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NASA in Your Neighborhood

Project Bubble

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Abstract

In the world, one out of every four people suffers or will suffer from a mental disorder at some point in their life. Only in Spain, nearly 3 million people have been actually diagnosed with depression, making it the most prevalent mental illness.

Today, we are more aware of mental health than ever before, but have you ever wondered how the weather truly affects our mood?

Our challenge, "NASA in our neighborhood" began with this question. The main goal was to discover how we could connect the environment with people to improve the quality of life within our town.

After studying resources and data from NASA's satellites, we had the idea that we could correlate quantifiable parameters such as temperature, air quality or humidity with something as intangible as emotions and moods, such as happiness, anger or sadness.

All of this led us to create Bubble.

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1. Introduction

1.1 Who we are

Our team, Swanse Science, is comprised of four dedicated telecommunications engineers who share a deep passion for science and technology. Each member of our team brings a unique set of skills. Our members:

- Alberto San Segundo Gonzalo
- Paula Bartolomé Mora
- Pablo Ruiz Giles
- Miguel Varas Heredia

1.2 About the Challenge: NASA in Your Neighborhood

Satellites can tell us a lot about the Earth system. We can learn about air quality, water quality, tree canopy, and even urban heat from the vantage point of space. This information is even more powerful when combined with information about people living on the ground.

Our challenge is to look around our neighborhood or town and formulate a question about how the environment and humans are related, research the question using data from NASA satellites and information about people, and present our findings in a creative way.

1.3 Our Project's objective

Taking into account the proposed challenge, we are going to formulate the main question "How does climate affect our mood?"

The increasing mental health issues in our society motivated us to start this project, aiming to boost the well-being of our town's residents and lift their mood through the creation of the Bubble app. In Chapter 4, we will dive into how it works.

2. State of Art

2.1 Climate impact on our mood

The weather have a big impact on our mood. Sunlight is recognized for its ability to evoke feelings of happiness and positivity. In other terms, people usually report increased levels of energy and a more optimistic outlook on life because sunlight stimulates the release of serotonin.

On the other hand, rain tends to be associated with feelings of sadness and even depression. Research findings suggest that the limited sunlight during rainy days reduces serotonin production within the body, affecting various aspects of mood, appetite or even sleep patterns. This also results in increased sense of sadness and melancholy.

In addition, temperature also influences on our mood. When the temperature hovers around 22 degrees Celsius, people tend to experience improved moods. Furthermore, extremely hot weather can cause feelings of irritability, whereas extremely cold temperatures may reduce motivation and lead to feelings of frustration. [1]

2.2 Emotions and Hormones

Emotions play a crucial role in a person's state of mind. Understanding the five emotions and knowing how to manage them is fundamental to living a fuller and more conscious life, but emotional states can also be shaped by a range of external influences, such as weather conditions, temperature, rainfall and even the natural environment around us. Below, we have condensed the five fundamental emotions that humans experience, as well as the hormones that can intensify or dampen them.

2.2.1 Emotions

- **Happiness:** Joy is an inner reaction that brings us freshness, enlightenment and even warmth. It tells us that something pleasant or positive has happened, it signals an achievement, it helps us to overcome fears and to strengthen bonds. Almost all of us know how to express joy in different ways, to a greater or lesser extent.
- **Sadness:** Sadness is a low mood, which informs our organism of different things, for example, that expectations have not been fulfilled, of a loss or that something has moved away. In other words, it informs us that we have to adapt or ask for help, which is why it lowers our mood.

- **Fear:** Fear is a feeling of fear of something physical or real; or of something neurotic, remember that the mind does not differentiate between imagination and thought. Fear is positive, it is constructive, although it can be unpleasant, it indicates danger and teaches us to attack, flee or remain immobile.
- **Disgust:** Disgust is an emotion that gives us insight, that informs us that something is happening, that protects us. Everyone feels disgust towards different things, materials, animals, people, colors, textures, or tastes. If we are able to observe from another perspective, we will see that this reaction of protection, which helps us to take distance, to eliminate possible dangers. [2]
- **Anger:** Rage or anger is the emotion that produces the most muscular energy. It informs us that something has happened, that something is happening, that something is being imposed between our objectives or that there is an injustice between what we think and what we believe. In those moments, anger is activated to overcome that barrier between what we feel and something is imposed, physical or moral or psychological. [3] [4]

