Water Resources & Information Management System

Submitted By

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Under the Guidance of

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as a part of

Partial fulfillment of the degree of Bachelor of Technology in Computer Science and Engineering

CERTIFICATE OF PROJECT COMPLETION

This is to certify that the report entitled **"Water Resource & Management System"** submitted by **B. Chaitanya Kumar Reddy** bearing ID.No. **R170528** and in partial fulfillment of the requirements for the award of Bachelor of Technology in Computer Science and Engineering is a bonafide work carried out by them under my supervision and guidance.

The report has not been submitted previously in part or in full to this or any other University or Institution for the award of any degree or diploma.

Project Guide,

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Declaration

We, hereby declare that this report entitled **"Water Resource & Management System"** submitted by us under the guidance and supervision of **T.Sandeep Kumar Reddy** is a bonafied work. We also declare that it has not been submitted previously in part or in full to this university or other university or institution for the award of any degree or diploma.

We will be solemnly responsible if any kind of plagiarism is found.

Date:19-09-2022

Place: RK Valley

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With gratitude,

B. Chaitanya Kumar Reddy , R170528

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ABSTRACT

In this work, the proposal is made to implement WRIMS(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 a state, we developed a unified platform which tells details about the water supply and water demand in a state.

1.INTRODUCTION

1.1 Introduction to project

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 real-time and historical information related to rainfall, reservoirs, MI tank, river gauge, ground water, water demand, water quality, evapotranspiration of a 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.

WRIMS means Water Resources Information and Management System. For a state with major, minor and medium rivers. There are lot of reservoirs in a state, so any state government would aim to become 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 Water Resources Information and Management System.

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

1.2 Importance 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.

1.3 Spring Framework

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.

1.4 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.

1.5.Kafka and Storm

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.

Storm : It is an open-source and real-time stream processing system. Apache Storm was mainly used for fastening the traditional processes. It reliably processes the unbounded streams. It has spouts and bolts for designing the storm applications in the form of topology. Any programming language can use it. Thus, it is simple to use. It can process millions of messages within a second.

1.6 Databases

MySQL:

MySQL is a relational database management system(RDBMS) developed by oracle that is based on structured query language. A database is a structured collection of data. It may be anything from a simple shopping list to a picture gallery or a place to hold the vast amounts of information in a corporate network. A relational database is a digital store collecting data and organizing it according to the relational model. In this model, tables consist of rows and columns, and relationships between data elements all follow a strict logical structure. An RDBMS is simply the set of software tools used to implement, manage, and query such a database. It contains static data in our project.

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.

PostgreSQL :

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

2.PRELIMINARIES

2.1 Collecting Water Resources Data

Mainly the water resources data is collected in the form of six ways:-

1) Reservoirs

2) MI Tanks

3) Rainfall

4) Soil Moisture

5) Lift Irrigation Schemes

6) Water Conservation Structures

2.2 Hardware Components

• Processor: 64-bit, quad-core, 2.5 GHz minimum per core

• RAM: 4 GB or more.

• HDD: 5 GB of available space or more.

• Display: Dual XGA (1024 x 768) or higher resolution monitors.

• Keyboard: A standard keyboard

2.3 Software Components

- **Java: Java is a general-purpose, high-level programming language that is designed to** be platform-independent, meaning that Java code can run on any platform that supports Java without the need for recompilation.
    - o Version:8 or 11

- **IntelliJ Idea:** IntelliJ IDEA is an integrated development environment (IDE) for Java and other programming languages, developed by JetBrains. It is designed to increase developer productivity by providing a powerful set of tools and features that simplify the coding process.

- Ubuntu OS 20.04
- **Cassandra: Cassandra is a column-oriented database, which means that data is stored** in tables as columns rather than rows.
    - o Version: 5.0.1

- **MySQL: MySQL is a relational database management system(RDBMS) developed by** oracle that is based on structured query language
    - o Version:5.7

3.PROPOSED METHOD AND FLOW OF THE PROJECT

3.1 Proposed Method

There are various stakeholders that utilize, track, and manage water based on their capabilities and requirements in the state. This in turn leads to the different authorities working independently which may sometimes end up in conflicting situations in the time of crisis. Moreover, effective collaboration and process alignment among different authorities is difficult to achieve due to the operational inefficiencies arising out of fragmented IT systems. Here we developed one authoritative 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.

A single, unified and an authoritative platform for comprehensive, authoritative and consistent data and information of water resources for the state time visibility of water resources.

