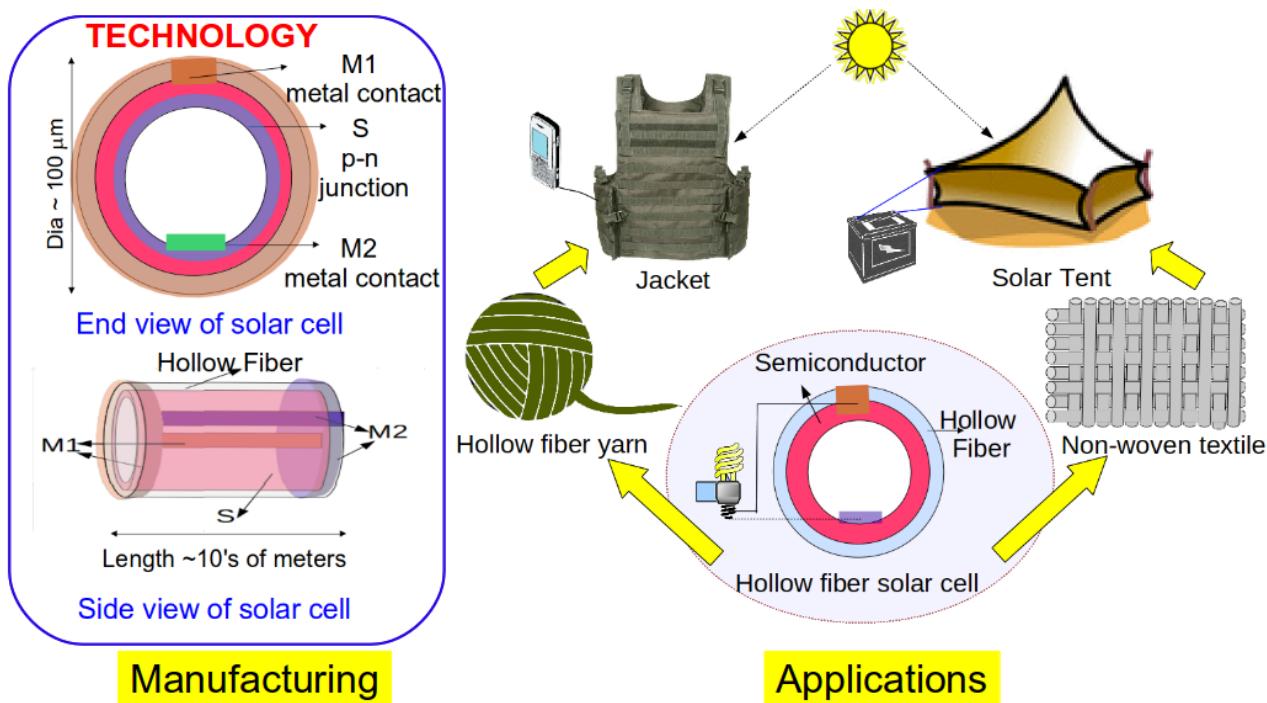


Figure Solar Textile

# Chapter 4: Conclusions

## 4.1 Values of Our Product

### *Users value*

We get inspiration from one of the most usual scenes in daily life: people always talk about they lack of sleep and complain about their sleep quality. Our product is trying to solve or improve this specific problem and situation.

### *Market value*

Currently there is no such a product that concerning both visual and audio to help people improve their sleep quality. We just try to catch this gap.

### *Society value*

In social context, people can be more productive and more efficient if they have a good rest, which will finally influence the outcome of work positively.

## 4.2 Project Reflection

### *Concern about Ergonomics*

In our design, we consider not only the physical ergonomics but also the cognitive ergonomics, and we started from human, did a lot of background research about the principles of sleep. We believe this is a very good chance to learn ergonomics in a more practical way, discovering social problems at the beginning, learning the principles behind with ergonomic concerns, thinking about solutions or improvements properly and finally trying to illustrate the technical feasibility.

### *Group Work*

We learn a lot from each other and have a more complete understanding about this course by comparing with each other. Generally, group work makes our design concept more reasonable and fully-developed, with all the methods and knowledge that we had been through, and discussions and controversy promote more dedicated thinking, especially for the background research part. Most importantly, every one in our group plays a specific role that takes charge of a specific part of content, which improve our project quality overall.

