Faculty of Electronics and Computer Technology and Engineering

DEVELOPMENT OF AI-POWERED APP FOR AUTISM EDUCATION

MAIZATUL AMIRAH BINTI AZHAR

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Dr. Masliinah binti Mohd Nasir
Ketua Program Sarjana Muda
Teknologi Kejuruteraan Elektronik
Fakulti Teknologi dan Kejuruteraan Elektronik dan Komputer (FTKEK)
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Signature : 

Supervisor Name : DR. HASLINAH BINTI MOHD NASIR

Date : 12 FEBRUARY 2024

Signature : 

Co-Supervisor Name (if any) : EN. NOOR MOHD ARIFF BIN BRAHIN

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DEDICATION

It gives me great pleasure to dedicate my senior thesis to each one of you who has encouraged and believed in me over my academic career. Your love and support have meant the world to me, and I will always be appreciative of your encouragement and direction.

To my family, thank you for always being there for me and for your endless love and patience. Your sacrifices and belief in me have allowed me to pursue my dreams and I am so grateful for everything you have done for me.

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Sincerely, Maizatul Amirah Binti Azhar.

ABSTRACT

This project describes the development of an AI-powered app for autism education. Autism is a neurodevelopmental disorder that affects communication, social interaction, and behaviour. The goal of this project is to develop a mobile application that uses artificial intelligence (AI) to fulfill the particular needs of people with autism spectrum disorder (ASD), who struggle to understand emotions, learning abilities, motor skills, and social communication. This project aims to study the spectrum of autism and learn skills, develop AI-powered applications for autism, and integrate the functionality of the developed AI for autism children's education using MIT App Inventor and Teachable Machine. Machine learning is used focusing on the image classification that use for image and object detection by utilizing Teachable Machine web-based tool where the model build will be trained. The project has been accomplished successfully, and the five modules that created the are finished. A certain part of the module uses the camera to identify objects, poses, and images that the Teachable Machine library's trained model has used. More module and whole application interface are being created using MIT App Inventor. Moreover, this project is integrating a database to store the information of every module and data that the user has completed from this application. The results proves that this application allows autism children to interact with and be more creative in gaining more learning skills. It is consider to enhancing the application of user interface and overall user experience. Focusing on more intuitive and engaging design can make this project more accessible and enjoyable for children with autism.

ABSTRAK

Projek ini menerangkan pembangunan aplikasi dikuasakan kecerdasan buatan (AI) untuk pendidikan autisme. Autisme ialah gangguan perkembangan saraf yang menjejaskan komunikasi, interaksi sosial dan tingkah laku. Matlamat projek ini adalah untuk membangunkan aplikasi mudah alih yang menggunakan kecerdasan buatan untuk memenuhi keperluan khusus mereka yang mengalami gangguan spektrum autisme (ASD), yang mempunyai kekurangan untuk memahami emosi, kebolehan pembelajaran, kemahiran motor dan komunikasi sosial. Projek ini bertujuan untuk mengkaji spektrum autisme dan mempelajari kemahiran, membangunkan aplikasi berkuasa AI untuk autisme, dan menyepadukan kefungsian AI yang dibangunkan untuk pendidikan kanak-kanak autisme menggunakan MIT App Inventor dan Teachable Machine. Pembelajaran mesin digunakan dengan memfokuskan pada klasifikasi imej yang digunakan untuk pengesanan imej dan objek dengan menggunakan alat berasaskan web daripada Teachable Machine, di mana binaan model akan dilatih. Projek ini telah berjaya dicapai, dan lima modul yang dicipta telah selesai. Bahagian tertentu modul menggunakan kamera untuk mengenal pasti objek, gaya dan imej yang telah digunakan oleh model terlatih Teachable Machine. Lebih banyak modul dan antara muka aplikasi keseluruhan dibuat menggunakan MIT App Inventor. Selain itu, projek ini menyepadukan pangkalan data untuk menyimpan maklumat setiap modul dan data yang telah digunakan oleh pengguna daripada aplikasi ini. Hasilnya membuktikan bahawa aplikasi ini membolehkan kanak-kanak autisme berinteraksi dan lebih kreatif dalam mendapatkan lebih kemahiran pembelajaran. Ia dipertimbangkan untuk meningkatkan aplikasi antara muka pengguna dan keseluruhan pengalaman pengguna. Memfokuskan pada reka bentuk yang lebih intuitif dan menarik boleh menjadikan projek ini lebih mudah diakses dan menyeronokkan untuk kanak-kanak autisme.

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LIST OF ABBREVIATIONS

AI	-	Artificial Intelligence
ASD	-	Autism spectrum disorder
SDG	-	Sustainable Development Goals

CHAPTER 1

INTRODUCTION

1.1 Background

Autism spectrum disorder (ASD) is a complex neurological condition that affects communication, social interaction, and behaviour. It is estimated that around 1 in 54 children in the United States have ASD, making it a significant public health issue. Children with autism face challenges in developing social and communication skills, which can significantly impact their daily lives and long-term outcomes. Traditional educational approaches often struggle to provide tailored support for children with autism due to the diverse range of symptoms and needs that individual with autism exhibit [1].

New opportunities for creating educational tools that can benefit children with autism have been opened by recent developments in AI and machine learning. AI-powered educational technologies can offer children with autism targeted learning experiences that meet their unique requirements and encourage the growth of their social and communication skills [2].

In this context, the development of an AI-powered app for autism education can provide a promising solution to address the unique challenges faced by children with autism. Such an app could provide learning skills [3]. Additionally, an AI-powered app can facilitate remote learning, which can be especially beneficial for children who may have difficulty attending in-person classes. This paper describes the development of an AI-powered app for autism education and its potential impact on improving the quality of life for children with autism [2].

1.2 Problem Statement

Autistic children suffer from some difficulties including social skills, repetitive behaviors, speech and nonverbal communication, and accommodating to the environment around them [4]. Thus, dealing with autistic children is a serious public health problem as it is hard to determine what they feel with a lack of emotional cognitive ability. This project aim to design and develop an AI-powered app for autism education that provides learning skills for children with autism, helps them develop communication and social skills, and is usable and effective for both children with autism and their caregivers [5]. The application uses machine learning algorithms to analyse a child with autism learning skills. This project focusing on improving learning skills to function and participate positively in the community. Further, the system can provide a new method to help the child to be capable of improving learning skills [6].

1.3 Promote Sustainable Development Worldwide

Several Sustainable Development Goal (SDGs) are relevant to this project. Firstly, it is immediately applicable and focused on quality education and lowered the level of by offering a customized and complete learning experience, the initiative intends to improve the quality of education for people with autism, in line with the sustainable development goal of guaranteeing inclusive and equitable education for all. Furthermore, this project dedicate to diversity and accessibility guarantees that people with different levels of autism may access learning materials, which helps minimize educational gaps. This is in line with the objectives of reduced inequalities, which are aimed at reducing social inequalities and encourage tolerance.

In conclusion, by emphasizing quality education, reducing inequalities, encouraging well-being, and creating collaborations, This project meets with many sustainable construction goals, particular quality education and educed inequalities. It serves as an example of how focused efforts can advance the larger worldwide goal of sustainable development.

1.4 Project Objective

The objective of this project is to design and develop an AI-powered app for autism education that provides learning skills for children with autism and helps them develop communication and social skills. Specifically, the objectives are as follows:

a) To study the spectrum of autism and learn skills to adapt to the application module.

b) To develop an AI-powered algorithm for autism education with Teachable Machine.

c) To integrate the algorithm with MIT App Inventor to complete the functionality of AI-powered app with database that provide autistic children module result.

1.5 Scope of Project

The scope of this project are as follows:

a) To adapt learning skills and optimize the application module for individuals on the spectrum.

b) Modelling machine learning algorithm using Teachable Machine.

c) Designing interactive application for autism children include features such as autism learning skills and performance.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explains the research and literature related to this project. It contains some work that has already been done by other researchers or institutes. They have also described several concepts of this project in this chapter. This is because the understanding between theory and work will be very helpful in preparing this project. This chapter discusses the important information and details that are found in several studies and research from related previous studies. Therefore, the discussion begins with the study of autism, artificial intelligence, and its concepts. It is important to do some research on these concepts because they are the main objective of this project. Furthermore, as this project involves technology that combines virtual information with the real world, it is vital to study the concepts of virtual reality and artificial intelligence to compare the differences.

2.2 Autism

Autism is a neurodevelopmental disorder that affects individuals across the globe, regardless of age, gender, or cultural background [7]. It is characterized by difficulties communicating and interacting with others, as well as repetitive behaviors or narrow interests. It's critical to realize that every person with autism is different and can encounter a variety of strengths and challenges. Compared to their peers, who are usually developing, children with autism frequently exhibit distinct behavioral characteristics. They may fail to communicate verbally and nonverbally, have trouble interacting with others and interpreting social signs, engage in repeated behaviors, or have a laser-like fixation on a single interest.

Children with autism frequently exhibit sensory sensitivities, such as being overwhelmed by specific noises or textures [4].

Early identification and intervention are crucial for children with autism. Diagnosis typically occurs in early childhood, and with appropriate support and interventions, children with autism can make significant progress in their development [8]. Early intervention programs often involve a multidisciplinary approach, incorporating speech therapy, occupational therapy, behavior therapy, and educational support to address the specific needs of each child [4].

Promoting understanding, acceptance, and inclusion for kids with autism is crucial. They possess special skills and viewpoints that they can use to advance society. It is crucial to provide an inclusive environment that meets their requirements and offers chances for development [9]. Campaigns for raising awareness, instruction, and training for caregivers, teachers, and the public can accomplish this. It is also critical to create a network of support for parents of autistic children. To negotiate the difficulties and celebrate the accomplishments of their children's journey, parents and other caregivers play a crucial role in their development. As a result, they frequently need access to resources, information, and support networks [10].

2.2.1 Autism Level Category

It is important to remember that these are general descriptions and that everyone with autism is unique. Support needs and characteristics can vary widely, and it is essential to consider the specific strengths, challenges, and individuality of each person on the autism spectrum [7]. Everyone with autism is unique, and Table 2.1 shows the simplified represent autism category level.

Table 2. 1 Autism Category Level [8].

Level	Support Needs	Characteristics
1	Requiring support	Difficulty with social interactions
		Challenges with adapting to changes
		Engages in repetitive behaviours
		Can work alone with support
2	Requiring strong support	Significant challenges in communication
		Difficulty with social interaction and relationships
		Pronounced repetitive behaviours
		Require assistance with daily living activities
3	Requiring very strong support	Severe difficulties with social interaction
		Limited verbal or non-verbal communication
		Highly repetitive behaviours
		Requires significant assistance with daily living

2.2.2 Autism Visual Communication

Many autistic children learn and think creatively. It is possible to use this feature of their difficulty to support their communication and emotional expression[9]. The most common ways to communicate visual communication are photos, drawings, and colour. As a result, images like pictures and colours can be used to design a learning system for the children that will help them in their development of vocabulary, understanding of concepts, and basic skills [10]. The tasks are meant to encourage children to improve their skills in

interacting with others. There are three methods of using colours and pictures to teach autistic children as shown in Table 2.2:

Table 2. 2 Methods of using colours and pictures for autistic children [11].

