**Strezball: Pressure-Based Game using Stress Ball**

Adam Zikry bin Mohd Aris 1, a), Quek Albert 1, b) , Goh Hui Ngo 1, c), Ting Choo Yee 1, d)

1*Faculty of Computing and Informatics, Multimedia University, Persiaran Multimedia, 63100 Cyberjaya, Selangor, Malaysia*

*Corresponding author: b ) quek.albert@mmu.edu.my*

*a) adam.zikry23@gmail.com*

*c)hngoh@mmu.edu.my*

*d)cyting@mmu.edu.my*

**Abstract.** This paper presents Strezball, a pressure-based interactive game that integrates a sensor-equipped stress ball and facial expression recognition to support stress reduction through adaptive and immersive gameplay. Designed around calming scenarios such as blowing bubbles and launching fireworks, Strezball transforms repetitive squeezing into meaningful game interactions. A user study involving 17 participants evaluated the system’s effectiveness using pre- and post-intervention assessments: the Perceived Stress Scale (PSS) and Short-Term Stress Questionnaire (SSQ). Results showed a modest reduction in stress levels, highlighting the potential of combining tactile input and emotion-aware feedback for gamified stress management and cognitive well-being support.

# INTRODUCTION

In today’s high-pressure environments, stress has become a widespread issue, influencing mental health, workplace performance, and overall quality of life [1]. Acute stress is short-lived and often situational, chronic stress results from prolonged exposure and is more difficult to manage without targeted intervention [1]. Stress is a natural human response to perceived threats or demands, but persistent or unmanaged stress, especially in its chronic form, can lead to significant negative health outcomes [2].

A variety of tools have been developed to manage stress, including mindfulness practices, physical activity, and therapeutic aids such as stress balls [3]. Created for physical rehabilitation, stress balls have evolved into popular handheld tools believed to offer tactile distraction and promote relaxation [4]. At the same time, casual digital games have been shown to reduce stress by providing soothing, low-stakes environments where players can experience control, escapism, and emotional regulation [5].

This paper introduces Strezball, a novel integration of pressure-based physical interaction with emotionally adaptive gameplay. By embedding a force-sensitive resistor (FSR) into a stress ball and incorporating facial emotion recognition to adjust game parameters in real time, the system offers an engaging method for self-regulated stress relief. We report on the design, implementation, and user testing of Strezball, contributing new insights to the design of affective, sensor-driven game experiences for mental well-being.

# RELATED WORK

Hans Selye first coined the term "stress" in 1936, defining it as the body's non-specific response to any demand for change [6]. Building upon this, the American Psychological Association (APA) describes stress as a normal physiological reaction to everyday pressures, impacting various bodily systems and influencing behavior and emotions [7]. Understanding these fundamental definitions is crucial as this research explores a novel approach to stress management.

Research was done on the effectiveness of casual games in reducing stress in students [8]. The study involved 80 undergraduate students with an average age of 19.46 years. Participants were assigned to either the video game group or the mindfulness meditation group. Each intervention lasted 20 minutes, and their stress levels were assessed before and after using the Psychological Stress Measure (PSM-9) for perceived stress and Physiological metrics, such as heart rate and blood pressure. This project will utilize this research as a reference for the game and stress measurement methods employed. The game will follow a similar aesthetic and vibe to the game they used, which was Flower by Thatgamecompany

Recent research has highlighted the usage of immersive and game-based environments in promoting interactive and engaging learning. For example, T. Ahmad et al developed a bilingual virtual reality environment to teach regarding colors, famous personalities, Urdu alphabets, geometry, and fruits to children, emphasizing the benefits of VR for enhancing attention and motivation through immersive design [9]. Similarly, Tan Lin and Neo modeled a virtual campus tour in Minecraft, demonstrating how familiar game platforms can be used to simulate real-world experiences in a cost-effective, accessible way [10]. Although these studies focus on the potential of immersive and game-based platforms for education purposes, the design principles could be used to create an interactive and immersive experience that could aid in reducing stress.

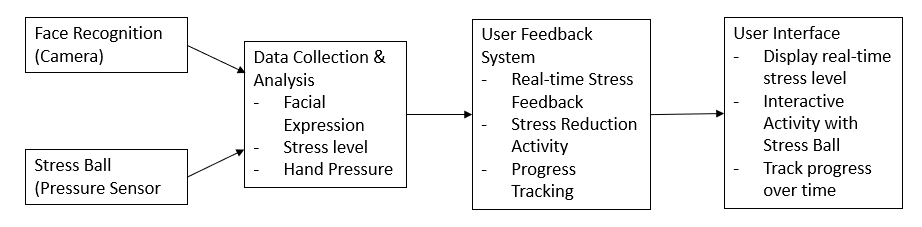
RehaBall, a project focused on upper limb rehabilitation, provides a relevant precedent for integrating sensor-equipped stress balls with a digital game [11]. This system couples a virtual reality car racing game with an oval-shaped stress ball, fitted with sensors and actuators, to facilitate home-based rehabilitation for wrist injuries. Patients can personalize their rehabilitation by adjusting the range of motion, and therapists can track progress through a stored database. Although RehaBall prioritizes physical rehabilitation, this research applies a similar technological approach to mitigate psychological stress. Our project will modify a stress ball with a pressure sensor and integrate it into a virtual reality game, but with the distinct aim of reducing stress levels rather than rehabilitating physical injuries.

