# Project Presentation

## Land Cover Classification on Hyper-spectral Imagery using CNN – SVM Hybrid

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# Overview of Research Area (Introduction)

- Land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc.

- Land cover classification has become very crucial to carry the prediction to the dynamic change of land use, prevention to natural disaster, land management, crop planning, water management in farms etc.

- Manual classification of land cover is not possible. With rapid development of remote sensing technology, Land use/Land cover classification has become the most rapid and effective measure to monitor the condition on global Surface.

- Most of the existing land cover approaches are pixel-based single-date multi-spectral images using conventional techniques like random forests (RFs), neural networks (NNs), and support vector machines (SVMs).

- With the proper mapping of land future plaaning can be done and crop farming process can be improved.

# Literature Review

- In the field of land cover mapping using remote sensing, many works had already been carried out. Many researches were carried out using different machiene learning algorithms. Some of these researches are:-

## Land cover using MLP:-

In this research, land cover is indentified using remote sensing technique on multi-temporal LandSat images. Machine learning algorithm used in this work is Multi-layer Perceptron. The accuracy obtained is better on comparison to other Machine learning algorithms (RF, SVM etc.).

The Reference for the research can be found here.

## Land cover using RF(Random Forest):-

In this research, land cover is indentified using remote sensing technique on multi-temporal images. Machine learning algorithm used in this work is random forest. The accuracy obtained is ~86%.

The Reference for the research can be found here.

# Literature Review

**Land cover using SVM:-**

In this research, land cover is identified using the SVM algorithm. The result obtained by this model is average but less than compare to the other machine learning approaches like MLP, CNN etc.
The Reference for the research can be found here.

The accuracy obtained using only SVM on Indian pines dataset is ~83.6%.

**Land cover using CNN:-**

In this research, land cover is identified using the CNN algorithm. The result obtained by this model is better on compare to other models like MLP, SVM, RF etc. CNN is an approach suitable to apply ML models on images.
The Reference for the research can be found here.

The accuracy obtained using only CNN on Indian pines dataset is ~85.5%. This can be improved based on the CNN model architechture.

# Open Research Issues

Land cover classification makes use of Remote sensing techniques, which are dependent on the satellite images. There are many research issues in the field of remote sensing like image size, pixel to area ratio, image quality, processing speed etc.

Major research issues in remote sensing are -

**1. Pixel to area ratio :-** Remote sensing techniques mostly depends on the pixel size of that image. If one pixel of image maps to larger area on grung then it can produce noisy results.

**2. Computational Power :-** Dimension of a satellite image is very large as compared to the normal images. Training machine learning models on such high dimensional images requires higher computational power.

**3. Cloud Noise :-** If the satellite image contains clouds in the study area then it can produce noisy or false results. The areas that are covered with clouds need to be masked. That can leads to smaller training set.
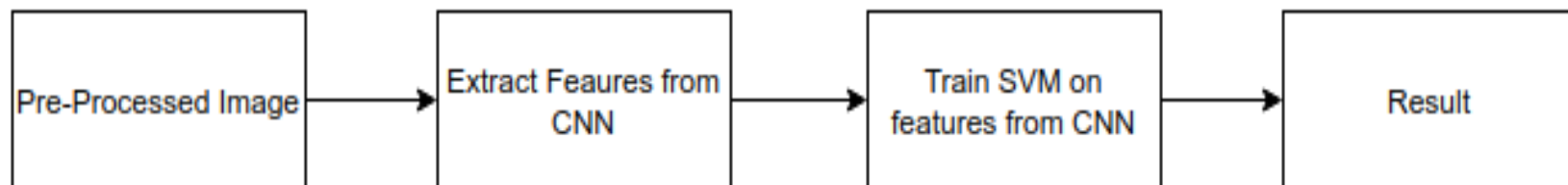
# Proposed Approach

There are researches carried out on this topic with different type of models. Some uses only CNN, Only SVM etc. But the accuracy obtaned can be improved.

So, for land cover classification a hybrid model of CNN and SVM is proposed. This approach is used because as from the previous researches on the land cover classification shows that CNN algorithm generally provides better results as compared to other algorithms.