No.	Method	Details	Pictures
1	The development of a visual learning system for autism children	• Avoid giving children too many choices so they feel confused. • Determine the best teaching level for the children. • Make sure that everyone involved in the children education is familiar of the signs that children are used to. • Recognize that certain children could react negatively to specific colours.	
2	Helping the child associate visual cues with words and concepts	• Practice connecting words with children individual. • Assist children in identifying between what is real and what is not. • Use the children's unique skills to teach them a new topic.	

		• Start by using colours relationships to explain basic concepts in math.	
3	Ways to help a child with basic skills using visual cues	• Helping children in communicating their ideas through pictures. • Use eye contact to teach children how to ask for help. • To help children in interacting with family members at home, use visual signs. • Help children in developing pictures for communicating health issues.	

2.3 Autism education

Autism education refers to the process of providing learning opportunities and support to individuals on the autism spectrum[12]. It aims to address the unique challenges faced by individuals with autism and promote their overall development and well-being. Autism education encompasses a wide range of strategies, interventions, and approaches tailored to the specific needs and strengths of individuals with autism[13]. Here are some key components of autism education:

Table 2. 3 Key components of autism education.

Key components	Detail
Individualized Education Plans (IEPs) [14].	Collaboratively by educators, therapists, and parents which are personalized plans developed many individuals with autism receive education through IEPs. The individual's educational needs are addressed using IEPs, which provide specific objectives, modifications, and approaches.
Special Education Services [15].	In inclusive or specialised educational settings, people with autism frequently benefit from specialised instruction and support. To support learning and development, special education teachers and support personnel offer focused interventions, accommodations, and modifications.
Communication and Social Skills [16].	The growth of communication and social skills is emphasised in autism education. This includes boosting verbal and non-verbal communication, understanding

	social cues, facilitating peer interactions, and teaching proper social behaviour and problem-solving abilities.
Applied Behaviour Analysis (ABA) [17].	A frequent intervention in autism education is ABA. It reduces problematic behaviours while teaching and reinforcing desired behaviours using the concepts of behaviour analysis. Schools and therapy sessions are two places where ABA techniques are used.
Visual Supports [18].	Autism education frequently makes use of visual supports like social stories, visual cues, and visual schedules. They give tasks, routines, and social expectations a visual representation, making it easier for people with autism to comprehend and get around in their surroundings.
Sensory Integration [19].	Sensory sensitivity or problems processing sensory information are common in people with autism. Strategies to deal with these difficulties may be incorporated into autism education, such as developing sensory-friendly environments, offering sensory breaks, and including sensory activities in the curriculum.
Assistive Technology [20].	Apps, software, and other assistive technology products can be very useful in autism education. For people with autism, these tools can help with organisation, learning, communication, and skill development.

It is critical to understand that autism is a spectrum condition, and that different autistic people have different educational needs and preferences. To provide the finest support and growth opportunities, an individualised and person-centred approach is essential in autism education.

2.4 Education Application

For people with autism spectrum disorders, creating an AI-powered education application can result in a distinctive and successful learning environment [21]. There are a few crucial factors and features to include in such an application, such as personalized education, which makes use of AI algorithms to provide specific learning experiences catered to the needs, strengths, and learning preferences of the individual. To optimize engagement and learning outcomes, adjust the lesson's pace, difficulty level, and content.

Communication support, which includes characteristics that aid in language and communication development, is another crucial factor to consider. Use AI-powered natural language processing to support verbal and nonverbal communication skills by offering speech recognition, language training, and targeted feedback [22].

The inclusion of accessibility features can guarantee that users of all abilities can access the app. Give users the flexibility to change font sizes, colours, sound levels, and input methods to suit their individual preferences. Resources, articles, and advice for parents, family members, and educators are available under the application section titled "Parent and Educator Resources" [23]. Include instructions on how to help people with autism use the application and encourage cooperation between the home and school settings.

With the help of the application's collaborative learning and social connection capabilities, people with autism may communicate and work together with peers, therapists,

and educators. Encourage social interaction and provide opportunities for joint educational efforts [24].

2.5 Artificial Intelligence (AI)

AI has the potential to revolutionize the field of autism education by enhancing learning experiences, personalizing interventions, and supporting individuals on the autism spectrum. The creation of AI-powered apps for autism education has the potential to solve the difficulties experienced by people with autism and advance their general development and well-being [21]. The various uses of artificial intelligence to produce powerful and useful apps for autism education are explored [5].

Artificial intelligence (AI) includes machine learning, where a model can do tasks automatically without human interaction. Therefore, the input data provided to the standard machine learning models trains them, allowing these models to predict outcomes with high accuracy. In the context of deep learning, which is a develop of machine learning, huge amounts of data are used to train models that are highly accurate at predicting outcomes. Both models have high levels of success when used to diagnose specific neurological illnesses, including autism, ADHD, and depression [22].

AI algorithms can analyse user data, such as performance, preferences, and progress, to provide personalized learning experiences. These apps maximize engagement and improve learning results by tailoring material, difficulty levels, and pacing to individual needs [5]. Personalization makes sure that those with autism receive specialized guidance and support, promoting a more welcoming and productive learning environment.

AI-powered apps that use natural language processing (NLP) techniques may comprehend and interpret written or spoken language, facilitating engagement and communication between people with autism and the app. The growth of communication

skills and the improvement of language understanding are facilitated by speech recognition, language modelling, and personalized feedback [21]. These features give autistic people the chance to practice and improve their communication skills in an encouraging and flexible learning environment.

Visual and Gesture Recognition shows that AI-powered computer vision enables apps to recognize and interpret visual cues and gestures. The application and teaching of social skills, emotion vision, and non-verbal communication are all made possible by this functionality[4]. These apps can help people with autism learn to interpret signals from society and navigate social situations by offering real-time feedback and direction.

Making use of reinforcement and gaming with customized gaming, prizes, and reinforcement based on user progress and performance, AI improves the gamification components of apps [23]. These apps foster a good and engaging learning environment by boosting motivation and engagement. Gamification components use AI algorithms to customize the app experience and deliver helpful, personalized feedback to promote skill and knowledge improvement [5].

2.6 Previous Related Research

Table 2.2 below shows the comparison of methods and solutions by different authors for past research.

Table 2. 4 Comparison to past research

No.	Author	Method	Solution
1	Kamran Khowaja et al. [24].	Augmented Reality (AR)	• provides the learning of letters and words in an interactive environment. • ideation and design processes were conducted collaboratively with teachers and specialist.
2	Alverson C et al. [25].	Augmented Reality (AR)	• provides fully interactive three-dimensional simulations of real-world settings and social situations.
3	Erden Y et al. [26].	Artificial Intelligence (AI) (machine learning)	• adult diagnostic procedures as childhood diagnosis
4	Zhang Y et al. [27].	Artificial Intelligence (AI) (deep learning)	• deep learning to music perception education. • using gesture interactive robots.
5	Singh A et al. [28].	Artificial Intelligence (AI) (deep learning)	• socially designed robot called 'Tinku', developed to assist in teaching special needs children.

2.7 Summary

The literature review concludes the past research related to this project with its technology used during the project's development as well as the upgraded system for better flexibility. As it contains previous research, the understanding between theory and the Work will assist in developing this project.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will describe the strategy that will be implemented to this project as well as the processes that will turn out to meet its objectives. To develop a clear vision and more knowledge of the best way to handle it, complete study on the application software was also done. This was done to maintain the project constant flow. This chapter also contributes significantly to giving a broad overview of how the project flowchart was created.

3.2 Selecting and Evaluating Tools for a Sustainable Development

Evaluating the project's direct alignment with the SDGs is the first step in the selection process. The AI-powered app primarily contributes to quality education by boosting the accessibility and quality of education for autistic individuals. By guaranteeing that people with different levels of autism may access specialized educational materials, it minimizes inequality.

Furthermore, the application reach within its intended audience, the high standard of its instructional materials, and the degree to which it promotes equality of access and inclusivity are a few examples of important performance indicators. Keeping track of user development and getting input from parents, teachers, and people with autism can give important insights into how the application affects people's lives and wellbeing. Selecting and evaluating tools for the SDGs, such as this AI-powered software, essentially entails a

continual process of alignment with these global objectives and the measurement of its practical impact in promoting an inclusive and sustainable future.

3.3 Block Diagram

Block diagram representation of a system or project that shows several components or subsystems as blocks or boxes. It explains how all these parts are related to one another and how data and communication move between them. A block diagram represents a high-level view of the project structure helps with system learning.

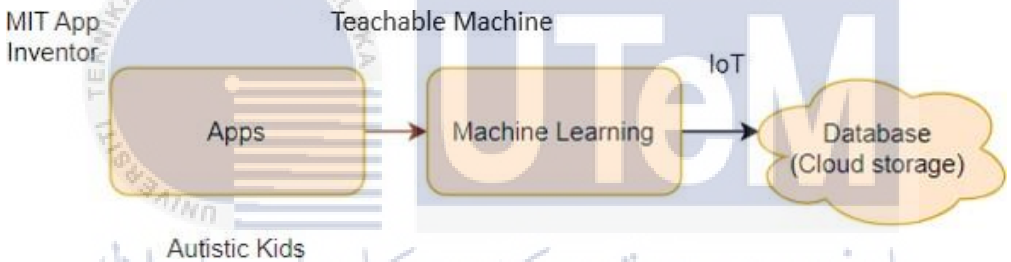

Figure 3. 1 Block Diagram of the Education App

The block diagram of Figure 3.1 represents a system where education application called ‘Play Home’ is used to develop autism learning application, the software used is Teachable Machine and MIT App Inventor to create the interactive application. Autism children will use the application to see their learning skills and database using cloud storage to save the data of the autism children using the application that based on machine learning algorithm.

3.4 Flowchart of the Project

The project workflow describes the order in which actions or tasks must be implemented to finish a project. It provides a broad overview of the project's requirements and the connections via those.

