Fall asleep with Asleep

Asleep is a sleep tech solution company. We digitalize the sleep process by conveniently monitoring, accurately analyzing, and providing all-day care for user’s sleep.
Problem Statement

Worldwide Stats

Roughly 62% of adults worldwide feel that they don't sleep well when they go to bed.

(Source: World Economic Forum 2019)

Continuously increasing sleep-related diseases

- Serious sleep problems in modern society, social/economic costs are large, estimated to be $143 billion national economic losses in Easter Asia
- Sleep disorder patients (East Asia): 100 million people
- Medical expenses (East Asia): $1,430 million

Demand for equipment, lack of polysomnography

Number of sleep disorder cases increases, but massive equipment needed for the center to build, only in the main cities where there is no accessibility and the long waiting time required

After applying for the salary of a polysomnography -> # of people
- 2018 July -> 2020 Dec: 4.3X increase (East Asia)
- Average waiting time: 3-6 months (East Asia)

Average waiting time for the PSG

3-6 months

4.3X increase
Sleep Market Growth

Domestic and foreign sleep Market Size

- US: 45 Billion USD
- China: 38 Billion USD
- Japan: 9 Billion USD
- Korea: 3 Billion USD

World Market Size: about 120 Billion USD

In 7 years, sleep market: 600% market growth
### Competitors’ limitations

- **Bed type**
  - Simple sleep assistance function / absence of measurement and diagnostic technology

- **APP**
  - Incorrect measurement due to sensor limitations, low diagnostic precision, and only nighttime sleep intervention

- **Wearables**
  - Uncomfortable to wear during sleep

- **non-contact method**
  - Inaccuracy of sleep condition prediction, absence of breath measurement

  - Used only in hospitals due to the expensive unit price of sensors.

### Differentiation & Asleep Solution

#### Solution 1

**RF sensing based contactless sleep monitoring**

AI-based IoT solutions extract movements, heart rate, respiratory rate

![RF signal and Reflected RF signal image](image)

#### Solution 2

**AI based personalized sleep analysis**

- User A Data, User B data ->
  - User A diagnosis, User B diagnosis

![User A and User B Data flow](image)

#### Solution 3

**day-time to night-time entire sleep hygiene management**

- Using personalized data to provide daily sleep hygiene management

![Sleep hygiene management and Sleep inducing by step diagnosis icons](image)
Asleep’s contactless sleep monitoring device operating principle

**Principle**
RF signals radiated in the air by the transmitter are reflected in the human body, reaching the receiver. The RF signal reflected in accordance with the human body's motion will vary the propagation path. The receiver can analyze this signal to measure the movement of the human body.

**Result**
A person's breathing incurs the thoracic and abdominal movement. The RF signal's amplitude and phase are affected by the movement, and thus by analyzing the received RF signal, we can measure the person's breathing pattern.

Asleep’s IoT research on contactless sleep monitoring device

**Wi-Fi-based RF sensing technology developed for a contactless sleep monitoring device**

Wi-Fi (802.11 g/n/ac/ax) with OFDM extracts channel state information (CSI) which reflects the wireless channel experienced by radiated OFDM signals.

**CSI represents amplitude attenuation and phase difference**
- A person's general movement causes a significant change in the channel, resulting in a change in amplitude detected over a certain threshold.
- A person's chest or abdominal movements cause phase difference in the signal's reflex path, and this cycle can be analyzed to extract breathing patterns.

**Asleep's Wi-Fi-based contactless sleep monitoring is convenient and accurate**
- Affordable cost of making Wi-Fi-based solutions for other technologies.
Asleep’s operating principle of artificial intelligence-based sleep diagnostic software

AI sleep stage breathing and movement pattern reading diagnosis
If the autonomic nervous system recovery has been associated with deep sleep that the autonomic nervous system is stabilized
Breathing is responsible for the autonomic nervous system, and the deeper the sleep, the autonomic nervous system is recovered and stabilized
REM is the state in which the muscles are paralyzed and physical movement is dramatically decreased
The deeper the sleep, there is less movement. Stable autonomic nervous system leads to regular breathing patterns

Breathing and movement features of each sleep stage
Wake - breathing aperiodic / body movements high
REM - breathing periodic / body movement none
NRM - breathing very periodic / body movement medium
*breathing is deeply related to the autonomic nervous system

