Acropolis Institute of Technology and

Research, Indore

Department of Computer Science and Engineering

B. Tech. IV Semester

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Synopsis on:-

Automatic Road Extraction and alert generation for new roads

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S. No	Date	Title	Page No.	Signature

SDLC MODEL

SDLC is a systematic process for building software that ensures the quality and correctness of the software built. SDLC process aims to produce high-quality software that meets customer expectations. The system development should be complete in the pre-defined time frame and cost. SDLC consists of a detailed plan which explains how to plan, build, and maintain specific software. Every phase of the SDLC life Cycle has its own process and deliverables that feed into the next phase. SDLC stands for **Software Development Life Cycle** and is also referred to as the Application Development life-cycle.

Waterfall Model

Description:

The **Waterfall Model** is a traditional, linear approach to software development. Each phase must be completed before the next one begins. The phases typically include requirement gathering, design, implementation, testing, deployment, and maintenance.

Advantages:

1. **Simple and easy to understand**: The sequential nature of the model makes it easy to manage and track progress.
2. **Well-defined stages**: Clear milestones and deliverables at each phase.
3. **Best for small, well-defined projects**: Works well when project requirements are stable and well-understood from the beginning.

Disadvantages:

1. **Inflexible**: Once a phase is completed, it's difficult to go back and make changes or corrections.
2. **Late testing**: Testing only happens after the development phase, potentially delaying bug discovery.
3. **Not suitable for complex or evolving projects**: If requirements change during the project, it can lead to significant delays and rework.

Iterative Waterfall Model

Description:

The **Iterative Waterfall Model** is an enhancement of the traditional Waterfall approach. It allows for iterative development, breaking the project into smaller modules or phases, where each iteration goes through the Waterfall steps (requirements, design, implementation, testing).

Advantages:

1. **Flexibility**: Provides the opportunity to revisit earlier stages and make improvements in future iterations.
2. **Early testing**: Testing occurs after each iteration, allowing for earlier bug detection.
3. **Risk reduction**: Smaller, incremental changes reduce the risk of large-scale failure.

Disadvantages:

1. **Time-consuming**: Iterations can add significant time to the development process due to repeated phases.
2. **Complex to manage**: Managing multiple iterations requires careful coordination and can lead to complexity.
3. **Resource-intensive**: More resources are often needed for each iteration, leading to higher costs.

Agile Model

Description:

The **Agile Model** emphasizes iterative, incremental development with a strong focus on collaboration, flexibility, and customer feedback. Work is divided into small cycles (called sprints), which typically last a few weeks. Each sprint results in a potentially shippable product increment.

Advantages:

1. **Flexibility**: Changes can be made at any stage of the development process.
2. **Customer collaboration**: Frequent feedback from customers ensures the product meets their needs.

3. **Faster time to market**: The product is delivered in increments, allowing some features to be released earlier.

Disadvantages:

1. **Can be hard to scale**: As projects grow larger, managing all iterations and teams can become complex.
2. **Less predictability**: The final product can evolve unpredictably, making it harder to estimate timelines and costs.
3. **Requires skilled teams**: Agile relies on effective communication and a high level of expertise, which may not be available in every team.

V-Model (Verification and Validation Model)

Description:

The **V-Model** is an extension of the Waterfall Model that emphasizes verification and validation. Each development stage is directly linked to a corresponding testing phase, ensuring that testing is done at every step of the development process.

Advantages:

1. **Clear and structured**: The direct relationship between development and testing phases ensures thorough validation.
2. **Early defect detection**: Testing is done in parallel with development, leading to early identification of issues.
3. **High reliability**: The V-Model ensures high-quality output through extensive verification and validation.

Disadvantages:

1. **Inflexible**: Like Waterfall, it's difficult to go back and make changes once a phase is completed.
2. **Late user feedback**: User feedback is usually collected late, after development and testing, which can lead to dissatisfaction.
3. **Not ideal for complex projects**: The model is best suited for small to medium projects with clear, unchanging requirements.

Spiral Model

Description:

The **Spiral Model** is a risk-driven, iterative approach to software development. It combines elements of both Waterfall and Iterative models, with a focus on identifying and mitigating risks at every phase of development. The process involves repeating cycles (spirals), each consisting of planning, risk analysis, development, and evaluation.

