A

Internship Project Report

On

WATER RESOURCES INTEGRATED MANAGEMENT SYSTEM

Submitted to

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE AND TECHNOLOGIES
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in partial fulfilment of the requirement for the award of the Degree of

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE & ENGINEERING

Submitted by

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Under the Guidance of

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES

(catering the Educational Needs of Gifted Rural Youth of AP)

R.K Valley,Vempalli(M), Kadapa(Dist) – 516330

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(A.P.Government Act 18 of 2008)

RGUKT-RK Valley

Vempalli, Kadapa, Andhrapradesh-516330.

CERTIFICATE OF PROJECT COMPLETION

This is to certify that I have examined the thesis entitled "**Water Resources Integrated Management System**" submitted by **T.Ravi Kumar (R170524)** under our guidance and supervision for the partial fulfilment for the degree of Bachelor of Technology in computer Science and Engineering during the academic session September 2022 – April 2023 at RGUKT-RKVALLEY.

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DECLARATION

I, **T.Ravi Kumar (R170524)** hereby declare that the project report entitled "**Water Resources Integrated Management System**" done under guidance of **Ms. Shaik Shabana** is submitted in partial fulfillment for the degree of Bachelor of Technology in Computer Science and Engineering during the academic session September 2022 – April 2023 at RGUKT-RK Valley. I also declare that this project is a result of our own effort and has not been copied or imitated from any source. Citations from any websites are mentioned in the references. To the best of my knowledge, the results embodied in this dissertation work have not been submitted to any university or institute for the award of any degree or diploma.

Date : T Ravi Kumar

Place : RK Valley R170524

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With Sincere Regards,

T Ravi Kumar,

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ABSTRACT

In this work, the proposal is made to implement TNWRIMS(Tamil Nadu Water Resources And Management System).In this work, we use latest technologies to provide unified visibility into water resources in a single platform. In this work we develop one authorative system for all water supply, demand and environmental factors, with a vision of making water related data accessible transparently in real-time for different stakeholders through an online GIS/MIS web-portal as well as seamlessly available through mobile,tablets etc.By collecting information of the various water resources in Tamil Nadu,we developed a unified platform which tells details about the water supply and water demand in Tamil Nadu.

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1. INTRODUCTION

Water is precious natural resource for sustaining life and environment. Effective and sustainable management of water resources is vital for ensuring sustainable development. considering its increasing scarcity, the planning and management of water resource become most important. In our dashboard we will be showing realtime and historical information related to rainfall, reservoirs, MI tank, river gauge, ground water, water demand, water quality, evapotranspiration of Tamil Nadu state which will be very useful for the government to take appropriate decisions in critical situations. It also contains content management and asset management where they can edit any information related to any component. It contains system monitoring which contains information about the working of api's in our dashboard and user analytics which tells how many people are visiting our dashboard.

TNWRIMS means TamilNadu Water Resources Information and Management System. TamilNadu is a riverine state with major, minor and medium rivers.Adyar river,Amaravathi river,Bhavani river,Ambuliyar river are major rivers in Tamil Nadu.There are lot of reservoirs in Tamil Nadu,so Tamil Nadu government has aimed to make Tamil Nadu a drought proof state by providing assured water to all sectors in the state,towards this journey it is decided to provide near real time visibility of all water resources in the state and developed Tamil Nadu Water Resourses Information and Management System.

In TNWRIMS project mainly we have to develop a website for water management in Tamil Nadu.For Frontend mainly we use Angular Technology.For Backend we mainly use Java,Spring Boot,Play server,Maven,Kafka,Storm.

1.1Importance of the Project

Water is having very important role in our life. But nowadays we are noticing a scarcity of it. So, we need to manage and use water resources effectively. In our project we will be showing real-time information about water sources. Here we will be having two things:-

A. Data Integration and management system: Here we will be collecting hydrological and meteorological data in different formats from different sources. Hydrological and Meteorological data: weather data, reservoir data, rivers, pump houses, ground water level, soil moisture, evaporation, surface water. Sources: web scrapers, external API's integration, mobile app data entry, manual file uploads, manual file uploads, automatic weather stations, automatic rain gauge, satellite data from external agencies (NRSC, IMD, ECMWF).

B. Smart Decision System: Helps or advice the authorities in their decision making process.

2.REQUIREMENT ANALYSIS

This project involved analyzing the design of a few applictions so as to make the application more users friendly.To do so, it was really important to keep the navigations from one screen to the other well-ordered and at the same time reducing the amount of typing the user needs to do.This also includes maintaining the flow of the application.

