CBCentra School Management System

Technical Documentation

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1. System Overview

CBCentra is an enterprise-grade desktop school management system built for Windows environments with MySQL database backend. The system supports multi-user concurrent access across multiple computers on a network.

Key Technical Features

- **Platform**: Windows Desktop Application
- **Database**: MySQL 5.7+
- **Architecture**: Client-Server
- **Multi-User**: Simultaneous access support
- **Security**: Role-based access control (RBAC)
- **Audit**: Comprehensive logging and activity tracking

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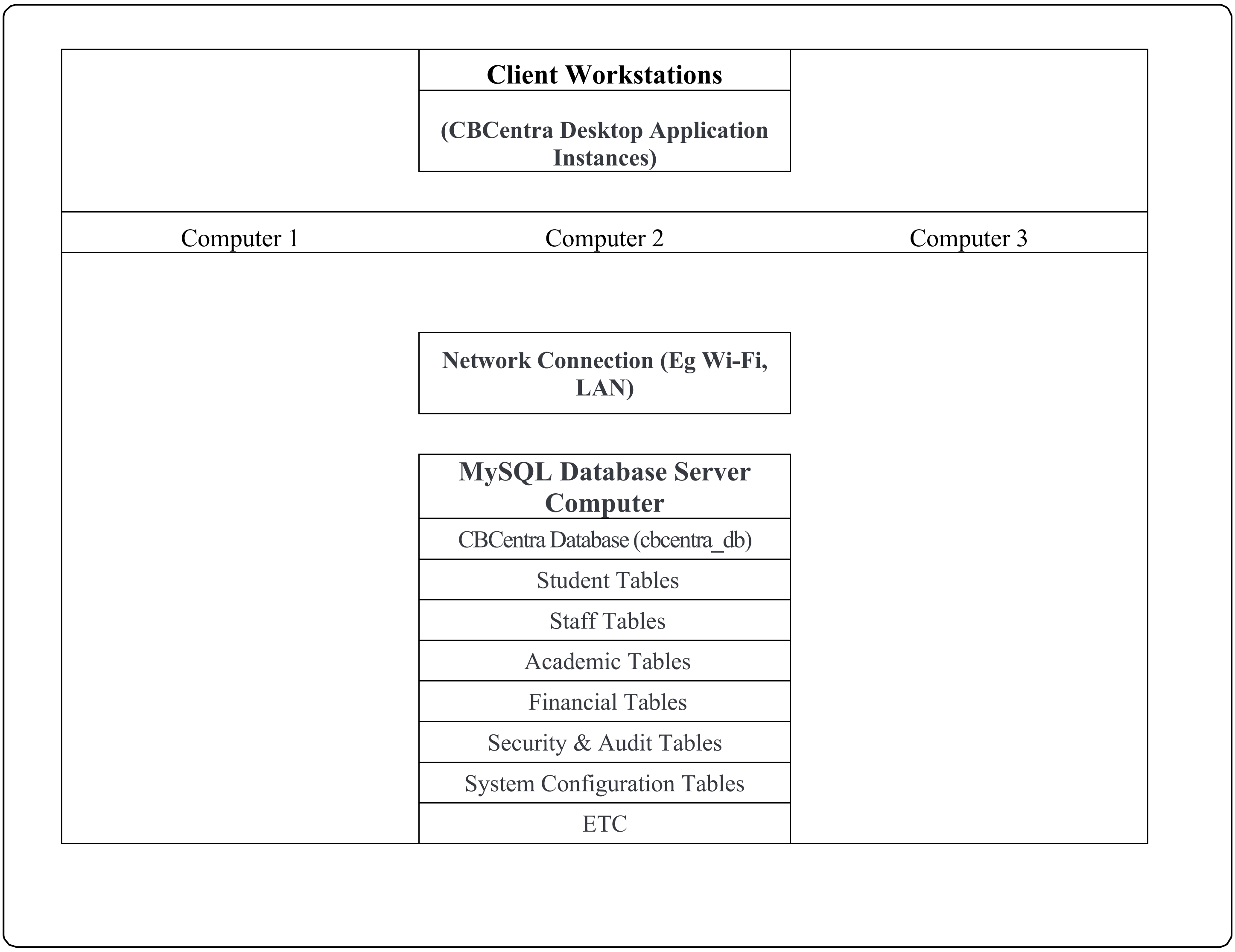
2. System Architecture