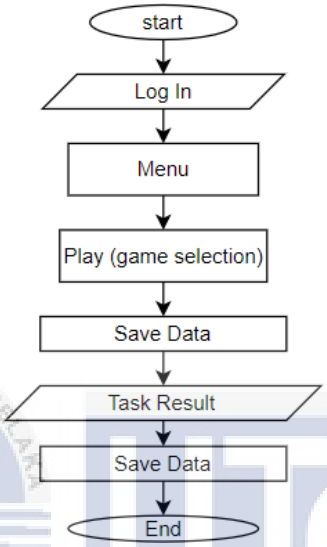

Figure 3. 2 Education Application General Process Flow

By referring to Figure 3.2, it represents the flowchart of project implementation that is used throughout the project. As stated in Figure 3.2 above, it shows the steps of the project's development. Play Home begins with a log in which the user needs to state the details needed to save in the database for their saved module that has been done. Then, it will display a menu that will forward to the module selection that the user will select. The user can click the button back to go back to the menu, choose another module to play, or click the exit button to end the application. The result of the task will save data in a database to observe the autism children's learning skills throughout the task given in this interactive application.

3.5 Software

Software developments were chosen as a step to identified specific software tools that will be use throughout of the project development.

3.5.1 MIT App Inventor

A user-friendly, visual programming environment known as MIT App Inventor makes it easier for everyone, including children, to create fully working apps for smartphones and tablets. With MIT App Inventor, beginners can create their first basic app in about 30 minutes. Additionally, our block-based tool speeds up the development of difficult, high-impact apps compared to standard programming environments. By allowing everyone, especially young people, to change from technology consumption to technology creation, the MIT App Inventor determination aims to make software development more accessible.

Anyone can use MIT App Inventor, an online programming platform, to find solutions to problems in the real world. It offers a web based "What you see is what you get" (WYSIWYG) editor for creating applications for mobile phones that are intended for the Android and iOS operating systems. Anyone can create a mobile phone app using a block-based programming language that is based on and inspired by such languages. App Inventor is used by individuals all around the world to create mobile solutions for serious problems related to the platform has also been modified to meet the needs of more specific groups by creating apps.

3.5.2 Teachable Machine

Google developed Teachable Machine, an online application that makes training machine learning models easier without requiring users to be very proficient in coding or machine learning methods. It is intended to open up AI and machine learning to a wider range of users, such as educators, enthusiasts, and students.

Users can train models to recognize and classify objects, gestures, or sounds by providing examples and assigning labels with Teachable Machine. The application makes use of transfer learning, a method that uses user data to enhance a trained neural network. Creating personalized machine learning models for applications like voice identification and image categorization is made simpler for individuals using this method.

Teachable Machine is an excellent instrument for teaching since it enables users play with machine learning ideas and get practical experience with AI. It is an invaluable resource for anybody interested in exploring into the potential of artificial intelligence since it fills the gap between academic machine learning research and useful, approachable applications.

3.6 Project stage

While every project may have unique characteristics and requirements, most projects can be broadly categorized into the following stages such as initiation, planning, execution, monitoring and control, and closure. For Play Home application, there is a few stages that need to be complete before completing the whole project.

3.6.1 Play Home Development

Play Home is an application that has been developed that is intended for this project. This project developed an application that must meet the specific needs of children with autism who have difficulty understanding emotions, learning new things, using their motor skills, and interacting with others.

This project intends to use MIT App Inventor and Teachable Machine to analyze the spectrum of autism and learn skills, to build AI-powered applications for autism, and integrate the functionality of the generated AI for the education of autistic children. Using the Teachable Machine web-based application, which focuses on imagine classifying for object and image detection, machine learning is utilized to train the built model.

3.6.2 Module Development

Table 3. 1 Module Development of the Play Home

No.	Module	Explaination
1	Catch the cat	This module focuses more on autistic children's concentration through the module by moves around as much as they can. It can be sensory tool for helping children with autism and other sensory processing disorders stay calm and focused.
2	Matching number with pictures	Basic skills of counting for autistic kids must be developed to make sure that they keep on improving day by day so that

		they are not left behind and stay in the same mental state through the years.
3	Shape Detector	Children with autism may find that learning how to play modules is an important aspect of their social development with other people. Children with autism can improve their ability to interact with their environment by moving around rather than simply sitting there.
4	Pose Detector	This module helps develop body awareness, improve coordination and motor planning, and build strength in the trunk and upper body.
5	Emotion Face	This module can help autistic children learn how to recognize different emotions in themselves and others since autism kids is having trouble learning how to recognize emotions.

3.6.3 Application Development

Table 3. 2 Application Development of Play Home

No.	Process	Explaination
1	Define objective	Determine the specific objective of your AI application. Identify the problem you want to solve or the functionality you want to incorporate using computer vision and AI techniques.

2	Design Interface	Use MIT App Inventor, a visual programming environment, to design the user interface (UI) of your application. Drag and drop components to create the desired layout, buttons, menus, and screens.
3	Integrate Teachable Machine	Explore Teachable Machine, an open-source library for computer vision and image processing. Familiarize with its functions and capabilities. Import the necessary Teachable Machine libraries into your project in MIT App Inventor.
4	Access Camera and Image Processing	Utilize the camera component in MIT App Inventor to access live video feed or capture images. Use Teachable Machine functions to process and analyze the images in real-time, applying computer vision algorithms such as object detection, image recognition, or facial recognition.
5	Machine Learning Integration	If your AI application requires machine learning, you can train and integrate models using frameworks like TensorFlow or PyTorch. Train models on a dataset relevant to your application, export the trained model, and integrate it into your MIT App Inventor project.
6	Real-Time Feedback and Results	Display the real-time results of the computer vision or machine learning processing on the user interface. This could involve displaying detected objects, recognized faces, or any other relevant information derived from the analysis.

7	User Interaction and Actions	Define how users interact with the AI application. This may involve allowing users to take specific actions based on the results, such as triggering alerts, performing further analysis, or accessing additional information.
8	Testing	Test your AI application thoroughly, ensuring that it performs as expected. Solicit feedback from users, collect data on application usage, and iteratively refine your application based on the feedback received.
9	Deployment and Distribution	Once your AI application is complete, package it for distribution. Generate the necessary installation files or package the app for deployment on Android devices. Publish your application to relevant app stores or distribute it to your target audience.
10	Maintenance and Updates	Regularly maintain and update your AI application to address bugs, security issues, or to incorporate new features and enhancements. Continuously monitor user feedback, engage with the user community, and keep up with advancements in Teachable Machine and AI technologies to ensure your application remains relevant and effective.

3.6.4 Database Integration

To integrate a database for performance and monitoring purposes in an AI-powered app for autism education using MIT App Inventor, there are a few steps, including choosing the suitable database. Select a database service that can effectively handle performance monitoring and data storage. Then, define the data structure by determining the specific data fields and structures required for performance monitoring. This may include metrics such as user engagement, completion rates, time spent on activities, or progress tracking data.

For data collection, it must be implemented in Play Home to collect relevant performance and monitoring data. This can involve tracking user progress tracking data or any other metrics that important for monitoring performance. Utilize appropriate MIT App Inventor components and blocks to collect and process this data. For data storage, it needs to store the collected performance data in the connected database. Use database-related blocks or APIs provided by your chosen service to insert or update data records. Ensure that data is accurately stored, along with the necessary identifiers to link it to the corresponding users or activities. For testing, it must thoroughly test the performance monitoring functionality within Play Home. Validate data collection, storage, and analysis processes.

By integrating a database for performance and monitoring purposes using MIT App Inventor, Play Home can effectively track user engagement, analyze performance, and provide valuable insights to educators, therapists, and administrators involved in autism education. The data collected can help optimize instructional strategies, identify areas for improvement, and ensure the effectiveness of the application in supporting the learning and development of individuals with autism.

3.7 Summary

This chapter describes and explains the methodology of 'Development of an AI-Powered App for Autism Education'. Project methodology is one of the most significant chapters in handling a project to ensure that the project can be completed systematically guided by following the correct sequence of the project methods. The developer of project determination and complete project integration at three stages of methodology. These stages are deed as the guidance for completing this project.

CHAPTER 4

RESULT

4.1 Introduction

This chapter will go into more detail about the overall project's outcomes and research. Before the data has been finalized, all project test results from simulations of the working setting and data analysis are incorporated. The conclusion of this review and evaluation provides a standard for assessing if the project objective has been achieved.

4.2 Result

As a result, the AI-powered Play Home interactive education application has been created. This module can be good for autism educators to use as teaching material. By using this application, educators can attract children with autism to learn more in a fun way.

4.2.1 First Step: Registration and Module Selection

All the work progress for the applications functioning can be started by clicking the register button to save the user data such as name, password and the progress of the user, in the database as shown in Figure 4.1 shown.

Figure 4. 1 First page of Play Home application.

Figure 4.2 displayed that user must enter their registered name and password on the first page that appears after clicking the "register" button in order to access the Play Home module application.

Figure 4. 2 Second page of Play Home application

Upon selecting the "Log In" button, the module selection page will be displayed immediately. Users are able to select the module they wish to begin with. As shown in Figure 4.3, there are five modules which is "Catch the Cat," "Matching Number with Pictures," "Shape Detector," "Pose Detector," and "Emotion Face."

Figure 4. 3 Third page of Play Home application

4.2.2 Second Step: Catch The Cat Module

The "Catch The Cat" module's Level 1, Level 2, and Level 3 are displayed in Figures 4.4, 4.5, and 4.6. By clicking the "start" button, this module will begin and the user can click on the cat as many times as they like. As soon as all level is finished, the result shown in percentage form. Figure 4.7 illustrates that the user will be able to view their total score once every level has been finished.

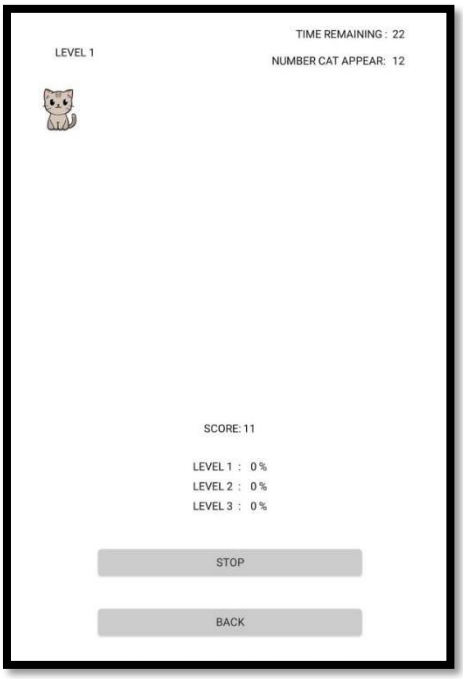

Figure 4. 4 First Level of 'Catch The Cat' Module.

