Anamel: Children's Psychological and Mental Health Detection Application by Drawing Analysis Based on AI

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***Abstract*—Psychological and mental health issues affect many people worldwide. However, the impact of these issues is stronger on children starting from early ages until their teenage. Using drawing to analyze and detect such feelings is a common way for specialists to help children express their feelings. Due to that, this study employs artificial intelligence to improve and ease this process by developing an application to help parents and specialists have a first-look analysis of their children's drawings. The Anamel application allows users to go through an experience that simulates clinics and psychological centers by being able to detect several feelings: happiness, sadness, anger, and aggression. Users start by answering pre-questions to collect initial information about the child. Then they can upload the image of the drawing, which is processed using computer vision techniques, where the AI model based on YOLO deep learning architecture provides the analysis results with an accuracy of 94%. Finally, they answer the post questions to ensure the final result. Specialists can also register themselves in the application to allow parents to communicate with them for extra help.**

***Keywords*—Application; mental health; drawings; artificial intelligence; YOLO; deep learning; computer vision; flutter**

I. Introduction

In our fast-paced world, children face many challenges and changes in their daily lives. Understanding children's emotions at an early age is crucial for ensuring their healthy psychological development and preventing future mental health issues.

These challenges have a strong impact on children's feelings and mental health, especially children who cannot express their feelings in words. Due to that, drawing serves as a solution for specialists to analyze, understand, and communicate with each child's thoughts and feelings [1]. However, this manual process is complex and time-consuming for specialists and parents. Although some research has explored emotion detection in children's drawings, practical mobile applications that seamlessly integrate AI models for real-time analysis and user interaction remain very limited.

This study presents an efficient method to overcome these obstacles by providing an AI (Artificial Intelligence) based application to ask, analyze, and help to get the most correct results for children's drawings after training and testing three YOLO (You Only Look Once) models trained on drawings for children in the range of 5 to 15 years old. The YOLO algorithms are known for their great accuracy and speed, which have been proven by several experiments in comparative studies [2]. Because of these benefits, we trained different versions of the YOLO algorithm on our dataset to see the range of results. All the tested models were trained on 500 drawings collected manually by the authors from their surrounding society. The YOLOv8-cls (You Only Look Once Version 8 Classification) model was chosen after a long time of research and work on training and comparing other modern AI models, such as YOLOv9 and ResNet50 [3]. This model reached 94% accuracy after 10 epochs with a compact model size of 2.83 MB, which is suitable for mobile applications. Next, the application interfaces were built using Flutter, connected to Firebase for storing data. Flutter is an open-source UI software development toolkit created by Google. It is used for building natively compiled applications for mobile, web, and desktop from a single codebase [4]. Firebase is a comprehensive app development platform by Google that provides tools to build, improve, and grow apps [5]. By integrating Flutter and Firebase, the trained AI model in TensorFlow Lite format, the system ensures efficient on-device performance suitable for real-world use.

Hence, this study bridges psychology and technology by providing an intelligent, accessible, and reliable tool that supports early emotional assessment and facilitates communication between parents, children, and specialists.

II. Related Work

Despite the significance of drawing analysis in psychological diagnosis, it has not experienced substantial technological advancements. Currently, only one application worldwide is dedicated to the analysis of children's drawings, which is limited in its capabilities [6]. This literature review synthesizes findings from research papers that present studies and applications related to the analysis of children's drawings for diagnosing psychological conditions and mental health. It also includes research papers on the general diagnosis of psychological and mental conditions.

A study [6] proposed creating an application based on artificial intelligence to recognize children's emotions through their drawings. This is due to children experiencing many different emotions, such as happiness, sadness, fear, and feelings that are difficult to express. In the ESRA application that analyzes drawings and classifies them into only two categories: positive and negative emotions, a convolutional neural network model was applied to classify drawings, where three pre-trained models were used to train the model: ResNet18, ResNet34, and

ResNet50. The study conducted four experiments using different combinations of datasets consisting of 102 drawings from a local school and 521 drawings from online sources. The deep learning model trained using the Fastai library in Python classified graphics into positive or negative emotions with an accuracy of between 55% and 79%, and the study stressed the need for further development to improve the accuracy of the artificial intelligence model. With the addition of more feelings and emotions.