Advantages:

1. **Risk management**: Regular risk assessment ensures that potential issues are identified and addressed early.
2. **Flexibility**: The model allows for frequent changes and refinements in each iteration.
3. **Continuous customer feedback**: Regular evaluations allow for customer input throughout development.

Disadvantages:

1. **Complexity**: The need for constant risk management and iteration can make the process harder to manage.
2. **Expensive**: The frequent iterations and detailed risk management make this model more resource- and time-intensive.
3. **Requires skilled professionals**: The success of the Spiral Model depends heavily on skilled managers and teams who can effectively handle risk analysis and iteration planning.

RAD (Rapid Application Development) Model

Description:

The **RAD Model** is an incremental model that emphasizes rapid development and iteration. It focuses on delivering working software quickly, using prototypes and user feedback to make improvements. Development is divided into smaller, time-boxed phases called components or modules.

Advantages:

1. **Faster development**: The focus on prototypes and short iterations allows for faster delivery of functional software.

2. **User involvement**: Regular feedback from users during each iteration ensures the product meets their needs.

3. **Flexibility and adaptability**: The model allows for easy changes and improvements based on feedback.

Disadvantages:

1. **Requires skilled developers**: RAD requires a team of skilled developers who can rapidly build and iterate prototypes.

2. **Less suited for large projects**: It is difficult to scale RAD for large, complex systems.

3. **Quality issues**: Due to the rapid pace of development, there may be trade-offs in product quality and long-term maintainability.

DevOps Model

Description:

The **DevOps Model** is a set of practices and tools designed to integrate and automate the work of software development (Dev) and IT operations (Ops). It aims to shorten the development lifecycle, deliver features more frequently, and improve the quality and reliability of software systems.

Advantages:

1. **Faster delivery**: By automating workflows and continuous integration/continuous deployment (CI/CD), DevOps accelerates the delivery of software.

2. **Improved collaboration**: Developers and operations teams work together more closely, breaking down silos and improving communication.

3. **Continuous improvement**: DevOps supports continuous testing, monitoring, and feedback, leading to ongoing improvements.

Disadvantages:

1. **Requires significant cultural change**: Successful DevOps adoption requires shifting organizational culture, which can be difficult.

2. **Complex toolchain**: Managing the various tools and processes for continuous integration, delivery, and deployment can be complex.

SIH PROBLEM STATEMENT

problem statement :-

- Automatic Road Extraction and alert generation for new roads

Description:-

Background: Department of Space has made available its medium resolution satellite images through Boonidhi portal. Resourcesat satellite images (LISS IV sensor) are useful to extract roads with width of 20 feet and above due to its resolution. Description Roads: are linear features on satellite images and quite clearly visible for human interpretation because of their linearity. Automated road extraction is required in view of very large volume of imagery available nowadays. The roads extracted must be saved to a GIS database. When there is a change or new road development compared to previous image of the same area, there should be an alert generated. Expected Solution: A software based solution is expected that has a GUI to specify the area of interest for road extraction and alerts generation. Output should be in the form of shapefiles with geographical references. It should make use of ISRO ├ö ├ç ├ûs Boonidhi images. The alert should be sent to configured email ids.

UML TOOL: INSTALLATION OF STAR UML

Here are the steps to install StarUML on Windows:

1. Go to staruml.io/download
2. Select the operating system (OS) version for your system
3. Click the Download button
4. Right-click on the downloaded file and select Show in Folder
5. Click on the open file and click Yes in the popup window
6. The installation will start
7. After installation, a popup will ask you to buy a license
8. Click Buy Now or close the window
9. StarUML is ready to use

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Index

Sr No	Title	Page no	Signature
1	Project title	1	
2	Introduction	1	
3	Project benefit	1	
4	Problem statement	2	
5	Objective	2	
6	Intended user	2-3	
7	Proposed solution	3	
8	Proposed system	3-5	
9	Expected outcome	5	
10	Conclusion	6	

Synopsis

Title:- Automatic Road Extraction and alert generation for new roads

Introduction :-

In the modern era of urbanization and infrastructure development, monitoring road networks efficiently is crucial. Traditional methods of road mapping and detection involve manual surveys and periodic satellite imagery analysis, which are time-consuming and costly. This project proposes an automated solution that leverages advanced image processing, GIS technologies, and machine learning algorithms to detect newly constructed roads and generate real-time alerts. The system aims to enhance road monitoring capabilities by providing accurate and timely information to relevant authorities.

