Laughtr
A Human Computer Interaction Report

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Concept

Laughtr is a multimodal, information visualisation system designed for the administering and study of laughter therapy on children and young people in a hospital environment.

Long term hospitalisation can have dramatic negative effects on the emotional development of children and young people. As such the practice of offsetting these effects is both a wide and deep area of study for doctors and academics. Our app aims to provide a platform for one such practice; Laughter Therapy. The health benefits of laughing are a timeless nugget of common sense but modern research is uncovering what its effects really are and how they come about. The act of laughing has been shown to decrease stress hormones like cortisol and release positive hormones like endorphins, with the result of reducing levels of stress, anxiety, depression, and increasing tolerance for pain. It's clear to see why harnessing the power of laughter would be a great tool for helping those with serious and debilitating illness. That is why more and more hospitals have been introducing Laughter Therapy. The origins of Laughter Therapy come from the famous journalist and peace advocate Norman Cousins who, when faced with a collagen disease that was crippling him with pain, decided to take matters into his own hands and leave the dreary confines of the hospital. The best pain medicine he could find was not morphine but loud, sustained, and sometimes forced, laughter. He would eventually make a full recovery and while the effects of his home-brand therapy on the disease itself is inconclusive it had assuredly helped his coping with it. Nowadays the therapy takes place within the hospital. Whether it be sessions of group laughter or bringing humour straight to their beds, whether it be young children undergoing surgery or breast cancer patients or elderly alzheimer's victims, whether the laughter be totally natural or totally simulated, laughter has been deployed and studied with great results.

It was for these reasons that we wanted to create a platform for Laughter Therapy that took advantage of mobile devices and their access to the treasure trove of humour found on the internet. Additionally we wanted our platform to be a method of deriving both qualitative and quantitative analysis on the effects of Laughter Therapy live as it happens. The result of this being Laughtr.

Design

Laughtr takes the form of an android app with three main functionalities.

First is a mood evaluation module that uses questions from the Child Health Questionnaire, a globally recognised and academically researched health survey for children, adapted for mobile devices and for multiple levels of maturity and reading comprehension so that the evaluation can be performed with minimal guidance from doctors or parents. Studies show self administered evaluations are no less effective than doctor administered ones and are found to be more comfortable and acceptable to young people. Tests are administered before and after the therapy session to evaluate effectiveness of the treatment and answers are recorded to evaluate changes in mood over longer time frames.

Second is the laughter module. This module records the patients' laugh and provides them with some laugh-motivating material to get them into the mood. The laugh data is saved to the phone for future examination. The material consists of funny images and videos sourced from an external database. This allows all material to be checked and vetted for age appropriateness as well as categorised to provide patients' with content personalised to their own sense of humour and their own sensitivities. There may also be merit in analysing how the patients' tastes changes over time in relation to their mood.

Lastly there is the analysis module. This takes the patients' laugh and provides visualisation and analysation. This has benefits for doctors in evaluating their patients mood, academics in studying the effects of laughter therapy, and also for the patient themself by providing more interesting (but perhaps less medically useful) analytics like the sound wave and the spectrogram. Comparisons are also made to past laughter recordings to again evaluate change over time in relation to mood, but also to encourage the patients to laugh in different ways and with increased passion. Simulated laughter has been shown to provide similar health benefits to natural laughter and often laughing in an absurd or forced manner will bring forth natural laughter as a consequence.

These three modules describe the functional aspects of the app design but what about the non-functional ones?

Dealing with a young target audience comes with a unique set of challenges. The younger generations' heightened familiarity with mobile interaction allows them to adapt and learn the use of the app quickly and make explicit teaching less necessary, but conversely they have higher quality standards for user experience. While adults might accept an application that was more clinical in nature a child is unlikely to engage with such an app. There must be a greater focus on the side of laughter than on the side of therapy.

As such the visual and interactive quality of the app was high on our list of priorities. Many custom assets like the age buttons were created with the intention of feeling like a commercial quality app. Additional consideration to things like making the items and toys on the age display buttons age appropriate and gender neutral. Some assets were not custom made but chosen from existing libraries like the emoji buttons that were picked for their familiarity and appeal to young users. Some other visual motifs we used were the use of primary colours, commonly used for children's products to keep things bright and friendly and colourful, and a Christmas background that was mostly to lift our own spirits and would hopefully do the same for the children.

