TLE CodePlus: Documentation

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1. Product Overview

TLE CodePlus is a comprehensive competitive programming education management system designed to track student progress on Codeforces. It provides detailed analytics, progress tracking, and automated management features for educational institutions.

1.1. Live Application Links

- **Frontend Application:** https://tle-code-plus.vercel.app/
- **Backend API:** https://tle-codeplus.onrender.com/
- **GitHub Repository:** https://github.com/ashut0shj/TLE-CodePlus
- **Video Walkthrough:** https://drive.google.com/file/d/1qmWsmpT6ouuzN-rjlaXYkKhqNGnsrh9i/view?usp=sharing

1.2. Key Features

- Student progress tracking and analytics
- Contest history visualization
- Problem-solving statistics
- Activity heatmaps
- Automated data synchronization with Codeforces
- CSV export functionality

2. Technology Stack

2.1. Frontend Technologies

Technology	Purpose
React.js	Primary UI framework with component-based architecture
Tailwind CSS	Utility-first CSS framework for responsive design
Recharts	Data visualization library for interactive charts
Calendar Heatmap	Activity pattern visualization over time

TABLE I
FRONTEND TECHNOLOGY STACK

2.2. Backend Technologies

Technology	Purpose
Node.js	JavaScript runtime environment
Express.js	Web application framework for RESTful APIs
MongoDB	NoSQL database for flexible data storage
Mongoose	Object Data Modeling (ODM) library

TABLE II
BACKEND TECHNOLOGY STACK

3. User Interfaces

3.1. Student Management Interface

- **Student Table:** Complete CRUD operations with advanced filtering
- **Search & Sort:** Efficient data navigation
- **Data Export:** CSV export for external analysis
- **Visual Indicators:** Color-coded rating systems and inactivity highlighting

3.2. Student Profile Dashboard

- **Contest History:** Interactive rating progression charts
- **Performance Analytics:** Problem-solving patterns and statistics
- **Activity Visualization:** Daily coding activity heatmaps
- **Achievement Tracking:** Personal milestones and hardest problems solved

3.3. BONUS FEATURES

- **Mobile & Tablet Responsive:** Optimized for all screen sizes
- **Dark/Light Mode Toggle:** System-wide theme switching
- **Well-Documented Code:** Comprehensive code documentation

4. Automation & Performance Features

4.1. Mailing Service

- Integrated mailing service for student notifications
- Configurable inactivity period for reminder triggers
- Automatic and manual reminder sending capabilities
- Email reminder tracking and counting per student

4.2. Automatic Data Refresh

- Scheduled job runs daily at 2 AM server time
- Fetches latest Codeforces data for all students
- Updates ratings, contests, and problem data automatically
- Refreshes inactivity status and reminder tracking

4.3. Manual Data Refresh

- User-triggered refresh for specific students
- Immediate profile and activity stats update
- Available from student profile page
- Fetches real-time data from Codeforces API

4.4. Caching & Rate Limiting

- Database caching prevents excessive API calls
- Data refresh only at scheduled times or manual triggers
- Fast UI performance with cached data
- Protection against external API rate limits

5. API Endpoints

5.1. Base URL

`https://tle-codeplus.onrender.com/api`

5.2. Student Management Endpoints

Method	Endpoint	Description
GET	`/students`	Retrieve all student records
GET	`/students/:id`	Fetch specific student details
POST	`/students`	Create new student profile
PUT	`/students/:id`	Update student information
DELETE	`/students/:id`	Remove student record
GET	`/students/export`	Download student data as CSV

TABLE III: Student Management API Endpoints

5.3. Data Synchronization Endpoints

Method	Endpoint	Description
GET	`/students/:studentId/contests`	Get contest participation history
GET	`/students/:studentId/problems`	Fetch problem-solving statistics
POST	`/students/:id/refresh`	Trigger manual data sync

POST	/students/:id/send-reminder	Send reminder notifications

TABLE IV: Data Synchronization API Endpoints

5.4. Analytics Endpoints

Method	Endpoint	Description
GET	/students/:id/heatmap	Generate activity heatmap data

TABLE V
ANALYTICS API ENDPOINTS

6. Database Models

6.1. Student Model

Field	Type	Description
name	String	Student full name
email	String	Email address
phoneNumber	String	Contact number
codeforcesHandle	String	Codeforces username
currentRating	Number	Current Codeforces rating
maxRating	Number	Maximum rating achieved
enrollmentDate	Date	Registration date
isActive	Boolean	Activity status
lastUpdated	Date	Last profile update
lastSubmissionDate	Date	Last problem submission
lastDataSync	Date	Last synchronization with Codeforces

