AI Powered Products

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***Abstract*— AI-powered technology is a technological advancement that is drastically changing the way many operations are carried out. By use of machine learning, Deep Neural Network, Natural Language Processing etc, artificial intelligence is offering business organizations and other entities multiple benefits that make life much easier. With the current inefficiencies in the performance of various operations, artificial intelligence is geared towards changing the current dynamics by offering a significant number of advantages to all areas of life. In this paper, we begin with various applications of AI. We than explore various technologies used in AI powered products. In parallel, we highlight the unique advantages for future technologies, focusing on opportunities.**

***Index Terms*— Used: Machine Learning, Computer Vision, Natural Language Processing, Deep Neural Network, Natural Language Generation, Edge Computing, Mapping, Generative Adversarial Networks, Perception.**

I. INTRODUCTION

AI systems have the ability to learn and adapt as they make decisions. From machine learning to computer vision, these technologies are fueling the AI craze. Artificial intelligence has changed the way many organizations operate through the introduction of virtual assistants, AI Powered drone, automated cars, robots and many more. The world is on the cusp of revolutionizing many sectors through artificial intelligence and data analytics The AI in Robotic, Automated cars, Drones not only helps to learn the model to perform certain tasks but also makes machines more intelligent to act in different scenario.

II. VIRTUAL ASSISTANT

A voice assistant relies on a mix of technology, including natural language processing (NLP), artificial intelligence (AI), and voice recognition. The mixture allows the technology to understand questions, provide answers and complete tasks as commanded by the users.



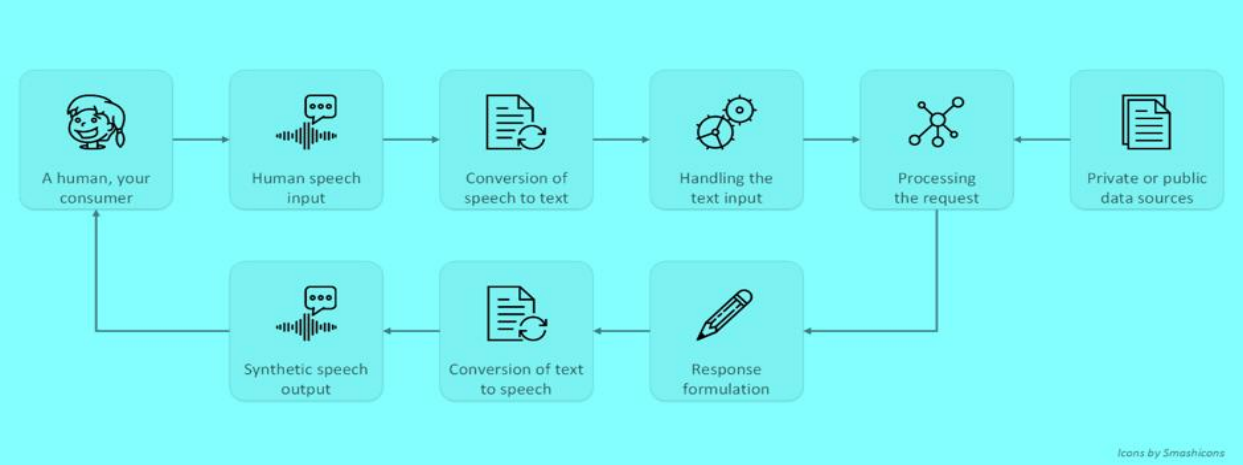
Technology Behind the Voice
Deep Neural Network (DNN):
When an input voice is given to voice assistant, the basic thing which is done is that the voice is converted to text, analysed to come up with a reply in text and is then converted back to voice. As soon as the voice is transcribed to text using Natural Language Processing (NLP), it is analysed based on the dataset that it has. Depending on the questions, the virtual assistant is hoping to solve these challenges by using large deep neural networks.

