

**STATEMENT OF CASE FOR OBTAINING SANCTION OF COMPETENT  
AUTHORITY FOR WHITELISTING OF 'CHANGE DETECTION AND OBJECT  
DETECTION IN SATELLITE IMAGERY USING ARTIFICIAL INTELLIGENCE (AI)  
ALGORITHMS'  
BY COLLEGE OF MILITARY ENGINEERING (CME), PUNE**

**BACKGROUND**

1. CME is an approved Research Centre of Savitribai Phule Pune University (SPPU) for research and development with research scholars (both civilians and military officers) doing research under the approved guides (professors from CME) of SPPU. CME is the nodal centre for AI and Robotics for the Corps of Engineers and has been constantly striving to undertake research and development in the niche fields of Artificial Intelligence. This proj of satl imagery interpretation is being undertaken to gain information remotely on the enemy territory by automating the task of extraction of information from a satl image this technique will help in faster generation of intelligence for real time situational awareness. To address the issue college had proposed to project under the aegis of HQ ARTRAC for developing Sarvatra Drishti: **Change Detection and Object Detection in Satellite imagery using Artificial Intelligence (AI) Algorithms.**

**AIM**

2. The aim of this proposed project was to develop an automated AI based system for automated information extraction and object classification from satl imagery. Post development of the project, the appln needs to be fielded for whitelisting to ensure it meets security, compliance, and performance standards for secure installation on auditable PCs of the user's for further exploitation.

**DETAILED JUSTIFICATION**

3. For handling large imagery data and identifying smallest of changes, imagery interpreters must spend hours looking at data and going through various details. This may lead to prioritisation of task of imagery interpretation, which may lead to not checking a large chunk of data on a regular basis, which might contain small signatures of critical intelligence. In addition, there is a huge cognitive load that is employed in undertaking the task of interpretation. All this lead to creating an opportunity for automated computer vision and artificial intelligence driven system to analyze satl imagery datasets that can take on the cognitive load, report all small changes, generate priority lists and make it available for experts to analyse in for greater details. This approach has created a data driven priorities, automatically report changes in low priority areas and create intelligence database using satl images for immediate action or for any future reference. A stable automated system would potentially be able to analyse all generated imagery data for the areas of interest, generate intelligence, flag major changes and create priority pipelines based on observed changes, geo-political context, current engagements and field intelligence. This methodology leaves no satl image unanalyzed, how much so ever

low priority area that may be covering. This would drastically reduce pressure on experts to manually go through individual datasets. Further, due to automated prioritization, smallest of the details would get captured hence reinforcing information pipeline for accurate intelligence gathering is able to give pre-emptive intelligence and help intelligence community to focus on areas that were getting missed. With the advent of niche technologies of AI, it is time to apply the latest technologies to enable automated satl image interpretation in an effective and efficient manner.

### **FINANCIAL JUSTIFICATION**

The proj has been devp through IR&D fund costing Rs 40.77 lakhs.

### **CONCLUSION**

4. Using Change and Object Detection with Artificial Intelligence (AI) algorithms in satl imagery offers significant advantages for identifying 09 military targets like Emplacement, Tank, Plane, Warship, Oil tank, Helicopter, Arty Gun, Vehicle & tents developed in the project. AI enhances accuracy by precisely identifying and classifying targets, which helps in reducing false positives. Automated change detection helps detect alterations or new installations (Bldg) and tracks which is carried by analyzing sequential images. The system efficiently processes High Resolution (HR) imageries which contains large volumes of data quickly, reducing manual effort and allowing analysts to focus on interpreting results. AI also improves intelligence quality by identifying subtle patterns leading to more informed decision-making. Overall, this appln enhances operational efficiency and cost-effectiveness by automating detection processes and providing detailed classification of the object. It also provides to generate customizable report as per user requirement. The AI algorithm of the appln assist in reducing the cognitive load and pressure on intelligence experts for data extraction and image interpretation.

