

PediPulse: Enhancing Monitoring Child Development and Intervention

Dr. Noor Hasrul Nizan Mohammad Mor
Department of Information System
Kulliyyah of Information and
Communication Technology (KICT)
International Islamic University Malaysia
nhasrul@iium.edu.my

Nurul Nuha Binti Mohd Zaki Udin
Department of Information System
Kulliyyah of Information and
Communication Technology (KICT)
International Islamic University Malaysia
nuha.mzu@live.iium.edu.my

Nor Ani Jannah Binti Ahmad Zaini
Department of Information System
Kulliyyah of Information and
Communication Technology (KICT)
International Islamic University Malaysia
anijannah.zaini@live.iium.edu.my

Abstract— The growth and development of children in Malaysia have traditionally been recorded in physical health booklets, a method prone to challenges such as misplaced records, lack of accessibility, and limited oversight of developmental progress. This paper aims to address these issues by developing PediPulse, a comprehensive web application that digitally tracks child growth milestones and facilitates early detection of autism spectrum disorder (ASD). Using design thinking (DT) methodology, the study conducted literature reviews, interviews, and online surveys to define problems and gather system requirements. The platform was built using the Laravel framework, providing a modern, efficient, and user-friendly solution that overcomes the limitations of manual recording methods. The findings offer a practical digital tool to support parents in overseeing child development effectively, highlighting its potential as a key enabler for early intervention in developmental health. Future work will focus on expanding the platform's functionality and assessing its impact on child healthcare practices in Malaysia.

Keywords—child development monitoring, digital health tracking, autism spectrum disorder (ASD), web application

I. INTRODUCTION

In Malaysia, following childbirth, parents usually the mother are tasked with monitoring their child's development up until 6 years old. However, they are relying on a government-provided manual record book to receive an update about their child's progress during the appointment time. For this project, we decided to solve this problem by developing a user-friendly web application that implements functions for parents to easily track, record child's development and milestone and perform M-CHAT screening. The problems faced by parents, summarized below, motivate us to develop the web application. This project aims to address the pressing need for accessible tools and resources to assist parents in monitoring and detecting child development abnormalities early for autism spectrum disorder (ASD).

A. Problem Statement

Parents face significant challenges in monitoring their child's developmental progress and detecting early signs of Autism Spectrum Disorder (ASD):

- Parents lack a comprehensive digital platform to effectively track and oversee their child's growth milestones and assess risks of ASD.
- Traditional manual recording methods, such as health handbooks, are time-consuming, error-prone, and often result in incomplete or misplaced information.

- Missing critical developmental insights deprives children of timely intervention and support, causing long-term developmental setbacks.

B. Project Objectives

- To develop a web application for parents to track and record child's growth and developmental milestone, and early risk detection of ASD.
- To assist parents in tracking child growth progress by incorporating and automated feedback.
- To provide a clear summary of recorded data through dashboard, displaying the child development status and potential risk of ASD.

C. Project Scope and Limitation

PediPulse will only cover in allowing parent to track their child's growth, developmental milestones and take the M-CHAT test and provide the result of any potential risks of ASD. The system is limited to parents whose child is currently 1 to 6 years old and the observations for M-CHAT test provided are from 18 to 30 months. The system will also provide some tips and intervention for parents in taking care of their child. However, the web application does not provide medical advice and does not substitute be seen regularly by a healthcare professional. This is because the system is built to assist for immediate respond and monitoring but not replacing the existing handbook that are required for hospital use.

II. LITERATURE REVIEW

This section will discuss existing products on the market including web applications and mobile applications. All the applications listed execute the same scope of functions and features, catering to the needs of parents and caregivers concerned with child development, milestone tracking, and autism spectrum disorder (ASD) risk detection. The five applications that have been reviewed include CDC Milestone Tracker, Child Development & Parenting, Kinedu, Child Growth Tracker, Autism AI.