2.2.2 Hormones

Hormones that Affect Happiness:

- **Serotonin:** Serotonin levels can be increased by engaging in the following activities:
  - Exercising.
  - Dancing.
  - Consuming sweets or spicy foods.
- **Endorphin:** To activate endorphins, consider the following actions:
  - Consuming foods like rice, pasta, and eggs.
  - Recalling happy moments.
  - Getting sunlight in the early morning.
  - Walking and jogging.
- **Dopamine:** Dopamine can be increased through various activities such as:
  - Exercising.
  - Listening to music.
  - Engaging in sexual activities.
  - Practicing Yoga and meditation.
  - Achieving set goals and objectives.
- **Oxytocin:** Oxytocin can be influenced by:
  - Physical contact.
  - Laughter or crying.
  - Petting your pet.
  - Acts of generosity.[5]

Hormones that Affect the Sensation of Disgust and Increase Stress:

- **Adrenaline:** Adrenaline is increased during stress, fear, exercise, pleasure, or high cardiovascular activity. It is often associated with danger and strong emotions. To decrease adrenaline levels:
  - Practice deep breathing exercises.
  - Try meditation techniques.
  - Focus on pleasant and positive memories.
  - Relax your body by alternately contracting and relaxing different muscle groups. [6] [7]
- **Cortisol:** Cortisol levels can be influenced as follows:
  - To increase cortisol:
    - Experience stress.
    - Pregnancy.
    - Engage in intense exercise.
    - Serious illness.
    - Exposure to hot or cold temperatures.
    - Certain thyroid diseases.
    - Obesity.
    - Use of certain medications like contraceptives.
  - To decrease cortisol:
    - Engage in moderate and regular exercise, as intense exercise can temporarily raise cortisol levels.
    - Ensure you get enough quality sleep, as lack of sleep can result in high cortisol levels.
    - Laugh and have fun, as laughter is associated with lower cortisol levels.
    - Consider getting a dog as the companionship of a pet has been shown to reduce cortisol levels.
    - Maintain a healthy diet.

Hormones that Generate Fear or Terror:

- **Catecholamines:** Catecholamine levels increase with exercise, exposure to danger, illness, or trauma. The sympathetic stimulation triggers the release of endogenous catecholamines. To decrease catecholamine levels:
  - Regular exercise, particularly aerobic exercises like walking, running, swimming, or cycling, can help reduce catecholamine levels in the body.
  - Meditation and deep breathing techniques can lower stress levels and, consequently, decrease catecholamine levels.

- **Adrenaline:** Adrenaline levels increase in abnormal situations or during high physical or mental activity. It is often elevated when facing danger or high-stress situations. To reduce adrenaline levels, consider relaxing activities such as:
  - Yoga.
  - Pilates.
  - Gentle walking.
  - Spending time with animals or petting them.

Hormone that Affects Anger:

- **Testosterone:** This hormone is closely related to the feeling of anger and tends to increase during high-intensity physical activities.

Hormones that Affect Sadness:

- **Melatonin:** Melatonin levels decrease in darkness and increase with exposure to sunlight. [8]
- **Hypocretin:** Hypocretin levels increase when a person is in a state of depression or a similar emotional state.

3. NASA Resources

The data used for this project has been obtained at EarthData [9], in order to use it in the proyect demo we have used its API using the Python API [10].

With the API when download data automatically based on the current date. We have selected a dataset that contains data from the satellites Terra and Aqua that gets the Enhanced Vegetation Index wich is obtained from the near infrared bands [11].

Using it, we get the total canopy cover, thus indicating the total vegetation count and density, also it has an acceptable resolution of 0.05 degrees and temporal resolution of 16 days and a temporal extent from 2012-01-17 to Present.

