Department of Computer Science & Engineering
The University of Texas at Arlington

System Requirements Specification
CSE 4316: Senior Design I
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Forcast Tx
Severe Weather Prediction Model

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Revision History

Version	Date	Author(s)	Description
0.1	03.17.2025	MB, KP, KPh, KS, NS	document creation
1.0	07.17.2025	MB, KP, KPh, KS, NS	Updated for Closeout

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1 Product Concept

This section describes the purpose, use and intended user audience for the Severe Weather Prediction Model and the associated web application. The Prediction Model is a system that outputs data. The web Application is a system that displays the data. General users of the web application will be able to view the data in user friendly formats such as graphs, maps, and interactive displays. They will also be able to filter and select certain weather types or perils which they are interested in viewing predictions for. Advanced users will be able to view data inputs, chosen features, machine learning model descriptions, and supply or update data.

1.1 Purpose and Use

This system is designed to predict severe weather events in Texas by analyzing historical weather data and applying machine learning techniques. Its purpose is to forecast both the frequency and severity of events (such as wind, hail, and rain/flood hazards) over the next 5-10 years. In doing so, it provides critical insights for risk management and disaster mitigation, potentially reducing losses and saving lives.

1.2 Intended Audience

The primary users of this system are State Farm's risk management and claims teams, and, with State Farm's discretion, emergency response coordinators, and other stakeholders involved in disaster preparedness. The system may also serve meteorological researchers and policy makers who require accurate, data-driven forecasts of severe weather trends.

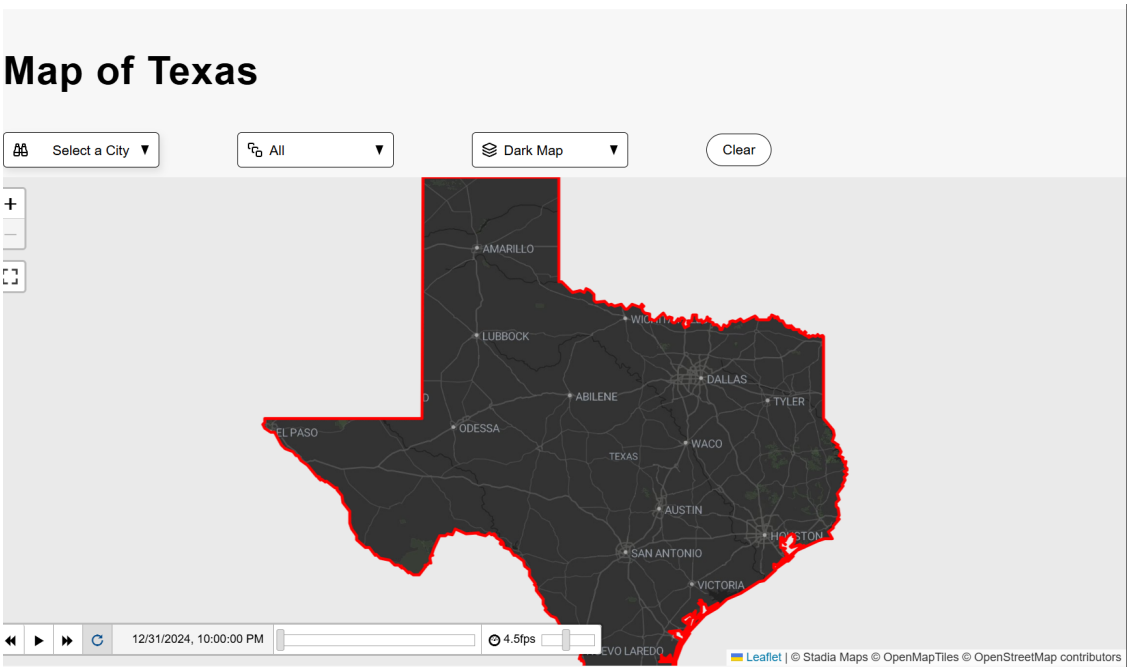

Figure 1: (Updated) Web Application

2 PRODUCT DESCRIPTION

This section provides the reader with an overview of the Severe Weather Prediction Model and its web application component. The primary operational aspects of the product, from the perspective of end users, maintainers and administrators, are defined here. The key features and functions found in the product, as well as critical user interactions and user interfaces are described in detail.