The first app is the CDC Milestone Tracker mobile application developed by the Centers for Disease Control and Prevention (CDC). [1] This app offers child milestone tracking, an ASD screening test with questions from the M-CHAT, and tips and interventions for parents to teach and bond with their child. For the child milestones, after the user takes the test, immediate records and feedback are provided. Additionally, all the features of this app are displayed on the dashboard. This application is free to use, but unfortunately, it does not offer a growth and development chart.

Secondly, the Child Development & Planning mobile application, developed by BabyG Tech Pvt Ltd, offers features including a growth and development chart that can record the child's weight and height, milestone tracking, and tips. [2] For milestone tracking, after recording a milestone, the system will show the progress of the child's milestones. This app also provides tips to help couples who are first-time parents. However, it requires a paid subscription to access more detailed information and tips. Additionally, a disadvantage of this app is that it does not provide information related to ASD.

Thirdly, there is a web-based application named Kinedu, developed by Kinedu Inc. [3] This application provides a thoughtfully crafted dashboard with the aid of multimedia elements such as pictures. Moreover, the application also provides visualization for the progress made by the children by including pictures of each of the progress. Various modules of activities with the usage of video guidelines are being provided for a clear understanding and implementation. However, as a child development application, this app does not provide growth chart and ASD risk detection which could impede early interventions.

On the other hand, there is another application named Child Growth Tracker from ABQ App Source, LLC. [4] that consists of growth and development charts. It allows them to track their child's growth pattern with the aid of growth chart feature to provide visual representation of their child growth. Unfortunately, this application does not include milestone assessment, making the app with only one sole function.

Similarly, to Autism AI, develop by Seyed Reza Shahamiri. [5] This application does include functionality to assess any risk of having ASD with the use of AI. However, the screening test for ASD used is tailored for adult participants as well, making it lack the specificity for young children under 6. After taking the test, the app does not offer any tips or intervention for the high level of risk of ASD.

TABLE I. LITERATURE REVIEW SUMMARY

App Name/Features	Dashboard	Growth and Development chart	Milestone tracking	ASD Screening Test (i.e. M-CHAT)	Summary Report	Tips and Intervention	Free Subscription
CDC Milestone Tracker	✓	✗	✓	✓	✓	✓	✓
Child Development & Parenting	✓	✓	✓	✗	✗	✓	✗
Kinedu	✓	✗	✓	✗	✗	✓	✗
Child Growth Tracker	✗	✓	✗	✗	✗	✗	✓
Autism AI	✗	✗	✗	✓	✓	✗	✓

III. METHOD

A. Requirement Engineering

To gather the requirements for PediPulse, we utilized online interviews and surveys as our primary elicitation techniques. The online interview was conducted with a pediatric doctor to gain expert insights into the essential functionalities required to monitor child development effectively and to identify critical milestones that parents may overlook. This interview also helped highlight the importance of early detection of developmental delays, including Autism Spectrum Disorder (ASD).

Simultaneously, an online survey was designed to collect detailed feedback from parents regarding their experiences and challenges in manually recording their children's

development using traditional methods, such as health record books. The survey, created using Google Forms, was distributed through social media platforms to ensure broad accessibility and reach.

The combined insights from the pediatric interview and survey responses were instrumental in identifying key pain points and defining functionalities that the web application should provide. This user-centered approach ensures that PediPulse is tailored to the needs of parents, offering a user-friendly and effective solution for tracking child development milestones and facilitating early ASD risk.

The development approach chosen for the PediPulse web application is rapid prototyping model. The development phases involved are prototyping, testing, and refining. A quick creation of a prototype based on the requirement document is produced. Then, when the user gets the overview of the system, their feedback will be used for the next iteration for improvement of the functionalities.

B. Development Requirement

The development of PediPulse uses several essential tools and technologies to ensure the system works effectively by using Laravel framework. MySQL is used as the database server to securely store and manage data. For programming, the project relies on PHP for back-end development and HTML along with Bootstrap for designing a responsive and user-friendly front-end. To host and test the application, XAMPP is used as the web server.

