Research Article

A Digital Mental Health Intervention for Children and Parents Using a User-Centred Design

Ahmed Redha Mahlous and Bersan Okkali

1 Prince Sultan University, Riyadh, Saudi Arabia
2 King's College University, London, UK

Correspondence should be addressed to Ahmed Redha Mahlous; armahlous@psu.edu.sa

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The number of children with mental health problems is ever-growing; as a result, nearly 850,000 children in the UK are believed to have clinically significant problems, and only a quarter show evidence of mental illness. Family members often have a hard time dealing with children with mental health problems. As a result, digital mental health interventions are becoming popular for people seeking professional mental health services. Previous studies in this area have also shown that parents who are divorced or working away from home struggle to maintain contact with their children. This lack of communication between the parents and their children can worsen the children's mental health conditions and prevent early diagnosis. Human-centred design thinking is applied step by step in this paper to provide an intuitive understanding of the design process. Five stages of the design thinking process were examined to follow a correct path. The results were promising, and the feedback received assured that the product helps parents to better monitor their children's mental health and provides support when needed. The design thinking process was followed in concordance with the user needs identified from previous studies in this area, which led to a working solution that benefits both parents and children in tackling these problems.

1. Introduction

Child and adolescent mental health problems are associated with a wide range of functional disorders, and their prevalence has increased significantly [1]. The “1998 Australian Child and Adolescent Mental Health Survey and Welfare” is one of the few national studies in the world, which provides the first national picture of child and adolescent mental health to date [2]. The survey noted that mental health problems are relatively common in about 14% of children and adolescents. In addition, it was observed that only one out of every four children with mental health problems and one out of every four adolescents attended professional services [3].

Depression and other mental health problems can affect people’s social and interactive lifestyle. Although there are few people looking for professional help in recent years, it can be seen that there is an increase in health-related applications delivered through mobile and desktop devices, to support the management of chronic health conditions [4]. Thus, digital mental health interventions are getting popular for low-help-seeking people to help professional mental health services. Undoubtedly, technological advances in treatment are not limited to Web-based programs, yet socially assistive robotics (SAR), which is among the new and emerging technology-based treatment options, has emerged.

Every 1 out of 5 children has a major mental health problem. However, only 20% of them receive assistance [5]. Approximately 41% of parents show that they believe their children have recently experienced a behavioural or emotional adjustment problem, but less than 2% took action against it [6]. Previous studies have shown that divorced parents or parents working away from home have difficulty maintaining contact with their children. According to [7], working parents have a certain disadvantage arising from trying to fulfil their work and family responsibilities at the
same time. Difficulties in balancing work and family occur in 75% of parents [8]. There are many available interventions currently that help parents overcome this. However, these interventions are not enough. It has been reported that they have difficulties in keeping track of their children’s mental health while working, and therefore, they are more likely to quit their job [9]. For this gap to be closed, this research is trying to find a working solution that will benefit both parents and children in overcoming these issues. The solution would need to tackle this issue from two different sides: the children’s side and the parents’ side. For the former, a friendly physical product that uses an AI system that is able to use speech and emotion recognition to detect different feelings and analyses is proposed. The product should be a safe haven for children and a friend that is always present when no one else is around. A mobile application complementary to this product will have to be designed for the parents’ use. To obtain a solution to this problem, a wide range of research has been done using existing data from previous studies, rather than having preliminary qualitative data to comply with COVID-19 regulations and avoid face-to-face interactions.

2. Background

Digital interventions often come to mind as a way to increase access to evidence-based treatment without assistance. Various online programs have been produced for the scope of mental health issues and tried with children and adolescents. These days, digital mental health interventions (DMHIs) are picking up expanding considerations as a solution to the low rates of looking and selecting proficient mental health interventions. Studies think about tending to assist the reasonability of computerised or other self-help mental well-being programs; this will be as viable as face-to-face programs [10].

Lately, the expanding prevalence and usefulness of electronic devices hold an incredible guarantee for improving the delivery of mental health services. As [11] states that in this way, there has been an extraordinary intrigue in collaborating with digital interventions and numerous definitions of support have developed. Writing tends to focus on “engagement as a usage,” and in computer science and human-computer interaction (HCI) writing, on “engagement as flow.” “Young people report feeling more comfortable discussing sensitive and personal issues in the relative anonymity of an online context and use the Internet as a major source of mental health information” [12]. Therefore today, young people with health problems feel more comfortable getting help for their mental health than they prefer face-to-face, taking into account the development of the Internet, but they use the Internet as a major source of mental health information [13].

