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Optimizing Screen Time Management for Children's Devices: Leveraging Token Bucket and Time-Based Algorithms in a Famie Parental Control System

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ABSTRACT

This study aims to develop a parental control system, Famie, designed to optimize screen time management on children's devices. The system addresses the growing need for parents to effectively monitor and regulate their children's screen time in a balanced manner. Integrating the Token Bucket Algorithm and a Time-Based Algorithm enables parents to set flexible screen time schedules and efficiently reset usage time. Famie serves as the parent app, while Famkid functions as the child app. The two apps are connected using a QR code-based pairing system, allowing parents to seamlessly link their devices with their children's. This connection enables centralized control over screen time and schedule management. The research applies these algorithms to provide a personalized approach to digital parenting, ensuring that children develop responsible screen time habits while maintaining a secure digital environment. Key features include setting screen time schedules via token buckets, where the device remains locked when the bucket is empty and unlocks only when another active bucket becomes available. Additionally, the time-based algorithm serves as a daily reset mechanism, ensuring that buckets are refilled at midnight. Although Android's security policies impose limitations on device-locking capabilities, the system still offers effective control by focusing on schedule-based access. The results of this study are expected to empower parents in promoting healthier technology habits for their children, benefiting families, researchers, and educational institutions by contributing to the evolving field of algorithm-driven parental control systems.

INTRODUCTION

Children today face significant risks in the digital age, including screen addiction (Christakis, 2008), exposure to harmful content (Livingstone *et al.*, 2011), and cyberbullying (Kowalski *et al.*, 2014), even as technology offers remarkable benefits for education and development (Plowman *et al.*, 2010). These challenges leave parents struggling to balance granting digital freedom with ensuring their children's safety online—a task that becomes increasingly complex as technology evolves.

To address this, the Famie Parental Control System provides an innovative solution, empowering parents to manage and supervise their children's device usage effectively. Through two interconnected apps—Famie for parents and FamKid for children—parents can set precise schedules for device access, such as 7:30–8:30, with automatic restrictions outside these periods. This structured approach is reinforced by a parent-set PIN, preventing unauthorized use and ensuring greater control. The system stands out with its integration of two advanced algorithms. The Token Bucket Algorithm dynamically tracks active usage within the scheduled time frames, ensuring children adhere to their allotted screen time. Complementing this is a time-based algorithm that resets schedules automatically at midnight, maintaining consistency and flexibility for daily usage.

By combining real-time adaptability with seamless integration via a secure QR code connection, Famie offers a comprehensive solution that empowers parents while fostering healthier digital habits for children in an increasingly connected world.

Statement of the Problem

This study aims to enhance parental controls by optimizing time-based and token bucket algorithms. It explores how these algorithms can be improved to better manage screen time for children, providing solutions to the following key questions:

1. How does a parent effectively regulate their child's excessive gadget use?
2. How can parental control systems provide appropriate time limitations for children's device usage?
3. How can the token bucket algorithm assist parents based on their preference child's needs, while effectively managing screen time?

Objectives of the Study

The main objective of this study "Optimizing Screen Time Management for Children's Devices: Leveraging Token Bucket and Time-Based Algorithms in a Famie Parental Control System" is to devise a system that allows parents to easily oversee and empowering parents to monitor and regulate their child's device usage. Effectively:

1. To develop a user-friendly Parental Control System interface to empower parents in managing their children's screen time effectively.
2. Implement the Token Bucket Algorithm to provide flexible and efficient screen time management, enabling

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parents to set limits and schedules based on their children's needs.

3. By utilizing the token bucket algorithm to manage screen time according to parental preferences and the child's needs. This approach ensures a tailored digital experience aligned with family values and promotes healthy screen time habits.

Scope and Limitation

The goal of this study, titled "Optimizing Screen Time Management for Children's Devices: Leveraging Token Bucket and Time-Based Algorithms in the Famie Parental Control System," is to develop a solution for managing children's screen time using the Famie parent app and the FamKid child app. The system leverages the Token Bucket Algorithm to set personalized time limits and a time-based algorithm for daily resets, offering parents an intuitive and customizable interface. QR code technology facilitates easy access to features and resources. This system is primarily designed for Android devices, as iOS functionality has not been implemented.

A limitation of the system is that while it can set a PIN lock, it cannot fully lock the device due to Android's security policies. The app cannot restrict system-level features like the home and back buttons without higher-level permissions, such as Device Owner, which are not available to third-party apps. Despite having Device Admin privileges and a PIN lock, the FamKid app remains constrained by Android's security framework in fully locking the device.

LITERATURE REVIEW

In today's digital age, the influence of applications on child development has garnered significant attention. While educational apps can enhance learning and creativity, unregulated use of entertainment apps may lead to issues such as reduced attention spans, poor sleep, and diminished physical activity. The risks of exposure to inappropriate content, cyberbullying, and online predators highlight the need for robust parental controls and collaboration among developers, educators, and policymakers to ensure safe and balanced digital engagement for children.

Othman *et al.* (2022) emphasize the role of artificial intelligence (AI) and influencing children's behavior on smart devices and propose that AI-based parental control systems can provide more adaptive personalized intervention. Similarly, Livingstone and Helsper (2008) and Charity *et al.* (2022) stress the importance of parental interventions to mitigate physical, social, and psychological risks associated with excessive device use. Radesky *et al.* (2016) and Johnson & Smith (2023) explore various parental strategies for managing screen time and promoting balanced usage.

Gupta *et al.* (2019) compare parental control systems for mobile devices, evaluating their effectiveness in content filtering, screen time management, and usability. Similarly, Martinelli *et al.* (2008) propose security frameworks for monitoring mobile devices, underscoring the need for more robust measures to enhance functionality and safety. According to Gao *et al.* (2024) and Wu *et al.* (2018) explore the Token Bucket Algorithm's role in optimizing resource allocation and screen time management, enabling more tailored and efficient parental control systems. These studies collectively inform the development of Famie, leveraging algorithms to foster healthier digital habits and secure environments for children.