C. Design and Functionality Requirements

Figure 1 depicts a use case diagram to illustrate the interaction of the user with the application. It highlights the main functionalities of the application that involve modules such as registering parent child, record child growth, tracking child development milestone, ASD risk screening and view tips and interventions.

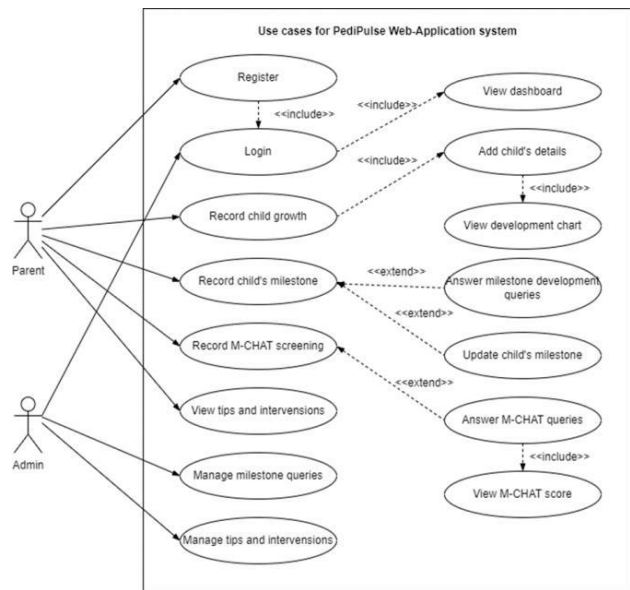


Fig. 1 Use Case diagram of PediPulse

The Entity Relationship Diagram(ERD) of PediPulse and its relationship between entities is displayed on Fig. 2 below.



Fig. 2 ERD of PediPulse

D. Prototype Development

In this phase the prototype was developed to provide a visual representation of proposed features. It allows users to evaluate the system's usability and provide feedback in making sure it aligns with their needs and expectations. Figure 3 illustrates the main interface of parent's dashboard with the summary of their child's growth data, milestone development, ASD screening score, tips and interventions.

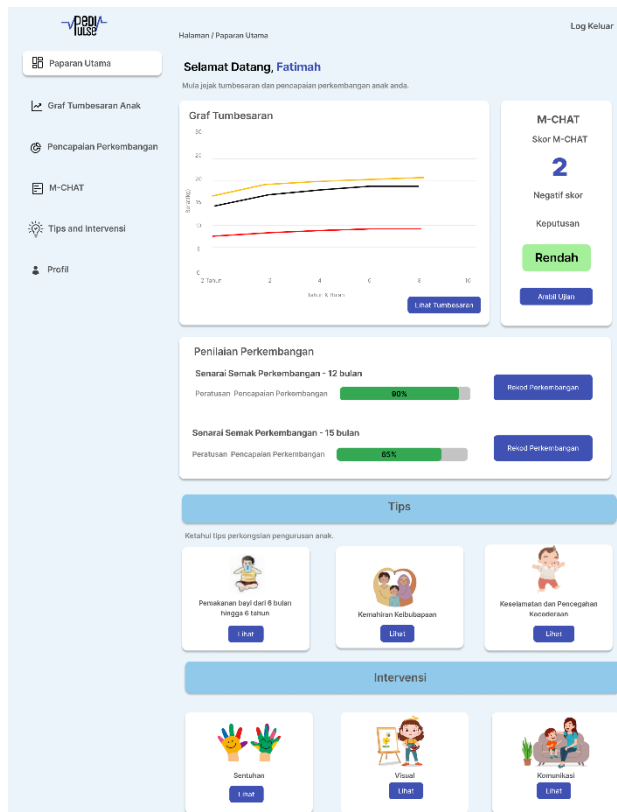


Fig. 3 User Dashboard

Tips and interventions aim to support and guide parents in fostering their child's development effectively. The tips are thoughtfully curated from the Child Health Record Book issued by the Malaysian Ministry of Health (MOH), ensuring they align with trusted and evidence-based practices. Meanwhile, the interventions are sourced from reputable websites specializing in strategies and activities designed for children who may show signs of potential Autism Spectrum Disorder (ASD). These interventions offer practical approaches to help parents address developmental challenges and nurture their child's growth holistically. Figures 4 and 5 illustrate the tips and interventions interface.

