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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 chil- dren's devices. The system addresses the growing need for parents to effectively monitor and regulate their children's screen time in a balanced manner. By integrating the Token Bucket Algorithm and a Time-Based Algorithm, the system 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 link their devices with their children's seamlessly. This connection enables centralized control over screen time and schedule management. This research applies these algorithms to provide a person- alized 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 through 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 over screen time 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, exposure to harmful content, and cyberbullying, even as technology offers remarkable benefits for education

and development. These challenges leave parents struggling to balance granting digital freedom with ensuring their children's safety online—a task that becomes increas- ingly 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 chil- dren 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 inte- gration via a secure QR code connection, Famie offers a comprehensive solution that empowers parents while fostering healthier digital habits for children in an increasingly con- nected world.

RESEARCH QUESTIONS

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?

RESEARCH DESIGN

This study employed a quantitative descriptive-correlational research design to examine the relationship between financial literacy and debt management among faculty members. The descriptive aspect was used to summarize the levels of financial literacy and the extent of debt management using numerical data, while the correlational aspect analyzed whether a statistically significant relationship exists between the two variables. This design allowed the researchers to explore patterns and associations without manipulating any variables, making it suitable for investigating naturally occurring relationships (Bhandari, 2023).

LITERATURE REVIEW

In today's digital age, the influence of applications on child development has garnered significant attention. While educational apps can enhance learning, 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.

In 2022 Othman et al. emphasize the role of AI and parental controls in managing children's behavior with smart devices. Livingstone and Helsper (2008) and Charity et al. (2022) stress the importance of parental interventions to mitigate physical, social, and psychological risks linked to excessive device use. Radesky et al. (2016) and Johnson and Smith explore parental strategies for managing screen time and promoting balanced usage. Gupta, Mishra, and Pandey in 2019 compare parental con- trol 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, highlighting the need for more robust measures to enhance functionality and safety. According to Gao et al. (2024) and Wu, Z., Song, X., 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, Smith, and Patel (2021) introduces a mobile app for comprehensive parental control, emphasizing content filtering, screen time regulation, and online interaction monitoring to balance digital access with child safety. Livingstone and Helsper (2008) highlight the importance of parental mediation in mitigating online risks, further supporting the need for effective control mechanisms.

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

Technological frameworks also play a role. Gonzalez and Kim in 2019 highlight MongoDB and Node.js for scalable backend

development, while Lee and Park (2021) showcase Dart's cross-platform advantages for building user-friendly apps. In this study, these technologies support Famie, enabling intuitive parental control features across iOS and Android.

This research presents a proactive prototype for managing children's screen time, empowering parents to promote health- ier digital interactions while expanding on prior findings to support responsible technology use among young user.

METHODOLOGY

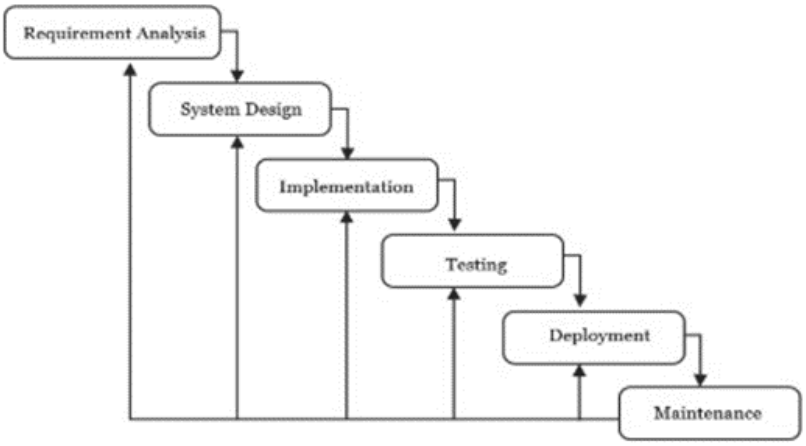

Fig. 1
Iterative Waterfall Model of Software Development Life Cycle

The development of the Famie Parental Control System employed the Iterative Waterfall Model. This method follows a structured sequence, starting with high-level requirements and progressing through requirement analysis, system design, im- plementation, testing, integration, delivery, and maintenance, incorporating feedback loops to link each phase to the preced- ing one.

