LBP Report

AI/ML in target detection for reduction in False Alarm

Submitted to:

Prof. Dharmendra Singh

Submitted by:

Name: Krishna Bhardwaj

Email: krishna_b@ece.iitr.ac.in

Enrolment Number: 20116047

Branch: ECE 3rd year

Name: Divyansh Verma

Email: divyansh_bv@ece.iitr.ac.in

Enrolment Number: 20116031

Branch: ECE 3rd year

❖ OBJECTIVES:

- To find the efficient ML technique for detection of different classes in target area like Vegetation, Water Body, Building and Road
- To detect the change of different classes in two images of different dates using different ML techniques like Support Vector Machine, Random Forest, and Deep Neural Networks
- To reduce the false alarms in the results and hence improve the accuracy.

❖ INTRODUCTION:

Change detection (CD) is a phenomenon of detecting change in targets of the same geographical area by observing the set of images captured at different periods to find Geospatial changes: natural or human-made occurrences. Remote Sensing (RS) technology provide a potent data source for continuous observation and evaluation over time for evaluating changes various temporal and spatial resolution datasets. To learn the reduction of false alarms, this project implements post-classification techniques of change detection: Random Forest, Support Vector Machine and Neural Network.

This study involves satellite imageries of Sentinel-2 satellite. To extract features for implementing classification techniques, spectral indices of respective classes are used. Three classification techniques are utilized to deduce an optimum classification model. After the classification maps are produced, change in the target area is evaluated from the results of two dates. Reference image from google earth is compared with results to calculate confusion matrix. False alarms are then reduced by refining the model which further improves the accuracy of change detection model.

Various classification techniques used here are Support Vector Machine (SVM), Random Forest and Deep Neural Network (DNN). SVM classify data points even when they are not otherwise linearly separable by mapping the data to a high-dimensional feature space. Random forest combines the output of multiple decision trees to reach a single result. DNN represents the type of machine learning when the system uses many layers of nodes to derive high-level functions from input information.

Application:

- Tracking environmental conditions – deforestation, desertification
- Land-use and land-cover (LULC) change
- Impact of natural disasters - floods
- Urban expansion

- Agriculture: finding changes in vegetation
- Analysing climate change

❖ WORK FLOW AND METHODOLOGY

- As shown in the figure 1 different band images are obtained using different wavelength waves, hence different bands contain information about different land covers in a different way. For example, band-2 and band-3 image will have different pixel value at the same location.