# GAME CONCEPT

This game will be a very casual simulation of everyday activities such as blowing bubbles and watching fireworks. The type of player for this game will be for casual gamers. The gameplay will involve the player squeezing the stress ball to perform the suitable action in the game mode. This game will be run on a computer and use a stress ball fitted with a pressure sensor as the controller. The main reference for the game will be Flower, and the design for the stress ball will be similar to the one used in the RehaBall paper. The design intention of this game is to give the player a much more interactive experience than simply squeezing a stress ball for stress relief.

## Input Data

There are two inputs used for collecting user data and it is through pressure sensor and the facial recognition system. From the inputs, the system will generate a system feedback by displaying an interactive game output. The interactive output will be varied from how the stress ball is being squeezed and the player’s facial reaction to the game. The overall framework is as shown in Figure 1.



**FIGURE 1**. General framework for the hardware

## Destress Mechanics

The main input of the game is through the stress ball. The gameplay will adjust to the player's stress level as detected by the facial recognition system. For example, if the system detects the player to be stressful through the facial recognition system, the player will need to perform more squeezing achieve the objective or to clear the stage. This control is implemented to encourage the player to perform more squeezing to the stress ball for destressing.

## Facial Recognition

The facial recognition system is used to detect the player's stress level in real time. The system uses facial landmarks to detect the current stress level of the player. The reference for this system is based on a paper called AlexNet [12]. This system would allow for a much more dynamic gameplay experience that would be suitable for the player's current stress level. First, a model is trained with a set of data of people's expressions. These expressions are classified into six emotions: angry, fearful, happy, neutral, sad, and surprised. These expressions will then be further classified into 3 stress levels: no stress, mild stress, and stressed (see Figure 2). If the detected emotion is angry or surprised the stress level will be set to stressed, else if the emotion detected is fearful or sad the stress level will be set to mild stress and if the emotion detected is happy and neutral the stress level will be set to no stress. The system will detect the player’s stress level every few seconds. If the system detects no stress for five times the game mode will end faster. As long as the system does not detect it five times, then the difficulty will be determined on whether the player is stressed or has a mild stress.

A person taking a selfie

Description automatically generated

**FIGURE 2.** Facial recognition camera

## Gameplay

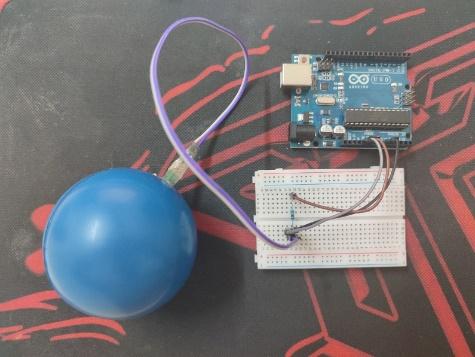
The core mechanics of the game is squeezing the stress ball. Depending on the game mode you will either be blowing bubbles or launching fireworks. For the blowing bubble, every time the player squeezing the stress ball it will blow a bubble. At a certain size, the bubble will detach from the blowing stick and fly away. You need to blow as many bubbles as possible to attract the kids at the park. For the fireworks, every time you squeeze the stress ball it will fill up the launch gauge. Once the launch gauge is full, a firework will launch and lit the sky up. Thus, this will fill up the satisfaction meter. The more fireworks the higher the satisfaction meter.

# IMPLEMENTATION

## Stress Ball Device

The pressure sensor that is used in this project is a force-sensitive resistor. When a pressure is applied, the resistance will increase thus indicating a higher pressure. This value is initially an analog value and is to be converted to a range of numbers based on the level of pressure. Based on these thresholds, the code will output a certain value to indicate each pressure level. This is to ensure easier input management to use later on when configuring the inputs in-game. Figure 3 shows the physical configuration on the stress ball connected to the Arduino board through the breadboard.

To receive the data from the Arduino Uno board into unity. The System.IO.Ports namespace is used that provide classes for controlling serial ports. First, the serial port is assigned to the serial port to which the Arduino Uno board was connected, and then open the serial port. A read timeout is also set to 1 millisecond to allow the program to frequently check for new data without blocking for too long. Figure 4 is the pseudocode used to read the input from the Arduino board from the port.