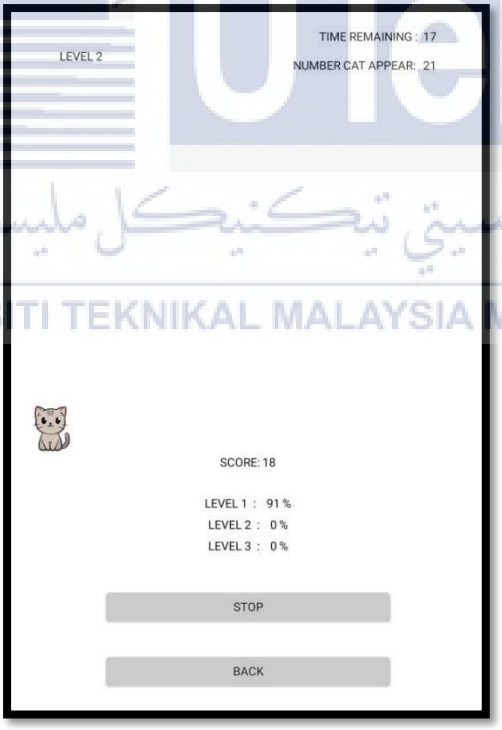

Figure 4. 5 Second Level of 'Catch The Cat' Module.

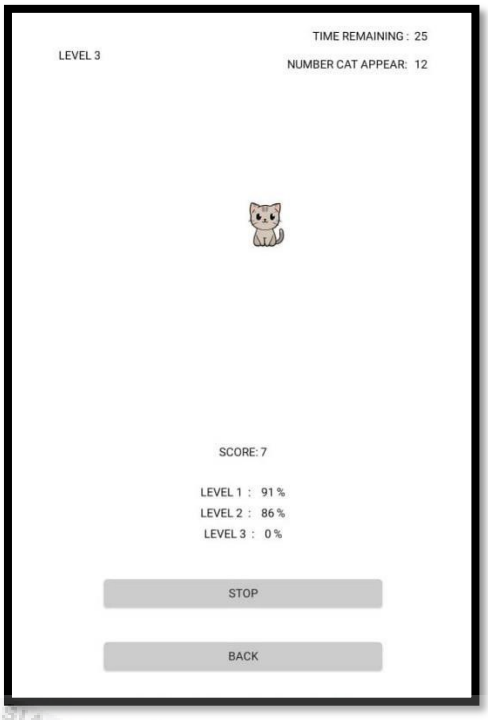

Figure 4. 6 Third Level of 'Catch The Cat' Module.

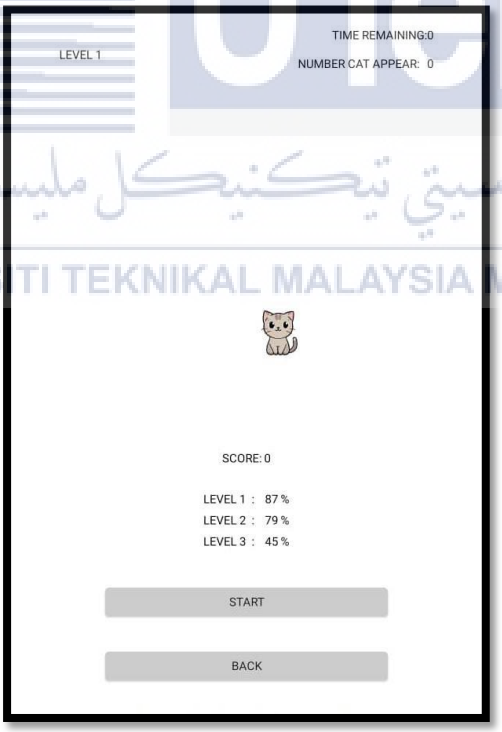

Figure 4. 7 Result of 'Catch The Cat' Module For Each Level.

4.2.3 Third Step: Match Number with Pictures

Figure 4.8 shows the step on using the second module. User need to drag the pictures to the correct number as indicated in the picture and finish the task from number one to ten. The notifier will shows if it is correct or wrong and if the user has complete the module.

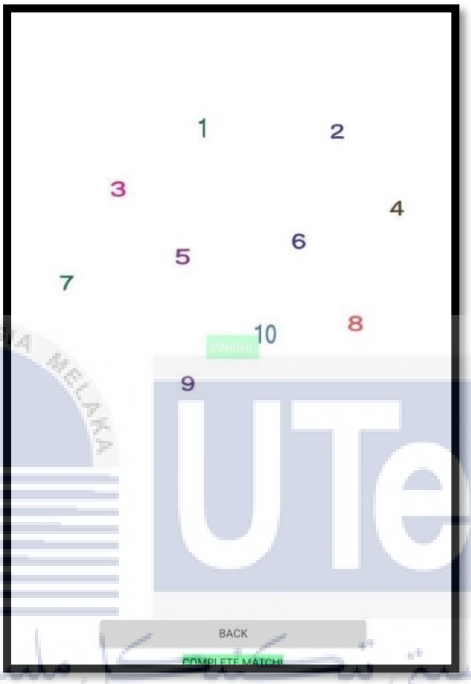

Figure 4. 8 'Match Number with Pictures' Module.

4.2.4 Fourth Step: Shape Detection

Figure 4.9, 4.10, 4.11, and 4.12 shows the circle, square, star and triangle shape for shape detection module. User need to move around to capture the shape indicated to move for the next shape. In order to discover the correct shape, the user need to kept moving about by this module, which uses machine learning for object detection.

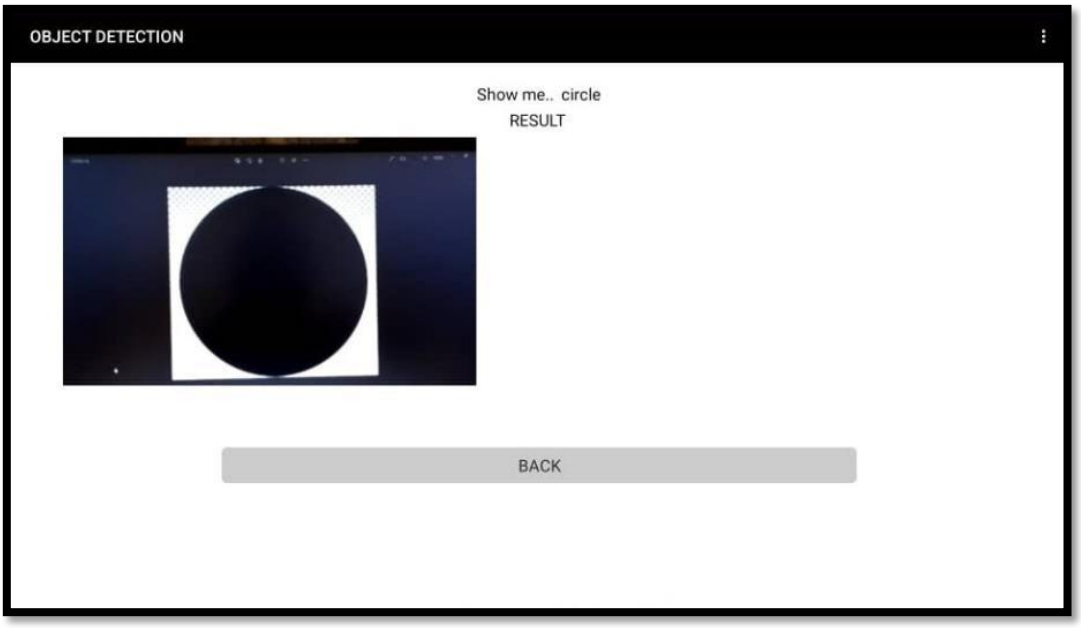

Figure 4. 9 Circle Shape Detection.

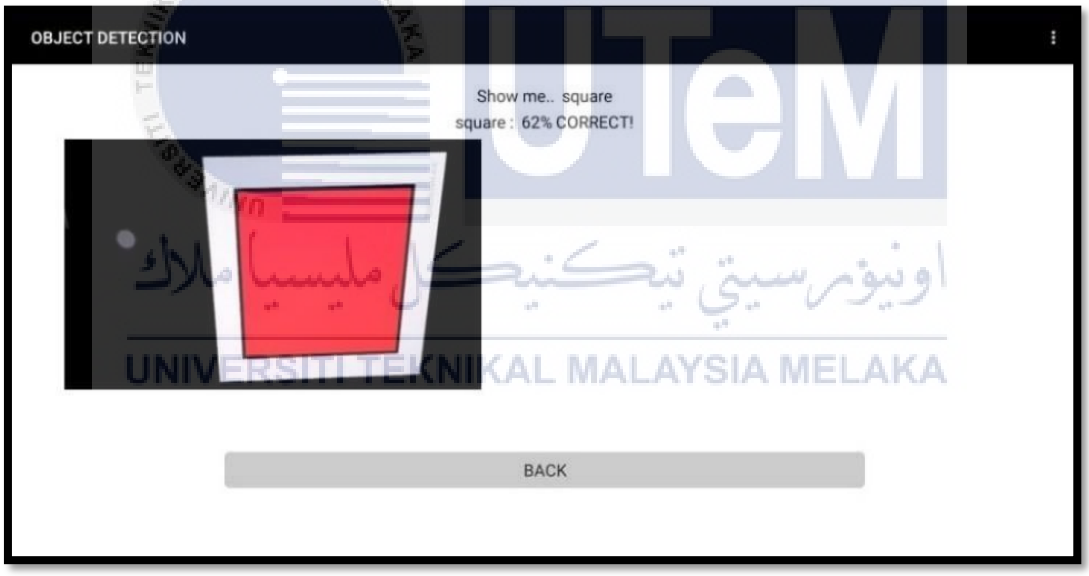

Figure 4. 10 Square Shape Detection.

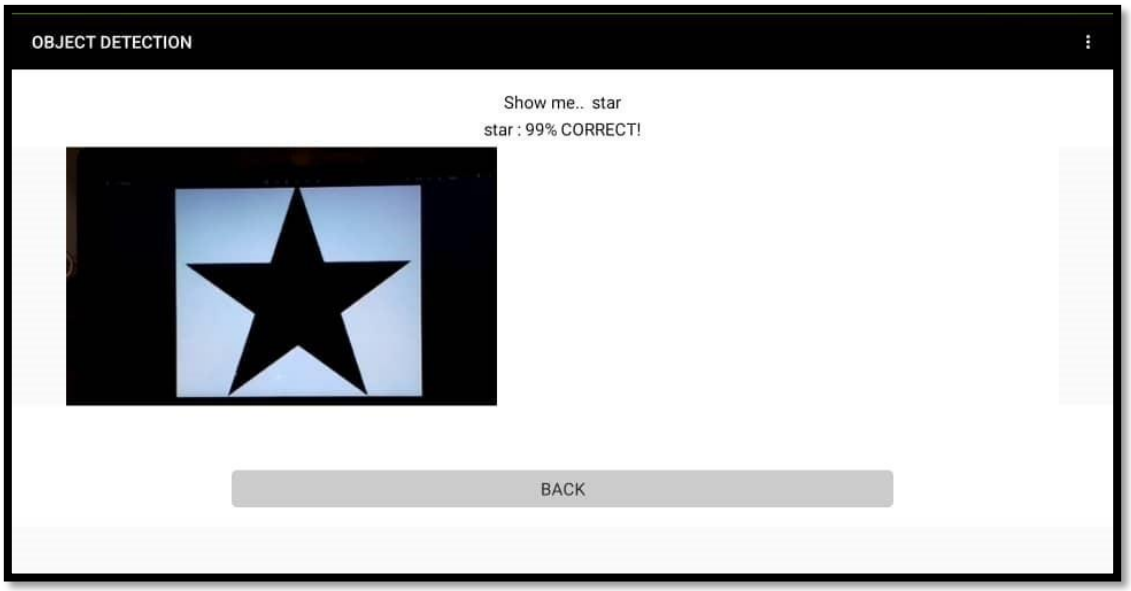

Figure 4. 11 Star Shape Detection.

