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## Project Progress Monitoring Service Using Geospatial Server

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### ABSTRACT

*The success of a project depends on efficient project monitoring, projects span across long duration and need that the same tasks be performed again and again over a number of brief segments to complete the job. Monitoring their development so becomes difficult. This is a matter of concern meanwhile Monitoring the project's development regularly can help ensure that resources are used and distributed effectively. The current methods of monitoring are either time-consuming, expensive, or necessitate a lot of human efforts. The study's goal is to examine the potential of using ArcGIS Pro to gather and visualize data for improved progress monitoring of linear projects. It also aims to make it possible for users - both operators and clients - to check the status of their projects online through dashboards and use as an operational tool for running their organization efficiently.*

**Key Words:** Project Progress Monitoring, Geospatial, ArcGIS Pro, PostgreSQL, ArcGIS Enterprise, Web Server, Dashboard.

### I. INTRODUCTION

It is valuable to know project monitoring is importance as it can be the difference between a project failing or being successful. It is important that a project manager can closely observe the progress of a project and make intelligent adjustments. This is due to the fact that projects often consist of numerous tasks spread out over a lengthy period of time, some of them need the team or individual working on them to wait until they have completed an earlier task. This indicates that as the project progresses, all the other jobs could be negatively impacted by the delay or poor execution of just one tiny work. Further the project planning phase outlines the expected standards, so a project manager can constantly monitor tasks and prepare to make changes to reach the expected standard of quality.

Project progress monitoring system is a web-based information system that helps in tracking the development of infrastructure projects by using geotagged data that is directly collected from the field in real-time. Overall, the monitoring process includes project planning, execution, and assessment to ensure that all development projects can be completed dependably at all levels and that any issues will be addressed right away. So here comes the process control, process control is an essential element in the monitoring service, in this project it monitors the geospatial related activities on web server. To keep a track of project and monitoring the project progress, this project progress monitoring service showing the updated status of project in the form of IQC, EQC and Final quality control. which will show the project has started or not, or it will be in progress or already completed, all this information will be shown in the dashboard. It will show all of the interconnected visualizations on a single screen.

### II. LITERATURE REVIEW

So many researchers have explored various methods for tracking the development of linear projects incorporating multiple technology combinations. This part presents a quick overview of these various tools and methods.

**Ahmed Al-Sulaiti et. al. [2021]** Using Data Analytics and Visualization Dashboard for Engineering, Procurement, and Construction Project's Performance Assessment.

In this study, conclusion can be obtained as follows; (a) the idea of data analytics methods and performance dashboards using data visualization, (b) Project progress reporting has been implemented to track the performance of the portfolio, (c) To evaluate the sustainability of EPC projects, a number of social, financial, and environmental sustainability measures, including safety, job creation, carbon emissions, and air pollution, can be combined, (d) a variety of decision-making techniques, including system dynamics, decision making based on multiple criteria with professional expertise, and life cycle sustainability evaluation, can be used to evaluate the overall project performance, (e) The Future dashboard improvements could be made with additional criteria for contractor performance measurement.

**P N Charikov et. al. [2020]** Study of student progress monitoring system of university department for distance learning system based on a Web portal for OLAP samples using to automate analysis.

In this study, conclusion can be obtained as follows; (a) The system is made to help teachers enhance the quality of their student's education. (b) Along with knowledge control, the system can be utilized as a simulator and in online mode for self-monitoring. (c) Development should increase productivity by utilizing OLAP technologies to preserve the relevant test statistics. (d) OLAP sampling will decrease the possibility of errors by automating the process for evaluating student knowledge.

**Elizabeth Rojas et. al. [2020]** Cities-Board: A Framework to Automate the Development of Smart Cities Dashboards.

In this study, conclusion can be obtained as follows; (a) Cities-Board, a framework for automating the construction of dashboards for smart cities, (b) is made up of a graphic domain-specific language that makes it possible to create, modify, and convert dashboard models in a more user-friendly language. (c) Future work can be done to incorporate interactive charts (such as 3D visualizers) and data models that are more appropriate for Big Data scenarios.

**Jia Yu et. al. [2019]** GeoSparkViz in Action: A Data System with built-in support for Geospatial Visualization.

In this study, conclusion can be obtained as follows; (a) A comprehensive solution that enables users to load, prepare, integrate, and perform Map Viz operations in the same system, (b) GEOSPARKVIZ combines the phases of data preparation and map visualization.