Furthermore, the work in [7] focused on analyzing children's drawings to identify potential psychological problems by using a shallow convolutional neural network (CNN) to extract features from drawings, specifically those depicting trees. The model uses a multi-label classification method using the sigmoid function in the fully connected layer. The study included a data set for the school's fifth grade with more than 300 drawings of males and females. The drawings were analyzed based on psychological problems such as anxiety, stress, aggression, division, insecurity, and inability to learn. These problems are identified through a preliminary psychological analysis conducted by psychoanalysts of children's drawings. The classification accuracy using the CNN model in the study reached 70.4%. The study emphasized the importance of early identification of potential psychological problems in children and the potential benefit of the artificial intelligence model in providing an auxiliary diagnosis to psychological counselors.

In the same context of our study, research in [8] explores the potential of using artificial intelligence (AI) to analyze children's drawings for psychological assessment, specifically focusing on the House-Tree-Person Test (HTP). By employing object detection technology, it achieves a mean Average Precision (mAP) of about 92.6% to 94.1%. The resulting psychological analysis table exhibits an average accuracy of 94.4%. This approach aims to overcome limitations in previous classification-based studies, offering a more comprehensive extraction of information from images.

In addition, the work in [9] introduced a database named EMOTHAW that connects emotional states to handwriting and drawing. The database included 129 samples from the participants. The emotional states of the participant, anxiety, depression, and stress, are evaluated using the Depression-Anxiety-Stress Scale (DASS) questionnaire. The data is collected using a digitizing tablet and includes pen positions, time stamps, pressure, pen azimuth, and altitude. The research shows an analysis of the database EMOTHAW using random forests, a machine learning algorithm, to identify features that are indicative of emotional states. The top-ranked features for each emotional state are identified and used to build random forest classifiers associated with each emotional state. The results show that stress and anxiety recognition perform better than depression recognition. The research also provides accuracy, sensitivity, and specificity evaluation measures obtained from cross-validation experiments.

However, the study [10] focuses on testing several methods of image classification, using machine learning and computer vision algorithms to classify DAPT (Draw-A-Person Test) images. A collection of 1000 sketches was collected from primary school students in Nigeria, aged 4 to 11. The sketches are manually classified according to age. The research investigates the possibility of combining sketch recognition with the analysis of cognitive tests. The main reason why the researchers conducted several image classification tests using machine learning and computer vision algorithms is to see if they can develop a model to classify images automatically. The research first conducts a classification test only using the pixel value of the pictures and SVM and ANN to classify them; the accuracy results are 18% and 17%. Then they used HOG (Histogram of Oriented Gradients) to extract features from pictures in all eight datasets, also using SVM and ANN to classify them, and the accuracy ranged from 17% to 48% with SVM trained on the Double_inv dataset obtaining the highest result, showing that the double data performed better. Then they used BoVW and used two different ways to classify the dataset: manual and formal methods. The manual method result reached 54% accuracy and 62% accuracy with the double dataset. The research also shows that a test was conducted using several types of CNN structures and algorithms, with the highest accuracy achieved in this experiment being 62% with the BoVW manual method.

Also, Binti [11] delved into the creation of a sketch recognition tool employing deep learning to observe the psychological growth of children. She collected a dataset of 1,051 children's sketches. The researcher asserts rapid design and prototyping cycles and employed the Rapid Application Development (RAD) approach. The programming language used in this research is Python with the convolutional neural network (CNN) model for image recognition. The highest accuracy achieved is 89%. The research aimed to overcome the limitations and constraints created by manual identification methods and the lack of psychological identification tools for children's mental and emotional development. The research showed that some traditional methods, such as the Drawing Person Test (DAPT) and some other psychological drawing tests, were explored as standard assessment techniques. One of the future recommendations of this research is to develop a user interface for the tool and expand its application in different fields.

