

Week 2: Building AI in your Company

1. Case Studies:

We will study two cases of AI in this topic which are:

- **Smart Speakers**
- **Self-driving Cars**

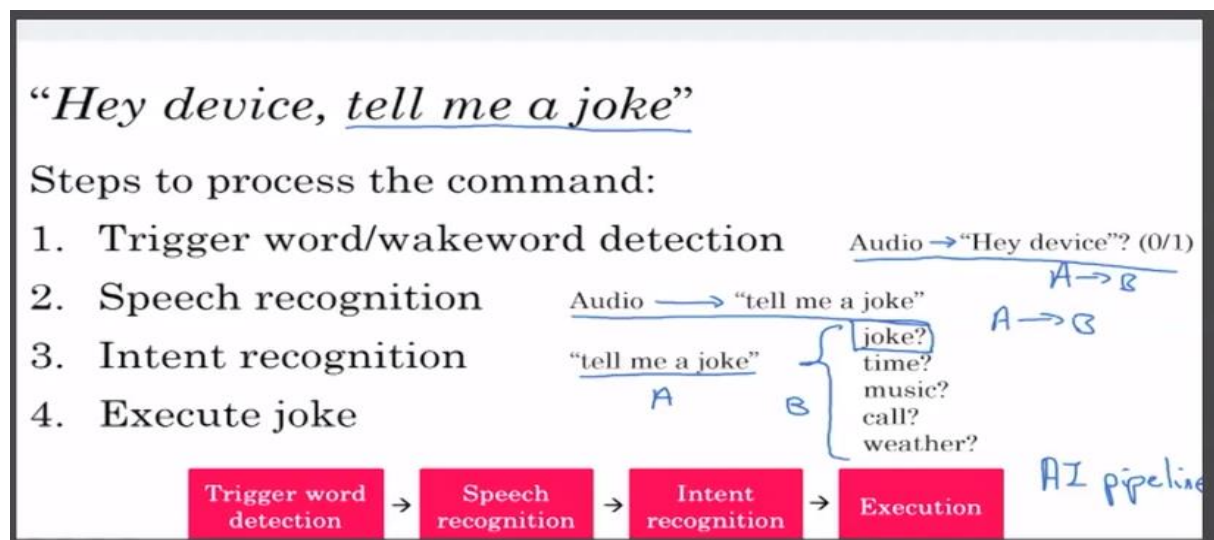
Smart Speakers:

There are different speech recognition devices developed by different companies. Some of them are Alexa from Amazon, Home from Google, Siri from Apple. These devices are used to perform very simple task and they can't perform the complex task.

There are different ways to call the device some of them are:

- Hey Device tell me Joke.
- Hey Device tell me something funny.
- Hey Device do you know some jokes.
- Hey Device what is funny today.

And many more. But device can recognize the intent or what you want easily in all these.



Trigger word/wake word is use to activate the device. **Hey Device** is the word which is used as calling word. As you can see all the examples I gave earlier, there is words which are common in all of them is Hey Device. So, in first step device just detect the trigger word. If you will use any other words to call the device, it is possible that it will not respond.

After first step the second step is to recognize the speech. **Speech** is the sentence except Hey Device. In this step device recognize speech and language. Like in the picture it will recognize "Tell me a joke".

Third step in this process is **Intent Recognition**. It means that it will recognize the purpose of the call. Like example from picture it will recognize that user is asking for the joke.

Last step is **Execution**. In this step it will execute or do the thing for what user asked. Like It will play a joke.

In all of these steps **first 3 are AI based** and the **last one is software based** that will execute the intent.

These four steps are known as AI Pipelining.

Other functions

- Play music
- Volume up/down
- Make call
- Current time
- Units conversion
- Simple question
- ...

