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LITTLE MILESTONES: AN ANDROID APPLICATION FOR TRACKING AND MONITORING HEALTH RECORD FOR TODDLERS

Tristan Carlyle S. Espino[1], Raven Ross C. Manesca[2], Cenon D. Lanceta[3], Memphis B. Deverala[4], Joshua Moises D. Bay[5], Jerian R. Peren[6]

Affiliation: Lyceum of the Philippines University Cavite

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Abstract: **The developed project of the researchers entitled "Little Milestones" addresses the challenge of ensuring proper monitoring for toddlers through the development of an Android application. This application, designed for infants to toddlers ranging from ages 0-3 years old, offers a comprehensive solution with features such as personalized profiles, immunization records, medication reminders, doctor's contact information, milestone tracking, growth monitoring, and daily tips. For early intervention in children aged 0-3, the project utilizes Android Studio (Java) for front-end and backend development, ensuring compatibility with Android Version 7.0 and higher. The developers also used Visual Studio and Notepad++ for the admin side, and Firestore for the database. While focusing on health record tracking in General Trias, Cavite, the project signifies its importance by benefiting pediatricians, parents, caregivers, and researchers, providing accurate health data, and contributing to future research in similar domains. Through functionality and compatibility testing, the researchers prepared test cases for the testers. Functional testing involved a technical adviser, three IT specialists, and one Pediatrician Administrator, with 116-119 criteria tested and a 100% success rate from all testers. Compatibility testing showed a 100% success rate from the Technical Adviser and IT Experts, and an 80% success rate from the Administrator. Not only this, but the application also aims to meet Android Core App Quality standards and the ISO/IEC-25010 criteria. The results of the evaluation indicate that the Android Core App Quality app quality received positive feedback being "Acceptable" and the adherence to the ISO/IEC-25010 criteria is "Highly Acceptable.**

Keywords: **Android Application, Milestones, Health Records, Android Core App Quality, ISO/IEC-25010.**

I. INTRODUCTION

Ensuring health monitoring and proper care is critical, especially when it comes to babies and toddlers who need to be monitored to preserve their health and wellbeing. However, due to the requirement for exact dosage readings, monitoring and tracking infant's records can be difficult for parents and caregivers, the researchers proposed "Little Milestones: An Android Application for Tracking and Monitoring Health Records for Toddlers". According to Utomo (2021), the findings show that medical monitoring mobile apps can help the government's program in developing the health of mothers and their children. The data-based application system allows faster and more effective measurement of children's nutritional status. By empowering them with accurate data, the app aims to improve overall toddler health and wellbeing while fostering a stronger collaboration between parents and healthcare professionals. With the potential to revolutionize how infant to toddler health is monitored and managed, this project holds the promise of easing the burdens faced by parents and caregivers such as having a hectic schedule leading to lesser time to monitor their toddlers, untimely intake of required medicines, scheduling appointments with their assigned paediatricians. thus, enhancing the overall quality of care provided

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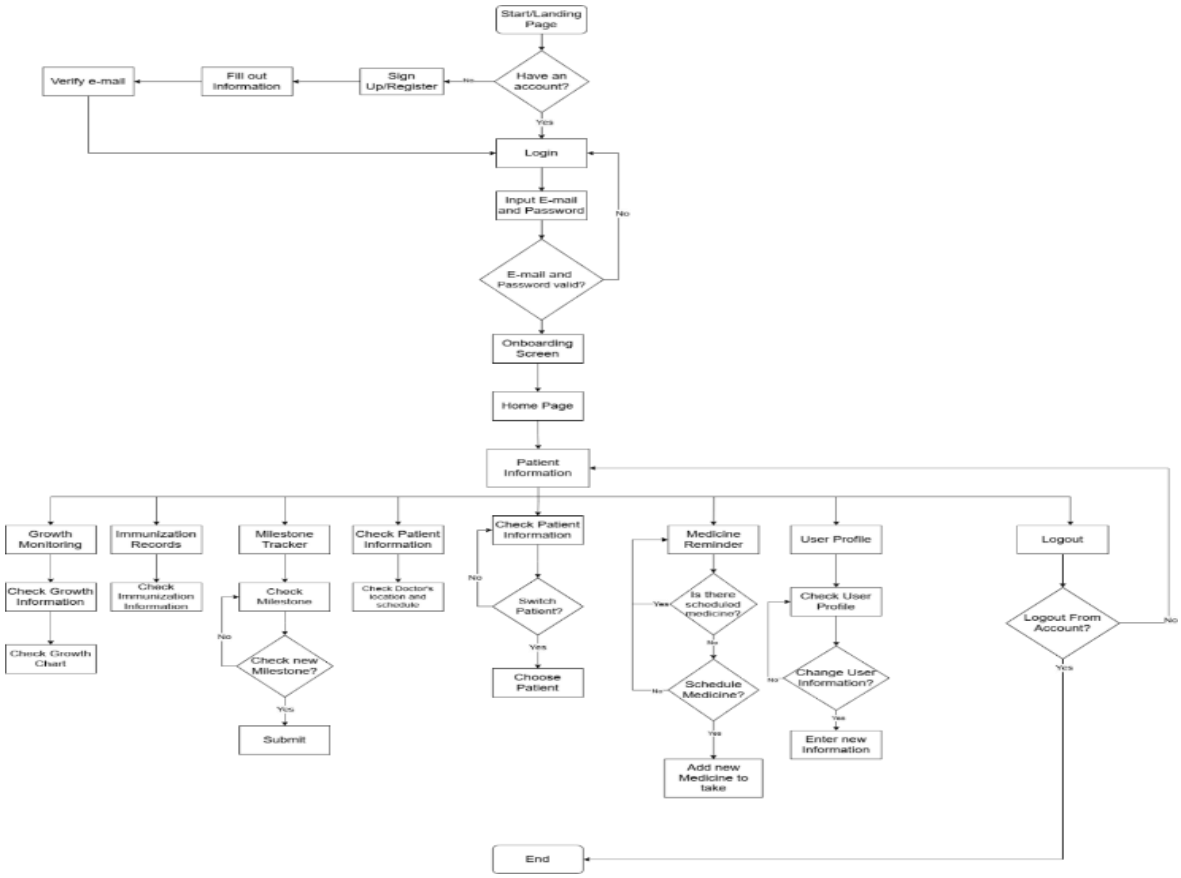
to toddlers, and promoting healthier outcomes in their early stages of life. This research entitled “Little Milestones: An Android Application for Tracking and Monitoring Health Records for Toddlers” focuses on providing convenient and efficient solutions for parents and caregivers to stay organized and informed. Parents can manage and record essential health information such as growth measurements, immunizations, and developmental milestones. The app provides a centralized platform to store and access all vital data, eliminating the need for paper records or multiple applications that would offer the same functions but would be needed to be either paid for or install other separate related applications that would lead to an unnecessary usage of space.

