**PureDrop - Water Management System**

**Full-Stack Web Application | Node.js, React, MySQL**

**Project Overview:**

Developed a comprehensive water management system that enables real-time monitoring, automated billing, and analytics for water utilities. The system serves both administrators and end-users with role-based access control and enterprise-level features.

**Key Technologies & Architecture:**

* **Frontend:** React.js with Tailwind CSS, Chart.js for data visualization
* **Backend:** Node.js/Express.js with RESTful API architecture
* **Database:** MySQL with comprehensive schema design
* **Authentication:** JWT-based secure authentication system
* **Security:** Helmet.js, CORS, rate limiting, input validation

**Core Features Implemented:**

**🔧 Database Management:**

* **18 Database Triggers** for automatic business logic execution
* **10 Database Views** for complex data aggregation and reporting
* **9 Stored Procedures** for secure data operations
* **Comprehensive Audit Logging** for all CRUD operations
* **Referential Integrity** with foreign key constraints

**💰 Automated Billing System:**

* **Automatic Bill Generation** based on meter readings
* **Dynamic Rate Calculation** ($15.50 per unit)
* **Payment Processing** with multiple payment methods
* **Overdue Detection** and automatic alert generation
* **Outstanding Balance Tracking** with detailed analytics

**📊 Analytics & Reporting:**

* **Real-time Dashboard** with consumption analytics
* **User Summary Reports** with connection statistics
* **System-wide Analytics** for administrators
* **High Consumption Alerts** with threshold monitoring
* **Payment History Tracking** with detailed reports

**�� Smart Alert System:**

* **High Consumption Detection** (>100 units threshold)
* **Payment Overdue Alerts** for unpaid bills
* **Automatic Alert Resolution** when payments are made
* **User-specific Alert Management** with severity levels
* **Real-time Notification System**

**👥 User Management:**

* **Role-based Access Control** (Admin/User)
* **Secure Authentication** with JWT tokens
* **User Profile Management** with connection details
* **Connection Status Tracking** (Active/Inactive/Suspended)
* **Complaint Management System**

**🏢 Administrative Features:**

* **Employee Management** with role assignments
* **Water Source Management** (Reservoirs, Wells, Rivers)
* **Connection Management** with meter tracking
* **Complaint Resolution** with status tracking
* **Audit Trail Monitoring** for compliance

**Technical Achievements:**

**Database Design:**

* **8 Core Tables** with proper normalization
* **Complex Relationships** across users, connections, readings, and bills
* **Performance Optimization** with indexed queries
* **Data Integrity** with constraints and validation

**API Development:**

* **RESTful API Design** with 15+ endpoints
* **Comprehensive Error Handling** with detailed responses
* **Rate Limiting** (100 requests per 15 minutes)
* **Input Validation** and sanitization
* **Health Check Endpoints** for monitoring

**Frontend Development:**

* **Responsive Design** with mobile-first approach
* **Modern UI/UX** with Tailwind CSS
* **Interactive Charts** for data visualization
* **Protected Routes** with authentication
* **Real-time Data Updates** with API integration

**Business Logic Automation:**

* **Automatic Complaint Escalation** for unresolved issues (>7 days)
* **User Suspension** for multiple unpaid bills
* **Automatic Bill Generation** on new meter readings
* **Alert Management** based on consumption patterns
* **Audit Logging** for all system activities

**Security & Performance:**

* **SQL Injection Protection** with parameterized queries
* **Cross-Origin Resource Sharing** (CORS) configuration
* **Input Validation** and sanitization
* **Connection Pooling** for database optimization
* **Error Handling** with graceful degradation

**Project Impact:**

* **Enterprise-level Application** suitable for water utilities
* **Scalable Architecture** supporting multiple users
* **Comprehensive Documentation** with setup guides
* **Production-ready** with proper error handling
* **Modular Design** for easy maintenance and extension

This project demonstrates advanced full-stack development skills, database design expertise, and the ability to implement complex business logic in a modern web application.