Key steps:

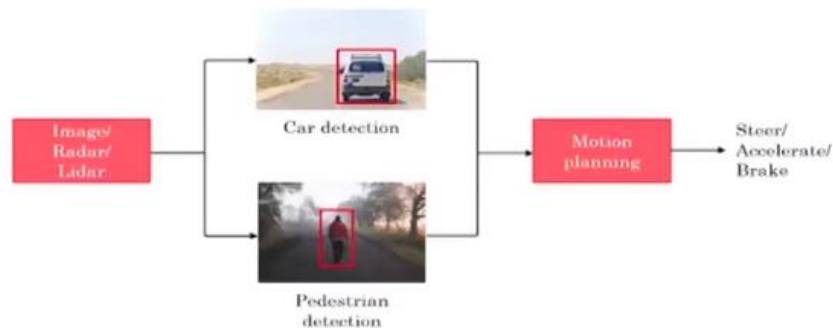
1. Trigger/wakeword detection
2. Speech recognition
3. Intent recognition
4. Specialized program to execute command

These specialized execution routines are written by software engineer

Self-Driving Cars:

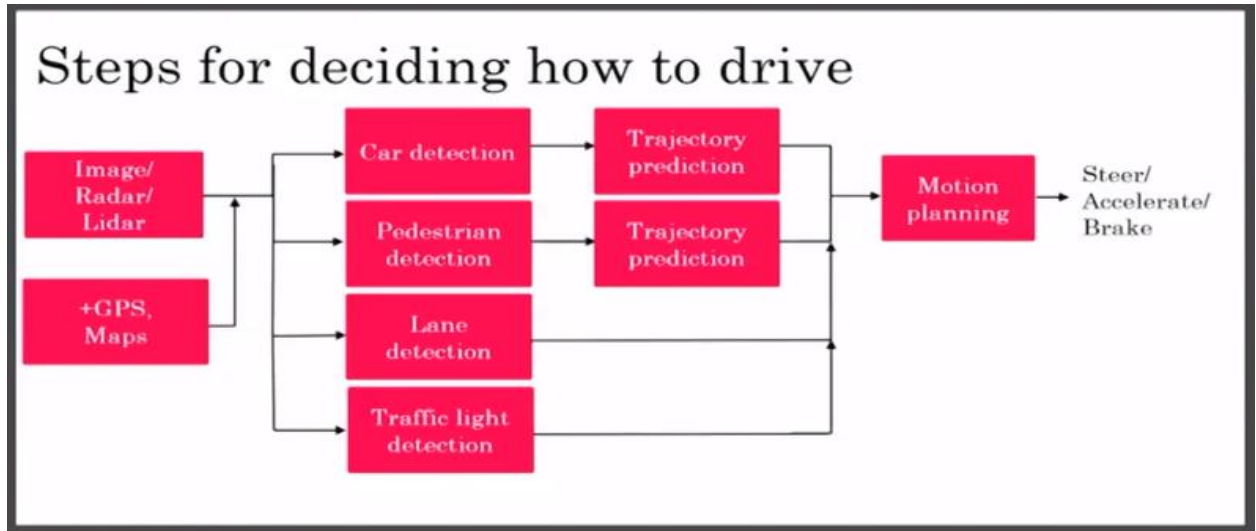
This is one of the popular projects in AI. There are three main steps for the working of the self-driving car.

How does it work



So, **first step** as shown in the picture is **image input**. It will be input by Radars, Lidars or by the camera. In **Second Step** It will detect the other cars, pedestrian (moving people without cars), any other hinderance or we can see object. **Third Step** is **Motion Planning** which means that what the car will do after detecting the other objects. Will it apply breaks or it will keep moving?

These steps are explained further in following picture:



In the 2nd and 3rd step there is one more step which is **trajectory prediction**. Self-Driving car in this step will predict the trajectory or next movement of the car or object on road. Then the decision goes to motion planning. Path is also shown to car to overtake or pass the other car.

2. Some Roles of an AI:

AI team may have hundreds of engineers but a small team have four or five members. All the members have their different roles. Following are some roles common in every AI team.

- **Software Engineer:**
For execution step in AI pipelining.
- **Machine Learning Engineer:**
Person who will build a model using AI.
- **Machine Learning Researcher:**
This role of the person who research the new ideas of the machine learning that can be implement in the product of their company to extend state of art.
- **Applied Machine Learning Scientist:**
Work of this person is in between the work of ML researcher and ML engineer. This person does research for the new ideas of machine learning and he also implement to take the product to the next level.

Roles in Data Science:

- **Data Scientist:**

Person who examine the data and provide insights and also make the presentation so that executive team can take decisions.

- **Data Engineer:**

There are Data administrative who maintain the data but there are separate data engineers. It is the new role in the data science but very important for proper work. Person who stores the data in the organize way so data can be easily accessible, secure and cost-effective way.

- **AI Product Manager:**

Help to decide what to build and what is feasible and valuable.

