*A****bstract— <placeholder>***

**Sleepify: A system towards personalizing and optimising sleeping environments**

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# Introduction

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# Sleepify’s Promise

This project aims to provide a better sleeping experience overall from having the room temperature automatically adjust to body and room temperature information from two sensors. Sleepify also promises improved performance and improved machine learning classification accuracy based on prolonged usage of the app. Continued usage of Sleepify is especially important for our machine learning algorithms; the average retention rate of mobile applications falls to around 15-20% after two weeks [5]. Lastly, Sleepify promises to deliver a slick and intuitive app, and web interface for the user to use and interact with, again motivating the user to continue using Sleepify regularly.

# Related Work

There are many sleep trackers on the market that use a variety of ways to track sleep quality. Most sleep trackers monitor the user’s different stage of sleeping, sleeping environment and provide sleep coaching advice. Majority of the trackers are found in the form of software application for iOS and Android. These applications use the accelerometer found in smartphones to track body movement throughout the sleep cycle. Using this data, “Sleep Cycle” wakes the user up during the lightest sleep phase, preventing the feeling of tiredness in the morning. In addition to the accelerometer, “Sleep as Android” [1] records audio through the microphone to detect snoring, speech, and ambient noise. This can be played back to the user the following morning, and can be a good indicator of sleep disturbances and stress [2]. Additionally, some applications also include the feature of playing soothing sound or music to make the user fall asleep peacefully.

Hardware sleep trackers such as “S+ By ResMed personal sleep solution” contain even more features, such as synchronizing the output music with the respiratory pattern of the user to provide a calming effect [3]. Another interesting feature by “Aura Smart Sleep system” includes a red light to induce the user into sleep [4]. “Sense” has a slow wake up light alarm to gradually wake the user up. Most of the aforementioned also have questionnaires for the user to record their daily behavior to help analyze their sleeping pattern.

However, some of the down sides of these applications include inaccuracy in telling whether the user is just lying in bed or actually sleeping. Some drain the battery of both the device or the phone quickly. Some of the applications lack a snooze alarm function.

Sleepify has taken into account the pros and cons of these existing sleep trackers in the market when prioritizing its aims. In addition to the generic functions such as sleep coaching advice and sleep environment monitoring, it has taken an active role to provide a novel edge to sleep tracking - adjusting the sleeping environment. Sleepify analyses the best sleeping temperature and connects to smart heating devices to adjust the optimum sleeping temperature automatically. Manually changing the start time of the sleep record would also be enabled to prevent the problem of false sleep detection.

# System Design and Implementation

## Overall High Level Design

Sleepify consists of a front-end and a back-end, each consisting of two parts. The front-end is what the user sees and uses, and consists of an iOS application and the web interface. Additionally, this front-end connects to the sensors for data collection and temperature adjustment. The back-end consists of the databases, APIs, and machine learning modules – these both provide, and accept information from the front-end applications.

## Sensors

## Backend (Database, API)

## Machine Learning

## iOS Application

## Web Interface

# Evaluation Criteria and Setup

# Results

# Discussion

# Conclusion

In conclusion, this report highlighted the motivation behind in building a system that is capable to alter the users thermal sleep environment to achieve better sleep quality. We have identified that the thermal environment is a key factor in affecting sleep quality, this justifies our rational in controlling this factor in order to provide better sleep quality to users. We have discussed related works, however to the authors’ knowledge there is no work that has developed a complete system to alter sleeping environments. Finally, we have also presented some of our prelimiarly works.

# References

[1] U. Team, *Sleep as Android Unlock*. Urbandroid Team, 2016.

[2] M. M. Ohayon and C. M. Shapiro, ‘Sleep disturbances and psychiatric disorders associated with posttraumatic stress disorder in the general population’, *Compr. Psychiatry*, vol. 41, no. 6, pp. 469–478, Nov. 2000.

[3] ‘S+ by ResMed’. [Online]. Available: https://sleep.mysplus.com/. [Accessed: 01-Feb-2017].

[4] ‘Withings’. [Online]. Available: https://www.withings.com/uk/en/products/aura. [Accessed: 01-Feb-2017].

[5] ‘Can Push Notifications Really Help App Retention? Find Out.’, *Leanplum*, 24-Oct-2016. .