Proposal for the Centralised Web Portal for Flood Forecasting System in Pamba Basin-Phase I

IRRIGATION DESIGN AND RESEARCH BOARD

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Abstract

This proposal aims to develop a centralized web portal to disseminate flood forecasting and reservoir operation results from the Pamba Flood Forecasting and Reservoir Operations System. The portal will cater to key stakeholders such as the Kerala State Disaster Management Authority (KSDMA), the Department of Agriculture, the Public Works Department (PWD), and the Local Self Government Department (LSGD). By integrating open-source technology, this portal will enable real-time access to critical flood forecasting data, facilitating timely and data-driven decisions to manage floods and optimize water resources. The Flood Forecasting and Integrated Reservoir Operations System (FF & IROS) currently generates daily outputs from hydrologic and hydraulic models in HEC-DSS (Data Storage System) and TIFF formats. The results from the models are essential for flood prediction, but they are currently not in a user-friendly format. The operator needs to manually save the DSS files and analyze the discharge data at 36 locations. This data must then be made available to multiple departments, and the manual process creates delays and inefficiencies.

The proposed solution will automate this process by converting the DSS files into viewable formats, such as graphs and images, and pushing these results into a centralized web interface. Stakeholders will be able to log in securely and access the data, allowing them to view real-time flood forecasts and analyze historical data. The ability to compare discharge levels across locations and time periods will enable departments to monitor and manage flood risks more effectively. The system will integrate both the hydrologic and hydraulic results, ensuring a comprehensive view of flood risks across the Pamba, Manimala, and Achenkovil river basins.

The scope of the project includes designing and developing the web portal, integrating the DSS and TIFF file conversion processes, and implementing a secure, role-based access system for different stakeholders. The portal will allow users to select specific dates and locations to view and compare flood forecasting data, enhancing their ability to respond to evolving flood conditions.

1. Introduction

Flood forecasting and reservoir management are critical components of disaster preparedness and response, especially in flood-prone regions such as Kerala. The Pamba, Manimala, and Achenkovil river basins frequently experience floods during the monsoon season, leading to widespread damage to property, infrastructure, and agriculture. Accurate and timely flood forecasts can significantly mitigate the impacts of these events by allowing government agencies, municipalities, and citizens to take preventive actions. However, the current process of generating and sharing flood forecasting data remains manual, fragmented, and inefficient.

The Pamba Flood Forecasting and Reservoir Operations System generates daily outputs from sophisticated hydrologic and hydraulic models, specifically using the Hydrologic Engineering Center's Data Storage System (HEC-DSS) format and hydraulic model outputs in TIFF format. While these formats are suitable for technical use, they are not easily accessible or interpretable for non-experts. Currently, the system operator must manually run the models, save the results, and then distribute them to stakeholders. This method delays the dissemination of crucial flood forecasting data and reduces its effectiveness.

To address this challenge, this proposal seeks to develop a centralized web portal that will streamline the process of converting, storing, and disseminating flood forecasting data to various stakeholders. By leveraging open-source technologies, this portal will automate the conversion of the HEC-DSS and TIFF files into visual formats (such as graphs and images) that can be easily accessed and analyzed by non-technical users. The portal will provide real-time data visualization, allowing stakeholders to access the information they need to make timely decisions regarding flood management and mitigation.

The key stakeholders for this project include the Kerala State Disaster Management Authority (KSDMA), the Department of Agriculture, the Public Works Department (PWD), and the Local Self Government Department (LSGD). These departments rely on accurate flood forecasting data to plan and execute their operations, including disaster response, infrastructure management, and agricultural resource allocation. By providing these stakeholders with a centralized, user-friendly platform, the proposed web portal will enhance their ability to respond to flood risks effectively.

2. Problem Statement

The current process of sharing flood forecasting data presents several challenges:

1. Manual Data Handling: The operator must manually process and distribute the HEC-DSS outputs, which results in delays. Stakeholders do not have real-time access to critical data.
2. Limited Accessibility: The technical nature of DSS files and TIFF images limits their usefulness to a broader audience. Stakeholders without expertise in hydrologic models may struggle to interpret the data effectively.
3. Inefficient Collaboration: Different departments need to act in concert when responding to flood risks, but the lack of a centralized system complicates coordination. Without a common platform for accessing the same data in real-time, decision-making becomes fragmented.