Related System

The SmartParent study by Gonzalez *et al.* (2021) introduces a mobile application for comprehensive parental control, emphasizing content filtering, screen time regulation, and online interaction monitoring to balance digital access with child safety. Additionally, Livingstone and Helsper (2008) underscore the importance of parental mediation in mitigating online risks, further supporting the need for effective control mechanisms.

Choi *et al.*'s (2020) GuardianGate study develops an adaptive IoT parental control system, providing device-specific policies, risk assessments, and real-time monitoring to ensure children's safety in the IoT era. Similarly, Martinelli *et al.* (2008) address screen time management through restrictions, promoting healthier digital habits alongside improved device security.

Technological frameworks also contribute significantly: Gonzalez and Kim (2019) highlight the use of MongoDB and Node.js for scalable backend development, while Lee and Park (2021) showcase Dart's cross-platform advantages for building user-friendly applications. In this study, these technologies support Famie by enabling intuitive parental control features across both iOS and Android platforms.

This research presents a proactive prototype for managing children's screen time, empowering parents to promote healthier digital interactions and supporting responsible technology use among young users.

MATERIALS AND METHODS

Methodology

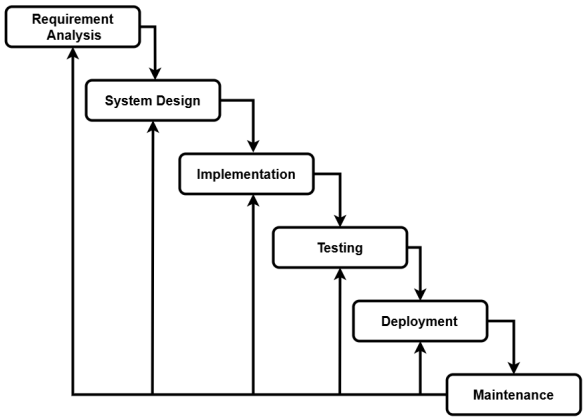


Figure 1: Iterative Waterfall Model of SDLC

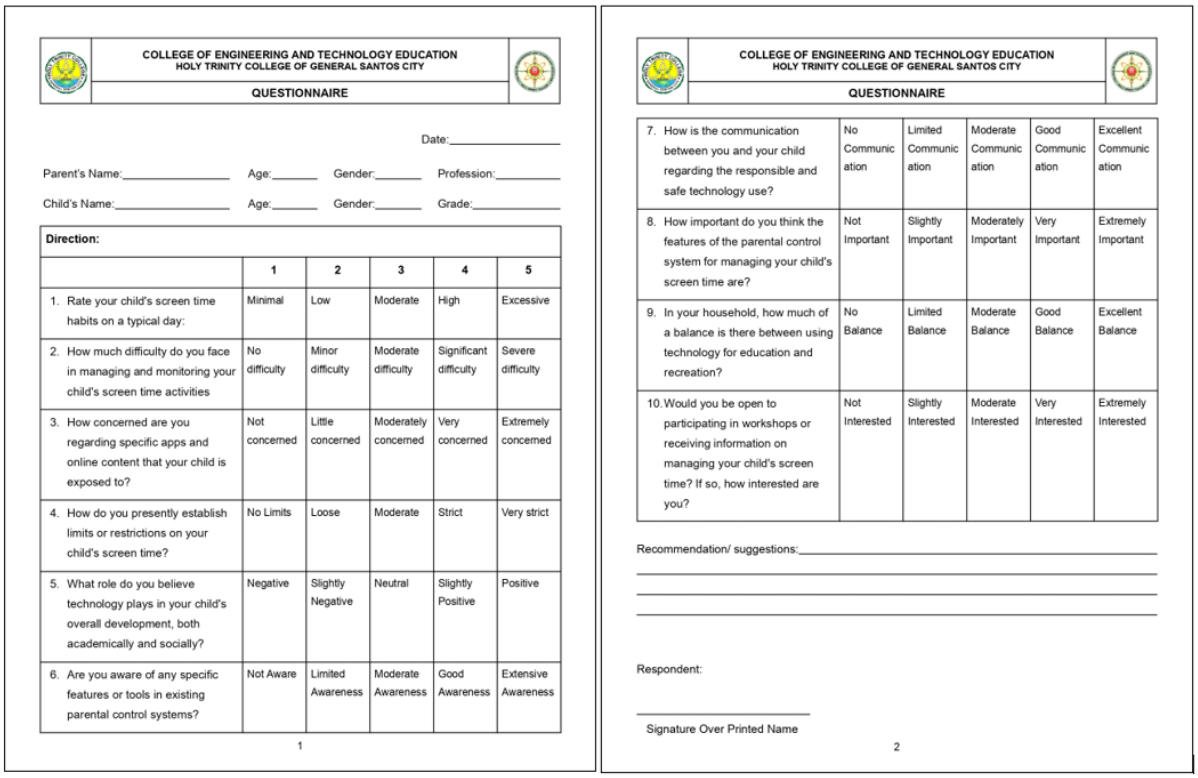
The development of the Famie Parental Control System employed the Iterative Waterfall Model of Software Development Life Cycle (SDLC). This method follows a structured sequence, starting with high-level requirements and progressing through requirement analysis, system design, implementation, testing, integration, delivery, and maintenance, incorporating feedback loops to link each phase to the preceding one.

Requirements Analysis

During the Requirements phase, thorough data collection, analysis, and planning were conducted to understand the application's needs. A survey of 10 parents or guardians assessed challenges and behaviors related to children's digital use. Key requirements for the Parental Control System were identified:

- Screen Time Habits: Rating of typical daily screen time.
- Management Difficulty: Difficulty in managing screen time activities.
- Concerns about Online Content: Concerns about specific apps and content.
- Establishing Limits: Current practices for setting screen time limits.
- Perception of Technology's Role: Beliefs about technology's impact on development.
- Awareness of Parental Control Features: Knowledge of existing features and tools.
- Communication with Child: Level of communication about safe technology use.
- Importance of Parental Control Features: Importance of system features.
- Balance between Education and Recreation: Balance between educational and recreational use.
- Interest in Workshops or Information: Interest in further guidance on managing screen time.