In keeping with high quality user experience we maintained strict standards for response time to prevent boredom or frustration compounding on what might already be a bad mood, and provided auditory feedback where appropriate. Haptic feedback was also included in button presses. All these feedback vectors are able to be disabled in the settings menu. We wanted to avoid sensory overload from too much feedback but in designing for hospitalised children we knew we would have to cover a range of disabilities and preferences so we made customisation a priority.

Covering disabilities, we made sure not to get too carried away on style. Particularly with text. While many apps targeted towards children use handwritten or cartoon-like fonts our audience are more likely to have problems with such fonts due to possible sight issues from their conditions or reading issues from the low target age of the app and the nature of their illnesses interfering with their education. We could not forego style completely and risk making the app seem unfriendly or, as mentioned above, too clinical. So fonts were chosen for a mix of style and functionality. We used white text with black outlining to be able to maintain consistency across different backgrounds and contexts within the app as well as to ensure readability in different light levels. Text in general was kept to a minimum. Outside of the teenager mood evaluation screen, where we thought it was safer to assume a basic reading comprehension and a willingness to answer more in-depth question, most screens only use a line or two of text. Along with being succinct it again plays into our goal of readability as we can obviously make text larger when there is less of it. This is particularly an issue as our app is deployed on mobile devices with varying screen sizes. A hospital setting would be more likely to provide children with a tablet device for using the app than a phone but to cover our bases we ensured readability and functionality over a range of devices.

We made a conscious effort to focus on making the contents of the app age appropriate. To reduce the need for text further we tried to rely on visual imagery to provide context and information to the users. The mood evaluation screens for children and young children use image based metrics to gauge their emotional state rather than the question and answer form used for the teenagers. Different videos are available on the laughter screen depending on the age selected on the start screen and these videos can be screened by relevant authorities before they are made accessible on the app. There are a lot of sensitive aspects to working with children that we believe we gave proper consideration to.

We'd like to talk about certain aspects of the design came about, how we evaluated those aspects, and as well touch on designs that we cut after evaluation or we felt were out of scope.

The mood evaluation screen was one where we iterated through many ideas. We performed a design studio to work through all our concepts together and come to one we felt fit right. Many of our ideas were variations of the question and answer format we used for the teenager mood evaluation but two ideas were unlike the others. The first was using facial recognition technology for moods in a way similar to modern camera filters. This technology already exists and is widely used but adapting it for our specific needs of mood evaluation was far outside our expertise or the scope of the project. There would also be the issue of calibrating it to work with children as the existing technology is mostly designed for adults. The second idea was to create visual scenarios, like comic books, to express the questions in visual form to children who could not read. Unfortunately we could not find instances where this had been done before and without any examples or professional research we did not feel we could accurately translate the questions into images in an empirically effective way. We would love to do a project on this but again it was outside of our scope. This idea was still very useful to us as we adapted it into the emotion images and face images we use for the child mood evaluation screens in the final design. The core of the idea, expressing moods and emotions visually rather than through text, was something we discovered was a necessity in our design that we may not have otherwise realised.

For the laughter screen we once again performed a design studio. This is where we got the most varied and useful ideas. Individually we had concepts for the laughter module but as a team our vision did not go beyond the rather basic idea of a screen where you laugh. Initial designs produced ideas such as

- An animated gif playing. Although simulated laughter can provide the same health benefits of natural laughing it felt unlikely that children would laugh on command without something to laugh at.
- A countdown screen. We needed a way of preparing users for the laugh in a way that didn't feel too commanding or wordy and built up a kind of suspense.
- A waveform. We wanted to provide the user feedback to show the device was picking up their laugh and what better way than a waveform.

In our second round of the design studio we now had a much more unified idea of what the laughter screen was meant to be and what it should include. Modifications made during this process were

- Changing the animated gif to a youtube playlist. We needed to create a variety of laughter content to appeal to the different maturity and taste of the users' which required some sort of greater control structure. We thought a central web server would work and android natively supported webviews. It then occurred to one of the members during the design studio that this meant we could embed youtube playlists and use its platform to provide a much wider variety than we could.