These limitations underscore the need for an automated, web-based platform that not only simplifies data sharing but also ensures that all stakeholders have access to timely, comprehensible flood forecasting information.

The proposed centralized web portal will serve as a comprehensive solution to the aforementioned problems. The portal will automate the process of converting HEC-DSS and TIFF outputs into visual formats such as graphs and images, which will be stored in a centralized database. Stakeholders will be able to log into the portal, select specific dates and locations, and view the relevant flood forecasts in an easy-to-interpret format.

The key features of the proposed portal include:

1. **Automated Data Processing**

Python scripts will be developed to convert raw HEC-DSS files into graphical outputs. This will eliminate the need for manual data handling, ensuring that stakeholders have immediate access to flood forecasting data.

2. **User-Friendly Web Interface**

The portal will feature an intuitive, easy-to-navigate interface where users can view, compare, and analyze forecast data from multiple locations. The interface will allow users to select specific dates and generate comparative graphs of flood forecasts for different stations.

3. **Secure Access**

Role-based authentication will be implemented to ensure that only authorized users from

KSDMA, Department of Agriculture, PWD, and LSGD can access the portal. Each department will have tailored access to the data relevant to their operations.

4. **Real-Time Updates**

The system will be updated daily, providing real-time access to flood forecasts, allowing stakeholders to monitor current conditions and historical data trends.

5. **Scalability**

Built on open-source technology, the system will be flexible and scalable, enabling future upgrades and the addition of new functionalities as required.

2.1 Objective of the Project

Facilitate Real-Time Data Access

Provide a secure, centralized platform where stakeholders can view flood forecasting results as they are generated, ensuring that critical decisions regarding water management and disaster response are based on the most current data.

Enhance Data Visualization

Convert complex hydrologic and hydraulic model outputs into intuitive visual formats (graphs, images) that are easy to interpret. This will allow stakeholders to better understand and act on the data, even if they are not technical experts in hydrologic modelling.

Enable Data Comparison Across Locations

The portal will allow users to compare discharge data from different locations and across various dates. This functionality will be essential for assessing regional flood risks and making data-driven decisions.

Build a Scalable, Open-Source System

Utilizing open-source technologies will ensure the system is cost-effective, scalable, and flexible, allowing future upgrades and adaptations as needed by the stakeholders.

The major works involved in this project include system design, data processing automation, web portal development, database integration, and security implementation. The database will store daily flood forecasts and historical data, making it accessible to stakeholders through a responsive, web-based platform. Python scripts will be developed to process DSS files, extract relevant data, and generate graphs/images. Open-source web technologies such as Django or Flask for backend development and JavaScript frameworks for the front end will be utilized to build an interactive interface that works across devices.

The expected outcomes include a centralized portal that provides seamless access to flood forecast data, improved decision-making through real-time and historical data analysis,

enhanced collaboration between stakeholders, and more efficient flood risk management. The system will be scalable, allowing future upgrades and adaptations as the forecasting system evolves. By leveraging open-source technology, the portal will be cost-effective and flexible, ensuring long-term sustainability and adaptability.

2.2 Scope of Work

The scope of this project includes the following

Data Processing and Conversion

The raw output from the hydrologic and hydraulic models is generated in DSS and TIFF formats. The project will develop scripts to automate the conversion of these files into graphs, images, and other visual formats suitable for web-based display.

Database Design and Management

A central database will be developed to store daily forecast data, including discharge data for 36 locations and results from the hydraulic model in TIFF format. This database must be capable of storing large amounts of historical data, ensuring the system can handle daily outputs over many years.

Web Interface Development

The portal's interface will be designed to provide users with easy navigation and access to real-time and historical data. The design will ensure that users can select specific dates, compare data across locations, and view graphical outputs with ease. The interface must also support secure login for various stakeholders.