By addressing these requirements, the Famie Parental Control System aims to help parents manage their child's online experiences effectively.



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QUESTIONNAIRE

Date:_____

Parent's Name:_____ Age:_____ Gender:_____ Profession:_____

Child's Name:_____ Age:_____ Gender:_____ Grade:_____

Direction:					
	1	2	3	4	5
1. Rate your child's screen time habits on a typical day:	Minimal	Low	Moderate	High	Excessive
2. How much difficulty do you face in managing and monitoring your child's screen time activities	No difficulty	Minor difficulty	Moderate difficulty	Significant difficulty	Severe difficulty
3. How concerned are you regarding specific apps and online content that your child is exposed to?	Not concerned	Little concerned	Moderately concerned	Very concerned	Extremely concerned
4. How do you presently establish limits or restrictions on your child's screen time?	No Limits	Loose	Moderate	Strict	Very strict
5. What role do you believe technology plays in your child's overall development, both academically and socially?	Negative	Slightly Negative	Neutral	Slightly Positive	Positive
6. Are you aware of any specific features or tools in existing parental control systems?	Not Aware	Limited Awareness	Moderate Awareness	Good Awareness	Extensive Awareness

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QUESTIONNAIRE

7. How is the communication between you and your child regarding the responsible and safe technology use?	No Communication	Limited Communication	Moderate Communication	Good Communication	Excellent Communication
8. How important do you think the features of the parental control system for managing your child's screen time are?	Not Important	Slightly Important	Moderately Important	Very Important	Extremely Important
9. In your household, how much of a balance is there between using technology for education and recreation?	No Balance	Limited Balance	Moderate Balance	Good Balance	Excellent Balance
10. Would you be open to participating in workshops or receiving information on managing your child's screen time? If so, how interested are you?	Not Interested	Slightly Interested	Moderate Interested	Very Interested	Extremely Interested

Recommendation/ suggestions:_____

Respondent:

_____
Signature Over Printed Name

2

Figure 2: Questionnaire

System Design

The System Design phase ensures that all specifications are met and prepares the system for development. The user interface is crafted using Visual Studio Code and Dart, while Android Studio is used for emulator visualization. Node.js and MongoDB are employed for scalable database management and data processing. Materials such as demos, code, and documentation are securely archived for future reference. This phase integrates technologies and algorithms, including the time-based and token bucket algorithms, which are crucial for creating a fully functional system.

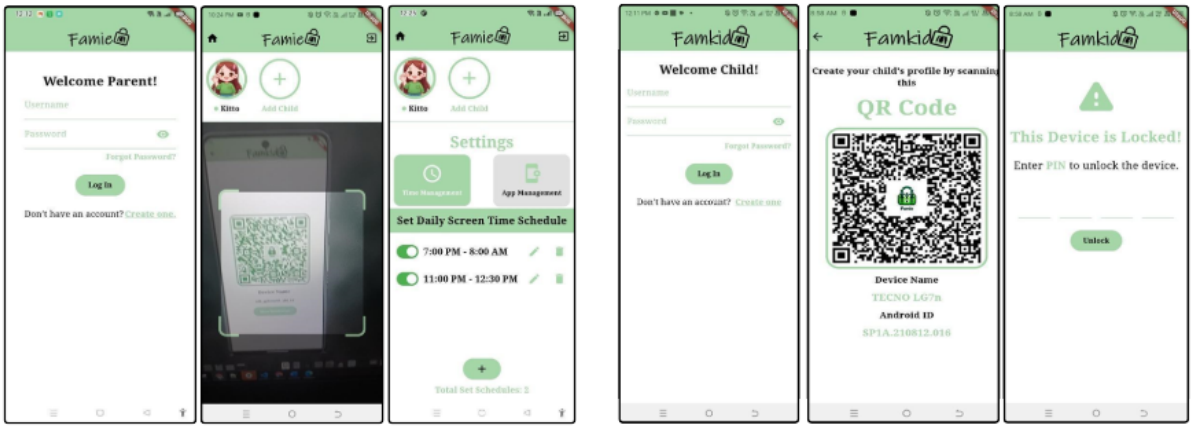

Figure 3: System Design of Famie and Famkid

Within the System Design phase, the architecture of the Famie Parental Control System is developed to optimize screen time management for children's devices using token bucket and time-based algorithms. This architecture outlines how the system components interact and work together.

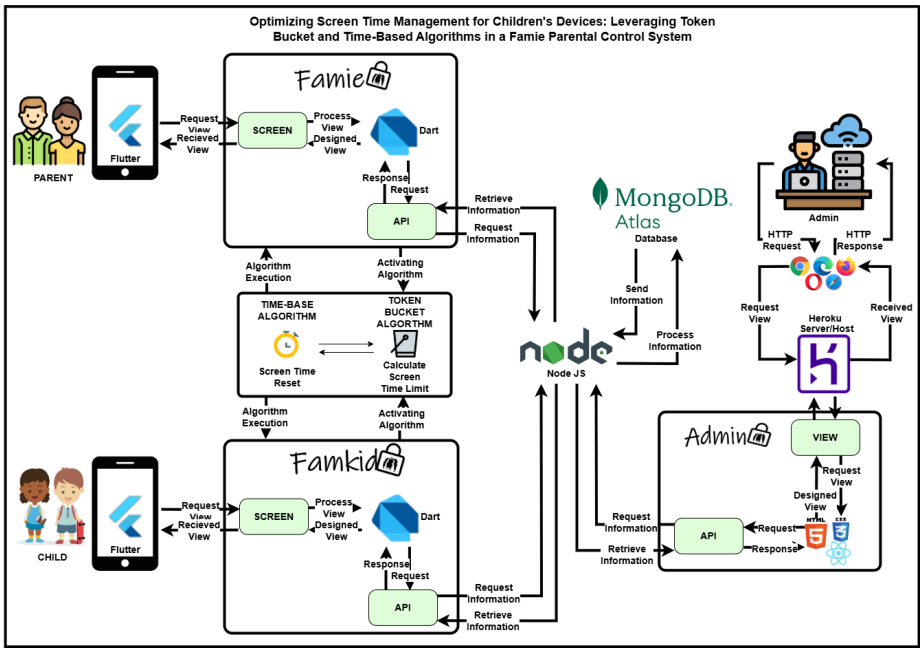

Figure 4: System Architecture

The system includes Flutter applications for both parents (Famie) and children (Famkid), allowing them to request and display screen time data. The user interface is processed by the screen component, while an API manages communication between the applications and the central server. The Node.js server handles data interactions, and MongoDB Atlas stores user information, screen time settings, and usage statistics. The admin interface, hosted on Heroku and developed with HTML, CSS, and React, enables administrators to monitor system information.