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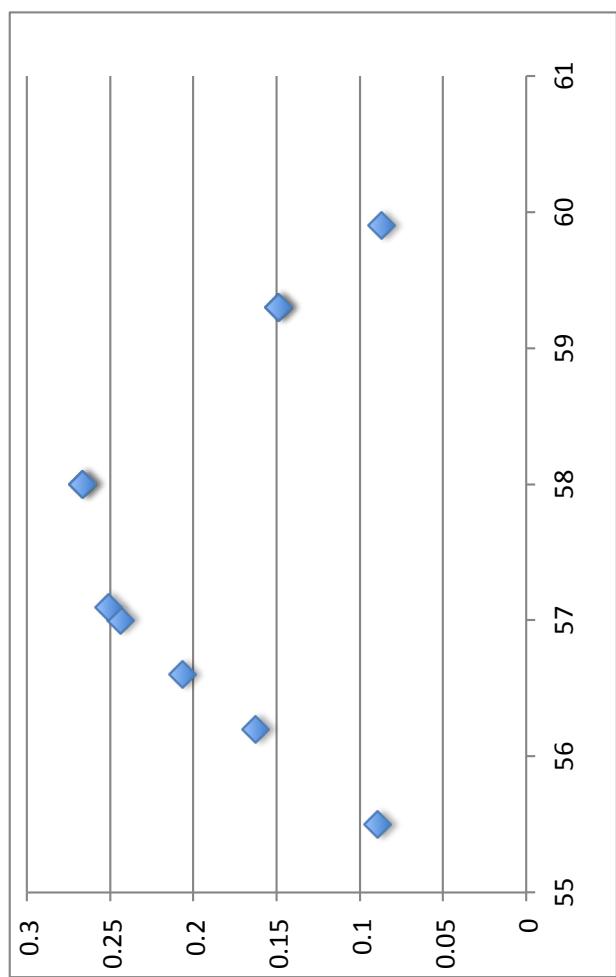
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# Appendices: Facial Anthropometry Measurement Data

	Age	Gender	Head Conference	Intraocular	Extraocular	Ear Dist	Glabella-Sellion
P1	Allison	24	F	57	0.243859067	4.4	12.5
P2	Arno	28	M	58	0.266464767	3.6	11.2
P3	Fred	28	M	58	0.266464767	4.3	12
P4	Yaya	24	F	56.6	0.20653821	3.5	11.5
P5	Anna	25	F	56.2	0.162345446	4	11
P6	Chris	24	M	55.5	0.089011197	3.25	13.3
P7	Elaine	24	F	59.3	0.14885032	4	11.6
P8	Michelle	23	F	59.3	0.14885032	4.1	11.9
P9	Quincey	34	M	57.1	0.251250901	4.5	12
P10	Daniel	25	M	59.9	0.087202442	4.5	13
AVG				57.69	4.015	12	28.05
DEV				55.28	0.438463225	0.745355992	0.8553752
90%min				60.09	0.228278582	0.228278582	0.228278582
90%max					0.3	0.25	0.2



# Appendices: Online Research on Stress&Sleep

## Research Survey: Stress and Sleep

This is a survey for our design project with the theme of " Design for Adaption". The focused area is the interrelation between stress and sleep plus their influence on people's life.

Thank you for your great help!

\* Required

### Your Gender? \*

- Male
- Female

### Your age? \*

- Under 18
- 18-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- Above50

### Your occupation? \*

Please tell us your job title as well as your professional discipline

### How many hours of sleep do you think is ideal? \*

- Less than 5 hours
- 5 hours

# Appendices: Online Research on Stress&Sleep

- 
- 6 hours
  - 7 hours
  - 8 hours
  - 9 hours
  - More than 9 hours

## How many hours of sleep do you usually get? \*

- 4 hours or less
- 5 hours
- 6 hours
- 7 hours
- 8 hours
- 9 hours
- More than 9 hours

## Do you consider yourself a light sleeper? \*

"Light sleeper" refers to people who get awoken by noise or disturbance easily

- Yes
- No

## What are your sleeping habits like? \*

This refers to whatever you need to prepare for your sleeping, including environment, light (on/off), noise level, or even doll to hug, etc.