2.1 Requirement Specification

2.1.1 Functional Requirements

- Data collection from sensors and websites
- Real-time data processing
- Dashboards, heatmaps, graphs and tables generation
- Flood forecasting
- Reservoir managaement & planning
- Canal Management System
- Water Audit and Budgeting

2.1.2 Hardware Requirements

- Sensors for data collection
- High-speed internet connectivity
- Computer servers for data processing and storage
- Processor: A multi-core processor with a clock speed of at least 2.5 Ghz.

- RAM: At least 16 GB of RAM is recommended for running the system in production.However, the actual RAM requirements will depend on the amount of data being processed and the number of concurrent users accessing the system.
- Storage: The system requires a minimum of 500GB of storage for storing data.However, the actual storage requirements will depend on the amount of data being processed and the duration for which the data needs to be stored.
- Network: The system requires a reliable high-speed internet connection to ensure smoothe data transfer.
- Operating System: The System can any operating system that supports Docker containers.Howerver, Linx-based operating systems are recommended for running the system in production.
- Server: A dedicated server is recommended for running the system in production.The server should have sufficient resources to handle the load generated by the system.
- Backup and Recovery: The system should be backed up regularly to ensure data integrity and availability.A backup solution should be implemented to ensure that the system can be quickly restored in case of data loss or system failure.

3.Technologies Used

3.1HTML

It is a markup language for formatting and displaying web documents and web pages.It gives basic structure to the webpage without any stylling.HTML elements tell the browser how to display the content.It can be assisted by technologies such as Cascading Style Sheets and scripting languages such as Javascript for styling and functionality.

3.2CSS

It gives styling for the web pages created by HTML.It gives look adn feel to the website.

Types of CSS

- Inline CSS (Using styles as attributes in html elements)
- Internal CSS (Including a separate style tag in html document)
- External CSS (Using external file for styling)

3.3Spring Boot

Spring is the most popular application development framework for enterprise Java. Millions of developers around the world use Spring Framework to create high performing, easily testable, and reusable code. Spring enables developers to develop enterprise-class applications using POJOs. The benefit of using only POJOs is that you do not need an EJB container product such as an application server but you have the option of using only a robust servlet container such as Tomcat or some commercial product. Testing an application written with Spring is simple because environment-dependent code is moved into this framework.

Spring framework provides inversion of control and dependency injection. In dependency injection we will using @component for the class declaration and @autowired for the object. Normally for the object creation we will be using new class name() but by using spring framework we just need to write @autowired class-name object-name then object will be automatically created and also one more advantage is that only one object will be created.

3.4 Bootstrap

Bootstrap is a CSS framework which helps in developig web pages very faster and with little efforts.Helps to customize the CSS properties.Used for developing responsive and mobile-first websites.Componenets like navabar, carouse, utility, cards, dropdowns, buttons etc.

3.5 Javascript

Javascript is used to develop interactive web applications.Used to develop Dynamic websites.It is the programming language of the web and responsible for performing actions in a website.

3.6 Angular JS

Angular JS is a discontuinued free adn open-source javascript based web framework for developing single-page applications.It was maintained mainly by google and a community of individuals and corporations.

3.7 NodeJS

NodeJS is a open source sever Environment that allows us to run javascript on the server(outside a web broweser). It is an Event driven architecture capable of Asynchronous Input/output.It is a Javascript built on Chrome v8 javascript engine.Runs equally well on all platforms(Windows,Mac and Linux).

3.8 PostgresSQL

Postgres is a traditional RDBMS(relational database management system) SQL database. It is highly stable database management system.PostgresSQL is used as the primary data store or data warehouse for many web,mobile,geospatial and analytical applications.

3.9 Cassandra

Cassandra is a column-oriented database, which means that data is stored in tables as columns rather than rows. This makes it highly efficient for querying large datasets because it only reads the columns that are required for a query, rather than reading entire rows. Cassandra is also designed to handle high write-throughput, making it well- suited for applications that require real-time data processing. In our project we will be storing business data in Cassandra.

3.10 Kafka

Apache Kafka is a distributed publish-subscribe messaging system and a robust queue that can handle a high volume of data and enables you to pass messages from one end-point to another. Kafka is suitable for both offline and online message consumption. Kafka messages are persisted on the disk and replicated within the cluster to prevent data loss.