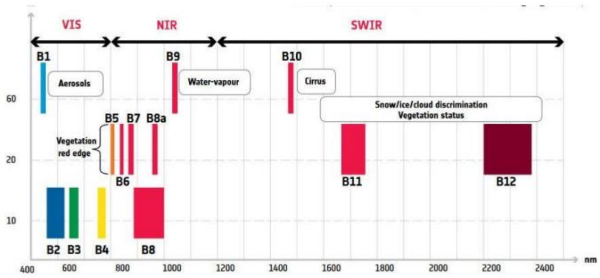


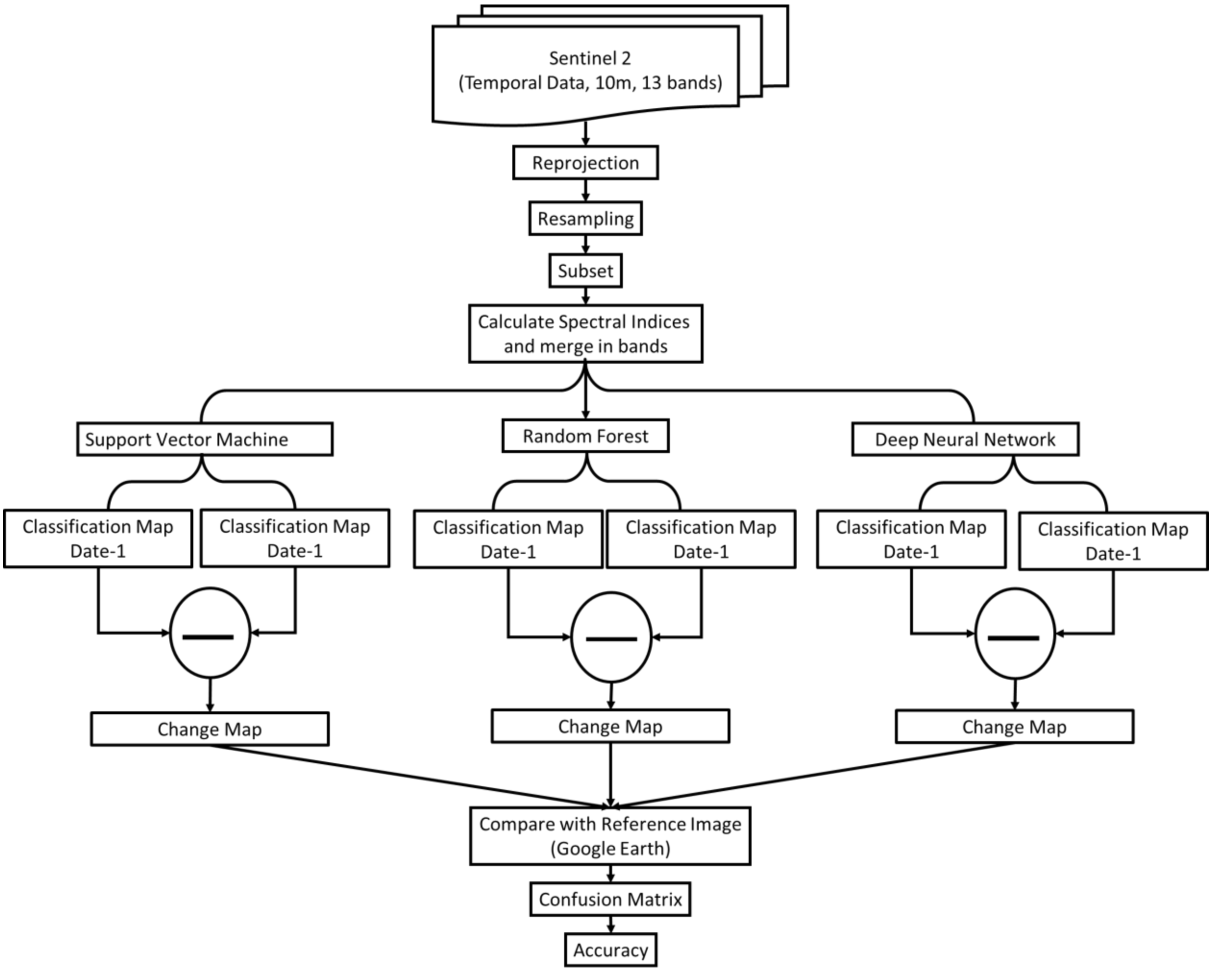
Fig-1. Sentinel-2 bands spectrum

- New bands can also be formed using available bands. Mathematical operation can be applied on the values in the 2 bands to get a new band. These new bands are also known as spectral indices.
- These spectral indices are very helpful in highlighting some of the features like PISI spectral indices can highlight the road, NDWI can highlight the water surface present in the image.
- Hence, we have added 4 new spectral indices namely PISI, NDBI, NDVI, NDWI to our data. The description of different spectral indices can be found in the table 1.
- Hence for one pixel of an image we have 16 band data and we need to form corresponding output to train out ML technique model.
- For output preparation we have used masking technique in which a mask is created on some class and pixels values for that are picked up.
- Basically, we have picked up some pixels of each class using SNAP software.
- Now to prepare for certain class say road we give output corresponding to road pixel as 1 and rest as 0. Similarly for the other classes.
- All the models SVM, Random Forest and DNN are trained for the input and output.
- Then pixels of whole image are given as input and output is predicted based on which a binary image is created as output image.
- Change is detected for two images of different dates and which is compared with reference image prepared using google earth data.

