UNIVERSITY OF BARISHAL

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

WEB ENGINEERING PROJECT REPORT

AgroHelp – Smart Farming Platform

A Report Submitted in Partial Fulfillment of the Requirements for the Course
CSE-2210: Web Engineering Lab

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1 Introduction

AgroHelp is a smart, user-friendly digital agricultural platform designed to empower farmers with the right tools, knowledge, and support. It aims to improve agricultural productivity by offering intelligent crop suggestions, step-by-step farming practices, automated cost analysis, and market insights. By making crucial farming information accessible in one place, AgroHelp helps farmers make better decisions with confidence.

Agriculture plays a vital role in Bangladesh's economy, employing the majority of the population and ensuring food security. However, farmers face challenges such as climate change, pest attacks, and fluctuating market prices. Many still rely on traditional practices, limiting productivity and profitability. AgroHelp addresses these issues by providing crop recommendations, cost estimation, market insights, and step-by-step farming guidelines. It also includes AI-powered leaf insect and disease detection to help farmers protect their crops.

The platform emphasizes accessibility and inclusiveness, allowing farmers with limited technical knowledge to use it easily. It connects farmers with experts, buyers, and financial institutions while sharing success stories to encourage modern farming practices. By combining technology with agriculture, AgroHelp promotes sustainable, data-driven farming that enhances productivity and supports rural development in Bangladesh.

2 Scope of the Project

2.1 Purpose and Goals

- Provide a smart and user-friendly platform to support farmers with accurate agricultural information.
- Suggest suitable crops based on soil conditions, weather patterns, and regional climate.
- Offer step-by-step farming guidelines to simplify planting, irrigation, fertilization, pest management, and harvesting.
- Help farmers estimate production costs and compare them with real-time market prices.
- Enable direct communication with agronomists, buyers, wholesalers, and rural banks.

- Share success stories of agri-entrepreneurs to inspire and encourage innovative farming.

2.2 In Scope

- Farmer registration, login, and profile management.
- Crop and soil advisory system using environmental and regional data.
- Step-by-step farming guidelines covering all major stages of cultivation.
- Automated cost estimation and real-time market price comparison tools.
- Communication features for farmers to connect with experts, buyers, wholesalers, and financial institutions.
- Success stories and tips from agricultural entrepreneurs.
- Integration of external APIs such as Gemini AI.
- Secure data storage and management using MongoDB.
- Responsive web interface accessible on desktop, tablet, and mobile devices.

3 Relevance

Agriculture is the backbone of Bangladesh's economy, providing food, employment, and income for millions of people. Yet farmers continue to face persistent challenges such as reliance on traditional methods, lack of timely access to accurate agricultural advice, unpredictable weather due to climate change, pest and disease outbreaks, and limited awareness of real-time market prices. These issues often result in reduced productivity, higher costs, and lower profitability, leaving farmers vulnerable and less competitive in modern agricultural markets.

AgroHelp directly addresses these challenges by combining technology with agriculture in a way that is practical, accessible, and farmer-friendly. The platform offers personalized crop recommendations, step-by-step farming guidelines, automated cost estimation, and real-time market insights to support data-driven decision-making. It also enables farmers to connect with agronomists, buyers, wholesalers, and financial institutions, ensuring better access to knowledge, trade, and financial resources. By including multi-language

support and success stories of agri-entrepreneurs, AgroHelp ensures inclusivity and encourages innovation among farmers across diverse regions.

The relevance of this project lies not only in solving immediate farming challenges but also in contributing to broader national goals. It aligns with the vision of Digital Bangladesh and supports sustainable agriculture by empowering farmers to adopt modern practices, reduce costs, and improve yields. Ultimately, AgroHelp enhances food security, promotes rural development, and strengthens the agricultural economy of Bangladesh.

4 Technology Stack

4.1 Frontend

- **HTML5:** Semantic markup structure for building the overall user interface.
- **JavaScript (ES6+):** Modern syntax, asynchronous programming, and component logic.
- **React 19:** User interface development using functional components and hooks.
- **React Router DOM (v6):** Client-side routing with nested and protected routes.
- **Tailwind CSS 4:** Utility-first CSS framework for responsive and consistent design.
- **Cloudinary:** Secure and efficient image hosting for media and profile images.
- **Fetch API:** Native Fetch API with custom wrapper for REST API communication.