Station : Pune

Dated : 17 Sep 24

  
Col  
Project Officer



## CHECKLIST

1. **Name of the Proj(incl version No):** Sarvatra Drishti: Change Detection and Object Detection in Satellite Imagery using Artificial Intelligence (AI) algorithms.
2. **Name of Sponsor** : College of Military Engineering.
3. **Types of Software** : Customized AI based application (standalone software)
4. **Brief Justification Endorsement of Reqmt for Devp of Sw Appln** : Automated change and object detection from satl imagery using artificial intelligence (AI) is essential because for handling large imagery data and identifying smallest of changes imagery interpreters must spend hours looking at data and going through various details. To optimize the time, resources, and accuracy the software which is based on the Deep Learning framework model is developed which takes in the temporal Satl images as an input and detects the changes which have occurred between the images. The model has a Supervised Classification that identifies objects which are of military relevance based on the pre-fed training data of various features of military importance (09 tgt features). The model has been trained to identify the objects like military targets such as Emplacement, Tank, Plane, Warship, Oil tank, Helicopter, Arty Gun, Vehicle & Tent and infrastructure accurately. The Graphical User Interface designed for the software has facility for undertaking change detection among two images of the same location and displays the output on a GIS background highlighting the changes in the area of interest like Bldg and tracks.
5. **Aim & Scope Purpose Incl Utility, Beneficiaries and Tgt Users**
  - (a) **Aim.** The aim of this project was to design and develop an indigenous automated satl image analysis process, to detect changes and identify the military oriented tgts/objects in temporal satl image data.
  - (b) **Scope.** To create a Geo Spatial analysis engine for Change Detection and Object Detection in satl imagery using Artificial Intelligence (AI) which would include the fwg:-
    - (i) **Target Identification.** With high resolution imagery and correlation training database, nine (09) targets like Emplacement, Tank, Plane. Warship, Oil Tank, Helicopter, Artygun, Vehcile & Tent will get identified.
    - (ii) **Target Classification.** Once targets are identified, classification of the targets is undertaken with correct labelling and counting of detected objects into different classes, ex : landform changes like bldgs, detected objects like vehicles, guns, fuel tanks etc. is carried out.

(iii) **Change Detection using Past Data from Database.** This module detects any structural change in a particular location from temporal data. Change detection in the context of satl imagery involves identifying and analysing differences or changes that have occurred between multiple images captured at different times. It encompasses the comparison of pixel values, object characteristics, and spatial patterns between two or more images to detect areas of change or significance.

(iv) **Retrain Model.** The retraining feature in object detection systems is incorporated for enhancing accuracy and adaptability, allowing the model to evolve dynamically in response to user feedback and changing environments. This feature enables the user to manually correct erroneous detections, in this manner the system continuously learns from its mistakes, and improves the precision and confidence in identification of tgts..

(v) **Annotations.** It is essential for object detection as it provides labeled training data crucial for teaching models to recognize and localize objects within images accurately. By annotating images with bounding boxes and class labels, the training process becomes supervised, enabling models to learn from ground truth information about object presence, location, and category.

(vi) **Report Generation.** After completing object detection, correction loops, or change detection, the application offers a report generation feature. This functionality consolidates information from downloaded results and user-provided data to create comprehensive reports. Reports contain essential details such as functionality performed, date, classes detected, and location information.

(c) **Beneficiaries and Tgt users.** The software will assist commanders in field to take decisions on real time basis in an operational environment provided they have high resolution satl imageries. This will immensely benefit all DGMI for generation of int report, DIPAC for change and object identification, Comd/Corps IITs & Mil Svy units for updation of maps.

6. **To be Hosted on Internet/ADN with brief Justification** : Current appln is devp for installing in standalone sys. The software also has the capb to run in enterprise mode. However, as, the access of satl imagery over ADN will consume higher bandwidth, hosting on ADN is not recommended.