Architecture Overview



Client Workstations

(CBCentra Desktop Application Instances)

Computer 1 | Computer 2 | Computer 3

Network Connection (Eg Wi-Fi, LAN)

MySQL Database Server Computer

CBCentra Database (cbcentra_db)

Student Tables

Staff Tables

Academic Tables

Financial Tables

Security & Audit Tables

System Configuration Tables

ETC

Database Connection Model

- **Connection Type**: TCP/IP
- **Default Port**: 3306
- **Connection Pooling**: Managed by application
- **Transaction Support**: ACID compliant
- **Data Synchronization**: Real-time across all clients

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3. System Requirements

Server Requirements (MySQL Database Host)

- **Operating System**: Windows Server 2016+ or Windows 10/11
- **Processor**: Intel Core i5 or equivalent (2.0 GHz+)
- **RAM**: 8GB minimum, 16GB recommended

- **Storage**: 50GB minimum free space (for database growth)
- **MySQL Version**: 8.0 or higher
- **Network**: Gigabit Ethernet recommended

Client Workstation Requirements

- **Operating System**: Windows 10/11 (64-bit)
- **Processor**: Intel Core i3 or equivalent (1.6 GHz+)
- **RAM**: 4GB minimum, 8GB recommended
- **Storage**: 500MB free space for application
- **Display**: 1366x768 minimum resolution (1920x1080 recommended)
- **Network**: LAN connection to database server

Network Requirements

- **Bandwidth**: 100 Mbps minimum (Wi-Fi or Wired)
- **Connection Type**: Ethernet (recommended) or Wi-Fi
- **Latency**: <10ms within local network
- **Firewall**: Port 3306 open for MySQL connections
- **Static IP**: Recommended for database server

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4. Installation Guide

Phase 1: Database Server Setup

Step 1: Install MySQL Server

1. Download MySQL Installer from:
    - Official MySQL: https://dev.mysql.com/downloads/installer/
    - Direct Link (v8.0.41.0): https://dev.mysql.com/get/Downloads/MySQLInstaller/mysql-installer-community-8.0.41.0.msi
    - Also available on CBCentra Website: https://benewoku.github.io/CBCentra-Website/
2. Run the installer
3. Select "Server Only" or "Developer Default"
4. Configure MySQL Server:
    - **Port**: 3306 (default)

    - **Root Password**: Set strong password (minimum 12 characters)
    - **Authentication**: Use Strong Password Encryption

5. Complete installation and start MySQL service

Step 2: Verify MySQL Installation

Open Command Prompt and test:

```bash
mysql -u root -p
```

Enter root password when prompted.

Step 3: Create CBCentra Database

```sql
CREATE DATABASE school_management CHARACTER SET utf8mb4 COLLATE utf8mb4_unicode_ci;
```

Step 4: Create Database User (Optional)

You can use the root user directly or create a dedicated user for better security:

Option A: Using Root User (Simpler)

```sql
-- Grant remote access to root user
GRANT ALL PRIVILEGES ON school_management.* TO 'root'@'%' IDENTIFIED BY 'your_root_password';
FLUSH PRIVILEGES;
```

Option B: Create Dedicated User (More Secure)

```sql
CREATE USER 'cbcentra_user'@'%' IDENTIFIED BY 'YourSecurePassword123!';
GRANT ALL PRIVILEGES ON school_management.* TO 'cbcentra_user'@'%';
FLUSH PRIVILEGES;
```

Note:

- Replace passwords with your actual strong passwords
- Use `'%'` to allow connections from any IP, or specify IP address like `'192.168.1.%'` for local network only

Step 5: Import Database Schema

1. Locate `CBCentra_Database.sql` file from the release package
2. Import using MySQL Workbench:
   - Open MySQL Workbench
   - Connect to MySQL server
   - Select `school_management` database
   - Go to **Server** → **Data Import**
   - Select **Import from Self-Contained File**
   - Browse and select `CBCentra_Database.sql`
   - Click **Start Import**

Alternative (Command Line):

```bash
mysql -u root -p school_management < CBCentra_Database.sql
```

Step 6: Verify Database Tables

```sql
USE school_management;
SHOW TABLES;
```

You should see all CBCentra tables listed.