This architecture provides a scalable and efficient solution to help parents regulate children's digital activities, promoting healthy screen habits. To achieve this, we employed advanced algorithms that enhance the system's functionality and ensure precise time management.

Token Bucket Algorithm for Screen Time Schedule

In Famie Parental Control System, the Token Bucket Algorithm enforces the screen time schedule defined by parents. During active usage periods, tokens are consumed as the device is used. Once the bucket is empty, the child is locked out of the device and must enter a parent-set PIN to regain access. The device remains inaccessible until a new active schedule begins, providing parents complete control over when and how the device can be used. When the scheduled limit is reached, the device automatically locks, ensuring that it cannot be reopened outside of the designated schedule.

The illustration below visually represents the token bucket mechanism, showing how tokens are consumed during usage and refilled over time. This ensures that the bucket maintains the maximum number of tokens allowed for scheduled usage.

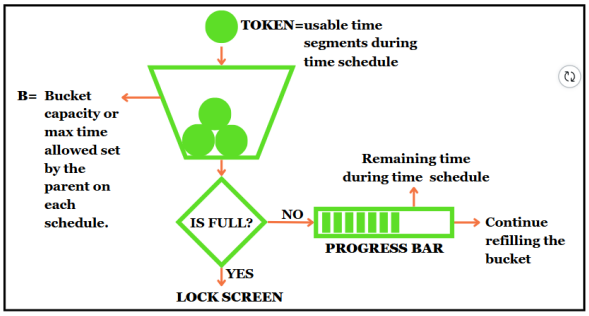

Figure 5: Token Bucket Algorithm Visualization

Below is the formula used to calculate and update the remaining tokens, aligning the child's screen time with the parent-defined schedule:

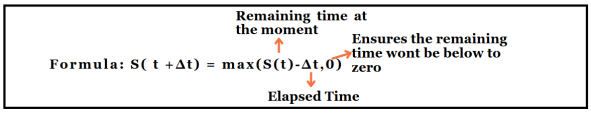

Figure 6: Token Bucket Algorithm Formula

Process Overview

Starting Schedule

- The parent sets a screen time schedule from 7:00 AM to 8:00 AM, which is 1 hour (60 minutes × 60 seconds = 3600 seconds).
- The system begins with 3600 tokens, where each token represents 1 second of screen time.
- Therefore, the bucket is initially full with 3600 tokens.

Device Usage

- As time progresses, tokens are consumed based on the device usage.
- By 7:30 AM, 30 minutes (1800 seconds) have passed, meaning 1800 tokens have been used up.
- The remaining tokens in the bucket after 30 minutes would be calculated as follows:
- Formula Example:

$S(t + \Delta t)=\max(S(t)-\Delta t,0)$
$S(t + \Delta t)=\max(3600-1800,0)$
$=\max(1800,0)$
$=1800$ tokens

Extending the Schedule

- The parent decides to extend the time by 1 hour, adding an additional time slot from 8:00 AM to 9:00 AM (60 minutes × 60 seconds = 3600 seconds).
- At 8:00 AM, 1800 tokens are still left in the bucket from the initial schedule.

Adding More Time

- According to the formula, the system adds the new time in seconds (3600 seconds for the additional hour) to the remaining tokens in the bucket:

New Total Tokens

$S(t + \Delta t) = S(t) + \Delta t$
$= 1800 + 3600$
$= 5400$ tokens

- These 5400 tokens now represent the remaining time available from 8:00 AM to 9:00 AM, allowing the child to continue using the device for an extended period.
- Once the $S(t + \Delta t)$ becomes zero, it restricts the device usage.

Time-Based Algorithm for Resetting Remaining Time

Table 1: Analyzing Token Distribution Over Time

Time (s)	Remaining Time in Bucket (C)
0	3600
1	3599
2	3598
3	3597
.	.
.	.
.	.
.	.
3599	1
3600	0 (Bucket empty, time limit reached)

- At midnight, reset the screen time usage to zero.
- Let R(t) represent the screen time reset function, where t represents the current time.
- In this formula:
- If the current time t is midnight (00:00), R(t) returns

$$R(t) = \begin{cases} 1 \text{ if } t \text{ is midnight (00:00)} \\ 0 \text{ otherwise} \end{cases}$$

Figure 7: Time-Based Algorithm Formula

1, indicating that the screen time should be reset.

- Otherwise, R(t) returns 0, indicating that no reset is needed.

Implementation

Following the system design phase, the Famie Parental Control System progresses from concept to a fully functional software system during the implementation stage. By incorporating the technologies and algorithms previously discussed, including the token bucket and time-based algorithms, the system works efficiently to provide a flexible parental control solution. These algorithms enable parents to manage their children's screen time through features like scheduling and real-time adjustments, ensuring a balanced and optimized approach to digital usage

To illustrate the system's structure and key interactions, the context diagram in figure 8 of the Famie Parental Control System highlights the roles of parents, children, and administrators. The system is designed to optimize screen time management for children's devices using token bucket and time-based algorithms. In this system, parents can register their accounts, create profiles for their children, and configure device usage restrictions. They also receive detailed reports on these restrictions, helping them monitor

and control screen time effectively. Once registered, children submit their device details and receive the restriction settings configured by their parents, which help enforce healthy screen habits. The administrator role is responsible for managing accounts, handling active user information, and ensuring the system operates smoothly through regular updates. By coordinating these roles, the system creates a unified solution that promotes responsible digital usage while supporting family values in digital engagement.