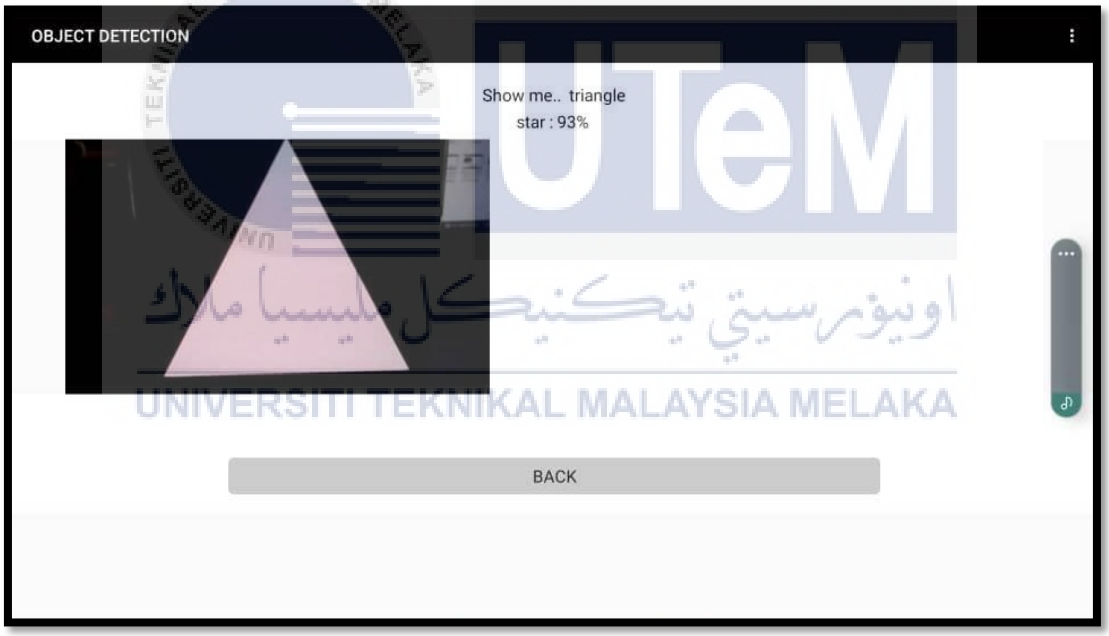

Figure 4. 12 Triangle Shape Detection.

4.2.5 Fifth Step: Pose Detection

Figure 4.13, 4.14, and 4.15 shows the first, second and third level of pose detection module. User need to move around to capture the pose indicated to move for the next pose. In order to discover the correct pose, the user need to kept moving about by this module, which uses machine learning for pose detection.

Figure 4. 13 First Level of Pose Detection.

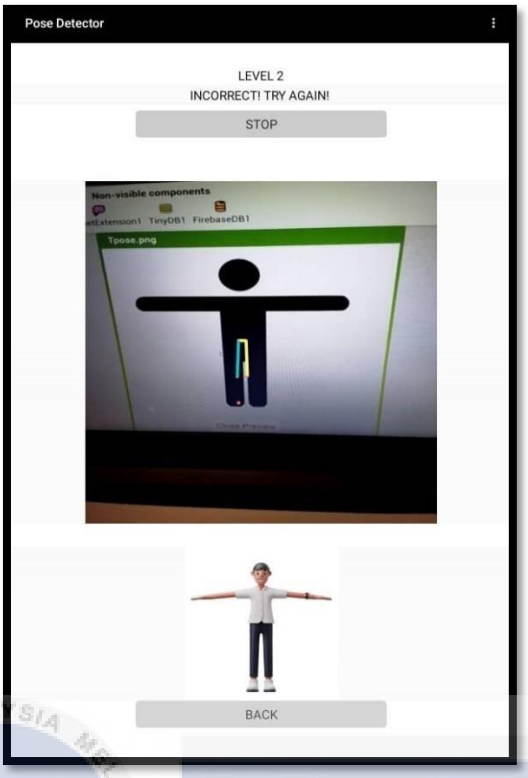

Figure 4. 14 Second Level of Pose Detection.

Figure 4. 15 Third Level of Pose Detection.

4.2.6 Sixth Step: Emotion Detection

Figure 4.16, 4.17, 4.18, and 4.19 shows the different level of emotion face detection module. User need to move around to capture the emotion of human face so that it indicated to move for the emotion face. In order to discover the correct emotion face, the user need to kept moving about by this module, which uses machine learning for image detection.

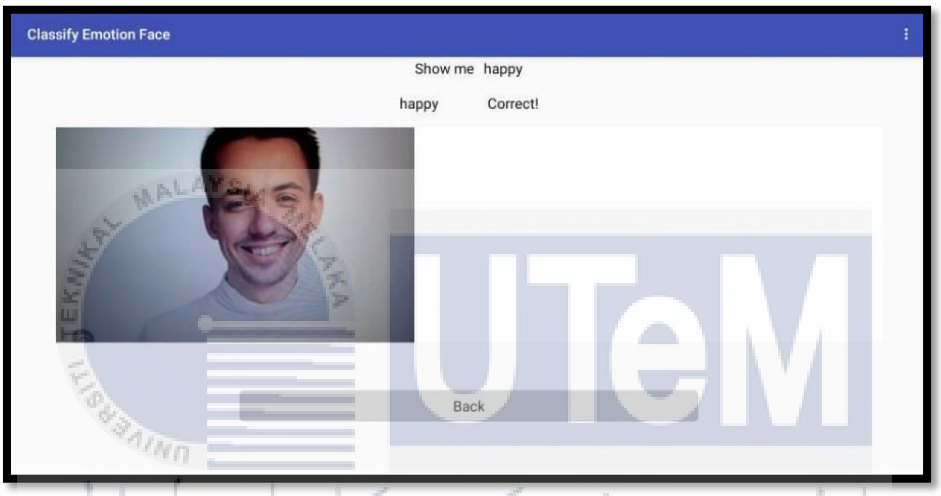

Figure 4. 16 Happy Face of Emotion Face Module.

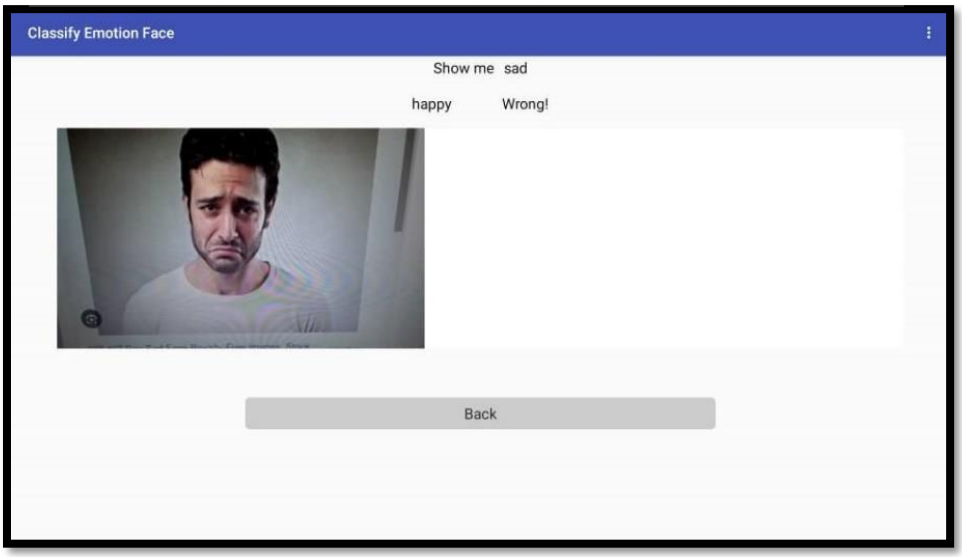

Figure 4. 17 Sad Face of Emotion Face Module.

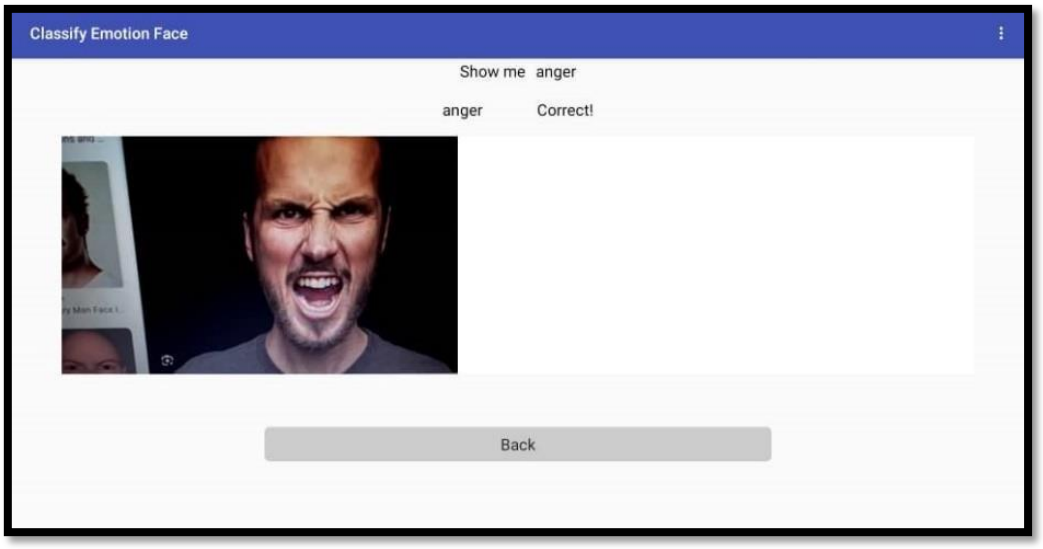

Figure 4. 18 Angry Face of Emotion Face Module.

Figure 4. 19 Surprise Face of Emotion Face Module.

4.2.7 Firebase Data Collection

Analyzing all of the data collected to inform the development of the app is part of the analysis process for the Firebase data collection. At first, information is gathered about user interactions, app usage trends, and user reviews. To assure accuracy and dependability, this data is then obtained, cleaned, and converted. Figure 4.20 shows the firebase data collection for each user and module.