Phase 2: Client Application Installation

Step 1: Install CBCentra Application

1. Download `CBCentra_Setup.exe` from GitHub releases
2. Run the installer with administrator privileges
3. Follow the installation wizard:
   - Accept license agreement
   - Choose installation directory (default: `C:\Program Files\CBCentra`)
   - Create desktop shortcut (recommended)
4. Click **Install**
5. Launch CBCentra after installation

Step 2: Initial Database Configuration

1. On first launch, you'll see the Database Configuration screen
2. Enter database connection details:
   - **Host/Server**:
     - `localhost` (if database is on same computer)
     - `192.168.1.100` (example IP of database server)
     - `server.domain.com` (domain name of database server)
   - **Port**: `3306`
   - **Database Name**: `school_management`
   - **Username**: `root` (or `cbcentra_user` if you created a dedicated user)
   - **Password**: [Your MySQL password]
3. Click **Test Connection**
4. If successful, click **Save Configuration**
5. Configuration is saved to `database_config.json`

Step 3: First Login

1. Default administrator credentials:
   - **Username**: `admin`
   - **Password**: `admin123`
2. **IMPORTANT**: Change the default password immediately after first login
3. Navigate to **Settings → Change Password**

Phase 3: Multi-Computer Deployment

Installing on Additional Workstations

1. Install CBCentra application on each workstation (repeat Phase 2, Step 1)
2. Configure database connection pointing to the same database server
3. All workstations must be on the same network as the database server
4. Each user logs in with their own credentials

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5. Database Configuration {#database-configuration}

Configuration File Location

Database configuration is stored in JSON format:

```
C:\Users\[Username]\AppData\Local\CBCentra\database_config.json
```

Configuration File Structure

```json
{
  "host": "localhost",
  "port": 3306,
  "database": "school_management",
  "username": "root",
  "password": "encrypted_password_here"
}
```

Note: The password is encrypted for security. Do not manually edit this file unless necessary. To update database settings, use the application's Database Configuration screen (Menu → Settings → Database).

Network Configuration for Remote Access

Configuring MySQL for Remote Connections

1. Edit MySQL configuration file (`my.ini` or `my.cnf`):

```ini
[mysqld]
bind-address = 0.0.0.0
port = 3306
max_connections = 100
```

2. Restart MySQL service:

```bash
net stop MySQL80
net start MySQL80
```

3. Configure Windows Firewall:

Option A - PowerShell (Administrator)

```bash
New-NetFirewallRule -DisplayName "MySQL Server" -Direction Inbound -Protocol TCP -LocalPort 3306 -Action Allow
```

Option B - GUI Method

1. Open **Windows Defender Firewall** → **Advanced Settings**
2. Click **Inbound Rules** → **New Rule**
3. Select **Port** → Click **Next**
4. Select **TCP** → Enter **3306** in Specific local ports → Click **Next**
5. Select **Allow the connection** → Click **Next**
6. Check all profiles (Domain, Private, Public) → Click **Next**
7. Name: **"MySQL Server"** → Click **Finish**

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6. Module Overview

Student Management Module

Database Tables:

- `students` - Core student information
- `student_admissions` - Admission records
- `student_attendance` - Daily attendance tracking
- `student_health_records` - Medical information
- `student_documents` - Associated documents

Key Features:

- Complete student lifecycle management
- Admission and registration
- Attendance tracking
- Academic performance monitoring
- Health records management
- Document storage

Staff Administration Module

Database Tables:

- `staff` - Staff personal information
- `staff_qualifications` - Educational credentials
- `staff_assignments` - Class and subject assignments
- `staff_attendance` - Staff attendance records

- `staff_payroll` - Salary and payment information

Key Features:

- Staff profile management
- Qualification tracking
- Assignment management
- Attendance monitoring
- Payroll processing

Academic Management Module

Database Tables:

- `subjects` - Subject catalog
- `classes` - Class/grade structure
- `timetables` - Schedule management
- `academic_years` - Year definitions
- `terms` - Term/semester management
- `curriculum` - CBC curriculum tracking

Key Features:

- Subject and class management
- Timetable scheduling
- Academic year/term setup
- Curriculum tracking
- Competency-based assessment

Assessment & Grading Module

Database Tables:

- `exams` - Examination definitions
- `exam_marks` - Student marks/grades
- `activities` - Projects and activities
- `competencies` - CBC competency assessment
- `report_cards` - Generated reports

Key Features:

- Exam management
- Mark entry and calculation
- CBC grading system
- Activity/project tracking
- Report card generation
- Performance analytics

Financial Management Module

Database Tables:

- `fee_structures` - Fee definitions
- `student_fees` - Fee assignments
- `payments` - Payment records
- `expenses` - Expenditure tracking
- `budgets` - Budget planning
- `suppliers` - Supplier management
- `payroll` - Staff salary processing

Key Features:

- Fee structure management
- Payment processing
- Expense tracking
- Budget management
- Payroll processing
- Financial reporting

Parent Management Module

Database Tables:

- `parents` - Parent information
- `student_parent_relationships` - Student-parent links
- `parent_communications` - Communication logs

Key Features:

- Parent database

- Student-parent relationships
- Communication tracking
- Parent portal integration

Library Management Module

Database Tables:

- `library_books` - Book catalog
- `library_categories` - Book categories
- `library_borrowing` - Loan records
- `library_inventory` - Stock management

Key Features:

- Book catalog management
- Borrowing system
- Inventory tracking
- Library reports

Health Management Module

Database Tables:

- `health_visits` - Sick bay visits
- `medical_conditions` - Student conditions
- `medical_inventory` - Medical supplies
- `medical_records` - Health history

Key Features:

- Sick bay visit tracking
- Medical condition database
- Health records management
- Medical inventory

Communication Module

Database Tables:

- `emails` - Email messages
- `notifications` - System notifications

- `sms_logs` - SMS records
- `email_templates` - Message templates

Key Features:

- Email system
- Bulk messaging
- Notification center
- Spam detection
- Template management

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7. Security & Access Control

User Authentication

- **Password Requirements**: Minimum 8 characters, complexity enforced
- **Session Management**: 30-minute idle timeout (configurable)
- **Login Attempts**: Maximum 3 failed attempts before account lockout
- **Password Expiry**: 90 days (configurable)

Role-Based Access Control (RBAC)

Predefined Roles

1. **Administrator**
   - Full system access
   - User management
   - System configuration
   - All module access
2. **Headteacher**
   - All academic modules
   - Student and staff management
   - Financial overview
   - Report generation
3. **Teacher**
   - Class management

   - Mark entry
   - Attendance marking
   - Student records (read-only)
4. **Secretary**
   - Student admissions
   - Communication
   - Document management
   - Basic reporting
5. **Accountant**
   - Financial management
   - Fee processing
   - Payroll
   - Financial reports

Database Tables for Security

- `users` - User accounts
- `roles` - Role definitions
- `permissions` - Permission catalog
- `role_permissions` - Role-permission mapping
- `user_permissions` - Individual user overrides
- `tab_access` - Tab visibility control

Permission Granularity

Permissions are defined at multiple levels:

- **Module Level**: Access to entire modules
- **Tab Level**: Visibility of specific tabs
- **Action Level**: Create, Read, Update, Delete (CRUD)
- **Record Level**: Own records vs. all records

Audit Trail System

Logged Activities

- User login/logout

- Failed login attempts
- Record creation/modification/deletion
- Permission changes
- Configuration changes
- Report generation
- Data exports

Audit Tables

- `audit_logs` - Comprehensive activity log
- `login_activity` - Login tracking
- `change_history` - Data modification tracking

Log Retention

- **Default**: 365 days
- **Configurable**: 90-730 days
- **Archival**: Automated archival after retention period

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8. Network Deployment

Single Server Deployment

```
School Network: 192.168.1.0/24

[Database Server]
IP: 192.168.1.10
Role: MySQL Server
OS: Windows Server 2019

[Workstation 1 - Admin Office]
IP: 192.168.1.101
User: Administrator

[Workstation 2 - Teachers Room]
IP: 192.168.1.102
User: Teachers

[Workstation 3 - Accounts]
```

IP: 192.168.1.103
User: Accountant

Network Configuration Checklist

□ Assign static IP to database server

□ Configure firewall rules (port 3306)

□ Test network connectivity between workstations and server

□ Configure MySQL for remote access

□ Install CBCentra on all workstations

□ Configure database connection on each workstation

□ Create user accounts with appropriate roles

□ Test concurrent access

Performance Optimization for Network Deployment

1. **Database Server**:
   - Enable query caching
   - Optimize MySQL buffer pool size
   - Regular index optimization
2. **Network**:
   - Use wired connections (avoid Wi-Fi for critical workstations)
   - Implement QoS for database traffic
   - Monitor network latency
3. **Client Workstations**:
   - Close unnecessary applications
   - Ensure adequate RAM
   - Regular disk cleanup

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9. Backup & Recovery

Automated Backup System

CBCentra includes a built-in backup system accessible through the application interface.