Get started with a small team:

You can start your work if you have 1 software engineer, 1 ML engineer or data scientist. If you have none and you have idea you can start you work alone gradually with the progress you will get the team.

3. AI Transformation Playbook:

Playbooks are vital to any organization, from business to professional sports team. Simple they help the organization to plan and strategize tactics that will ultimately bring them success.

We have studied about the AI transformation, in this we will have explanation of it.

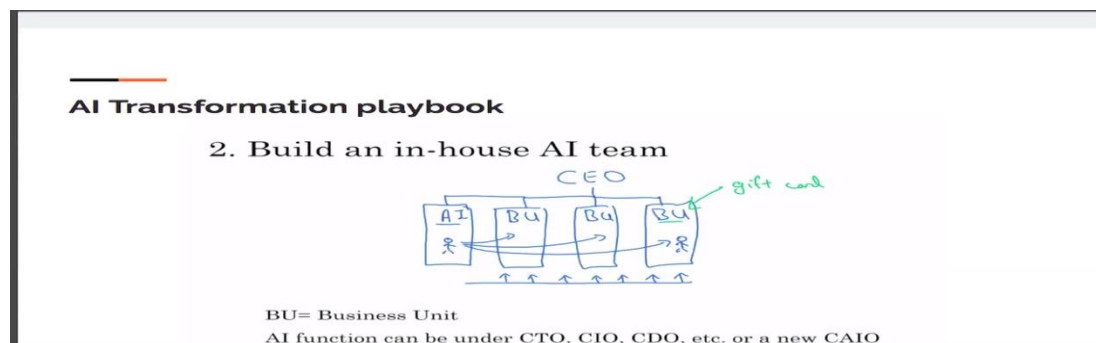
- **Execute Pilot projects:**

It is important for the newly transformed AI company that they do successful projects even they are not valuable. The project must be simple and small.

Company should show the result and launch the product with in 6-12 months to show that they are actually an AI company. Team can be built insource and it can be outsourced.

- **Build an in-house AI Team:**

There is no problem that you have outsourced team working but you should start building an in-house AI team (from you company).



When you build an in-house AI team it will be a centralized team which will be communicating with all of the business units or the business unit will communicate with the AI team. AI team will be observing that what they can automate in business unit and business unit will also be telling AI team, the project that can be beneficial. The person who leads the AI team is CAIO (Chief AI officer) or also known as CTO (Chief technology officer), CIO (Chief information officer), CDO.

- **Provide broad AI training:**

After training you main in-house AI team you have to shift training to broad level. Broad training means you have to train every person who is part of the team it includes top management and middle management. You have to train the people who want to shift from like software to AI or people from business and executive domain, managers etc.

AI Transformation playbook	
3. Provide broad AI training	
Role	What they should learn
Executives and senior business leaders	<ul style="list-style-type: none"> • What AI can do for your enterprise • AI strategy • Resource allocation
Leaders of divisions working on AI projects	<ul style="list-style-type: none"> • Set project direction (technical and business diligence) • Resource allocation • Monitor progress
AI engineer trainees	<ul style="list-style-type: none"> • Build and ship AI software • Gather data • Execute on specific AI projects