Apart from this, Lawrie [12] showed the analysis of children's drawings as indicators of mental well-being, and the main goal of this research is to assess the validity of the emotional indicators themselves as well as the accuracy of LASSO regressions. The dataset used in this research is a set of 453 drawings from the children in India, where 219 households have at least one child with CLP (cleft lip/palate) present, and they were included in the survey sample. Each child was asked to draw a picture of their family and indicate where each family member is. The method used in this research includes manual evaluation for each drawing and assigning a score of 1 to each emotional indicator variable if it is present, but this is a time-consuming process. So, the researcher shows an interest in further research that could use machine learning for analysis and showing signs of emotional distress in the children. Although HFDs are still an important tool, fast and cost-effective for analyzing children’s emotions.

In addition, the work in [13] proposed mental health disorder prediction by a decision support system (DSS) based on AI. The study aimed to find solutions for problems of mental health

assessment tools, which require a long time and have low participation rates. And the results must be analyzed manually by experts. The study found that improving the DSS and the psychological tests by artificial intelligence and advanced analytics is an efficient solution to discover mental problems. Then it used a Network Pattern Recognition (NEPAR) algorithm to build assessment tools, identify the questions for the participants, and reduce the number of questions in the test. Furthermore, they predicted mental issues by training machine learning models with participants' responses to the test and historical data. In conclusion, the results showed that the DSS can automatically diagnose mental disorders using only 28 questions without any human input, with an accuracy level of 89%. That means that this method was successful in developing the DSS that can replace traditional paper-based examinations, decreasing the possibility of missing data for predicting mental disorders. It also has fewer questions than its counterparts, which leads to higher participation and completion rates. Future work for this study is using deep learning models and the Psikometrist framework datasets for further improvement.

Furthermore, research in [14] presented machine learning algorithms for mental health behavioral modeling. The study addressed the challenge of predicting mental disorders of different groups, such as high school students, college students, and working professionals. The common notion between these categories is the stress and depression in daily life that they go through. The study aimed to identify people with mental illness by using machine learning algorithms. At first, they prepared a questionnaire supported by experts. Then, based on the person's score, which depends on his response, his mental health status was predicted. In addition, it used clustering techniques to identify groups and potential classes for further processing, as well as classification algorithms such as SVM, KNN, and Random Forest for finding mental health illnesses. The results were on two target groups in the ages of 18 to 21 years and 22 to 26 years, which showed that SVM, KNN, ensemble (bagging), and tree ensemble (random forest) performed best with 90% accuracy. In conclusion, they successfully developed a framework for discovering the mental health status of people by building prediction models using clustering and classification algorithms. Future work involved more sections of society and more types of mental illnesses. Also, it implied physiological parameters and deep learning methods, such as recursive neural networks, for higher classification accuracy.

Finally, previous research has primarily focused on detecting psychological and mental issues through questionnaires. Only one study has examined emotions in children's drawings, identifying positive and negative feelings. A significant gap remains in the diagnosis of limited mental issues, despite the promising accuracy of detection results.

In summary, previous studies have mainly focused on detecting a limited number of emotions and have achieved moderate accuracy levels. Building on these findings, the Anamel study [2] advanced the field by improving both accuracy and the variety of recognized emotions. However, a remaining gap lies in integrating such models into practical mobile applications for real-world use, a gap that this research aims to address.