Kafka is built on top of the ZooKeeper synchronization service. It integrates very well with Apache Storm and Spark for real-time streaming data analysis.

3.11 Flink

Apache Flink is an open-source distributed stream processing framework that was designed to handle real-time data processing applications.Flink supports both batch and streaming data processing and provides a powerful, flexible and fault-tolerant system for processing data streams.

3.13 Quartz Scheduler

Quartz is an opensource job scheduling framework that can be integrated into java applications.It allows developers to schedule jobs or tasks to run at specific times or intervals and provides a range of features for managing and monitoring those jobs.

3.14 Geo Server

Geoserver is open-source server for sharing and publishing geospatial data.It provides a web interface for managing and publishing geospatial data in various formats, including Open Geospatial Consortium(OGC) standards such as Web Map Service(WMS), Web Feature Service(WFS) and Web Coverage Service(WCS)

3.15 Docker

Docker is an opensource platform for building, developing, deploying and running applications in containers.Containers are lightweight, portable and self-contained environments that allow developers to package their applications and dependencies into a single unit that can be easily depolyed across different environments.

3.16 Maven

Apache Maven is a software project management and comprehension tool. Based on the concept of a project object model (POM), Maven can manage a project's build, reporting and documentation from a central piece of information. When we use maven we no need to take care of dependencies. In each module we will be having the POM file where we will be writing all the libraries that module requires when we build the project it will automatically all those libraries and store them jars in maven repository(.m2) directory.

4.1SOFTWARE ARCHITECTURE

4.2 Event Driven Architecture

The event-driven architecture pattern is a popular distributed asynchronous architecture pattern used to produce highly scalable applications.It is also highly adaptable and can be used for small applications as well as large, complex ones.The event-driven architecture is made up of highly decoupled, single-purpose event processing components that asynchronously receive and process events.

Event channels are conduits in which events are transmitted from event emitters to event consumers.