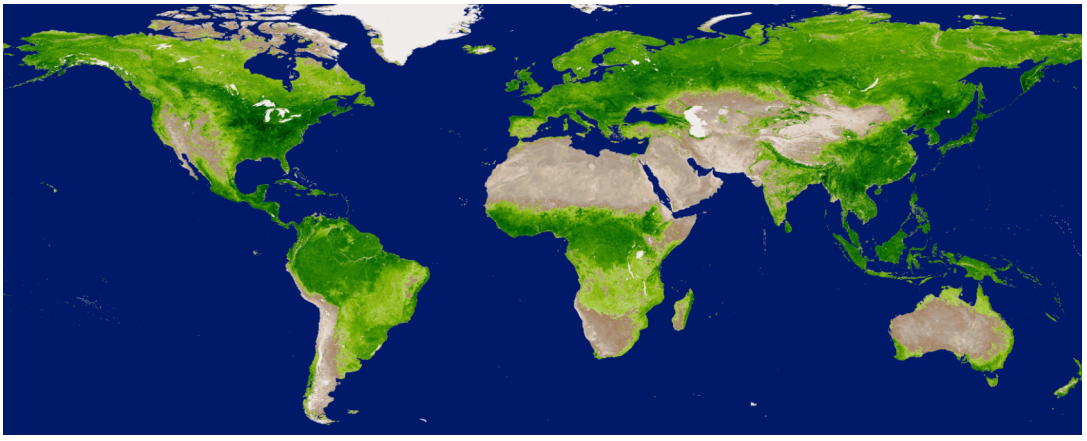

Figure 3.1: Global Image

The Figure 3.2 is an example of the retrieved global data, and plotted using Maplotlib module.

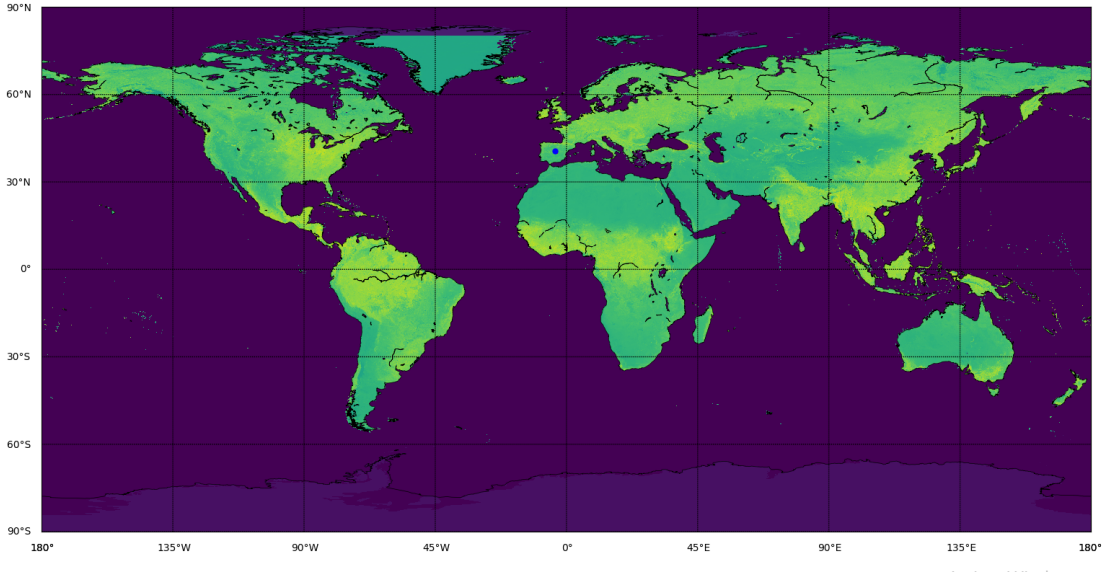

Figure 3.2: Retrieved Data

4. Our Application

4.1 Introduction

Do you want to improve your mood and feel better every day? Bubble is the mobile app designed for just that. Bubble features an artificial intelligence-based algorithm that uses user data, weather conditions in their location and severate climate parameters as input to understand how they are feeling at that moment.

Are you looking for a serotonin boost or need to reduce cortisol? Don't worry, Bubble knows it. As you can see in the Figure 4.2, our app predicts hormone levels and suggests challenges and locations based on these results.