“Mental health is a state of successful realisation of mental function, and the ability to engage in productive activities, to fulfil relationships with other people, to adapt to change, and to cope with the individual’s cultural challenges” [14], which means that mental well-being enormously influences people’s activities, choices, and ways of life in daily life. Mental illness can influence an individual’s thought process, recognition, feelings, and judgments and result in destitute concentration, destitute organisational abilities, and failure to complete ventures and make choices. According to [14], the most common mental health disorders are depression, anxiety and panic, bipolar disorder, behavioural disorders, obsessive-compulsive disorder, and eating disorders. Studies have shown that the treatment of mental health should be treated at an early age.

According to [15], characterising terms that recognize the mental health of children and adolescents is essential because the involvement of sentence clarity can lead to confusion and uncertainty about the persistence of inclusion, the curability of problems and confusion, and the need to allocate resources according to the Welfare Alert.

The number of children with mental health problems is increasing; 850,000 children in the UK are believed to have clinically significant problems, and only a quarter show evidence of mental illness. “One in 8 children have a diagnosable mental health disorder, that is, roughly 3 children in every classroom” [16]. In 2004, one in ten children aged 5–16 years were diagnosed with a mental disorder. Percentage rates are as follows: 3% anxiety disorder, 1% depression, 6% behavioural disorders, 2% hyperkinetic disorder, and 1% less common disorder such as autism and eating disorders. In some children, more than one disorder has been diagnosed as a result of research [17]. Many grown-ups are comfortable with a direct face-to-face dialogue in the treatment of these disorders, but this is not the case with children and adolescents. Numerous children discover it troublesome to precise themselves in words alone, so research has been done on ways to engage children using distinctive communication strategies and recreations [14]. Some examples of tools used are storybooks, artwork, puppets, and board games [18]. These materials provide a way to include children in an indirect communication.

According to studies involving parents, or families in the treatment of a child, it can affect treatment participation and treatment outcomes [19]. Most working parents reported that it was personally important for them to balance work and family [6]. The work-and-family conflict that occurs because of this affects the relationship between the parents of young children. Children who experience social disadvantage are highly likely to experience emotional and behavioural problems [20].

2.1. AI and Emotion Detection. Artificial intelligence (AI) is a recreation of human insights in machines, which are modified to think and act like humans. Emotional AI refers to innovations that use effective computing and artificial intelligence techniques to detect, learn about, and associate with human emotional life. Based on current data, the high prevalence of mental sickness and consequently the requirements for effective mental health care combined with later progress in AI have driven to an increment in research into how the machine learning (ML) field can help in diagnosis, determination, and treatment [21].
Feelings play a central role in most shapes of common human interaction, so we may anticipate that computational methods for the preparation and expression of feelings will play a developing part in human-computer interaction [22]. Psychologist Paul Ekman [23] showed that there are six universal basic emotions: anger, disgust, fear, happiness, sadness, and surprise. These emotional classes, as translated from facial expressions, are imperative key variables influencing social interaction between individuals. In case artificial intelligence robots can oversee complex social scenarios with people, it is important that they can see different emotional categories. It was found that children learned to express the concepts of happiness, sadness, and anger before the concepts of fear, confusion, and disgust at an early age [24].

Mental sickness is one of the foremost treated health issues around the world. In the past, it was thought that there were extraordinarily strong clues to mental illness in the voice. Although these clues in early detection make it prominent in more extreme forms of the disease, “ordinary speech” still raises controversy on this issue [25]. Emotional Facial Action Coding System (aka EmFACS), which incorporates mapping facial muscle setups, particularly to different emotional categories, is utilised in numerous feelings, acknowledgements, and classifications [26]. For instance, “emotion recognition in speech” is used in call centres to detect anger in the voice of employees and to give them appropriate feedback. According to [27], this is useful for the prescribed application that needs to detect negative moods such as anger, hopelessness, fear, and anxiety to protect the user from depression or put users in a positive, happy, and calm mood. This AI-based system can be used to detect the voice of the person using that intervention, and it will become increasingly accurate as over time you will learn the characteristics of the person’s voice and can use the voice perception as a therapist, give insight into the users’ mood, and perhaps give some tasks while feeling depressed or sad. Recently, robots for communicating with users have also been introduced, and this area has advanced enough.