In this work, CNN is used as a feature extractor which will extract the best possible features from the image and then these features are classified using SVM.
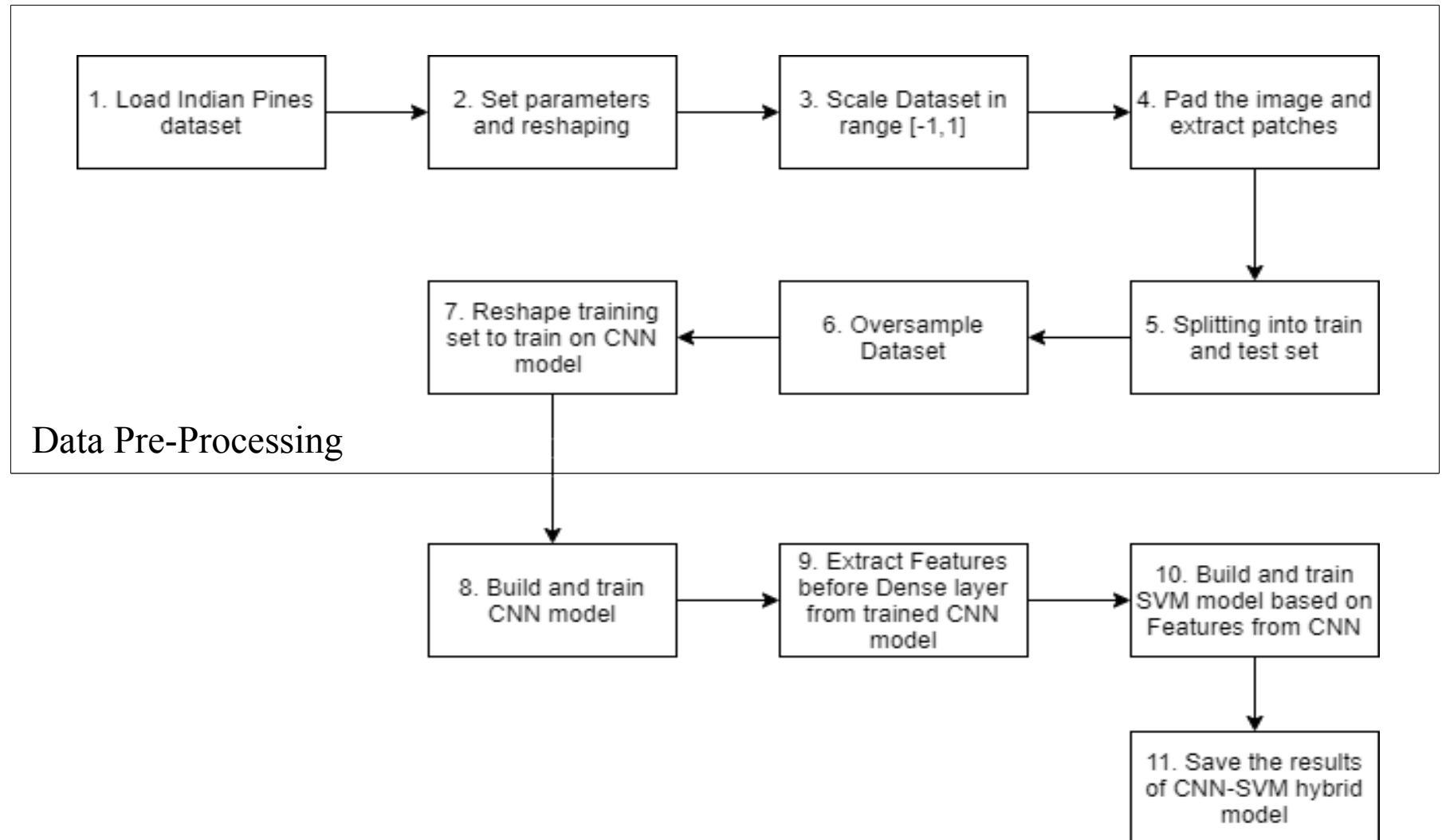
The features were extracted from the last layer of CNN. These features can be different based on the patch_size and filter maps in the processing layers.

Pre-Processed Image → Extract Feaures from CNN → Train SVM on features from CNN → Result

# Proposed Approach

The detailed Flow Chart of the proposed approach can be seen as -

# Experimental Evaluation, Results & Discussion

**Dataset Used :-**

In this work, the dataset used is INDIAN_PINES. The IP dataset consist a hyper-spectral satellite image subset of dimension 145x145x200. The study area has a dimension of 145x145 pixels and 200 images were captured on different spectral band ranges. The pixel size in the IP dataset is equal to 10m X 10m on earth.

**Algorithms Used :-**

The machine learning algorithms used for land cover classification are -
   1. CNN (Convolutional Neural Networks)
   2. SVM (Support Vector Machine)

CNN is used as feature extractor whereas, SVM is used as classifier.

# Experimental Evaluation, Results & Discussion

In this work, three machine learning models are trained on indian pines dataset seperately.

**1. Only CNN :-** In this, only CNN is used as a feature extractor as well as classifier.

**2. Only SVM :-** In this, only SVM is used as a classifier based on patches from image.

**3. CNN_SVM Hybrid :-** In this, CNN is used as a feature extractor and SVM is used as classifier.

The accuracies obtained from these 3 models are – **85.5% , 83.7% , 92.3%** respectively.

**Outcome :-** From the results it can be seen that the Hybrid model is a success as compared to seperate models.

# Significant References

https://medium.com/nybles/a-brief-guide-to-convolutional-neural-network-cnn-642f47e88ed4

https://medium.com/machine-learning-101/chapter-2-svm-support-vector-machine-theory-f0812effc72

https://ieeexplore.ieee.org/document/7729859

https://ieeexplore.ieee.org/abstract/document/1293752

https://ieeexplore.ieee.org/document/6626036

https://ieeexplore.ieee.org/document/8659654

https://medium.com/@openweathermap/satellite-imagery-landsat-8-and-its-band-combinations-5ce297440d1c