MICRO-INTERACTIONS WITHIN USER INTERFACES

Mihael Jergović, Nikolina Stanić Loknar [iD] *, Tajana Koren Ivančević* [iD] *, Ana Agić Cmrk* [iD]
University of Zagreb, Faculty of Graphic Arts, Zagreb, Croatia

Abstract: *This article examines the impact of micro-interactions on the user experience of digital products. A well-structured information architecture with beautiful illustrations is no guarantee for good user experience. It is the small details that can make the experience of digital products more entertaining, more intuitive and closer to people. Small additions make the product more appealing and give users an element of feedback or satisfaction when completing a task. These details, called micro-interactions, are feedback-based events that help users complete a task while making it interesting. The paper explains the process of creating micro-interactions based on the four main components, which are: triggers, rules, feedback, and modes of operation and loops. Warning micro-interactions as well as positive and negative feedback are designed. The impact of the micro-interactions on the user experience was examined through testing the designed prototypes.*

Key words: micro-interaction, user experience, feedback, prototype, prototype testing

1. INTRODUCTION

Cognition and emotion cannot be separated; human cognitive thoughts lead to emotions. It is the emotional system that determines whether a situation is safe or not, whether something that happens is good or bad. Cognition provides understanding, while emotions provide value judgments. A person without a functioning emotional system has difficulty making decisions. Human cognition and a functioning emotional system are present in the use of all digital products. If emotions are not taken into account when designing user interfaces, people are left to draw their own conclusions about personality, and these conclusions can be negative or indifferent (Norman, 1990). The world of user experience design is growing rapidly and there are many ways to improve the user experience, including analyzing potential users, good information structure, and thoughtful written content. Many product designers know that a good user experience is much more than just usability. A good user experience also has a lot to do with the look and feel of a product, but when it comes to designing a great look and feel, nothing contributes more than small details like microinteractions. Although they are small, microinteractions have a huge power to make the experience of using a product more effective and emotional for the user. That's why we say that details are not just details, they create design. Digital interfaces are essential to everyday life in today's fast-paced online world. Users' interactions with them shape their experience and perception of the products they use, whether they are shopping online or using social networks. When completing small tasks, most users are unaware that they are constantly encountering micro-interactions. By incorporating user insights, using consistent design elements and prioritizing engagement, micro-interactions can be created that meet user expectations and contribute to product success (Gapsy Studio, 2024).

2. MICRO-INTERACTIONS

In the field of user experience (UX) design, one of the most important aspects is microinteraction. Micro-interactions are small, subtle interactions that users have with a digital product or service. They can be as simple as clicking a button or as complex as an animation that provides feedback to the user. These small details may seem insignificant, but they can have a significant impact on the overall user experience. Microinteractions are not product features, but they are just as important. They differ from features in size and scope. Features are usually complex (multiple use cases) and time-consuming, while microinteractions are simple, short and easy. For example, the music player is a function and the volume control is a microinteraction within this function (Kolte & Rao, 2024).
Microinteractions in digital products are most commonly used for:

- the execution of a task (mostly in simple applications where one microinteraction represents the entire application),

- the connection of devices with each other,
- Interacting with a single data element, such as humidity or temperature,
- controlling an ongoing process, e.g. changing the TV channel,
- adjustment of settings,
- displaying or creating a small piece of content, e.g. a status message and
- switching a feature or function on or off.

2.1 The importance of micro-interactions

Considering that the user interface should keep the user informed of what is happening by providing feedback. The app should not leave the user in the dark - it should inform the user about the status of the system, and micro-interactions can help provide appropriate visual feedback (Boyd & Bond, 2021; Nielsen, 2012). Micro-interactions are important for any digital product because they enhance the user experience by providing immediate feedback and increasing the overall usability of the product. Micro-interactions provide visual feedback on system status and prevent user errors (Antal, 2022). When the user clicks the button and sees the animation, it gives them visual confirmation that their action was successful. If a user makes a mistake and sees an error message, they know what went wrong and can take steps to correct the error. In addition, micro-interactions can also create an emotional connection between the user and the product. For example, a playful animation or sound effect can evoke a feeling of joy, while an error message can trigger frustration. These emotional connections can influence how users perceive the product and how satisfied they are with it overall. Furthermore, these interactions can strongly influence the personality of the brand and the user's loyalty towards it. Micro-interactions can help guide the user through a product or service and give them visual cues as to what actions they should take or what information they should provide. They make it easier for users to achieve their goals and increase the likelihood that they will return to the product in the future (Batchu, 2018). An enjoyable experience means more than just ease of use — it needs to be engaging, and this is where micro-interactions can play a macro role by contributing positively to the look and feel of a product or service (Joyce, 2018).