3. Methods

As long as product design is a part of our lives, there have been efforts to formulate and validate the patterns of design processes. These models differ in their content, structure, or graphical representation depending on the discipline or academic background [28]. They also show significant similarities. Most process models easily fit into the analysis to define, design, and finalise. Despite the different visual representations, all models follow the basic design process framework, resulting in five stages. One of the important differences between the models is that some of them are developed to be general and comprehensive, while others are developed to provide an intuitive understanding of the design process. One of these models, human-centred design thinking, is applied step by step in this paper.

Design thinking is often described by researchers as an analytical and creative process in which they can have the opportunity to experiment, create, and prototype, collect, feedback, and redesign [29]. The design process can be described as a temporary process in which the design is changed based on the new information obtained, or on the obtained requirements and specifications [30]. Thanks to this continuous change, inconsistencies in the problem area expressed by the needs and specifications are eliminated and the proposed design solution is improved.

Since the design thinking used in this paper is a flexible and iterative process, there is no fixed step to follow (Figure 1). The first design cycle was completed after the prototype of the designed solution was evaluated with feedback and suggestions from user tests. After that, the prototype was improved with this feedback and suggestions, and another user test was performed. The prototype was finalised with the new feedback and suggestions, so the second design cycle was completed. The design section discussed the latest version of the prototype and how feedback and suggestions were used to improve the prototype features including two-cycle processes. The user tests performed are discussed in the evaluation section below.

3.1. Requirements and Specifications. Parents who are away from their children due to work commitment, travelling, and divorce, or for any other reason tend to have difficulties in keeping track of their children’s mental health while working, and therefore, they are more likely to quit their job [9]. The research aims to find a beneficial solution for both parents and children to overcome the mental health problems caused by the lack of physical time that parents can spend with their children and the inability to be diagnosed early in the future. It is of great importance to find the most critical designs and needed features of the final product, taking into account both parent and child preferences. It is most important to determine the necessary and optimal functions to realize this idea without exceeding the confidentiality limits of both parents and children, and to create products accordingly. For this reason, 5 stages of the design thinking process were examined to follow a correct path.

3.2. Empathise and Define Stage. In the first phase of the design process, an existing data analysis (secondary research) was carried out. This can increase the number of data
available and the likelihood of using these data for research by encouraging a comprehensive understanding of the problem while reviewing papers containing pre-existing data on the research problem. “It has the advantage of not collecting additional data from individuals who require special treatment with respect to safeguards for their well-being and privacy or are challenging to recruit or access.” [31]. Due to these advantages, more effective, fast, and extensive research was conducted. Therefore, previous research papers were used to gain an empathetic understanding of what does the target population feel about the existing interventions about mental health that is being used nowadays.

3.3. Problem Statement. Mental health problems that have increased in the past years create difficulties for people in many ways. These problems start to appear more frequently in children. About 41% of parents believe their children had a behavioural or emotional adaptation problem, but less than 2% took action against it [6]. One reason for this is that most families have a job and do not spend enough time with their children, so early diagnosis is not possible. Parents are more likely to have difficulties in keeping track of their children’s mental health while working and therefore quit their job [9]. Early diagnosis can help us overcome these problems and help us achieve the desired solution by recording or monitoring the mental health of these children.

3.4. Requirements. Considering the following determined problem statement and the themes that are decided in accordance with this problem statement, the user requirements were determined:

1. Parents need comprehensive education and assistance in terms of mental health.
2. Parents need an accessible and useable product that will not interfere with their busy daily schedule.
3. The intervention should create a comfortable and safe environment for communicating with children.
4. A long-term relationship between the intervention and children should be established using screen-based characters.
5. The intervention should be engaged in activities with children in which hearing, seeing, and movement abilities are used.
6. The intervention should involve smart speakers that positively influence family relationships and increase parents’ participation in their children’s lives.