III. METHODOLOGY

The Anamel application is designed to analyze children's drawings to help specialists and parents get a better understanding of the children's emotions and psychological states, and to work as a supportive assistant for the specialist. When developing the Anamel application, the starting point was to thoroughly explore various children's drawings to understand the common elements that could indicate different psychological and emotional states. This involved not only collecting a wide range of drawings from different age groups and backgrounds but also exploring existing literature on this subject. To make sure the application is effective, we have been to interviews with child psychologists and specialists who analyze children's drawings professionally. The experts showed invaluable insights into the markers that can be found in the children's drawings. In the interviews, the specialists emphasized an important point, which was the importance of pre-analysis and post-analysis questions. Pre-analysis questions help set the context by understanding the child's environment, recent experiences, and mood at the time of drawing. Post-analysis questions, on the other hand, provide a clear insight after the pre-analysis. These two steps of the questioning process make sure that the assessments made by the Anamel application are both comprehensive and accurate.

IV. WORKFLOW DIAGRAMS

Data Flow Diagrams (DFDs) are important in the Anamel application for mapping out the flow of information inside the system, as shown in Fig. 1. DFDs describe how data transfer between different processes, data stores, and external entities, giving a very high-level overview of the Anamel application's data processing. And in the context of the Anamel application, DFDs represent, for example, how user inputs, such as uploading a child's drawing or answering pre-analysis questions, are processed and analyzed. The DFD diagrams highlight the key data sources and outputs to make sure that all necessary data handling steps are accounted for and correctly implemented.

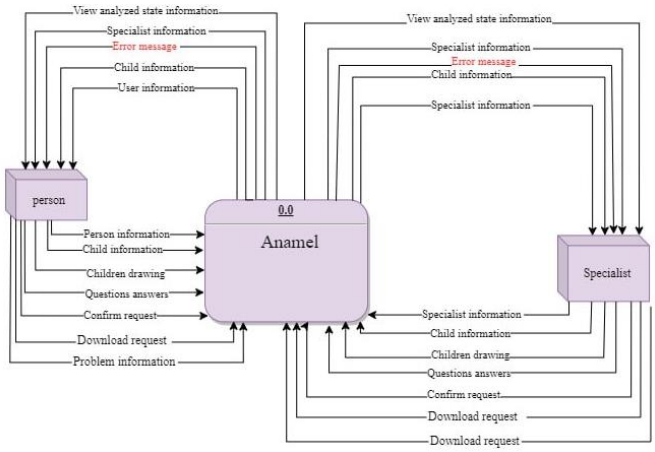

Fig. 1. DFD level 0 diagrams.

The use case diagram for the Anamel system illustrates each task along with the corresponding user, as presented in Fig. 2.

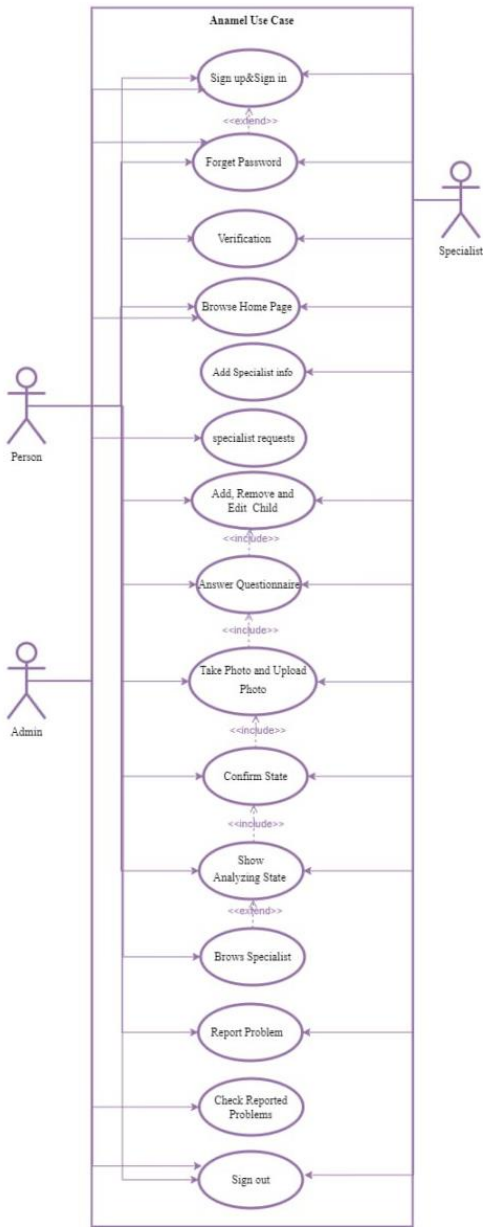

Fig. 2. Use case diagram.

