

# **ShwasAR: An Interactive Augmented Reality-based Mobile Application for Stress and Anxiety Management**

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### **Abstract**

In today's fast-paced world, stress and anxiety have become very common problems, affecting the health and well-being of people across all age groups and professions. While many methods exist to manage stress, they often fail to keep users engaged, leading to inconsistent practice and limited benefits. To address this issue, we have developed ShwasAR, an innovative mobile application that uses Augmented Reality (AR) and a gamified reward system to make stress management an interactive and rewarding experience. The ShwasAR application works in a simple manner. The user first enters the main worry that is causing them stress. Based on this input, the app suggests a suitable breathing technique. During the exercise, the user is guided by a visual cue bubble that expands and contracts in sync with their breathing rhythm for six cycles. Upon successful completion, the user is rewarded with a virtual sapling. Using their phone's camera and AR technology, they can then plant this sapling in their own real-world environment, such as their room, and watch their virtual garden grow with consistent practice. To test its effectiveness, a study was conducted with 40 participants (20 males and 20 females) aged between 16 and 40 years. This group included school and college students, IT professionals, doctors, engineers, and housewives, representing a wide section of society. Participants were asked to use the ShwasAR app daily for 15 minutes over a period of 14 days. We used a pre-study and a post-study stress assessment questionnaire to measure changes in their stress levels. The findings showed a noticeable improvement in the self-reported well-being of the participants, suggesting that ShwasAR is an effective and enjoyable tool for managing the pressures of day-to-day life.

**Keywords:** Stress Management, Augmented Reality (AR), Mobile Health (mHealth), Breathing Exercises, Gamification

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## **Introduction**

In the modern world, life has become incredibly fast-paced and demanding. From the pressure of exams for a school student to the deadlines faced by an IT professional, and the daily challenges of a housewife, no one seems to be immune to stress and anxiety. It has become a primary factor affecting our daily lives, impacting people of all ages, from young teenagers to adults in their mid-career. This constant exposure to stress is not just a matter of feeling worried or tense; it can lead to serious health problems over time, affecting both our mental and physical well-being.

Many solutions are available today to help people manage their stress. These range from simple mobile apps that play calming music to more structured wellness programmes. However, a common problem with these existing solutions is that they often fail to keep the user interested in a long time. People might use them for a few days, but soon the novelty wears off, and they stop practicing. This is a major issue because consistency is the key to effective stress management.

Among the many techniques available, breathing exercises, also known as 'Pranayama,' in our ancient Indian traditions, are a scientifically proven and powerful way to calm the mind and body. The simple act of regulating one's breath can have profound effects on reducing stress levels. But if this method is so effective and easily available, why don't more people practice it regularly? The answer is quite simple: for many, just sitting and breathing can be a boring activity. It is not interactive, it is difficult to keep track of the breathing cycles, and there is no immediate sense of reward or accomplishment, which makes it hard for people to stay motivated.

Recognizing these challenges, we felt the need for a new approach—one that could make the simple act of breathing both engaging and rewarding. In this research, we present our solution: ShwasAR, an Augmented Reality (AR) based mobile application designed to transform stress management into an interactive game. We have developed a mobile app that not only guides users through various breathing techniques but also uses technology to make the experience fun. After completing an exercise, users are rewarded with a virtual sapling which they can plant in their own room using AR. This creates a sense of achievement and encourages them to come back every day to tend to their virtual garden. Through this research, we have developed and tested ShwasAR to see if such an interactive and gamified approach can truly help people manage their stress and anxiety in a more consistent and enjoyable way.

### **1. Literature Review**

The rising prevalence of stress and its negative impact on health is a topic of significant concern globally and particularly in India [1], [2]. The American Psychological Association has highlighted stress as a major public health issue, with studies showing its link to chronic diseases like

cardiovascular disorders and depression [3], [4]. In the Indian context, stress among students due to academic pressure and among IT professionals due to demanding work environments is well-documented [5], [6]. This establishes a clear need for effective, accessible, and engaging stress management interventions.

For centuries, breathing exercises, or *Pranayama*, have been a cornerstone of yogic practices for promoting mental and physical well-being [7]. Modern scientific research has validated these ancient practices, demonstrating that controlled, slow breathing techniques can effectively regulate the autonomic nervous system, decrease heart rate, and lower blood pressure, thereby reducing feelings of stress and anxiety [8], [9]. Studies by researchers like Zaccaro et al. have provided comprehensive reviews on how practices like diaphragmatic breathing directly impact psychological and physiological states [10]. The clinical effectiveness of various breathing techniques, such as the 4-7-8 breath and box breathing, in reducing anxiety has been confirmed in multiple randomized controlled trials [11], [12].