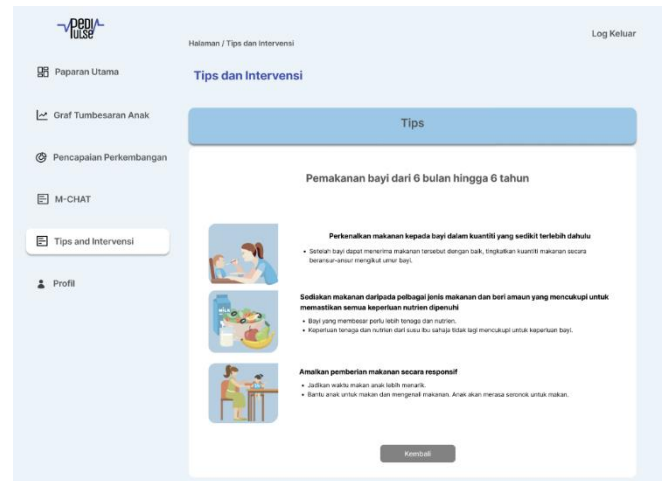


Fig. 4 Tips page

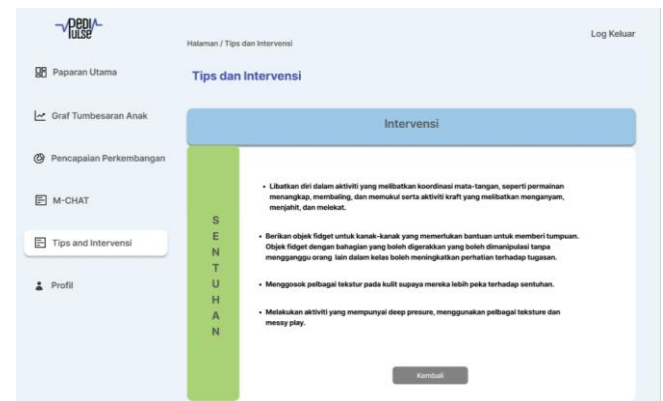


Fig. 5 Interventions page

IV. RESULT

A. The System

The PediPulse Web Application has been successfully developed to support both parents and administrators in monitoring and managing child growth and development. The system provides modules for recording child information, tracking developmental milestones, visualizing growth charts, conducting M-CHAT screenings, and viewing parental tips and child interventions. The Admin Module, on the other hand, allows system administrators to manage core components of the application, including milestone questions, tips, and interventions. This ensures that the system remains up-to-date with accurate, relevant content.

Figure 6 depicts the homepage of PediPulse which will appear when user navigate to PediPulse homepage. In

homepage user can login and register to interact with the system functionalities.