2.2 Examples of the most common micro-interactions

Micro-interactions can be found in almost all digital products, and every day designers and developers come up with new microinteractions to improve the interaction with their product and increase user satisfaction. Some of the most common micro-interactions in applications and websites are:

- contact and newsletter subscription forms,
- buttons in social networks,
- call-to-action buttons,
- touch and hold elements on the screen,
- horizontal scroll buttons,
- bars to indicate progress,
- audio and/or visual feedback,
- click/float to show images or text,
- page transitions and
- hover animations on buttons or linked images.

3. EXPERIMENTAL PART

In the experimental part of the work, prototypes of simple actions in mobile devices were created, which the user encounters daily through microinteractions. The goal of creating a prototype is to show how much micro-interactions within the interface influence the user experience, i.e. the feedback that the system or application transmits to the user. Before a prototype could be created for each micro-interaction, the basic components of microinteractions had to be defined: triggers, rules, feedback and repeat loops (Figure 1) (Saffer, 2013).
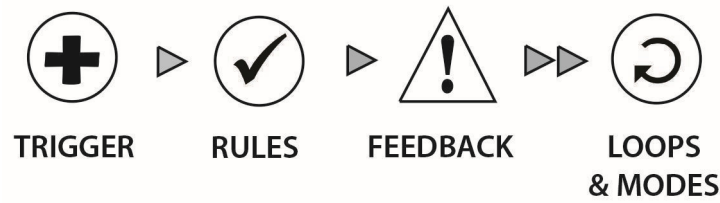
Figure 1: Model of the emergence of microinteractions

Before designing a rule, one must clearly define what the goal of the microinteraction is. The goal of the first designed microinteraction is to warn the user about the changes that occur when the SIM card is turned off. The user's goal is to switch off the SIM card, and this is linked to the rules of this microinteraction. The rules of the microinteraction can be most easily illustrated with a flowchart that graphically depicts the user's path to the goal and the encounter with the microinteraction (Figure 2).
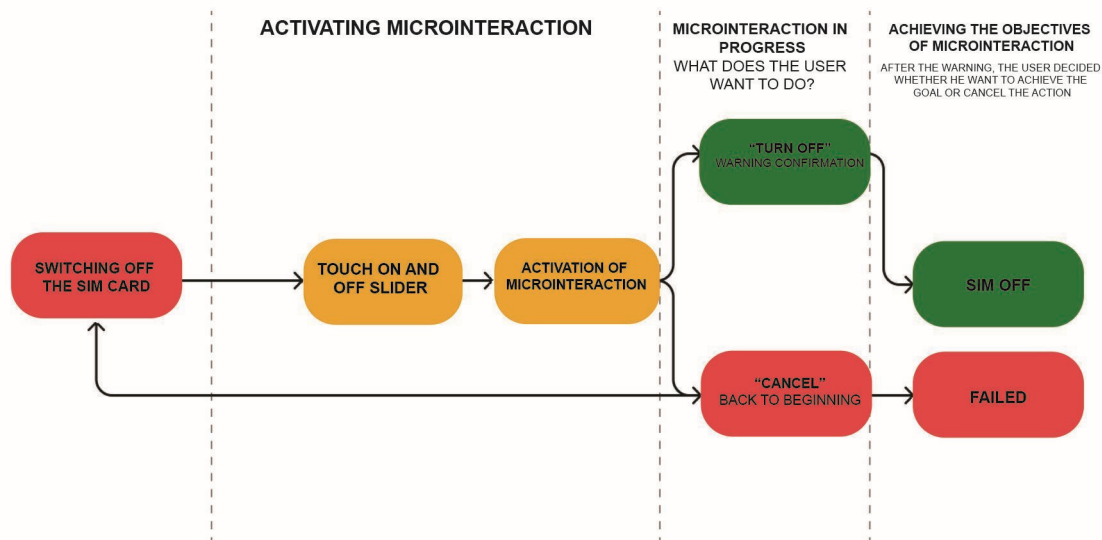