## Do you use anything to help you sleep? (ie: caffeine, sleep pills) \*

## Does your schedule affect your sleep schedule? \*

- Yes
- No

## How does sleep quality influence your mood? \*



# Appendices: Online Research on Stress&Sleep

**Does your mood effect your sleep? \***

- Yes
- No

**Do you usually feel refreshed when you wake up in the morning? \***

- Yes
- No

**Do you take naps? \***

If yes, when and where? If no, why not?

**What is the position when you are taking a nap? \***

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# Appendices: Online Research on Stress&Sleep

Timestamp	Your Gender?	Your age?	Your occupation?	How many hours of sleep do you think is ideal?	How many hours of sleep do you usually get?	Do you consider yourself a light sleeper?	What are your sleeping habits like?	Do you use anything to help you sleep? (i.e. caffeine, sleep pills)	Does your mood affect your sleep schedule?	How does sleep quality influence your mood?	Does your mood effect your sleep?	Do you take naps?	What is the position when you are taking a nap?		
12/11/2013 23:32:	Male	26-30	IT engineer	8 hours	7 hours	Yes	nothing special	no	yes	a lot	yes	yes	no	n/a	
12/11/2013 23:32:	Male	43	Male	18-25	9 hours	No	too complex fall asleep immediately, dont know what happens afterward	no	yes	dont know	yes	yes	no	sit in a chair	
12/11/2013 23:34:	Male	52	Male	18-25	investment manager assistant	6 hours	6 hours	No	Yes	generally irrelevant	No	yes	no	not at all	
12/11/2013 23:35:	Male	43	Male	26-30	Accountant	6 hours	7 hours	No	Yes	not at all	No	no	no, not necessary	take nap while seated	
12/11/2013 23:35:	Male	55	Male	26-30	project operator	7 hours	7 hours	Yes	quiet environment	very much	yes	no	Afternoon in lab	Bend over the desk	
12/11/2013 23:41:	Female	45	Female	18-25	Student	8 hours	8 hours	No	With my bear	Not much	no	no	after lunch , in the office	on the desk	
12/11/2013 23:42:	Female	25	Female	18-25	student	7 hours	8 hours	Yes	in dark environment	laziness	yes	no	after lunchtime and after staff room	Lying on the desk	
12/11/2013 23:49:	Male	47	Male	18-25	graduate student	8 hours	8 hours	No	warm,quiet, light off	much	no	no	yes, midnoon	趴到 , 流口水那种睡 at night.	
12/11/2013 23:56:	Male	18-25	student	8 hours	8 hours	No	light , noise	no	No	much	yes	yes	it would affect	null	
12/11/2013 0:00:	Male	53	Male	18-25	investor relation management	7 hours	6 hours	No	quiet, light-off	quite	yes	no	sleep at night.	sleep at night.	
12/12/2013 0:06:	Female	05	Female	18-25	assistant store manager	7 hours	7 hours	No	listen to music	n/a	yes	yes	yes	at noon sometimes lying down	lying down
12/12/2013 0:07:	Male	53	Male	18-25	Future Dealer	7 hours	6 hours	No	light off	nope	yes	yes	yes	seldom	laying
12/12/2013 0:17:	Male	35	Male	18-25	Student	7 hours	8 hours	No	Quiet and dark	No	yes	yes	yes	Yes, library	Desk
12/12/2013 0:17:	Female	37	Female	18-25	final year university student	8 hours	7 hours	No	light off , better without noise	better sleep quality	yes	yes	no	no , always have class after lunch	sit on libra's chair
12/12/2013 0:36:	Female	20	Female	26-30	product manager Master	8 hours	8 hours	No	quiet and dark	better mood	no	no	no	afternoon in the office	side lay
12/12/2013 0:41:	Female	47	Female	18-25	communication engineering	8 hours	7 hours	Yes	no light, a bottle of water within reach	very much	yes	no	no	sometimes,30 minutes on the desk or bed	sleep on stomach or lie flat
12/12/2013 1:11:	Male	32	Male	18-25	EE	8 hours	8 hours	Yes	light quite environment	not much, 5 minutes for getting settled	yes	yes	yes	yes, noon	sleep in bed
12/12/2013 1:11:	Male	42	Male	18-25	EE	8 hours	8 hours	Yes	light quite environment	somehow	yes	yes	yes	yes,noon	sleep in bed
12/12/2013 1:43:	Female	00	Female	18-25	Master student EE MASTER STUDENT	8 hours	8 hours	No	light off	no	no	no	no	No	No
12/12/2013 17:48:	Male	57	Male	18-25	ux designer	9 hours	7 hours	No	NO	A LITTLE	yes	no	no	I DONT KNOW	on my bed at home
12/12/2013 18:20:	Female	49	Female	18-25	student	8 hours	8 hours	Yes	light off and quiet environment	sleep less then	yes	no	no	no	busy with work
12/12/2013 18:36:	Female	23	Female	18-25	I am vulnerable to noise and light	no.. mayb milk+ turmeric	no	yes	no	directly	no	yes	yes	no time	on stomach
12/12/2013 20:07:	Female	41	Female	18-25	graduate student	More than 9 hours	8 hours	Yes	light off , quiet	barely influence	yes	no	no	noon , in my bedroom	bed
12/12/2013 22:37:	Male	17	Male	18-25	student	8 hours	6 hours	No	nothing	negative	yes	yes	yes	seldom	home
12/13/2013 0:46:	Male	42	Male	18-25	Student	8 hours	8 hours	Yes	No noise	Small paper ball to block ear	yes	yes	yes	Yes at student hall in the noon	Bed
12/13/2013 1:48:	Female	43	Female	18-25	Design student major in building engineering and management	8 hours	6 hours	Yes	Comfortable bed, no noise and all sudden alarms	Wine sometimes	yes	no	no	No really, rarely have time to take naps.	Lean on the desk usually
12/13/2013 2:24:	Male	11	Male	18-25	na	9 hours	5 hours	Yes	light off, none noise	lack of sleep may let me feel upset	yes	no	no	not, hard to fall asleep	none
12/13/2013 6:44:	Female	24	Female	18-25	architecture student	8 hours	6 hours	No	drinking red wine	no influence	yes	yes	yes	sometimes	lie on the bed
12/13/2013 8:03:	Male	47	Male	18-25	a bed	6 hours	6 hours	No	doll to hug	A lot	no	no	no	yes, on the table	lie on front