It is decided that the solution should address this problem from two different angles: child side and parent side, because the current problem is caused by the families’ inability to spend time with their children due to the intensity of work. Therefore, two different solutions should be produced, and these solutions should work in a connected way. For children, a friendly physical product is recommended that uses an artificial intelligence system that can use speech and emotion recognition to detect and analyse different emotions. The product should be a safe haven for children and a companion to have at all times, even when no one is around. A complementary mobile application for this product should be designed for the use of parents so that parents’ involvement in the treatment can increase greatly. The mobile application provides a more convenient way of being downloaded to their phones that are always with them in their daily lives.

3.5. Ideate Stage. The ideate stage is an important stage because it is concerned with gathering the feedback of any design product. First, How Might We (HMW) questions were created to determine different designs. With the help of these questions, different solutions were drawn for the design elements and different perspectives were conveyed on the design ideas.

3.6. User Design Ideas. Considering the described requirements and ideas, the main features of the product and application are determined. Children experience different emotions during the day due to the situations they encounter. A friendly physical product is recommended that uses an artificial intelligence system that can use speech and emotion recognition to detect and analyse these emotions. A mobile app displays the results of emotion analysis performed by the AI system in this physical product owned by children and can help parents monitor their children’s mental health. It also helps parents to observe their children’s different behavioural patterns and detect any red flags that may arise and allow parents to communicate directly with children via the physical product from anywhere and anytime. The main features are the analysis of emotions shown in various activities during the day by the child, help from professional employees (psychologists), and a way of communication using the application through the product provided by the children while far away.

3.7. Assumptions. The key assumption for the problem statement is that if an organised, useful, improved product is created with the help of recent interventions using artificial intelligence that has an impact on treatment and matches daily life activities, parents will be more willing to seek help by being more involved in their children’s mental health, despite the stress in their lives.

This key assumption is the basis on which the prototype is tested because it stems from the problem statement and the resulting user needs and requirements. Advancing to the design section, the following secondary assumptions have been made to have an idea for the design of the product:

1. It is important for the children to feel safe and comfortable with the intervention.
2. Children can express their feelings and emotions better if they interact with a friendly product.
3. If children interact with an avatar, this makes them longer associated with the intervention.
Children will not feel lonely because their use of smart speakers is wide. If parents have a way to keep track of their children’s daily emotions in a structured and understandable way, they can more effectively monitor their children’s mental health. If parents have an accessible and usable product that does not interfere with their busy daily schedule and indicates that they should devote time to their children when necessary, they will be able to maintain work and family responsibilities at the same time. If parents can have a way to communicate with their children, even if they are not physically, the problem of distance between them can be solved. If parents can get professional help at the click of a button whenever they need it, it will help them be effective in their children’s lives.

4. Design

To solve the problem that parents and children are facing, the designed solution for parents was turned into a visual prototype using “Figma,” an interface design tool. The feedback and suggestions obtained from user tests are shown below in the final prototype section.

4.1. Flower Pot. Based on the research conducted and the information obtained in this paper, it has been decided that the “smart speaker” feature of the product, which can be used by children when searching for solutions to mental health problems, is the key feature. The AI system found uses a smart speaker that filters the body of the person’s language by digitising their sounds in a machine-readable format and uploading them to their artificial intelligence system before analysing the meaning of the words, making them both helpful and abstract in their lives. The smart speaker is used as a “virtual assistant” to answer questions and perform various automated tasks. It can include telling the weather, playing music, chatting, and countless other tasks [32]. They will be able to own a product that will positively affect their mental health (Figure 2). Particularly due to the need of having vision, hearing, and movement features, a screen attached to the product will be provided and, on this screen, will have avatars of their own choice (Figure 3). The aim of this product is to provide a “virtual friend” that children can enjoy talking to it and at the same time have conversations that benefit their own mental health. The AI system will be programmed to make children feel better by giving feedback and opinions about the situations they are experiencing. When they provide a connection with the application used by the families, they will definitely not exceed the privacy rules and will not explain the child’s thoughts and related opinions to the parents. In studies on the benefits of plants, it is emphasised that the use of plants is widespread to solve health problems [33]. Based on this, it was decided to use a flowerpot for children to take responsibility for growing plants and to positively change the atmosphere around them. The mentioned screen will be placed on this flowerpot and will play a great role in communication with children.