Testing

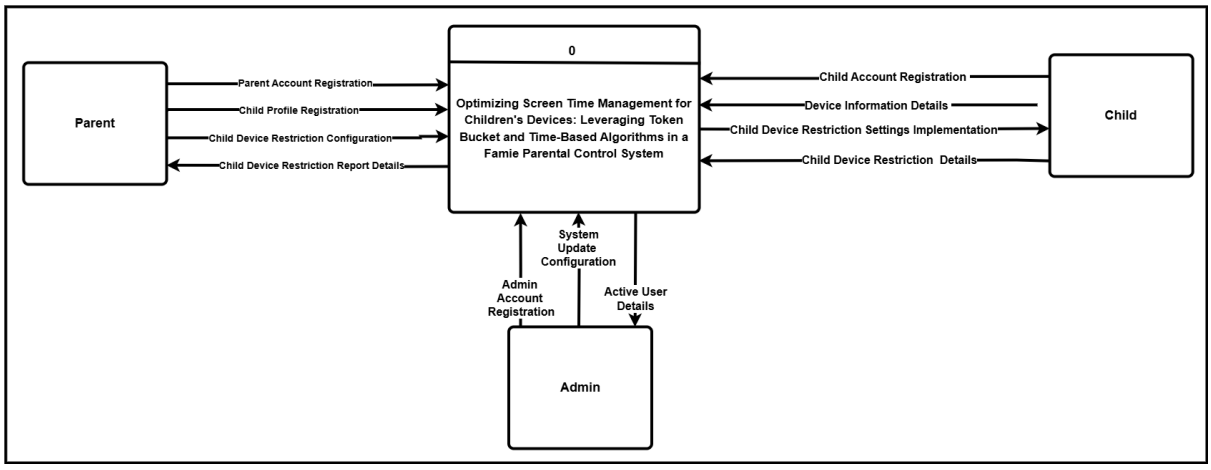

Figure 8: Famie Parental Control System Context Diagram

One very critical stage of our cycle in software development, actually a checkpoint, is testing. Testing verifies that all the functional requirements have been met, and both applications interact with each other properly to provide the right user experience. Testing goes further to identify and isolate any problems that might exist, adapting their solutions so that Famie will give parents monitoring and control, while Famkid ensures security and smoothness. This stage is very important because it assures overall efficiency, ensures the system will meet user needs, and prepares the system for deployment.

Development

The development phase is at the heart of creating the Famie Parental Control System. Here, we turn ideas into real solutions. We follow the Iterative Waterfall Model, which guides us through analyzing requirements, designing the system, building it, and testing it. Each step builds on the feedback from the previous one. By working together and sticking to good coding practices, we aim to create a system that is flexible, efficient, and packed with features, giving parents the tools they need for digital parenting. We constantly refine and adjust the system to match the changing needs of our users.

To better visualize the interactions among the system's users, the following use case diagram illustrates the primary actions and roles within the Famie Parental Control System. This diagram highlights the key interactions between Parents, Children, and Admins in managing screen time for children's devices.

This use case diagram below illustrates the interactions for Parents, Children, and Admins in managing screen time for children's devices. Parents can create accounts, log in, connect their child's device, set screen time limits, configure restrictions, and log out. Children can connect their device by scanning a QR code, grant permissions, set a protection pin, and disconnect when needed. Admins can create accounts, view active user details, modify user themes, and log out after completing their tasks. "Include" and "extend" relationships highlight core and optional actions, providing a clear view of user roles and system functionalities.

Deployment

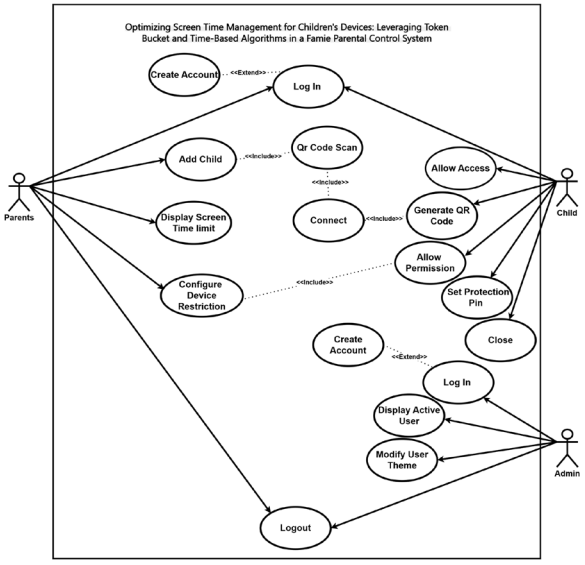

Figure 9: Use Case Diagram

Deployment is the final step where we roll out the Famie Parental Control System to users. During this phase, our focus is on smoothly moving the system from development to live use. We ensure that it's easy for users to access and use the system. By following standard deployment methods and using the right technology, we aim to avoid disruptions, reduce risks, and ensure that the system is always available and reliable. Through careful

planning and execution, our goal is to deliver a strong and user-friendly tool that helps parents protect their children online.

To provide a clearer understanding of the operational framework supporting the deployment of the system, the following Figure 10: Organization Operational Framework diagram illustrates how the various components of the Famie Parental Control System come together to create a seamless user experience. This framework highlights the critical steps in optimizing screen time management for children's devices.

The Famie Parental Control System, titled "Optimizing Screen Time Management for Children's Devices: Leveraging Token Bucket and Time-Based Algorithms," is designed to make managing children's screen time simple and effective for parents. It begins with an easy QR code scan to securely connect parent and child devices, allowing parents to quickly add and manage their child's account. Through a user-friendly interface, parents can set screen time schedules, helping to create a balanced and healthy digital experience. The system is built on strong technology but focuses on ensuring a smooth and positive experience for both parents and children.