Spectral Indices	Spectral Indices Formula
NDWI	Normalized Difference Water Index (NDWI) **NDWI = (GREEN-NIR) / (GREEN+NIR)**
PISI	Perpendicular Impervious Surface Index (PISI) **PISI = 0.8192 * BLUE - 0.5735 * NIR + 0.075**
NDBI	Normalize Difference Build-up Index (NDBI) **NDBI = (SWIR – NIR) / (SWIR + NIR)**
NDVI	Normalized Difference Vegetation Index (NDVI) **NDVI = (NIR-RED) / (NIR+ RED)**

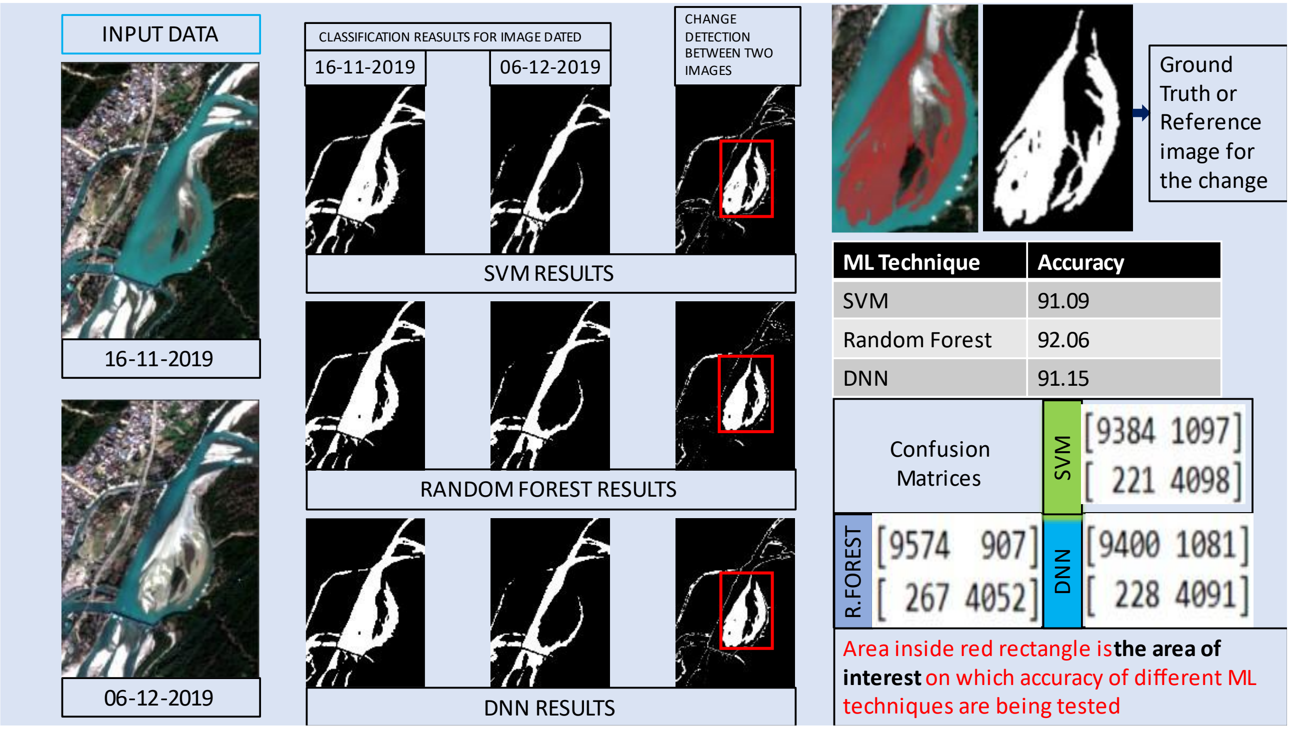
Table 1. Spectral Indices Formula

- **Model Architecture:**

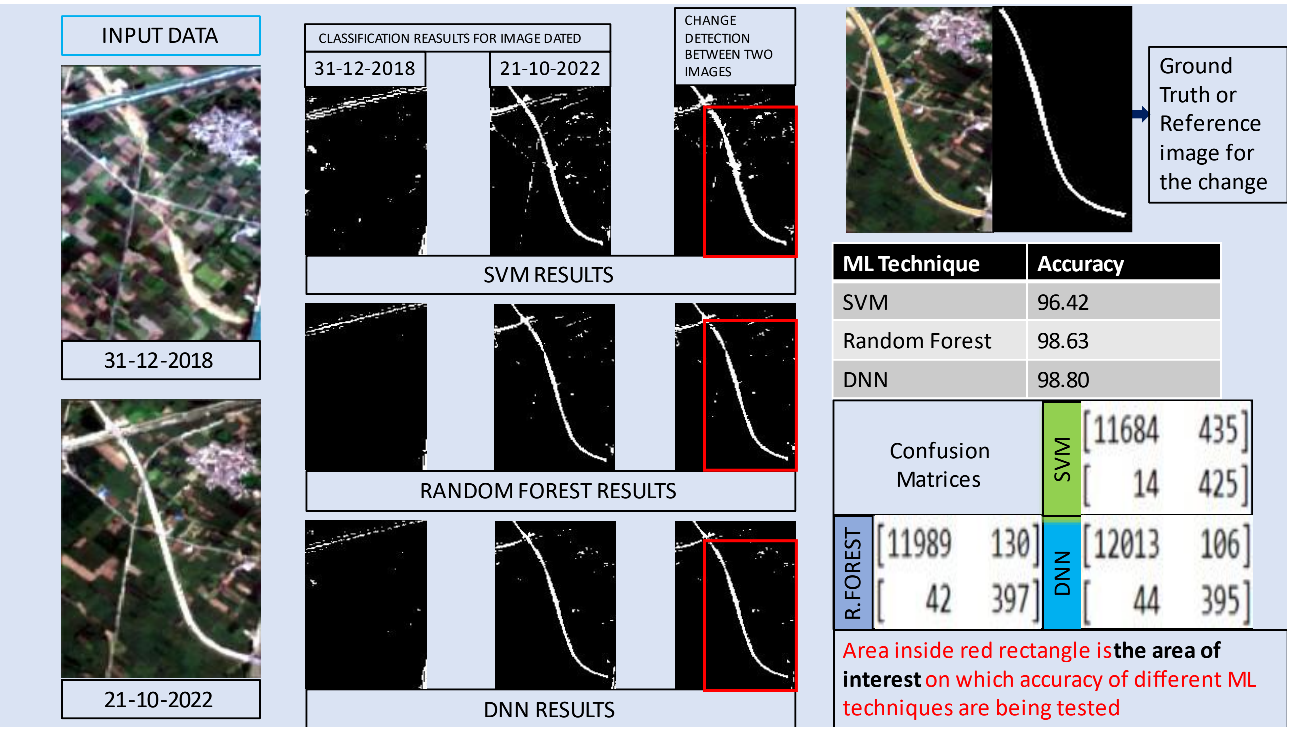


❖ RESULT

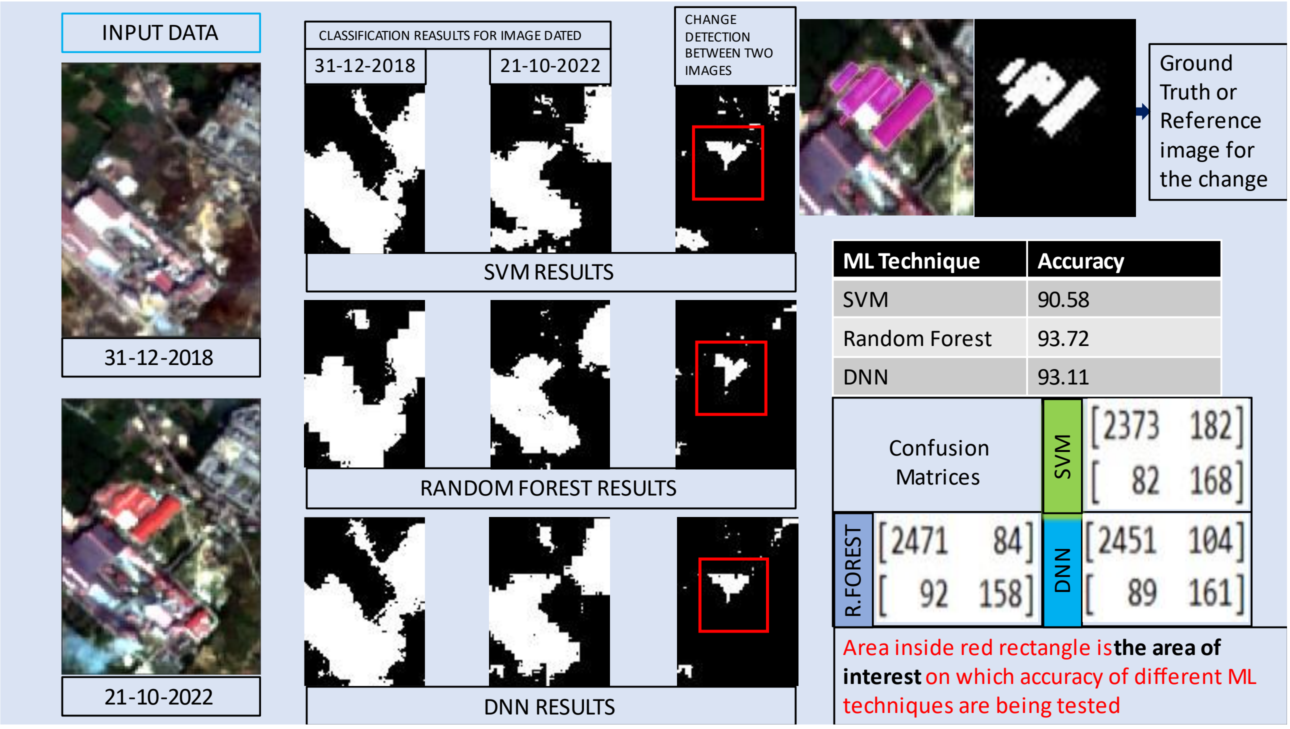
➢ Water Class



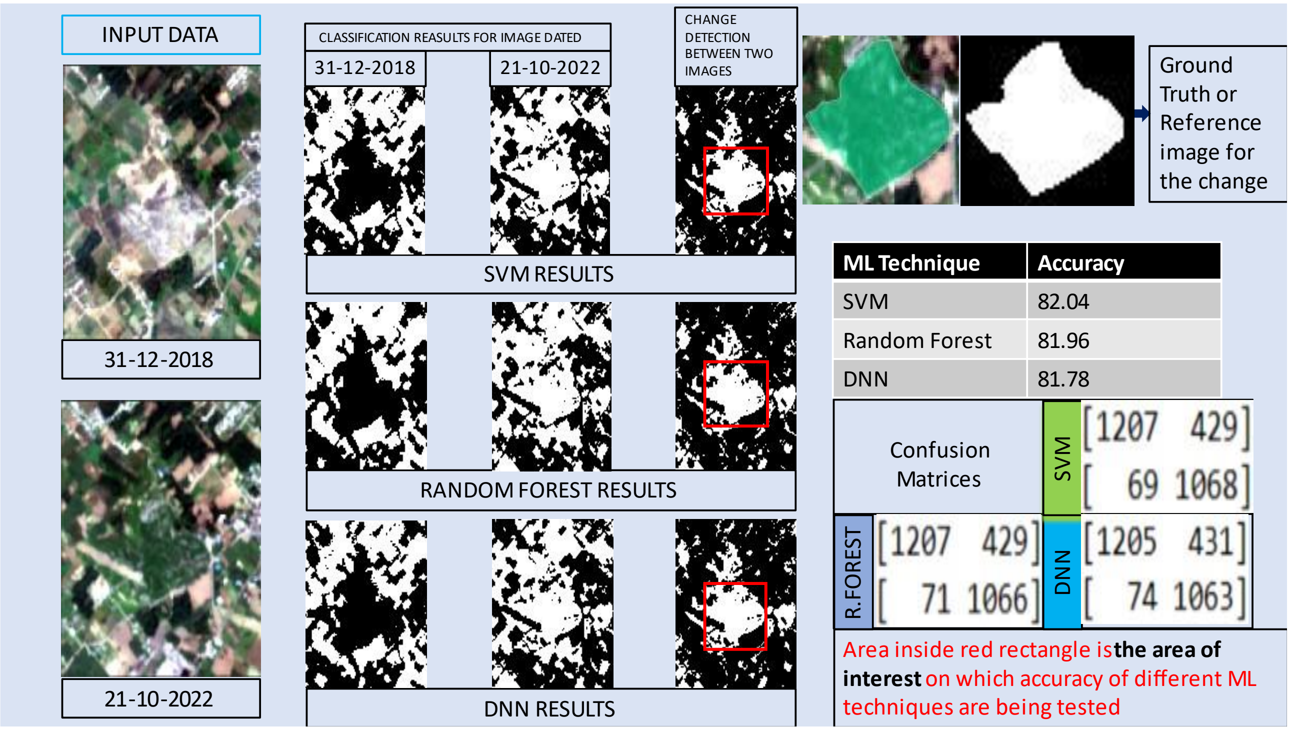
➢ Road Class

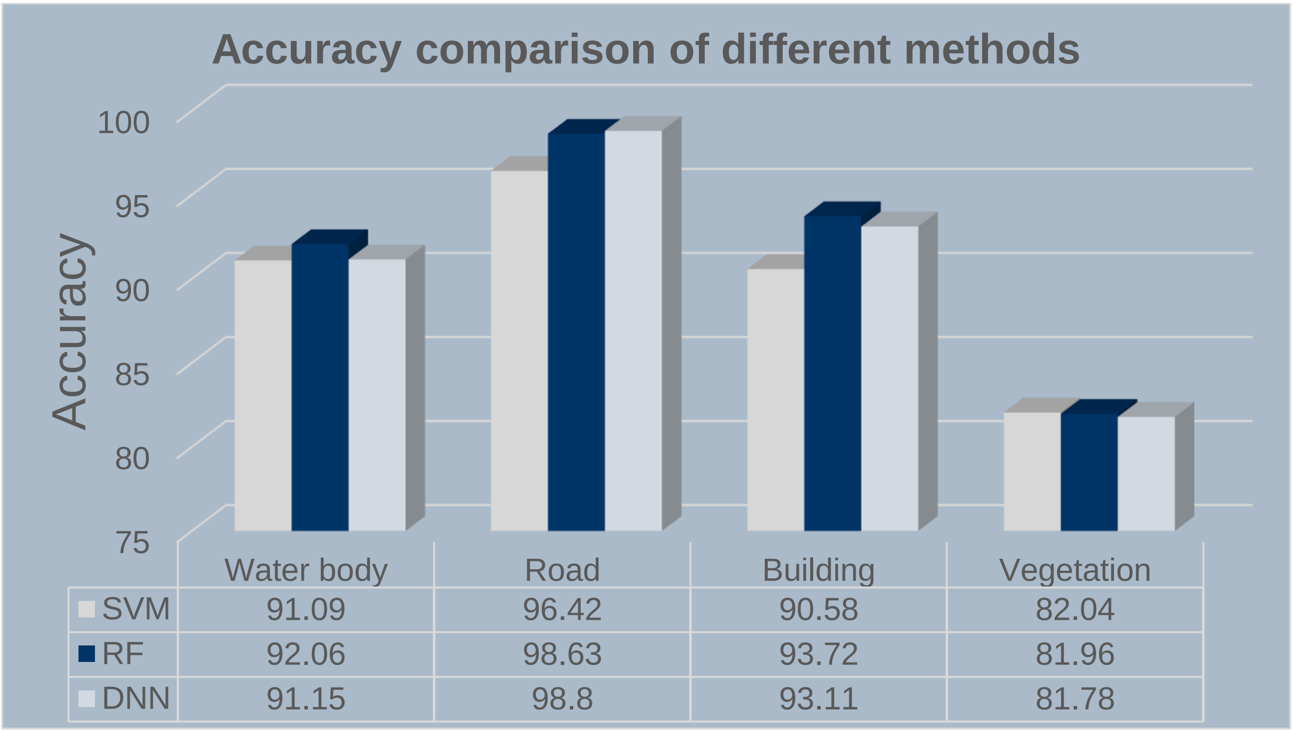


➢ Building Class



➢ Vegetation Class





❖ CONCLUSION

- There are numerous techniques for detecting changes; however, it is difficult for selecting an optimum and definite method. The temporal, spatial, spectral, and radiometric resolutions of remotely sensed data have a significant impact on the success of a remote sensing change detection project.
- Post-classification-based approach delivers considerable accuracy as compared to the algebraic approaches.
- False Alarms are reduced by:
    - Fusing additional band in input data from Spectral Indices for respective classes.
    - Better selection of ROIs for multi class results.

- For water class Random Forest performs the best, for road class DNN performs the best, for building class Random Forest performs the best and for vegetation class SVM performs the best in change detection.

❖ REFERENCES

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