NLP, NLG
NLP, the ability of machines to understand and learn from the languages that humans speak and write, has been deployed in these assistants.
Apart from NLP, Natural Language Generation (NLG), which generates the text and speech using predefined data, is also put to use to power the responses given by AI assistant

The Inner Workings of a Voice Assistant
Regardless of the complexity of the service any voice assistant provides, they all follow a similar process. The typical process flow of a voice assistant contains several elementary steps which are explained below:

1. The human speech input

As said, voice assistants are available either integrated in a device, through a stand-alone speaker or through an app on your mobile phone. But regardless of how you engage with the voice assistant, it still all starts with you and the input you provide.



2. Conversion of speech input to text input

The voice assistant will try to describe what it heard and convert to text what it understood.

Sometimes it doesn't understand correctly, but the assistant will always try to convert what it heard to text. The natural language processor (NLP) used in the voice assistant will always convert something into words that are part of a specific language dictionary.

3. Handling the text input

Once there is a description of the utterance, the voice assistant still needs to understand the description. A voice assistant can listen to a lot of different requests, questions, or remarks on a lot of different topics. Somehow, it needs to know how to handle your request. One of the ways to give structure to a large set of topics, is through categorization of the input. This categorization is called 'intent mapping': it tries to understand the intent of the textual input and map that to a specific target. An important part of developing a voice assistant is training this intent on many variations of input. Next to mapping the input to the right intent, it will also try to catch pieces of useful information from that given input. These small pieces of information are called entities.

4. Processing the request

After it has mapped the intent of the request, the next step can take place. Any proper voice assistant is programmed to gather all relevant information before it provides a response. It could access anything from restricted internal company systems to publicly available data sources.

5. Response formulation

Once the required information is gathered and the relevant answer to the request is searched for, it can prepare the response. The voice assistant can formulate a textual response following the linguistic patterns of the specific language. The response should provide a best possible answer to the request and of course, should do so in a friendly manner.

6. Text to synthetic speech output

Finally, it will pronounce the formulated response in audible output. Most voice assistants could be connected to use one of many different synthetic voices, for instance a male or female voice.

III. AI POWERED ROBOT



AI in getting integrated into robots to develop the advanced level of robotics that can perform multiple tasks and learn new things with a better perception of the environment. Nowadays, robots are developed through machine learning training. A huge number of datasets is used to train the computer vision model, so that robotics can recognize the various objects and carry out the actions accordingly with right results.
The main idea of converging AI and Robotics is to try to optimise its level of autonomy

IV. HOW AI IS USED IN ROBOTICS?

Computer Vision
Computer vision is a key technology in Robotics and uses Convolutional Neural Networks and OpenCV.

Natural language processing (NLP)
NLP can be used for voice commands to a robot.

Edge computing
The Cloud is the dominant architecture today. In contrast, Edge Computing involves implementing analytics away from the centralized nodes and towards the source of the Data.
AI at the Cloud and Edge are complimentary. Hence, in Edge computing, the processing of data occurs near the source i.e., at the point of origin - rather than transmitting the data to the Cloud. Often, this means the device may not be continuously connected. We can see AI and Edge being used in complex applications of robotics like autonomous cars drones.

Complex event process
Complex event processing (CEP) combines data from multiple streaming sources to infer a more complex event with the goal of responding to the event as quickly as possible. An event is described as a Change of State. One or more events combine to define a Complex event. For example, the deployment of an airbag in a car is a complex event based in the data from multiple sensors in real time. This idea is used in Robotics ex Event-Processing in Autonomous Robot Programming

Transfer learning and AI
Transfer learning is a technique that reuses knowledge gained from solving one problem and reapplies it in solving a related problem

Transfer Learning applies to Mobile devices for inference at the edge. The same principle applies to Robotics i.e.; the model could be trained in the Cloud and deployed on the Device. In addition, transfer learning can be used by Robots to train other Robots

GANs
Generative Adversarial Networks (GANs) can be used to get better data (esp. image data). This can help in areas where Data is not easy to come by or similar data is needed but not available for training. GANs could thus be used in training Robotics.
Mixed reality
Mixed Reality is also an emerging domain. It is mainly used in the field of Programming by demonstration (PhD). PhD creates a prototyping mechanism for algorithms using a combination of physical and virtual objects

Use of Sensors in Robotics
The sensor helps the robots to sense the surroundings or perceive the visuals of the environment.
From motion sensors to computer vision for object detection, there are multiple sensors providing a sensing technology into changing and uncontrolled environments making the AI possible in the robotics.