Resources

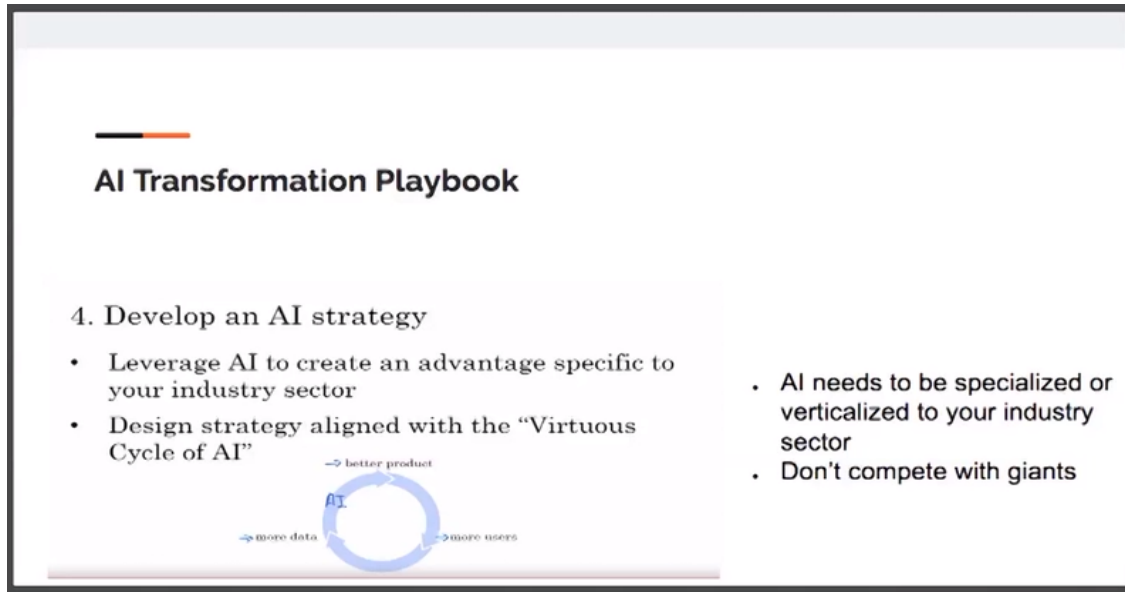
- Online courses
- Books
- Curate rather than create content

Enterprise means the specific business sector they working in. Top management should be trained so that they can know how to execute the project when it is ready. Other roles and their purpose of leaning AI is explained in the picture. Curate rather create content means that written or ready-made content should be used for training instead creating your own.

- **Develop an AI strategy:**

You must have a strategy that what kind of projects you are going to do or from where you are going to collect or acquire data for the projects, how can you use the people around you, how can you use your expertise. For example, if you have experts in image processing and you don't have experts in computer vision then you have to make half of team to work for the image processing which your specialty and other half should focus on learning computer vision. Company

should not build the project that are popular and already available in company project should be unique, it will be identity of the company. You have to work on specialization and keep improving in it. Start automating the task you are good at. Automate your specialty.



Virtuous Cycle of AI involves three things which are: If **Product is better**, it is obvious that there will be more **user** and when users are more there will be **more data** collected from the user so it will again improve the product and this cycle will be running in the same manner.

- **Develop Internal and external communication:**

When your company is transformed to an AI company then there must be communication between your employees, stakeholders and sponsors etc. that your company is now an AI company.

It is observed that when company changes its field to AI, employees think about that there are not going to work in this company anymore, so this situation can be handled by proper communication, they should know that they will get the training and they will work in that field too.

4. Pitfalls of AI:

These are misconceptions about AI:

First pitfall of AI is that, thinking AI can do everything. There are limitations of AI. We have discussed this earlier too. We should be realistic and logical about what AI can do and cannot do.

Secondly, if you have hired 2 to 3 ML engineers and you are thinking that it is now team is complete and you are going to do a project which will flourish in market, it is

not possible you should pair engineering talent with business talent and work cross-functionally and together to find the valuable projects. There must be cooperation and communication.

Next pitfall is expecting that your first project will get hit and become popular or it will be perfect. It is not like that you will improve your projects gradually with time. You will change your strategy, will cooperate with your AI team and try to improve.

AI Pitfalls

AI pitfalls to avoid

Don't:

- Expect the AI project to work the first time
- Expect traditional planning processes to apply without changes
- Think you need superstar AI engineers before you can do anything

Do:

- Plan for AI development to be an iterative process, with multiple attempts needed to succeed
- Work with AI team to establish timeline estimates, milestones, KPIs, etc.

5. Taking First Step:

Some initial steps you can take

- Get friends to learn about AI
 - This course
 - Reading group
- Start brainstorming projects
 - No project is too small
- Hire a few ML/DS people to help
- Hire or appoint an AI leader (VP AI, CAIO, etc.)
- Discuss with CEO/Board possibilities of AI Transformation
 - Will your company be much more valuable and/or more effective if it were good at AI?

6. Survey of AI App Areas:

There are a lot of field in which AI is doing its work some are:

- **Computer Vision:**

Computer vision is one of the popular aspects of the AI which means giving vision to computer means computer can see things and can identify them. Computer vision have following things shown in picture:

AI Application areas

Computer Vision

- Image classification/Object recognition

-Face recognition

register



new



cat

- Object detection



- Image segmentation



- Tracking

Face Recognition example can be given through Facebook and Instagram when it automatically shows people name in the picture. It's the face recognition.

