*CLOUD APPLICATION DEVELOPMENT*

**PHASE-3**

**IMAGE RECOGNITION SYSTEM**

**USING IBM CLOUD VISUAL**

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**CHAPER-1**

**INTRODUCTION**

* 1. Project overview

Image Recognition is a tool that using cloud visual recognition algorithms to analyze images and allow users to automatically identify subjects and objects contained within the image and organize and classify these images into categories.

* 1. Purpose

The purpose of an image recognition system is to analyze and identify objects, patterns, or features within images. It has various applications, including:

1. Object Recognition: Identifying and categorizing objects within images, such as detecting animals in wildlife photos.

2. Facial Recognition: Recognizing and verifying individuals based on facial features, often used for security and access control.

3. OCR (Optical Character Recognition): Converting printed or handwritten text in images into machine-readable text.

4. Medical Imaging: Assisting in the diagnosis of medical conditions by analyzing medical images like X-rays or MRIs.

5. Autonomous Vehicles: Enabling self-driving cars to detect and respond to objects and road signs.

6. Augmented Reality: Enhancing real-world experiences by overlaying digital information on images or videos.

7. Quality Control: Checking for defects or inconsistencies in manufacturing processes through image analysis.

8. Content Moderation: Filtering out inappropriate or harmful content in user-generated images and videos on platforms.

9. Agriculture: Monitoring crop health, detecting diseases, and optimizing farming practices using aerial images.

10. Art and Entertainment: Transforming images into art styles, applying filters, or enhancing special effects in movies and games.

Image recognition systems use machine learning and deep learning techniques to achieve these purposes, making them valuable in a wide range of industries.

* 1. Concepts

The IBM Visual Insights platform, built on cognitive infrastructure,is a new generation of video/image analysis platforms. The platform offers built-in deep learning models that learn to analyze images and video streams for classification and object detection.IBM Cloud Visual Recognition includes tools and interfaces for anyone with limited skills in deep learning technologies. You can use IBM Cloud Visual Recognition to easily label images and videos that can be used to train and validate a model. The model can then be validated and deployed in customized solutions that demand image classification and object detection.

**PROCESS**

**Step 1: Create an IBM Cloud Account**

Use the link given to signup or login to IBM cloud. https://cloud.ibm.com/registration

If you already have an IBM Cloud account you can just log in using the link above the Email field.

**Step 2: Confirm Your Email Address**

An email is sent to your email address to confirm your account. Go to your email account, and click on the “Confirm Account” link in the email that was sent to you.

**Step 3: Login to Your Account**

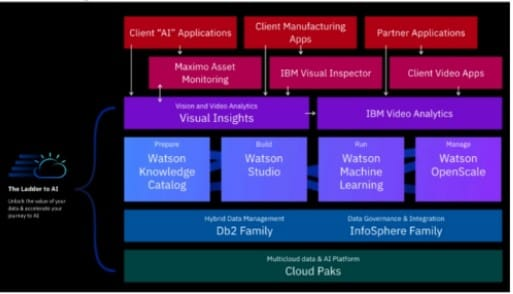
**Step 4: Create a New Resource**

On your dashboard page, click on the Create a resource on the top right to create a new source.

**Step 5: Create a Visual Recognition and Watson Studio Resource**

On the Catalog page, select the AI category from the left pane, and then select the Visual Recognition resource.On the Catalog page, select the AI category from the left pane, and then select the Watson Studio resource. On the next page, you will get to name your service instance and choose your region. Click on the arrow to reveal the drop-down menu of regions. Make sure to select the region that is closest to you. Then scroll down and make sure that the lite plan is selected, and click the Create button.On the next page, click the Get Started button to start using Watson Studio.