Moreover, Bubble offers users the choice to undertake these challenges individually or in the company of others. This feature of connecting with like-minded groups enables users to become part of a community that shares their common interests.

Figure 4.1: Bubble App Logo

This is where its name comes from, related to the concept of heterotopia [12] - 'environments within environments.' Each 'bubble' in the app represents a heterotopia where users can experience and interact uniquely. The metaphor of the bubble emphasizes a separate place where interactions and experiences are different from everyday life.

So, if you're ready to uplift your mood and discover exciting new challenges, all you have to do is download Bubble and start feeling better with just a click.

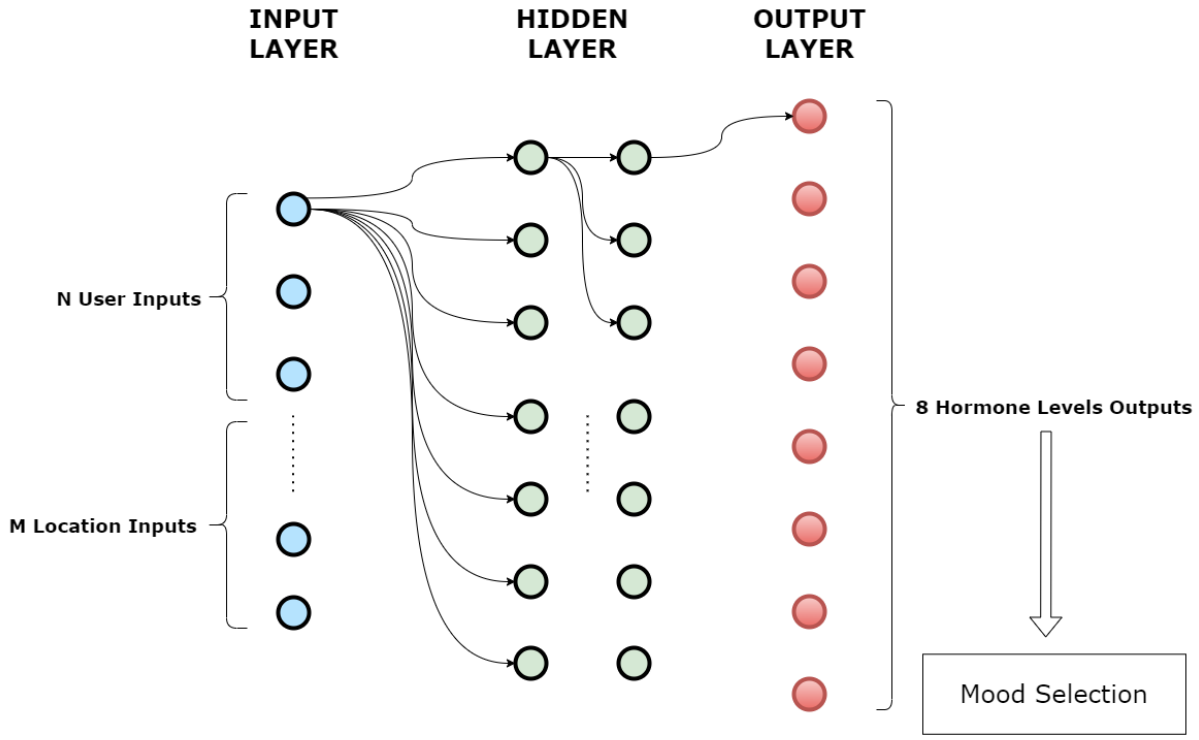

Figure 4.2: Artificial Neural Network Structure

4.2 User Experience

In this section, we will demonstrate the user experience when using the app, as well as its operation with the following figures. Additionally, the flowchart of the app can be observed in the Figure 4.3.