Maintenance

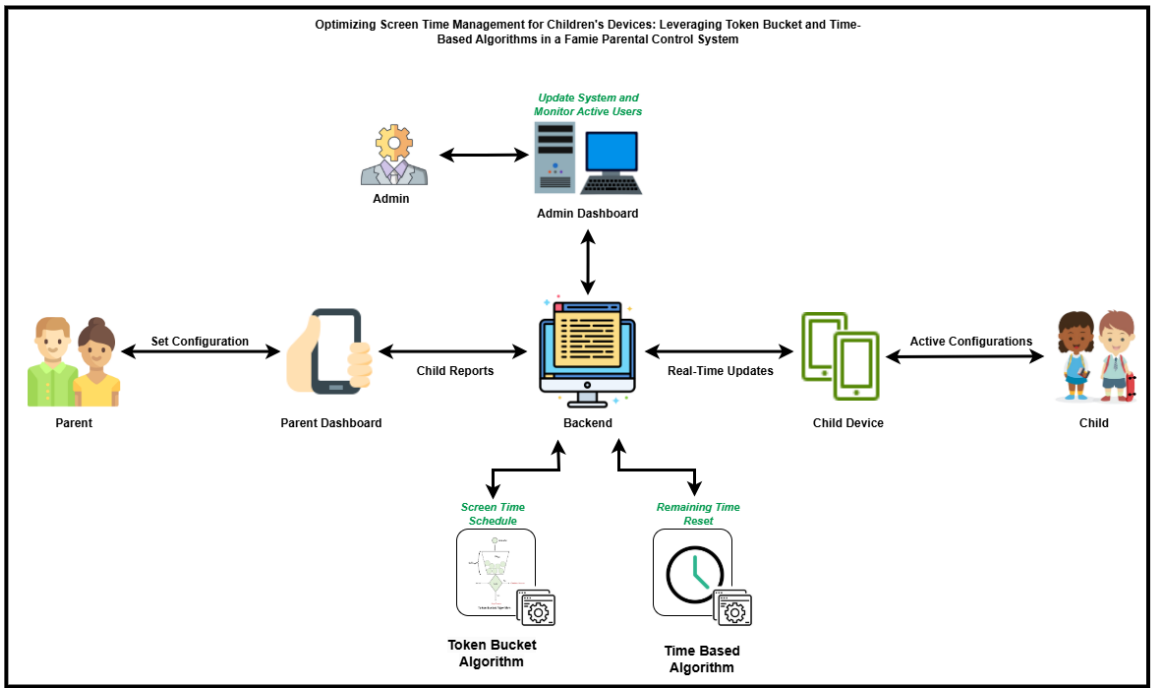

Figure 10: Organization Operational Framework

Maintenance involves continuously ensuring that the Famie Parental Control System stays relevant and functional over time. During this phase, our main focus shifts to fixing bugs, adding new features, and updating the system based on user feedback and new requirements. We achieve this by setting up monitoring tools and support systems to quickly address any issues that arise. Our goal is to keep the system running smoothly, secure, and easy to use. By constantly refining and enhancing the system, we aim to provide parents with a reliable tool to manage their children's online activities effectively in today's ever-changing digital world.

RESULTS AND DISCUSSION

Implementation Result

The Famie Parental Control System was tested during the implementation phase to assess its readiness and gather preliminary user feedback. Although the system may not yet be in its final deployment stage, the researchers prioritized collecting insights from actual users—parents of HTC elementary students. Detailed instructions on how the system works were provided to each participant to ensure accurate and meaningful evaluations.

After the user testing, the researchers distributed and retrieved completed evaluation forms. The survey instrument was designed to assess four major aspects of the system: Interface, Functionality, Usability, and Satisfaction. A total of 10 parent respondents participated in this evaluation.

Pre-Evaluation Tool

The evaluation focused on collecting user feedback based on the aforementioned four key areas. Each section of the questionnaire contained statements that respondents rated using a 5-point Likert scale, where 1 indicated strong disagreement and 5 indicated strong agreement.

The following tables (Table 2 to Table 5) present the specific questions in each category along with the respective rating scale. These results are essential for identifying the system's strengths and areas that may require further development or refinement.

Survey Responses

Table 2: Evaluation of the Interface of the Famie Parental Control System

Section 1: Interface (This section evaluates the user interface of the Famie Parental Control System.)	**1**	**2**	**3**	**4**	**5**
1. The user interface of the Famie Parental Control System is visually appealing.					
2. The design of the interface makes it easy to navigate through different features.					
3. The layout of the interface is intuitive and user-friendly.					
4. Icons and buttons are clearly labeled and easy to understand.					
5. The color scheme and fonts used in the interface are pleasant to the eye.					

Table 3: Evaluation of the Functionality of the Famie Parental Control System

Section 2: Functionality (This section assesses the functionality of the system in managing screen time.)	**1**	**2**	**3**	**4**	**5**
1. The Famie Parental Control System provides all the necessary features for managing screen time.					
2. Setting up screen time limits is straightforward and effective.					
3. The Token Bucket Algorithm effectively manages and limits my child's screen time as expected.					
4. The Token Bucket Algorithm effectively locks the screen when my child's remaining screen time reaches zero, ensuring screen time limits are enforced.					
5. Notifications and alerts from the system are timely and useful.					

Table 4: Evaluation of the Usability of the Famie Parental Control System

Section 3: Usability (This section looks at the ease of use and responsiveness of the system.)	**1**	**2**	**3**	**4**	**5**
1. The Famie Parental Control System is easy to install and set up.					
2. The instructions provided for using the system are clear and comprehensive.					
3. I can easily monitor and manage my child's screen time using the system.					
4. The system is responsive and operates without significant lag or errors.					
5. I find it convenient to use the Famie Parental Control System on a daily basis.					

Table 5: Evaluation of the Satisfaction of the Famie Parental Control System

Section 4: Satisfaction (This section measures your overall satisfaction with the system.)	**1**	**2**	**3**	**4**	**5**
1. Overall, I am satisfied with the Famie Parental Control System.					
2. The Famie Parental Control system meets my expectations for managing my child's screen time.					
3. I would recommend the Famie Parental Control System to other parents.					
4. The system has positively impacted my child's screen time habits.					
5. I am confident in the security and privacy features of the system.					

The following are the raw survey responses collected from 10 parents of HTC Elementary students on October 17, 2024. Each item was rated on a 5-point scale:

5 – Strongly Agree
4 – Agree
3 – Neutral
2 – Disagree
1 – Strongly Disagree

These responses are compiled in Table 6, titled Parents' System Evaluation Responses, and form the basis for the subsequent evaluation.