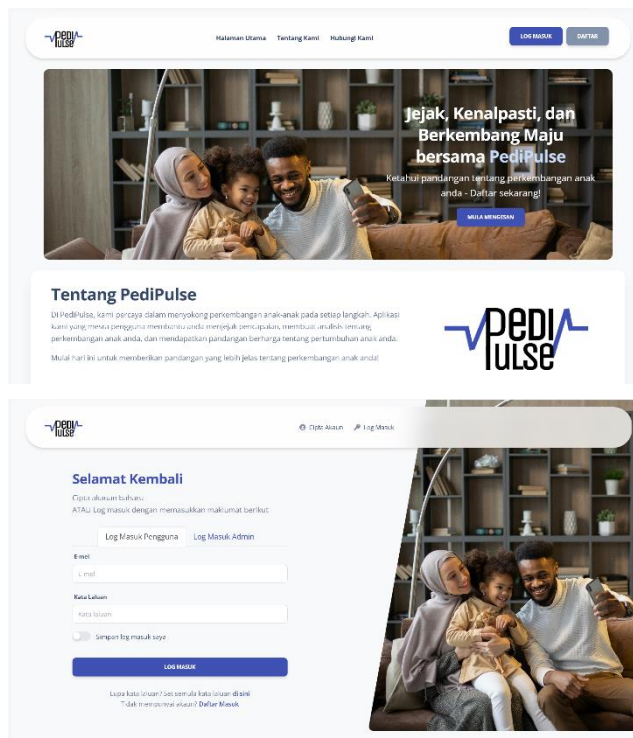


Fig. 6 PediPulse Homepage Interface

Once user successfully login, user can view their dashboard where all the data regarding child growth and development are displayed within one page.



Fig. 7 Milestone Tracking Checklist

The Milestone Tracking Module allows parents to record achievements against predefined milestones for various age groups.

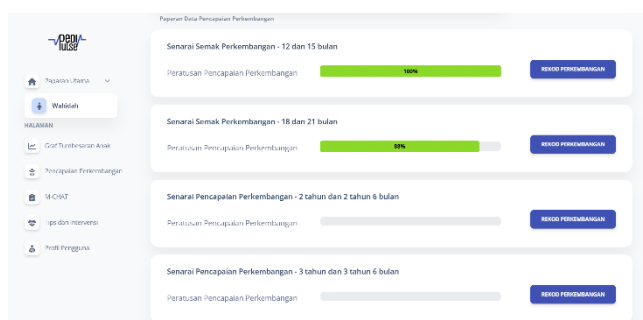


Fig. 8 Milestone Tracking Checklist

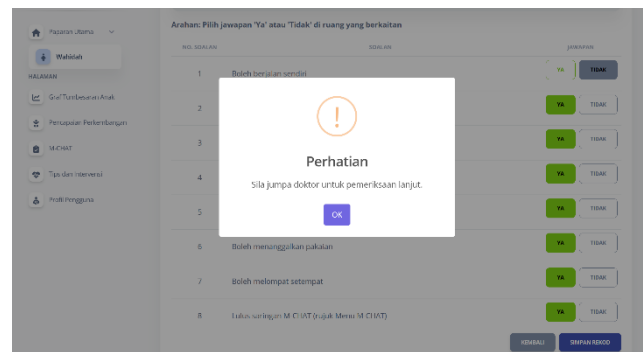


Fig. 9 Milestone Tracking Interface with popup alert after submitting

Parents can update or delete milestones, and the system automatically recalculates progress percentages and immediate response to unarchived milestones development. Figure 8 and 9 above shows the interface for managing child's developmental milestones.

The Growth Chart Module visualizes height and weight data over time, compared against standard growth percentiles with different labels. Parents can input their child's measurements, and the system generates graphical charts. This module allows parent to successfully understand the growth data over time. Figure 10 illustrates this module in action.

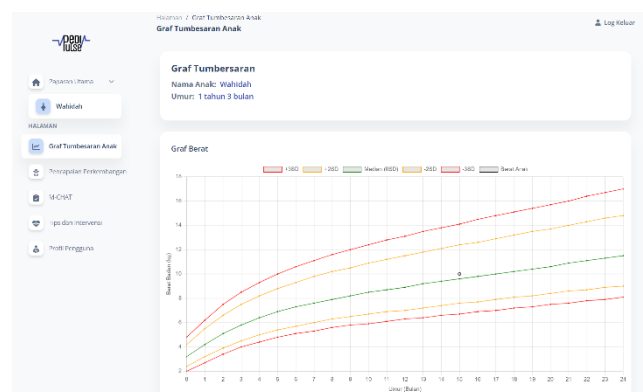


Fig. 10 Growth Chart Visualization

The M-CHAT Screening Tool assists in identifying potential ASD risks. Parents answer a series of questions, and the system processes responses to generate risk levels (low, moderate, or high). As shown in Figure 11, the interface is aimed in guiding parents through the screening process and displaying results with corresponding recommendations.