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:

1. **Screen Time Habits:** Rating of typical daily screen time.
2. **Management Difficulty:** Difficulty in managing screen time activities.
3. **Concerns about Online Content:** Concerns about spe- cific apps and content.
4. **Establishing Limits:** Current practices for setting screen time limits.
5. **Perception of Technology's Role:** Beliefs about tech- nology's impact on development.
6. **Awareness of Parental Control Features:** Knowledge of existing features and tools.

7. **Communication with Child:** Level of communication about safe technology use.
8. **Importance of Parental Control Features:** Importance of system features.
9. **Balance between Education and Recreation:** Balance between educational and recreational use.
10. **Interest in Workshops or Information:** Interest in fur- ther guidance on managing screen time. By addressing these requirements, the Famie Parental Control System aims to help parents manage their child's online experi- ences effectively.

System Design

The System Design phase ensures that all system requirements and specifications are thoroughly addressed, serving as the blueprint that guides the subsequent development process. During this phase, the user interface is carefully crafted using Visual Studio Code and Dart, enabling a responsive and user-friendly design. For testing and visualization, Android Studio is utilized to emulate the application environment across various devices. On the backend, Node.js and MongoDB are implemented to support scalable database management, efficient data handling, and real-time operations. In addition, essential materials such as demos, source code, and technical documentation are securely archived to support future development, debugging, and deployment activities. This phase also integrates core technologies and algorithms, notably the time-based and token bucket algorithms, which play a critical role in ensuring proper system functionality.

Fig. 3.

System Design

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.

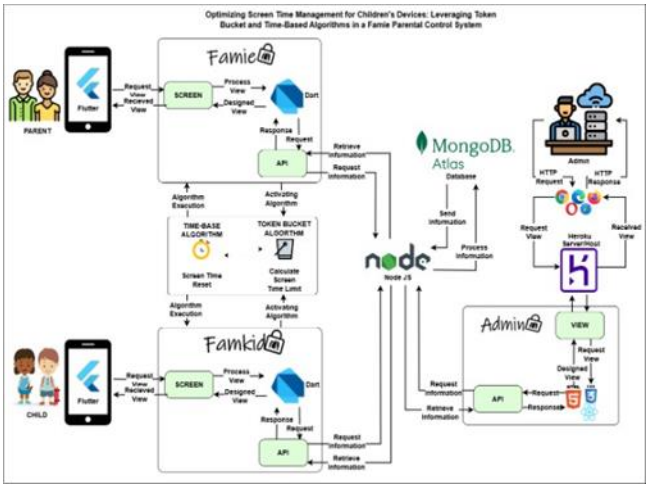

Fig. 4.

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 employ advanced algorithms that enhance the system's functionality and ensure precise time management.

1.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.

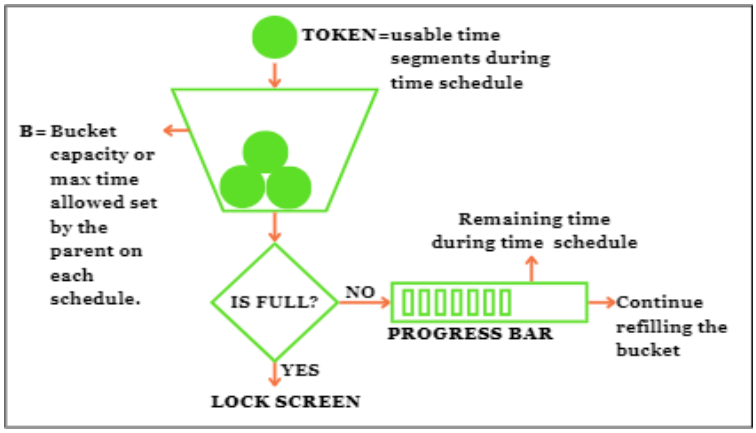

Fig. 5
Token Bucket Algorithm Visualization

The illustration above 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.