**Vinayakumar S. Petimani et. al. [2019]** Monitoring the Construction Project by 4D Application of GIS.

In this study, conclusion can be obtained as follows; (a) encourage the integration of spatial and non-spatial data and the portrayal of 4D GIS principles in the monitoring of construction projects, (b) MSP and GIS integration work is being done to develop 4D models that provide an excellent visual representation of project construction progress, (c) Clients can learn about the actual status of the project site using this 4D GIS output without physically visiting it, which saves the clients a great deal of their valuable time.

**Julia Ratajczak et. al. [2019]** BIM-Based Augmented Reality Tool for The Monitoring of Construction Performance and Progress.

In this study, conclusion can be obtained as follows; (a) Discusses approaches, technologies, as well as the functions that have been implemented and those that are planned for a mobile augmented reality application for the construction site, (b) Users can access context-sensitive information on the construction project, including a 3D model, technical specifications for building materials and components, and a list of construction activities, (c) In order to facilitate effective management of construction activity on site, Lean building techniques are included in the programme such as Location-based Management System (LBMS) and Building Information Modeling (BIM).

**Ko Ko Lwin et. al. [2019]** City Geospatial Dashboard: IoT and Big Data Analytics for Geospatial Solutions Provider in Disaster Management.

In this study, conclusion can be obtained as follows; The City Geospatial Dashboard is crucial for rapid collection, sharing, and planners, decision-makers, and other geospatial information consumers can see the results of big data analytics through visualization.

**Jiong You et. al. [2018]** Remote-sensing based Modern Agricultural Park Construction Progress Monitoring.

In this study, conclusion can be obtained as follows; (a) a Regulatory system's framework that provides a quick and convenient approach to investigate several geospatial data for ground features of building materials in contemporary agricultural parks, (b) In a service-oriented architecture environment, the regulatory system will be developed to offer users with helpful features that are beneficial, such as online visualization, geographic navigation and querying, reconfiguring and conversion, area of interest delineation, real-time data analysis, on-demand data distribution and processing, themed map construction, etc.

**Benjamin Mayer et. al. [2017]** A Dashboard for Microservice Monitoring and Management

In this study, conclusion can be obtained as follows; (a) a dashboard for comparing different services over time, it contains similar visualization components for comparing run time metrics such as response time and the throughput of different services over time, (b) Also provides run time information on the utilization of resources such as CPU and memory in the service runtime environment.

**Meyliana et. al. [2014]** University Dashboard an Implementation of Executive Dashboard to University.

In this study, conclusion can be obtained as follows; The success of each university can be tracked with the help of the university dashboard.

Therefore, the methods currently available RFID tags or QR codes, satellite photos, photogrammetry, light recognition and ranging and manually recordkeeping are among the methods for keeping track of the development of linear projects. However, the monitoring of the linear projects requires carefully designed progress monitoring service as operator can be able to control steps to be taken to get the project on track as per assigned schedule time. Furthermore, monitoring such projects is difficult because of the numerous work sites that must be watched at once, the remote locations where they must be observed, and the varied work environments. Additionally, timely project completion while following to the necessary standards for quality, affordability, and sustainability can be made possible by properly monitoring linear projects.

This project will give users-both operators and clients-the ability to monitor the status of their projects online through a dashboard using the ArcGIS Enterprise portal, which will also serve as an operational tool to help users run their organizations successfully. The ArcGIS Enterprise site has a variety of widgets and features, including home, zoom-in/zoom-out, the legend, a pie chart, a graph, a map, an indicator, a gauge, a list, some details, and more. All of the widgets are available on a single screen on the dashboard's user interface. These widgets are simple to set up and can be connected to one another for real-time data visualization. Therefore, ArcGIS Enterprise is simple and easy to use tool. As e-commerce has grown quickly, project progress monitoring has moved from the days when it required visiting the construction site physically. As a result, this research evaluates and studies the evolution and current e-project progress monitoring system closely before building the system.

### **III. OBJECTIVES**

The objective of this study is to create an automated system for project progress monitoring using IT techniques. Typically, monitoring project progress is done on paper, with photos of the completed work affixed to demonstrate the progress. Creating a model that can automatically evaluate project progress is the main goal of this study.

To design an automated project monitoring system that will handle proper project data analysis and interpretation.

To analyze big data processing project.

To implement the developed automated Project Monitoring System.