II. METHODOLOGY

A. Process Model

Figure 1: Process Diagram of “Little Milestones” Parent Side

Authors a



The figure above illustrates the user flow for parents and caregivers. Users start from the landing page and can either log in or register. New users register by filling out their name, email, and password, and then receive a verification link via email. After verifying, users can log in using the verified email and password. Once logged in, users see the onboarding screen, which guides them through the app's features. After onboarding, users click the "Get Started" button to access the home page, which includes features like growth monitoring, immunization records, milestone tracker, doctor information, child information, medication reminder, user profile, and log out.

Figure 2 illustrates the administrator's workflow. The administrator begins on the landing page and can either log in directly with their email and password or reset their password if forgotten. After logging in, the administrator is directed to the home page, accessible via the 'home' tab, along with the patients, settings, and logout tabs. Under the patients tab, the administrator can create a new patient or view all patients' information. For each patient, the admin can view and edit details, including patient information, growth monitoring, vaccines, and milestones. The settings tab allows the admin to update the doctor's photo and information, change the password, and view the doctor's schedule. The log-out button allows the administrator to exit the application.

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Figure 2: Process Diagram of "Little Milestones" Admin side

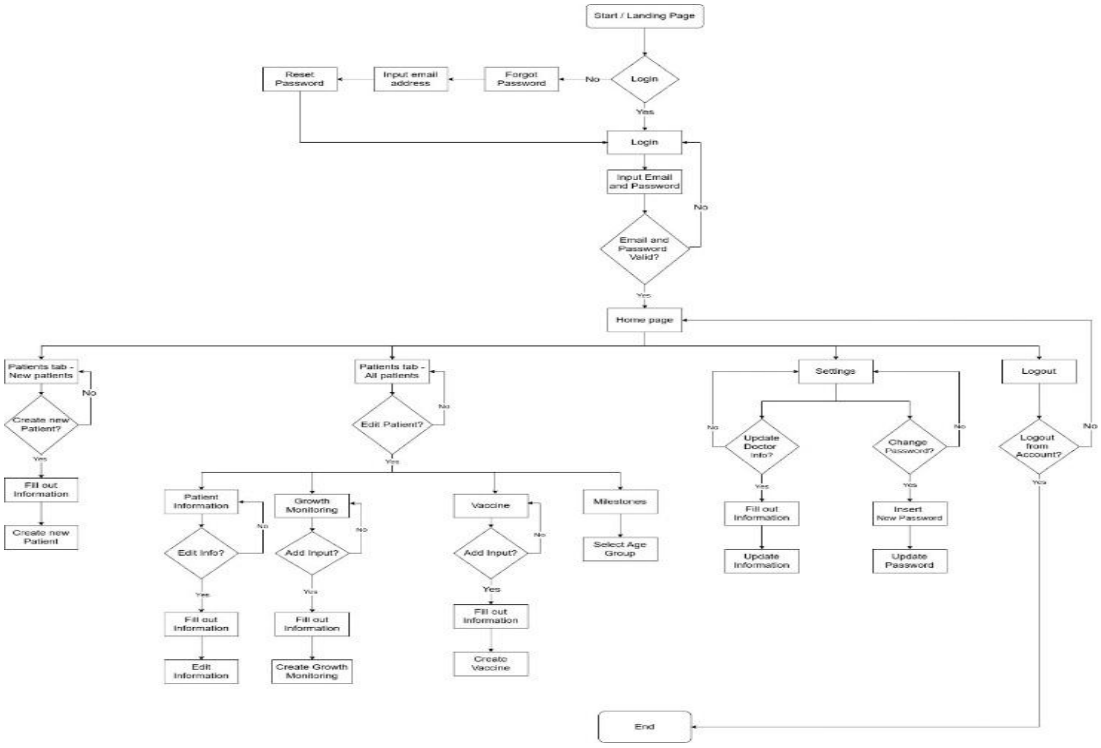
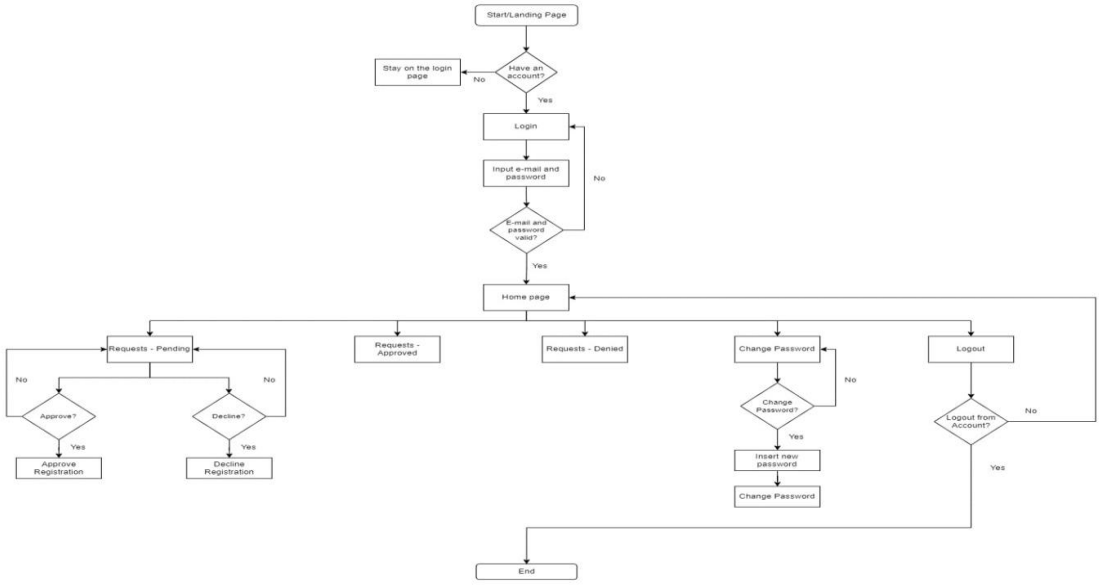