4.2. Mobile Application. A mobile application has been designed that can help parents monitor the mental health of their children by displaying the results of the emotion analysis performed by the AI system in the product for children.

4.3. Wireframes. For the first version of the prototype low-quality wireframes, the two-dimensional framework draft of the application was designed by implementing screens of the primary interfaces, taking into account the sketches made to provide a clear presentation of the layout and flow. Multiple reviews have been carried out to ensure that there are no issues or gaps affecting the consistency of design elements: page structure, layout, information, architecture, user flow, functionality, and intended behaviours. The layout was planned to design on an iOS device (Figure 4).

4.4. Infrastructure of the Model. The following draft versions were obtained in the prototype stage, which is the fourth step of the design thinking process. The application has been concretely developed with the feedback and suggestions obtained from user tests for the evaluation and improvement of the developed prototype. Later, as mentioned in the methods, the prototype was developed by going through the design cycle for the second (last) time and another user test was carried out. In the next section, the evaluations made are mentioned.

4.4.1. Final Version of the Prototype

1. Home Screen. The main page of the application has a simple design and contains only the name of the application. There is a “start” button under the title that is desired to be seen by users so that users can enter the application. Then, there is a piece of small information in the window that opens to remind the users of the purpose of the application. The user enters the application by pressing the button below.

2. Pot ID. On this screen, users are asked to log into the system by typing their distinctive identification numbers.
(IDs) on the flowerpot, which is a product prepared for children. In order not to miss the slightest support, help is provided with small question marks.

(3) Current Mode. A practical feature has been added as a practical solution for parents who want to see what the current mood of their children is in their daily work environment. The emotions children have at the moment are shown on a screen using emojis, indicating the time and date when the application is opened. To be interesting, a colour different from white was chosen, not going beyond the colour harmony of the application (Figure 5). With this feature, the aim is to see the emotions of children at any time without wasting time.

(4) Calendar. One of the first features, the calendar, was used for a more useful apostle of emotion definition, which is the main feature of the app. The purpose of this calendar is to create an effective design by facilitating the selection of days. The selected day and the current day are clearly shown on the calendar.

(5) Analysis. The emotions acquired by the system through emotion recognition are shown in the section under the calendar. The hourly intervals of emotions are shown under emotions as it is thought to make great progress to solve the problem statement. One of the updates made after user testing is that parents may want to take notes about these feelings their children have and they can provide more detailed and cautious information on their own.

4.4.2. Feedback: “If They Can Make Notes about These Feelings”. More detailed sentiment analysis is provided by pressing the buttons with a pie chart and a graph icon located at the bottom of each page. A pie chart displays daily emotions clearly, and the graph compares the level of daily emotions (Figure 6). Under both of the demonstrations, reports of the AI system are shown. These reports allow parents to be more involved in the mental health monitoring of their children by contributing greatly to them.

Scheduled Message. To solve the problem of parents being away physically or having long work and not being able to be with their children, a feature has been added so that they can reach the children with the help of a flowerpot. Although this may seem like a simple message interface, the set time and day will facilitate communication with children in any way. They also stated that in addition to messages that parents can reach their children if desired, there should be additional features such as voice message, and video and image sharing. Therefore, the message features that they can reach their children have been updated and made in a multidirectional way.

4.4.3. Feedback: “Adding More Interactive Elements between Kids and Parents except for Chat like a Video Call or Video Sharing.”
Professional Help. As stated in the requirements, it was understood that when children had mental problems, the parents want to feel not alone in this process and wait for a helping hand. To overcome this problem, a feature has been added to the application where they can get help from psychologists (Figure 7). The number of psychologists owned by the application was shown as 3+ psychologists, but according to the user testing, this feature was updated by mentioning that there should only be one psychologist and that special and single-focused help could be received.

Feedback: “I’m not sure if you can choose the therapist and stick to the same person, or if you have to use the online one. Because I would choose the ability to stay connected to a therapist so you can maintain consistency.”

A screen was added to this professional help feature upon a perturbation found in one of the survey responses. On this screen, it is selected whether you want to talk to the psychiatrist on the phone or by texting. In this way, the satisfaction of the users has been ensured by communicating in the desired ways (Figure 8).

Feedback: “I would change the chat part. Since it is about a children’s health and I am a mother, I think I would prefer calling to messaging about my children. Because it is too emotional and hard to talk about my children’s bad mood, in texting, I believe that the emotions are disappearing.”