Figure 2: Flowchart for micro-interactions in user alerts

This action can be accompanied by further micro-interactions, e.g. tactile through the vibration of the device and visual through animations and visual feedback. In this example, subtle feedback was also used by changing the color and appearance of the switch as well as a pleasant animation when performing the action. The second micro-iteration developed for research purposes in this thesis has positive and negative feedback. The goal of the user is to upload the file, while the goal of the microinteraction is to provide feedback to the user about the success of the upload, with a separate microinteraction for success and failure. Even the small and often overlooked design features, such as the small animation that shows when something is uploaded, are of great importance. This is an example of a microinteraction - a functional and interactive detail of a particular digital product that is intended to enhance its use (Lagerquist & Samuelsson, 2021). It is activated by a manual trigger or microinteraction rules that require the user to hold the icon and drag it to the desired location. The time required to load the file is replaced by a pleasant animation of the progress bar, which also indicates a microinteraction and is linked to the main interaction that provides the most important information about success (Figure 3).
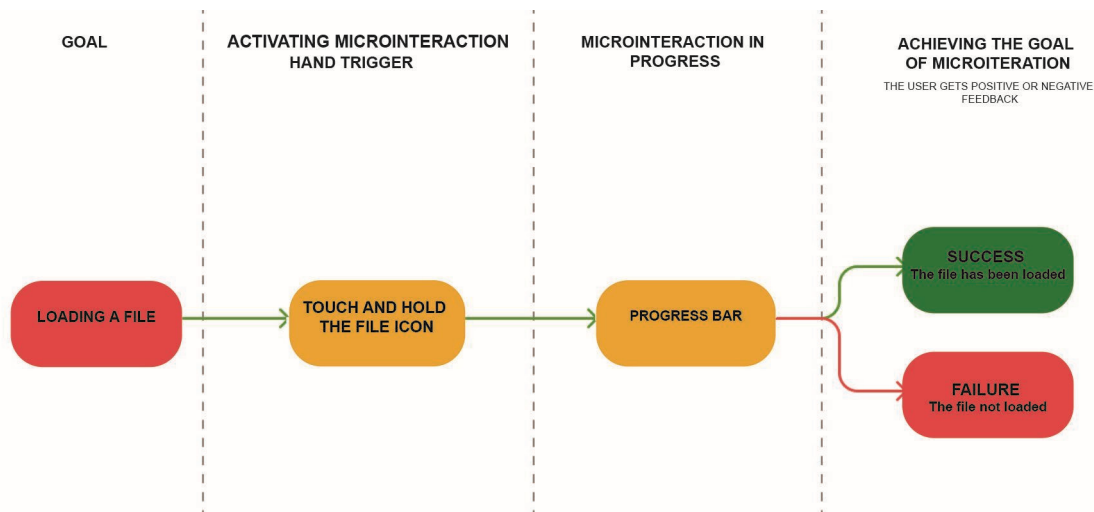
Figure 3: Flowchart for microinteractions with positive and negative feedback

3.1 Creation of the prototype

The prototype was created in Figma. For previously designed microinteractions, components were created that are connected by interactions to investigate the effects of the microinteractions on the users. All components needed to create microinteraction prototypes were designed according to the principle of atoms and molecules. All components used are native components of the Android system. Atomic design is considered a method for creating reusable components in a design system. There are 5 different levels in atomic design, atoms, molecules, organisms, templates and pages (Figure 4).
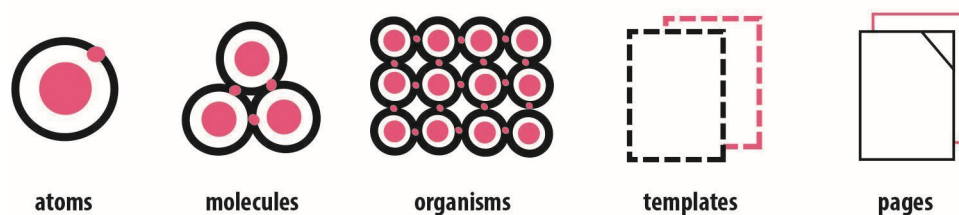

Figure 4: Atomic design

3.1.1 Atoms

They represent the smallest unit of UI elements and cannot be broken down further, e.g. Lego bricks. They serve as the basic building blocks of the user interface. Some examples are colors, fonts, animations and individual images. For the prototypes for removing the sim card and loading the file, the finished native components had to be changed. Text and color styles were created and icons were added.