Figure 3: Process Diagram of "Little Milestones" Super Admin side



The figure above illustrates the super administrator's workflow. The administrator will begin at the landing page. If the user does not have an account, he cannot log in and remains on the login page. If the administrator has an account, he can log in directly using his valid email address and password. When an administrator logs in, he or she is taken to the home page, accessible via the 'home' tab, along with the requests, change password, and logout tabs. Under the requests tab, the administrator can manage pediatrician registrations through the 'pending', 'approved', and 'denied' sections. The administrator can approve or decline pediatrician registrations in the 'pending' section by clicking the 'approve' and 'decline' buttons. The 'approved' section displays all approved pediatrician accounts, while the 'denied' section shows all declined registrations. The administrator can change the password through the change password tab. The logout button allows the user to exit the application at any time.

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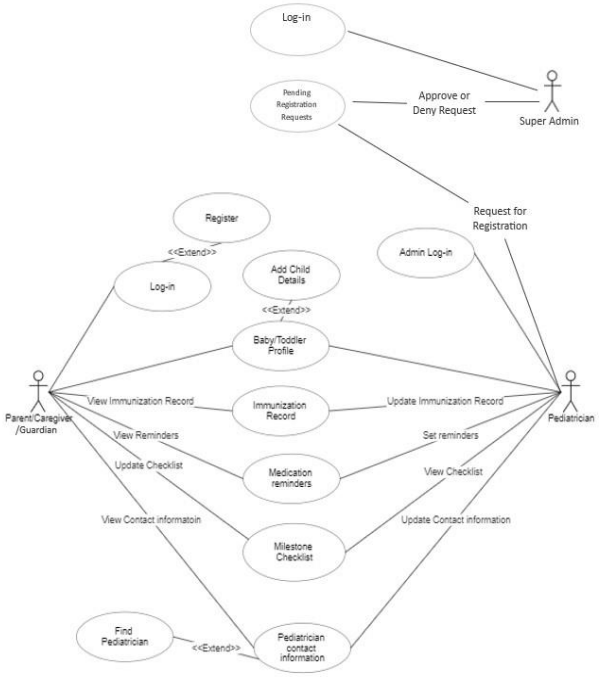
B. Object Model

Figure 4(a): Use Case Diagram of "Little Milestones"



As shown in Figure 4, there are three types of users: the parent/caregiver, the pediatrician, and the super admin. Registering an account is required for the parent or caregiver to view the child's health records, including growth measurements, immunization records, reminders, child information, milestone checklist updates, and pediatrician contact information. The pediatrician must register by sending a request through the Little Milestones website, providing their first name, last name, email address, mobile number, clinic location, and PRC ID number. After agreeing to the terms and conditions and getting approved, the pediatrician can log in to add and update patient information, view checklists and milestones, and update their own contact information. The super admin is responsible for verifying registration requests, managing a pending list, and approving or denying requests. Upon approval, an email with a default password is sent to the pediatrician.

C. Agile Model

The Agile methodology chosen to effectively address the dynamic healthcare needs of infants and toddlers, rapidly adapting to evolving requirements, involving stakeholders throughout development, managing project complexity, and delivering a solution that bridges gaps in healthcare tools. Agile's iterative and flexible approach ensures timely delivery while upholding ethical and privacy considerations. In the first loop, stakeholders engage with pediatricians and parents to refine app requirements based on active user feedback, leading to collaborative design and iterative development. Testing ensures system integrity, and an incremental release strategy minimizes end-user disruptions. The second loop incorporates feedback to refine designs and enhance functionality through iterative testing and deployment. The third loop iteratively adjusts requirements based on user needs, refining design and enhancing system functionality. The fourth loop focuses on anticipating future needs and technological innovations, ensuring the app remains adaptable and user-centric through rigorous testing and incremental advancements.