Project Benefits:-

- Real-time monitoring
- Automated road detection
- Accurate data integration
- Scalable solutionCost-effective implementation

Problem Statement:-

Automatic Road Extraction and alert generation for new roads.

Objective:-

he primary objectives of this project include:

1. Developing an AI-based system for automatic road extraction from satellite imagery.
2. Implementing image processing techniques to detect changes in road networks.
3. Integrating GIS and remote sensing data to enhance detection accuracy.
4. Generating real-time alerts for newly constructed roads.
5. Creating a scalable and cost-effective solution applicable to various geographical regions.

Intended Users:-

- **Government Authorities:** Urban planners, municipal corporations, and transport departments for infrastructure planning.

- **Mapping and Navigation Services:** Organizations like Google Maps, OpenStreetMap, and navigation service providers for updating road databases.
- **Disaster Management Agencies:** To ensure updated road accessibility for emergency response.
- **Construction Companies:** For monitoring and verifying road development projects.
- **Environmental Analysts:** To study the impact of new roads on natural landscapes and ecosystems.

Proposed Solution:-

1. **Automated Road Extraction:** Utilizing deep learning models on satellite images to identify road networks.
2. **GIS Integration:** Storing and analyzing extracted road data in GIS for precise mapping and analysis.
3. **Change Detection:** Comparing new and old satellite images to detect modifications in road infrastructure.
4. **Real-time Alerts:** Sending automated notifications to stakeholders upon detecting new roads.
5. **User-friendly Interface:** Developing an intuitive dashboard for easy monitoring and customization.

Proposed System

7.1 System Features

1. **Automated Road Extraction:** Extract road networks using deep learning models on satellite images.
2. **Real-time Monitoring:** Provide near real-time updates on newly detected roads.
3. **Customization:** Allow users to configure monitoring parameters and alert thresholds.
4. **Visualization:** Display road changes through interactive GIS-based maps.
5. **Multi-platform Support:** Enable integration with different mapping services.
6. **Scalability:** Ensure the system handles large-scale image processing and multiple user interactions.

7.2 Process Flow

1. Collect satellite images for monitoring.
2. Preprocess images (clean, filter, segment).
3. Analyze road networks using deep learning models.
4. Detect changes by comparing historical and new images.
5. Generate alerts and update GIS maps.
6. Provide interactive visualization and insights.
7. Allow user customization for enhanced monitoring.

7.3 Hardware Requirements

1. Standard computing hardware (desktop or server).
2. Sufficient RAM and processing power for deep learning models.
3. Storage capacity for handling large satellite image datasets.
4. Internet connectivity for real-time data updates and API integration.

7.4 Software Requirements

1. **Operating System:** Compatible with Windows, macOS, and Linux.
2. **Programming Languages:** Python for backend development.
3. **Libraries/Frameworks:** Utilize TensorFlow, OpenCV, and GIS tools.
4. **Database:** Use PostgreSQL with PostGIS or MongoDB for geospatial data storage.
5. **Web Framework:** Develop frontend using Flask or Django.
6. **Visualization:** Integrate Leaflet, Matplotlib, or Plotly for GIS-based analysis.

EXPECTED OUTCOMES:-

- An AI-driven automated system capable of detecting new roads with high accuracy.
- A web-based or mobile alert system to notify relevant stakeholders.
- Enhanced road mapping efficiency, reducing manual labor and associated costs.
- Integration with existing GIS platforms for seamless data utilization.

Conclusion:-

This project presents a novel approach to automatic road extraction and alert generation, leveraging modern AI, GIS, and remote sensing technologies. By providing accurate, real-time insights into new road developments, this system aims to revolutionize infrastructure monitoring and planning while ensuring cost-effectiveness and scalability.