4.2 Backend

- **Node.js:** Server-side JavaScript runtime environment.
- **Express.js:** Lightweight framework for building RESTful APIs.
- **CORS:** Enables secure cross-origin communication.
- **express-rate-limit:** Protects APIs from excessive requests and abuse.
- **Gemini AI API:** Integration of `@google/generative-ai` for intelligent chat features.

4.3 Database and Authentication

- **MongoDB Atlas:** Flexible, document-based cloud database.
- **Mongoose:** Object Data Modeling (ODM) for schema definition and validation.
- **JWT:** Stateless authentication using signed JSON Web Tokens.
- **bcrypt:** Secure password hashing mechanism.
- **Bearer Token Flow:** Token-based session handling after login.

5 System Architecture

Our platform follows a simple layered architecture for performance, reliability, and scalability. Users interact with a responsive React-based frontend through their web browsers to access advisories, market prices, inputs, questions, and success stories.

The frontend communicates with a centralized Node.js and Express backend via secure HTTPS REST APIs. The backend handles business logic, JWT-based authentication, password verification using bcrypt, and all CRUD operations. Data is stored securely in MongoDB Atlas, ensuring flexible and scalable storage. This clear separation of layers makes the system easy to maintain and scale.

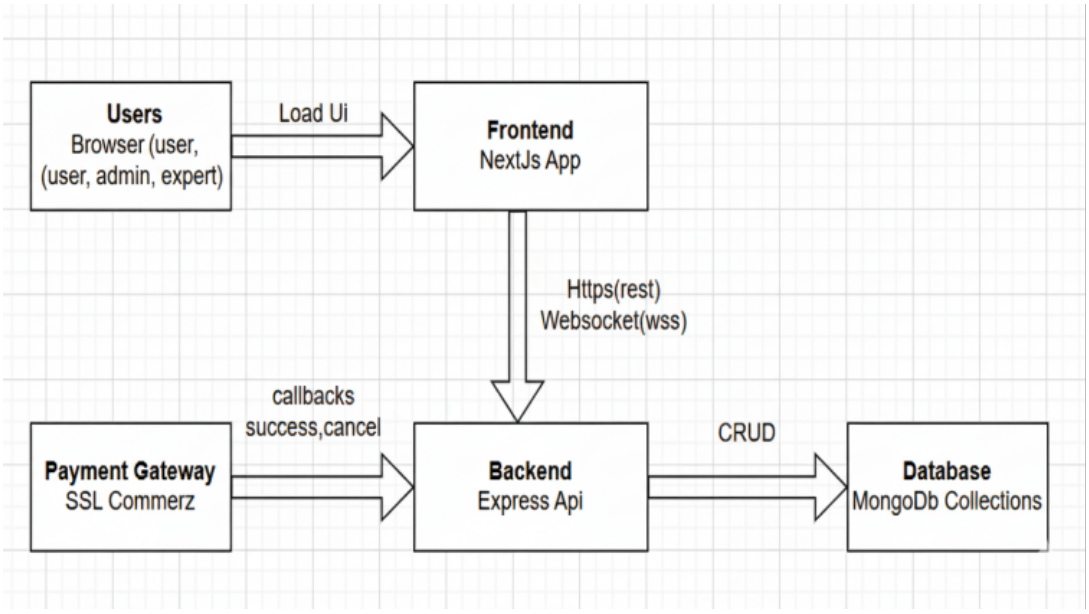

Figure 1: System Architecture of AgroHelp Platform

6 Database Design

This section presents the database design of the AgroHelp platform, based on the actual MongoDB and Mongoose models used in the system. The design explains the core entities, their attributes, relationships, and indexing strategies to ensure data integrity, performance, and scalability.