Figure 3.1.1: Generic Design of an event-driven architecture

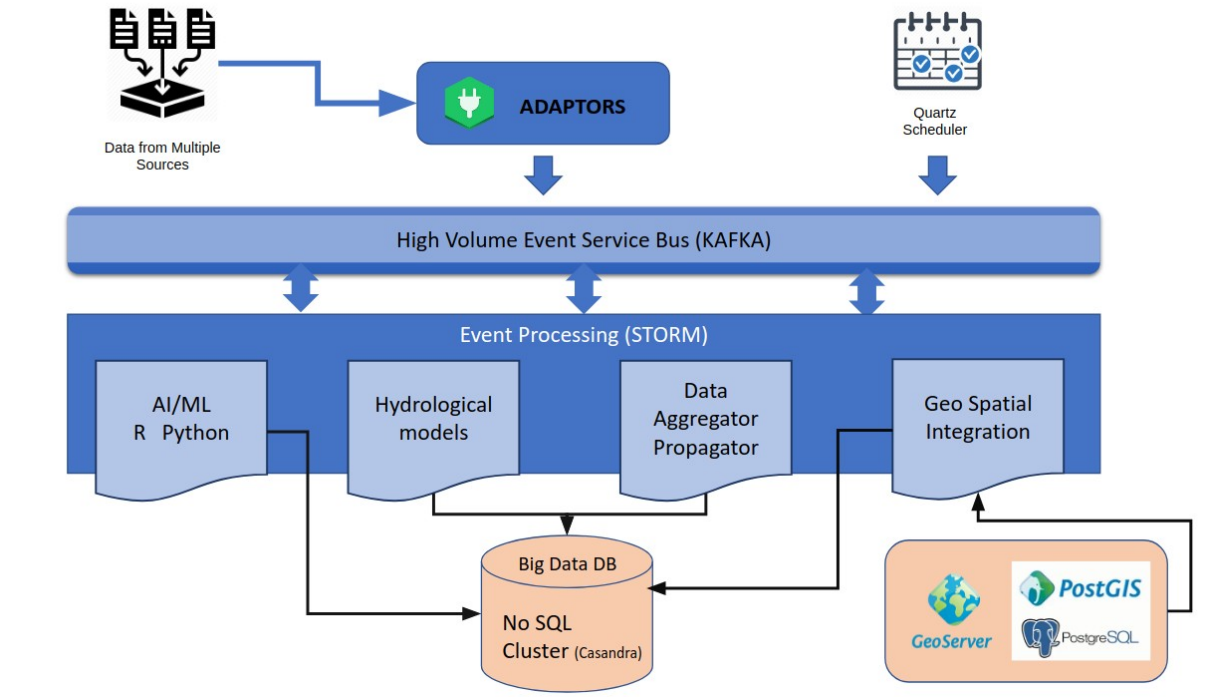

Figure 3.1.2: Event driven backend architecture

4.3 Web Application Overview/Architecture

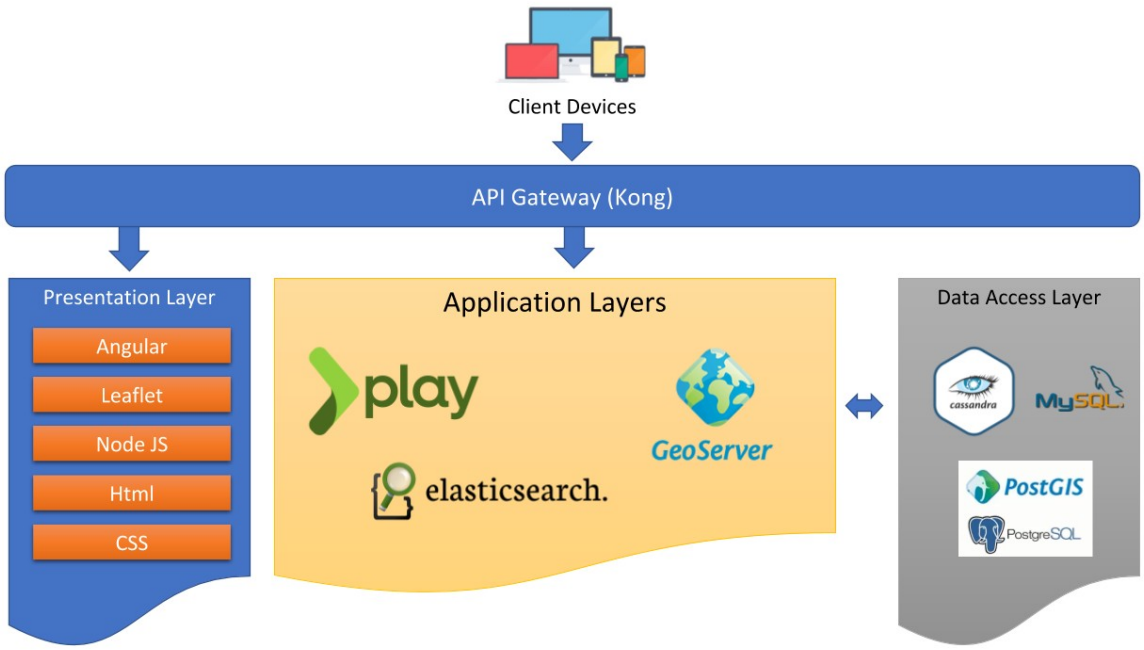

Figure 3.2.1: Web Application Architecture

5.Advantages and disadvantages

5.1 Advantages

• Reduce the wastage of water.

• Helps in taking critical decisions.

• Officials can easily monitor the information of water resource for the state of Tamil Nadu.

• One authoritative system for all water resources related information

• Helps key decision makers for effective planning of water resource management

5.2 Disadvantages

• Sometimes server becomes slow due to heavy processing

• In User Analytics we are using GA4 free version, it has some limitations of getting user information. That is it can track only up to 10000 thousand page views

• For some modules in the dashboard we will be scraping from external sites. We can scrape and store the data successfully only when they are following a consistent format.

6.SOFTWARE ENVIRONMENT

6.1 Intellij IDEA

Intellij IDEA is a popular Integrated Development Environment(IDE) developed by JetBrains.It is primarily used for programming in Java,but also supports several other programming languages like Kotlin, Scala,Groovy and Python.

Intellij IDEA provides advanced features like code completion, syntax highlighting, code refactoring, debugging, and unit testing.It offers advanced code analysis, navigation features, code completion, refactoring tools, debugger and unit testing tools, integration with various web frameworks and application servers.It is available in both community and ultimate editions with the ultimate edition offering additional features.Intellij IDEA is known for its user-friendly interface and high productivity features for developers.