**FIGURE 3.** Stress ball configuration

using System.IO.Ports;

SerialPort sp = new SerialPort("COM7", 9600);

// Start is called before the first frame update

void Start()

{

sp.Open();

sp.ReadTimeout = 1;

}

**FIGURE 4.** Pseudocode to receive data from Arduino

## Game Modes

For the game, there are two main game modes. These game modes are Bubble Blowing and Fireworks (Figure 5).

The objective of the first game mode is to attract all the kids at the park to the player. There are two parts of this game mode. One is the blowing bubble function, and the other is gathering the kids in front of the player. Every time the player squeezes the stress ball; the bubble will expand a certain value. At a certain size, the bubble will detach from the blowing pipe and fly away. After the bubble detaches, a new bubble will be created in its place and the process repeats. To attract the kids, there is a specific number of bubbles the player must blow. This value is determined by your current stress level detected by the facial recognition software

For the second game mode which is fireworks game mode. In order to launch a firework, the player will have to fill up the launch meter. Every firework that launched it will fill the satisfaction meter. There are two bars that must be filled. When the player squeezes the stress ball it will fill up the launch meter. When the launch meter is full, a firework will launch, and the satisfaction meter will increase to a certain value. The maximum value of launch meter is determined the player's stress level. A higher level of stress will contribute more squeezing of the stress ball in order to launch the firework.

A video game of a park

Description automatically generated A group of lights at night

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**FIGURE 5.** Screenshot for bubble blowing mode (left) and firework mode (right)

# PRELIMINARY TESTING

The testing was conducted on the 29th of June. Two main things were tested: the stress level testing and the gameplay experience testing. The stress level testing is to test the stress level of the player before and after gameplay. Meanwhile, the gameplay experience testing is to gather feedback from players regarding their experience. By the end of the testing, there were 17 respondents. Every single one has tested their stress levels and the gameplay experience. Figure 6 shows the testing done by testers.

A person in a black head scarf holding a phone

Description automatically generatedA group of people sitting at a table

Description automatically generated

**FIGURE 6**. Stress level testing (left) and the gameplay experience testing (right)

The overall testing was a success, other than some issues with the hardware being unresponsive at times. There were 17 testers in general and all the questionnaires were answered clearly. Before the tester starts the game, they will have to fill in the stress assessment which is based on the Perceived Stress Scale (PSS) instrument to get their initial stress level. The PSS is designed to measure the perception of stress. It assesses how unpredictable, uncontrollable, and overloaded respondents find their lives.

After the tester has finished playing the game, they will have the form again but, in the after-gameplay section. The questions are based on the Short-term Stress Questionnaire (SSQ) instrument to get their final stress level. The Short-term Stress Questionnaire (SSQ) is a concise tool designed to assess immediate or short-term stress levels.

Based on the score of the before and after for the stress assessment, we can see that there is a decrease in the score with a difference of two points. It is not a substantial amount of decrease as the score indicates that the player is still experiencing mild stress. This score could have been influenced by the game (see Table 1)

The questions for the second section will be based on the Game Experience Questionnaire (GEQ) [13]. It consists of 33 linear-scale questions that will generate a score for each of these elements, competence, sensory and imaginative, immersion, flow, tension/annoyance, challenge, negative affect and positive affect.

**TABLE 1**. The average score for each question before and after gameplay

|  |  |  |
| --- | --- | --- |
| Question No | Before (PSS) | After (SSQ) |
| 1 | 3 | 3 |
| 2 | 3 | 2 |
| 3 | 3 | 2 |
| 4 | 2 | 2 |
| 5 | 2 | 3 |
| 6 | 3 | 3 |
| 7 | 2 | 3 |
| 8 | 2 | 2 |
| 9 | 3 | 2 |
| 10 | 3 | 2 |
| Total Score: | 26 | 24 |

Based on the result of the GEQ, Figure 7 shows the game's strongest components were the positive effect and the sensory and immersion. This is a good result for this project as having a positive effect could in turn result in the reduction of stress levels. In addition, the low score on the negative effect is also a very good telling of the gameplay experience. A high score on the sensory and immersion of the game is also a good indication that the game can pull the player's attention and make the facial recognition system more effective. The final average score of 2.2 out of 5 is not exactly the best score. There is still more to be improved from the accuracy of the sensor to making the stress ball easier to use.

A screenshot of a computer

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**FIGURE 7**. Game experience testing result

# CONCLUSION

Strezball demonstrates a promising direction in designing interactive systems for stress relief, combining a pressure-sensitive stress ball with emotion-aware digital gameplay. Our initial user testing with 17 participants showed a modest but measurable decrease in perceived stress levels, alongside positive feedback on immersive experience and emotional engagement. These findings support the feasibility of tactile and emotionally adaptive interactions as tools for cognitive and emotional self-regulation. Nonetheless, several limitations emerged, including hardware reliability issues and the limited sensitivity of the stress-detection mechanisms. To enhance efficacy, future work will focus on improving the physical design of the stress ball, refining the facial recognition model, and exploring additional physiological data sources such as heart rate or skin conductance.

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