A. AI Model Algorithm Used

In study [2], various versions of YOLO were trained using a dataset comprising 500 drawings is given. The dataset was split into 80% for training, 10% for testing, and 10% for validation. The drawing was annotated with several emotional categories: happy, sad, anxious, angry, and aggressive. YOLOv8-cls showed the best performance, with a high accuracy of 94% and a sample size of only 2.83MB that can be used to build a mobile application.

B. System Architecture

The Anamel system architecture is shown in Fig. 3. To utilize the application, the client first must install it on their mobile phone. Each user walks on a specific path and undertakes designated tasks to achieve the goal of the application, which is the analysis of children's drawings.

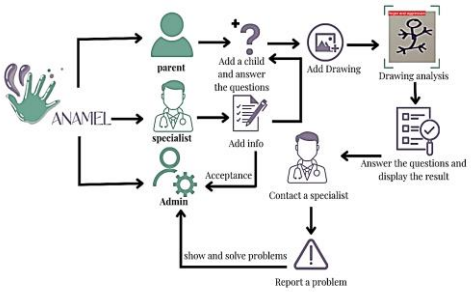

Fig. 3. System architecture.

The MVC diagram in Fig. 4 organizes the code into model, view, and controller, enhancing maintenance and development.

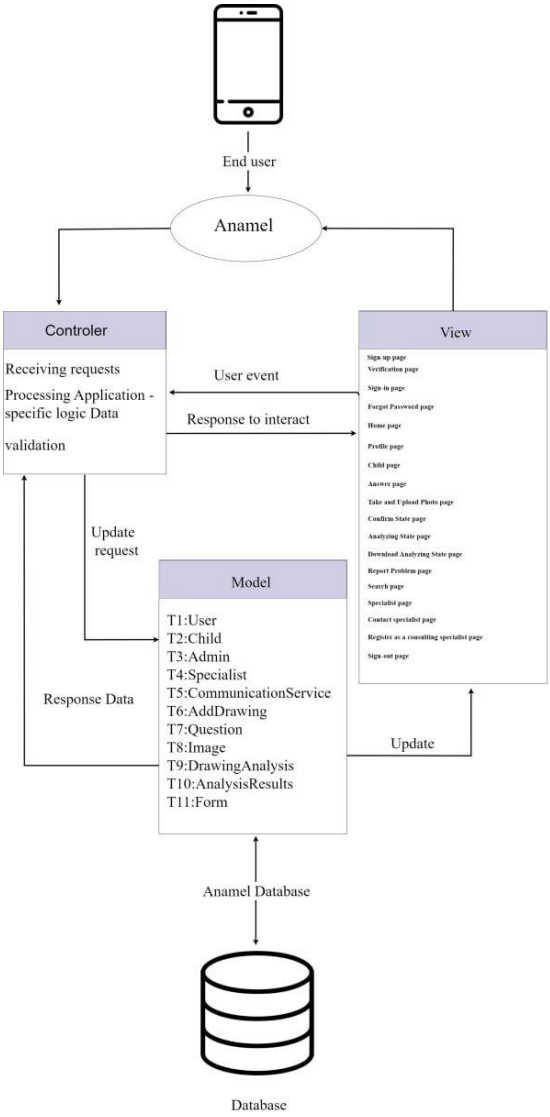

Fig. 4. MVC diagram.