(2) Reminders. The prototype of the proposed solution includes features that encourage the user to interact with their children while experiencing mental health problems. Although it is not included in the initially suggested design solution for this prototype, it is suggested that a reminder can be used to inform parents of an emergency, based on user responses (Figure 9).

Feedback: “If it is possible, I would love to have an alert message on my phone when my child is crying or in deep sadness when I am not at home. Therefore, I can call him immediately and cool down him.”

The most important point of the application is that it does not violate the private lives of children. In the analysis made with the help of AI, the words or sentences used by children are not conveyed with certainty. Emotions are transferred to practice with the analysis made only from the voices of the children. These feelings are then shown as a detailed analysis. It indicates whether there is a red flag depending on what may have pushed them to feel these emotions or how long they felt these emotions in that stationary.

It has been determined that the designed solution meets the user requirements and assumptions (Table 1).

5. Evaluation

Different usability tests were carried out to determine whether the application has suitable features for its target users. This was first done using an online survey by asking 15 target users about the following:

(1) Their first thoughts about the application
(2) To what extent do they think the product solves the problem specified
5.1. User Testing Protocol

5.1.1. Objectives. There are eight objectives aimed to be understood. It should show whether the proposed solution was made in accordance with the problem statement. Therefore, it is important that the survey questions should address the above condition in user testing:

(1) Is the application easy to use?
(2) Is it a convenient solution for daily use?
(3) Does the product match its purpose?
(4) Can users interact with the application without any assistance?
(5) Is the analysis of emotions can be understood clearly?
(6) Do they feel like the features are enough to address the solution?
(7) Do they think their children can interact with the flowerpot?
(8) Are they concerned about their children’s privacy?

5.1.2. Participants. To effectively explore usability issues, 15 participants were reached through the “Prolific” online survey platform. The reason for its recruitment of 15 users is that it is thought that a sufficient amount of information can be reached as a result of the survey. The participants have children aged between 9 and 15 and full-time jobs (Table 2). Most of the participants stated that they work on rotating shifts including night shifts. It was aimed to achieve a more effective evaluation and conclusion by dividing it into small groups of 5-5-5 people. The users in the first two test groups were asked about the design and features of the application, such as what they think about the application, will they use it, and whether it reflects its purpose or not. With the answers given, small changes were made in the application and a short video of the prototype was shown to the last group again. This time, questions were asked to develop the application further and to empathise with the target users such as how to use the application—for example, for what situations they use this application in their lives, and what problems may their children have with the product. The solution was developed by looking at the results obtained at the end of each 5-person assessment and evaluated once again.

5.1.3. Results. Participants watched a short video showing how the prototype worked and had a smooth understanding of its purpose and design process. The information obtained through the questions asked to the first 10 participants is as follows: they indicated the style and usability of the design

| Main functionalities | Key assumption and secondary assumptions |
|----------------------|------------------------------------------|
| Showing daily and weekly emotion changes using emotion detection | It is successfully testing the key assumption as the parents can monitor the emotion change of their children and detect any red flags that may arise. |
| Screen-based avatar and smart speaker | Secondary assumptions 2, 3, and 4 are tested by this feature. The successful testing of this functionality shows that including a screen that displays the avatar picked by the children creates a long-term relationship between children and the product in a friendly way. |
| Calendar | The calendar feature successfully tests the secondary assumption 5 because the analysis of the children’s emotions is displayed in an organised and structured way through the calendar for parents’ control. |
| Reminders | Including a reminder functionality successfully tests secondary assumption 6 as it alerts parents of any problems with their children, and, if necessary, devotes time to their children, maintaining work and family responsibilities. |
| Having a scheduled messaging platform | Secondary assumption 7 is tested by including a message feature, as the platform helps parents send any text or voicemail to their kids at the time and date they set. |
| Ability to get professional help | Secondary assumption 8 is tested by this feature. The successful testing of this functionality shows that parents do not feel alone when facing their child’s mental health problems and helps them get support when needed. |