Accessing Backup Features

1. Open CBCentra application
2. Navigate to **Menu → Settings → Database Tab**

3. Select **Backup** section

Backup Options

- **Manual Backup**: Create instant backup with a single click
- **Scheduled Backup**: Configure automatic daily/weekly backups
- **Backup Location**: Choose where backup files are saved
- **Backup History**: View list of all previous backups

Backup File Naming Convention

When you create a backup, CBCentra automatically names the file to include the school name and timestamp:

Format: `school_management_[SchoolName]_[Date]_[Time].sql`

Example: `school_management_StMarysAcademy_20241116_143025.sql`

This naming convention allows you to:

- Identify which school the backup belongs to
- Track when the backup was created
- Maintain multiple backups without overwriting

Restoring from Backup

To restore a backup:

1. **Rename the backup file** to `school_management.sql` (remove the school name and timestamp)
2. Use MySQL to import:

```bash
mysql -u root -p school_management < school_management.sql
```

3. Or use MySQL Workbench:
   - Server → Data Import
   - Select the renamed file
   - Target schema: `school_management`
   - Start Import

Important: Always rename the backup file to `school_management.sql` before restoring to ensure proper database restoration.

Database Information

In the **Database Info** tab, you can view:

- Current database size
- Number of tables
- Connection status
- Last backup date
- Database version

Database Maintenance

The **Maintenance** tab provides:

- **Optimize Database**: Optimize all tables for better performance
- **Check Integrity**: Verify database structure and data integrity
- **Repair Tables**: Fix any corrupted tables
- **Clean Up**: Remove old logs and temporary data

Backup Best Practices

- **Frequency**: Enable daily automated backups
- **Retention**: Keep at least 30 days of backups
- **Location**: Store backups on separate drive or external storage
- **Naming**: Keep the automatic naming convention for easy identification
- **Testing**: Periodically verify backups can be restored (rename and test import)
- **Off-site**: Maintain weekly off-site backup copies for disaster recovery
- **Organization**: Create folders by month/year to organize backup files

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10. Troubleshooting

Common Issues and Solutions

Issue: Cannot Connect to Database

Symptoms: "Connection failed" error on application launch

Solutions:

1. **Verify MySQL Service is Running**:

```
bash
```

```
services.msc
```

Look for "MySQL80" service, ensure it's running

2. **Test MySQL Connection**:

```bash
mysql -u root -p -h [server_ip]
```

3. **Verify Database Exists**:

```sql
SHOW DATABASES LIKE 'school_management';
```

4. **Check database_config.json**:
    - Location: `C:\Users\[Username]\AppData\Local\CBCentra\database_config.json`
    - Verify host, port, database name, and credentials are correct

5. **Check Firewall**:
    - Ensure port 3306 is open
    - Temporarily disable firewall to test

6. **Verify User Privileges**:

```sql
SHOW GRANTS FOR 'cbcentra_user'@'%';
```

User should have ALL PRIVILEGES on school_management database

7. **Check MySQL Configuration**:
    - Ensure `bind-address = 0.0.0.0` in my.ini
    - Restart MySQL after configuration changes

Issue: Slow Performance

Symptoms: Application is sluggish, queries take long time

Solutions:

1. **Check Network Latency**:

```bash
```

```
ping [database_server_ip]
```

Latency should be <10ms

2. **Optimize Database**:
   - Navigate to **Menu → Settings → Database Tab → Maintenance**
   - Click **Optimize Database**
   - This will optimize all tables automatically
3. **Check Database Size**:
   - Navigate to **Menu → Settings → Database Tab → Database Info**
   - View current database size and growth trends
   - Large databases may require more RAM allocation
4. **Increase MySQL Memory** (Advanced): Edit my.ini:

```
ini

innodb_buffer_pool_size = 2G
```

