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Land Use Case and Utilization Classification using CNN

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Abstract - *This project aims to develop an application capable of classifying land use patterns, more specifically help the agricultural companies use land use classification models to categorize what's in each image and optimize their efforts towards the parts of land that are important to them. Pictures taken from a satellite can save hours of manually sorting through imagery or toiling using manual land records. Most importantly, this is a provision to cut down on surveying costs that are usually expensive. Using Convolutional Neural Networks and Data Augmentation, the model trains over land patterns from over 27000 images taken by the European Sentinel-2 satellite thus increasing the identification capability Multifood. This dataset provides the model to train from every land scenario possible to optimize results for best land-use identification. In addition to sorting imagery, land use classification is important for identifying the parts of an image to which certain analyses can be applied. So with scope that can boost human capability to classify and use the results obtained for the said use cases.*

Keywords*: Convolutional Neural Network, Data Augmentation, Deep Learning, Land classification, Land use, Sentinel-2 satellite.*

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I. INTRODUCTION

LULC order assumes an essential part in the improvement of districts and countries. Precise and fitting data on LULC is critical for breaking down different socio-environmental concerns. This data is indispensable in a few applications including metropolitan land arranging, agribusiness, provincial administration, and maintainable turn of events. Far off detecting innovation is broadly used to examine the assessment of LULC changes. Distant detecting information acquired from numerous satellites has been comprehensively used to recover LULC data.

An assortment of techniques have been presented for LULC characterization with the turn of events and advances in distant detecting innovation and satellites. In this succession, Landsat – 8 OLI is an as of late dispatched earth observation satellite. Land cover, characterized as the collection of biotic and abiotic segments on the Earth's surface, is quite possibly the most pivotal property of the Earth framework. There are three major manners by which it is significant. The main lines in the cooperation of land cover with the air, which prompts guidelines of the hydrologic cycle and energy spending plan, and as such is required both for climate and environment forecast.

For instance, most environment models are currently combined with Land Surface Parameterizations (LSPs) which utilize advanced land cover information to create data sets of albedo, surface harshness, evapotranspiration, and breath. Second, land cover assumes a significant part in the carbon cycle going about as both source and sink of carbon. Specifically, the pace of deforestation, afforestation, and regrowth assume a critical part in the delivery and sequestering of carbon and subsequently influence environmental CO2 focus and the strength of the nursery impact.

At long last, the land cover additionally mirrors the accessibility of food, fuel, lumber, fibre, and haven assets for human populaces, and fills in as a basic pointer of other biological system administrations like biodiversity. Data ashore cover is basic to numerous public/worldwide applications including watershed the board and agrarian usefulness. Land cover, characterized as the collection of biotic and abiotic segments on the Earth's surface, is quite possibly the most pivotal properties of the Earth framework. There are three major manners by which it is significant. The main lies in the cooperation of land cover with the air, which prompts guidelines of the hydrologic cycle and energy spending plan, and as such is required both for climate and environment forecast. For instance, most environment models are currently combined with Land Surface Parameterizations (LSPs) which utilize advanced land cover information to create data sets of albedo, surface harshness, evapotranspiration, and breath.

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Data ashore cover is basic to numerous public/worldwide applications including watershed the board and agrarian usefulness. In this manner, the need to screen land cover is gotten from numerous converging drivers, including the actual environment, biological system wellbeing, and cultural requirements.

II. LITERATURE REVIEW

Dissecting land use and land cover (LULC) utilizing far off detecting (RS) symbolism is fundamental for some ecological and social applications. The increment in accessibility of RS information has prompted the improvement of new strategies for computerized design grouping. As of late, profound learning (DL) models have arisen as an incredible answer for approaching many AI (ML) issues. Specifically, convolutional neural organizations (CNNs) are as of now the cutting edge for some picture grouping assignments. While there exist a few promising recommendations on the use of CNNs to LULC order, the approval structure proposed for the examination of various strategies could be improved with the utilization of a standard approval system for ML dependent on cross-approval and its ensuing factual investigation. In this paper, we propose an overall CNN, with a fixed design and parametrization, to accomplish high exactness on LULC order over RS information from various sources like radar and hyperspectral. We additionally present a system to play out a thorough exploratory correlation between our proposed DL strategy and other ML calculations, for example, support vector machines, irregular woodlands, and k-closest neighbors. The examination showed that the CNN outflanks the remainder of the procedures, accomplishing an undeniable degree of execution for all the datasets considered, paying little heed to their various attributes.