V. IMPLEMENTATION

A. Backend and Frontend Implementation

The interfaces for the Anamel application are designed to visualize the progress and later implement the code and model

using several tools. Initially, Figma, a collaborative web application tool, is used to design and prototype user interfaces. This approach helps create a clear understanding of how the application will be built in a realistic manner.

For the coding process, Flutter, an open-source software development kit (SDK) created by Google, is utilized. Flutter supports the development of mobile, web, desktop, and native applications that run on Android and iOS systems, making the development process more efficient. It is fast, easy, and flexible, leveraging the Dart programming language.

The integrated development environment (IDE) used for building the code is Visual Studio Code, a source code editor from Microsoft. It is lightweight yet powerful and is available on Windows, macOS, and Linux. Using this setup, 30 user interfaces were built, along with basic files and database links. Users can log into the home page, and user data is both written and read effectively and efficiently.

Firebase is also an essential tool in the Anamel application, providing real-time database capabilities and backend services that simplify the development process. It includes features such as Firestore, a flexible, scalable database for mobile, web, and server development, and Firebase Authentication, which handles user authentication and security. These tools ensure data is stored, synced, and retrieved efficiently, enabling seamless integration between the frontend and backend components of the application.

B. Database Implementation

The Anamel application utilizes Firebase, which is a Google cloud computing technology, exclusively designed for applications of mobile and web. Firebase is designed to be a NoSQL database; hence, it stores its data in the document-oriented model. Writing in the back end involves using means to connect to the Firebase database, which supports free sign-in and sign-up through email, which has further capabilities through Cloud Firestore.

Information regarding users is stored and retrieved in the right manner, whereby users can sign in to the site and then be redirected to the home page. Depending on the type of user, different functions are available. More features include the ability to register new children, enable the display of data stored about a child, allow the user to capture new drawings or upload them directly from a camera for the sake of analysis, and display the results of the analysis in a section called ‘results’. A registration form is made available based on the tables to collect specialist information; this information is stored in the application database and can be seen on the ‘Contact Specialist’ page. Moreover, there is a possibility for the user to report previously created issues that are already in the database and put into the administrator’s consideration.

VI. Testing Results

The creation of the “Anamel” application completion marks a significant advancement of the model for analyzing children's drawings [2], which was developed into an application that facilitates the process of analyzing children's drawings in a simple and user-friendly way by integrating it into a mobile application using Flutter. The primary objective was to ensure greater accessibility and usability for specialists and parents after achieving high accuracy and a smaller size for use in the application.

A. Integration for AI Model

Integrating the model [3] into the “Anamel” application was achieved through a series of systematic steps that ensure compatibility and high-efficiency performance within the Flutter framework. This process involved converting the model to tflite format to be suitable for Flutter using flutter_tflite/flutter_tflite.dart for TensorFlow Lite, and image_picker/image_picker.dart for uploading images. The architecture of the application was designed to support efficient image processing and real-time analysis while ensuring an easy and consistent user experience across different devices.

This process consisted of multiple crucial steps:

- Users can capture or upload images using pickImageCamera() and pickImageGallery() , which provided by the ImagePicker library. These images are then processed by the pre-trained TensorFlow Lite model, which is initialized via the tfLteInit() method and performs inference via the runModelOnImage() function.

To further ensure the accuracy of the model, the post-questions were combined with psychological standards approved by psychologists and were integrated into the post-analysis questions:

- After the model analyzes the drawing, users are asked to answer additional questions based on the model's analysis of different emotions, including questions about anger, aggression, anxiety, and sadness, to provide an accurate and integrated experience of the model's results.

B. System Testing

System testing is the level of testing that validates a complete and integrated software product. It checks how components interact with each other and with the system as a whole and performs comprehensive testing of each input into the system to verify the desired output [15]. Anamel was tested using six different scenarios, as shown in Fig. 5 to Fig. 10. A comprehensive test will be carried out to evaluate the application's performance and user satisfaction. The testing strategy included user and functional tests.

