**1. Key Stakeholders and Their Roles**

| **Stakeholder** | **Role** | **Interest in the Project** |
| --- | --- | --- |
| **Government Agencies** | Urban Planning, Environmental Monitoring | Use land type classification for urban development, environmental conservation, and resource management. |
| **Agricultural Organizations** | Farmers, Agribusinesses | Utilize land type data for crop monitoring, soil health assessment, and precision agriculture. |
| **Environmental NGOs** | Conservation Groups | Monitor deforestation, water bodies, and other environmental changes. |
| **Research Institutions** | Academics, Researchers | Use the model and dataset for research in remote sensing, machine learning, and environmental science. |
| **Technology Providers** | Cloud Service Providers, Software Developers | Provide infrastructure (e.g., cloud platforms) and tools (e.g., QGIS, TensorFlow) for model development and deployment. |
| **End Users** | General Public, Urban Planners, Farmers | Access land type classification results for personal or professional use. |
| **Project Team** | Data Scientists, ML Engineers, DevOps, Project Manager | Develop, deploy, and maintain the land classification model. |

**2. Stakeholder Needs and Expectations**

| **Stakeholder** | **Needs and Expectations** |
| --- | --- |
| **Government Agencies** | - Accurate and up-to-date land type classification for policy-making. - Scalable solutions for large-scale land monitoring. - Easy-to-use tools for non-technical users. |
| **Agricultural Organizations** | - High-resolution land type data for precision agriculture. - Timely updates on land use changes (e.g., crop health, soil conditions). - Integration with existing agricultural management systems. |
| **Environmental NGOs** | - Reliable data on environmental changes (e.g., deforestation, water body shrinkage). - Tools for monitoring and reporting environmental issues. - Access to historical data for trend analysis. |
| **Research Institutions** | - Access to high-quality datasets for academic research. - Open-source model code for reproducibility and further development. - Collaboration opportunities with the project team. |
| **Technology Providers** | - Increased adoption of their platforms (e.g., cloud services, software tools). - Feedback on tool performance and usability. - Opportunities for partnerships and co-development. |
| **End Users** | - User-friendly interface for land type classification. - Fast and accurate results. - Affordable or free access to the tool. |
| **Project Team** | - Clear project goals and timelines. - Access to necessary resources (e.g., data, computing power). - Support from stakeholders for feedback and testing. |

**3. Stakeholder Engagement Plan**

| **Stakeholder** | **Engagement Strategy** |
| --- | --- |
| **Government Agencies** | - Regular updates on project progress. - Workshops or training sessions on how to use the tool. - Customized reports for specific regions or use cases. |
| **Agricultural Organizations** | - Collaborate on pilot projects to test the tool in real-world agricultural settings. - Provide tailored solutions for precision agriculture. - Offer training on interpreting land type data. |
| **Environmental NGOs** | - Share environmental monitoring reports generated by the tool. - Provide access to historical data for trend analysis. - Collaborate on environmental conservation projects. |
| **Research Institutions** | - Publish open-source code and datasets for academic use. - Organize joint research projects or hackathons. - Share findings through conferences and publications. |
| **Technology Providers** | - Collaborate on optimizing the model for their platforms. - Provide feedback on tool performance and usability. - Explore co-marketing opportunities. |
| **End Users** | - Develop a user-friendly interface for the tool. - Provide tutorials and documentation for non-technical users. - Offer customer support for troubleshooting. |
| **Project Team** | - Regular team meetings to track progress and address challenges. - Provide access to necessary resources (e.g., data, computing power). - Encourage collaboration and knowledge sharing within the team. |

**4. Potential Challenges and Mitigation Strategies**

| **Challenge** | **Mitigation Strategy** |
| --- | --- |
| **Differing Stakeholder Needs** | - Prioritize stakeholder needs based on project goals. - Develop customizable features to meet diverse requirements. |
| **Limited Resources** | - Seek funding or partnerships to support project development. - Use open-source tools and datasets to reduce costs. |
| **Resistance to Change** | - Provide training and support to help stakeholders adopt the tool. - Demonstrate the tool’s benefits through pilot projects. |
| **Data Privacy Concerns** | - Ensure compliance with data privacy regulations. - Use anonymized data for public access. |

**5. Communication Plan**

| **Stakeholder** | **Communication Channel** | **Frequency** |
| --- | --- | --- |
| **Government Agencies** | Email updates, workshops, reports | Monthly |
| **Agricultural Organizations** | Pilot project meetings, training sessions | Bi-weekly |
| **Environmental NGOs** | Environmental reports, collaboration meetings | Quarterly |
| **Research Institutions** | Open-source code releases, joint research projects | As needed |
| **Technology Providers** | Feedback sessions, co-development meetings | Quarterly |
| **End Users** | Tutorials, customer support, user forums | Ongoing |
| **Project Team** | Team meetings, progress reports | Weekly |