Despite the proven benefits of these techniques, their adoption remains low. The primary reason, as many studies on adherence to wellness practices suggest, is the lack of engagement and motivation [13]. Traditional methods are often perceived as monotonous and fail to provide the immediate feedback that modern users, especially younger ones, have come to expect from digital experiences [14].

To address this engagement gap, researchers have turned to technology. Mobile health (mHealth) applications have emerged as a popular medium for delivering mental wellness interventions due to the widespread availability of smartphones [15], [16]. However, many early-generation wellness apps were little more than digital timers or audio guides, and they still struggled with long-term user retention [17]. This led to the exploration of gamification—the use of game design elements in non-game contexts—to enhance user motivation. Research has shown that incorporating elements like points, badges, and leaderboards can significantly improve engagement in health-related behaviours [18], [19]. The use of reward systems has been linked to the brain's dopaminergic reward system, creating positive feedback loops that encourage repeated actions [20], [21].

More recently, immersive technologies like Virtual Reality (VR) and Augmented Reality (AR) have shown immense potential in transforming mental healthcare [22], [23]. VR has been successfully used to create immersive, calming environments for meditation and stress reduction [24], [25]. AR, on the other hand, offers a unique advantage by overlaying digital information onto the user's real world, making the experience more personal and integrated into their daily life [26]. A systematic review by Mitsea et al. highlights the growing interest in using immersive technologies for breathing interventions [27]. Studies have explored using AR for biofeedback and to create more

intuitive visual guides for breathing exercises [28]. Our work, ShwasAR, is situated at the intersection of these promising fields. It builds upon the established benefits of breathing exercises and leverages the motivational power of gamification and the engaging, interactive nature of AR to create a novel and effective tool for stress management that is accessible, affordable, portable, and, most importantly, interactive and rewarding [29], [30].

## **2. System Design**

To address the problems of low engagement and inconsistency in current stress management practices, we propose our solution, ShwasAR, an Augmented Reality (AR) based mobile application. Our contribution is a complete system that combines proven breathing techniques with modern interactive technology to make the process of managing stress not only effective but also enjoyable. We chose to develop a mobile application for several important reasons. Recently, almost everyone, from a young student to a working professional, owns a smartphone. This makes a mobile app the most accessible, portable, and affordable way to deliver a health solution. People carry their phones everywhere, which means they can use ShwasAR anytime and anywhere they feel a wave of stress or anxiety coming on, whether it's before an important exam, during a break at the office, or at home after a long day.

Our application is built around the core principle of breathing exercises. By integrating these powerful techniques into a mobile app, we make it easy for users to practice them correctly and consistently. But we knew that just having the exercises was not enough. To solve the problem of boredom, we introduced Augmented Reality. AR helps to make the abstract concept of breathing more concrete and interactive. Instead of just listening to instructions, users can actually see their breath in the form of a visual guide. This makes the exercise more engaging and helps them to focus better. Furthermore, the AR-based reward system provides the motivation that is often missing in other apps.