3.1.2 Molecules and organisms

Molecules are groups of atoms that are linked together and can take on various new properties. They form relatively simple elements of the user interface that work together as a whole. Some examples are: Form tag, search input and buttons.
Organisms are relatively complex user interface components made up of groups of molecules and/or atoms. Most organisms can function independently without relying on other elements on the page. Some examples are: Navigations, sidebars, forms and pop-ups. The native components used to create the organisms were used for the prototypes created, the status bar, lists, dialog boxes, etc.

3.1.3 Templates and pages

Templates are pages without actual content and provide the basic structure of the design content. Basically, they assemble organisms into a proper website layout (Figure 5**)**.
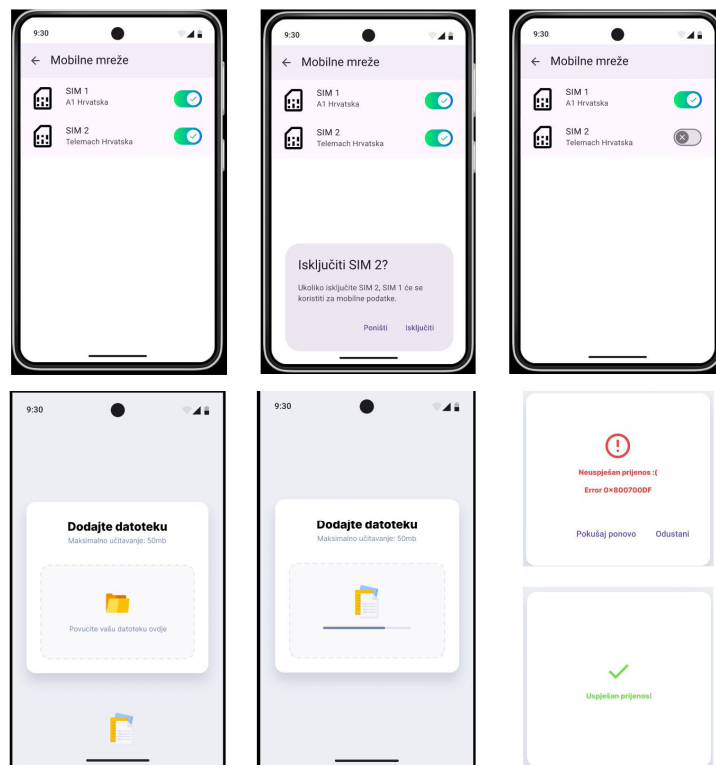
Figure 5: Templates for prototypes

Pages are specific instances of templates that show what the final user interface will look like when the actual representative content is present (Frost, 2016).

3.2 Adding interactions between components

After all components, organisms and pages have been completed, interactions between the components must be added to make the prototype usable and ready for testing.
The prototype consists of three parts:

1. Hotspot - a place where the interaction takes place. The hotspot can be the frame itself or an object within the frame. A hotspot can be located on any object, e.g. a button, an icon or a title.
2. Link - an arrow or "noodle" that connects a hotspot to a destination.
3. Destination - the place where the link ends. In most cases, the destination must be a top-level frame (Figure 6).
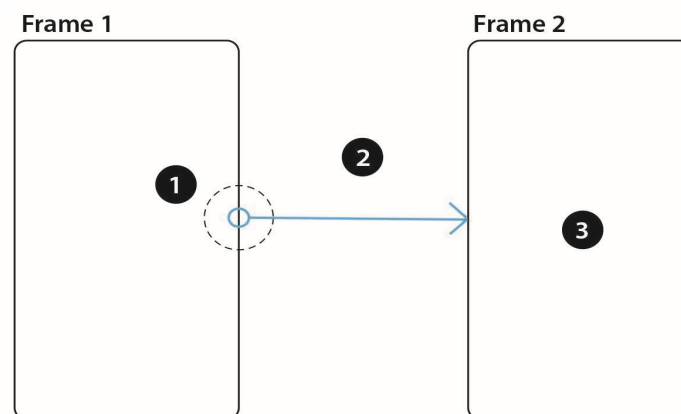

Figure 6: Parts of the prototype

Once an interaction is created, the interaction details model is used to configure the following (Figure 7):

    A) Trigger - Defines what type of interaction sets the prototype in motion, e.g. a mouse click or a touch gesture.

    B) Action - defines what type of event occurs when the user interacts with the focus point, e.g. switch to another frame or switch on an overlay.