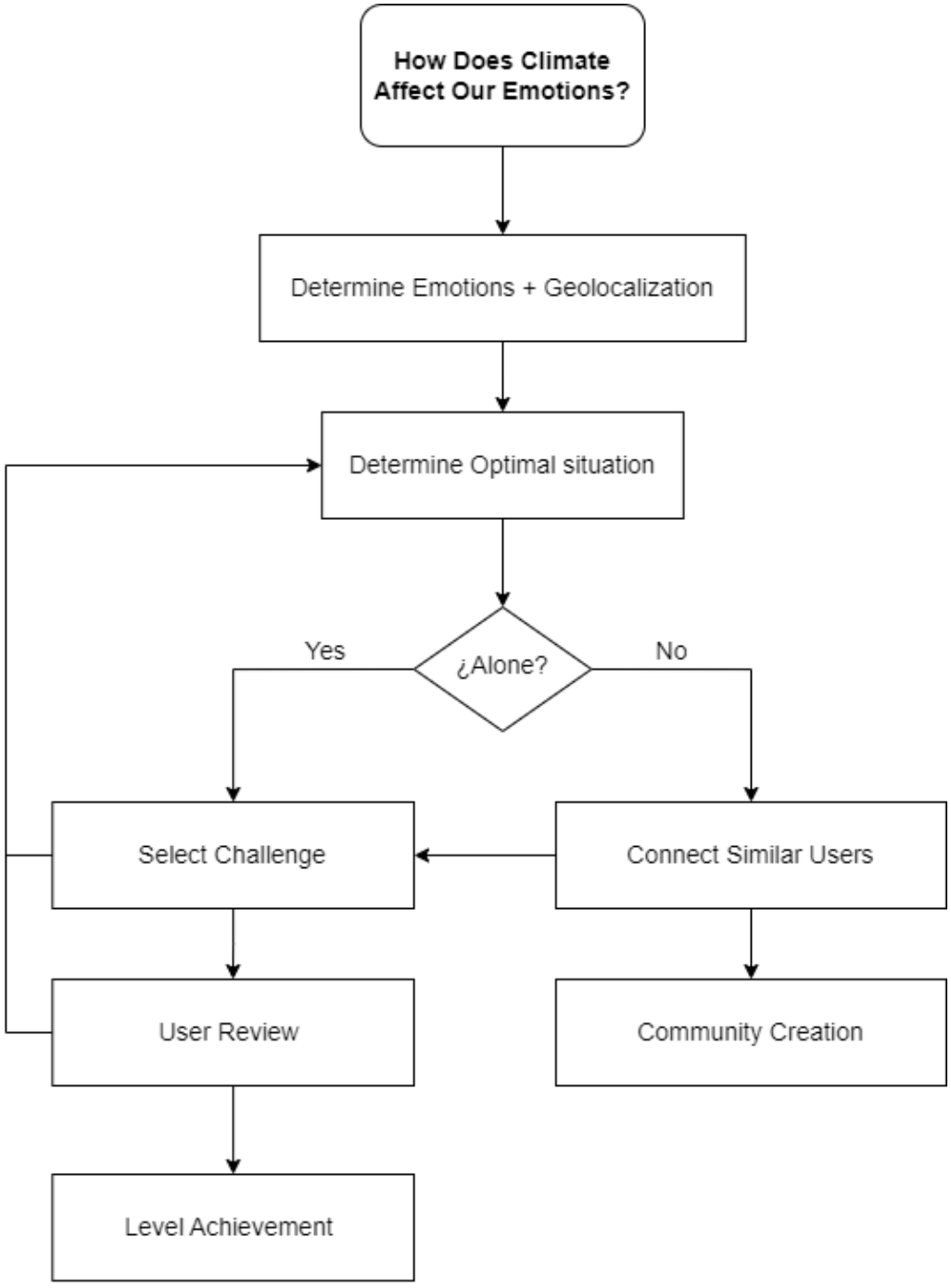

Figure 4.3: Bubble Application Flowchart

4.2.1 Example of use

At the initiation of the application, users are given two options: to login or to register. For new users, the registration process entails providing personal information and specifying their favorite hobbies. This information allows the app to give a unique experience for them.

On the main screen, each user can access their statistics, view their activity history, and most notably, find the option to enhance their mood.