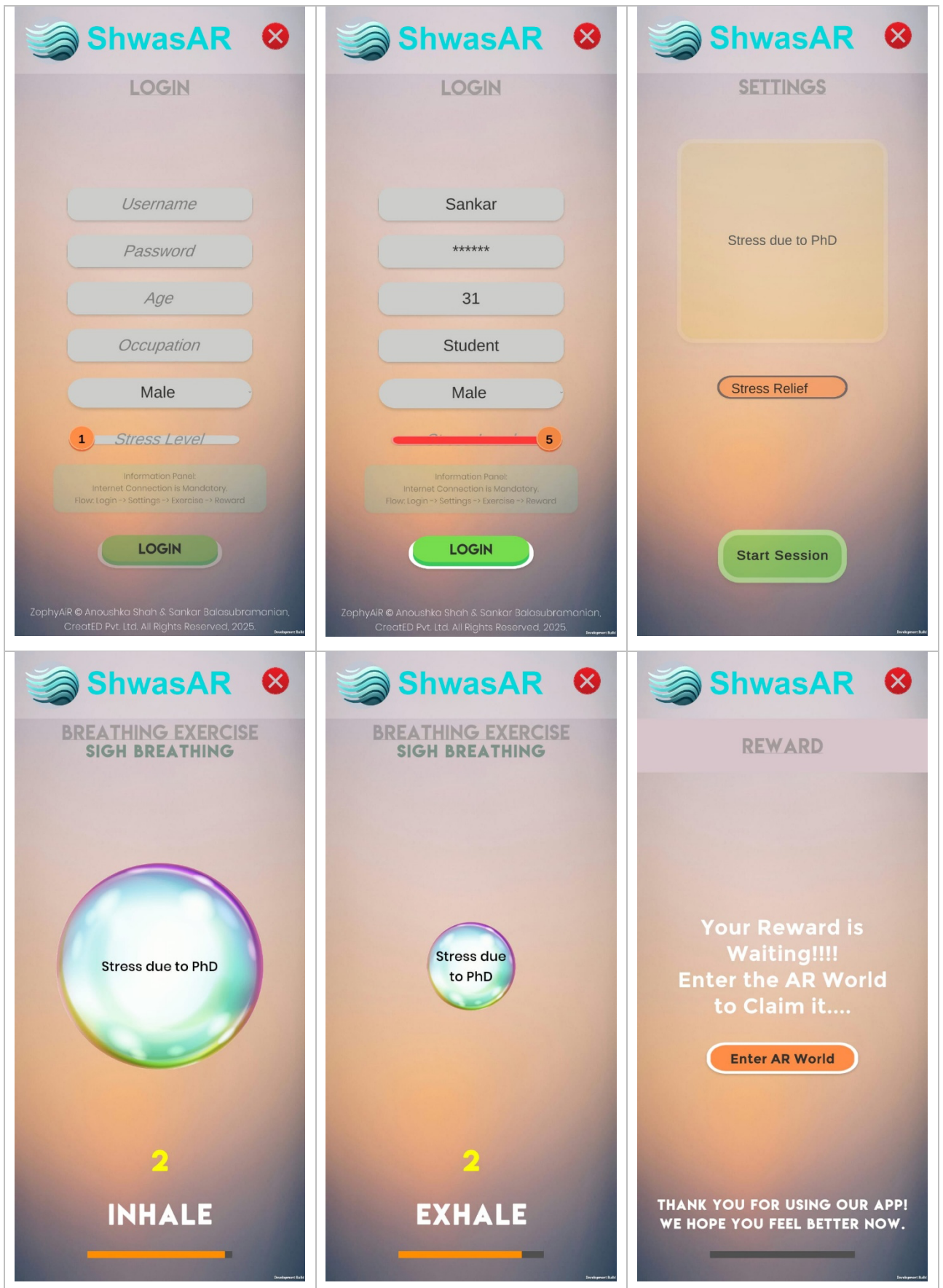
### **2.1. User Flow of ShwasAR**

We designed the ShwasAR application to be very simple and intuitive, ensuring that using it is a calm and stress-free experience. The entire process, from opening the app to completing an exercise, was designed to be a smooth and logical journey as shown in Table 1.

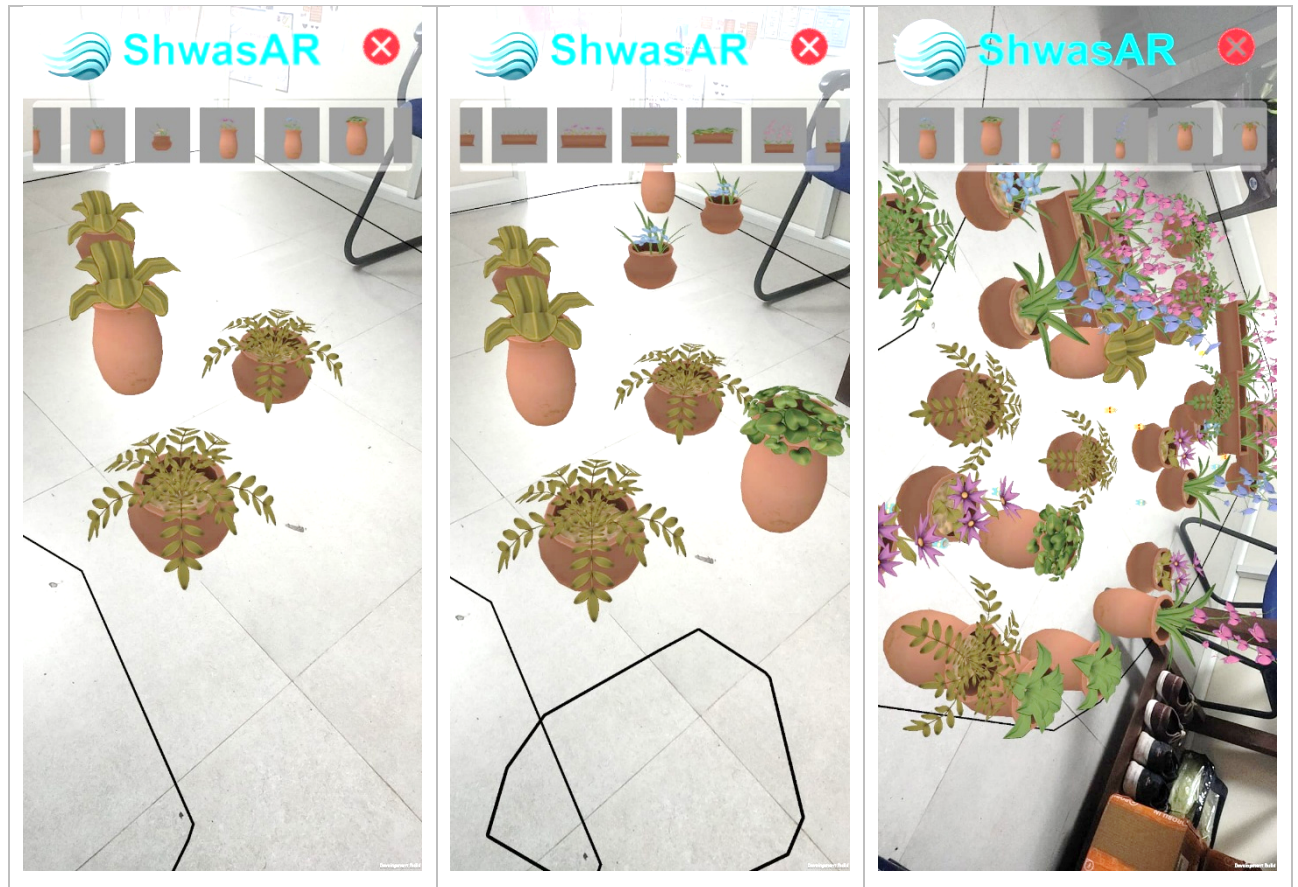
- **Greeting and Expressing Worry:** When a user first opens ShwasAR, they are greeted with a welcoming screen. The first step is to enter what is currently worrying them or causing them stress. This could be anything from "exam pressure" to "work deadline" or "family problems." This step is important because it helps the user acknowledge their stressor, which is the first step towards managing it.