TABLE VI: Student Model Structure

6.2. Contest Model

Field	Type	Description
studentId	ObjectId	Reference to student
contestId	String	Codeforces contest ID
contestName	String	Contest title
contestDate	Date	Contest date
oldRating	Number	Rating before contest
newRating	Number	Rating after contest
rank	Number	Contest rank
problemsSolved	Number	Problems solved in contest
totalProblems	Number	Total problems in contest
ratingChange	Number	Rating change (+/-)
contestType	String	Type of contest

TABLE VII: Contest Model Structure

6.3. Problem Model

Field	Type	Description
studentId	ObjectId	Reference to student
problemId	String	Unique problem identifier
problemName	String	Problem title
contestId	String	Associated contest
problemIndex	String	Problem index in contest
rating	Number	Problem difficulty rating
tags	Array[String]	Problem categories/topics
solvedDate	Date	Solution date

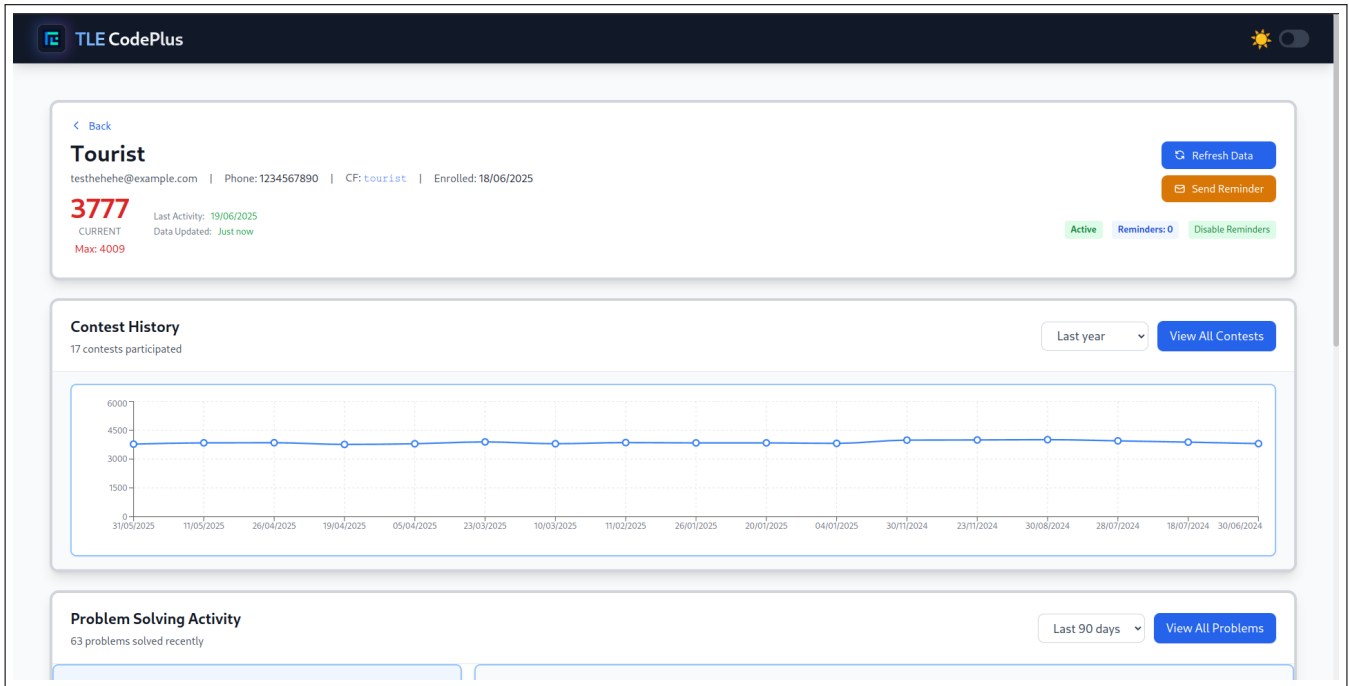|		
submissionId	String	Submission identifier
verdict	String	Submission result
programmingLanguage	String	Language used
timeConsumed	Number	Execution time
memoryConsumed	Number	Memory usage
points	Number	Points scored