6.1 Collections and Key Fields

6.1.1 Users Collection

- **Core Fields:** name, email (unique), password, role (buyer — seller — admin), isActive
- **Profile Fields:** avatarUrl, phone, about, city, country
- **UX Fields:** wishlist (references to listings or products)
- **Security Fields:** passwordChangedAt, sellerApprovedAt
- **System Fields:** createdAt, updatedAt
- **Indexes:** unique index on email; compound index on {role, isActive}; index on createdAt

6.1.2 Advisories Collection

- **Core Fields:** title, message, type (disease — weather — tip)
- **Targeting Fields:** crops (string array), locations (region or district), validFrom, validTo
- **Relational Fields:** createdBy (User reference), verifiedBy (User reference, optional)
- **UX Fields:** attachments (URL array), tags (string array)
- **System Fields:** createdAt, updatedAt
- **Indexes:** compound index on {type, status, validFrom}; text index on title and message; optional index on crops and locations

6.1.3 Inputs Collection

- **Core Fields:** name, inputType (seed — fertilizer — pesticide — equipment), brand, note
- **Commerce Fields:** price, currency, unit (kg — L — piece — bag)
- **Seller & Location Fields:** sellerId (User reference), marketName, district, upazila, geo (Point)
- **UX Fields:** images (URL array), specs (key-value map), tags (string array), ratingAvg, ratingCount
- **System Fields:** createdAt, updatedAt
- **Indexes:** indexes on inputType and brand; price index; geospatial index on geo; text index on name and note

6.1.4 Markets Collection

- **Core Fields:** commodity, price, unit, date
- **Location Fields:** marketName, district, upazila, geo (Point)
- **Provenance Fields:** source (manual — scrape — api), reportedBy (User reference)
- **UX Fields:** notes, tags (string array)
- **System Fields:** createdAt, updatedAt
- **Indexes:** compound index on {commodity, date}; index on {district, upazila, date}; geospatial index on geo

6.1.5 Questions Collection

- **Core Fields:** title, body, status (open — answered — closed)
- **Classification Fields:** crops (string array), diseases (string array), tags (string array)
- **Engagement Fields:** views, upvotes, downvotes

- **Relational Fields:** askedBy (User reference), acceptedAnswerId (Answer reference, optional)
- **Embedded Fields (Optional):** answers array containing body, author (User reference), createdAt, isAccepted
- **System Fields:** createdAt, updatedAt
- **Indexes:** text index on title and body; indexes on status, askedBy, tags, and createdAt

6.1.6 Stories Collection

- **Core Fields:** title, content, status (draft — published — archived)
- **Author & Context Fields:** author (User reference), category, tags (string array)
- **Media & UX Fields:** coverImage, images (URL array), likes, commentsCount
- **Publishing Fields:** publishedAt
- **System Fields:** createdAt, updatedAt
- **Indexes:** text index on title and content; indexes on status, publishedAt, author, and tags

7 Application Workflow

The application workflow illustrates the role-based interaction of administrators, users, and experts within the system. It ensures controlled management, efficient user engagement, and expert-driven support through clearly defined dashboards and functionalities.

7.1 Admin Dashboard Workflow

Figure 1 illustrates the workflow of the Admin Dashboard. It shows how administrators manage users, posts, user roles, and advisory or marketplace content to ensure smooth system administration.