- **The Breathing Exercise Phase:** After the user enters their worry, the app suggests a suitable breathing exercise. We have included a variety of scientifically backed breathing techniques in the app, such as the popular 4-7-8 Breathing for stress relief, Box Breathing for focus, and Diaphragmatic Breathing for deep relaxation. Once the exercise begins, the main screen shows a large, calming bubble. This bubble serves as a visual guide, slowly expanding as the user needs to inhale, holding its size to indicate the hold period, and then gently contracting to guide the exhale. This visual synchronisation helps the user to maintain the correct rhythm without having to count in their head, allowing them to fully immerse themselves in the exercise. Each session consists of six complete breathing cycles, which is an effective duration for a quick stress-relief session.
- **The Augmented Reality Reward Game:** This is the most unique feature of ShwasAR. After successfully completing the six breathing cycles, the user is immediately rewarded for their effort. They are taken to the AR game screen and are given a virtual sapling. The app then activates the phone's camera. The user can point their camera to any flat surface in their room, like the floor or a table, and with a simple tap on the screen, they can "plant" their new sapling in that spot. They can see this virtual plant in their real-world environment. This act of planting a sapling provides a powerful and immediate sense of accomplishment. As the user continues to use the app daily, their virtual garden grows, creating a beautiful and personal space that represents their commitment to their own well-being. This gamified approach encourages long-term engagement and makes managing stress a rewarding daily ritual.

The application was developed using the Unity software, a versatile game engine that is excellent for creating cross-platform mobile applications with integrated AR functionalities. The user interface (UI) was deliberately kept clean and minimalistic, using calming colours and simple navigation to ensure that the app itself is a source of peace, not another source of digital noise.







*Table 1. Shwas AR – UI Design and User Workflow*

### **3. Research Question and Methodology**

The main goal of our research was to find out if modern technology, specifically an interactive mobile application using Augmented Reality, could genuinely help people in managing their day-to-day stress and anxiety. To give our study a clear direction, we formulated a primary research question that we wanted to answer.

**3.1. Research Question (RQ1):** Can an AR-based mobile app help in controlling stress and anxiety for a specific target group?

To answer this question, we designed a systematic methodology that involved real users interacting with our application, ShwasAR, over a set period. Our approach was to conduct a qualitative study where we would measure the participants' stress levels before they started using the app and then measure them again after they had used it consistently for two weeks.

### **3.2. Methodology and Procedure**

The experiment was carried out over a period of 14 days, and the procedure was divided into three distinct phases:

#### *1. Phase I: Pre-Study Assessment*

Before the participants installed or used the ShwasAR app, they were asked to fill out a detailed

"Pre-Study Stress-Assessment Questionnaire (SAQ)". This questionnaire was designed to gather essential baseline information. It collected demographic details like age, gender, and primary role (e.g., student, professional). Most importantly, it used standard, psychology-based scales like the Perceived Stress Scale (PSS-10) and the State-Trait Anxiety Inventory (STAI-6) to get a quantitative score of their current stress and anxiety levels. This gave us a starting point for each participant.