D. *Test Plan*

The purpose of this test plan is to define the testing strategy and activities for the pediatric health monitoring app, ensuring that it meets the requirements of pediatricians, parents, and effectively monitors the health of babies. The test plan is crucial for developers as it provides a clear roadmap of testing expectations, facilitates early issue detection, guides debugging efforts, and promotes collaborative improvement, ensuring the delivery of a high-quality software product. The proponents

planned to use functionality and compatibility testing and prepared several test cases for the chosen respondents mainly being the technical adviser, the researcher's partner pediatrician, and three (3) IT experts.

E. Evaluation Plan

The Evaluation Plan outlines a systematic framework to assess the app's functionality, user interface, performance, and adherence to pediatric health monitoring needs, aiming to validate its effectiveness, user satisfaction, and quality. It ensures targeted improvements and alignment with pediatric health monitoring objectives. Evaluation criteria include Android Core App Quality and ISO/IEC 25010 standards. Android Core App Quality focuses on Visual Experience, Functionality, and Privacy & Security for parents and pediatricians, while ISO/IEC 25010 covers Functional Suitability, Usability, Reliability, Security, and Maintainability. Thirty-three end-users participated, including seven pediatricians as web admins, twenty-six parents using the app, and thirteen IT experts. Devices included Android phones with versions 11.0, 12.0, and 13.0, and browsers such as Google Chrome, Firefox, Microsoft Edge, and Opera were used for website testing.

F. Evaluation Tool

The evaluation tools used by the researchers are based on Android Core App Quality and ISO/IEC 25010 standards. The app underwent evaluation by thirteen (13) IT experts and thirty-three (33) end-users, including seven (7) pediatricians and twenty-six (26) parents. For Android app development, Android Core App Quality assesses "Visual Experience" for visual design and user interface clarity, intuitiveness, and adherence to design guidelines. "Functionality" evaluates core features, responsiveness, reliability, and compatibility. "Performance and Stability" focuses on speed, responsiveness, and stability, including resistance to crashes. "Privacy and Security" ensures secure data handling and regulatory compliance. For the web, ISO/IEC 25010 standards assess "Functionality" for essential functions and interoperability, "Reliability" for service continuity, "Usability" for ease of use and satisfaction, "Efficiency" for resource optimization, "Maintainability" for fault identification and modification ease, and "Portability" for adaptability across different environments.

Table 1: ISO 25010 Scoring System

Numerical Rating	Equivalent
4	Highly Acceptable
3	Acceptable
2	Fairly Acceptable
1	Unacceptable

The ISO 25010 scoring system employs a numerical scale ranging from 1 to 4 to assess the acceptability of items. A rating of 4 signifies that the item is "Highly Acceptable," indicating exceptional quality and adherence to the highest standards. A rating of 3 deems the item "Acceptable," indicating that it meets satisfactory standards and is considered good. A score of 2 labels the item as "Fairly Acceptable," suggesting some acceptability but with noticeable shortcomings or areas for improvement. The lowest rating, 1, categorizes the item as "Unacceptable," indicating that it falls short of meeting the required standards and is considered inadequate. This scoring system provides a clear and concise method for qualitative evaluation, with each numerical rating.

G. *Statistical Treatment of Data*

The data were gathered from a total of forty-six (46) evaluation respondents, mainly being twenty-six (26) parents/guardians, seven (7) pediatricians, and thirteen (13) IT experts. The collected data were computed, and undergone data interpretation and validation based on the weighted mean and standard deviation. The following are the formulas used by the researchers.

Computation of Mean

The mean is the arithmetic average of the scores given by test respondents. The formula used for the weighted mean is $\bar{x} = (\Sigma x) / n$, where Σx is the total sum of scores and n is the number of respondents. This method enhances the precision and relevance of the evaluation process. It aligns with the emphases outlined in ISO/IEC-25010 and Android Core App Quality standards.

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Standard Deviation Formula

Standard deviation measures the dispersion of data from its mean, indicating absolute variability; higher dispersion results in a greater standard deviation. In our evaluation using ISO/IEC 25010 and Android Core App Quality, standard deviation is computed based on scores for each criterion. This helps us understand the consistency of our evaluation across different groups, such as pediatricians, parents, and IT experts.

Table 2: Likert Scale

Range	Description
3.26-4.00	Highly Acceptable
2.51-3.25	Acceptable
1.76-2.50	Fairly Acceptable
1.00-1.75	Unacceptable

The table outlines the mean intervals for evaluating acceptability. A mean of "1.00 to 1.75" is deemed "Unacceptable," indicating the application fails to perform its main functions. A score of "3.26 to 4.00" is "Highly Acceptable," signifying the application meets its objectives and functions smoothly. The intervals in between, "1.76 to 2.50" and "2.51 to 3.25," correspond to "Fairly Acceptable" and "Acceptable," respectively, reflecting varying degrees of functionality and consistency.