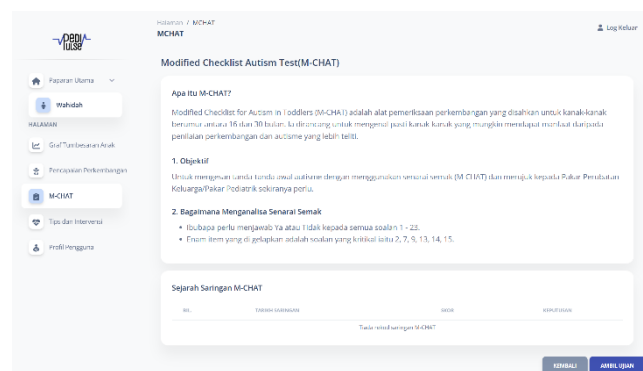


Fig. 11 M-CHAT Screening Interface

Ujian Saringan Perkembangan Tingkat Laku Kanak-Kanak (M-CHAT)

Araban, jawab semua soal. Pilih 'Ya' atau 'Tidak' pada setiap jawaban yang disediakan.

1. Bagaimana Mengenalisi Senarai Semak?
 - Apakah perlu menjawab Ya atau Tidak pada semua soal 1 - 23.
 - Isikan item yang di gelapkan acalah soal yang kritikal lalu 2, 7, 9, 13, 14, 15.

No. Soal	Soal	Jawaban
1	Adakah anak anda seronok apabila diomang, dibuai atau dijinjak kakak/paha dan sebagainya?	Ya / Tidak
2	Adakah anak anda menunjukkan minat terhadap kanak-kanak lain? (contohnya bergaul, bermain, berkawan)	Ya / Tidak
3	Adakah anak anda suka memanjat, contohnya tangga, kerusi, meja dan lain-lain?	Ya / Tidak
4	Adakah anak anda seronok bermain "cak-cak" atau main sorok-sorok?	Ya / Tidak
5	Adakah anak anda pernah bermain objek kecil/beraturan, contohnya mainan, terutamanya anak patung atau mainan masak-masak dan sebagainya?	Ya / Tidak

Fig. 12 M-CHAT Screening Questions Interface

Keputusan Ujian Saringan Modified Checklist Autism Test (M-CHAT)

Maklumat Balas Saringan M-CHAT

Skor M-CHAT Wahadah adalah 1.

Ciri ini anak anda mungkin mempunyai **Risiko Rendah** Autism Spectrum Disorder (ASD).

Risiko Rendah: Risiko Rendah menunjukkan jumlah skor berada di bawah ambang risiko rendah ke normal.

- Tidak tindakan susulan diperlukan pada masa ini.
- Teruslah memantau perkembangan anak secara berkala.

Nota: Pastikan anak mendapat peluang untuk terus berkembang dengan sokongan pendidikan dan persekitaran yang positif.

Fig. 13 M-CHAT Screening Result Interface

In M-CHAT screening module, scoring algorithm is designed to assess the likelihood of ASD by processing the answers provided by parents, evaluating critical and non-critical questions according to predefined rules. The algorithm assigns weightage to critical questions, where a higher number of failed responses indicates a higher risk level.

Additionally, administrators have access to specialized modules that allow them to maintain and manage system data effectively:

- Milestone Question Management:** Admins can add, update, or delete questions associated with developmental milestones. This ensures that the questions remain relevant and up-to-date. Figure 14 shows the interface for managing milestone questions.
- Tips and Interventions Management:** Admins can create and edit parenting tips and developmental interventions. This feature helps enrich the system with resources tailored to parents' needs. Figure 16 illustrates this module.