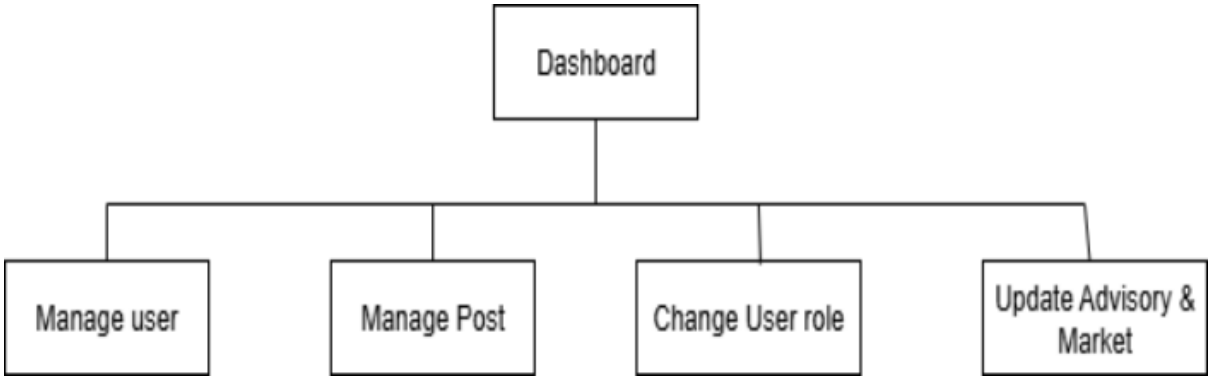

Figure 1: Admin Dashboard Workflow Diagram

7.2 User Dashboard Workflow

Figure 2 represents the User Dashboard workflow after successful login. It highlights user interactions such as cost calculation, expert consultation, AI assistant usage, content posting, and marketplace viewing.

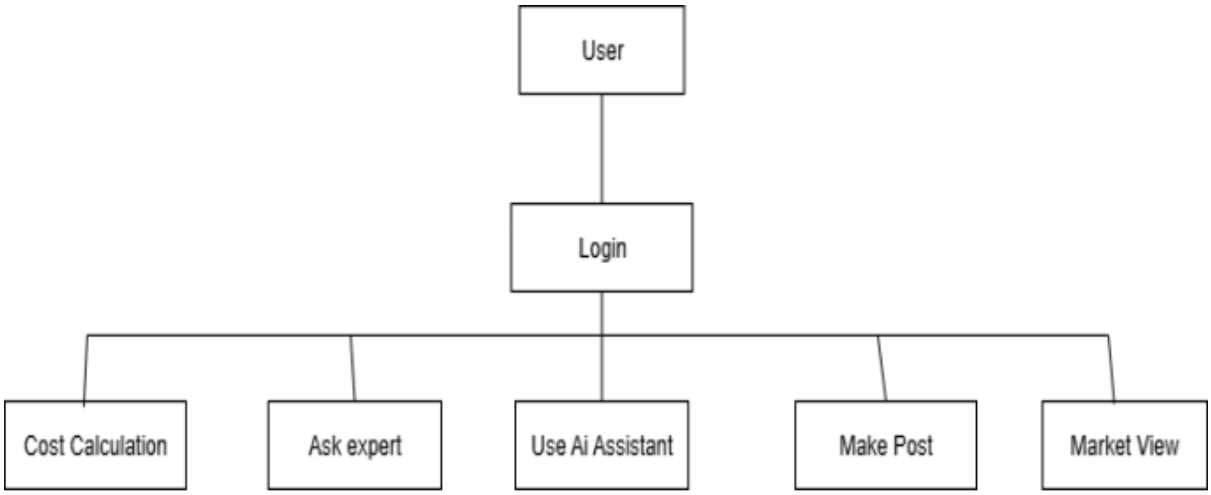

Figure 2: User Dashboard Workflow Diagram

7.3 Expert Dashboard Workflow

Figure 3 depicts the Expert Dashboard workflow. It demonstrates how experts log into the system and respond to user questions through a structured question-answer process.

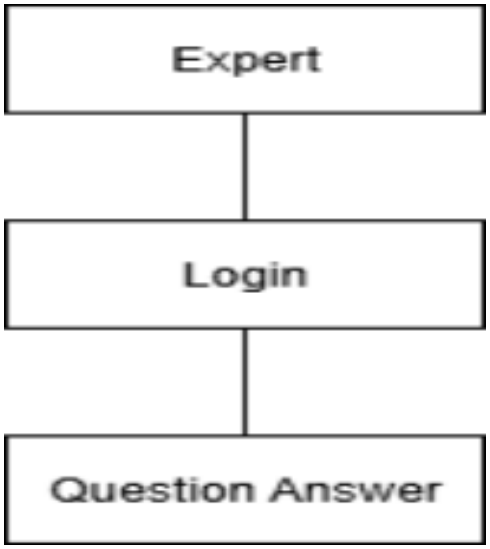

Figure 3: Expert Dashboard Workflow Diagram

8 Security and Privacy

AgroHelp protects farmer accounts, crop data, advisories, and market insights through clearly defined security and privacy rules. The primary goal is to ensure that only authorized users can access the system, recommendations are delivered securely, and sensitive information remains protected.