H. User Interface

Figure 4(b): Parent Side: Login Page of Little Milestones

(Application)

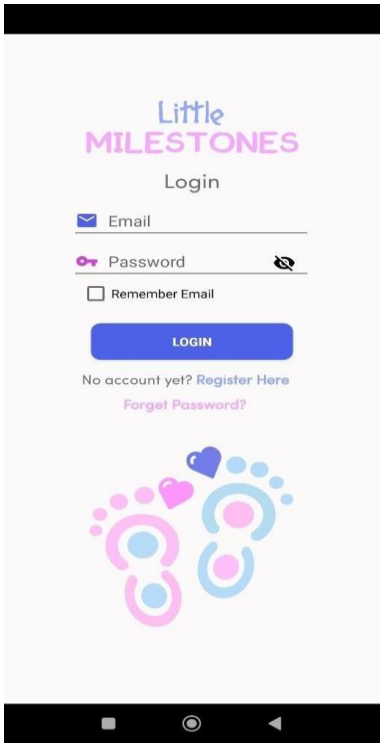
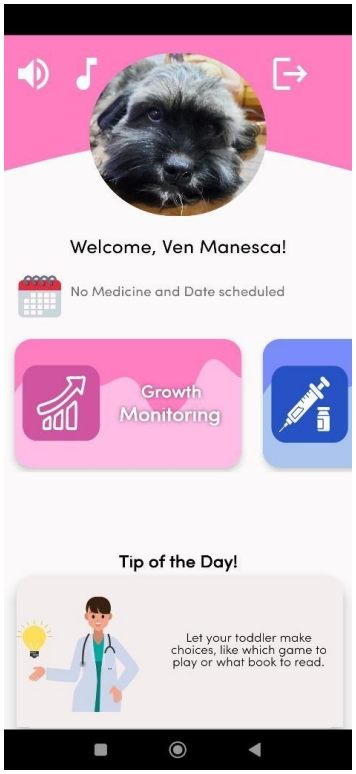


Figure 5: Parent Side: Home Page of Little Milestones (Application)



After registration, the user can now log in using the email he/she registered, and the password input from the registration.

After onboarding, users are welcomed to the app's home screen, which features profile customization, a medication reminder, growth monitoring, immunization records, milestone tracking, doctor information, and daily tips. Additional buttons include options to mute/unmute sound effects and background music, as well as a log out button.

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Figure 6: Parent Side: Child Information Page of Little Milestones

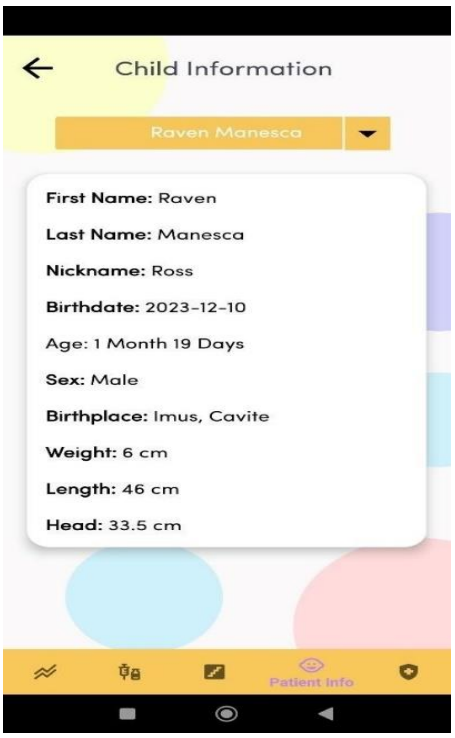
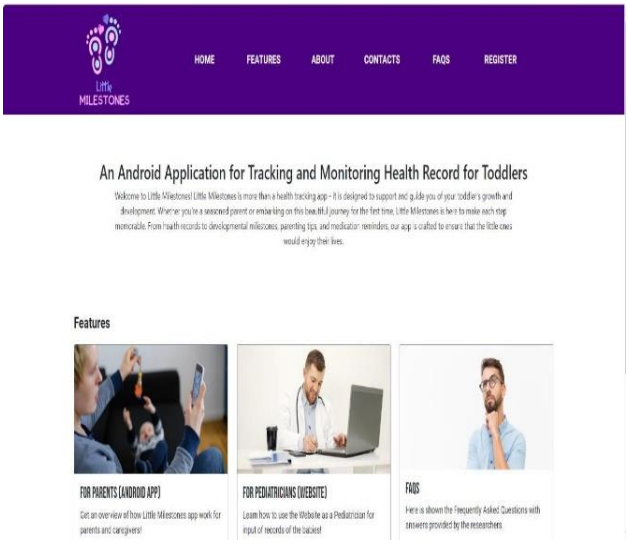


