Context-aware wakeup system

For adults, the average sleep time should range from 7-9 hours. During this time the sleep cycles from deep sleep to lighter sleep. With this context-aware wakeup system, we want to time the user's waking up time to the point when the user is experiencing lighter sleep making waking up to the morning activities easier. Figure 1 shows how the sleep cycles between the lighter sleep and the deeper sleep and the potential times when the user could be woken up.

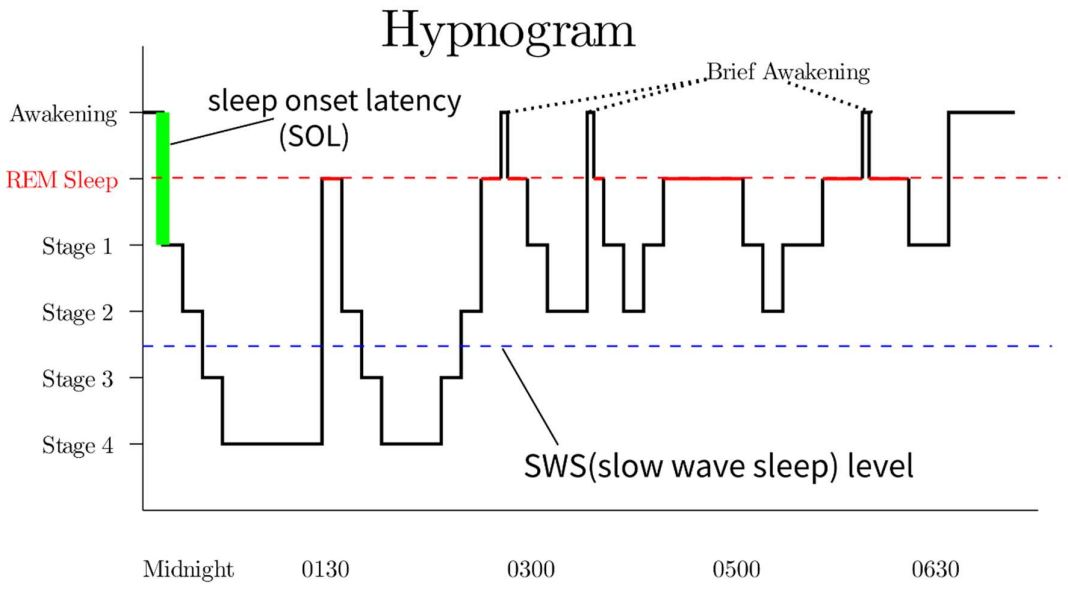

Figure 1 Sleep levels during the sleep (Wikipedia)

The system

The system contains smart lights, automated window curtains and an application, which tracks the user in multiple ways. Items such as the smart pillow or the smart bed could be implemented to track the user's state of sleep. Also, other wearable sensors, such as smart ring, or smart watches can be utilized in the future for example heart rate tracking. However, at this point of the design process, we utilize sensors available within the phone. Figure 2 shows the configuration of the system. In this system, the lights and the automated curtains are controlled by the application. Mobile phone is intended to be in the charger during the night, however, if the user forgets to plug in the charger, the system will drive in the battery-saving mode and use the sensors more carefully.