Kemaskini Senarai Perkembangan

No.	Tajuk Checklist	Berkaitan Laku	Tarikh Akhir	Tindakan
1	Senarai Senarai Perkembangan	10/10/2024	2024-10-10 08:41:08	PAPAR SOALAN / PADAM / SUNTING
2	Senarai Senarai Perkembangan	10/10/2024	2024-10-10 08:41:08	PAPAR SOALAN / PADAM / SUNTING
3	Senarai Senarai Perkembangan	10/10/2024	2024-10-10 08:41:08	PAPAR SOALAN / PADAM / SUNTING
4	Senarai Senarai Perkembangan	10/10/2024	2024-10-10 08:41:08	PAPAR SOALAN / PADAM / SUNTING
5	Senarai Senarai Perkembangan	10/10/2024	2024-10-10 08:41:08	PAPAR SOALAN / PADAM / SUNTING
6	Senarai Senarai Perkembangan	10/10/2024	2024-10-10 08:41:08	PAPAR SOALAN / PADAM / SUNTING

Fig. 14 Milestone Checklist Management Interface

Edit Senarai Pencapaian Perkembangan

Nama Senarai Pencapaian Perkembangan

Senarai Senarai Perkembangan

Kategori Senarai Pencapaian Perkembangan

12 dan 13 bulan

Penerangan Senarai Pencapaian Perkembangan

Senarai Senarai ini membantu menilai pencapaian perkembangan bayi berumur 12 dan 13 bulan dalam aspek motor, komunikasi, dan sosial.

Sasaran Pencapaian Perkembangan

Saya dapat berdiri tanpa bantuan

Saya mengambil benda kecil dengan menggunakan ibu jari dan telunjuk (thumb & index finger grasp)

Saya memegang 2 objek satu sama lain

Saya memegang dan melepaskan benda kecil

Saya boleh bermain tepak senarai atau mendengar lagu

Fig. 15 Milestone Checklist Question Management Interface

Senarai Intervensi

No.	Tajuk	Isi Kandungan	Tarikh	Tindakan
1	10 Petua Keibubapaan Cara Membesarkan Anak Autisme	10 Petua Keibubapaan Cara Membesarkan Anak Autisme	2024-10-10 08:41:08	PAPAR / PADAM / SUNTING
2	Mengenal Anak dengan Spektrum Autisme	Mengenal Anak dengan Spektrum Autisme	2024-10-10 08:41:08	PAPAR / PADAM / SUNTING
3	Mengenal Anak Autisme yang Mengalami Masalah Belajar	Mengenal Anak Autisme yang Mengalami Masalah Belajar	2024-10-10 08:41:08	PAPAR / PADAM / SUNTING
4	Apakah Autisme	Apakah Autisme	2024-10-10 08:41:08	PAPAR / PADAM / SUNTING

Fig. 16 Tips and Interventions Management Interface

Edit Tajuk: 10 Petua Keibubapaan Cara Membesarkan Anak Autisme

Tajuk

10 Petua Keibubapaan Cara Membesarkan Anak Autisme

Penerangan

10 petua keibubapaan untuk membantu ibu bapa memahami dan menyokong perkembangan anak autisme dengan lebih baik.

Rujukan

<https://www.autismperempuan.com/10-petua-keibubapaan-cara-membesarkan-anak-autisme/>

Sumber

Tajuk Sumber

Chatur Pita / No file chosen

Fig. 17 Tips and Interventions Management Interface

B. Testing and Validation

The testing was conducted to evaluate the website's effectiveness and ensure it met user needs. Black Box Testing was used to test the functionality of the system. The test cases are produced based on system specification and requirements then the results of these tests are evaluated to informed further refinements to the web application. The testing was conducted with the users of the system. The results of the test case are shown in Table 2 below.