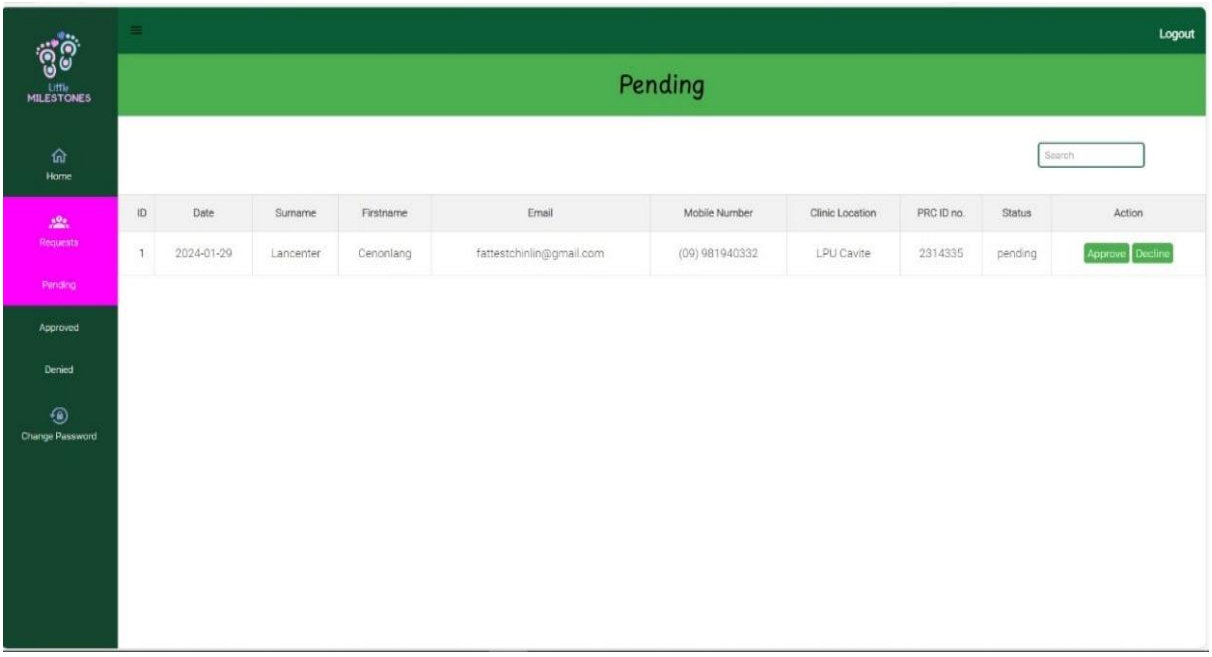
Figure 7: Home screen of "Little "Milestones" Website



On this page, the user will see his/her child's information such as the first name, last name, nickname, birthdate, age, sex, birthplace, weight at birth, length at birth, and head circumference at birth.

This is the welcome or home page of the Little Milestones. The users can choose between the different buttons available.

Figure 8: Super Admin – Pending page of "Little Milestones"



On this website, the super admin has the only access to records and is the one responsible for approval and denial of requests. The Requests page has three parts which are the pending, approved, and denied. For the pending page, this is where the super admin can either approve or deny the request of the user after verifying the request.

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Figure 9: Super Admin – Approved page of "Little Milestones"

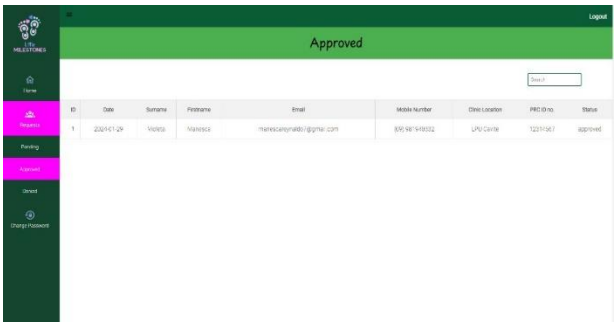
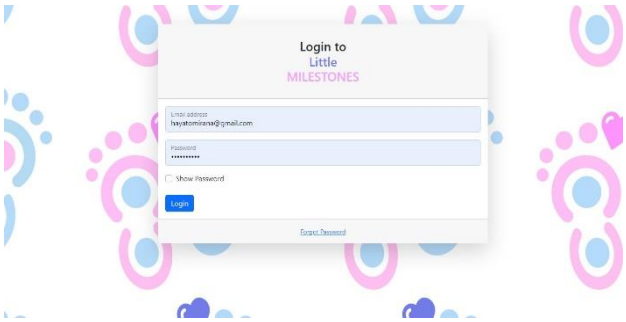


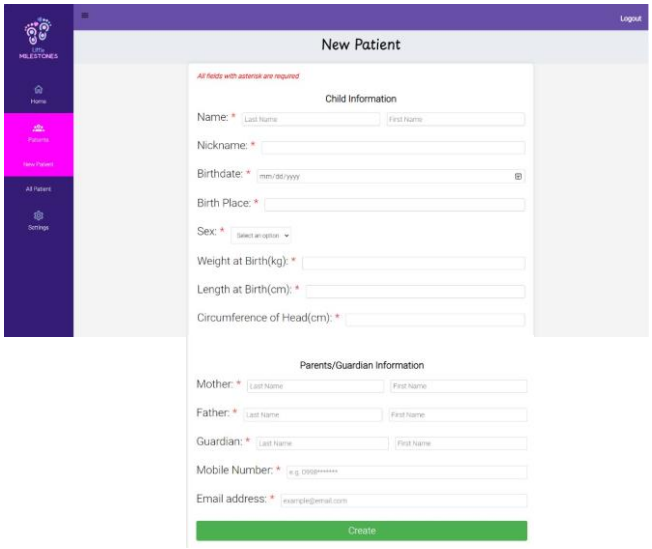
Figure 10: Admin: Log in Page of "Little Milestones"



The super admin will be able to view the different accounts that he/she approved

After the approval from the super admin, the pediatrician will receive an email with the default password in it. Now, the pediatrician can log in to the site.

Figure 11: Admin: New Patient Page of "Little Milestones"



For adding new patients, the admin will have to input the information of the baby, as well as the parents'. The email address that is inputted in this field should be the same as the registered email address of the parent on the user side.

III. RESULTS

Table 3: Test Results of the Functionality Test

Test Respondent	Pass	Fail	Test Criteria	Percentage
Technical Adviser	117	0	117	100%
IT Expert – 1	117	0	117	100%
IT Expert – 2	117	0	117	100%
IT Expert – 3	117	0	117	100%
Admin/Client	117	0	117	100%
Average Percentage				100%

Participating in Functional Testing were the technical adviser, three (3) IT specialists, and one (1) Pediatrician Administrator. The instrument has 116 criteria tested: both in technical adviser, IT expert 1, and the administrator. IT expert 2 has 118 criteria tested and the IT expert 3 has 119. Upon tallying all the responses, the researchers received a one hundred percent (100%) from all the testers. Hence, no major flaws were discovered in the system. Despite this, the researchers still received suggestions and opinions from the participants to where enhancement to the system is still open.