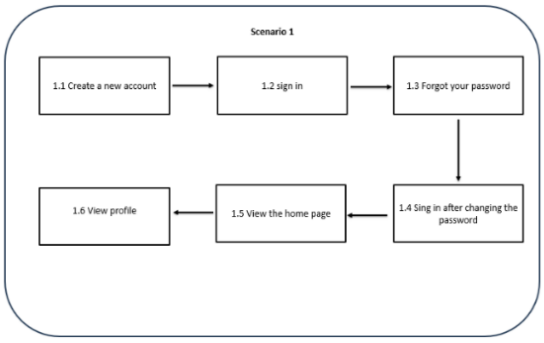

Fig. 5. Scenario 1 for user.

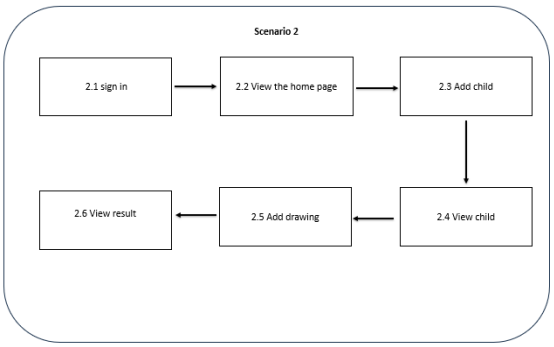

Fig. 6. Scenario 2 for user.

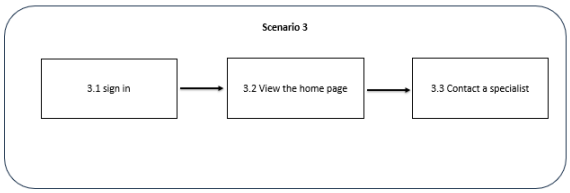

Fig. 7. Scenario 3 for user.

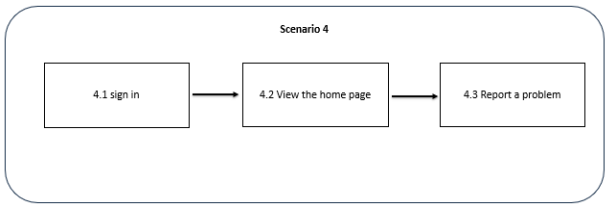

Fig. 8. Scenario 4 for user.

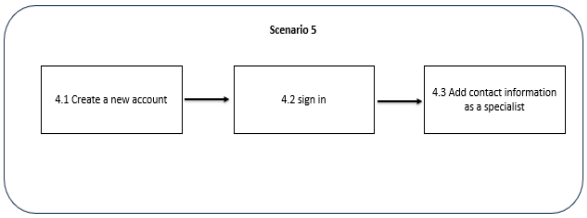

Fig. 9. Scenario 5 for specialist.

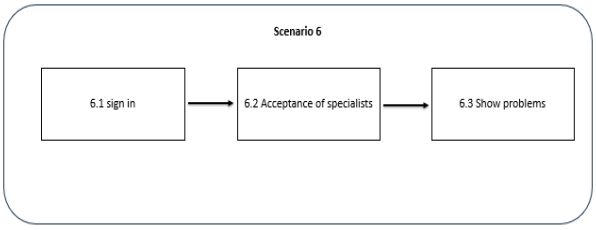

Fig. 10. Scenario 6 for the admin.

C. User Testing

User testing was conducted with a variety of participants to ensure that all features of the application work properly while ensuring how easy and effective the application is to use. A total of 5 users participated in the test, 3 of whom played the role of the parent (user). One specialist and one administrator. Table I summarizes participant information.

TABLE I. SUMMARY OF PARTICIPANT INFORMATION

User Type	Participants information			
	Gender	Job	Educational Level	Experience in Using Technology
Parent 1	Female	Teacher	Bachelor	Advance
Parent 2	Female	Teacher	Bachelor	Normal
Parent 3	Male	Accountant	Bachelor	Advance
Specialist	Female	Psychologist	Master	Advance
Admin	Female	Student	Bachelor	Advance

D. Results

As illustrated in Fig. 11, all detected errors were minor and were related to the front-end component.