2.1 FEATURES & FUNCTIONS

Historical Weather Data (External Element)
What it is: A source of previously recorded weather observations (e.g., NOAA and ERA5 datasets).
Role in the system: Provides the core data for training and validating the predictive models.
Why it matters: Ensures the system has accurate, long-term historical data to identify trends and patterns.

Data Ingestion & ETL Layer (System Component)
What it is: A pipeline that retrieves, cleans, and transforms raw weather data into a standardized format.
Role in the system: Ensures data consistency and quality before storage and modeling.
Why it matters: Formats and standardizes data from different data sets and sources into a single digestible data set suitable for model training.

Data Storage (System Component)
What it is: A cloud-based hybrid storage solution consisting of Google Cloud Storage (GCP Buckets) for large-scale JSON and raw data storage, and PostgreSQL instances for structured data access and query efficiency.
Role in the system: Serves as the central repository for storing historical weather data and machine learning model outputs, supporting efficient querying, analysis, and visualization.
Why it matters: Combines the scalability of GCP Buckets for bulk data with the relational power of PostgreSQL for analytics, enabling robust long-term storage, flexible data access, and fast retrieval for user-facing components and model training workflows.

Predictive Modeling (System Component)
What it is: A suite of machine learning or statistical forecasting methods (e.g., ARIMA, SARIMA, Random Forest, LSTM).
Role in the system: Generates predictions on future frequency and severity of weather events.
Why it matters: Delivers the core functionality-actionable forecasts that inform risk management decisions.

Security and Monitoring (System Component)
What it is: Mechanisms for authentication, authorization, and continuous system health checks.
Role in the system: Protects data and system integrity, monitors performance, and alerts on anomalies.
Why it matters: Ensures data confidentiality and system reliability over time.

API and Integration (System Component)
What it is: RESTful endpoints for programmatic access to stored data and forecast results.
Role in the system: Provides a means of delivering stored data to our front-end user interface. Additionally, enables external services, partners, or applications to consume forecasts and historical data.
Why it matters: Extends the system's reach beyond the user interface, supporting broader usage scenarios.

User Interface (System Component)
What it is: An interactive dashboard for viewing historical data, filtering results, and visualizing forecasts.
Role in the system: Provides a consumable, user-friendly way for stakeholders to analyze weather trends.
Why it matters: Facilitates informed decision-making by presenting complex data in an accessible format.

