

MOON APP: SLEEP IMPROVEMENT THROUGH DREAM LOG ANALYSIS

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Keywords

Invision Studio,
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Abstract

The current research on m-health shows a poor quality of sleep in Portugal. This paper presents the development of a high-fidelity visual prototype of a mobile application — Moon App — that aims to improve the user's sleep through self-assessment. Developing it was the result of our concern surrounding the lack of sleep being experienced in today's society. The app intends to offer both informative and practical content, and also to promote a self-analysis of the user sleep performance. By establishing a connection between the users' dreams or nightmares, and the overall quality of the sleep. Considering these goals, the features were defined with the objective of giving the user a distinct experience in the fields already mentioned. The methodology adopted consisted mainly of an User-Centered Design approach to software development and evaluation: an initial analysis of the state of the art of other mobile applications within the sleep domain; exploratory data-gathering interviews with end-users; the information collected was used for the development of the features, based on a persona and scenarios of use; and finally we've conducted usability tests on the prototype, with a total of 10 participants in order to evaluate and understand the efficiency of the features and to evaluate possible weaknesses. The feedback of the dream log and the calendar features implemented was positive. The majority of users would use these features to register their dreams, share them with friends and use the log to self-access their sleep quality history. The results from the prototype evaluation point to the relevance of using a mobile app for the self-analysis and personal improvement of each person's health, specifically through the promotion of better sleep.

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1. Introduction

1.1. m-Health

In the matter of M-Health, Prof. John Orzechowski, clinical assistant professor at UIC, tells how “Mobile Health continues to reach heightened interest levels and activity across the globe”. He says that, “its solutions hold the promise to provide new, innovative care access and delivery models that produce better outcomes, and that M-Health is being viewed increasingly by many as an important technology metaphor to achieving a patient-centric paradigm change.” (Orzechowski, 2014)

1.2. Sleep/Sleeping habits today

A survey made by *Deco Proteste* (DECO, 2016) verified some concerning numbers about the common sleeping habits of the Portuguese: two-thirds responded that, on average, they didn't have a good night of sleep. These numbers have duplicated since the last survey made by the same source back in 2004, which reveals a tendency of worst sleeping habits by the Portuguese in 12 years. These habits seem to progressively affect the daily life and routines since 4 in 10 answered that the lack of sleep made them experience concerning somnolence that influenced their productivity and increased risks of accidents (Garbarino, Guglielmi, Sanna, Mancardi, & Magnavita, 2016). These tendencies, verified globally, need to be treated as a major global problem since the lack of sleep is not only associated with short-term negative effects such as accidents and illnesses but is also associated with a decrease of the general well-being.¹ The quality of sleep and the nightmare frequency have a direct relationship to well-being (Blagrove, Farmer, & Williams, 2004).

In 2019, a survey published by the Portuguese newspaper *Público* revealed more recent statistics concerning these matters (Mendes, 2019). In this article, the pulmonologists Susana Sousa and Sílvia Correia explain that even with the increasing awareness of the connection of bad sleeping habits with diseases, most people don't attribute to healthy sleep the same importance as to healthy eating habits, or regular exercise.

With the statistics already mentioned, it leaves no doubt that this is an issue that needs to be tackled in the current young generations,

¹ In 2003, professor and dream researcher Allan Hobson explain that even when humans dream, the brain is active. Through experiments he defends that understanding how we create dream's narratives helps to understand the nature of consciousness and that dreams offer insight into humans waking lives. His research focuses not only on the dream's story itself but also in correlation with dreamer's daily life experience.

as this problem will aggravate in the future. There is a necessity of raising awareness for better sleeping habits and studies surrounding the sleeping matter.

1.3. Moon: a concept application

The Moon application gives the user exercises and instructions for a better sleep routine. It explores the possible connections between our dreams and the quality of our sleep. The goal is to context the theme throw an analysis in order to provide an insight able to contribute to the development of the app and future advances. (Hobson, 2003). Here, the developer team, being only specialized in Design, haven't searched for a scientific approach, but have given priority to designing the user experience in the development of a self-analysis tool for the users' sleeping health. The app presents three main features: a) the first presents exercises and instructional plans to the users, aiming to promote better sleeping habits; b) the user is invited to record/track his dreams in a dream log in order to promote a deeper insight on his dreams; c) the final overall dream log activity can be viewed or reviewed in a global calendar.

In a first approach to the theme, a search was conducted on the Google Play Store, to understand what the market had to offer in the M-Health/Sleeping area. After choosing three key applications², the aim was to study the features already accomplished by those apps and see what it would offer to the user. A final app was chosen to serve as a study case. Interviews with *Shleep*³ users were made to understand what strengths and elements could be improved in a future app. This also allowed for the development of the personas, scenarios and the development of original features in a User-Centered Design approach (Cooper, Reimann, Cronin, & Noessel, 2014). Then the steps to develop *Moon* were presented through those interviews, which resulted in the present prototype application. To evaluate the usability of the app, two separated sessions with potential *Moon* users were developed. This was essential to test these features and understand what the user needed.