**ARCHITECTURE DESIGN**

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**PLANNING**

IBM Visual Insights provides an easy to use graphical user interface (GUI) that you can use to quickly create computer vision-related artificial intelligence (AI) solutions. You must be familiar with the following concepts before you can start using IBM Visual Insights: Data set A data set is a collection of images and videos that you uploaded to IBM Visual Insights. An example of a data set would be images of cars. Category A category is used to classify an image. The image can belong to only a single category. An example of a category for a data set that contains cars would be car manufacturers (Toyota, Honda, Chevy, and Ford). Custom asset Custom assets are certain assets that are created outside of IBM Visual Insights but that can be used by IBM Visual Insights. Custom model Also known as a custom network. This is a model that was trained outside of IBM Visual Insights. For information about what is supported by custom models, see “Model functionality” Custom inference script Contains files that specify actions to be done outside of IBM Visual Insights. For example, to be used with preprocessing, post-processing, or Maximo Asset Monitor. For more information, see “Preprocessing and post-processing” and “Integrating IBM Visual Insights Training and Inference with Maximo Asset Monitor”. Object An object is used to identify specific items in an image or specific frames in a video. You can label multiple objects in an image or a frame in a video. An example of objects in an image of cars might be wheel, headlights, and windshield. Project Project groups allow you to group trained models with the data sets that were used for training. This grouping is optional but is a useful way to organize related data sets. For example, project groups would be useful with a workflow that clones data sets as you refine labels and work toward a more accurate model. For more information about projects,“Creating and working with project groups,” Model A model is a set of tuned algorithms and that produces a predicted output. Models are trained based on the input that is provided by a data set to classify images or video frames, or find objects in images or video frames. Neural network A model implementation using a deep learning framework with nodes and weights. Training concepts Iteration A full forward and backward pass using a set of images in the training of the neural network. Batch The set of images used in a full forward and backward pass in training of the neural network. Batch size The size of the batch of images used in an iteration. Epoch The measure for an entire data set passed forward and backward through the neural network one time. Usually the batch size is smaller than the full data set, so an epoch consists of multiple iterations of "Batch size".

**CHECKING THE APPLICATION AND ENVIRONMENT**

Before you can use the commands to check the application status, you must log in to the IBM Cloud Private cluster.

cloudctl login -a https://<cluster-domain-name>:8443/ --skip-ssl-validation

Example

In the following example, cloudctl is used to log in to the IBM Cloud Private cluster icp1 with master node icp1.domain.com as the user admin, to access the default namespace where the IBM Visual Insights application is installed:



**REQURIMENT SPECIFICATION**

the software and hardware requirements and understand the supported file types before you can install IBM Cloud .

Hardware requirements IBM Visual Insights requires the following hardware:

**Hardware**

The following dSSevices are supported:

• POWER8 S822LC (8335-GTB) or POWER9 AC922 with at least one NVIDIA NVLink capable GPU

• POWER9 IC922 with at least one NVIDIA T4 GPU

• x86 system with at least one NVIDIA Pascal, Volta, or Turing-architecture GPU

**Required specifications**

Your device must meet these minimum requirements:

• 64 GB of memory

• Ethernet network interface

• 75 GB of storage for installation, and at least 40 GB of storage for runtime. See “Disk space requirements” on page 18 for details.

• The Nvidia GPU must be configured in the "Default" compute mode. The "Exclusive Process" mode will cause trainings to fail. See nvidia-smi usage for details on compute modes.

• There are multiple options for deploying the model for testing. Deploying a model to a Xilinx FPGA requires the Xilinx Alveo U200 Accelerator card.

**Software requirements**

You must install the following software before you install IBM Visual Insights:

Linux

• Red Hat Enterprise Linux (RHEL) RHEL 7.6 ALT (little endian) for POWER9™

• RHEL 7.7 for x86

• Ubuntu 18.04

**Image support**

• The following image formats are supported:

– JPEG

– PNG

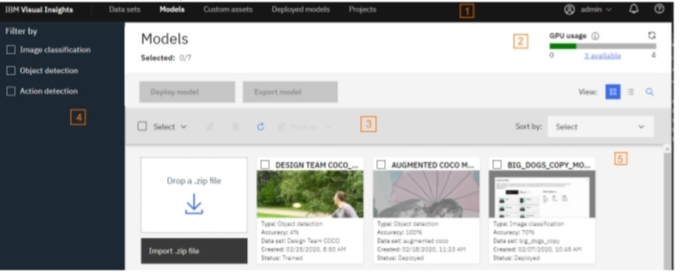
– DICOM

• Images with COCO annotations are supported. For details, see “Importing images with COCO annotations”.