User Authentication and Access Control

A strong authentication system will be created to ensure that only authorised individuals have access to sensitive data. The system will provide role-based access management, allowing different departments to view data that is relevant to their operational needs.

Stakeholder Training and System Maintenance

Once the system is deployed, training sessions will be provided to stakeholders, ensuring they can efficiently use the portal to access and analyze flood forecasting data. Ongoing system maintenance and support will also be included to ensure long-term system reliability.

3. Major Works Anticipated

System Design and Architecture

The core database will be precisely constructed to store a large volume of hydrologic and hydraulic data, with the potential to sustain daily data submissions over an extended period of time. This database will store DSS file outputs, as well as the accompanying graphs and images. In addition, a complete system architectural plan will be created to define the backend, database, and frontend components. To ensure a strong and scalable solution, the development process will take into account open-source tools such as PostgreSQL for the database and Django or Flask for the web interface.

Data Conversion and Processing

Python-based scripts will be developed to process DSS files by converting them into readable graphs and images. These scripts will extract data, such as discharge measurements at key locations, transform it into graphical formats, and store the outputs in the database. Additionally, TIFF files from hydraulic models, including flood extent maps, will be processed and displayed on the portal. This will involve using GIS tools and integrating the data through open-source mapping libraries like Leaflet or Mapbox to ensure accurate and accessible visualization.

Web Portal Development

The front-end of the portal will be developed using HTML5, CSS3, and JavaScript to ensure an interactive and responsive design that functions seamlessly across various devices. Users will have the capability to select specific dates and locations, prompting the system to retrieve the relevant DSS data from the database, generate the necessary graphs and images, and display them on the portal. Additionally, the portal will feature graphical comparison tools, allowing users to overlay graphs from different locations or dates for comparative analysis. This functionality will be particularly valuable for departments such as KSDMA and PWD to evaluate the variability in discharges across the river network.

Security and Access Control

The system will have a secure login mechanism that will allow stakeholders to access the site using unique credentials. Role-based access controls will be established to ensure that only authorised users can see or download specified datasets. Furthermore, data security will be ensured using HTTPS encryption, which protects all connections between users and the portal.

Testing and Validation

Before implementation, the portal will go through comprehensive system testing to verify

data processing accuracy, stability in high-traffic areas, and visualisation accuracy. Following testing, stakeholders will validate the system to ensure that it fulfils their specific needs. Any feedback will be included into the final version to ensure that it meets the needs of all users.

Training and Support

All stakeholders will receive comprehensive training to ensure they understand the portal's functions and can appropriately interpret the data. In addition, ongoing technical support will be provided to address and fix any difficulties that may emerge following deployment.

4 Expected Outcomes

Centralized and Accessible Data

The web portal will be a one-stop shop for accessing daily and historical flood predicting data, ensuring that all departments are informed and able to take appropriate action

Improved Decision-Making

The capacity to visualise and compare data from numerous places will help stakeholders make better decisions about flood mitigation and water resource management.

Real-Time Flood Monitoring

By automating the data conversion process and delivering real-time updates, stakeholders would be able to continuously monitor river releases and flood hazards.

Cost-Efficient and Scalable Platform

Using open-source technology guarantees a cost-effective solution that can be maintained and scaled without incurring hefty license fees. The technology will be adaptable enough to accommodate future upgrades as the forecasting system develops.

Enhanced Collaboration Between Departments

A centralised platform allows many departments to receive flood forecasting data at the same time, encouraging interdepartmental collaboration and a united approach to flood risk management.

5 Timeline and Deliverables

Milestone	Timeline	Deliverable
System Design and Architecture	1 month	Detailed system architecture and database design document
Data Processing Scripts	1 month	Python scripts for DSS and TIFF processing
Front-End Development	2 weeks	Web interface with interactive features
User Authentication Setup	2 weeks	Secure login and role-based access control
System Testing and Validation	3 week	Fully tested and validated system
Training and Support	1 weeks	User training manuals and sessions