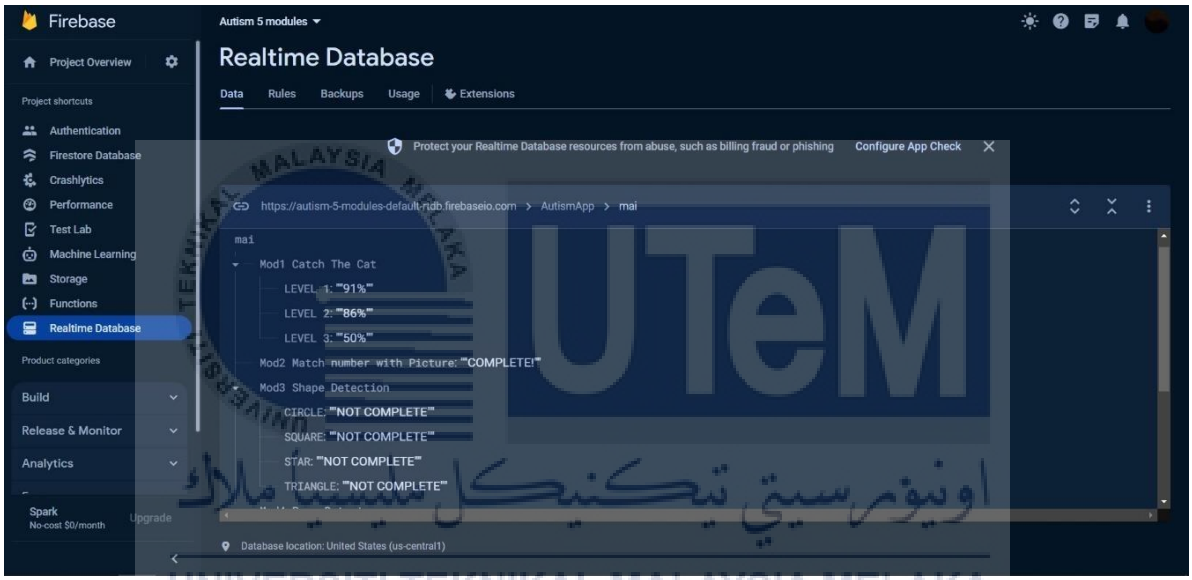

Figure 4. 20 Firebase Data Collection

Based on data collected from Module 1: Catch the Cat, as shown in Figure 4.21. According to this line graph, the accuracy average of the user score for level one to three was around 87%, 77%, and 41% accuracy, respectively. This indicates that there are various challenges for the user to overcome at each level.

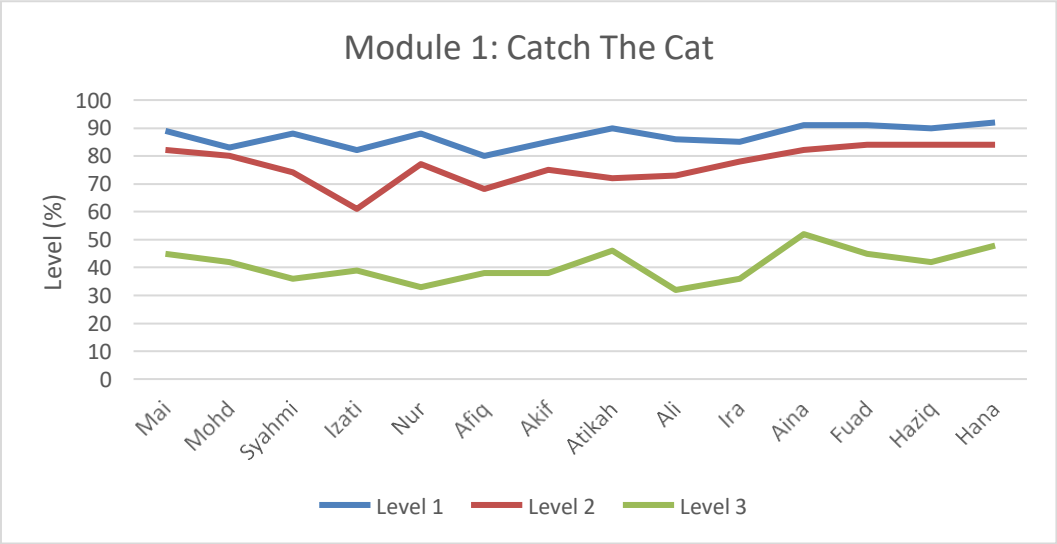

Figure 4. 21 Data Collection of Module 1: Catch The Cat

Based on data gathered from Module 2: Match Number With Pictures, as shown in Figure 4.22. The line graph reveals that a large percentage accuracy of users obtained a score of 100%. These demonstrate how simpler it is for the user to finish all of the tasks in this module.

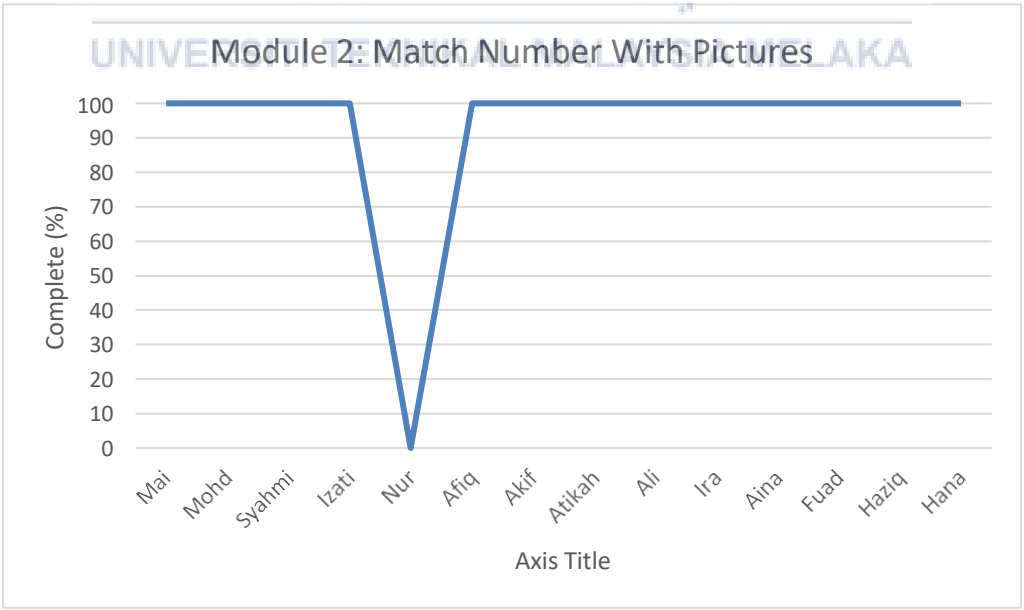

Figure 4. 22 Data Collection of Module 2: Match Number With Pictures

According to information obtained from graph of Module 3: Shape Detetctor, as illustrated in Figure 4.23. The line graph shows that the user has finished the majority accuracy of the shape detection module at a 100% completion score. A small number of users were unable to completely complete the entire module.

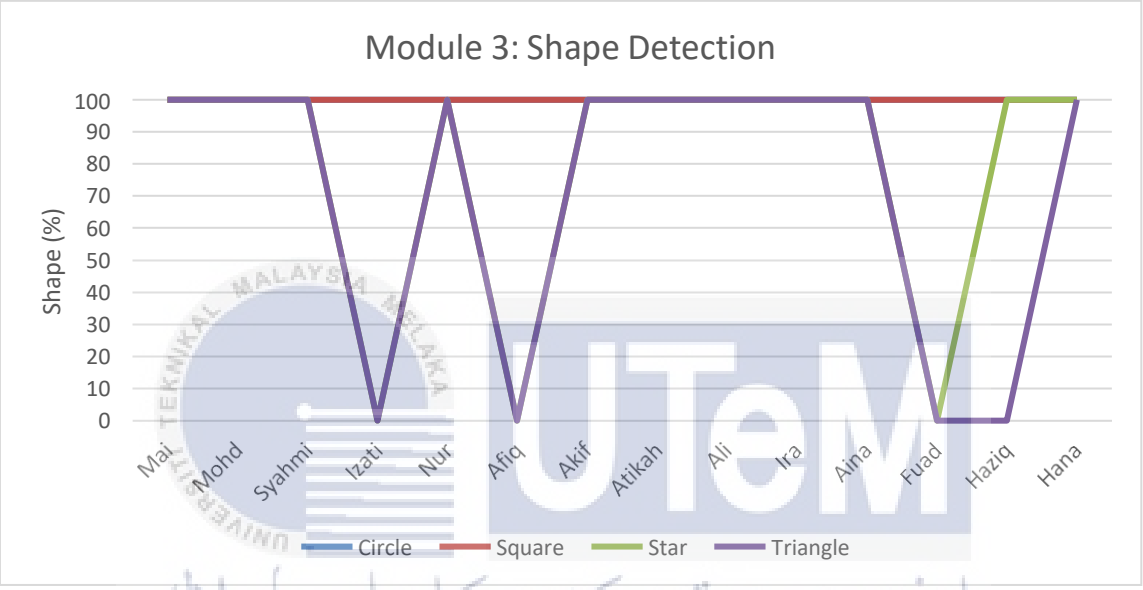

Figure 4. 23 Data Collection of Module 3: Shape Detetctor

Based on data from the Module 4: Pose Detector graph, as seen in Figure 4.24. The line graph demonstrates that most users finish the first, simple level. Just 35% accuracy of users finish the level 2 task, which is a medium difficulty. Finally, only 7% accuracy of the 14 users were able to succeed in completing this challenging level, which is challenging for children with autism.