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Table 4: Test Results of the Compatibility Test

Test Respondent	Pass	Fail	Test Criteria	Percentage
Technical Adviser	10	0	10	100%
IT Expert – 1	10	0	10	100%
IT Expert – 2	10	0	10	100%
IT Expert – 3	10	0	10	100%
Admin/Client	8	2	10	80%
Average Percentage				96%

The test results indicate the performance of different roles in meeting predefined criteria. The Technical Adviser and IT Experts 1, 2, and 3 all demonstrated a 100% success rate, with all 4 respondents in each category passing the test. On the other hand, the Administrator role showed a slightly lower success rate, with 8 out of 10 passed meeting the criteria, resulting in an 80% success rate. These results highlight a strong performance in the Technical Adviser and IT-Expert roles, while the Administrator role, although still effective, may benefit from further attention to meet the established criteria more consistently.

Table 5: Evaluation Result (Core App Quality) from seven (7) Pediatricians

Criteria	Mean	Standard Deviation	Interpretation
Visual Experience	3.18	0.56	Acceptable
Functionality	2.08	0.69	Fairly
Privacy and Security	3.33	0.54	Highly Acceptable
Average Mean and Standard Deviation	**2.87**	**0.60**	**Acceptable**

Table 5 summarizes the evaluation of various app criteria by 7 pediatricians. Each criterion includes mean, standard deviation, acceptability level, and rank, with an overall average mean of 2.87 and a total standard deviation of 0.60, indicating acceptable app performance. Visual Experience is rated as "Acceptable," Functionality as "Fairly Acceptable" due to missing features like audio and media, and Privacy and Security as "Highly Acceptable." The rankings highlight the relative strengths of each criterion, with lower ranks indicating better performance

This table summarizes the evaluation of various app criteria by 7 pediatricians. Each criterion includes mean, standard deviation, acceptability level, and rank, with an overall average mean of 2.87 and a total standard deviation of 0.60, indicating acceptable app performance. Visual Experience is rated as "Acceptable," Functionality as "Fairly Acceptable" due to missing features like audio and media, and Privacy and Security as "Highly Acceptable." The rankings highlight the relative strengths of each criterion, with lower ranks indicating better performance.

Table 6: Evaluation Result (Core App Quality) from twenty - six (26) End-Users (Parents)

Criteria	Mean	Standard Deviation	Interpretation
Visual Experience	3.33	0.50	Highly Acceptable
Functionality	2.14	0.76	Fairly
Privacy and Security	3.24	0.58	Acceptable
Average Mean and Standard Deviation	2.91	0.61	Acceptable

This table presents the app criteria ratings from twenty-six (26) parent end-users, focusing on visual experience, functionality, and privacy and security. Each criterion includes mean and standard deviation values, indicating central tendency and variability. Visual experience is rated as "Highly Acceptable," functionality as "Fairly Acceptable," and privacy and security as "Acceptable," with criteria ranked by mean scores. The overall average mean and standard deviation classify the app as "Acceptable," with functionality deemed "Fairly Acceptable" due to the absence of audio and media features.

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Table 7: Evaluation Result from the ten (10) IT Experts

Criteria	Mean	Standard Deviation	Interpretation
Content	3.42	0.38	Highly Acceptable
Navigation	3.47	0.38	Highly Acceptable
Structure and Design	3.41	0.35	Highly Acceptable
Appearance and Multimedia	3.27	0.12	Highly Acceptable
Uniqueness	3.43	0.19	Highly Acceptable
Average Mean and Standard Deviation	**3.40**	**0.29**	**Highly Acceptable**

The table presents assessment results based on responses from ten (10) IT Experts using evaluation instruments developed by the researchers. Results indicate the system achieved an average score of 3.40, categorizing it as "Highly Acceptable." Navigation received the highest mean score of 3.47, attributed to strong ratings for Navigation Tools (Q7) and Means of Navigation (Q9), both rated "Highly Acceptable" by most experts.

Table 8: Evaluation Result (Core App Quality) thirteen (13) IT Experts

Criteria	Mean	Standard Deviation	Interpretation
Visual Experience	3.32	0.39	Highly Acceptable
Functionality	2.57	0.53	Acceptable
Performance and Stability	3.61	0.22	Highly Acceptable
Privacy and Security	3.30	0.35	Highly Acceptable
Google Play	3.56	0.17	Highly Acceptable
Average Mean and Standard Deviation	3.27	0.12	Highly Acceptable

In this table, the criteria for evaluating the app are presented based on feedback from 13 IT experts. Each criterion includes the mean and standard deviation of the scores given by the experts, as well as the rank and overall acceptability. The total average mean and standard deviation for all criteria are also calculated, being 3.27 for the average mean and 0.12 for the standard deviation, which is “Highly Acceptable” in the interpretation, showing that the app as a whole is highly acceptable according to the experts' assessments.