**WORKING WITH USER INTERFACE**

The Image recognition system user interface is made up of these basic parts: the navigation bar, the side bar, the action bar, the data area, and the notification center.

Interface areas:



**1: The navigation bar**

The navigation bar lets you access the notification area (the bell icon), work with your profile, or access the IBM Visual Insights Knowledge Center (the question mark icon). If you click the arrow by your user name, you can log out, view your usage metrics, and can see the version number of the product.

**2: The header bar**

The header bar on the Training, Models, Model details, and Deployed Models pages shows GPU usage details in these categories:

Training

GPUs currently used for training jobs by IBM Visual Insights. Deployed Models GPUs currently used for deployed models by IBM Visual Insights. External

External GPUs are those that are used for processes outside of IBM Visual Insights. For IBM Cloud Private installations, all GPUs are listed as External.

Note: If the output shows "Unknown", then GPUs are in use, but not for IBM Visual Insights training or deployment. This either indicates an issue with a GPU in use by a training or deploy job that failed unexpectedly, or there are other applications on the system using GPUs. This could lead to unexpected resource contention and application issues.

**3: The action bar**

This is where you find the actions that you can take on images, videos, data sets, and models in the current data area. The available actions differ depending on what type of object you are working with.

**4: The side bar**

Data sets and models have a side bar with filtering options. Filtering helps you specify which objects to include in the data area.

Navigating: If the side bar is long, for example, if you have a data set with a lot of different types of objects, you can scroll through the side bar content. To scroll, hover over the appropriate content and use your mouse roller or keyboard arrow keys. If the mouse pointer is right over the categories, for example, scrolling moves you through that list. If the mouse pointer is further to the right, on the edge of the side bar, scrolling moves you through all of the content on the side bar.

**5: The data area**

This is where you find the objects that you can act on. It lists the objects of the selected type, or displays the data included in the data set.

**CODING AND SOLUTION**

Source code

1. \*Create an IBM Cloud Account\*: If you don't have an IBM Cloud account, sign up for one.

2. \*Create a Visual Recognition Service\*:

- Log in to your IBM Cloud account.

- Go to the IBM Cloud Catalog.

- Search for "Visual Recognition" and select it.

- Follow the instructions to create a new instance of the service.

3. \*Get API Key and URL\*:

- Once your Visual Recognition service instance is created, you'll find an API Key and a URL in the service's dashboard. You'll need these to authenticate your requests.

4. \*Install Required Libraries\*:

You can use the Python SDK to interact with IBM Cloud Visual Recognition. To install it, you can use pip:

bash

pip install ibm-watson

5. Code:

from ibm\_watson import VisualRecognitionV4

from ibm\_watson.visual\_recognition\_v4 import FileWithMetadata, AnalyzeEnums

# Initialize the Visual Recognition service

visual\_recognition = VisualRecognitionV4(

version='2021-09-09',

authenticator\_id='apikey',

authenticator\_type='iam',

authenticator\_implicit=False,

authenticator\_url='YOUR\_API\_URL',

authenticator\_apikey='YOUR\_API\_KEY'

)

# Analyze an image

with open('path\_to\_your\_image.jpg', 'rb') as image\_file:

results = visual\_recognition.analyze(

images\_file=FileWithMetadata(image\_file),

features=[AnalyzeEnums.Features.OBJECTS.value],

).get\_result()

# Print the results

print(results)

Output:



Fig.1 Detecting the overall contents of the image, based on the custom training data.