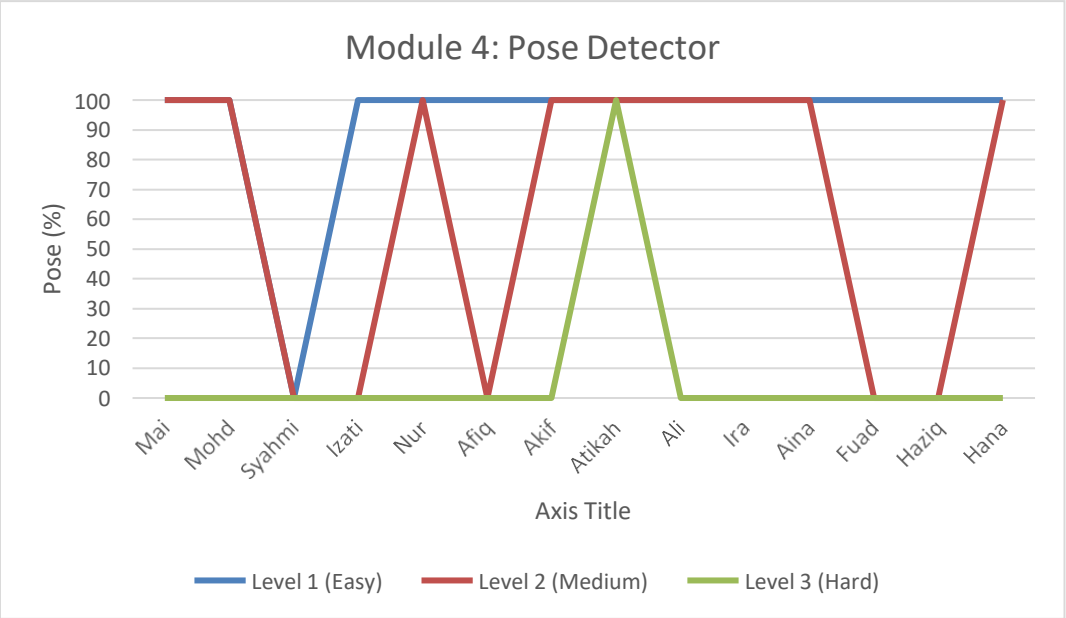

Figure 4. 24 Data Collection of Module 4: Pose Detector

Based on information acquired in the Module 5: Emotion Face graph in Figure 4.25. According to the line graph, the majority of users were successful in making the happy emotion face. At the same time, the user faces challenges in finishing the other emotion face since the graph displays an up-and-down line indicating task completion or failure.

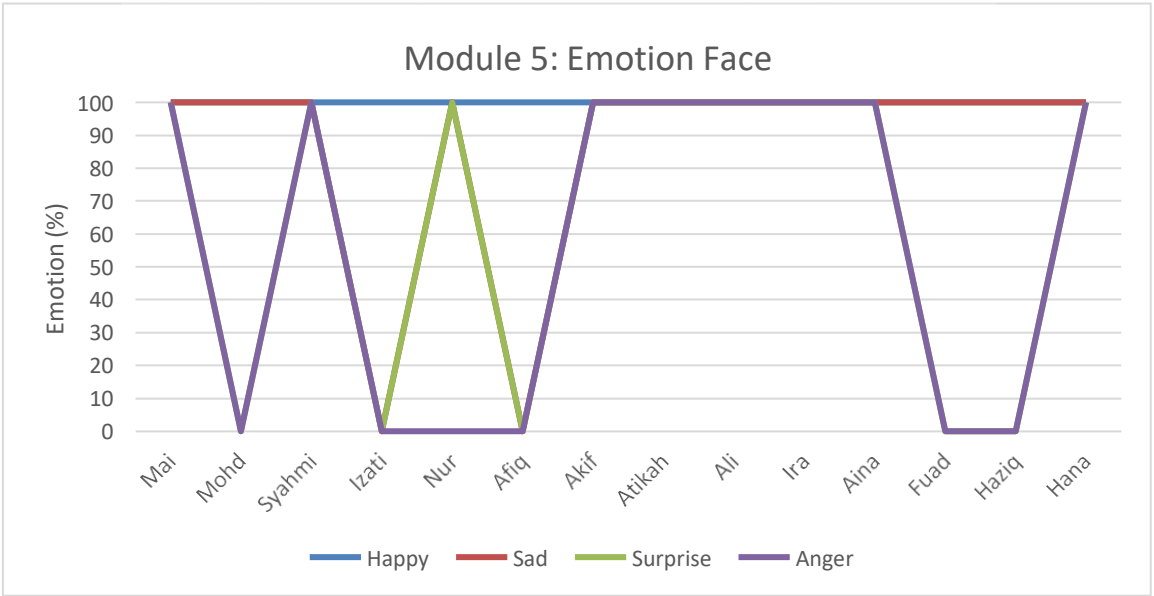

Figure 4. 25 Data Collection of Module 5: Emotion Face

4.3 Analysis

Analysis was conducted to get a better understanding of how things work in this development of AI-powered app for autism education.

4.3.1 Module 1: Catch The Cat

When the start button on this module is pressed, the cat figure will begin to move and the timer, which has been set to 30 seconds, will begin to count down as seen in Figure 4.26 below. After the timer goes off, the level one score will automatically be shown, beginning with level two as seen in Figures 4.27 and 4.28. After level 3 is completed, all of the scores will be displayed as shown in Figure 4.29. The score will be expressed as a percentage by dividing the score by the total number of cats that appear and multiplying the result by 100%.

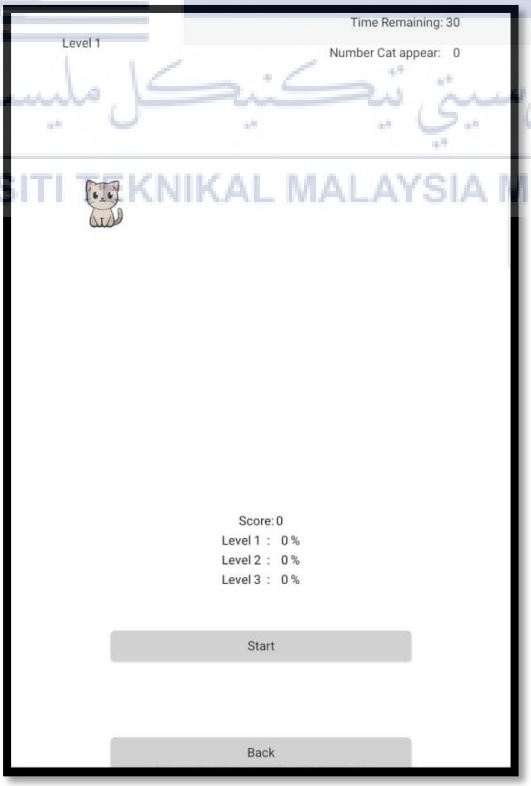

Figure 4. 26 Level 1

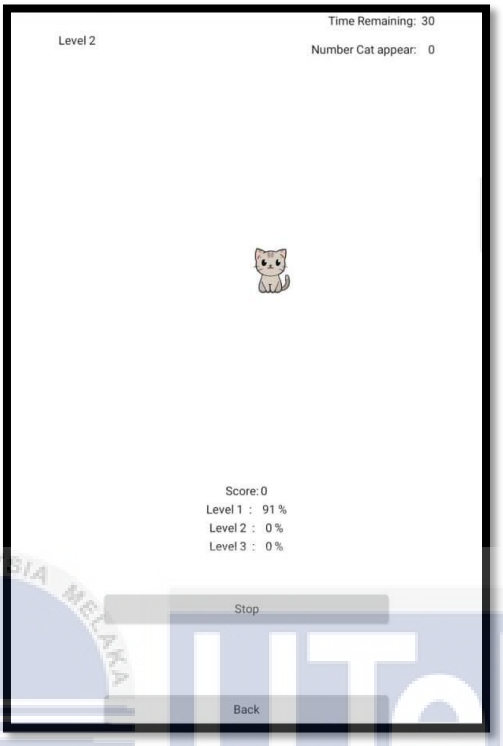

Figure 4. 27 Level 1 Score

Figure 4. 28 Level 2 Score

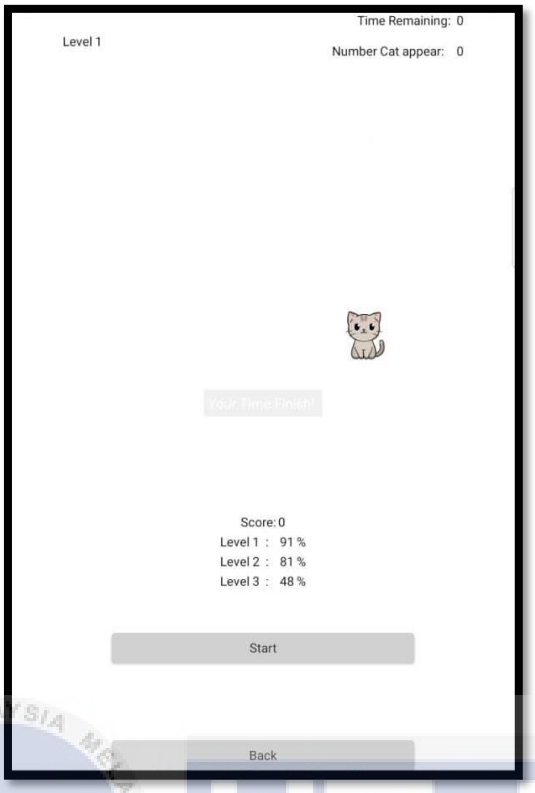

Figure 4. 29 Level 3 Score

4.3.2 Module 2: Match Number With Pictures

As seen in Figure 4.30, this module begins by dragging the images that matches the numbers in the interface. Both Figures 4.31 and 4.32 showed that the user will be notified if the match is correct or wrong. If the user matches the number of pictures and shows exactly as described, the "Finish" notification will appear as in Figure 4.33.

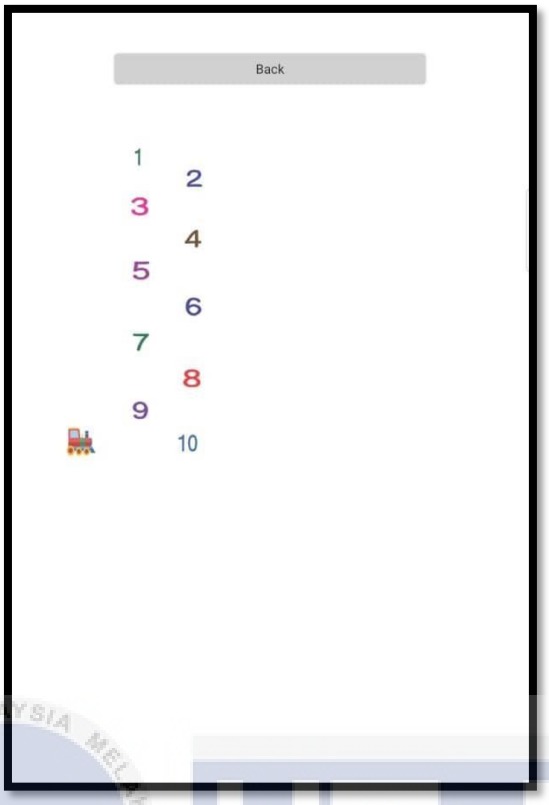

Figure 4. 30 Start of Module 2

Figure 4. 31 Correct Match of Module 2

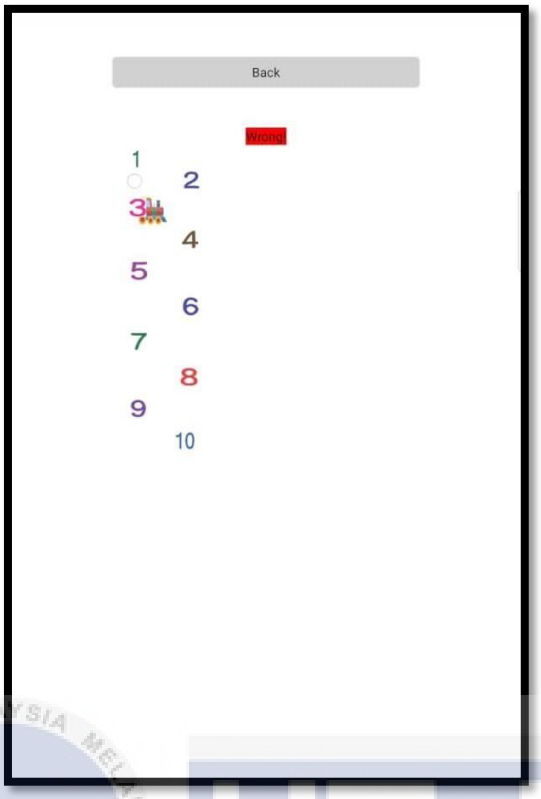

Figure 4. 32 Wrong Match of Module 2

Figure 4. 33 Complete Match of Module 2

4.3.3 Module 3: Shape Detetctor

As seen in Figure 4.34, this module begins automatically by detecting the shape using camera . Both Figures 4.34 and 4.35 showed that the user will be notified if the shape is correct or wrong. If the user matches the shape exactly as described, the "Finish" notification will appear.