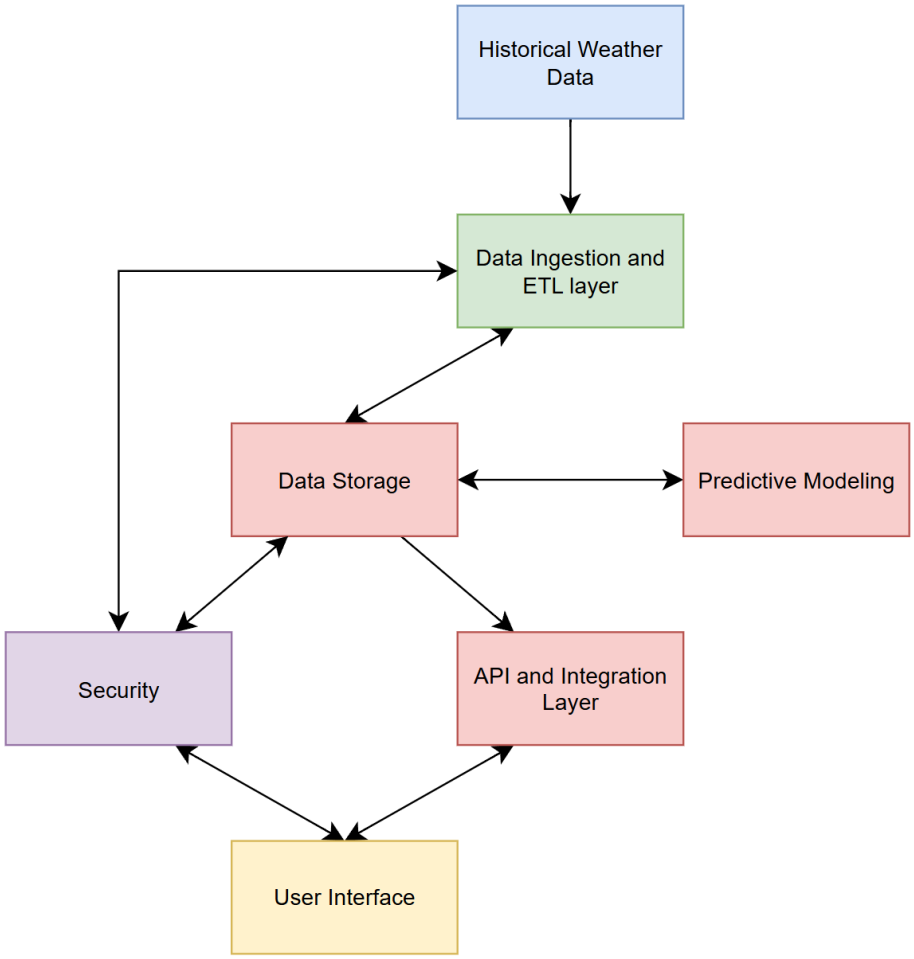

Figure 2: System Overview

2.2 External Inputs & Outputs

Table 1: External Inputs and Outputs

Name	Type	Description	Use
Historical Weather Data	Input	Weather data covering at least 10 years, used for model training and validation.	Source: ERA5 and NOAA data transformed to CSV
User Input Parameters	Input	Filters such as geographic region, peril type, and year provided by users via a web form or API call parameters.	Drives data querying and model customization
User Authentication Data	Input	Credentials or tokens submitted by users or services for authentication.	Ensures only authorized access to the system
Forecast Output	Output	Predicted frequency and severity of weather events over the next 5–10 years.	Delivered as CSV, JSON, or via API
Dashboard Data	Output	Aggregated data formatted for visualization on the web interface.	JSON objects or SQL query returns
API Responses	Output	Structured data (e.g., JSON) returned by the RESTful API to external applications.	Programmatic consumption of forecasts and historical data
Security & System Logs	Output	Records of system events (e.g., login attempts, API calls, ingestion errors).	Aids monitoring, auditing, and incident response
Monitoring Alerts	Output	Automated notifications for abnormal system behavior (e.g., resource spikes, repeated login failures).	Allows prompt administrative or support team action

2.3 Product Interfaces

User Interface: A web-based application accessible via standard browsers featuring interactive charts and data filters.

API Interface: RESTful APIs enabling secure, programmatic data retrieval for integration with external systems.

Data Management Interface: Pre-packaged Administrative tools such as Github actions or Cloud platform console controls for data ingestion, storage management, and periodic model re-training.

3 Customer Requirements

Forecast TX aim's to develop a data-driven model to forecast severe weather patterns in Texas, Focusing on a specific peril-wind, hail, or rain in high risk areas. By leveraging historical weather data from resources like the NOAA and implementing machine learning techniques the project will predict the frequency and severity of weather events for the next 5 to 10 years. The system will ensure efficient data storage, retrieval, analysis, and visualization, providing stakeholders with actionable insight to mitigate potential losses and improve disaster preparedness. Built on a cloud-based infrastructure with a scalable database and automated data pipelines, the project will offer a user-friendly interface for accessing and interpreting predictions.

3.1 Web-Based User Interface

3.1.1 Description

Forecast TX shall provide a web-based user interface with the following components:

- **Login Page** - Allows users to securely authenticate into the system.
- **Register page** - Enables new users to create accounts.
- **Authentication page** - Provides standard authentication using standard security solutions. (Google accounts, Microsoft accounts etc.)
- **Dashboard** - The main user interface for accessing predictive weather data consisting of:
  - **Overview page** - Displays a higher-level summary of predictions and key insights.
  - **Detailed page** - Provides in-depth analysis, Historical trends, and future predictions.
  - **Export page** - Accommodates export of desired front end user interface views for generating reports.

The web-interface will ensure intuitive navigation and a efficient user experience by incorporating interactive charts, data filtering options, and real-time updates where applicable.

3.1.2 Source

State Farm Requirements and UX/UI Design Principles

3.1.3 Constraints

A detailed description of realistic constraints relevant to this requirement. Economic, environmental, social, political, ethical, health & safety, maneuverability, and sustainability should be discussed as appropriate.