- **Natural language processing a.k.a. NLP:**

This is another area where AI is used. In this we process the languages we speak so that system can know what are we saying. Example of NLP are shown in picture:

AI Application areas

Natural Language Processing

- Text classification

- Sentiment recognition

- Information retrieval

- E.g., web search

- Name entity recognition

- Machine translation

Email → Spam/Non-Spam

Product description → Product category

"The food was good" → ★★★★★

"Service was horrible" → ★

Queen Elizabeth II knighted
Sir Paul McCartney for his
services to music at the
Buckingham Palace

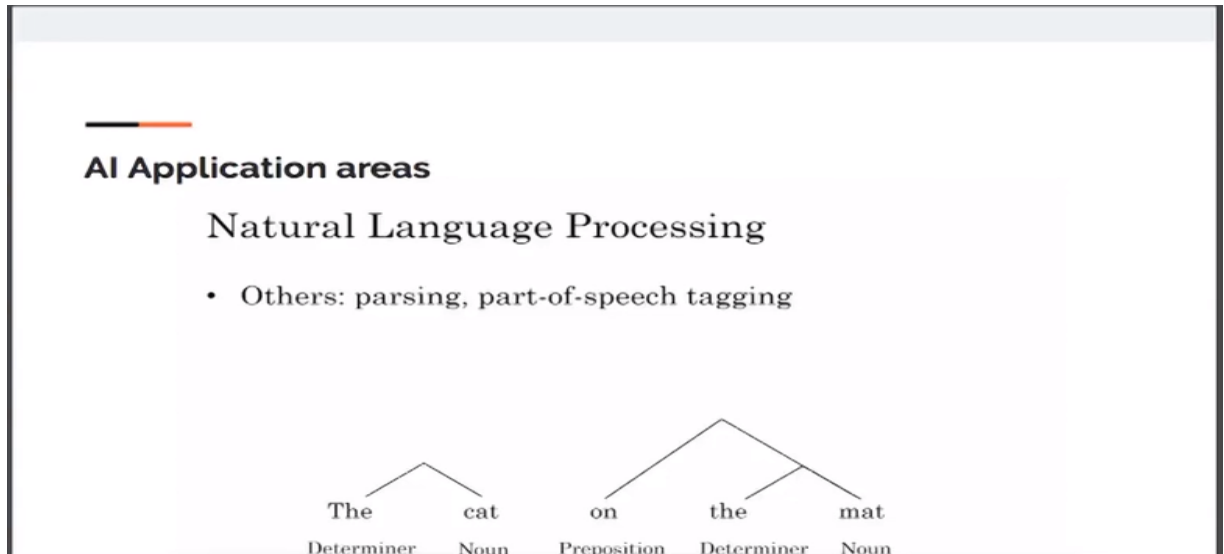
AIは、新たな電気だ

AI is the new electricity

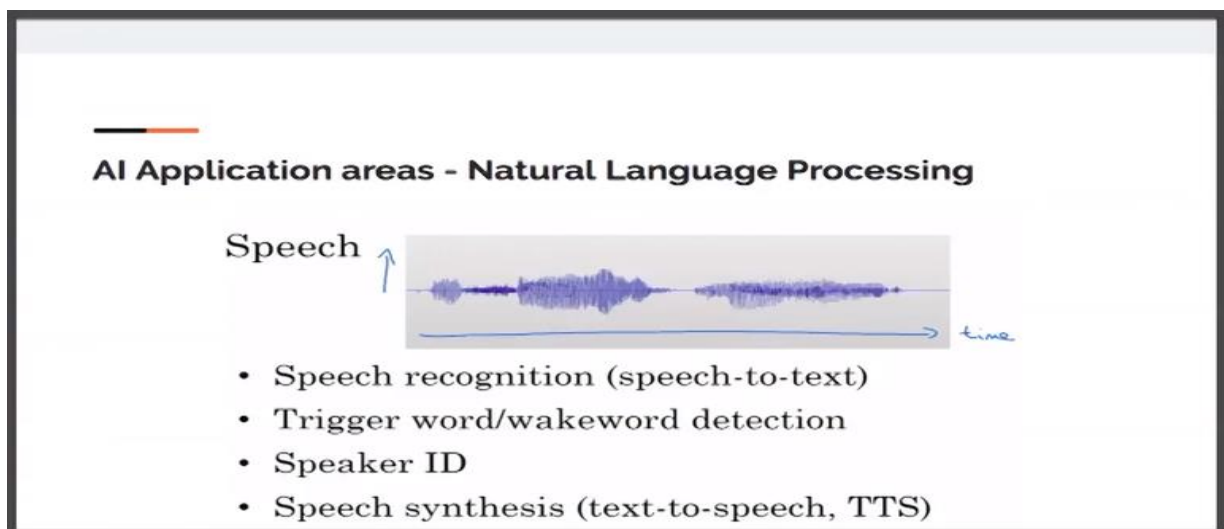
Firstly, Emails are classified according to their intent (what they are saying) like if it is from brand or anything it will be in primary or others will be in primary. It is text classification. Name entity recognition is another example that gives names, places, names of companies and entities automatically from the text given.