2 The choice criteria of these key applications was based on the availability to test, considering their potentiality in further analysis.

3 Mobile application. Available online on: <http://shleep.com/>

2. State of the art in sleep monitoring mobile applications: an analysis of three study cases

In terms of the digital applications universe⁴, mostly directed to the sleeping area, a considerable number of apps were found in which the aim was to improve and control the user’s sleep. The three selected apps present different characteristics and each one has qualities that we considered in the conception of *Moon*. The cases or applications referred are *Pzizz*, *Sleep Town* and *Shleep*. The following images (Figure 1) illustrate each one of them.

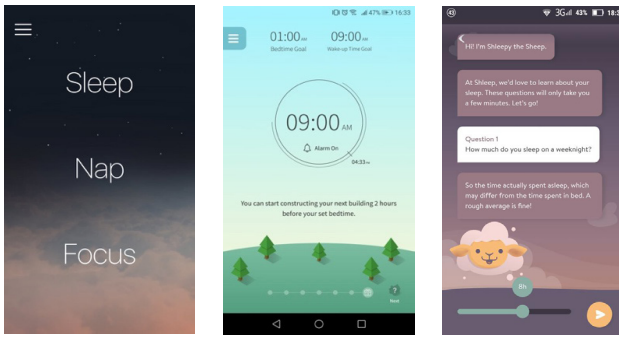


Fig.1 Pzizz⁵, Sleep Town⁶, and Shleep applications main screen (from left to right).

After initial analysis of the online information and initial testing of the apps in the mobile environment, we’ve compiled a SWOT analysis (Table 1)

Table 1 Features analyses of the applications studied (SWOT).

	Pzizz	Sleep Town	Shleep
Strengths	Main feature audio; No need to have direct contact with the device during the use of the app.	Helps to control the electronic device's use during sleep hours; Use of the app like a game (levels).	Audio as one of the features; Offers both practical and informative content.
Weaknesses	Limited content; Doesn't offer informative content.	Doesn't offer informative content;	Doesn't offer rewards for completing the steps; Colors too bright to use at night hours.
Opportunities	There is a demand for apps that help the user to relax.	People use electronic devices in their bedroom and at night hours.	People suffer from irregular sleep schedules.
Threats	Other relaxation practices that do not require or avoid the use of electronic devices.	Other applications that offer a vaster content (informative and practical).	The idea that electronic devices are negative influences on sleep habits.

4 We've searched Google Play using the keyword "sleep". In the first 50 results, 24 applications used audio for sleep improvement. And with the search word "dream" in a sample with the same amount of results, we identified 4 applications that have a connection with sleep and 1 that presents a dream journal.

5 Available online at <https://pzizz.com>

6 Idem at <https://sleeptown.seekrtech.com>

After the analysis and use of the three applications, *Shleep* was the app chosen as a case of study. We've selected and conducted 13 interviews with users of this app. All the information collected until this point was used to plan how *Moon* could answer the real user's needs, using the strengths of the applications studied and minimizing their weaknesses. The first feature presented is the center of the app — the sleeping plan. It consists of different plans of audio with informative and practical content (each plan presents a different theme). To avoid direct contact, distract, or excite the user in relaxation times, the device's screen is turned off once the user starts to listen to the audio. Every time the user finishes a plan he or she gets a badge. This gamification element presents a way to motivate and promote the constant use of the app (Lister, West, Cannon, Sax, & Brodegard, 2014). The badges come in the form of characters with distinct personalities. Another main feature is the dream log. Resembling a diary for dreams, users can also share it with friends. This feature allows the user to classify his dreams or nightmares. Then this information is presented in the calendar which allows for the user to compare in a temporal scale the periods in which more dreams or nightmares were registered.

3. Development & evaluation of Moon: a high fidelity interactive prototype in Invision Studio

From the data gathered in the initial research and interviews, we knew that the persona's goals consist of sleeping better and at a regular schedule. The persona also aims to feel more energetic to complete the tasks that are asked of him during the day. Having trouble to fall asleep the persona feels that anxiety and stress may be influencing negatively his sleeping hours. The main occasion for the persona to use the app it's at the end of the day, specifically before turning in to bed. Another possible use case scenario is in the morning, after waking up, this way the persona can register the dream(s). Having this persona's desires, needs and behaviors as a primary target user in mind, the app's system architecture and visual design were developed (Figure 2).