**2. User Stories & Use Cases – Scenarios Illustrating How Users Interact with the System**

**User Stories**

1. **As a Government Urban Planner**, I want to classify land types in a specific region so that I can make informed decisions about urban development.
2. **As a Farmer**, I want to monitor crop health and soil conditions using land type data so that I can optimize my agricultural practices.
3. **As an Environmental NGO**, I want to track deforestation and water body changes over time so that I can report on environmental issues.
4. **As a Researcher**, I want to access high-quality satellite imagery and land type classification data so that I can conduct academic research.
5. **As an End User**, I want to upload a satellite image and receive a land type classification report so that I can understand the land use in my area.

**Use Cases**

1. **Urban Planning**:
   * **Actor**: Government Urban Planner
   * **Description**: The urban planner uploads a satellite image of a region and receives a detailed land type classification report. The report helps in planning new infrastructure projects.
   * **Steps**:
     1. Upload satellite image.
     2. Run land type classification.
     3. View and download the classification report.
2. **Precision Agriculture**:
   * **Actor**: Farmer
   * **Description**: The farmer uses the tool to monitor crop health and soil conditions. The tool provides insights into which areas need irrigation or fertilization.
   * **Steps**:
     1. Upload satellite image of farmland.
     2. Run land type classification.
     3. Analyze results to identify areas needing attention.
3. **Environmental Monitoring**:
   * **Actor**: Environmental NGO
   * **Description**: The NGO uses the tool to track changes in forest cover and water bodies over time. The tool generates reports that can be used for advocacy and policy-making.
   * **Steps**:
     1. Upload time-series satellite images.
     2. Run land type classification for each image.
     3. Compare results to track changes over time.
4. **Academic Research**:
   * **Actor**: Researcher
   * **Description**: The researcher accesses the tool to download high-quality satellite imagery and land type classification data for academic research.
   * **Steps**:
     1. Access the tool’s open dataset.
     2. Download satellite images and classification data.
     3. Use the data for research and analysis.
5. **General Land Use Analysis**:
   * **Actor**: End User
   * **Description**: A general user uploads a satellite image of their area of interest and receives a land type classification report.
   * **Steps**:
     1. Upload satellite image.
     2. Run land type classification.
     3. View and download the classification report.

**3. Functional Requirements – List of Features and Functionalities**

1. **User Authentication**:
   * Users can create accounts and log in to access the tool.
2. **Image Upload**:
   * Users can upload satellite images in supported formats (e.g., GeoTIFF, JPEG).
3. **Land Type Classification**:
   * The system can classify land types (e.g., agriculture, water, urban, desert) from uploaded satellite images.
4. **Report Generation**:
   * The system generates a detailed report with land type classifications and visualizations (e.g., maps, charts).
5. **Historical Data Access**:
   * Users can access historical satellite images and classification data for trend analysis.
6. **API Integration**:
   * The system provides an API for developers to integrate land type classification into other applications.
7. **User Dashboard**:
   * Users have a dashboard to view past classification results, download reports, and manage their account.
8. **Data Export**:
   * Users can export classification results in various formats (e.g., CSV, PDF).

**4. Non-Functional Requirements – Performance, Security, Usability, and Reliability Criteria**

1. **Performance**:
   * The system should classify land types within **2 seconds** for a standard-sized satellite image.
   * The system should handle up to **100 concurrent users** without performance degradation.
2. **Security**:
   * User data and uploaded images should be encrypted both in transit and at rest.
   * The system should comply with **GDPR** and other relevant data privacy regulations.
3. **Usability**:
   * The user interface should be intuitive and require minimal training for non-technical users.
   * The system should provide tooltips, tutorials, and documentation to guide users.
4. **Reliability**:
   * The system should have **99.9% uptime** to ensure continuous availability.
   * The system should automatically retry failed classification requests.
5. **Scalability**:
   * The system should scale horizontally to handle increasing numbers of users and larger datasets.
   * The system should support deployment on cloud platforms (e.g., AWS, Google Cloud) for scalability.
6. **Maintainability**:
   * The system should have modular code and clear documentation to facilitate future updates and maintenance.
   * The system should include logging and monitoring tools to track performance and detect issues.
7. **Compatibility**:
   * The system should support multiple satellite image formats (e.g., GeoTIFF, JPEG, PNG).
   * The system should be compatible with major web browsers (e.g., Chrome, Firefox, Safari).