<table>
<thead>
<tr>
<th></th>
<th>Wake</th>
<th>REM</th>
<th>NREM</th>
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<tr>
<td>Upper airways resistance</td>
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<td><img src="image2" alt="Graph" /></td>
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<tr>
<td>Body movement</td>
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<td><img src="image5" alt="Graph" /></td>
<td><img src="image6" alt="Graph" /></td>
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<tr>
<td>Non-respiratory sounds</td>
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<td><img src="image8" alt="Graph" /></td>
<td><img src="image9" alt="Graph" /></td>
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<tr>
<td>Breathing pattern periodicity</td>
<td><img src="image10" alt="Graph" /></td>
<td><img src="image11" alt="Graph" /></td>
<td><img src="image12" alt="Graph" /></td>
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Asleep’s AI research on artificial intelligence-based sleep diagnostic software

Automated sleep staging Artificial Intelligence Research through artificial neural networks like TCN and LSTM that process time series data
Sleep-level auto-READ Artificial Intelligence using EEG / EMG / EOG signal = accuracy 85%
Polysomnography Abdominal respiration-based sleep stage readings AI = accuracy 70%

Artificial intelligence-based sleep diagnostic software research

Sleep stage diagnosis
Sound-based sleep diagnostics and artificial intelligence
Sound in breathing and movement patterns to extract
high precision RF-sensing-based sleep diagnosis artificial intelligence

Sleep disorders diagnosis
Obstructive and Central sleep apnea
RF sensing & sound sensor fusion diagnostics

World’s highest Asleep AI accuracy
PSG steps
AI prediction
Accuracy 80%
Personalized sleep hygiene management

With AI-based IoT solutions, Asleep provides personal sleep hygiene management both day-time and night-time.

**Maintain body enhancement for sleep**
- Nap after awake for 8 hours
- Keep your sleeping time constant
- Take a shower within 2 hours of bedtime

**Sleep loss factor avoidance**
- Melatonin Care 6 hours before bedtime
- Don’t consume food within 3 hours of sleep
- Create an optimal sleep environment

**Circadian parameters adjustable**
- Regardless of the bedtime, set a constant wake time
- Even if waking up in the middle of the sleep, don’t be exposed to light
- Get some sunlight after 30 minutes of wake time

Asleep Application

Today's Sleep Analysis
You are in a quality sleep.
- 75%
- 7 hours
- High
- Sleep quality
- Sleep hours
- Regularity

How many hours do you sleep on a daily basis?
1. Less than 4 hours
2. 5 to 7 hours
3. 7 to 8 hours
4. 8 hours or more

Sleep Habit Alarm
- Daily
- Weekly
- Monthly

Abdominal Breathing
- Fall into a peaceful sleep with abdominal breathing, a comfortable breathing method
- Forming the basis of good sleep
- Let’s get started with abdominal breathing
History/Accomplishments

2020.06  Asleep Corporation Established / KAIST ES program main entry and completion

2020.07  Korea’s largest Sleep Center for Seoul National University Bundang Hospital and joint research and collaboration, the Advisory concluded Seoul Asian Hospital for transfer of technology-based cooperation and domestic AI voice analysis challenge ranked 1st out of 400 teams

2020.08  Non-contact sleep measurement, prototype development, completion and artificial intelligence-based sleep analysis solution development complete. Collaborated with Korea’s most credible insomnia specialist, Kosleep Counselor Shin Hong-bum, director of internal cooperation

2020.09  2 source technology patent complete

2020.09  Kakao Ventures seed investment

2020.09  Selected digital CES 2021 Eureka Museum

2020.10  Hanwha Life open innovation decision

2020.10  Selected as one of Top 10 companies for Korea’s most influential digital healthcare company

2020.10  2 additional Source technology patent applications

Team AI

- CART-4 artificial intelligence-based atrial fibrillation diagnostics ring type device
- Robovolt Golf cart and ESS lithium battery failure and fire prediction artificial intelligence
- NAVER search engine keyword search improved for enhanced learning based on the core keyword navigation
- Poweron commercial power use data-based sales or opening and closing visual prediction services

Team IoT

- Korea Research Foundation academic research paper excellence recognition at the International Conference ACM MobiCom, MobiSys, SenSys, ACM/IEEE IPSN
- IoT scheduling Protocol development
- Backscatter communication system development
- For IoT heterogeneous communication system development
- Samsung Electronics main domestic largest papers subject to human Tech in the silver award, Bronze Award

Team Strategy / Planning

- Attorney remote legal Advisory start-up representatives and platform building and marketing
- United States San Francisco gym sharing startups Copa-dow rider platform build and business
- Artificial intelligence-based battery bad detection solutions business channel progress
- Medical devices of Channel variety and one life, Anan Medical Center Bundang Hospital, such as medical channel build
- KAIST tech day / CES 2021 / build promotional channels for medical devices including multiple media impressions