Table 9: Overall Evaluation Result (Core App Quality) twenty-six (26) End-users (Parents), seven (7) Pediatrician, twelve (13) IT-Experts

Criteria	Mean	Standard Deviation	Interpretation
Visual Experience	3.32	0.39	Highly Acceptable
Functionality	2.57	0.53	Acceptable
Performance and Stability	3.61	0.22	Highly Acceptable
Privacy and Security	3.30	0.35	Highly Acceptable
Google Play	3.56	0.17	Highly Acceptable
Average Mean and Standard Deviation	3.27	0.12	Highly Acceptable

The overall evaluation of the core app quality from twenty-three parents, seven pediatricians, and thirteen IT experts shows Performance and Stability as the highest-ranking criteria with a mean score of 3.39, followed by Privacy and Security (3.33), and Visual Experience (3.28), all within the highly acceptable range. However, Functionality scored lower with a mean of 2.26, indicating it is only fairly acceptable. The average mean of 3.06 and standard deviation of 0.09 suggest an overall acceptable core app quality, with feedback emphasizing the need for functional improvements. Notably, only IT experts evaluated the security aspects.

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Table 10: Evaluation Result (ISO25010) seven (7) Pediatrician

Criteria	Mean	Standard Deviation	Interpretation
Functional Stability	3.76	0.16	Highly Acceptable
Usability	3.64	0.26	Acceptable
Reliability	3.42	0.30	Highly Acceptable
Security	3.37	0.32	Highly Acceptable
Maintainability	3.42	0.28	Highly Acceptable
Average Mean and Standard Deviation	3.52	0.27	Highly Acceptable

The assessment findings from seven pediatricians show that "Functional Suitability" is rated highest with a mean score of 3.76 and a standard deviation of 0.16, indicating it is "Highly Acceptable" and the application operates well with minimal modifications. "Usability" follows closely with a mean score of 3.64 and a standard deviation of 0.16, also deemed "Highly Acceptable," highlighting the system's adaptability and reusability. "Reliability" (mean score 3.42, SD 0.30) and "Maintainability" (mean score 3.42, SD 0.28) are also rated "Highly Acceptable," ensuring the application executes essential functions reliably and is easy to maintain. "Security" scored a mean of 3.37 with a standard deviation of 0.32, indicating it effectively protects private information. Overall, the mean score is 3.52 with a standard deviation of 0.27, reflecting a "Highly Acceptable" evaluation.

Table 11: Evaluation Result (ISO25010) thirteen (13) IT Experts

Criteria	Mean	Standard Deviation	Interpretation
Functional Suitability	3.69	0.15	Highly Acceptable
Performance Efficiency	3.59	0.29	Highly Acceptable
Compatibility	3.58	0.05	Highly Acceptable
Usability	3.74	0.16	Highly Acceptable
Reliability	3.48	0.13	Highly Acceptable
Security	3.51	0.26	Highly Acceptable
Maintainability	3.58	0.13	Highly Acceptable
Portability	3.67	0.04	Highly Acceptable
Average Mean and Standard Deviation	**3.61**	**0.09**	**Highly Acceptable**

The system underwent a rigorous evaluation based on ISO 25010 standards by 13 IT experts. Across multiple quality characteristics such as functional suitability, performance efficiency, and usability, it consistently achieved highly acceptable ratings with an overall mean score of 3.61, demonstrating robust adherence to standards and reliability in meeting diverse performance criteria.

The evaluation of the system under ISO 25010 criteria, involving feedback from seven pediatricians and thirteen IT experts, shows consistently high acceptability across all dimensions. Functional Suitability leads with a score of 3.73, reflecting excellent user experience, followed closely by Usability, Compatibility, Maintainability, Performance Efficiency, and Portability, all scoring above 3.5. These results underscore the system's strong adherence to standards and highlight its robust foundation for further development and implementation

Table 12: Overall Evaluation Result (ISO25010) seven (7) Pediatrician, twelve (13) IT-Experts

Criteria	Mean	Standard Deviation	Interpretation
Functional Suitability	3.73	0.16	Highly Acceptable
Performance Efficiency	3.59	0.29	Highly Acceptable
Compatibility	3.58	0.05	Highly Acceptable
Usability	3.69	0.21	Highly Acceptable
Reliability	3.45	0.22	Highly Acceptable
Security	3.44	0.29	Highly Acceptable
Maintainability	3.50	0.21	Highly Acceptable
Portability	3.67	0.04	Highly Acceptable
Average Mean and Standard Deviation	**3.58**	**0.18**	**Highly Acceptable**

IV. CONCLUSION

The researchers successfully developed "Little Milestones: An Android Application for Tracking and Monitoring Health Record for Toddlers," featuring user registration, personalized profiles, health record management, medication reminders, doctor contact storage, milestone tracking, and data visualization. The application underwent rigorous testing including functionality, conformance, and compatibility tests, achieving a perfect score in all modules and compatibility across Android versions 11.0 to 13.0 with recommended resolutions. User acceptability was assessed by 33 end users, including parents, pediatricians, and IT experts, using the Android Core App Quality tool and ISO/IEC 25010 standards. Feedback from parents indicated high acceptability for visual experience and acceptable ratings for functionality and privacy/security, resulting in an overall acceptable rating. Pediatricians rated the app acceptable for visual experience and functionality but highly acceptable for privacy/security, aligning with an overall acceptable Core App Quality rating. Moreover, they rated the app highly acceptable across all ISO/IEC 25010 criteria, highlighting strong performance in functional suitability, usability, reliability, security, maintainability, and portability.

Overall, "Little Milestones" demonstrates robust adherence to both Android Core App Quality and ISO/IEC 25010 standards, reflecting its comprehensive functionality, user-friendly design, and strong performance across critical healthcare application criteria.

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