Machine translation is also another domain in which one language is converted to other language.

Another part of NLP is parts of speech tagging in which words are tagged in the way what they are. Noun if it is name, place or (if it is noun) and all in the same way. Through this app can be developed that have this function.



Speech is one of the most important domains of NLP. Voice to text conversion, text to voice translation, language conversion all are related to speech.



- **Robotics:**


The first thing that comes to mind of ordinary person is robotics when he hears word AI. In start a lot of work was done in hardware but now AI is more than this and now work is done in smart apps domain.

- **General machine learning:**


In General machine learning we have different type of data it can be images, audio, text (unstructured data). And machine learning does its work on all of this data.

AI Application areas - General Machine Learning

- **Unstructured data (images, audio, text)**



image



audio

AIは、新たな電気だ
AI is the new electricity

text
- **Structured data**

House size (square feet)	# of bedrooms	Price (1000\$)
523	1	100
645	1	150
708	2	200

Clay batch #	Supplier	Mixing time (minutes)
001	ClayCo	35
034	GooClay	22
109	BrownStuff	28

7. Survey of AI Techniques:

In this we will first of all talk about **unsupervised learning**. The value of unsupervised learning is a lot smaller than the value created through supervised learning. As in supervised one labels are given that what is A and what is B in A to B conversion. On the other hand, in Unsupervised learning we provide only data.

Unsupervised learning used clusters. As in supervised learning there are limited classes like 5, 10 that is ok and easy to control but in unsupervised learning there is variety of data so it is very difficult to manage. So, concept of cluster is used.

Cluster:

Cluster in unsupervised learning is collection of related data. As I said there is variety of data in unsupervised learning. So, actually the related data is combined together in cluster and different clusters of related data is form.

In classification classes are made in clustering groups are made.

Transfer Learning:

In Transfer learning we actually transfer learning from one model to another. Like what it means is in every detection model first layers detect the edges in every detection mode like if it is human detection, car detection or building detection so we use trained layers of one model in another model. We attach it to classifier and its learning is in this way transferred to second model. So, if second model don't a lot of data it does not matter and it will work because initial learning is done and model only need to learn classification.

Other AI Techniques

Transfer learning



Learn from task A, and use knowledge to help on task B

As shown in this picture there is one model of car detection enough data (100,000 images) is given to it and works well. On the other hand, second model is Golf cart detection model there are only 100 images which is not sufficient data for model so what will we do is as we know in both of model first layers will detect edges in both of the models so we will use some first trained layers of car detection model in Golf cart detection model and last layers will detect cart in cart detection so data will be sufficient.

Reinforcement Learning:

In Reinforcement learning we give only data to model and even model don't know about the data that about what is. Don't have classes or labels. Model by it self-explores the data and try to know about the data. And performs the things on the data.

For Example If you are going to your home through the way you do not know you go to that way and ask different people and get answered (reward), your reward can be positive or negative (sometime people will say that it's the way sometime they will say no that is not the way) and you keep on doing this till you reached home.

In this way model developed in reinforcement learning tries to get positive reward and keep on learning. Most of online games and AI based games works on reinforcement learning.

Reward Signals:

Getting positive, negative or no reward is Reward signals.

GANs (Generative Adversarial Network):

It is another AI technique. It generates due to the self-learning of models. In this model is trained on a lot of images and after its model starts making images by it self on the behalf

of the training it already had. These images don't exist in this world. Model combine different data from different images and forms a image.
This benefited Animation Industry a lot to develop different characters.