6.2 YAML Files

YAML(YAML Ain’t Markup Language) is a human-readable data serialization language that is often used for configuration files, data exchange, and data storage.It was designed to be easily readable by humans and is oftern used in modern software development practices.

YAML files use indention and whitespace to represent hierarchies, making it easier to read and wirte than other data serialization formats such as JSON or XML.YAML files are often used for configuration files in software developement such as defining application settings or specifying build and deployment configurations.

YAML supports a wide range of data types, including strings, numbers, booleans and null values as well as more complex data structures such as maps,lists and nested structures.It also supports comments,allowing developers to provide additional context or documentation within the configuration files.

7.IMPLEMENTATION

7.1 River Gauge Component Functionalities

7.1.1 River Gauge Definition

A river gauge is a device to measure the height or depth of water in a river or other body of water.The data collected by river gauges is used to monitor water levels,track changes over time and help predict floods or other natural disasters. Accurate river gauge data can help emergency responders and officials make informed decisions about evacuations, road closures and other measures to protect people adn property.

7.1.2 Scraping

Web scraping is the process of extraction information from website using automated tools. It involves writing code to visit a website, inspects its HTML structure and extract the relevant data. The extracted data can be used for various purposes, such a research,analysis or building applications.Web scraping can be done manually but it is typically done using automated tools such as web crawlers, which systematically browse the web adn collect data from multiple websites.

When scraping data, it is important to adhere to ethical and legal guidelines such as respecting the website's terms of use, avoiding exeessive or disruptive requests adn obtaining explicit consent if necessary.Additionally, it is important to ensure the quality and accuracy of the scraped data as well as protect the privary and security of any personal information that may be invovled.

7.1.3 Aggregation

Aggregation is the process of combining multiple data points into a single summary value either over time or over space to gain a better understanding of the data.The types of data aggregations we are using in this project are spatial and temporal data aggregation.

7.1.4 Spatial Aggregation

Spatial Aggregation refers to the process of collecting and combing data from lower-level geographic units into higher-level units.For example, in a village, data may be collected from various rivergauge stations, sensors.This data can then be aggregated at the mandal level which is a higher-level administrative division.The mandal data can then be aggregated at the District-level which is a higher-level administrative division from Mandal.Ths District data can then be aggregated at the State level,Which is a higher-level administrative division from district.

7.1.5 Temporal Aggregation

Temporal Aggregation can also refer to the process of summarizing data over time periods such as hourly to daily, monthly and yearly intervals. This type of aggregation is often used in time-series analysis to identify trends and patterns over time.Hourly data can be aggregated into daily data by summing or averaging the hourly values for each day.Similary, daily data can be aggregated into monthly data by summing or averaging the daily values for each month.Finally monthly data can be aggregated into yearly data by summing or averaging the monthly values for each year.

7.1.6 API’s

APIs(Application Programming Interfaces) are tools that allow users to access and retrieve information about data resources such as river gauge stations data,rating table data,time series data, aggregated date etc.They can also to used to update meta data and upload several meta data of rivergauge stations, rating table data and historical data.

Overall, APIs are powerful that can help users access and utilized software, systems and data in a more efficient and effective way while also providing flexibility and customization options.