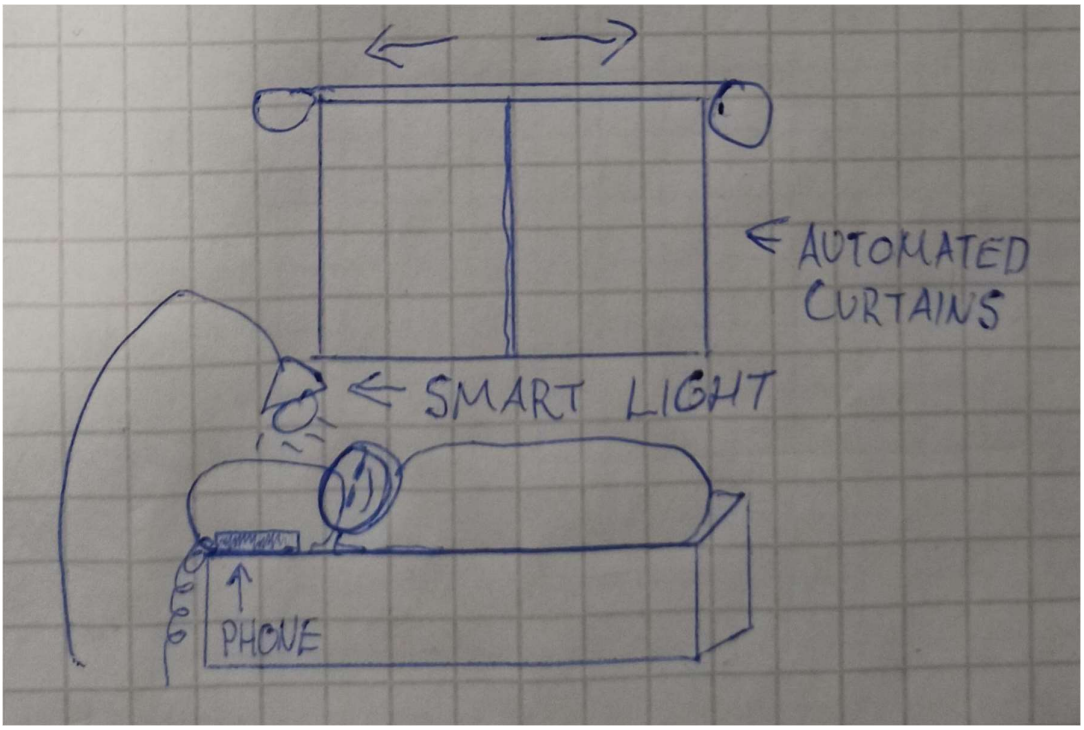

Figure 2 System configuration

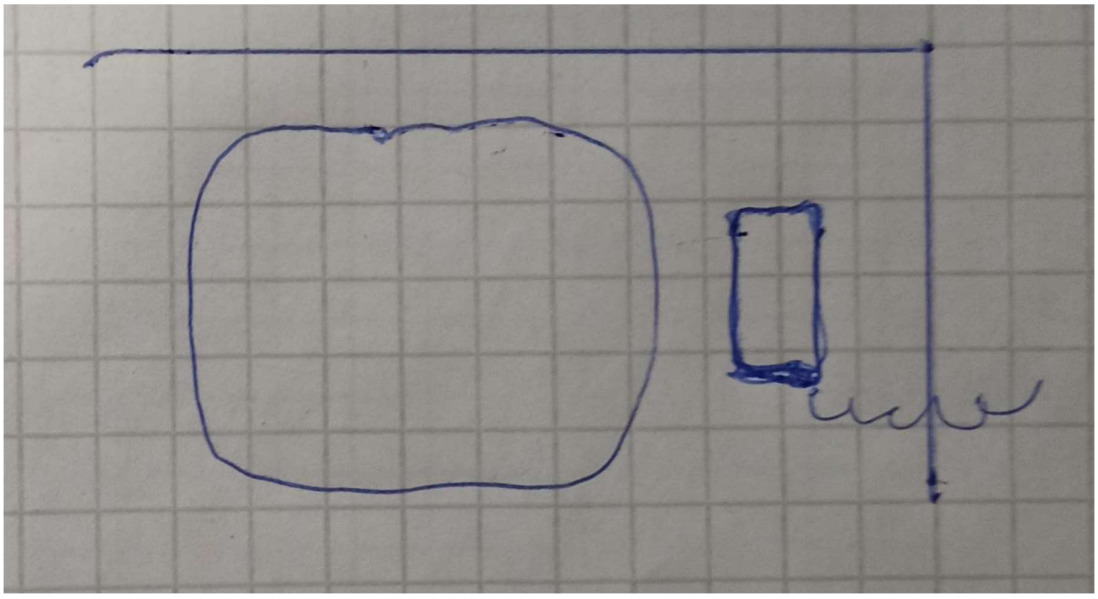

Figure 3 Location of the mobile phone

Case 1 – Going to sleep

The system detects when the user is going to sleep by detecting the connection to the other parts of the system while considering the time of the day and the earlier set time when the user has to be woken up. At this point, the system pops up a notification to the