TABLE VIII: Problem Model Structure

Fig. 1. Main Page with Student Table View

Fig. 2. Student Profile Overview and Contest History
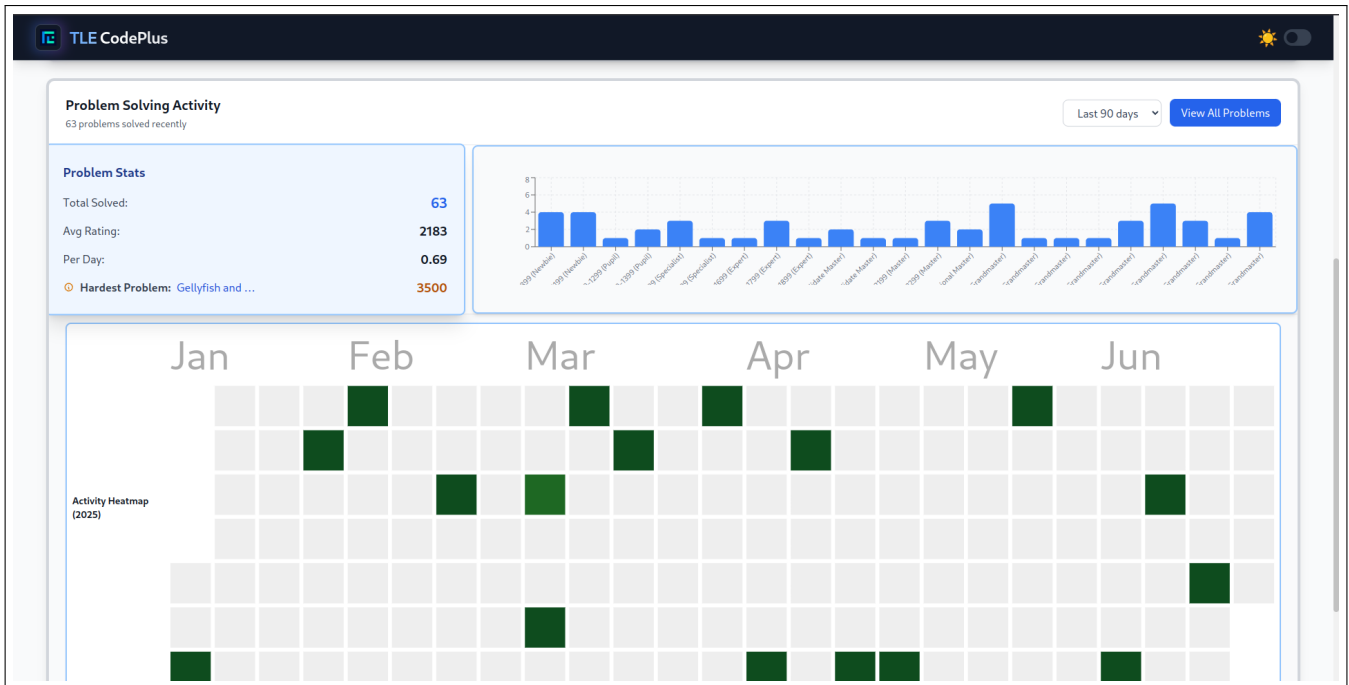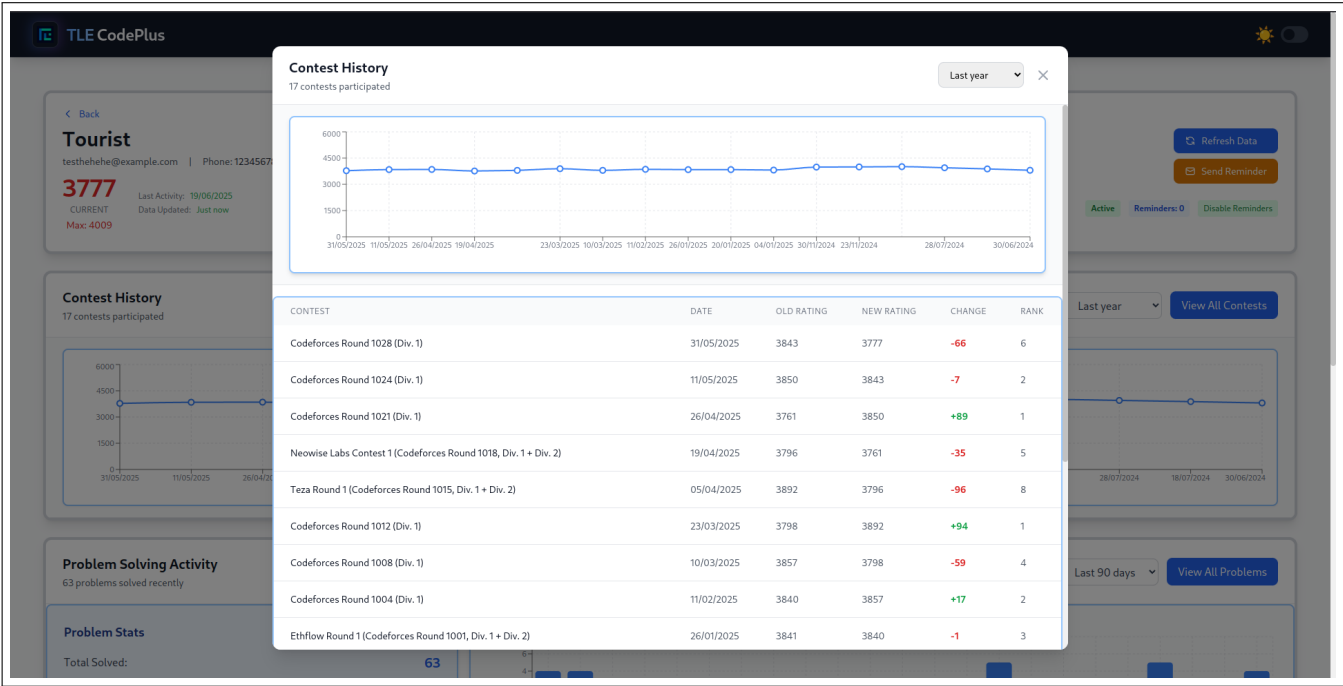