To developed interactive report generation tool in the form of dashboard.

To track projects with real-time data.

To build a dashboard to track the development of a geospatial activities on a web server.

### **IV. PROPOSED METHODOLOGY**

The approach for monitoring the progress of various projects that incorporate GIS on a web platform is described in this section, resulting in the creation of the dashboard-style Web-based GIS application that is suggested in this study and made possible by ArcGIS Enterprise. This process calls for the completion of numerous activities, and the system's three primary stages of data flow are data collecting, data storage and processing, and data visualization. The management's monitoring requirements are first converted into data entries that can be entered into a form and collected. Following that, this form is distributed among the individuals tasked with carrying out the work on site. They can alter the pertinent location data in the forms as they work on the various project sheets and upload it to the ArcGIS server. The monitoring group in the office can then use this information to build a database. Using the information from this database, ArcGIS Enterprise then develops the web-based GIS tool for monitoring.

The open-source platform ArcGIS Explorer was selected for data collection since it may be used to gather information in far-off locations. ArcGIS server is leader in application area of Web GIS, and it is used to store the various geospatial activities as shape file dataset. The server end of ArcGIS Server performs all kinds of operations, including map indexing, spatial database administration, and storage. Maps, globes, geoprocessing tools, and address locators are just a few of the resources that the GIS server hosts and makes available to client applications as services. The GIS server makes the necessary adjustments, generates a response, and sends it back to the client application whenever a client application requests the use of a specific service. A suitable database management system that can define, manipulate, handle, and manage all of the data recorded in the .shp file must be used to enter all of the data and we don't have to upload the database file again and again in ArcGIS Enterprise.

A free database management system called PostgreSQL is capable of handling data gathered from a variety of applications. PostgreSQL gives users, control over the metadata and give access to connect the database as the user don't have to upload the database again and again in the ArcGIS Enterprise. As we do any changes in the database it can automatically reflect and show the updated status in dashboard which is created in ArcGIS Enterprise portal. The first GIS software platform, ArcGIS Enterprise Portal is for GIS, powering mapping and visualization, analytics and data supervision. By using ArcGIS Enterprise, a dashboard will be created for showing the project progress status. A dashboard is a view of geographic data and information that enables decision-making, trend-spotting, and event monitoring.

The Operations Dashboard for ArcGIS allows even non-programmers can quickly create richly functional customizable dashboards. A dashboard is created by fusing different widgets or pieces. A widget is a part of a dashboard's building block. The application has widgets such as home, zoom-in/zoom-out, the legend, a pie chart, a graph, a map, an indicator, a gauge, a list, some details. Only the widget has to be added by the user and set its functionality and placement. The user can also set up communication between widgets and other elements, for example, when a district is chosen from a list of districts, the map view shows its associated geographic area. Drag, configure, configure actions, duplicate, remove, and other common operations are connected with widgets. The application created with the dashboard adheres to the principles of responsive design and works properly on gadgets with various screen sizes.

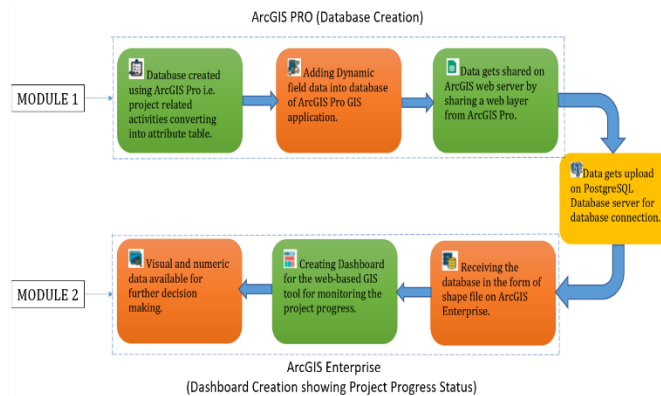


Fig 1: Block Diagram of the System

The open-source GIS programme ArcGIS Pro was selected for data collection used to gather data in far-off locations. ArcGIS Pro was used for creating the dynamic fields in the database according to client requirement. These fields can be designed to accept inputs for text, numeric, location (geospatial locations, routes, and forms utilizing the device's GPS position or for choosing grids from a map), time, and data. Then the updated database is uploaded on PostgreSQL server for database connection as if operator did any specific changes in the database, it can automatically reflect in the ArcGIS Enterprise portal and will show the updated status in dashboard which was created. Then after database connection shape file will share as a web layer in ArcGIS Enterprise portal for final dashboard creation. After login in the enterprise portal, we have to import the file and create the dashboard as client requirement. The dashboard will show IQC, EQC and Final status of the project progress which will include has the project is started or not, in progress and completed.