mobile phone to confirm the alarm time. The example of the notification is presented in Figure 4. If the alarm time is not set, the system sets automatically the wake-up time from the point when the user falls asleep to 7-9 hours ahead. The curtains are automatically closed by the system in the evening if the user has set so. If not, the user can do that manually via the application. The user sets the phone next to the pillow as Figure 3 presents.

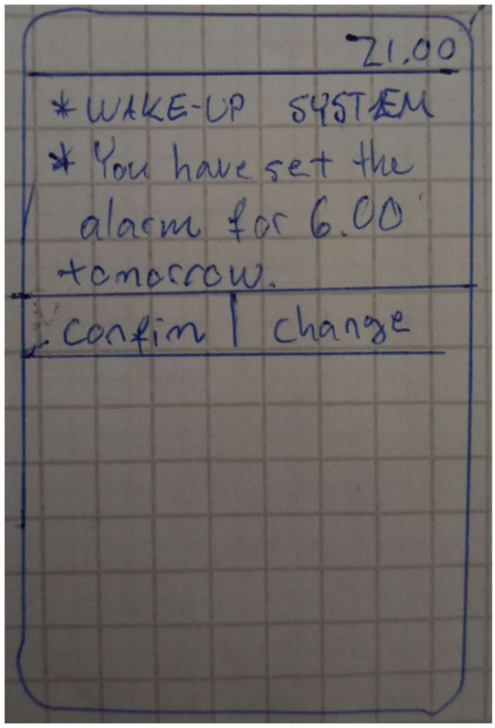

Figure 4 An example of the notification which is presented to the user when the user is near the bed around the expected time of going to sleep

Case 2 – Monitoring the sleep

The application tracks users' body motion in the bed via the accelerometer, the sounds the user makes via the microphone, and the lighting of the room via the ambient sensor (for example the lights if the user is reading something or lights caused by the television/other device). Based on the values given by this combination of sensors, the system detects when the user has fallen asleep. In other words, when there is not too much body motion, the user has set all the lights off and no noises. Now the system records the user's activity during sleep.

Case 3 – The waking up the user

The system will predict the point when the user is in the state of the light sleep near the wake-up time. At this point, the smart lightning will lighten up the room increasing the intensity of the lightning step by step and the curtains will open to give some natural lightning (if available). The system saves the data of the user's activity during sleep, the

sleep duration, and noises during sleep. The user is able to see how much the user sleeps on average during the night, and the system will encourage them to sleep more if the weekly average is less than required for healthy sleeping. Figure 5 gives an example of the recorded data from a night. From this data, the application shall learn more about the users' sleeping patterns and therefore be able to provide even better wake-up services to the user.

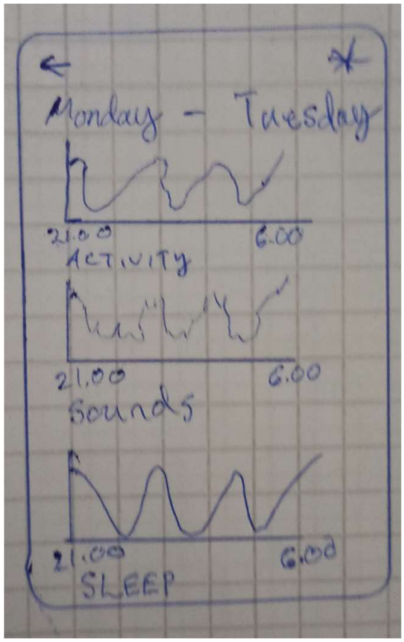

Figure 5 Example of the data that the application saves