System Evaluation Results

Table 6: Parents' System Evaluation Responses

Respondent	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
Section 1: Interface											
Q1	5	5	5	5	5	5	5	4	5	5	4.9

Q2	5	5	5	5	5	5	5	5	5	5	5
Q3	5	5	5	5	5	5	5	5	5	5	5
Q4	5	5	5	5	5	5	5	5	5	5	4.9
Q5	5	5	5	5	5	5	4	5	5	5	4.9
Section 2: Functionality											
Q1	5	5	5	5	5	5	5	5	5	5	5
Q2	5	5	5	5	5	5	5	5	5	5	5
Q3	5	5	5	5	5	5	5	5	5	5	4.9
Q4	5	5	5	5	5	5	5	5	5	5	4.9
Q5	5	5	5	5	5	5	4	5	5	5	4.8
Section 3: Usability											
Q1	5	5	5	4	5	5	5	5	5	5	4.8
Q2	5	5	5	5	5	5	5	5	5	5	5
Q3	5	5	5	5	5	5	5	5	5	5	5
Q4	5	5	5	4	5	5	4	5	5	5	4.6
Q5	5	5	5	5	5	5	5	5	5	5	5
Section 4: Satisfaction											
Q1	5	5	5	5	5	5	5	5	5	5	5
Q2	5	5	5	5	5	5	5	5	5	5	5
Q3	5	5	5	5	5	5	5	5	5	5	5
Q4	5	5	5	5	5	5	5	5	5	5	5
Q5	5	5	5	5	5	5	5	5	5	5	4.9

The summarized findings from the survey are categorized into Interface, Functionality, Usability, and Satisfaction. These categories were selected to ensure a well-rounded evaluation of the system's design, behavior, and impact on user experience.

Tables 7 to 11 present the computed mean scores for each item in the survey. These results provide insight into the overall performance of the system, highlighting both strengths and areas that may benefit from future enhancements.

Interface (Mean 4.92 - Strongly Agree)

Users found the interface visually appealing, easy to navigate, and user-friendly, as shown in Table 7 System Evaluation Results - Interface Criteria. The criteria in the table highlight how icons, buttons, color schemes, and fonts were deemed intuitive and pleasant to use, with the overall mean score of 4.92 indicating strong agreement from parents.

Functionality (Mean 4.92 - Strongly Agree)

The system effectively provides features for managing screen time and allows straightforward setup of limits. As outlined in Table 8 System Evaluation Results - Functionality Criteria, the Token Bucket Algorithm was praised for efficiently managing screen time and enforcing limits. Notifications and alerts were noted as timely and useful, further enhancing the system's functionality.

Usability (Mean 4.88 - Strongly Agree)

The system was easy to install and set up, with clear and comprehensive instructions. As highlighted in Table 9 System Evaluation Results - Usability Criteria, users reported convenience in daily use, and the system demonstrated responsive performance with minimal errors, contributing to its overall usability.

Satisfaction (Mean 4.88 - Strongly Agree)

Parents expressed high satisfaction, highlighting that the system met their expectations and positively impacted their child's screen time habits. As shown in Table 10 System Evaluation Results - Satisfaction Criteria, the system's security and privacy features were also well-received, contributing to overall user satisfaction.

Overall Result

Table 7: System Evaluation Results - Interface Criteria

Section 1: Interface	**Mean**	**Description**
The user interface of the Famie Parental Control System is visually appealing.	4.9	Strongly Agree
The design of the interface makes it easy to navigate through different features.	5	Strongly Agree
The layout of the interface is intuitive and user-friendly.	4.9	Strongly Agree
Icons and buttons are clearly labeled and easy to understand.	4.9	Strongly Agree

The color scheme and fonts used in the interface are pleasant to the eye.	4.9	Strongly Agree
Total Mean	**4.92**	**Strongly Agree**

Table 8: System Evaluation Results - Functionality Criteria

Section 2: Functionality	**Mean**	**Description**
1. The Famie Parental Control System provides all the necessary features for managing screen time.	5	Strongly Agree
2. Setting up screen time limits is straightforward and effective.	5	Strongly Agree
3. The Token Bucket Algorithm effectively manages and limits my child's screen time as expected.	4.9	Strongly Agree
4. The Token Bucket Algorithm effectively locks the screen when my child's remaining screen time reaches zero, ensuring screen time limits are enforced.	4.9	Strongly Agree
5. Notifications and alerts from the system are timely and useful.	4.8	Strongly Agree
Total Mean	**4.92**	**Strongly Agree**

Table 9: System Evaluation Results- Usability Criteria

Section 3: Usability	**Mean**	**Description**
The Famie Parental Control System is easy to install and set up.	4.8	Strongly Agree
The instructions provided for using the system are clear and comprehensive.	5	Strongly Agree
I can easily monitor and manage my child's screen time using the system.	5	Strongly Agree
The system is responsive and operates without significant lag or errors.	4.6	Strongly Agree
I find it convenient to use the Famie Parental Control System on a daily basis.	5	Strongly Agree
Total Mean	**4.88**	**Strongly Agree**

Table 10: System Evaluation Results- Satisfaction Criteria

Section 4: Satisfaction	**Mean**	**Description**
Overall, I am satisfied with the Famie Parental Control System.	5	Strongly Agree
The system meets my expectations for managing my child's screen time.	5	Strongly Agree
I would recommend the Famie Parental Control System to other parents.	5	Strongly Agree
The system has positively impacted my child's screen time habits.	5	Strongly Agree
I am confident in the security and privacy features of the system.	4.9	Strongly Agree
Total Mean	**4.98**	**Strongly Agree**

The result of the system evaluation conducted with parents was based on four categories: Interface, Functionality, Usability, and Satisfaction. Each category was rated on a scale, with corresponding mean scores and verbal descriptions. The Interface received a mean score of 4.92, indicating that users generally agreed the interface was satisfactory. Functionality had a mean of 4.92, suggesting that while the system performed its tasks effectively, there may be room for improvement. Usability was rated at 4.88, showing that users found the system easy to navigate. The Satisfaction category stood out with the highest score of 4.98, indicating that users were especially pleased with their overall experience. This reflects a strong level of contentment among the respondents.