- Cross platform compatibility
- Responsive design
- Accessibility

3.1.4 Standards

- W3C Web Content Accessibility Guidelines (WCAG) 2.1 [19]

3.1.5 Priority

Critical

3.2 Users Roles and Permissions

3.2.1 Description

Forecast TX enforces user authentication by maintaining a manually curated list of approved users. Only individuals added by project owners are granted access to the system. All authenticated users share the same access level to the application's features. Project maintenance and administrative management are handled exclusively by developers through their associated cloud project accounts or GitHub accounts with access to the private repository.

3.2.2 Source

State Farm Requirements

3.2.3 Constraints

- Users Shall only have access relevant data based on their role.
- Admins shall have full control over data ingestion, system settings, and user management.

3.2.4 Standards

- NIST 800-63B (Digital Identity Guidelines) [13]
- OWASP Security Controls for User Management [16]

3.2.5 Priority

High

3.3 Cloud-Based Infrastructure

3.3.1 Description

Forecast TX shall be hosted on a cloud platform (AWS,Azure, or GCP) to ensure scalability, security, and high avaliability. The cloud service automated data ingestion, model training, and deployment with minimal downtime.

3.3.2 Source

State Farm Requirements

3.3.3 Constraints

- Cloud provider must comply with GDPR and CCPA for data protection.
- Infrastructure should allow for horizontal scaling to handle peak traffic loads.
- Cost efficiency must be considered to prevent excessive usage charges.

3.3.4 Standards

- ISO/IEC 27017 (Cloud Security) [6]
- NIST SP 800-145 (Cloud Computing) [11]

3.3.5 Priority

High

3.4 Data Accuracy and Reliability

3.4.1 Description

Forecast TX shall utilize high-quality, validated historical weather data from authoritative sources such as NOAA to ensure accuracy in predictions. The system shall implement data validation techniques to filter out anomalies and ensure consistency in data processing

3.4.2 Source

State Farm Requirements, NOAA Data Guidelines

3.4.3 Constraints

- The system must handle missing or incomplete data through interpolation techniques
- data sources must be cited and updated regularly
- Machine learning models must be trained on diverse datasets to avoid bias in predictions.

3.4.4 Standards

- NOAA Climate Data Records (CDR) Standards [10]
- ISO 8000-2:2020 (Data Quality) [8]

3.4.5 Priority

Critical

3.5 Data Export and Reporting

3.5.1 Description

Forecast TX shall provide export functionality to allow users to download forecast reports in CSV, and other formats for future analysis

3.5.2 Source

State Farm Requirements

3.5.3 Constraints

- Users must have filtering options(by date range, location, peril type) before exporting data
- data exports should include metadata (e.g., last update timestamp, data sources).

3.5.4 Standards

- W3C CSV on the Web (Data interoperability) [18]

3.5.5 Priority

High

3.6 ML Model Interoperability

3.6.1 Description

The machine learning models used for weather forecasting shall provide explainability features, enabling users to understand the reasoning behind predictions

3.6.2 Source

State Farm Requirements

3.6.3 Constraints

- The system shall provide confidence intervals for each prediction.
- Users shall have access to feature importance rankings for model outputs.
- model updated shall be version-controlled and documented

3.6.4 Standards

- IEEE P7003 (Algorithmic Bias) [3]

3.6.5 Priority

Moderate

3.7 Color Accessibility for Colorblind Users

3.7.1 Description

The Forecast TX Dashboard shall follow accessibility standards to ensure readability for colorblind users. Color schemes shall provide sufficent contrast and avoid color combinations that are difficult for users with protanopia, deuteranopia, or tritanopia to distinguish. The interface shall include alternative indicators, such as patterns, icons, or text lables, to supplement color-coded data

3.7.2 Source

State Farm Requirements, Web Accessibility Guidelines

3.7.3 Constraints

- The dashboard shall avoid reliance on color alone by including secondary indicators (e.g., shapes, textures, lables)

3.7.4 Standards

- WCAG 2.1 (Web Content Accessibility Guidelines) [19]

3.7.5 Priority

Moderate

4 Packaging Requirements

Packaging requirements define how the delivered product will be packaged for delivery to the end-user and how it will appear when completed. For this project, the predictive modeling system will be provided exclusively as a web-based application. Users will access the system through a web browser, eliminating the need for local installation. The packaging considerations include the cloud-based infrastructure, security measures, and user accessibility to ensure seamless deployment and interaction with the system.