    C) Destination - defines where the interaction ends. This can be another screen in the prototype or a layer that appears above the current screen. Not all interactions have a target, e.g. the Back trigger automatically returns to the previous screen.

    D) Animation settings - you define how the prototype moves from one screen to the next.

    E) State management – click here to clear the properties and state of the object when navigating within and between frames.

    F) Add action - add another action to the same trigger.
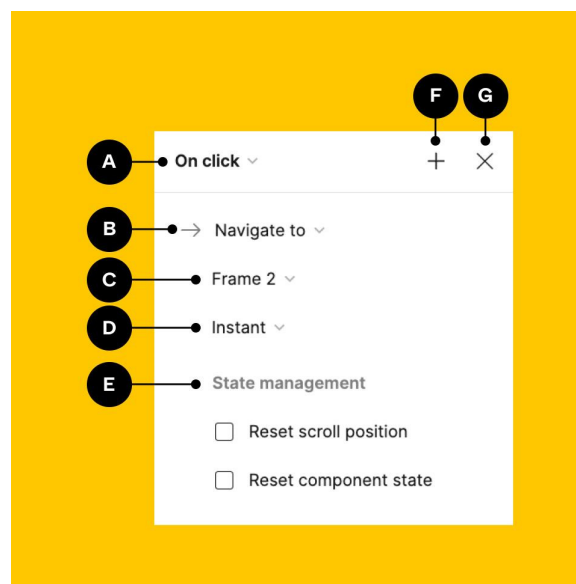
    G) Closing the interaction details model.

Figure 7: Configuration of the interactions

4. TESTING THE PROTOTYPE AND ANALYSING THE RESULTS

Prototype tests and user tests of the previously designed microinteractions were carried out. The test was carried out with 30 test subjects. The test was created via the Maze platform (Maze, n.d.), which enables direct testing of the Figma prototype. In addition to observing the time it took to achieve the goal, respondents were asked questions about the individual parts of the prototype and their experiences with them. For testing purposes, 3 surveys were created, i.e. one test for each prototype. The target group is people aged up to 30 years.

4.1 Prototype 1 - Microinteraction for user warning

For this microinteraction, a prototype was tested with four additional questions relating to the respondents' experiences. The average duration of the survey was 9.3 seconds.

Using data from the Maze analytics platform, it was found that the first screen of the prototype takes the longest time, as users read the prototype's instructions on this screen. Important information relates to the second screen, as this is when the micro-interaction is activated. It can be seen that users spend an average of two seconds on this screen, which indicates that the user reacts clearly and quickly to the system message, i.e. the warning message (Figure 8). The user reacts positively to the warning message and proceeds to remove the SIM card. As this is a test and users are given a specific target, all users are expected to switch off the SIM card regardless of the warning.
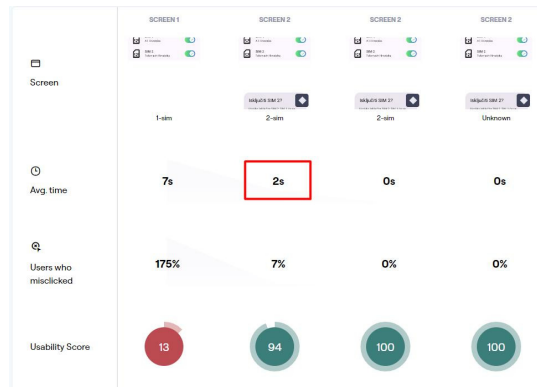
Figure 8: Display of the test results of the warning prototype

In the survey part of the test, questions were asked about the warning message, the subtle animation of the switch and the overall impression of the interaction. The goal of this part of testing test is to uncover human behavior and get feedback on the user experience during testing.

Respondents were asked a question about the warning message. In microinteractions, the warning message is the main carrier of information that can have a direct impact on the user experience. In the prototype example, we used a standard message that each mobile device displays when we want to disconnect one of the SIM cards. The native component of the Android system was used for the layout of the dialog box (Figure 9).
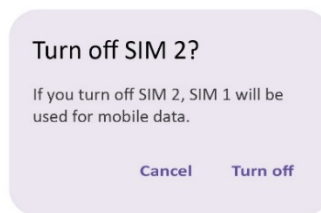

Figure 9: Warning message

The results obtained show that 81% of respondents consider the message to be useful and timely. Therefore, this type of warning is appropriate and users find these micro-interactions very useful, especially when it comes to more sensitive actions. Of the remaining 19% of respondents, 13% consider the message useful but are not satisfied with the message and the performance of the microinteraction. The results of this research confirm the fact that users are confronted with the same or similar microinteractions on a daily basis and find them very useful in almost all applications in which they appear.