The land cover portrays the actual material of the world's surface, though land use depicts the financial capacity of a piece of land. Land use data is normally gathered in geospatial data sets. As such data sets become obsolete rapidly, a programmed update measure is required. This paper presents another way to deal with land cover and to characterize land use objects dependent on convolutional neural organizations (CNN). The information is flying pictures and determined information like advanced surface models. Initially, we apply a CNN to decide the land cover for every pixel of the info picture. We think about various CNN structures, every one of them dependent on an encoder-decoder structure for getting thick class expectations. Besides, we propose another CNN-based approach for the forecast of the land use name of articles from a geospatial data set. In this unique circumstance, we present a technique for producing picture patches of indistinguishable size from the info information, which are grouped by a CNN. Once more, we look at changed CNN designs. Our analyses show that general exactness of up to 85.7% and 77.4% can be accomplished for land cover and land use, individually. The arrangement of land cover has a positive commitment to the order of the land use grouping.

Recognizing land-use requires the acknowledgment of a few predefined classes accordingly expanding the intricacy of the arrangement. Elevated scene arrangement, which plans to consequently mark an ethereal picture with a particular semantic classification can be utilized to recognize land-use class, A land-use "scene" is a unit that contains a few highlights and shows a remarkable situation like harbour, home, roadway, agrarian land and park .The extraction of centre highlights that address the first pictures is the vital procedure in scene characterization tasks.

Highlights can be low-level like minor subtleties of the picture, similar to lines, dabs, bends, edges and masses, and undeniable level highlights that are based on top of low-level highlights to distinguish objects and bigger shapes in the picture. Profound learning techniques can concentrate low-level and undeniable level highlights and the general area of highlights in a picture. In this way, Convolutional Neural Networks utilize the two sorts of highlights. The first convolutional layers will learn channels for discovering lines, dabs, bends, edges, masses and so forth while the last layers will figure out how to perceive normal articles and shapes.

The Convolutional Neural Network (CNN) is a succession of preparing layers where each layer takes in the portrayal of information from low to undeniable levels. The Convolutional Neural Networks are regularized variants of multi-facet perceptron. An advanced picture is a 2D cluster (or grid) of pixels, where every pixel is described by its (x, y) directions and its coordinates . Given an irregular

information picture, the CNN perceives the class it has a place with and the upsides of likelihood that the info has a place with each class.

Land use planning is an essential yet testing task in geographic science. As opposed to land cover planning, it

is for the most part unrealistic to utilize overhead symbolism. The new, unstable development of online geo-referred to photograph assortments recommends a substitute way to deal with geographic information revelation. In this work, we present an overall system that utilizations ground-level pictures from Flickr for land use planning.

Our methodology profits by a few novel viewpoints. In the first place, we address the intrusiveness of the online photograph assortments, like loose geolocation and lopsided spatial conveyance, by performing area and indoor/open air separating, and semi-directed dataset increase. Our indoor/outside classifier accomplishes cutting edge execution on a few benchmark datasets and approaches human-level exactness. Second, we use significant level semantic picture highlights extricated utilizing profound learning, explicitly convolutional neural organizations, which permit us to accomplish as much as 76% exactness on a difficult eight-class land use planning issue.

III. PROPOSED SYSTEM

The proposed system uses a supervised approach of a Convolutional Neural Network, where the input to our model will be a set of satellite or aerial imagery. (In all formats, RGB, Hyperspectral etc.)

The input data then breaks down the data available in the images pixel by pixel and then augments it to further create better accuracy training data. This augmented data is the given input to the CNN which is a VGG-16 + Adam Optimizer (TBD).

After being passed through CNN, we should have a flagged classification along with the following metrics.

1- Land Type - (up to 7 classifications - Forest, Wetlands, Agricultural etc.)
2- Land Score (Usability of Classified Land)

This approach saves a lot of human time and effort as now everyone from an educated farmer to national policymakers can make faster decisions based on reliable and recent data.