Figure 4. 34 Correct Shape of Module 3

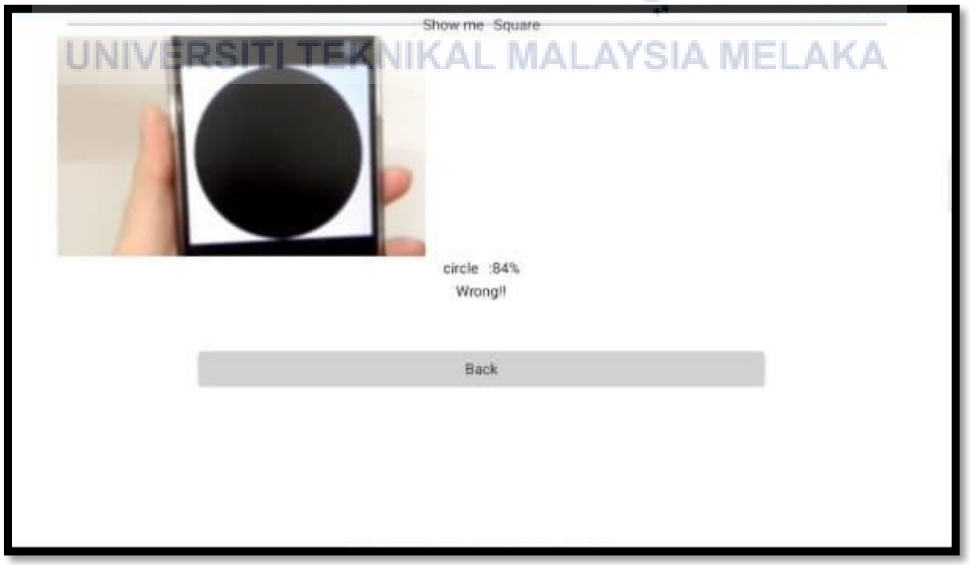

Figure 4. 35 Wrong Shape of Module 3

4.3.4 Module 4: Pose Detector

When the start button on this module is pressed, the camera will detect the pose that the user do as seen in Figure 4.36 below. If the incorrect pose detected, it will notify the user as 'Incorrect! Try Again'. Figure 4.37 shows after repeating the same step as level 1 to level 3 is completed, the notifier will come out as 'Finish' to shows the user has completely success.

Figure 4. 36 Incorrect Pose of Module 4

Figure 4. 37 Correct Pose of Module 4

4.3.5 Module 5: Emotion Face

As seen in Figure 4.38, this module begins automatically by detecting the emotion face using camera . Both Figures 4.38 and 4.39 showed that the user will be notified if the emotion face is accurate or inaccurate. If the user matches the emotion face exactly as described, the "Correct" notification will appear.

Figure 4. 38 Accurate Emotion Face of Module 5

Figure 4. 39 Inaccurate Emotion Face of Module 5

CHAPTER 5

CONCLUSION

5.1 Conclusion

As a conclusion, the development of an AI-powered app for autism education operated according to the objective stated. This project objective is to study how children with autism learn skills. By using this interactive application, children with autism learned on how to develop their learning skills by doing the module given.

This project aimed to develop an AI-powered application for autism education. By utilizing MIT App Inventor and Teachable Machine, an AI-based system created to develop an interactive module and task for autism children to complete to observe their learning skills. It stimulated that autism children learning skills by having them independently complete the tasks. This project also detects human joint key points and compare them to a reference image to determine the correct shape, pose, and facial emotion. This project helps autistic children develop and improve their learning skills.

It is important to note that the development of this AI-powered app for autism education has the potential to greatly benefit autistic children who have suffered from slow learning skills. By providing interactive educational modules that can improve autistic children's learning skills, this project integrated the functionality of AI developed for autism children's education, MIT App Inventor, and Teachable Machine.

5.2 Future Works

The development of an AI-powered app for autism education has come a long way, but there is still much room for improvement in terms of accuracy, reliability, and user experience. For future works, among the improvement that can be made are:

1. Consider enhancing the application of user interface and overall user experience. Focusing on more intuitive and engaging design can make this project more accessible and enjoyable for children with autism. This could involve incorporating colorful and visually appealing elements, clear and simple navigation, and interactive features that satisfy various kinds of learning approaches.
2. It should be a top priority to work continuously with specialists and experts in autism. Building partnerships with specialists in autism education, speech therapy, and behavioral therapy may help optimize the content of the application and activities. These professionals can offer useful knowledge on the special requirements of autistic children and can direct the creation of specific educational materials that correspond to best practices supported by research.
3. Develop a dedicated section within the app that offers resources and guidance for parents, caregivers, and educators. Offer parents advice on how to help their autistic children, how to use the app properly, and how to join a community forum where people can exchange experiences and experience. Long-term success requires encouraging the adults involved in the development of children's education.

5.3 Potential Commercialization

The development of an AI-Powered Autism Education App presents a significant business opportunity by providing to the unique requirements of people with autism and those who support them. It integrates into a developing market with a broad target audience that includes individuals of different origins, educators, caregivers, and parents. Its AI-driven configuration, which provides individualized learning experiences throughout developmental stages is a distinctive point of difference. The application emphasizes accessibility first, incorporates data-driven insights for efficient progress tracking, and guarantees a fun user experience. Strategic monetization techniques, effective marketing that highlights features and benefits, and a strong effort to handle data responsibly are all necessary for successful commercialization. All things considered, this research may improve the lives of those who are autistic and help make autism education easier for everyone in the future.

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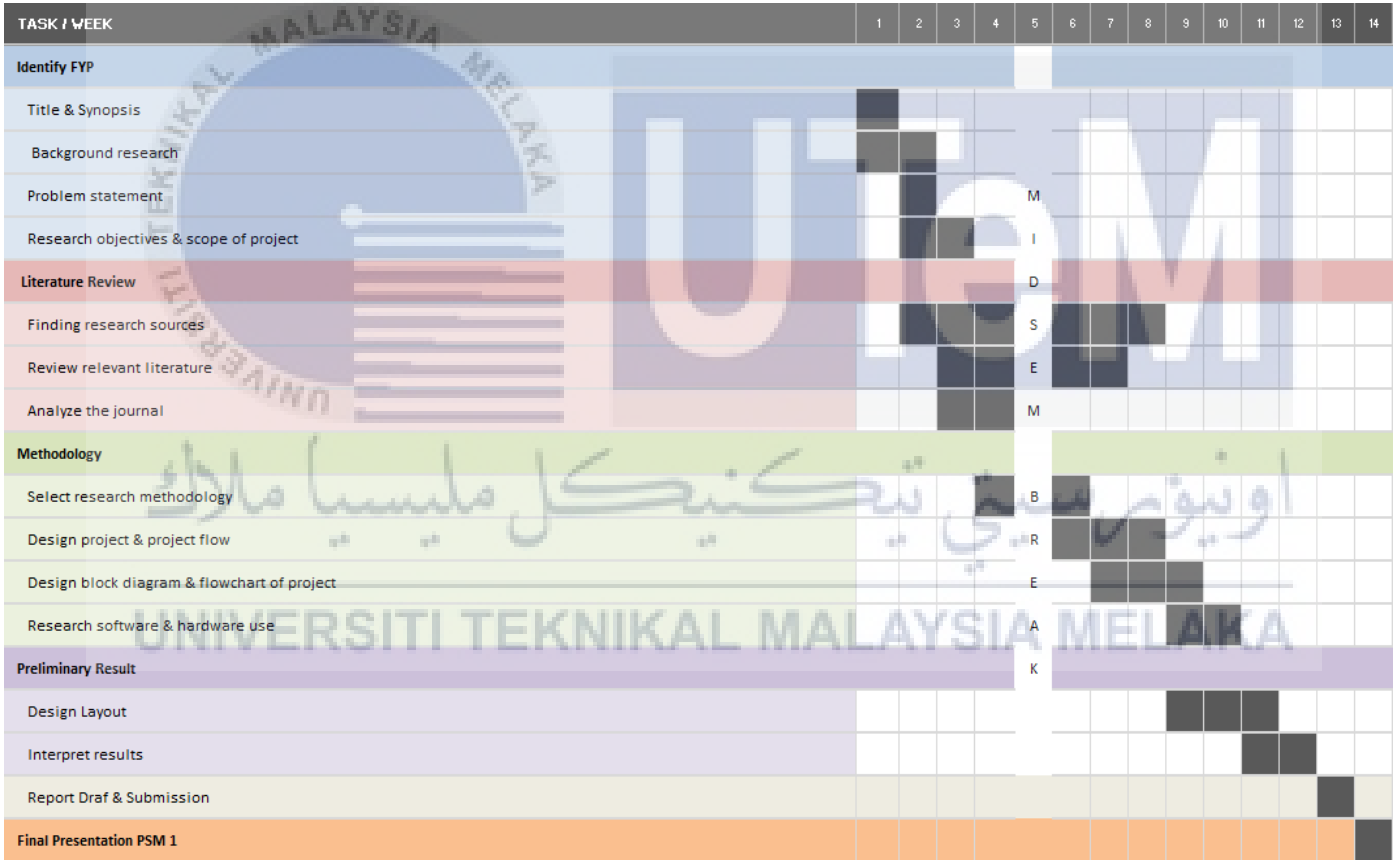
APPENDICES

Appendix A PSM 1 Gantt Chart



Appendix B PSM 2 Gantt Chart