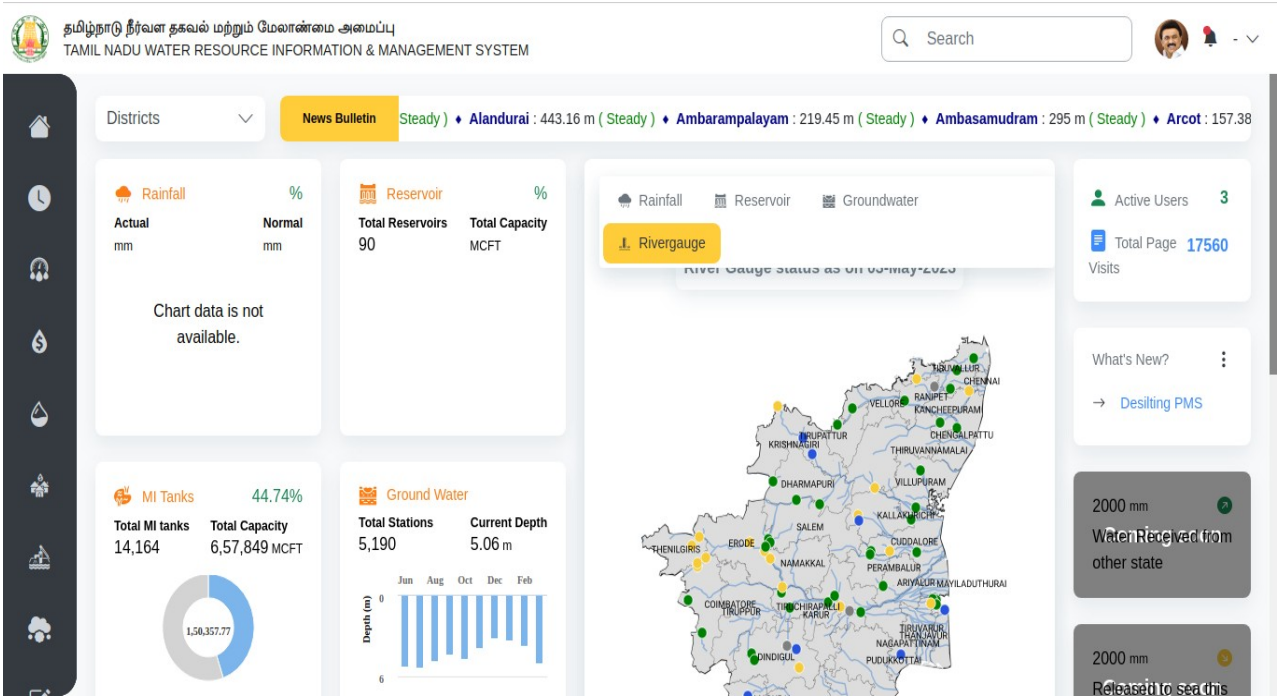

Figure 5.2.1 HomePage

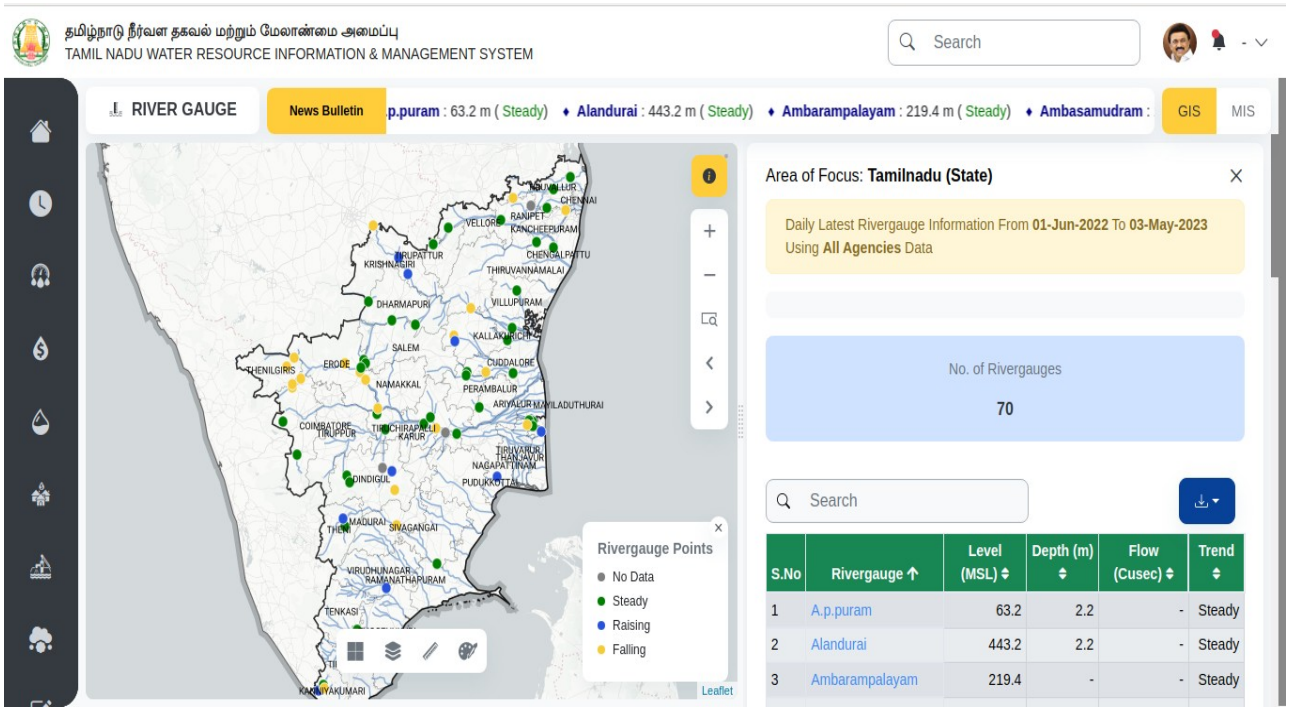

Figure 5.2.2 GIS View of RIVER GAUGE

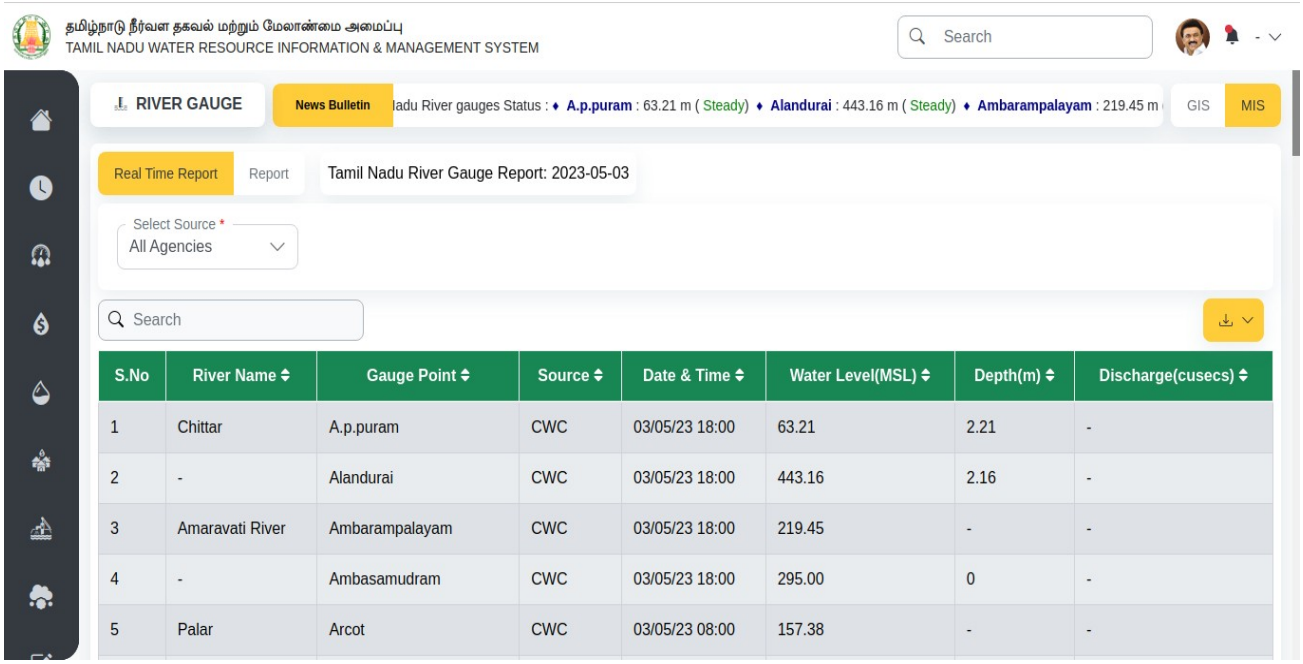

Figure 5.2.3 MIS View of RIVER GAUGE

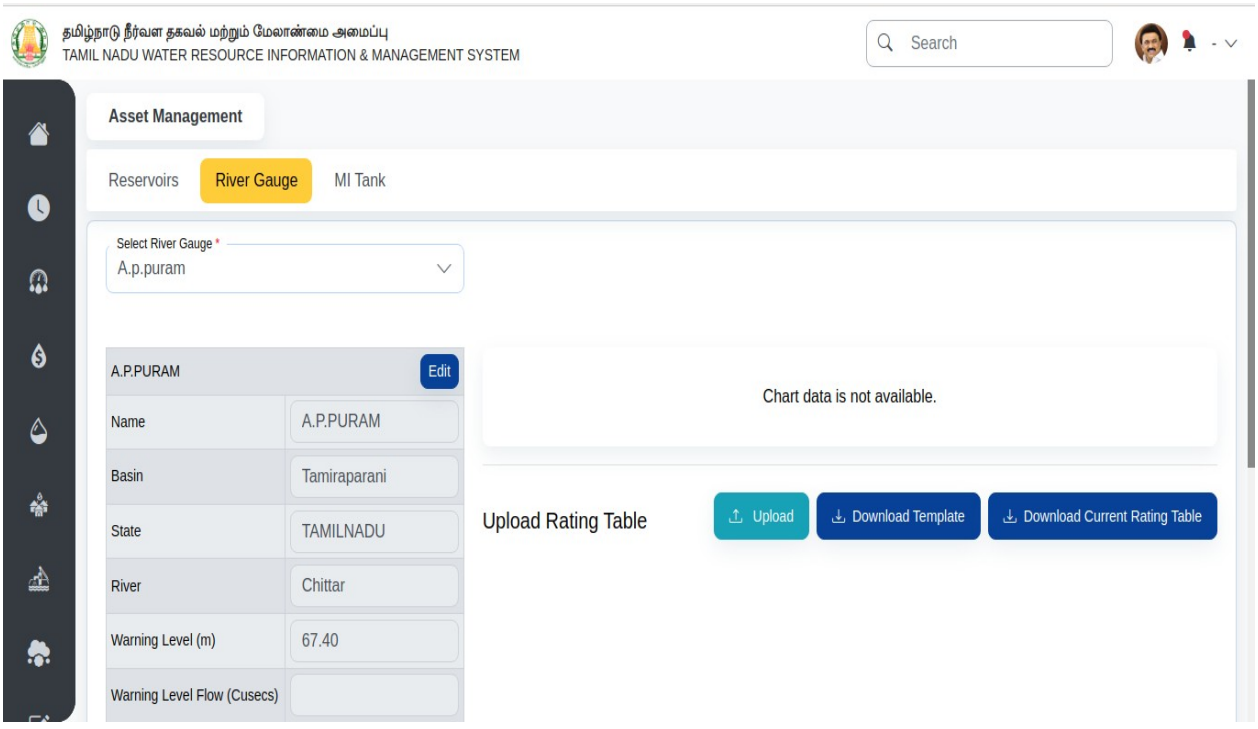

Figure 5.2.4 Content Management

9.CONCLUSION & FUTURE SCOPE

9.1 Conclusion

In conclusion, the project aims to provide real-time insights into various water resource parameters such as rainfall,groundwater level, river water level, inflow forecast, soil moisture, flood forecasting and reservoir water level.This system collects data from various sensors and websites, processes it using advanced technologies such as Kafka, Flink, Cassandra and PostgresSQL and generate dashboards, heatmaps, graphs and tables for visualization.The project uses a wide range of technologies and software tools.These technologies and tools have been chosen carefully to ensure that the system is scalable, reliable and efficient.

The project addresses several challenges in water resource management such as flood forecasting, reservoir management and planning, canal management system and water audit and budgeting.The system can help governments and organizations make data-driven decisions to manage water resources effectively.