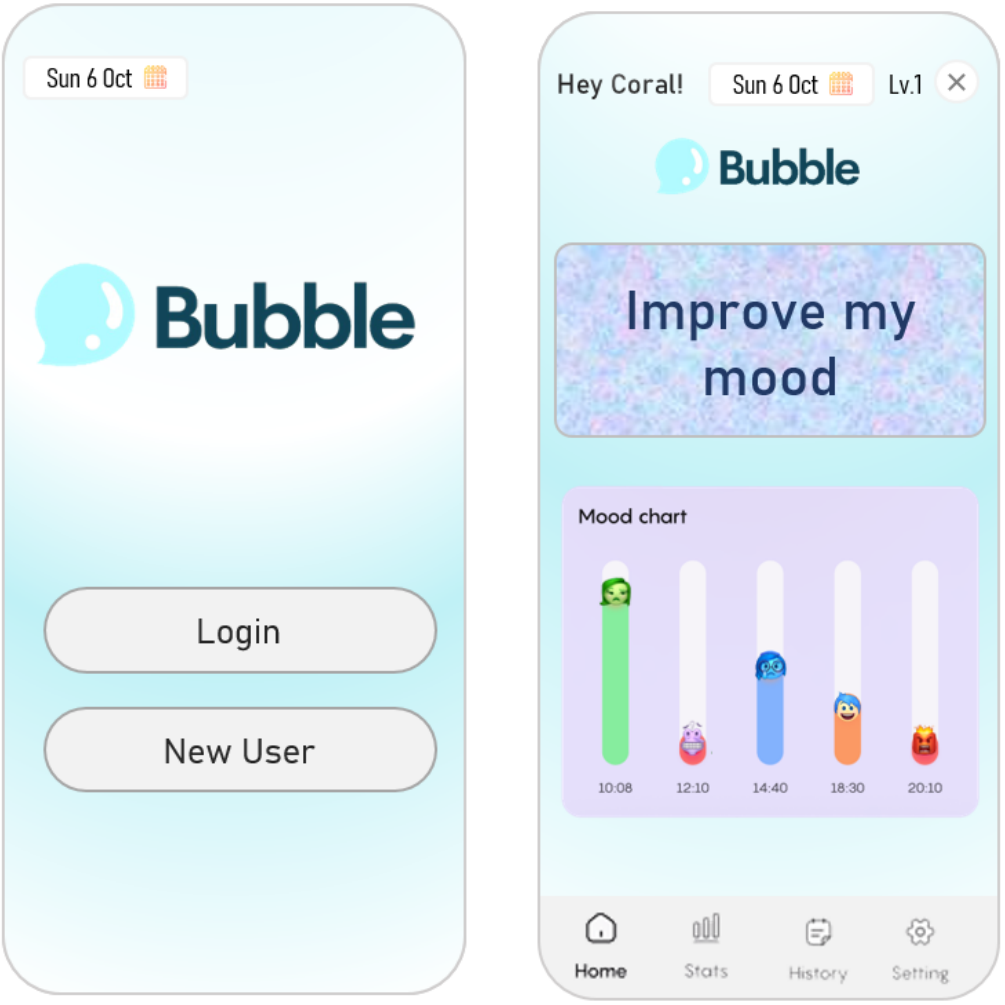

Figure 4.4: Main Screen

By selecting the option "Improve my mood", the user will be asked three questions:

1. Current location, so that the app can see the climatic characteristics of the environment and recommend a better place according to his preferences.
2. User mood, to determine an activity that will improve hormone levels and increase the hormones needed to feel better.
3. Whether you prefer to do the activity alone or with someone else.