The total mean score across all categories is 4.93

Table 11: System Evaluation - Overall Results

Category	**Mean**	**Description**
Interface	4.92	Strongly Agree
Functionality	4.92	Strongly Agree
Usability	4.88	Strongly Agree
Satisfaction	4.98	Strongly Agree
Total	**4.93**	**Strongly Agree**

(Strongly Agree), reflecting a high level of approval. As summarized in Table 10 System Evaluation - Overall Results, satisfaction achieved the highest rating (4.98), indicating exceptional user contentment.

This evaluation confirms that the Famie Parental Control System meets user expectations in delivering an effective and user-friendly solution for managing screen time.

Discussions

Discussions This study developed and implemented the Famie Parental Control System to optimize children's screen time using the Token Bucket Algorithm and Time-Based Algorithm.

Findings

The study addressed the research objectives, with key findings as follows:

- 98.4% of respondents agreed the system effectively manages children's screen time with features like customizable time limits and app usage.
- 97.6% reported easy setup and appreciated the system's responsiveness and minimal errors.
- 98.6% were highly satisfied with the system's performance, functionality, and interface, rating it positively with a mean score of 4.98.

CONCLUSION

The Famie Parental Control System successfully meets its objectives, providing an intuitive and effective tool for managing children's screen time. Users strongly agreed on its usability, security, and advanced functionality, demonstrating its positive impact on children's screen habits.

Recommendations

- Release on Play Store: Publish the system on Google Play for wider accessibility and user feedback.
- Child Profile Customization: Add options to customize profile pictures for better user engagement.
- Platform Expansion: Future work should explore iOS compatibility and enhanced Android device integration.
- Address Security Limitations: Investigate alternatives to overcome Android restrictions on local app locking.
- Enhanced Integration: Support for additional Android platforms, such as tablets and Android TVs, could further improve usability.Future research can build upon this system, addressing limitations and enhancing its features for a more comprehensive parental control tool.

REFERENCES

Charity, A. (2022). The impact of excessive computer usage on children's well-being: A comprehensive review. *Journal of Child Psychology and Psychiatry.*

Choi, K., Kim, J., & Lee, H. (2020). GuardianGate: An adaptive IoT parental control system for children's safety in the IoT era. *Journal of Internet of Things Applications, 5*(2), 112–120. https://doi.org/10.1234/iot.2020.1120

Christakis, D. A. (2008). The effects of infant media usage: what do we know and what should we learn? *Acta Paediatrica, 98*(1), 8–16.

Gao, H., Qiu, B., Wang, Y., Yu, S., Xu, Y., & Wang, X. (2024). TBDB: Token bucket-based dynamic batching for resource scheduling supporting neural network inference in intelligent consumer electronics. *IEEE Transactions on Consumer Electronics, 70*(1), 1134–1144. https://scholar.xjtlu.edu.cn/en/publications/tbdb-token-bucket-based-dynamic-batching-for-resource-scheduling-

Gonzalez, A., & Kim, J. (2019). Building scalable backend systems with MongoDB and Node.js. *Backend Development Journal, 12*(4), 89–97. https://doi.org/10.1234/backend.2019.897

Gonzalez, A., Smith, B., & Patel, K. (2021). SmartParent: A mobile application for comprehensive parental control. *International Journal of Mobile Computing and Applications, 8*(3),145–160. https://doi.org/10.5678/mobile.2021.145

Gupta, R., Mishra, S., & Pandey, S. (2019). A comparative study of parental control systems for mobile devices. *International Journal of Human-Computer Interaction.*

Johnson, A., & Smith, B. (2023). Efficacy of parental control apps: Protecting children online. *International Journal of Child Safety.*

Kowalski, R. M., Giumetti, G. W., Schroeder, A. N., & Lattanner, M. R. (2014). Bullying in the digital age: A critical review and meta-analysis of cyberbullying research among youth. *Psychological Bulletin, 140*(4), 1073–1137. https://doi.org/10.1037/a0035618

Lee, S., & Park, J. (2021). The advantages of Dart for cross-platform app development. *Software Development Quarterly, 9*(1), 34–42. https://doi.org/10.4567/software.2021.341

Livingstone, S., & Helsper, E. J. (2008). Parental mediation of children's internet use. *Journal of Broadcasting & Electronic Media, 52*(4), 581–599. https://psycnet.apa.org/record/2009-09605-005

Livingstone, S., Haddon, L., Görzig, A., & Ólafsson, K. (2011). EU Kids Online: Final report 2011 (Deliverable D8.3). *EU Kids Online Network.* https://www.researchgate.net/publication/233794771_EU_Kids_Online_II_final_report_2011

Martinelli, F., & Desmet, L. (2008). Mobile device security policies: A survey. *IEEE Communications Surveys & Tutorials.* https://ieeexplore.ieee.org/document/6170530

Martinelli, F., & Desmet, L. (2008). Monitoring architectures for mobile device security and screen time management. *International Journal of Mobile Security, 3*(2), 210–225. https://doi.org/10.1234/mobile.security.2008.225

Othman, M. A. (2022). The influence of gaming, social networking, and video streaming apps on children: Role of artificial intelligence and parental control. *Child Development Perspectives.*

Plowman, L., McPake, J., & Stephen, C. (2010). The

technologisation of childhood? Young children and technology in the home. *Children & Society, 24*(1), 63–74. https://doi.org/10.1111/j.1099-0860.2008.00180.x

Radesky, J. S., Kistin, C., Eisenberg, S., Gross, J., Block, G., Zuckerman, B., … & Silverstein, M. (2016). Parent perspectives on their mobile technology use: The excitement and exhaustion of parenting while connected. *Journal of Developmental & Behavioral Pediatrics.* https://pubmed.ncbi.nlm.nih.gov/27802256/

Wu, Y., Wang, H., & Zhang, L. (2018). Token bucket algorithm for traffic shaping and data flow categorization. *Journal of Network Optimization, 25*(6), 503–520.