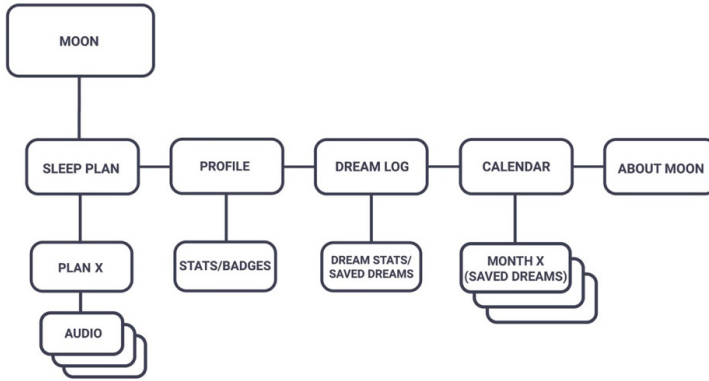


Fig.2 Application structure, *Moon* sitemap.

3.1. Main Features & Prototype

From the state of the art review and through the studies made, the main features of the app were implemented to then be tested with users. One of these features, already presented, is the sleeping plan that works along with the badges. Through the study of other applications, it was decided to encourage motivation and so the badges represent distinct characters so that the user would want to collect a specific one. The dream log is another important feature. It was developed to correlate the dreams and nightmares in a personal dreams’ archive. The calendar was thought of so that the users could perceive visually their dreams/nightmares through different periods of their life’s. These three features can be engaging to the user experience and can also allow a self-evaluation. Keeping in mind the study cases, it’s intended for *Moon* to be capable of providing informative content but also entertainment to the user.

Fig.3 High fidelity visual prototype of *Moon*.

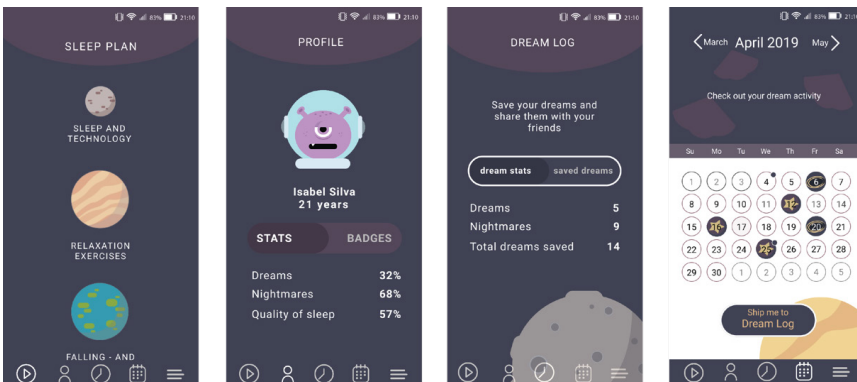




Fig.4 (top) High fidelity visual prototype of *Moon*: Audio Task

Fig.5 (center) High fidelity visual prototype of *Moon*: Dream Log

Fig.6 (bottom) High fidelity visual prototype of *Moon*: Calendar

3.2. Usability Evaluation

A primary analysis of the initial 13 interviews of the apps analyzed revealed that most of the people who were interviewed had irregular sleeping habits and the belief that if they could improve sleeping habits it would also improve their health.

Moon is a high-fidelity visual prototype designed and implemented in Invision Studio. After a primary analysis of the mobile prototype app, concerns were identified and required clarification during the usability tests, such as the possibility to rearrange the visual sequence of the audio clips to provide easy flowing progress. It was necessary, as well, to prove whether or not the user found interest in consulting the badges from the feature dream log, and also if verifying, consulting and adding dreams were eligible tasks through the dream log and the calendar.

The usability tests of the prototype Moon were conducted in two sessions, each with five participants following the guidelines proposed by Rubin & Chisnell (2008) in a classic “one on one” usability evaluation test session. The participants were students and student-workers, with ages ranging 20 to 44 years old. The tests took place, in a controlled academic environment for all the participants.

The interviews were conducted using a structured script, designed in advance. It started with a brief introduction to the subject matter, in which every participant consented to be recorded and filmed for the purposes explained.

Using the “thinking aloud” technique suggested by Rubin & Chisnell the participants were invited to share their thoughts throughout the usability tests in order to supply a further insight of the experience and to correlate it with the observed behavior.

The usability tests were conducted upon three distinct scenarios, each one corresponding to a specific group of tasks matching the features in analysis. The tasks goals and respective scenarios were described to the participants equally and beforehand. Each session was held individually and lasted, approximately, fifteen minutes each, followed by a debriefing session interview and SUS Questionnaire (Brooke, 1996).

4. Results & Discussion

The first batch of usability tests provided a significant upgrade to the prototype. While allowing the developers to compare one session to another, it became clear that not only were the improvements necessary, but they also allowed verifying that the concerns related to the first session were suppressed.

Analyzing the data collected from the global usability tests it is possible to confirm that the progress of the three features impacts the way participants engaged with the app.