Fig. 3. Problem Solving History and Submission Heatmap

Fig. 4. Contest History List and Performance Statistics
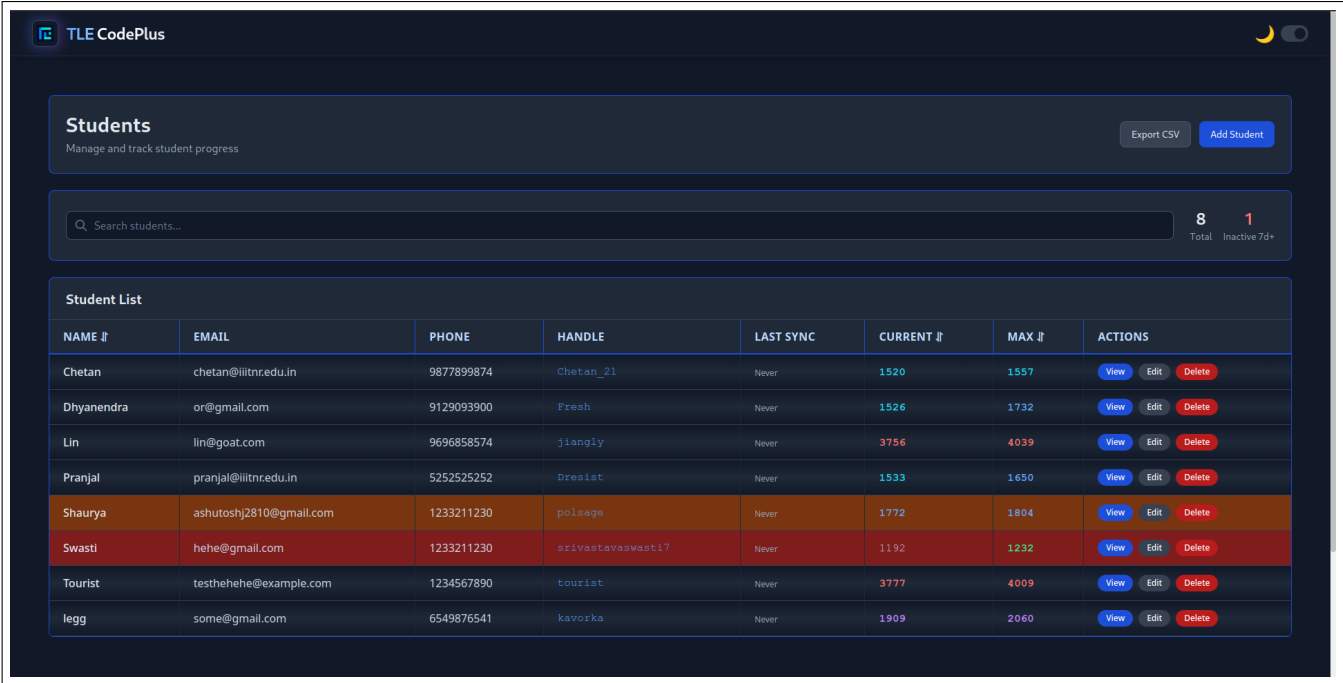
Fig. 5. Dark Mode UI Preview of the Student Dashboard

Fig. 6. Email Reminder