TABLE II. EXAMPLE OF TEST CASE IMPLEMENTATION

No.	Test Module	Expected Result	Pass/Fail
1.	User Authentication	System verifies users' credentials	Pass
2.	Add new child	Users can add new child details, and the data is stored correctly in the database.	Pass
3.	Record and View Growth Chart	The growth chart retrieves and display the correct data based on the child's details.	Pass
4.	Milestone progress tracker	Users can view and update milestone achievements, and progress is displayed.	Pass
5.	M-CHAT Questionnaire Submission	Users can complete and submit the M-CHAT questionnaire, and	Pass

No.	Test Module	Expected Result	Pass/Fail
		results are generated based on defined algorithm	
6.	Admin - Manage Milestone Questions	Admins can create, edit, and delete milestone questions successfully.	Pass
7.	Admin - Manage Tips and Interventions	Admins can add, edit, and delete tips and interventions, and updates are reflected.	Pass

C. The Model

The Rapid Prototype Model was chosen for this project due to its emphasis on iterative development and early user feedback. This approach ensures a simplified initial implementation that can be continuously refined, allowing us to address complex features like the M-CHAT screening test for ASD risk. By involving users early in the process, potential issues can be identified and corrected at each stage, avoiding further errors in subsequent phases.

The development process prioritized iterative feedback, including consultation with a pediatric doctor. This ensured the features aligned with professional standards and adhered to established medical guidelines. The system was designed with several key factors in mind, including intuitive data entry, user-friendly navigation, and visually accessible interfaces to enhance usability.

This model offers distinct advantages, including its adaptability for future iterations, ensuring the system remains relevant and effective. Additionally, it serves as an effective communication tool among stakeholders, offering a tangible framework for discussing and improving system functionality.

By combining iterative testing, expert guidance, and user input, the Rapid Prototype Model supports the creation of a reliable, user-friendly, and medically accurate system tailored to meet both user needs and professional expectations.

V. CONCLUSION

In conclusion, this system is capable of offering an efficient solution than traditional handwriting. With the system in place, data entry and storage are simplified, allowing for quick access to track the child's growth and development progress. Furthermore, the system minimizes the likelihood of errors in data entry. As this project focuses on enhancing child development monitoring and interventions, we have demonstrated the value of iterative feedback and

continuous improvement in addressing the needs of children and their caregivers. Therefore, for future development, the scope of the project could be expanded such as direct involvement of medical teams to provide more comprehensive and personalized care. By integrating medical professionals into the monitoring process, we can ensure that the interventions are not only effective but also medically sound. Last but not least, establishing advanced data analytics and artificial intelligence can further enhance the predictive capabilities of the platform. This can lead to earlier identification of developmental issues and more tailored intervention strategies directly enhance the child monitoring and their future well-being.

ACKNOWLEDGMENT

Alhamdulillah, all praises to Allah Almighty for His blessings. We have successfully completed our FYP 1 and 2 project, which we have been working on all this time. We would like to thank our supervisor, Dr. Hasrul Nizan, for guiding and instructing us throughout the process of completing this project. His advice and support are greatly appreciated and will be remembered. Also not to forget, Dr. Shahinaz for providing us with medical guidelines throughout the development of this system. Hopefully, we can continue this momentum in resulting project or system that can benefit the community.

REFERENCES

- [1] C. C. f. D. C. a. Prevention, "Autism spectrum disorder (ASD)," CDC Centers for Disease Control and Prevention, [Online]. Available: <https://www.cdc.gov/autism/index.html> . [Accessed 1 5 2024].J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
- [2] B. Ram, "Baby Development & Parenting," BabyG Tech Pvt Ltd, [Online]. Available: https://play.google.com/store/apps/details?id=com.babyg&hl=en_IN. [Accessed 1 5 2024].K. Elissa, "Title of paper if known," unpublished.
- [3] Kinedu, "Kinedu," Kinedu Inc., [Online]. Available: <https://app.kinedu.com/>. [Accessed 1 5 2024].
- [4] "Child Growth Tracker," ABQ App Source, LLC, [Online]. Available: <https://play.google.com/store/apps/details?id=com.abqappsource.childgrowthtracker&hl=en>. [Accessed 1 5 2024].
- [5] S. R. Shahamiri, "Autism AI," [Online]. Available: https://play.google.com/store/apps/details?id=com.rezanet.intelligentasdscreener&hl=en_IN. [Accessed 1 5 2024].