7. **Being Devp In-house or Through IT Funds** : Through IR&D funds.
8. **Usability of propose Appls by other Arms/Services/Est** : Change detection and object detection software applications are highly beneficial in military operations, particularly when customized for image interpretation teams and other military establishments. These tools significantly speed up the analysis of large volumes of imagery by automatically detecting changes in key features, such as roads and bldgs, and identifying nine specific objects of interest. This automation reduces the workload on analysts, enabling them to focus on interpreting the most critical information. The advanced algorithms employed by the software enhance the detection of subtle changes or objects that might be missed by human analysts, especially in high-resolution satl or drone imagery. As a result, image interpretation teams can produce more accurate intelligence reports, which are crucial for informed decision-making. Additionally, for field units, the ability to detect changes in satl imagery within their Area of Responsibility (AoR) is vital, and the software's output can be integrated with the Surveyshak software to further enhance the decision support system (DSS), ensuring timely and accurate operational responses
9. **HW and IT Infrastructure Reqcd** : Appx A
10. **Brief Details of Content of the SW Appl** : The appln integrates Compute Unified Device Architecture (CUDA), PostgreSQL, and a main executable file to create a powerful tool for military ops, particularly in int, svl, and reconnaissance (ISR). CUDA enables the appln to harness NVIDIA GPUs for high-performance, parallel processing, crucial for handling computationally intensive tasks like real-time object detection and change detection. PostgreSQL provides a robust, scalable platform for data storage and retrieval, ensuring that critical data is securely managed and easily accessible. The main executable file serves as the user interface, allowing military personnel to interact with the application efficiently. Together, these components ensure the appln operates effectively in various op envt, enhancing the overall decision-making and op capb of military forces. Proper installation and configuration of these elements are essential for maximizing the application's performance and ensuring its reliability in the field.
11. **Endorsement by Head of Br/Svc/Fmn** : Yes
12. **Details of User Base** : All Image Interpretation Teams (IITs), DGMI, Unit Fmns.
13. **Envisaged Cost of Entire Proj Incl Licence, Fees & Maint** : 40.77 Lakhs
14. **Projected Dt of Completion Incl MajTimeline**.
- (a) SW Devp Pd : Appx 8 months.

(b) Testing and Trials : Appx two months.

15. **Brief details of SW Platform and Tech Stack Proposed for Devp of Appl Incl Op Sys Dependencies (if any)** : Win 10, PostgreSQL, Python, Django, Javascript, Basic HTML and CSS.

16. **Brief Details of Proposed Network and Bandwidth Reqmts** : NA

17. **Brief details of OS & Sys Software Reqmts** : Win 10.

18. **Brief Details of Proposed Data Security Measure and Backup of Data** : User based authentication and authorization to handles software. Back up of data is inbuilt in the software.

19. **Brief Details of Proposed Database Engine to be Used in the Appln** : PostgreSQL.

20. **Details of SW Architecture and COTS SW Proposed to be Utilised** : Nil.

21. **Details of Proposed architecture** : Standalone.

22. **Brief Details of Proposed Utilisation of Public Key Infra (PKI) and Iden and Access Mgmt (IAM)** : NA

23. **Technology Dependencies (if any)** : Nil.

24. **Database Reqmt** : PostgreSQL.

25. **Enhancement/ Upgradation /Patch Mgt/SW Updt Procedure and Mechanism** : Upgradation can be provided with new \*.exe file which detailed instl manual.

26. **Details of the Licensing (if any)** : Perpetual.

Station :

Date :

Pune  
17 Sep 24

HoD

SCRI

**RECOMMENDATION OF COMMANDANT, COLLEGE OF MILITARY ENGINEERING**  
**ON STATEMENT OF CASE FOR OBTAINING SANCTION OF COMPETENT**  
**AUTHORITY FOR WHITELISTING OF SARVATRA DRISHTI S/W 'CHANGE**  
**DETECTION AND OBJECT DETECTION IN SATELLITE IMAGERY USING**  
**ARTIFICAL INTELLIGENCE (AI) ALGORITHMS'**

Recommended / Not Recommended



Station: Pune

Dated

लेफ्टिनेंट जनरल  
Lt Gen

आदेशक

Commandant

सैन्य इंजिनियरिंग कॉलेज, पुणे-४११०३१

College of Military Engg Pune-411031