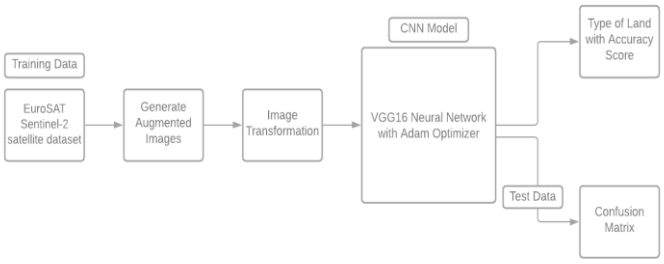

Fig 1: Proposed System Architecture

3.1 Advantages

Another factor worth considering is that the CNN has higher normal accuracy for all the datasets which suggests more steady behaviour for the characterization, regardless of their distribution. It appears to be that the CNN setup, particularly because of the regularization strategies and the smaller than normal cluster preparing takes into consideration accomplishing better execution on minority classes, subsequently mitigating the awkwardness issue of these sorts of datasets.

- Relatively cheap and rapid method of acquiring up-to-date information over a large geographical area. Example: Landsat 5 covers each area of 185x160km at a ground resolution of 30m every 18 days, cost of the original digital data is $5 000 (6 200 ha $-1, each hectare contains approximately 11 observations. Even with the cost of ground trothing this is very economical.
- It is the only practical way to obtain data from inaccessible regions, e.g.

Antarctica, Amazonia.

- At small scales, regional phenomena which are invisible from the ground are clearly visible. Examples: faults and other geological structures. A classic example of seeing the forest instead of the trees.
- Cheap and rapid method of constructing base maps in the absence of detailed land surveys.
- Easy to manipulate with the computer, and combined with other geographic coverages in the GIS.

Land cover change can influence the capacity of the land to support human exercises through the arrangement of various environment administrations and in light of the fact that the resultant financial exercises cause criticisms influencing the environment and different aspects of worldwide change. As needs be, deliberate evaluations of Earth's territory cover should be rehashed, at a recurrence that grants observing of both long haul drifts just as internal inconstancy, and at a degree of spatial detail to permit the investigation of human-initiated changes.

IV. METHODOLOGY

4.1 SYSTEM ARCHITECTURE

A system diagram is a simple and very high level description of a system that exists or needs to be built. It is a simple diagram that can be drawn collaboratively in little time. It can help a team get a clear, complete, and common understanding of a system.

System diagrams are especially useful in showing you how an adjustment of one factor may affect somewhere else. They are brilliant devices for flushing out the drawn-out effects of a change. Drawing a framework outline is a decent method of beginning to construct a PC model. The strategy assists you with outlining the design of the framework to be displayed. It shows the elements and connections that are significant and assists you with beginning to measure the linkages between factors.

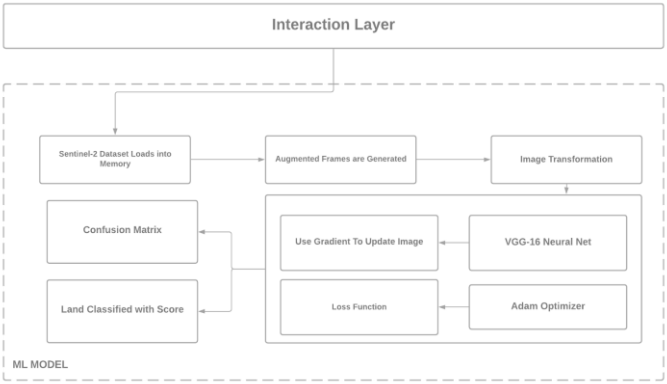

Fig 2: Overall System Architecture

The above diagram shows the detailed architecture of the developed system.
The project consists of 3 phases which are:

- Interaction Layer or Front End
- Endpoint and Flask Web Server
- ML Model

1. Interaction Layer : Front-end development is the art of creating sites and web applications that render on the client-side. HTML, CSS and JavaScript, the de facto building blocks of the web, and client-side frameworks such as Angular, React, Stencil and Vie.

2. Flask Web Server: Python Flask Framework is a lightweight miniature structure dependent on Werkzeug, Jinja2. It is known as a miniature system since it plans to keep its centre usefulness little yet normally extensible to cover a variety of little and huge applications. Jar Framework relies upon two outside libraries: The Jinja2 layout, Werkzeug WSGI toolbox. Despite the fact that we have plenty of web applications available to us.