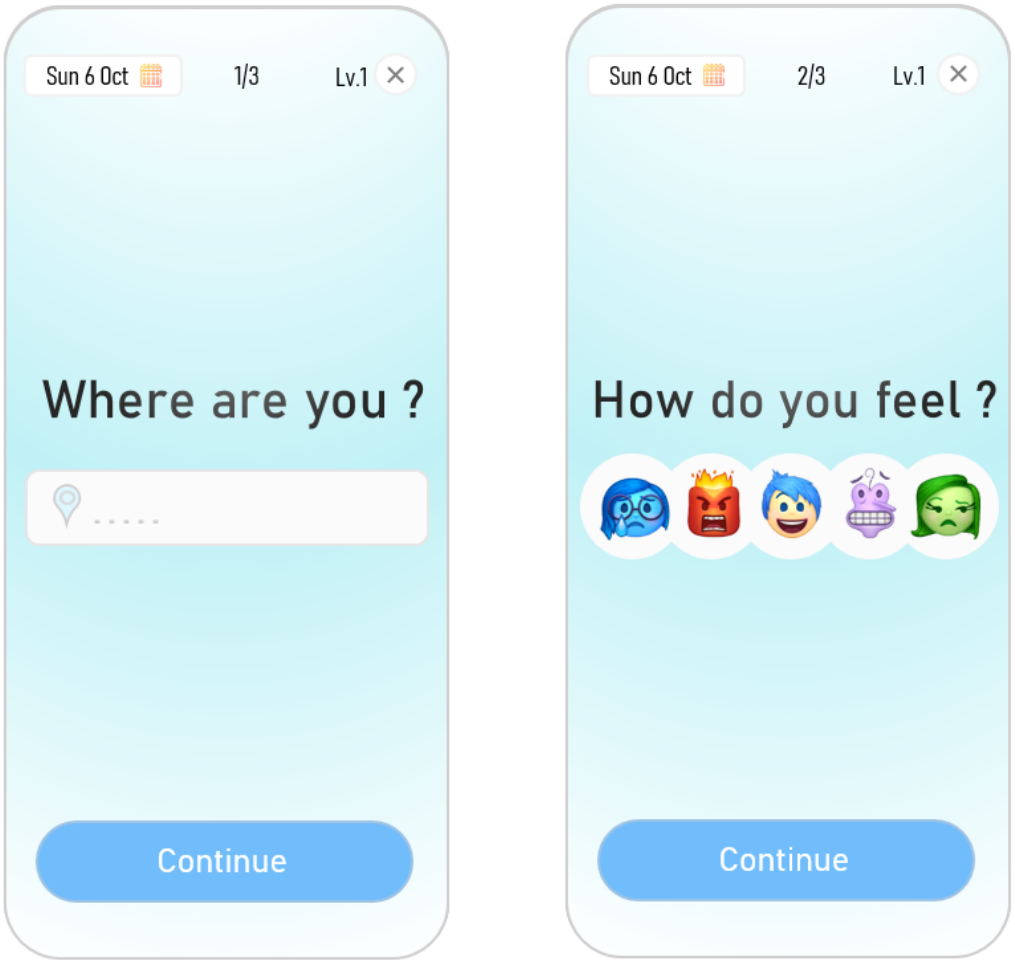

Figure 4.5: User Inputs

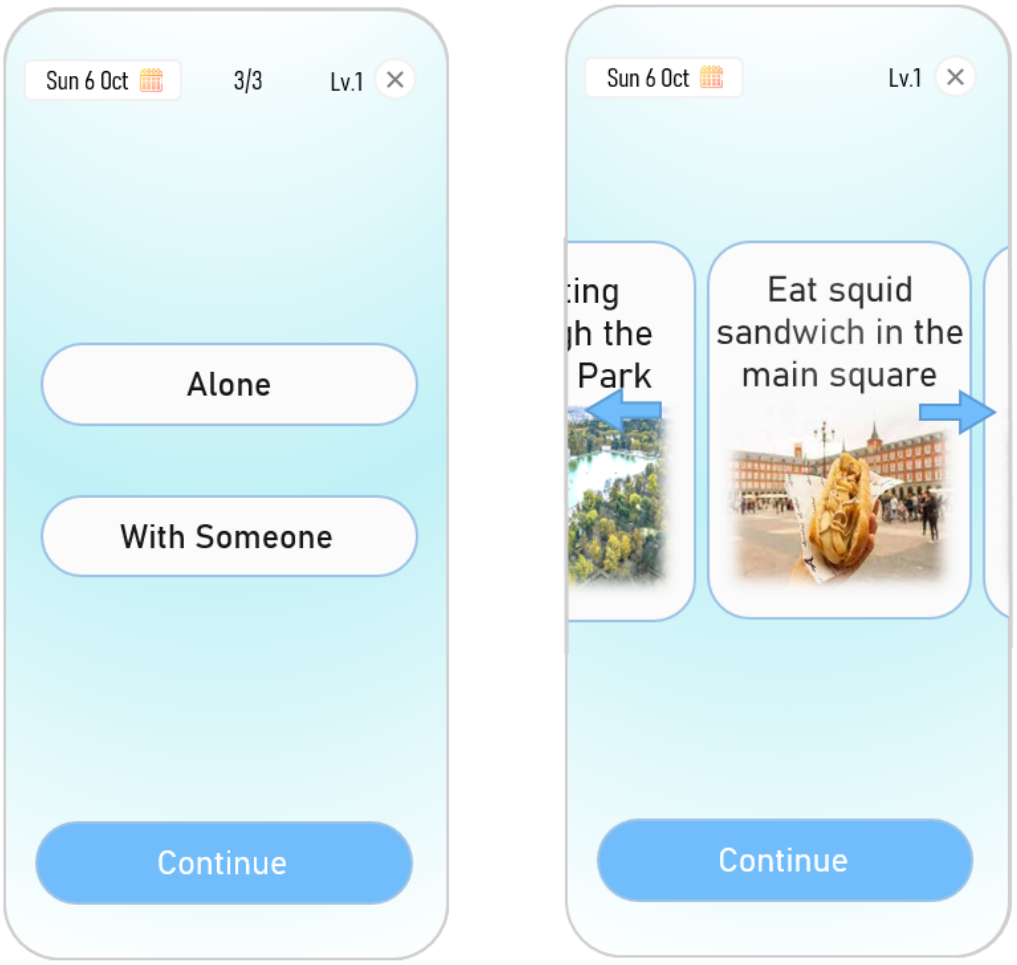

Figure 4.6: Challenge Selection

The app will suggest a list of the best actions for each user in order to improve their mood taking into account the specific activity and the location with the best climatic conditions.

Finally, when the user chooses the activity and performs it, the user will give feedback to the app to improve and train the algorithm, so that the user feels the need to use it and take care of the environment for more unique experiences.

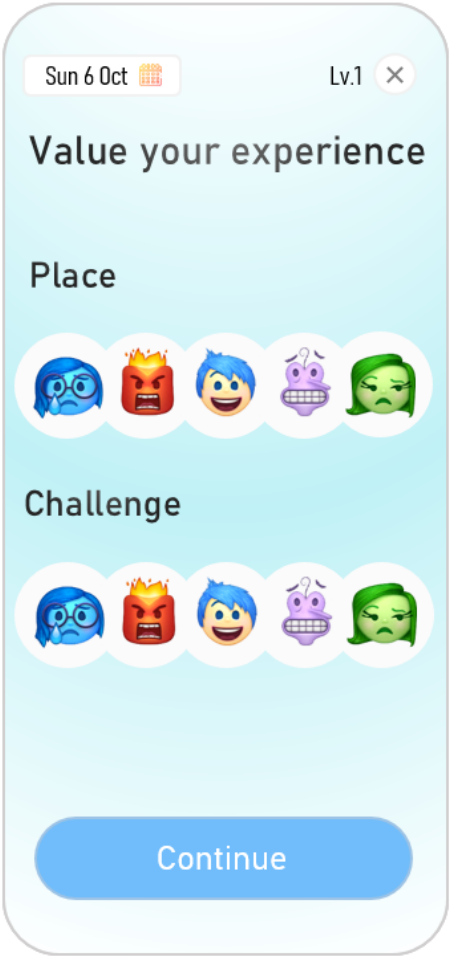

Figure 4.7: Experience Rating

5. Conclusions

In conclusion, the challenge "NASA in our neighborhood" has shed light on the intriguing relationship between climate and human emotions. As we navigate a world where mental health concerns affect a significant portion of the population, this research has given rise to a practical solution – Bubble.

The synergy between climate parameters and user data allows the app to comprehend emotional states, suggesting personalized challenges and connecting users with like-minded groups.

Our project has not only answered the question of how climate affects mood but has also provided a practical solution that can positively impact the lives of countless individuals. Bubble is not just an app; it is the beginning of a significant change in society.

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