**Components of a dashboard**

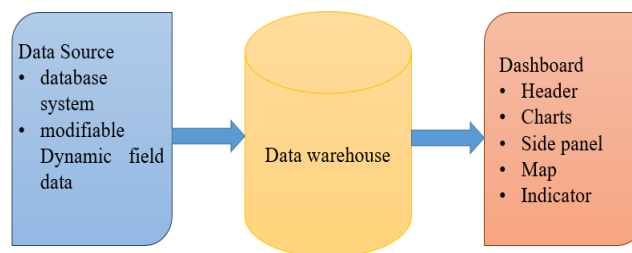


Fig 2: Components of a Dashboard

Data sources, data warehouses, and dashboards should all be included in a project status dashboard. The data source is often accessible as an automated database system, though it can also be individually updated. The dashboard project data that was updated during the reporting period is kept in the data warehouse. The dashboard is an assortment of charts and indicators that display the project statistics. As a result, it's crucial to determine the following when determining the needs for a dashboard: (1) the data sources; (2) the locations and methods of data storage; and (3) the appropriate charts for the data.

**Header :** The dashboard's header is a designated area at the top that can be used to apply business branding guidelines, give the dashboard a distinctive identity, and include links to more material.

**Charts :** It may take the form of a pie chart or a serial chart. A serial chart shows a sequence of data points along a horizontal (x) and vertical (y) axis. Pie charts are circular charts with sections, while serial charts can display multiple data sets. Each segment is sized appropriately for the quantity it represents.

**Side panel** : One or more selectors are hosted on the side panel in interactive dashboards. Only one side panel can be used on a dashboard, and it must be fixed in height and placement along the edge of the display, though it can be configured to retract when needed.

**Map** : A map made in ArcGIS Online is used to add features such as zooming in and out, basemap galleries, pop-ups, legends, and more. A dashboard may contain numerous Map elements.

**Indicator** : It can be used to present a count, a sum, an average, a minimum, or a maximum summary estimate in addition to the numeric attributes of specific features.

**Architecture/Workflow**

A diagrammatic representation of the data flow into the system is shown here.

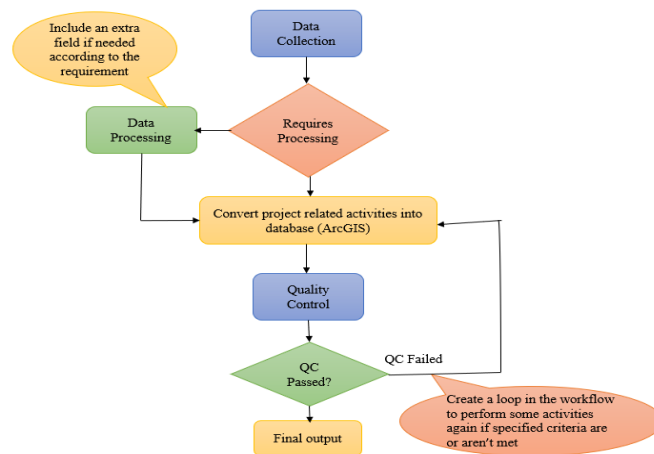


Fig 3: Flow Diagram for the designed system

**Algorithms**

In this project, while creating the database in ArcGIS Pro, we used a geodesic algorithm to compute the field value. Using a geodesic algorithm, the length calculation is converted. A shape-preserving algorithm is used in the geodesic length and area properties. In contrast to the traditional geodesic length and area assumptions, this method yields extremely accurate findings that are not influenced by the presumption that the input line or polygon features are built with geodesic arcs between the vertices. If there is a choice among the input features, only the features that are chosen will have values computed in the extra fields; all other features will keep their current value. We can specify a new field name or choose a current field. The sort of values that are written to a new field, if one is specified, determines the field type.

In ArcGIS Pro, the calculate field tool uses IF statements to calculate new values in the fields of an attribute table,

Step 1: In the calculate field geoprocessing pane, under parameters, selecting a table for input table.

Step 2: Selecting a field for Field Name (Existing or new).