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

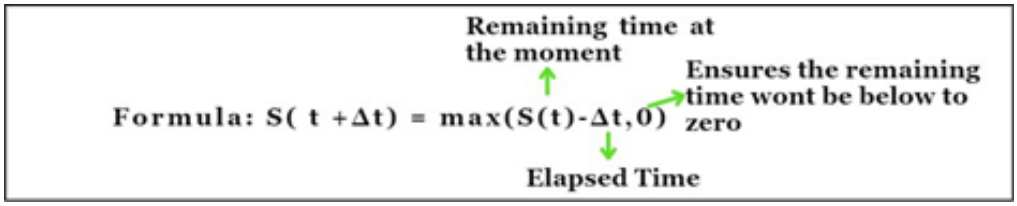

Fig. 6
Token Bucket Algorithm Formula

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 using the formula:

- **Formula Example:**

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

$= \max(3600 - 1800, 0)$

$= \max(1800, 0)$

$= 1800$ 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 addi- tional hour) to the remaining tokens in the bucket:

∗ **New Total Tokens =** $S(t+\Delta t)+\Delta t = 1800+ 3600 = 5400$ **tokens.**

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

Table 1

Token Bucket Algorithm: 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)

Time-Based Algorithm for Resetting Remaining Time

When the tokens reach zero, the system triggers the time-based algorithm to reset the screen time usage at midnight, ensuring a fresh start for the next day.

Let $R(t)$ represent the screen time reset function, where t denotes the current time. The reset function is defined as:

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

Fig. 7
Time-Based Algorithm Formula Illustration

If the current time t is midnight (00:00), $R(t)$ returns 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 incorpo- rating 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

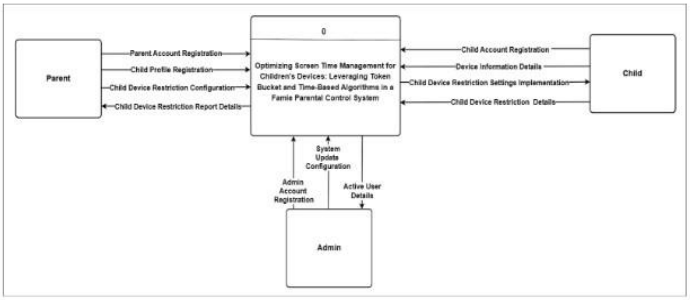

Fig. 8
Context Diagram

To illustrate the system's structure and key interactions, the context diagram of the Famie Parental Control System, shown in Figure 8, 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 reg- ister 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

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 sys- tem, 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.

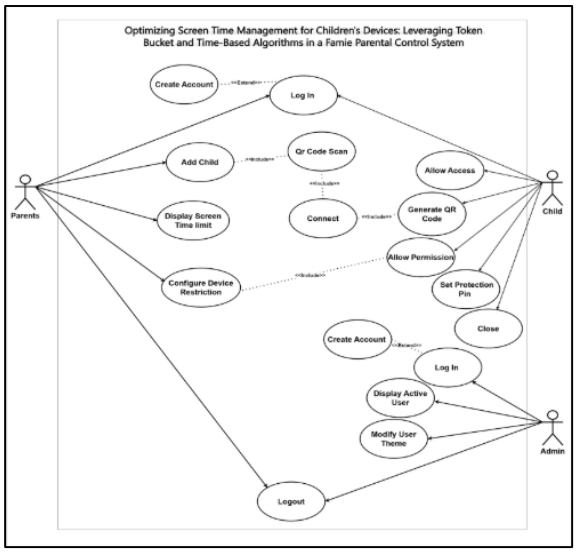

Fig. 9
Use Case Diagram

This use case diagram 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

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 frame- work supporting the deployment of the system, the follow- ing "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.