As part of the main notification microinteraction, there are some more subtle visual feedbacks to the user in this example. Because these are subtle microinteractions, users are usually unaware that they are interacting with them.

Animations are found in almost all parts of user interfaces, most commonly in the role of microinteractions. The prototypes tested had animated switch components that change color from gray when they are off to a gradient of green and blue when they are on (Figure 10). To investigate the impact of this change on the user, a question was asked about the switch animation.

Figure 10: Two switching states

Based on the results obtained, it was found that 26% of respondents were not sure or did not like the animation. A large number of respondents, namely 74%, confirmed that this animation is pleasant and likable. Thus, this secondary micro-interaction strongly influenced the final impression of the respondents. That is, after the user turned off the SIM card, the switch made this action better and more pleasant for the user with a matching animation and color change. This is confirmed by 71% of respondents who think that the switch has a good visual indication for "on" and "off". The remaining proportion of respondents would change the colors and shape of the icons.

4.2 Prototype 2 and 3 - Microinteraction for positive and negative feedback

In this part of the test, the effects of positive and negative feedback on users were examined. The test took the form of an A/B test in which respondents tested two prototypes of the same end goal and answered questions about the experience of using the two prototypes.
In the first part of the test, respondents had the task of dragging the file icon to the marked location. The tested microinteraction appeared at the end of the action, i.e. on the last screen of the prototype, after the loading bar was filled. In the first prototype, the test subjects received a success message in green, in the second prototype an error message in red (Figure 11).
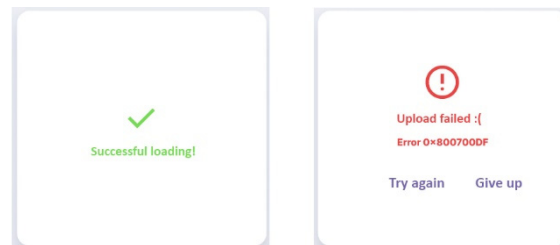

Figure 11: Success and error messages

The statistics obtained show that, on average, respondents took between 10-16s to reach the goal, of which 3s were spent loading the progress bar. The initial microinteraction of dragging the file icon was the trigger for all users to activate the microinteraction, which took an average of five seconds per user.
The second part of this test focused on users' impressions of the prototypes tested. For each of the examples, a question was asked about the feedback the system gave them.
In the case of an error message, the results are split. Part of the respondents consider this message to be good and normal, and another part think that this message has a direct impact on their mood, i.e. it is frustrating. This data confirms the relationship between design and microinteraction with the user's emotions.
As the description of the specific reason for failure was intentionally omitted when creating the prototype, 26% of respondents agreed with this opinion. In such microinteractions, it is therefore most important to explain the error that occurred to the user as clearly and precisely as possible.
As feedback is of great importance for the loyalty and commitment of users to a brand, product or application, a question was asked about the impact of success or failure on users. The first question related to the user's impression after completion. All users rated the unsuccessful prototype as a bad impression, while 70% of respondents rated the successful prototype as a good impression. As already mentioned, the feedback on success should therefore have been better designed visually and provided with an additional illustration or animation.
The next question relates to failure. The aim of this question was to determine the behavior of users when they encounter a failure, i.e. to what extent this affects the user experience.
The results of the test show that the largest number of users avoid the resulting problems. That is, 41% of users would still remain loyal to the product, with a high probability that the system would report the same error message.
The same proportion of users would use the application less or abandon it, while 19% of respondents would have a guilty conscience. It can be concluded from this that messages of this type also influence the emotional state of the user. Errors are an integral part of any application or interface, and it is very

important to pay attention to messages, colors, but also to a person's emotional connection with the product when designing it.