| Participants | Age | Number of children | Age of the children |
|--------------|-----|-------------------|---------------------|
| P1           | 43  | 2                 | 10,15               |
| P2           | 36  | 1                 | 9                   |
| P3           | 39  | 1                 | 11                  |
| P4           | 32  | 1                 | 9                   |
| P5           | 37  | 2                 | 10,11               |
| P6           | 38  | 3                 | 6,9,13              |
| P7           | 36  | 2                 | 5,9                 |
| P8           | 33  | 3                 | 7,9,11              |
| P9           | 31  | 1                 | 9                   |
| P10          | 33  | 2                 | 11,11               |
| P11          | 35  | 2                 | 13,10               |
| P12          | 37  | 1                 | 10                  |
| P13          | 41  | 2                 | 14,11               |
| P14          | 34  | 2                 | 11,13               |
| P15          | 34  | 1                 | 9                   |

Table 1: Visualization of the design solutions related to the assumptions made.

Table 2: Anonymous visualization of the participants with the letter P along with the participant numbers.
were positive. Participants are indicated by the letter P. For example, P4, P7, and P8 participants mentioned that the design excited them and wondered what kind of experience the app would create in real life:

“I think it’s user friendly and has a good interface. I would like to see how children interact with it to get the ratings for the day.”

All respondents said the design has an easy use; 80% said they could use the application. Later, the design was updated with the answers to the questions asked about how to improve this design. P3 and P4 suggested that the application should have a feature that they can take note of in more detail about the given analysis; P8 and P9 said little features needed to be added to increase interaction with the child, but P1 and P4 expressed dissatisfaction with the design of the professionally assisted messaging feature and expressed concern about this feature.

Then, user testing was applied to 5 more participants with updated survey questions to get a more detailed answer. The answers given by looking at the design and general application purpose are as follows—the thoughts on design are very positive, and the design according to P12 and P14 is very eye-catching and attractive:

“The application uses eye-catching colours and is very visual. Every screen is well designed and simple to understand. The functionality and the purpose of each button is clear from the text on the buttons as well as the icons provided.”

P15 stated that the design is suitable for daily use and the colours used have harmony. The rate of use of the application by participants is 90%. They argued that the purpose of the design was clearly understandable and said that it was easy to use. However, P14, in her suggestion for the development of the design, stated that the messaging used in communication with children is not suitable for them, and emotional issues should be communicated by call. Based on the responses given by 85% of the participants, it was stated that the solution made was suitable for its purpose. Some parents were asked to give an example of a situation in which they could use the app. Looking at the examples given, he stated that they can benefit from regular follow-up on a weekly basis, even if there is no red flag, mostly due to distance from business trips:

“As I sometimes need to travel for work, I would use this application to make sure my kids are fine, and it would provide me with ease of mind.”

“When I came home later than my child, I would control his mood regularly. Moreover, if there are some special cases when I need to be out for work or etc. I would also check it. I think checking weekly when there is no special case is also good, because maybe he can share his feelings easily with the pot, even we are not separate.”

However, they think there is a problem with the children part of the design. Because the flowerpot can only analyse the one spoken in its location, the parents stated that a product should be made that their children could carry around all time: “My child cannot take this to his school something like a toy that could be better.”

5.1.4. Heuristic Evaluation. This section discusses the user interface design and the use of heuristic methods to evaluate the content of the mobile application. Thus, the purpose of the heuristic evaluation is to improve the user interface design of the mobile application and evaluate the content of the application to ensure it matches the needs of the parents of the mentally healthy ocular. The evaluation was carried out by a nonexpert by relying on the set of 10 heuristic usability principles of Molich and Nielsen. This helped to evaluate the usability of the developed prototype. It is found that the design solution does not provide any means of error prevention. The results were then used in conjunction with user responses and the user scenarios to improve the application and fix the issues found (Table 3).

6. Results and Discussion

The target audience expressed their appreciation towards the application in the surveys and during the testing phase mainly due to its usability and ease of use. Although the application was only presented in a short video that explained the features and the flow of the application, the participants fully agreed that the design matched with its purpose. The results showed that the users are highly likely going to use the application if they were able to, and this supports the claim made about the application enabling parents to be more involved in their children’s lives. Nevertheless, it has been noted by some users that there is uncertainty as to how their children would interact with the physical plant product, which made them unsure to which extent would the application’s features be used. For this to be tested, a physical prototype would need to be made and the product should undergo a field study to accurately measure the success of the whole solution. With that said, the parents involved in the study were still optimistic about the usability and effectiveness of the application and the flowerpot.