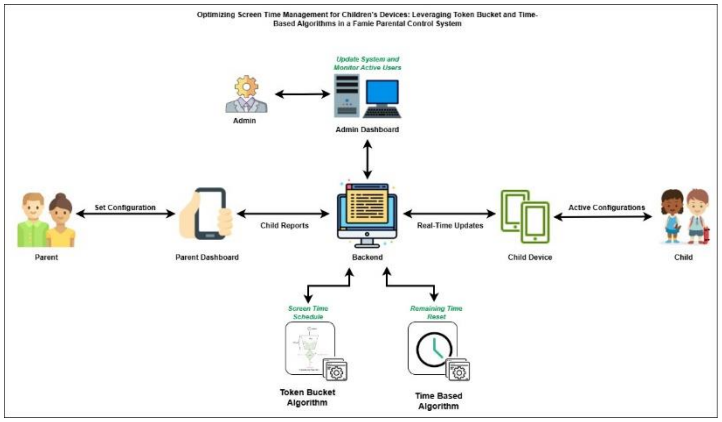

Fig. 10

Organization Operational Framework

The Famie Parental Control System, 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

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 software was tested during this period. Regardless of whether the system is ready for final deployment, feed- back from the parents was collected, providing a basis. The researchers instructed the parents in detail about how the system works. After the user testing, the researchers collected the forms filled out by the parents for evaluation purposes. The questionnaire had been divided into four groups, namely, Interface, Functionality, Usability, and Satisfaction. A survey questionnaire was administered to 10 respondents, particularly parents of the HTC elementary student, who were invited to respond.

A. Pre Evaluation Tool

The evaluation of the **Famie Parental Control System** focuses on gathering user feedback across four critical areas: Interface, Functionality, Usability, and Satisfaction. Each sec- tion includes a series of statements or questions designed to assess the system's performance and user experience in spe- cific categories. The users were asked to rate their agreement with each statement on a scale from 1 to 5, where 1 represents strong disagreement and 5 represents strong agreement.

The following tables (Table II to Table V) present the questions and the corresponding ratings provided by users in each evaluation section. These responses will help identify areas where the system is performing well and areas that may require further improvement.

Table 2

Section 1: Interface Table

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

Section II: Functionality Table

Section 2: Functionality Table ***(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.					

A. Survey Responses

Below are the raw responses from the 10 parents inter- viewed at HTC Elementary on October 17, 2024, regarding their child's screen time habits and use of parental controls. Each response is rated on a scale of 1 to 5, where:

Table 4

Section III: Usability Table

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 V

Section 4: Satisfaction Table

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.	

B. ***System Evaluation Results***

The evaluation of the Famie Parental Control System was conducted across four key categories: Interface, Functionality, Usability, and Satisfaction. These categories were carefully chosen to ensure a comprehensive assessment of the system's overall performance and its impact on user experience.

The summarized results are presented in Tables VII to XI, detailing the feedback collected from parents. Each table highlights the mean scores for individual criteria and an overall assessment, providing a clear view of the system's strengths and areas for improvement.

Table VI

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**

1) ***Interface*** *(Mean: 4.92 – Strongly Agree)*

Table VII

Interface Criteria

Interface	Mean	Description
The user interface of the Famie Parental Control System is visually appealing.	4.90	**Strongly Agree**

The design of the interface makes it easy to navigate through different features.	5.00	**Strongly Agree**
The layout of the interface is intu- itive and user-friendly.	4.90	**Strongly Agree**
Icons and buttons are clearly la- beled and easy to understand.	4.90	**Strongly Agree**
The color scheme and fonts used in the interface are pleasant to the eye.	4.90	**Strongly Agree**
Total Mean	**4.92**	**Strongly Agree**

Users found the interface visually appealing, easy to nav- igate, and user-friendly, as shown in Table VII-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.

2) ***Functionality*** *(Mean: 4.92 – Strongly Agree)*

Table VIII

Functionality Criteria

Functionality	Mean	Description
The Famie Parental Control System pro- vides all the necessary features for manag- ing screen time.	5.00	**Strongly Agree**
Setting up screen time limits is straightfor- ward and effective.	5.00	**Strongly Agree**
The Token Bucket Algorithm effectively manages and limits	4.90	**Strongly Agree**

my child's screen time as expected.		
The Token Bucket Algorithm effectively locks the screen when my child's remaining screen time reaches zero.	4.90	**Strongly Agree**
Notifications and alerts from the system are timely and useful.	4.80	**Strongly Agree**
Total Mean	**4.92**	**Strongly Agree**

The system effectively provides features for managing screen time and allows straightforward setup of limits. As outlined in *Table VIII - 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 function- ality.