# Appendices: Online Research on Stress&Sleep

Timestamp	Your Gender?	Your age?	Your occupation?	How many hours of sleep do you think is ideal?	How many hours of sleep do you usually get?	Do you consider yourself a light sleeper?	What are your sleeping habits like?	Do you use anything to help you sleep? (i.e. caffeine, sleep pills)	Does your schedule affect your sleep schedule?	How does sleep quality influence your mood?	Does your mood effect your sleep?	Do you usually feel refreshed when you wake up in the morning?	Do you take naps?	What is the position when you are taking a nap?
12/13/2013 8:15:47	Female	18-25	Student	8 hours	7 hours	Yes	quiet, lights off	no	Yes	No	Yes	Yes	Yes	extremely tired, on the long-term bus or in the lecture hall
12/13/2013 10:31:00	Male	26-30	PhD student	8 hours	6 hours	No	light off and no noise	no	No	a little	Yes	Yes	Yes	cannot say
12/13/2013 10:40:52	Male	18-25	bank	7 hours, 8 hours	6 hours	No	light off	no	Yes	well	Yes	No	No	in seating
							light off , hug doll sometimes . noise is OK if it is in same frequency , smells make me calm down sometimes ,							no time to take naps
							without cellphone in hand	calm down fragrance	Yes	super	Yes	No	No	nowhere
							just close eyes	no	Yes	little	Yes	No	No	
							quiet, dark environment	hot milk sometimes, or reading books		very much influenced	Yes	Yes	Yes	
							doesn't matter	no	Yes	no	No	No	No	very rare
							milk & light should milk be off	yes	strongly	Yes	Yes	No	No	studio at noon or afternoon
														右侧卧 , 双腿蜷起
12/13/2013 14:52:28	Female	18-25	designer	8 hours, 9 hours	6 hours	No								
12/13/2013 20:19:12	Female	18-25	student	8 hours	7 hours	No								
12/14/2013 1:47:35	Female	18-25	student in design and engineering	8 hours	6 hours, 7 hours	Yes								
12/14/2013 16:32:02	Female	18-25	Student	6 hours, 8 hours	6 hours	No								
12/14/2013 16:32:13	Female	18-25	student	6 hours, 7 hours	6 hours	No								