Furthermore, 67% of the participants stated that the flowerpot and the application do not invade the privacy of the children. The remaining 33% still had their concerns about the privacy of their children as they were seeing it from a broader and less accurate perspective. They saw that there is a flowerpot that listens to the speech of the children and later on informs the parents, which sounds troublesome for anyone that does not have knowledge about how it is implemented. Firstly, the AI and the smart speaker within the flowerpot would be implemented in a way that does not store any of the dialogues between the child and the flowerpot. Instead, the words and sentences will be analysed, and the speech would be discarded. Secondly, the smart speaker will not be listening to anything going on unless the child gives permission to. In addition to that, the application that the parents will have downloaded on their phone would not show neither the dialogues nor any of the sentences uttered by the child; it would just display the analysis and the overall emotion, which helps identify red flags. This is similar to when a parent takes their children to a psychiatrist if they are worried about their mental health. If asked, the psychiatrist never disclosed any of the private information of that
session, but they would only give advice to the parents based on their analysis of what they have been told by the child. Just as a psychiatrist keeps the private information of their patients hidden, the flowerpot does not share any of the data it has and instead just shares the overall analysis and advice with the parents only.

The evaluation of the application was supported with user scenarios and heuristic evaluation to identify any problems and establish a better understanding of the proposed solution. Due to the lack of resources, however, experts were not hired to carry out the heuristic evaluation. It was instead carried out by a nonexpert but strictly adhering to certain heuristic usability steps and common practices. A more successful evaluation would have been carried out if 3 to 4 experts in the field were available to evaluate the prototype.

Since the test is presented online as a short video that shows how the solution design has a flow and what features it has, the feature usage and interaction of the application are limited. Not all design issues can be explained unless accompanied by additional assessments or additional testing. For this reason, more user tests should be done in different environments. This will allow users to interact with the prototype and test whether the solution design is fully suited to the users’ needs and requirements. Preferably, on a larger project scale, after the tests were described in the assessment section, more participants are recruited and a few more rounds of usability tests are conducted to find new problems. In this way, the test completion times and the resulting error rates can be displayed clearly.

6.1. Limitations. Although positive results were obtained in the virtual prototype evaluations made using the target users, some limitations have emerged due to the obstacles encountered in this study. One limitation is that the flowerpot and applications have to be used together. Parents with more than one child are required to buy a pot for each child because the mobile application can only be used to analyze emotions using the analysis of one person’s conversations. At last, the flowerpot for children was designed as a product that the children cannot always be using in their daily routines and cannot carry with them when they are out of home; the prototype can only analyze children’s speech where they are located. Some participants also expressed this problem in their answers.

7. Conclusions

The paper aimed to find a useful solution for both parents and children that helps them cope with the mental health problems that they can face. The design thinking process was followed in concordance with the user needs identified from previous studies in this area. The requirements for the proposed solution were defined from the results of previous research papers and studies. Different ideas were explored, and an assumption list was created based on the defined requirements. The assumption list led to a unique prototype design. The prototype was tested using 3 system usability methods: user testing, user stories, and heuristic evaluation. Participants reacted positively to the prototype’s design, ease of use, and its suitability for their daily lives. The results also showed that the parents can follow the mental health of their children in a better way and can be supported with the developed prototype. The success of the project requires that were extracted from previous research papers to solve the problem statement has been achieved as expected.

7.1. Future Work. There are several aspects of the paper that can be enhanced by addressing the prototype’s limitations and by conducting a more comprehensive evaluation. If
positive results can be obtained in the additional evaluations, a functional mobile application can be implemented. Hence, the application can be developed by observing the interaction of the parents with the application better.

The single-person analysis system of the application can be further developed, and the limitation can be removed by adding a special voice recognition system for the person who is using and adding multiperson analysis to the application. Therefore, the problem that families with many children may have while using the product will be removed. Another feature that can be added is the video search feature. The video call, which is a feature identified by the participants during the evaluation, is added as an improvement that can be made in the future due to the limited time available.

**Data Availability**

The data and materials related to surveys and the questions asked on finding the data are available at https://github.com/bersanokkali/ResearchPaperData.

**Conflicts of Interest**

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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