Machine Learning in Robotics
Machine learning mainly helps to recognize the wide-ranging objects visible in different shapes, sizes and various scenarios.
And the machine learning process keeping running if robots detect new objects, it can make the new category to detect such objects if visible again in the near future.
Deep learning is also used to train such models with high-quality training data for a more precise machine learning process. Here, image annotation plays a key role in creating a huge amount of datasets helping the robotics to recognize and grasp different types of objects or perform the desired action in the right manner making AI successful in the robotics.

V. AUTOMATED CARS

An autonomous car is a vehicle capable of sensing its environment and operating without human involvement.

Essentially, a self-driving car needs to perform three actions to be able to replace a human driver: to perceive, to think and to act. These tasks are made possible by a network of high-tech devices such as cameras, computers, and controllers.

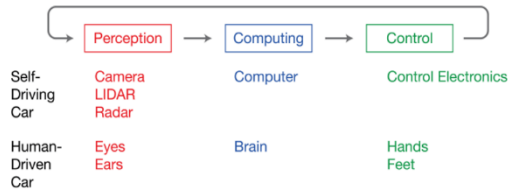


Figure 1: Like a human driver, a self-driving car executes a cycle of perceiving the situation, thinking about it and performing an action depending on the assessment. High-tech devices take over each of these tasks. A self-driving car's "sight" or perception is achieved via several mechanisms.

Cameras are installed on the roof and in other places around the car for 360º vision.

While cameras are good for identifying shapes and colours in the environment, they are not helpful in finding the distance to an object.

Fortunately, self-driving cars also have high-tech sensors, called LIDARs, that are much better at determining the location of people and objects around the car. LIDAR (or "Light Detection and Ranging") is a device with a constantly rotating laser beam. It sends invisible light pulses all around it. By measuring the travel time and location of the reflected laser light, it can discriminate the shape and location of surrounding objects.

In addition to cameras and LIDARs, self-driving cars often have conventional radars. Although radars can only see very fuzzily, they are great at detecting moving objects and are much cheaper than the other devices.

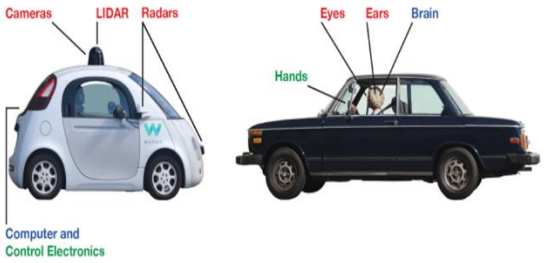


Figure 2: A side-by-side comparison with a conventional, human-driven car illustrates where the components of a self-driving car are located. (Photo of Waymo self-driving car by Grendel khan on Wikimedia Commons. Photo of human-driven car by Mick Tinbergen on Unsplashed.)

Once a self-driving car "sees" its surroundings, the cameras, LIDARs, and radars all send the information they perceive to the "brain" of the car.

The "brain" of a self-driving car is a powerful computer that often sits in the trunk and controls the car's thoughts and actions.

By use of GPS, it initially has a rough idea of the route it must follow to get to a destination. This is not enough, however, to navigate along a busy street, to change lanes or to stop at a traffic light when necessary. Therefore, the computer takes in camera, LIDAR, radar, and GPS data and determines the precise location of the car as well as the objects around it.