4.1 Cloud-Based Web Application Deployment

4.1.1 Description

The predictive modeling system for severe weather events will be packaged for seamless deployment and user interaction. The software components, including the predictive model, database, and web interface, will be available as a cloud-based service. The system will include pre-configured virtual machine images for deployment on cloud platforms such as AWS, Google Cloud, Digital Ocean, or Microsoft Azure.
For end-users, a web-based application will be the primary access point, ensuring ease of use without requiring manual installation. API access will be available for programmatic data retrieval and integration with external systems.

4.1.2 Source

The packaging requirements are derived from best practices in software deployment, cloud-based system design, and user accessibility considerations. Input from stakeholders, industry standards, and project guidelines inform these specifications.

4.1.3 Constraints

- The system must be deployable on multiple cloud platforms.
- User authentication and security measures must be integrated into the deployment package.
- The system must support scalability to accommodate growing datasets and user access demands.

4.1.4 Standards

- **ISO/IEC 27001**: Information security management best practices.
- **IEEE 830-1998**: Software requirements specification guidelines.
- **NIST Special Publication 800-53**: Security and privacy controls for federal information systems.
- **Cloud Security Alliance (CSA) Guidelines**: Best practices for secure cloud deployment.
- **RESTful API Design Standards**: Ensure seamless data access and integration.

4.1.5 Priority

Priority

5 Performance Requirements

This section specifies the performance requirements for our web-based severe weather prediction system. The performance requirements address how quickly critical operations must complete, including data retrieval, model execution, and user interface responsiveness. The system must provide timely responses to user queries (e.g., API calls and dashboard updates within 2 seconds under normal operating conditions) and complete model processing tasks efficiently to support near real-time updates. Additionally, the performance guidelines ensure that the system's startup, shutdown, and periodic maintenance operations do not impede its availability or responsiveness. These requirements are critical to ensuring a smooth user experience and reliable delivery of actionable forecasting insights.

5.1 Model Performance Evaluation Requirement

5.1.1 Description

The system shall employ cross-validation techniques to assess the performance and accuracy of the predictive model. The model will be trained on at least 10 years of historical weather data, and a separate validation dataset will be used to evaluate its generalization capability. Key performance metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and the R-squared value shall be computed to provide a general summary of weather event frequency and relative severity. This approach acknowledges that while precise prediction of individual weather events 5–10 years in advance is unrealistic, the model can provide valuable probabilistic insights.

5.1.2 Source

State Farm Requirements document - Technical Requirements section.

5.1.3 Constraints

- The model must be trained using at least 10 years of historical data.
- Limited computational resources may restrict the frequency or depth of cross-validation.
- The forecasting output is inherently probabilistic, and precise event prediction is not expected.

5.1.4 Standards

- Arlot, S. & Celisse, A. (2010). "A Survey of Cross-Validation Procedures for Model Selection" *Statistical Surveys*, 4, 40–79.Procedures for Model Selection. [2]

5.1.5 Priority

Critical

5.2 System Response Time Requirement

5.2.1 Description

The system shall ensure that all user interactions via the web interface and API calls have acceptable response times. Specifically, the system must return query results, dashboard updates, and API responses within 2 seconds under normal operating conditions. This requirement covers the time taken for data retrieval, processing, and display, ensuring a responsive user experience.

5.2.2 Source

State Farm Requirements document - Technical Requirements section.

5.2.3 Constraints

- Response times must be maintained even under moderate concurrent load.
- Performance may be influenced by the volume of data and the complexity of query operations.

5.2.4 Standards

- NIST Special Publication 800-55, "Performance Measurement Guide for Information Technology Systems." [12]

5.2.5 Priority

High

5.3 Model Prediction Execution Time Requirement

5.3.1 Description

The system shall complete the predictive modeling process-including data pre-processing, model inference, and post-processing-within a specified time frame that supports near real-time decision making for critical use cases. Although long-term forecasts (5–10 years ahead) are computed in batch processes, each model run should complete within an acceptable period (to be determined based on pilot testing) to allow for iterative improvements and timely updates.