Restart MySQL service after changes

Issue: Login Failed - Account Locked

Symptoms: "Account locked due to multiple failed attempts"

Solution (Administrator access required):

```
sql

UPDATE users SET failed_attempts = 0, locked = 0 WHERE username = 'username';
```

Issue: Missing Tables After Installation

Symptoms: Database errors about missing tables

Solution: Re-import the database schema:

```
bash

mysql -u root -p school_management < CBCentra_Database.sql
```

Verify tables exist:

```
sql
```

```
USE school_management;
SHOW TABLES;
```

Issue: Permission Denied Errors

Symptoms: User cannot access certain features

Solutions:

1. Check user role assignment in **Admin → User Management**
2. Verify tab access permissions in **Admin → Tab Access Control**
3. Check individual user overrides in **Admin → User Permissions**
4. Verify user has privileges on `school_management` database:

```
sql

  SHOW GRANTS FOR 'username'@'%';
```

Issue: Report Generation Fails

Symptoms: Reports not generating or showing errors

Solutions:

1. Check sufficient disk space for temp files
2. Verify printer/PDF driver installation
3. Check report templates are not corrupted
4. Review error logs:
   - Navigate to **Menu → Settings → Logging Tab**
   - View recent error messages and system logs
   - Export logs if needed for support

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11. System Maintenance

Daily Maintenance Tasks

- Monitor system logs via **Menu → Settings → Logging Tab**
- Check backup completion status in **Database Tab → Backup**
- Review login activity for suspicious attempts
- Monitor disk space on database server

Weekly Maintenance Tasks

- Review audit logs in **Menu → Settings → Logging Tab**
- Verify backup files are being created successfully
- Check database size and growth in **Database Info** tab
- Update user accounts as needed

Monthly Maintenance Tasks

- Database optimization via **Database Tab → Maintenance → Optimize Database**
- Review and archive old logs (if needed)
- Verify backup restoration capability
- Review system performance metrics
- Update user passwords expiring soon
- Review inactive user accounts

Quarterly Maintenance Tasks

- Full system backup verification
- Security audit review
- User access review
- Performance tuning
- Storage capacity planning
- Software updates (if available)

Built-in Maintenance Tools

CBCentra provides integrated maintenance tools accessible via **Menu → Settings**:

Database Tab

- **Backup Section**: Create and manage backups
- **Database Info**: View database statistics and health
- **Maintenance**:
  - Optimize all tables
  - Check table integrity
  - Repair corrupted tables
  - Clean up temporary data

Logging Tab

- View system logs
- Filter by date, type, or severity
- Export logs for troubleshooting
- Clear old log entries

Performance Monitoring

Key Metrics to Monitor:

1. **Database Response Time**: Check in Database Info tab - should be <100ms
2. **Disk Space**: Monitor in Database Info tab - maintain 20% free space minimum
3. **Active Users**: View in system dashboard
4. **Error Frequency**: Check Logging tab for recurring errors

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Support & Contact Information

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Appendix A: Database Schema Reference

Core Tables Summary

Table Name	Purpose	Key Fields
`users`	User accounts	id, username, password_hash, role_id
`roles`	System roles	id, role_name, description
`students`	Student records	id, admission_no, name, class_id
`staff`	Staff records	id, staff_no, name, department
`classes`	Class structure	id, class_name, level, capacity
`subjects`	Subject catalog	id, subject_name, subject_code

Table Name	Purpose	Key Fields
exams	Examination records	id, exam_name, term_id, year_id
payments	Fee payments	id, student_id, amount, date
audit_logs	Activity tracking	id, user_id, action, timestamp

Appendix B: Error Codes

Code	Description	Resolution
DB001	Connection failed	Check MySQL service and credentials
DB002	Database not found	Create database or import schema
AUTH001	Invalid credentials	Verify username/password
AUTH002	Account locked	Reset failed attempts counter
PERM001	Insufficient permissions	Check role and permissions
NET001	Network timeout	Check network connectivity
FILE001	File not found	Verify file path and permissions

Document Revision History

Version	Date	Author	Changes
1.0.0	November 2025	Ben Ewoku	Initial comprehensive documentation

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End of Documentation