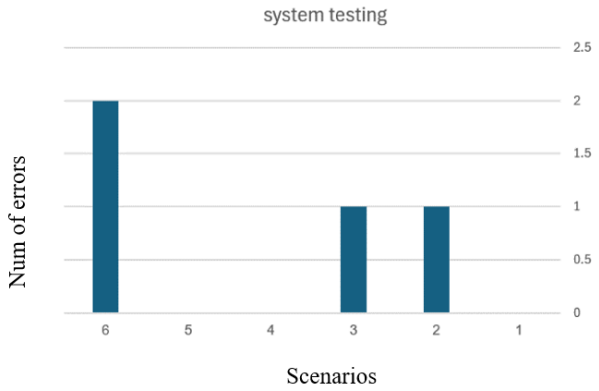

Fig. 11. System testing result.

Following the completion of system testing, these errors were resolved, and the system testing was rerun with no errors detected. Next, each participant was given several tasks to perform, and they were observed during testing. Total time to complete each task for each participant was recorded along with the number of errors for each task.

Parents were asked to perform the following tasks:

- Create a new account
- Sign in and add a child
- Add a drawing, and display the results
- Contact a specialist

The specialist was asked to perform the previous tasks in addition to the following tasks:

- Adding information for communication by users

The admin was asked to perform the following tasks:

- Sign in
- Acceptance of specialists
- Presentation of problems

The user testing phase was divided into three categories: Parents, Professionals, and Admin. Table II summarizes the effectiveness and efficiency of the main tasks performed by each user group.

TABLE II. SUMMARY OF USER TESTING RESULTS

Task	Participants information		
	User Type	*Effectiveness*	*Efficiency*
Create an Account	Parent	Completed without errors	Avg. Time: 1:03 min
Sign In and Add Child	Parent	One user needed assistance	Avg. Time: 1:21 min
Add Drawing	Parent	One user had device issues;	Avg. Time: 1:23 min
Communicate with Specialists	Parent	Completed without errors	Avg. Time: 0:20 min
Add Specialist Information	Specialist	Completed without errors	Avg. Time: 0:12 min
Accept Specialist and Present Problems	Admin	Delayed display problems that did not appear when the button was pressed	Avg. Time: 0:23 min

Overall, the ease of use and effectiveness of the app were tested, with overall user experience across different types of users. Average completion times indicate a smooth user experience. However, issues identified in admin tasks highlight areas that need better improvement for system speed, responsiveness, and functionality, and have been resolved for system efficiency.

VII. CONCLUSION

The development of the Anamel application represents a significant advancement in the intersection of artificial intelligence and child psychology. By transforming the previously developed children's drawing analysis model into an accessible mobile tool, this work bridges the gap between technological innovation and psychological practice. Using the Flutter framework and integrating the YOLOv8-cls model converted into TensorFlow Lite with a 94% accuracy rate [2]. The system achieved efficient on-device analysis suitable for real-world use.

The application architecture, supported by DFD, and MVC diagrams, demonstrates a clear and organized design process. Comprehensive testing involving parents, specialists, and administrators confirmed the reliability, usability, and efficiency of the system. The positive user feedback highlights the potential of Anamel as a supportive tool that can facilitate early emotional assessment and communication between parents and mental health professionals.

Beyond its technical achievements, Anamel contributes meaningfully to mental health technology by offering an innovative, AI-driven approach to emotional detection through children's drawings, an area with limited prior applications.

This study provides a foundation for further research in integrating AI into psychological evaluation tools.

Future work may include expanding the dataset with a larger and more diverse population to improve model generalization, adding more emotional categories, incorporating voice or behavioral data for multimodal analysis, and connecting the app to professional healthcare systems for automated reporting and follow-up.

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