5.3.2 Source

State Farm Requirements document - Technical Requirements section.

5.3.3 Constraints

- The execution time may vary depending on the volume of input data and model complexity.
- Resource availability on the cloud platform (e.g., CPU/GPU allocation) may impact processing time.

5.3.4 Standards

- NIST Special Publication 800-55, "Performance Measurement Guide for Information Technology Systems." [12]
- IEEE Standard 829-2008, which provides guidelines for test documentation and performance benchmarks in software systems. [9]

5.3.5 Priority

High

6 Safety Requirements

Forecast TX is a software-based project with limited safety requirements, aside from adhering to the policies and procedures for UTA's Senior Design Lab equipment that we may use or are currently using, as well as room regulations. These include lab equipment lockout/tag-out procedures, NEC warning compliance, and RIA Manipulator Safety standards.

6.1 Laboratory equipment lockout/tagout (LOTO) procedures

6.1.1 Description

Any fabrication equipment provided used in the development of the project shall be used in accordance with OSHA standard LOTO procedures. Locks and tags are installed on all equipment items that present use hazards, and ONLY the course instructor or designated teaching assistants may remove a lock. All locks will be immediately replaced once the equipment is no longer in use.

6.1.2 Source

CSE Senior Design laboratory policy

6.1.3 Constraints

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

6.1.4 Standards

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

6.1.5 Priority

Critical

6.2 National Electric Code (NEC) wiring compliance

6.2.1 Description

Any electrical wiring must be completed in compliance with all requirements specified in the National Electric Code. This includes wire runs, insulation, grounding, enclosures, over-current protection, and all other specifications.

6.2.2 Source

CSE Senior Design laboratory policy

6.2.3 Constraints

High voltage power sources, as defined in NFPA 70, will be avoided as much as possible in order to minimize potential hazards.

6.2.4 Standards

NFPA 70

6.2.5 Priority

Critical

6.3 RIA robotic manipulator safety standards

6.3.1 Description

Robotic manipulators, if used, will either housed in a compliant lockout cell with all required safety interlocks, or certified as a "collaborative" unit from the manufacturer.

6.3.2 SOURCE

CSE Senior Design laboratory policy

6.3.3 CONSTRAINTS

Collaborative robotic manipulators will be preferred over non-collaborative units in order to minimize potential hazards. Sourcing and use of any required safety interlock mechanisms will be the responsibility of the engineering team.

6.3.4 STANDARDS

ANSI/RIA R15.06-2012 American National Standard for Industrial Robots and Robot Systems, RIA TR15.606-2016 Collaborative Robots

6.3.5 PRIORITY

Critical

7 Security Requirements

This section outlines the security and privacy requirements specific to our web-based system for forecasting severe weather events. The product is designed to allow secure user access and to ensure the safe storage and transmission of model output data. All user interactions, including authentication and API communications, must be secured via HTTPS using industry-standard encryption protocols. Model output data will be stored in a PostgreSQL database hosted on Google Cloud Platform, leveraging its built-in encryption at rest (e.g., AES-256) and following Google Cloud security best practices.

7.1 User Authentication and Authorization Requirement

7.1.1 Description

The system shall enforce secure user authentication and authorization processes. All user communications must occur over HTTPS (TLS) to ensure encryption of data in transit. User passwords shall be stored using strong hashing algorithms (e.g., bcrypt or Argon2) with unique salts. For the initial launch of the product, an administrator must review and approve each registration before access is granted. This process ensures that only authorized users can access sensitive system functionalities and data.

7.1.2 Source

Based on industry best practices and guidelines as detailed in NIST SP 800-63B [13] and the OWASP Authentication Cheat Sheet [15].

7.1.3 Constraints

- All authentication transactions must occur over secure channels (HTTPS).
- Password policies must enforce complexity, minimum length, and rate limiting on login attempts.
- Session management must utilize secure, randomly generated session identifiers with appropriate timeout settings.

7.1.4 Standards

- NIST Special Publication 800-63B: Digital Identity Guidelines: Authentication and Lifecycle Management. [13]
- OWASP Authentication Cheat Sheet. [15]
- OWASP Application Security Verification Standard (ASVS). [14]

7.1.5 Priority

Critical

7.2 Secure Cloud Storage of Model Output Data Requirement

7.2.1 Description

The system shall securely store all model output data generated by the predictive modeling component in a PostgreSQL database hosted on the Google Cloud Platform (GCP). This storage solution must ensure data confidentiality and integrity through encryption at rest and in transit, along with strict access controls. The secure storage requirement is intended to protect sensitive model outputs while enabling authorized access via the web interface and API calls.