8.1 Security

- **Passwords:** Passwords are never stored in plain text; they are securely hashed using bcrypt before being saved.
- **Login Tokens:** Authentication is managed using JWT over HTTPS with short expiry times; password changes immediately invalidate existing tokens.
- **Role-Based Access Control:** User, Expert, and Admin permissions are verified on every protected API request and socket event.
- **Input Validation:** All requests are validated and size-limited; user input is sanitized before storage or rendering to prevent injection and XSS attacks.
- **CORS and Security Headers:** Only approved frontend origins can access the API; strict security headers such as HSTS, CSP, no-iframe, and no-sniff are enabled in production.

- **Realtime Safety:** Socket connections verify JWTs and join only assigned user sessions; message rate and length are limited to prevent abuse.

8.2 Payments

- **IPN Verification:** Payments are marked successful only after receiving and validating the SSLCommerz IPN using `val_id`.
- **Duplicate Prevention:** Each transaction ID is processed only once using idempotent upsert logic, even if the payment gateway retries.
- **Server-Side Authority:** Success or cancel pages inform users, but the final payment decision is confirmed by the server through IPN validation.

8.3 Privacy

- **Minimal Data Collection:** Only essential user information such as name, email, and optional phone number is collected; no card data is stored.
- **User Control:** All users, experts, and administrators can update their profiles and may request data export or account deletion.
- **Data Usage:** Personal data is never sold and is used solely to operate the platform and deliver selected features.

9 Advantages

9.1 For Farmers / Users

- **Timely advisories and updates:** Instant crop, disease, and weather guidance to protect harvests.
- **Transparent market prices:** Real-time commodity rates for fair buying and selling decisions.
- **Easy access to inputs:** Browse seeds, fertilizers, and tools with clear details from trusted providers.
- **Profile and wishlist management:** Maintain personal profiles, track subscriptions, and save preferred items.

- **Community learning:** Ask questions, share experiences, and learn from farmers and experts.

9.2 For Admin

- **Moderation tools:** Efficient management of users, advisories, market data, and stories.
- **Role and access control:** Assign roles (farmer, expert, admin) and approve expert accounts.
- **Content management:** Publish, update, verify, or archive advisories and market information.
- **Audit and tracking:** Monitor user and system activities using createdAt and updatedAt logs.
- **Platform security:** Secure operations using JWT-based authentication and bcrypt password hashing.

9.3 For Experts

- **Answer farmer questions:** Provide clear and practical solutions to agriculture-related problems.
- **Track engagement:** Monitor answered questions and follow up when necessary.
- **Profile and credibility:** Maintain expert profiles with verified credentials and expertise areas.
- **Secure authentication:** Ensure reliable expert verification and approval mechanisms.

10 Conclusion

AgroHelp is a smart and user-friendly digital agricultural platform designed to empower farmers in Bangladesh by providing timely agricultural information, expert guidance, and access to market and financial resources. By integrating crop recommendations, step-by-step farming guidelines, cost estimation, market insights, and expert connectivity, the platform simplifies traditional farming practices and enhances productivity.

AgroHelp promotes sustainable and data-driven agriculture, enabling farmers to make informed decisions with confidence. With its accessible design and technology-driven approach, the platform contributes to improving farmers' livelihoods and supports the long-term growth of Bangladesh's agricultural sector.

11 Future Work

In the future, AgroHelp can be enhanced with more advanced features to further support farmers and modernize agricultural practices. Potential future improvements include:

1. Integration with IoT devices to enable real-time soil condition and weather monitoring.
2. Predictive analytics for crop yield estimation based on historical and real-time data.
3. AI-based pest and disease prediction systems for early risk detection and prevention.
4. Partnerships with government and agricultural organizations to provide subsidies, training programs, and policy updates.
5. Livestock management features to support animal health monitoring and production.
6. Post-harvest logistics support, including storage, transportation, and market delivery solutions.