For both prototype examples, a micro-interaction for loading and a progress bar were used. After the user dragged the file icon, a bar with animation and color appeared on the screen, visualizing the progress of the process (Figure 12).
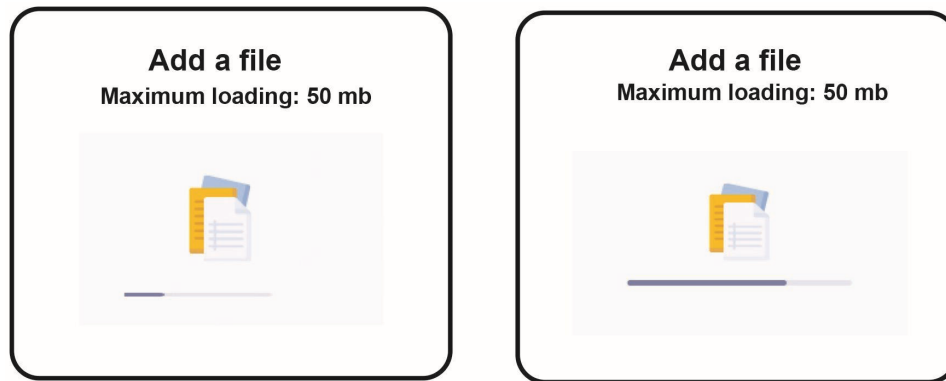

Figure 12: Progress bar

The progress bar, i.e. the animation that gives the user the impression that the page is loading, created a false sense of progress among the respondents in the case of the negative information example. For example, 44% of users surveyed thought that the progress bar was unnecessary with this microinteraction, while 33% of users thought the opposite.

5. CONCLUSIONS

When developing digital products, it's all about the details. Microinteractions provide appropriate feedback about the user's current action. Microinteractions are not product features, but they are just as important. Users encounter them every day. User testing has shown that special attention should be paid to the choice of shapes, colors, etc. in the design. Well thought-out and creative micro-interactions significantly improve and contribute to the design and user experience. When testing the prototype carried out in this paper, it was found that a poor error message is frustrating for users. Research has shown that in such situations users often ignore the problem, whereas the correct message should help them and offer a solution. The feedback the user receives has a direct impact on their mood and actions. It can therefore be said that microinteractions create an emotional connection between the user and the product. These connections have a direct impact on the user's perception and experience of using the product. Designing microinteractions is about finding the right way to make the desired interactions as pleasant as possible without overdoing it. These small details make the design and user experience special and create a strong connection between the user and the product.

6. REFERENCES

Antal, A. (2022) Micro-Interactions and Animations in UX Design for Mobile Applications. *Politehnica Graduate Student Journal of Communication*. 7 (1), 32-43.

Batchu, V. (2018) *Micro-interactions: why, when and how to use them to improve the user experience.* Available from: https://uxdesign.cc/micro-interactions-why-when-and-how-to-use-them-to-boost-the-ux-17094b3baaa0 [Accessed 4th April 2024].

Boyd, K. & Bond, R. (2021) Can micro interactions in user interfaces affect their perceived usability? In: Marti, P. & Parlangeli, O. (eds.) *Proceedings of the 32nd European Conference on Cognitive Ergonomics (ECCE '21), 26-29 April 2021, Siena, Italy.* New York, NY, USA, Association for Computing Machinery. Article 40, pp. 1–5.

Maze. (n.d.) *Design with Figma. Test with Maze.* Available from: https://maze.co/platform/integrations/figma/ [Accessed 13th June 2024].

Frost, B. (2016) *Atomic Design*. Reprint. Brad Frost Web.

Gapsy Studio. (2023) *A Comprehensive Guide on Microinteractions in Design.* Available from: https://levelup.gitconnected.com/a-comprehensive-guide-on-microinteractions-in-design-34c755b4cbe8 [Accessed 2nd May 2024].

Joyce, A. (2018) *Microinteractions in User Experience.* Available from: https://www.nngroup.com/articles/microinteractions/ [Accessed 1st June 2024].

Kolte, A. & Rao, D. (2024) Exploring Microinteractions in Human–Computer Interaction: Design Principles, Types, and User Experience. In: Bhattacharyya, S., Banerjee, J.S. & Köppen, M. (eds.) Proceedings of the 2023 International Conference on Human-Centric Smart Computing, Singapore. Singapore, Springer.

Samuelsson, A. & Lagerquist, A. (2021) *Microinteractions: The effects on web-based forms.* Bachelor thesis. Jönköping University.

Nielsen, J. (2012) *Usability 101: Introduction to Usability.* Available from: http://tinyurl.com/qie7 [Accessed 4th August 2024].

Norman, A. D. (1990) *The Design of Everyday Things.* New York, Doubleday.

Saffer, D. (2013) *Microinteractions: Designing with Details.* Sebastopol, O'Reilly Media, Inc.