7.2.2 Source

Derived from the security requirements section of State Farm requirements and industry best practices for cloud-based data storage.

7.2.3 Constraints

- Data must be encrypted at rest using strong encryption algorithms (e.g., AES-256).
- Access to the database should be restricted to authorized users and services only.
- The implementation must align with the security and compliance features provided by GCP.
- Integration with existing authentication and authorization mechanisms must be maintained.

7.2.4 Standards

- ISO/IEC 27001: Information Security Management Systems [5]
- ISO/IEC 27017: Code of practice for information security controls based on ISO/IEC 27002 for cloud services [6]
- Cloud Security Alliance (CSA) Cloud Controls Matrix (CCM) [1]
- Google Cloud Security Best Practices [4]

7.2.5 Priority

Critical

8 Maintenance & Support Requirements

Ongoing maintenance and support are critical to ensuring the long-term reliability, security, and performance of the predictive modeling system. Since this is a cloud-based web application, maintenance will include monitoring cloud infrastructure, managing database performance, updating predictive models, and addressing security vulnerabilities. A dedicated support team must be available to troubleshoot errors, apply updates, and ensure users receive timely assistance. Proper documentation, including troubleshooting guides and API references, must be provided to facilitate smooth maintenance and upgrades.

8.1 SOFTWARE UPDATES AND PATCH MANAGEMENT

8.1.1 Description

The system shall support scheduled updates to ensure bug fixes, security patches, and feature improvements. Updates shall be deployed with minimal disruption to users.

8.1.2 Source

Industry standards for software maintenance and security updates.

8.1.3 Constraints

- Updates must be tested in a staging environment before deployment.
- Security patches must be applied within industry-recommended timeframes.

8.1.4 Standards

- **NIST Cybersecurity Framework**: Guidelines for security monitoring and risk management.
- **ISO/IEC 27001**: Information security management best practices.

8.1.5 Priority

High

8.2 INCIDENT RESPONSE AND TROUBLESHOOTING

8.2.1 Description

The system shall have a documented incident response plan to address and resolve issues promptly. A dedicated support team must be available to diagnose and fix issues as they arise.

8.2.2 Source

Best practices in IT service management and security incident handling.

8.2.3 Constraints

- Incident response procedures must comply with regulatory and security requirements.
- Support response times must meet service-level agreements (SLAs).

8.2.4 Standards

- **ITIL (Information Technology Infrastructure Library)**: Best practices for IT service management.
- **NIST Special Publication 800-53**: Security and privacy controls for federal information systems.

8.2.5 PRIORITY

High

8.3 DATA BACKUP AND DISASTER RECOVERY

8.3.1 DESCRIPTION

The system shall implement automated data backups to prevent data loss. A disaster recovery plan shall be in place to restore operations in case of critical system failure.

8.3.2 SOURCE

Industry guidelines for cloud data protection and disaster recovery planning.

8.3.3 CONSTRAINTS

- Backup data must be stored in geographically redundant locations.
- Recovery processes must be tested periodically to ensure effectiveness.

8.3.4 STANDARDS

- **ISO/IEC 27031**: Business continuity and disaster recovery best practices.

8.3.5 PRIORITY

High

8.4 USER SUPPORT AND DOCUMENTATION

8.4.1 DESCRIPTION

The system shall provide comprehensive user documentation, including troubleshooting guides. A help desk or ticketing system shall be available for user support.

8.4.2 SOURCE

User support best practices and feedback from stakeholders.

8.4.3 CONSTRAINTS

- Documentation must be updated regularly to reflect system changes.
- Support channels must be available during defined business hours.

8.4.4 STANDARDS

- **ISO/IEC 20000**: International standard for IT service management.

8.4.5 PRIORITY

High

8.5 SYSTEM MONITORING AND LOGGING

8.5.1 DESCRIPTION

The system shall implement automated logging and monitoring tools to track system performance, security events, and potential failures. Logs shall be stored securely and accessible for review by administrators

8.5.2 Source

Derived from industry best practices in cloud-based system maintenance, security compliance guidelines, and stakeholder input regarding long-term system viability.

