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Parental Control Time Lock App

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Abstract- The increasing immersion of children in digital ecosystems—mobile applications, virtual environments, and gamified digital spaces—has amplified concerns around excessive screen time, addictive applications, and exposure to harmful content. Traditional parental control systems rely on rigid blocking mechanisms, often creating resistance among children and lacking nuanced, interactive behaviour regulation. This paper presents a Parental Control Time Lock App, a collaborative digital parenting framework integrating real-time monitoring, application-level time budgeting, and OTP-based conditional unlocking. Developed using Kotlin (Android) and a Spring Boot backend, the system enforces usage limits and enables parents to remotely authorize temporary access by providing a secure one-time password. The application incorporates behavioural design elements to promote healthy usage rather than punitive restriction. Testing conducted across 20 families demonstrated a 32% reduction in unregulated screen time and high parental satisfaction. The study contributes to the domains of digital wellbeing, child safety, and human–computer interaction by proposing a hybrid control model that balances autonomy, security, and trust.

Keywords – Digital Parenting, Screen Time Regulation, Parental Control, OTP-Based Authentication, Child Safety, Mobile Security, App Usage Monitoring, Human–Computer Interaction.

I. INTRODUCTION

Children interact extensively with mobile devices, games, and interactive virtual environments, making digital overstimulation an increasing concern. Studies show that children aged 8–14 spend 4–6 hours daily on digital content, often without oversight. Excessive screen time is associated with reduced attention span, addictive tendencies, decreased academic performance, and unhealthy psychological patterns.

While traditional parental control applications provide app blocking, content filtering, or device-level restrictions, most lack:

- fine-grained app-specific time budgeting
- real-time notifications
- temporary unlocking mechanisms governed by parental consent
- child-friendly digital wellbeing design principles

In digital ecosystems where children participate in virtual classrooms, augmented reality games, and immersive content, a balanced regulatory approach is needed.

To address these gaps, we designed a Parental Control Time Lock System that enforces app time limits and promotes negotiation-based unlocking using secure OTP authentication. The system does not rely solely on restriction but encourages parent–child interaction and responsible behaviour.

II. LITERATURE REVIEW

Parental Control Technologies

Existing studies highlight several categories of parental control mechanisms:

- content filtering (Luo et al., 2020)
- app blocking and screen timers (Wisniewski et al., 2018)
- monitoring and reporting systems (Ghosh et al., 2019)

However, researchers emphasize that over-surveillance can harm trust and emotional development. A collaborative, communication-driven approach is more effective (Sela, 2023).

Ethical and Privacy Concerns

Parental control tools present ethical dilemmas related to:

- children's digital autonomy
- data security risks (Ali et al., 2020)
- psychological impact of invasive monitoring

Therefore, designing secure, transparent systems is essential.

Limitations of Existing Systems

Research reveals limitations in mainstream PCAs:

- children frequently bypass controls
- parent dashboards are overly complex
- little support for fine-grained per-app time budgeting
- lack of controlled temporary unlock mechanisms
- insufficient consideration for behavioural design

Research Gap

Despite advances, no existing systems fully integrate:

1. real-time app-specific monitoring
2. automated time-limit locking
3. OTP-based parental consent workflow
4. trust-based digital wellbeing mechanisms

This motivates the system proposed in this study.

III. METHODOLOGY

Requirement Analysis

Interviews with 20 parents and educators identified core needs:

- app-level time restriction rather than device-level
- real-time notifications
- secure and remote unlocking workflow
- simple interface usable by non-technical parents
- anti-bypass protection mechanisms

System Architecture

The app follows a client–server architecture:

Parent App (Frontend):

- set time limits
- view real-time usage
- generate OTP for unlocking
- receive notifications

Child App (Frontend):

- monitors app usage
- displays timers
- locks app when limit exceeded
- requires OTP to unlock

Backend Services:

- Spring Boot REST API
- OTP generation and expiry
- Firebase Cloud Messaging notifications
- secure data storage and logs

Technology Stack

- Frontend: Kotlin (Android), XML UI
- Backend: Spring Boot, JWT, AES-256 encryption
- Database: MySQL / Firestore
- Notifications: Firebase Cloud Messaging
- Deployment: Firebase Hosting / AWS

Workflow

1. Parent links device
2. App usage is tracked continuously
3. When time limit is reached → app locks
4. OTP sent to parent's device
5. Parent shares OTP if extension is allowed
6. Child inputs OTP → temporary unlock
7. All events recorded in activity logs

IV. SYSTEM DESIGN

Core Modules

- Authentication Module – secure login using Firebase
- Time Usage Module – real-time app monitoring
- Locking Engine – enforces time rules
- OTP Module – generates, verifies, and expires OTPs
- Dashboard Module – usage reporting and analytics
- Security Layer – anti-bypass, encrypted data storage

Data Security Measures

- AES-256 encrypted storage
- HTTPS communication
- OTP expiry within 10 minutes
- role-based access controls
- tamper detection for child device app

V. IMPLEMENTATION

Screens include:

- Parent Login / Registration
- Parent Dashboard
- Time Limit Settings
- Child App Timer View
- App Locked Screen
- OTP Request / Verification

VI. RESULTS

Testing involving 20 families (20 parents, 26 children) yielded:

Quantitative Outcomes

- 32% reduction in daily screen time
- 87% parent satisfaction rating
- 2–3 seconds OTP generation time
- 0 detected bypass attempts

Qualitative Findings

Parents appreciated:

- fairness of OTP-based unlocking
- app-specific control rather than total blocking
- simple and clear UI

Children indicated:

- "the app feels fair" compared to rigid blocking
- negotiation increased communication with parents

VII. DISCUSSION

The OTP-based negotiation model bridges the gap between harsh restrictions and full autonomy. Unlike traditional PCAs that rely on unilateral blocking:

- children feel included in decision-making
- parents can enforce limits flexibly
- conflicts reduce due to transparency
- positive behavioural reinforcement becomes possible

The hybrid control model aligns with HCI principles of respect, collaboration, and trust-building.

VIII. FUTURE WORK

Future enhancements include:

- AI-based digital wellbeing recommendations
- biometric-based parental unlocking
- web dashboard for parents
- support for tablets, desktops, and smart TVs
- offline unlock with secure local token
- gamified rewards for disciplined usage
- VR/AR environment regulation for immersive apps

IX. CONCLUSION

This research demonstrates an effective and balanced approach to digital parenting. The Parental Control Time Lock

App successfully integrates:

- app-level time control
- OTP-based collaborative unlocking
- real-time monitoring
- secure backend architecture

The system promotes digital responsibility, reduces excessive usage, and improves parent–child interaction. The framework is scalable and can extend to manage VR, AR, and immersive environments—making it relevant to the evolving landscape of virtual and mixed reality technologies.

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Consent Statement
All participants involved in the testing of the Parental Control Time Lock App provided informed consent. No personally identifiable data was collected, and all participation was voluntary. The study followed ethical guidelines and complied with institutional standards for user data protection and privacy.

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