Overall, the project has the potential to bring significant benefits to the water resource management sector by providing real-time insights, optimizing resource utilization and improving water security.The project also has future scope for further development and expansion such as integrating with other systems and adding new features to address emerging challenges in the field of water management.

9.2 Future Scope

The proposed system has significant potential for future expansion including the integration of additonal sensors and data sources, the development of new DSS products and the deployment of the system in other regions.

Here are some possible areas that can be explored further:

- Additional water parameters: The project can be further developed to include additional water parameter such as water quality,sediment levels

and dissolved oxygen levels.This will provide a more comprehensive view of the water resource and help in better decision making.

- Integration with other systems: The project can be integrated with other systems such as weather forecasting systems and agricultural data systems.This will provide a more complete view of the factors affecting water resources and help in better planning and management.
- Improved analytics: The project can be further developed to include more advanced analytics such as predictive analysis and machine learning algorithms.This will enable better forecasting and decision making and help in identifying trends and patterns that are not easily visible with traditional methods.
- User customization: The project can be further developed to allow users to customize the dashboard and visualizations according to their specific needs.This will make the system more user-friendly and enable users to get the insights they need quickly and easily.
- Increased Automation: The project can be further developed to increase automation such as automated data collection and analysis to reduce human error and make the system more efficient.
- Expansion to other regions: The project can be expanded to cover other regions and countries which will increase the scope of the project and enable better global water management.
- Enhanced reporting: The project can be further developed to include more advanced reporting features such as custom reports and data exports.This will enable users to generate reports quickly and easily and share the data with other stakeholders.

10.REFERENCES

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