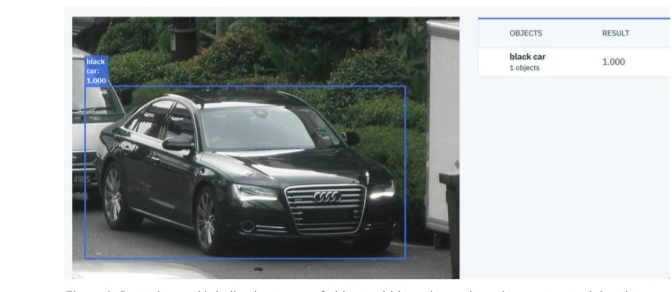


 Fig.2 Detecting and labelling instance of objects within an image, based on the custom training data.

Fig.3 Detecting and labelling instance of objects within an video frame, based on the custom training data.

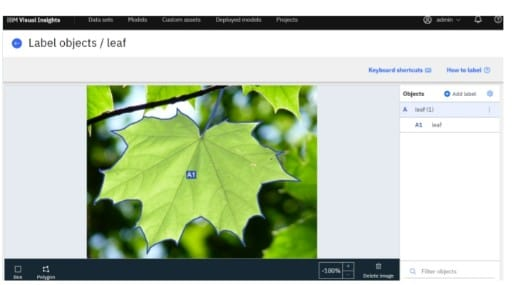
 Fig.4 Detecting and labelling the precise edges of an object



Fig.5 Auto labelled video

**ADVANTAGES AND DISADVANTAGES**

Advantages:

1. Automation: Image recognition systems automate the process of identifying and categorizing objects in images, reducing the need for manual labor.

2. Efficiency: They can process large volumes of images quickly and accurately, making them valuable in applications like quality control and security.

3. Accessibility: These systems can make visual information accessible to people with visual impairments by providing descriptions of images.

4. Medical Diagnosis: Image recognition is used in medical imaging to assist in the early detection of diseases, such as cancer, by analyzing medical images like X-rays and MRIs.

5. Security: Facial recognition systems can enhance security by providing access control and identity verification.

Disadvantages:

1. Data Privacy: Concerns about privacy arise when image recognition is used for surveillance, as it can lead to the potential for abuse and infringement on individuals' rights.

2. Bias and Discrimination: Image recognition systems can exhibit bias, especially when they are trained on biased data, leading to unfair outcomes, particularly in facial recognition applications.

3. Accuracy: These systems may not always be completely accurate, leading to misidentifications or false positives/negatives, which can have serious consequences in certain applications.

4. Resource Intensive: Developing and deploying robust image recognition systems can be resource-intensive, requiring substantial computational power and data.

5. Ethical Concerns: The use of image recognition in various domains, such as law enforcement or employment, raises ethical questions about consent, fairness, and accountability.

6. Limited Context Understanding: Image recognition systems lack an understanding of context and the ability to interpret images in the same way humans do, which can limit their capabilities in complex situations.

**CONCLUSION**

Image recognition systems offer a range of benefits, including automation, efficiency, accessibility, and applications in various fields like healthcare and security. However, they also come with challenges related to data privacy, bias, accuracy, and ethical concerns. To ensure responsible use, these issues need to be addressed**.**

**FUTURESCOPE**

1. \*Improved Accuracy\*:

Ongoing research and advancements in machine learning will likely lead to more accurate image recognition systems, reducing the risk of misidentifications.

2. \*Bias Mitigation\*:

Efforts to reduce bias in image recognition algorithms will continue, leading to more fair and equitable outcomes, particularly in areas like facial recognition.

3. \*Real-time Applications\*:

Image recognition will find applications in real-time settings, such as autonomous vehicles, where rapid and accurate image analysis is crucial.

4. \*AI in Healthcare\*:

Image recognition will play a greater role in healthcare, assisting in the diagnosis of various medical conditions and enabling remote patient monitoring.

5. \*Retail and E-commerce\*:

Enhanced image recognition will enable improved product recommendations and visual search capabilities, enhancing the online shopping experience.