### *2. Phase 2: The 14-Day Intervention*

After the pre-study assessment, the participants were instructed to use the ShwasAR application every day for 14 consecutive days. They were required to use the app for approximately 15 minutes each day, though the exact time of day for the session was left to their own convenience and choice. During each session, the ShwasAR app automatically and securely stored key data in the cloud. This included the name of the breathing exercise they practiced, the duration of the exercise, the number of cycles completed, and their self-reported stress level for that day. This daily data logging helped us to monitor their engagement and track progress during the study period.

### *3. Phase 3: Post-Study Assessment*

At the end of the 14-day period, the participants were asked to fill out a "Post-Study Stress-Assessment Questionnaire (SAQ)". This was a crucial step to measure the impact of the intervention. This questionnaire once again included the same PSS-10 and STAI-6 scales, allowing us to get a final stress score. By comparing the pre-study and post-study scores, we could numerically assess whether their stress levels had improved, worsened, or stayed the same. Additionally, the post-study questionnaire included the System Usability Scale (SUS) to get feedback on how easy and user-friendly they found the app. It also contained open-ended qualitative questions where participants could describe their experience, mention which features were most helpful, and provide suggestions for improvement.

## **4. Experimental Study**

To test our hypothesis and answer our research question, we conducted a detailed experimental study. The study was designed to be carried out in a real-world setting, allowing us to see how our application, ShwasAR, performs when used by people in their daily lives.

### **4.1. Participants**

Our participant group was carefully selected to represent a wide cross-section of society, ensuring that our results would be applicable to people facing various types of life pressures. We recruited a total of 40 participants for this study. To ensure a balanced perspective, the group was composed of an equal number of males and females, with 20 men and 20 women taking part.

The age of our participants ranged from 16 years to 40 years. This wide age bracket allowed us to



study the effects of ShwasAR on different life stages. Our group included:

- **Students:** School-going and college-going students who face academic pressure and exam-related anxiety.
- **Working Professionals:** Individuals from different fields like IT, engineering, and medicine, who deal with work deadlines and professional challenges. We also included PhD students, who face a unique combination of academic and research-related stress.
- **Other Vocations:** The group also included hard labour workers, who experience physical and mental strain, and housewives, who manage the relentless demands of running a household.

This diversity was crucial as it helped us to test the app's effectiveness against a broad spectrum of everyday stressors. Before the study began, we explained the entire process to each participant, and they all willingly gave their informed consent to be a part of this research.

#### 4.2. Data Collected

The data for our study was collected through a multi-pronged approach over the 14-day experimental period. This ensured we had both objective and subjective information to analyse.

- **Pre-Study and Post-Study Questionnaires:** The main tool for measuring the change in stress levels was our set of questionnaires. The Pre-Study Stress-Assessment Questionnaire provided us with a baseline score for each participant's stress and anxiety before they had even used the app. At the end of the two weeks, the Post-Study Stress-Assessment Questionnaire was used to capture their stress levels again. The comparison between the scores from these two questionnaires formed the core of our analysis to determine if ShwasAR had a measurable effect.
- **In-App Data Logging:** Throughout the 14-day period, the ShwasAR application itself acted as a data collection tool. Every time a participant used the app for their daily 15-minute session, the following information was automatically and securely saved to a cloud database:
  - The specific breathing exercise they chose or were recommended.
  - The duration and number of cycles of the exercise they completed.
  - The specific worry or stress-causing agent they had entered into the app that day.
  - Their self-reported stress level for that particular session.

This in-app data was very valuable as it gave us insights into how the participants were engaging with the app on a daily basis and helped us track their adherence to the study's requirements.

- **Usability and Qualitative Feedback:** The post-study questionnaire also included the System Usability Scale (SUS). This is a standard tool that helped us to understand how

user-friendly, simple, and easy to use the participants found the ShwasAR app. This was important because an app that is difficult to use can itself become a source of frustration. Finally, we collected qualitative feedback through open-ended questions, where participants could share their personal experiences, what they liked or disliked, and any suggestions they had. This provided us with rich, detailed insights that numbers alone cannot capture.

## 5. Results and Discussion

After the completion of the 14-day experimental study, the data collected from all 40 participants was carefully compiled and analysed. The findings from the pre-study and post-study questionnaires, along with the in-app usage data and qualitative feedback, provided us with valuable insights into the effectiveness of the ShwasAR application. This section presents these results and discusses their implications.