Through the badges, it was expected to encourage the participant's curiosity by describing badges or characters. The users were asked to explore this feature and, at the first session, the average time spent on this task was 1: 08 minutes while at the second session there was an increased average time of 1: 40 minutes. This happened because the guidance on the second session was null, this factor gave us a hint about the accessibility of the badges collected, as Participant X hinted:

I really like the illustrations, I am going to explore everything

A further improvement would be a button who leads the user (after finishing a plan) directly to the badges.

During the first test, the calendar presented constraints regarding the navigation of one month to another with a swiping action as all of the 5 participants referred. This interaction was changed to a simple tap interaction and tested. In the second usability test, none of the participants referred to this as an issue. The calendar proved to be a way of self-evaluation of sleeping habits useful to provide data related to the participant own life, as Participant Y mentioned out loud:

(...) to have a notion of how you are mentally and create a connection with other things in life.

So far, the results of the usability tests revealed that the prototype is on the right path, aware that there is yet much work to do and feeling positive about directions for further development.

5. Conclusion

The *Moon* app's first steps were accomplished by the study cases of apps highly presented on the market. Observing those features determined what would be best to implement on an app concerning sleeping habits, it was a goal to use the strengths of the apps studied and minimizing their weaknesses.

Following those premises, we created *Moon* with its focus on improving the quality of sleep of the users and providing an opportunity for the user to study the possible connections of their dreams and sleeping habits.

The two sessions of usability evaluation were significant to evaluate the user overall experience and validate the relevance of the features developed for the end-users. The feedback provided in the usability sessions was positive on key features like the dream log and calendar. Users have also shown curiosity and the motivation to engage in a self-analysis of their own dreams while saving and sharing them with close ones. The tests revealed some weaknesses on the navigability of the app that soon was improved upon to favor the overall users' experience.

We believe that it will be necessary for future studies to establish a long-term positive effect on the continuous use of such an app. Further usability tests will also be necessary since the short time provided wasn't enough to shape a strong view of the features mentioned above. And, if the concept proves valid and relevant in the present national/local context, this mobile app should be developed as a fully functional mobile application either in native code (such as Java or Swift for Android or iOS) or in device-independent hybrid Web technologies (HTML, CSS & JavaScript packaged with development frameworks such as Cordova or PhoneGap).

Although this mobile application concept has been developed to improve the users' well-being through dream analysis, we believe that this architecture of self-awareness through logs, insights through calendar visualization, and motivation for the positive reinforcement through gamification elements such as badges can be applied to other areas such as learning or physical exercise. Nevertheless, the development of the *Moon* app aims to, in the future, work more profoundly on the sleep-dream connection, to study a part so abstract of the human essence.

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References

- Blagrove, M., Farmer, L., & Williams, E. (2004). The relationship of nightmare frequency and nightmare distress to well-being. *Journal of Sleep Research*, 13(2), 129–136. <https://doi.org/10.1111/j.1365-2869.2004.00394.x>
- Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability Evaluation in Industry*, 189(194), 4–7.
- Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About Face: The Essentials of Interaction Design* (4th ed.). Indianapolis: John Wiley & Sons, Inc.
- DECO (2016). *Mais de 60% dos portugueses com problemas de sono*. Disponível em: <https://www.deco.pt/proteste.pt/casa-energia/dormir/noticias/mais-de-60-dos-portugueses-com-problemas-de-sono>
- Garbarino, S., Guglielmi, O., Sanna, A., Mancardi, G. L., & Magnavita, N. (2016). Risk of Occupational Accidents in Workers with Obstructive Sleep Apnea: Systematic Review and Meta-analysis. *Sleep*, 39(6), 1211–1218. <https://doi.org/10.5665/sleep.5834>
- Hobson, J. A. (2002). *Dreaming : an introduction to the science of sleep*. Oxford: Oxford University Press.
- Lister, C., West, J. H., Cannon, B., Sax, T., & Brodegard, D. (2014). Just a fad? Gamification in health and fitness apps. *JMIR Serious Games*, 2(2), e9. <https://doi.org/10.2196/games.3413>
- Mendes, F. (2019, Março 1). Quantas horas dorme? Menos de seis horas é a resposta de 46% dos inquiridos num estudo sobre o sono. *Público*. Available online at: <https://www.publico.pt/2019/03/01/sociedade/noticia/portugues-25-anos-provavel-durmal-1863854>
- Orzechowski, J. (2014) *Why is mHealth Important?* In *MS in Health Informatics & BS in Health Information Management Blog*. Consulted in 22nd June, 2019. Available online at: <https://healthinformatics.uic.edu/blog/why-is-mhealth-important>
- Rubin, J., & Chisnell, D. (2008). *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests*. Indianapolis: John Wiley & Sons.

