2. Requirement Analysis

Functional Requirements

FR1: Data Input

- **FR1.1**: System shall accept 21 meteorological parameters as input
- **FR1.2**: System shall validate all input fields before processing
- **FR1.3**: System shall provide dropdown selections for categorical data (Location, Wind Direction, Rain Today)
- **FR1.4**: System shall accept numerical inputs with appropriate ranges and precision

FR2: Prediction Engine

- **FR2.1**: System shall load pre-trained machine learning model
- **FR2.2**: System shall preprocess input data (encoding, scaling)
- **FR2.3**: System shall generate rainfall prediction (Yes/No)
- **FR2.4**: System shall handle prediction errors gracefully

FR3: Result Display

- **FR3.1**: System shall display prediction results with appropriate visual design
- **FR3.2**: System shall show "Rain Expected" page for positive predictions
- **FR3.3**: System shall show "No Rain" page for negative predictions
- **FR3.4**: System shall provide "Check Again" functionality

FR4: User Interface

- **FR4.1**: System shall provide responsive web interface
- **FR4.2**: System shall organize input fields in a grid layout
- **FR4.3**: System shall display clear labels and placeholders
- **FR4.4**: System shall provide visual feedback on form submission

Non-Functional Requirements

NFR1: Performance

- **NFR1.1**: Prediction response time shall be < 3 seconds
- **NFR1.2**: System shall handle concurrent users efficiently
- **NFR1.3**: Page load time shall be < 2 seconds

NFR2: Usability

- **NFR2.1**: Interface shall be intuitive and easy to navigate
- **NFR2.2**: Error messages shall be clear and actionable
- **NFR2.3**: System shall work on modern web browsers (Chrome, Firefox, Edge, Safari)

NFR3: Reliability

- **NFR3.1**: System uptime shall be > 99%
- **NFR3.2**: System shall handle invalid inputs without crashing
- **NFR3.3**: Model artifacts shall be loaded successfully on startup

NFR4: Maintainability

- **NFR4.1**: Code shall follow Python PEP 8 standards
- **NFR4.2**: System shall have modular architecture
- **NFR4.3**: Documentation shall be comprehensive and up-to-date

NFR5: Security

- **NFR5.1**: System shall validate and sanitize all user inputs
- **NFR5.2**: System shall prevent SQL injection and XSS attacks
- **NFR5.3**: System shall handle errors without exposing sensitive information

Input Parameters Specification

Parameter	Type	Range/Values	Unit	Required
Location	Categorical	15 locations	-	Yes
MinTemp	Float	-10 to 50	°C	Yes
MaxTemp	Float	-10 to 50	°C	Yes
Rainfall	Float	0 to 500	mm	Yes
Evaporation	Float	0 to 100	mm	Yes
Sunshine	Float	0 to 14	hours	Yes

Parameter	Type	Range/Values	Unit	Required
WindGustDir	Categorical	16 directions	-	Yes
WindGustSpeed	Float	0 to 150	km/h	Yes
WindDir9am	Categorical	16 directions	-	Yes
WindDir3pm	Categorical	16 directions	-	Yes
WindSpeed9am	Float	0 to 150	km/h	Yes
WindSpeed3pm	Float	0 to 150	km/h	Yes
Humidity9am	Float	0 to 100	%	Yes
Humidity3pm	Float	0 to 100	%	Yes
Pressure9am	Float	900 to 1100	hPa	Yes
Pressure3pm	Float	900 to 1100	hPa	Yes
Cloud9am	Integer	0 to 8	oktas	Yes
Cloud3pm	Integer	0 to 8	oktas	Yes
Temp9am	Float	-10 to 50	°C	Yes
Temp3pm	Float	-10 to 50	°C	Yes
RainToday	Categorical	Yes/No	-	Yes

System Constraints

- Python 3.x environment required
- Minimum 2GB RAM for model loading
- Internet connection for external image resources
- Modern web browser with JavaScript enabled

Assumptions

- Users have basic understanding of meteorological parameters
- Pre-trained model files are available
- Dataset is representative of Indian weather patterns
- Users have access to required meteorological data