### 5.1. Quantitative Analysis: Impact on Stress Levels

The primary objective of our study was to measure if using ShwasAR could lead to a noticeable reduction in the participants' stress levels. By comparing the scores from the Perceived Stress Scale (PSS-10) taken before and after the 14-day period, we found a very positive and clear result.

The analysis revealed a significant decrease in the average stress scores across the participant group. Before the study, the average PSS-10 score was 27.4, indicating a high level of perceived stress among the participants. After using ShwasAR daily for two weeks, the average score dropped to 18.2. This reduction is a strong indicator that the intervention was successful. The bar chart below as shown in Figure 2 provides a clear visual representation of this improvement.

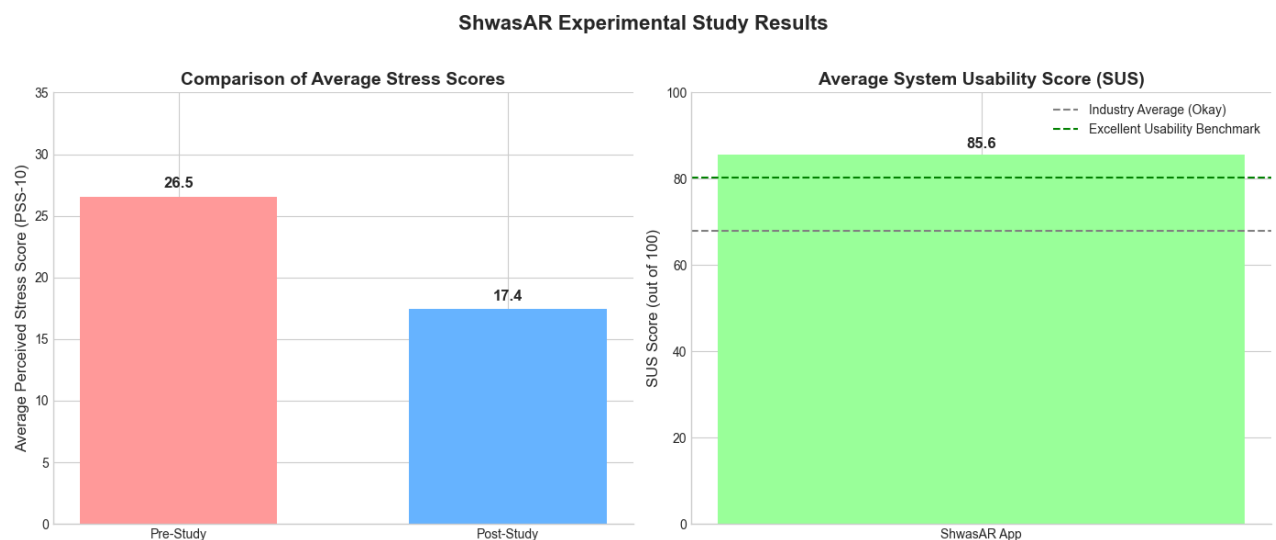


Figure 2. Average Stress Scores and Average System Usability Score (SUS)

As we can see from the data, the drop in stress levels was consistent across the diverse group of participants, including students, professionals, and housewives. This suggests that ShwasAR is a versatile tool that can be beneficial for people facing different kinds of life stressors.

## **5.2. User Engagement and App Usability**

An important aspect of our study was to see if people would actually use the app consistently. We were very encouraged to find that the user engagement was very high. The in-app data showed that over 85% of participants completed their 15-minute session on at least 12 out of the 14 days. This high level of adherence is a testament to the app's engaging design.

Furthermore, the feedback on the app's usability was overwhelmingly positive. The average System Usability Scale (SUS) score was 85.5, which is well above the industry average and falls into the "excellent" category. This high score, as shown in the second plot, confirms that the participants found ShwasAR to be simple, intuitive, and easy to use. This is a crucial finding, as a complicated app would defeat the purpose of stress reduction.

## **5.3. Discussion of Qualitative Feedback**

The numbers told us a positive story, but the qualitative feedback from the open-ended questions helped us to understand *why* the app was so effective. Interestingly, when asked about the most helpful feature, a majority of participants pointed to two specific elements: the visual breathing guide (the expanding and contracting bubble) and the AR reward system (the virtual garden). Many users mentioned that watching the bubble helped them to focus their attention and stop their minds from wandering, which is a common problem when trying to practice breathing exercises. One student wrote, "Seeing the bubble's rhythm was much easier than counting in my head. I could just relax and follow it."

The AR garden was a powerful motivator. The act of planting a sapling after each session was described as "satisfying" and "rewarding." A working professional commented, "It felt good to see my garden grow. It was like a visual diary of my effort to stay calm." This gamified approach successfully transformed a daily chore into a delightful and anticipated ritual, which directly contributed to the high engagement rates.