8.5.3 Constraints

- Logs must be encrypted and stored in compliance with security standards.
- Monitoring tools must provide real-time alerts for system failures or security breaches.

8.5.4 Standards

- **NIST Cybersecurity Framework**: Guidelines for security monitoring and risk management.
- **ISO/IEC 27001**: Information security management best practices.

8.5.5 Priority

High

9 Other Requirements

To ensure Forecast TX meets all necessary criteria for a complete and functional product, this section outlines additional requirements related to system architecture, deployment, and adaptability. These requirements focus on the setup and configuration needed for customers, ensuring ease of installation and integration with existing workflows. Additionally, considerations for modularity and extensibility will support future enhancements, such as additional weather perils and improved machine learning models.

9.1 Cross-Platform Compatibility

9.1.1 Description

Forecast TX shall be developed to support multiple operating systems, including Windows, Linux, MacOS, ensuring flexibility for different user environments. The system should be deployable via cloud platforms and on-premises setup where necessary

9.1.2 Source

State Farm Requirements

9.1.3 Constraints

- The software should be developed using cross-platform frameworks where feasible
- Dependencies should be carefully managed to avoid OS-specific limitations

9.1.4 Standards

- W3C Web Standards for browser compatibility [20]

9.1.5 Priority

Moderate

9.2 Responsive Dashboard

9.2.1 Description

Forecast TX shall be developed using the React framework to ensure highly responsive, modular, and maintainable user interface. The dashboard must dynamically adjust based on the user's screen size, providing an optimal experience across desktops, tablets, and mobile devices.

9.2.2 Source

State Farm Feedback

9.2.3 Constraints

- The UI components must be designed with re-usability and state management in mind
- The dashboard should follow best practices for accessibility (WCAG) and performance optimization
- The system should incorporate CSS frameworks (e.g., Tailwind CSS, Material-UI) or component libraries to enhance US consistency and responsiveness.

9.2.4 Standards

- W3C Web Content Accessibility Guidelines (WCAG) [19]
- React.js Best Practices [17]

9.2.5 PRIORITY

High

10 Future Items

In future iterations of Forecast TX, several enhancements are planned to expand functionality and improve predictive accuracy. Additional perils, such as tornadoes, flash floods, and extreme heat events, will be incorporated to provide a more comprehensive risk assessment. Furthermore, advance machine learning models, including deep learning and ensemble techniques, will be explored to enhance prediction reliability. These features have been considered and documented but will now be included in the prototype version due to constraints related to budget, time, technical feasibility, and resource availability. However, they remain a priority for future development as capabilities and resources expand.

10.1 Additional Perils for Predictions

10.1.1 Description

Future iterations of Forecast TX shall expand beyond wind, hail, and rain to include additional sever weather perils such as tornadoes, flash floods, and extreme heat events. This enhancement will improve predictive capabilities and provide stakeholders with a more comprehensive risk assessment

10.1.2 Source

State Farm Feedback

10.1.3 Constraints

- Requires extensive historical data weather data for additional perils.
- Increased complexity in data prepossessing and feature engineering.
- Higher computational demands for processing additional variables

10.1.4 Standards

- NOAA Weather Data Standards [10]
- W3C Web Content Accessibility Guidelines (For data visualization updates) [19]

10.1.5 Priority

Future

10.2 Integration of Additional Machine Learning Models

10.2.1 Description

Future iterations of Forecast TX shall incorporate additional machine learning models, including deep learning approaches (such as recurrent neural networks) and ensemble learning methods to improve the accuracy of sever weather predictions.

10.2.2 Source

Research on Predictive Weather Modeling and Machine Learning

10.2.3 Constraints

- Requires extensive model training and validation periods
- Increased cloud computing cost for model training and deployment
- Model explainability may become more complex with advance techniques

10.2.4 STANDARDS

- ISO/IEC 20546:2019 (Big Data Analytics) [7]

10.2.5 PRIORITY

Future

REFERENCES

[1] Cloud Security Alliance. Cloud Controls Matrix (CCM). https://cloudsecurityalliance.org/research/ccm/, 2020. Accessed: 2025-03-04.

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