3) ***Usability*** *(Mean: 4.88 – Strongly Agree)*

Table IX

Usability Criteria

Usability	Mean	Description
The Famie Parental Control System is easy to install and set up.	4.80	**Strongly Agree**
The instructions provided for using the sys- tem are clear and comprehensive.	5.00	**Strongly Agree**
I can easily monitor and manage my child's screen time using the system.	5.00	**Strongly Agree**
The system is responsive and operates with- out significant lag or errors.	4.60	**Strongly Agree**

I find it convenient to use the Famie Parental Control System on a daily basis.	5.00	**Strongly Agree**
Total Mean	**4.88**	**Strongly Agree**

The system was easy to install and set up, with clear and comprehensive instructions that guided users smoothly through the installation process. As highlighted in *Table IX* – Usability Criteria, users reported high levels of convenience in daily use, noting that the interface was intuitive and easy to navigate even for first-time users. The system also demonstrated responsive performance, with minimal delays or errors during operation, which significantly contributed to its overall usability and user satisfaction. Additionally, users appreciated the system's consistent behavior across different devices and platforms, further enhancing their confidence in its reliability. Feedback collected during the testing phase also indicated that users were able to complete tasks efficiently, with minimal need for technical support, highlighting the system's user-centered design. These usability outcomes not only confirm the system's practicality for real-world application but also support its readiness for wider deployment.

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

4. ***Satisfaction*** *(Mean: 4.98 – Strongly Agree)*

Table X

Satisfaction Criteria

Satisfaction	Mean	Description
Overall, I am satisfied with the Famie Parental Control System.	5.00	**Strongly Agree**
The system meets my expectations for man- aging my child's screen time.	5.00	**Strongly Agree**
I would recommend the Famie Parental Control System to other parents.	5.00	**Strongly Agree**

The system has positively impacted my child's screen time habits.	5.00	**Strongly Agree**
I am confident in the security and privacy features of the system.	4.90	**Strongly Agree**
Total Mean	**4.98**	**Strongly Agree**

Moreover, several parents noted improvements in their child's focus and daily routine, attributing these changes to the system's effective monitoring and control capabilities. The combination of functionality, ease of use, and strong data protection measures made the system a trusted tool in managing screen time within households.

Beyond immediate usability and satisfaction, many parents emphasized the system's long-term benefits in shaping responsible digital habits among their children. Several parents also appreciated the customizable features, which allowed them to adjust screen time limits based on their child's age, schedule, and specific needs.

This flexibility empowered users to tailor the system to their lifestyle, enhancing its relevance and effectiveness. Furthermore, some expressed interest in future updates that could integrate educational recommendations, reward-based systems, or synchronization with school-related tasks. The overwhelmingly positive feedback suggests strong potential for the system to be adopted in a wider range of households and educational settings, especially in the context of promoting balanced digital wellness for children and adolescents.

5) ***Overall Results***

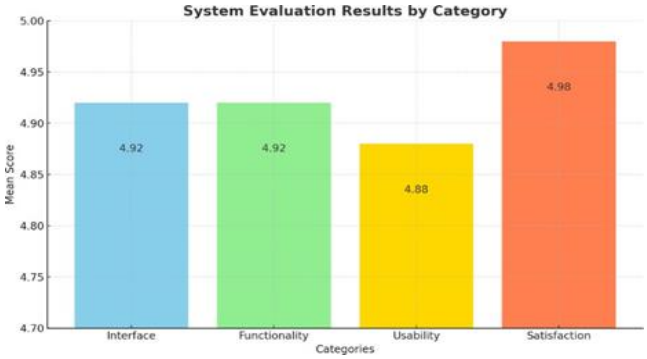

Fig. 7

System Evaluation by Category

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 descrip- tions. 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.

Table XI

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**

The total mean score across all categories is 4.93 (Strongly Agree), reflecting a high level of approval. As summarized in ***Table XI - 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.

SUMMARY

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 find- ings as follows:

- 98.4% of respondents agreed the system effectively man- ages children's screen time with features like customiz- able 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 perfor- mance, 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 lim- itations and

enhancing its features for a more comprehensive parental control tool.

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