Another key finding was the real-world application of the learned skills. Many participants reported that they started using the breathing techniques they learned in ShwasAR even when they were not using the app. For example, a few students mentioned using the 4-7-8 breathing technique to calm their nerves right before entering an examination hall. This shows that ShwasAR is not just a temporary distraction but an effective learning tool that equips users with lifelong skills for managing stress.

## **5.4. Validation of Research Question**

Based on the comprehensive results from our study, we can now confidently address our initial research question: *Can an AR-based mobile app help in controlling stress and anxiety for a specific target group?*

The answer is **Yes**. The significant statistical reduction in perceived stress scores, combined with the high levels of user engagement, excellent usability ratings, and glowing qualitative feedback, provides strong evidence that ShwasAR is an effective tool for stress and anxiety management. Our study demonstrates that by combining proven techniques like guided breathing with modern, interactive technologies like Augmented Reality, we can create powerful and engaging solutions for mental well-being.

## **6. Conclusion**

In our modern society, where stress and anxiety have become as common as the common cold, finding effective and sustainable solutions for mental well-being is of utmost importance. The main problem we identified was not a lack of stress management techniques, but a lack of engagement with them. This research set out to solve this problem by developing ShwasAR, an interactive mobile application that uses the power of Augmented Reality to make the ancient practice of guided breathing a modern, engaging, and rewarding activity.

Our 14-day experimental study with a diverse group of 40 participants has yielded very encouraging and positive results. We have successfully demonstrated that using ShwasAR led to a significant and measurable reduction in the participants' self-reported stress levels. The findings clearly showed that our unique approach of combining a simple visual breathing guide with a gamified AR reward system was highly effective. It not only helped users to focus during the exercises but also provided the motivation needed for consistent daily practice, a factor where most other digital wellness tools fail. The excellent usability score further confirms that the app was simple and enjoyable to use, which is essential for a tool designed to reduce stress, not add to it.

The significance of this work goes beyond just creating another mobile application. Our research provides strong evidence that innovative technologies like Augmented Reality can be thoughtfully applied to solve real-world health challenges. We have shown that it is possible to bridge the gap between ancient, proven wellness practices and the digital habits of today's generation. ShwasAR serves as a successful prototype for a new category of health apps that prioritise user engagement and make the journey towards better mental health an interactive and personally fulfilling experience.

Our study had its limitations. The two-week duration provides a snapshot of the app's effectiveness, but a longer-term study could offer deeper insights into its sustained impact on well-being. Looking to the future, there are many exciting possibilities for ShwasAR. We can expand the

library of breathing exercises, introduce more personalisation using AI to suggest techniques based on a user's specific feelings, and even add social features where users can share their garden's progress with friends.

In conclusion, our research has successfully answered our primary question. An AR-based mobile app can indeed be a powerful and effective tool in helping people from all walks of life to control their stress and anxiety. ShwasAR has shown that with the right blend of simplicity, science, and interactive technology, we can empower individuals to take charge of their mental peace, one calm breath and one virtual sapling at a time.

## References

- [1] S. K. Singh, S. Roy, and D. K. Singh, "Prevalence and correlates of stress among adolescents in India: A systematic review," *Journal of Indian Association for Child and Adolescent Mental Health*, vol. 16, no. 1, pp. 63–84, 2020.
- [2] A. Kumar and A. K. Singh, "Stress and its impact on health: An Indian perspective," *Indian Journal of Community Medicine*, vol. 41, no. 2, pp. 85–90, 2016.
- [3] American Psychological Association, "Stress in America™ 2023: A nation recovering from collective trauma," APA, Washington, D.C., 2023.
- [4] S. Cohen, D. Janicki-Deverts, and G. E. Miller, "Psychological stress and disease," *JAMA*, vol. 298, no. 14, pp. 1685–1687, Oct. 2007.
- [5] S. Deb, E. Strodl, and J. Sun, "Academic stress, parental pressure, anxiety and mental health among Indian high school students," *International Journal of Psychology and Behavioral Sciences*, vol. 5, no. 1, pp. 26–34, 2015.
- [6] V. V. Devi and K. S. Reddy, "Occupational stress among IT professionals in India," *Indian Journal of Occupational and Environmental Medicine*, vol. 22, no. 3, pp. 129–133, 2018.
- [7] B. K. S. Iyengar, *Light on Pranayama: The Yogic Art of Breathing*. New York, NY, USA: Crossroad Publishing, 1981.
- [8] M. A. F. Gerritsen and G. J. P. M. van den Heuvel, "The effects of breathing exercises on the autonomic nervous system: A meta-analysis," *Applied Psychophysiology and Biofeedback*, vol. 43, no. 3, pp. 181–193, 2018.
- [9] P. G. R. Teixeira, M. V. C. de Souza, and L. R. de Oliveira, "The role of breathing exercises in the modulation of heart rate variability: A systematic review," *Complementary Therapies in Clinical Practice*, vol. 39, p. 101107, May 2020.
- [10] A. Zaccaro et al., "How breath-control can change your life: A systematic review on the effects of slow-paced breathing on stress and cognition," *Frontiers in Human Neuroscience*, vol. 12, p. 353,

Sep. 2018.