3. ML Model (Custom Developed): The proposed system uses a supervised approach of a Convolutional Neural Network, where the input to our model will be a set of satellite or aerial imagery.(In all formats, RGB, Hyperspectral etc.)The input data then breaks down the data available in the images pixel by pixel and then augments it to further create better accuracy training data. This augmented data is the given input to the CNN which is a VGG-16 + Adam Optimizer (TBD).

In this stage, we make our Deep Learning model accessible to different clients by making a User Interface that acknowledges the REST API based Request-Response Model. After being passed through CNN, we should have a flagged classification along with the following metrics.

- **Land Type** - (up to 7 classifications - Forest, Wetlands, Agricultural, Industrial etc.)
- **Land Score** (Usability of Classified Land)

This approach saves a lot of human time and effort as now everyone from an educated farmer to national policymakers can make faster decisions based on reliable and recent data.

4.2 Data Flow Diagram

A Data Flow Diagram (DFD) depicts the movement of information for any cooperation or system. It uses described pictures like square shapes, circles and dashes, notwithstanding short substance names, to show data inputs, yields, storing centres and the courses between each level headed.

Data flowcharts can go from fundamental, even hand-drawn cooperation diagrams, to start to finish, staggered DFDs that plunge powerfully more significantly into how the data is managed. They can be used to separate a current structure or model another.

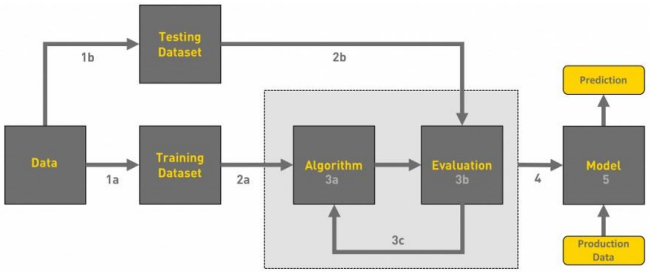

Fig 3: Data Flow Diagram for Deep Learning ML models

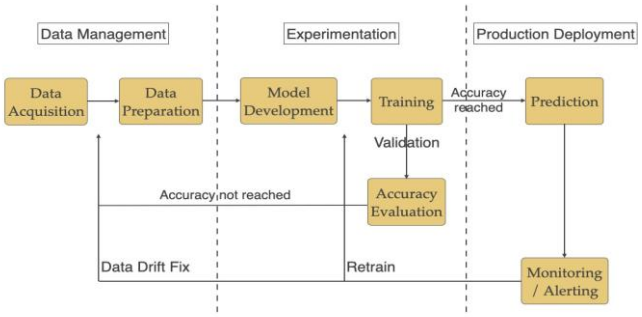

Fig 4: Deployment Workflow of ML Model

V. CONCLUSION

Earth perceptions can possibly react to the developing and pressing interest for convenient and precise land cover data over huge regions. In the new past, land cover planning from satellites has grown up. Through research on different issues in regards to information pre-preparing, arrangement and precision evaluation, new and extraordinary information/land cover items are being created which couldn't be delivered by previous strategies.

A significant number of the specialized impediments hampering further enhancements in land cover planning should be eliminated in the following not many years, particularly in the nature of satellite information (further developed adjustment, spatial and ghostly goal, unearthly inclusion, geolocation exactness) and the registering capacity, established on the aggregated information and involvement with the utilization of computerized investigation techniques.

This will require solid, continuous examination exercises just as new drives in the creation of land cover maps. The future exploration in LULC concentrates needs to address the most ideal methods of exploiting satellite-determined land cover data sets through LULC change displaying procedures which give significant contributions to concentrates in the arising spaces of ecological checking, an Earth-wide temperature boost and environmental change.

We introduced a system for land use characterization utilizing geolocated ground-level pictures. Our methodology maps a more extensive scope of classes than past work on this issue; utilizes undeniable level semantic picture highlights removed utilizing CNNs, a type of profound learning; fuses a novel, cutting edge indoor/outside classifier to help represent geolocation blunder; expands the preparation dataset in a semi-administered design, and uses district shape files to create exact guides.

The future project can incorporate a lot of features such as integrating the model with government offices, and related agencies. This can greatly increase the decision making capability of the region.

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