Step 3: Selecting a python 3 for expression type. [IF statements uses python scripts in the calculate field tool in ArcGIS pro].

Step 4: In the Expression text box above the code block box, writing the code in python for calculating the field value.

Step 5: If we want to calculate multiple field value which are already exist we have to directly select multiple rows and apply the value from drop down list those are already present.

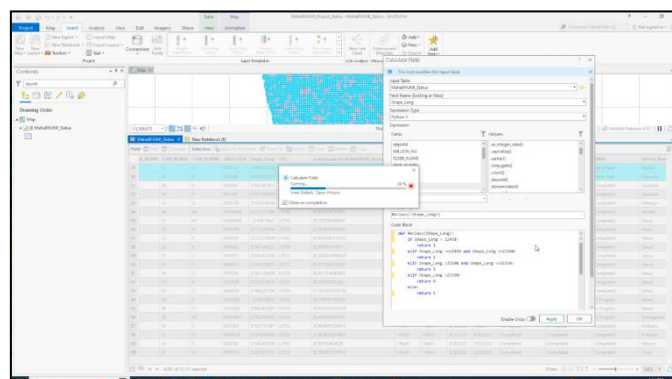




Fig 4: Execution of python code in ArcGIS Pro

Utilizing Edge-based Windows Grouping for Geodesic Computation; By disseminating the geodesic information from the source across the complete mesh, this algorithm calculates the geodesic distances at mesh vertices.

Based on this expansion strategy, a variation of the suggested geodesic algorithm is provided. VTP is the abbreviation for the vertex-sorted propagation method with order-free secondary merger.

Below is the pseudo code of VTP;

Algorithm: EWG-based SS-DGP Algorithm (VTP)

Input: M - Mesh, S - Source set;

Output: D - a vector containing the geodesic distances of M's vertices;

- procedure VTP (M, S)
- First, we Denote the wavefront as wf and the area it encloses as R;
- Then the next step is to define a priority queue Q and a FIFO queue W;
- Perform initialization
- Push all adjacent vertices of S into Q;
- while Q is not empty do
- Pop a vertex v from Q;
- Let consider  $E(v)$  be the subset of nonincident 1-ring edges of v; 9: Push the edges on the wavefront incident to v into W;
- 10: while W is not empty do
- Pop an edge e from W;
- Let assume the opposite edges of e are e0 and e1
- Propagate wle to e0 and e1 using Rules 1 and 2;
- Then we have to Update distance vector D and priority queue Q;
- Let the propagated lists be  $wle \rightarrow e0$  and  $wle \rightarrow e1$
- for each edge ei do
- if  $wle \rightarrow ei$  is not empty then
- Let wlei be the existing window list on ei
- if  $ei \notin R$  and  $ei \in E(v)$  then
- PrimeMerge ( $wle \rightarrow ei$ , wlei );
- else if  $ei \in wf$  then
- SecondMerge ( $wle \rightarrow ei$ , wlei );
- else
- Push ei to W;
- end if
- end if
- end for
- end while
- Update wavefront wf and R.
- end while
- end procedure

**SDLC method**

This project is being developed using the RAD methodology. Even though it is not originally usable, the rapid application development methodology (RAD) allows users to interact with it. It makes prototype reuse possible, which saves money and labour. The analysis, design, and implementation phases are improved by the RAD methodology so that they are carried out simultaneously until the system satisfies the users' requirements. By using techniques like prototyping and other RAD techniques, waterfall methodologies' time complexity is reduced. It establishes joint application development sessions, in contrast to waterfall and information engineering methods, to better grasp user requirements and choose functionality for design and usability.

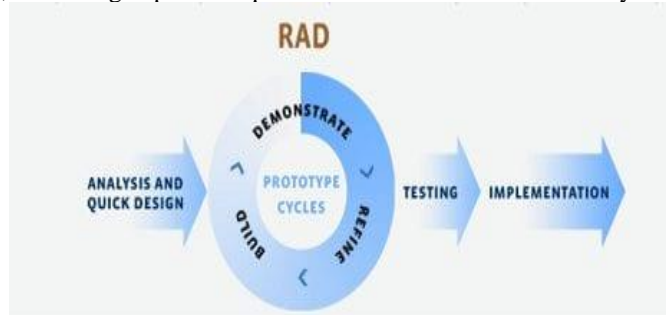


Fig 5: Rapid application development model

**V. RESULT AND DISCUSSION**

This section discusses the creation of systems, testing outcomes, and system application. It brings the project to life by providing a visual representation of the newly created system. All system programs will be downloaded to the user's computer during this phase. Programming languages that were used to create the system's architecture will be used during implementation.