- Modifying the countdown screen to be much more abrupt. With the laughs being provided by the content on the screen there was no longer a need to prepare the user to laugh beforehand. However we felt there was still merit in explaining that *something* was going to happen and building up the suspense so that the unexpected payoff of whatever laugh-inducing thing they were about to see would make it have more effect.

These design ideas were then collaborated into our final team design. While we include a mockup of what the curated playlists would have looked like in the final app we did not create a backend server behind it, the videos are embedded directly. This was out of scope for our project and a representation of it was all that was needed to show off the design principles behind it.

Design of the analysis screen was limited by what we believed we could actually create. Once again a design studio seemed like the best fit as it would allow us to express what we believed we could implement individually in our first designs and what we could implement as a team in our second designs before coming together and choosing exact requirements. There were two lines of thought between our designs. The first was what we described as sample analysis, providing analysis for the specific laugh sample we had just been provided. This included things like loudness, frequency, wavelength, pitch, timbre, general audio analysis metrics. We also wanted more visually appealing analysis like sound waves and spectrograms that were interesting to those less familiar with audio terms. The second we described as batch analysis, providing comparisons of the sample to previous samples and to samples of other things. We felt like while the sample analysis might be interesting to older kids it would not make much sense to younger ones. What might excite those kids however is seeing if they can laugh louder than they ever have or laugh in funny ways or see how their laugh compares to that of a monkey. A feature we would have liked but did not have the knowledge to implement was audio editing. We thought it would be fun to allow users to edit their laugh, modulating it or adding filters to it and seeing the effects they could come up with. This is one of the main improvements we would like to have implemented in a future version of the app.

With our final designs drafted we asked some fellow students to try our paper prototypes. While they were not our target demographic we could still use them to gauge things like layout and flow of screens and whether they had improvements to the concepts we used within the design. This resulted in a few structural changes like adding a continue button to control movement from the more complicated teenager mood evaluation screens rather than moving straight after evaluation is over to allow time to reflect on the questions and choices while proceeding from the pages for younger children immediately after selection due to the simpler choices and the lower patience for unnecessary button presses.

Implementation

Our first challenge for implementation was deciding on the platform we were targeting. Whilst we had decided on mobile devices in our design stage and had structured our designs to support tablets and phones, there was still the question of operating system. There were three major factors in our decision making. First was the skill-set of our team members. All of us were proficient in Java, the main language used in developing for Android, from our previous years at University, while none of us had much experience with the Xcode of iOS. One member had experience with React Native, a library that allowed for developing Android and iOS apps simultaneously using Javascript and while all members were familiar with Javascript we decided this would still make our implementation too reliant on one member. Second was the range of devices we had at our disposal. Again Android was a clear winner. Between the team members there was one iPhone compared to multiple Android phones and tablets, as well as the option for emulating Android devices on a PC. Lastly we looked at the devices available in hospitals. There would be no use developing an Android app if the hospitals solely used iOS devices or vice versa. The reality was that hospitals were actually quite split on the debate with no single standard. Some used on or the other and some used both. With the other points favouring Android we concluded that it should be our focus and an iOS counterpart was currently out of scope.

The app itself was coded using Android Studio due to its visual XML layout creator tools that allowed us to quickly translate our paper designs onto the app and also change them quickly if any issues arose that we had not anticipated. We used this initial stage to focus on layout and structure before implementing the deeper functionality. The majority of the visual assets were also done at this stage. It is typical for projects to use placeholders but we felt confident enough in the evaluations of our collaborative designs that we could create consistent visuals across screens. It also allowed us to make a number of alternative prototypes for comparison. Unlike the paper prototypes we only evaluated these alternatives within the team. We wanted to know if there were meaningful differences in interaction between touching paper and touching on an actual device. As far as layout was concerned there was not much difference but this is where we discovered the need for feedback such as sound and haptics. You don’t expect paper to give you feedback like that but we found it was so ingrained in our understanding of mobile apps that when it created a disconnect when it wasn’t present.

Once we had the shell of the app complete it was time to start including functionality. Some of this was easy, the mood evaluation module was simply setting up images as buttons and recording answers. The laughter screen presented more of a challenge. There were two main components, the youtube viewer and the waveform. The youtube view was implemented but was not used in the final demonstrated prototype due to a fault where only the first second of video would load. This issue occurred using both the official youtube api as well as a third party package and occurred on both real and emulated hardware. Without the time to

dedicate to track down the cause of the bug we instead chose to demonstrate the concept of the video by embedding a video manually. This would have to suffice for demonstration purposes. For the analysis and visualisation screen we encountered another challenge. Lacking in depth knowledge of audio analysis we had to rely on prebuilt packages to provide the analysis portion. This means that while things like the waveform could be displayed live, other visualisations like the spectrogram were just still images.