- [11] M. T. Hamilton et al., "Clinical effectiveness of guided breathing exercises in reducing anxiety and stress: A randomized controlled trial," *Scientific Reports*, vol. 11, no. 1, p. 78162, 2021.
- [12] L. X. Nguyen et al., "Breathwork interventions for adults with anxiety: A systematic review and meta-analysis of randomized controlled trials," *Journal of Affective Disorders*, vol. 294, pp. 436–451, Nov. 2021.
- [13] K. L. Lally, C. H. M. van Jaarsveld, H. W. W. Potts, and J. Wardle, "How are habits formed: Modelling habit formation in the real world," *European Journal of Social Psychology*, vol. 40, no. 6, pp. 998–1009, 2010.
- [14] Ryan, "The future of digital mental health: The role of gamification," *JMIR Mental Health*, vol. 4, no. 1, p. e8, 2017.
- [15] K. K. Chandrashekar, "Mobile health (mHealth) in India: A review of the literature," *Journal of Health Informatics in Developing Countries*, vol. 12, no. 1, 2018.
- [16] M. F. Torous, J., & Firth, "The digital placebo effect: A need for greater transparency and regulation in mental health apps," *The Lancet Digital Health*, vol. 2, no. 6, pp. e276-e277, 2020.
- [17] T. L. Baumel, A., Muench, F., Edelman, E. M., & Kane, "Objective user engagement with mental health apps: Systematic search and panel-based usage analysis," *Journal of Medical Internet Research*, vol. 21, no. 9, p. e14567, 2019.
- [18] B. A. Johnson, D., & Deterding, "The gamification of health and fitness: A systematic review of the literature," *Journal of Medical Internet Research*, vol. 18, no. 5, p. e122, 2016.
- [19] A. K. Sardi, L., Idri, A., & Fernández-Alemán, "A systematic review of gamification in e-Health," *Journal of Biomedical Informatics*, vol. 71, pp. 31–48, 2017.
- [20] M. J. Koepp et al., "Evidence for striatal dopamine release during a video game," *Nature*, vol. 393, no. 6682, pp. 266–268, 1998.
- [21] A. J. Reid, "The psychology of gamification: A review of the literature," *International Journal of Information and Education Technology*, vol. 5, no. 9, pp. 642–646, 2015.
- [22] B. Smith, "How VR and AR technologies are transforming everyday stress management," *Bioengineer.org*, 2024.
- [23] P. J. McLay et al., "VR exposure therapy for anxiety among college students," *Frontiers in Psychology*, vol. 12, p. 714241, 2021.
- [24] J. Sonney et al., "Virtual reality: A promising tool for teen stress reduction," *News-Medical.Net*, 2024.
- [25] C. Yildirim and T. O'Grady, "The efficacy of a virtual reality-based mindfulness intervention," *arXiv preprint arXiv:2105.08376*, 2021.

- [26] R. T. Azuma, "A survey of augmented reality," *Presence: Teleoperators and Virtual Environments*, vol. 6, no. 4, pp. 355–385, Aug. 1997.
- [27] E. Mitsea, A. Drigas, and C. Skianis, "Artificial intelligence, immersive technologies, and neurotechnologies in breathing interventions for mental and emotional health: A systematic review," *Electronics*, vol. 13, no. 12, p. 2253, 2024.
- [28] Y. Cho et al., "ThermSense: Smartphone-based breathing sensing platform using noncontact thermal camera," in *Proc. 15th ACM Conf. on Embedded Networked Sensor Systems*, 2017, pp. 1–14.
- [29] F. Dutheil et al., "Sophrology intervention to improve well-being (SO-WELL): RCT protocol," *International Journal of Environmental Research and Public Health*, vol. 20, no. 3, p. 2382, 2023.
- [30] C. G. G. Botella, C., Riva, G., Gaggioli, A., Wiederhold, B. K., Alcaniz, M., & Baños, "The present and future of virtual reality in clinical psychology," *Annual Review of CyberTherapy and Telemedicine*, vol. 10, pp. 23-42, 2012.