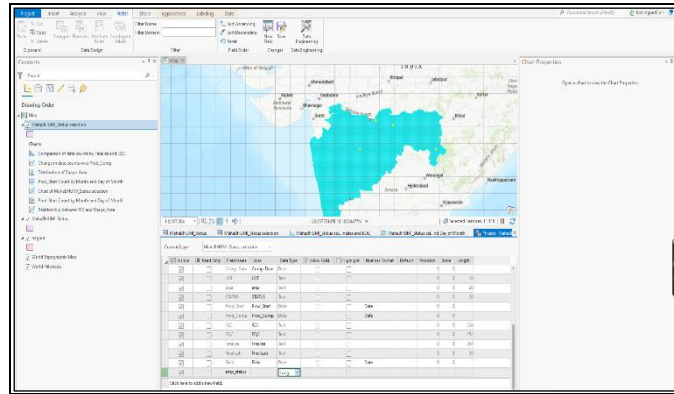


Fig 6: Adding dynamic fields into database

The open-source platform ArcGIS Explorer was selected for data collection, a suitable database management system that can define, manipulate, handle, and manage all of the data recorded in the .shp file and we have added the dynamic fields as per the client requirement.

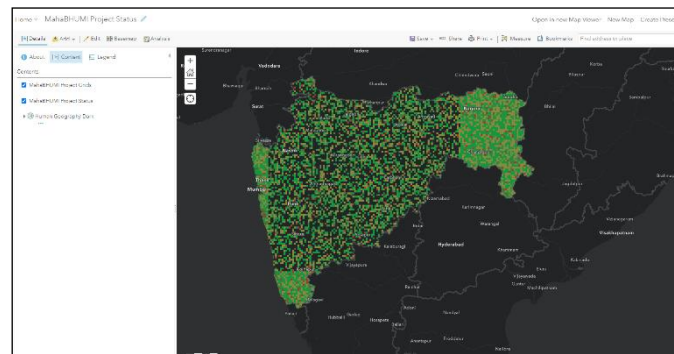


Fig 7: Configuration of Map

The above figure shows the Maharashtra map which contain the grids in polygonal shape and this map is linked to other components of the dashboard as we zoom in/zoom out the map the necessary action will occur in the dashboard.

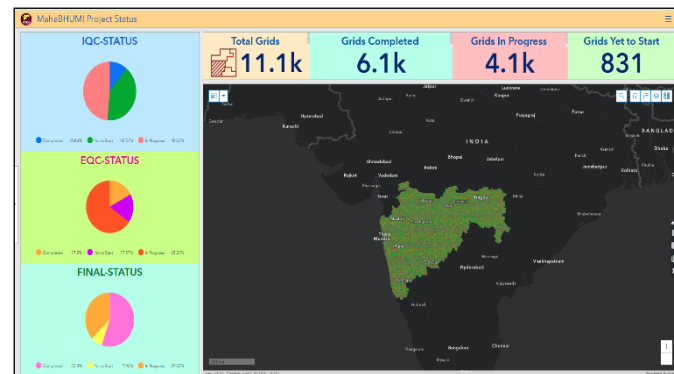


Fig 8: Monitoring dashboard for client

The above dashboard which is showing the IQC, EQC and Final status of the project progress which will include has the project is started or not, in progress and completed. The dashboard's user interface is set up so that each widget can be seen on a single screen. For real-time data visualization, the dashboard's elements are set up and connected to one another. The resulting Web-based GIS monitoring tool delivers data that helps the project managers or monitoring team can make a variety of decisions.

## **VII. CONCLUSION**

The project progress monitoring system will be a secure and user-friendly application which will allow the clients view the project quickly and conveniently in the form of dashboard. Operators and clients will be assisted in managing all difficult situations by this efficient Dashboard decision support system, which should focus on resolving alarm situations or reconfiguration requirements. Clients may observe project updates in real time, keep an eye on important KPIs, and keep things on track with the help of this dashboard. The dashboard will automatically display project data in readable, eye-catching graphics so that users can fully understand projects. An operator might impress their clients by identifying faults early on with the help of this technology. Operators will be able to see the workload of the team and simply track how much work has been performed in accordance with the timetable.

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