While not perfect, our resulting implementation fully served its role for demonstration purposes and would serve as a fine base for a commercially available app.

Evaluation

Our study of Laughtr was carried out with the intention to evaluate three things.

1. How closely the production system functions to the requirements and expectations outlined above.
2. Identify specific problems during testing and eradicate them.
3. What effect the application interface has on the user.

Setup

Due to the intended audience of our application, it would have been difficult to obtain consent for evaluation. This is purely due to the large amount of time it would take to collect permission from sick children, their parents and their hospital. Therefore, we decided to conduct a study on our design and implementation in a controlled laboratory environment as opposed to testing in the field. Despite the fact that we were not able to test the system in the context of intended usage, we hoped that our participants would keep the audience in mind as they evaluated the application.

Before conducting an evaluation, we considered several information-gathering methods. Cognitive walkthroughs are a way of considering how a design guides a user to its intended goals. This would have been an interesting way for us to evaluate the effect of our design choices, aimed towards children of different ages, on a user. However, we did not have access to a psychological expert who could provide us with an informed analysis, and we did not have access to our intended audience.

Heuristic evaluation aims to identify usability problems within an interface’s design, following some agreed-upon usability principles. We kept in mind Nielsen and Molich’s ten user interface design heuristics:

- Current system status should always be visible to the user
- Interface items should mirror their real-world counterparts
- Give the user control and freedom eg to move backwards from screens
- Follow consistent standards of a theme throughout
- Keep errors to a minimum
- Prioritise simplicity so that users do not have to rack their minds for where something is in the application
- Few interactions and fast navigation
- Reduce clutter by sticking to a minimalist design
- Do not display error messages in technical jargon
- Help or documentation should be easily available if it is needed

After comparing our initial design to these principles, we discovered that we were not mirroring real-world items, nor giving users the option to move backwards in screens. We defend these decision with the fact that

1. The intended audience are children, so a more imaginative interface is ideal over something that is realistic or minimalist
2. There is only one intended user flow in this application, with the goal being the analysis screen

We tried to make sure that participants would not feel embarrassed testing the application, as we are aware that laughing hysterically for no reason may look strange. Thus, the evaluation was carried out with the following aspects:

- We used a quiet, isolated space where participants could openly laugh as loud as they wanted without fear of being judged. Not even the evaluators were in the same room as the participant at this point.
- There was a control group which did not interact with the application but was given one of our three mood questionnaires twice in five minutes. The idea was that the control's mood should not change quickly without any stimulation, and an application user's mood would change because of laughter.
- The application was tested on one user at a time rather than in user groups. This meant that we could evaluate individual experiences as the application is intended for use by one person.
- Post-experience questionnaires were used so as not to interrupt participants' laughter.

This was a chance to record unexpected results, such as participants leaving the experience with a worse mood than they came in with. Participants' thoughts were all recorded using a questionnaire. The questions we asked can be seen in this questionnaire https://docs.google.com/forms/d/1flnHshfctaZLL1ptSHggh7pilXW5WPabzeFp5Px56Qw/edit .

Results

The control group received an assigned age for which to fill out a mood questionnaire. If the assigned age was 4-7, the participant would fill out a question like that which is displayed for that age group on the application itself. The same process applied for participants who were assigned ages 8-11 and 12+. The following results confirm our hypothesis: that the control group's mood does not change when completing the questionnaire twice within five minutes. In the case of 12+, the numbers in Minute 1 correspond to the response they gave for each question given in that category.

ID	Age group	Minute 1	Minute 5
1	4-7	Happy	Happy
2	4-7	Happy	Happy
3	8-11	Sleepy	Sleepy
4	8-11	Indifferent	Sleepy

5	12+	3, 4, 1, 3, 3, 3, 2	The same
6	12+	4, 3, 2, 4, 3, 2, 2	The same
7	12+	3, 4, 1, 2, 2, 2, 3	The same