3.2 Flow of the Project

➢ First we will be collecting station level data from different sources

➢ Now the collected data is station level we will interpolate it to grid level

➢ Then grid level data is aggregated to village, block, district and state

➢ This all data will be stored in the database.

➢ According to the UI requirement we will write API's to access the data from the database and expose to the UI.

3.3 Advantages and disadvantages

3.3.1 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

3.3.2 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

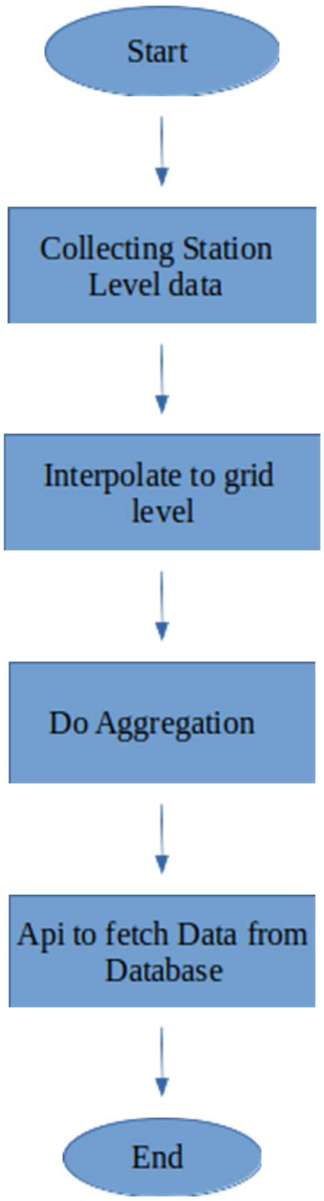
• For some modules in the dashboard we will be scraping from external sites. We can scrape and store the data successfully only when they are following a consistent format.

4.IMPLEMENTATION

4.1 Flow of API

- All the Api details will be present in the routes file which is present in conf folder.
- It also gives information about whether it is a get method or post method.
- the HTTP POST method is used to send data to a server to create or update a resource.
- the HTTP GET method is used to request data from a specified resource and should have no other effect.
- It also gives information about in which controller the implementation of the specific api is present.
- So when we hit that api it goes to that particular method in that particular controller.
- If it contains only simple logic then it will directly present it's logic in that.
- If it has complex logic then its logic will be present in the service class of the specific Module.

The Basic Process flow of any component ::



4.2 Scraping Data

We scrape the data from the reliable authorized trusted sites.

- There are few central and state websites which provide accurate rainfall, soil moisture data accurately.
- We utilize those resources in our system
- We write the code in Java in spring application which establishes a connection with those external sites and scrapes the required data from it.

Algorithm ::

scrapeData():

- Establish a connection with the external site using http libraries for a certain period of time.
- Scrape the required data from the site.
- Insert into the database of our system.

4.3 Interpolation

- Interpolation of Data means spreading the Data of few sensors to all over the state grids.
- The grids will be 5x5 or 2.5x2.5 km square boxes.

Algorithm ::

InterpolateData()::

- Take the list of all the grids and sensors geo locations
- Then we do inverse-distance-weighted interpolation
- Which results in giving us data for each grid
- Each grid gets its data from the n-nearest neighbors

4.4 Aggregations

There are two types of aggregations.

- Temporal aggregation: from real-time to hourly, daily, monthly, seasonally, yearly.
- Spatial aggregation: from grid level data to village, block, district, state.
- For these aggregations we will using simple aggregation or weighted aggregation based in our case.
- For example: if we are showing the number of rainfall stations in the specific block, then we just add the number of stations present in each village present in that particular block.
- If we want to show the rainfall of particular village, then we will be doing weighted average depending on the intersection area of the grid to the village.
- This aggregation logic will be present in the service module of its specific module.

Algorithm ::

aggregateData():

- Take the grid level data (interpolated data) of any component.
- Make a HashMap of each village to its all related grids data based on area of grid covered in that village.
- Then the weighted average is applied to get that village Data.
- Similarly all the villages weighted average gives their respective Mandal or Block in turn gives us of District and of State.
- Then we insert those respective data into the Cassandra Database.

Conclusion

Our dashboard provides information on water resources, providing near real-time visibility of water available from rainfall, reservoirs, canals, minor irrigation tanks, groundwater etc. which helps the key decision makers for effective planning of water resource management.

A single, unified and an authoritative platform for comprehensive, authoritative and consistent data and information of water resources for the state rendering real-time visibility of water resources.

References

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