Programmers have developed very smart algorithms that can be "trained" to identify 'objects' in the car's surroundings. For example, these algorithms classify a bulky, fast-moving object with two wheels as a motorcycle, rather than a bicycle. Other objects would be identified as cars, pedestrians, traffic lights or obstacles, accordingly.

Once the computer has determined which objects surround the car and how far away, they are, it must decide how to act and then execute its decision.

But how does the computer know which option is better? Programmers have developed algorithms that behave like the neurons in a brain. These algorithms can "learn" from the actions taken in previous situations and infer what to do in a new, similar situation .Once the car's computer decides what action to take, it sends electronic commands to controllers that turn the steering wheel and control the throttle and brakes.

It is important to note that this cycle of gathering information and deciding and executing an action is repeated several times per second. All this is by enabled high-speed computers and very smart algorithms, which allows the computer to constantly assess the situation and make quick decisions.

Mapping a technology revolution

First attempts to create autonomous vehicles (AVs) concentrated on assisted-driving technologies. These advanced driver-assistance systems (ADAS) including

emergency braking, backup cameras, adaptive cruise control, and self-parking systems first appeared in luxury vehicles.

Perception, localization, and mapping

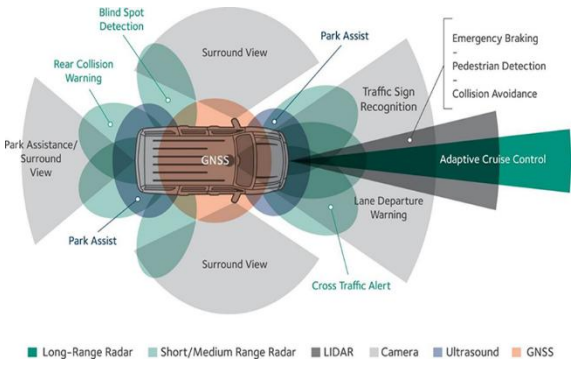
To perfect self-driving cars, companies in the AV space are now working on different approaches, focused on perception, mapping, and localization.

Perception:

The goal to achieve reliable levels of perception with the smallest number of test and validation miles needed.

Sensor Integration

Components like radar, LiDAR and cameras are used to provide the distance to objects that surround the vehicle. If the exact location of the surrounding objects is known, this technology can provide the absolute vehicle location with assistance from a high amount of map data. When integrated with complimentary technology such as: ultrasonic, inertial motion, digital maps, radar/LiDAR, and cameras, GNSS acts as the sixth sense to deliver the positioning performance required by autonomous vehicles.



Mapping:

AV developers are pursuing two mapping options:

Feature mapping:

This approach, which doesn't necessarily need lidar, can use cameras (often in combination with radar) to map only certain road features, which enable navigation. The map, for example, captures lane markings, road and traffic signs, bridges, and other objects relatively close to roads.

Localization

By identifying a vehicle's exact position in its environment, localization is a critical prerequisite for effective decisions about where and how to navigate. A couple of approaches are common.

HD mapping:

This approach uses onboard sensors (including GPS) to compare an AV's perceived environment with corresponding HD maps. It provides a reference point the vehicle can use to identify, on a very precise level, exactly where it is located (including lane information) and what direction it's heading.

Decision making:

Fully autonomous cars can make thousands of decisions for every mile travelled.

Neural networks:

To identify specific scenarios and make suitable decisions, today's decision-making systems mainly employ neural networks. The complex nature of these networks can, however, make it difficult to understand the root causes or logic of certain decisions.

SPAN® GNSS+INS Navigation

With the growing developments in automotive technology, the need for accurate, reliable, and robust ground reference has emerged. Global Navigation Satellite Systems (GNSS) + Inertial Navigation Systems (INS) are an essential component of achieving high accuracy ground truth, mobile mapping, and real-time precise positioning for autonomy.

VI. AI POWERED DRONES

Drones are unmanned, aerial devices used for a variety of purposes. When first developed, these devices were manually, remotely controlled. Now, however, drones often incorporate artificial intelligence, automating some or all operations. The incorporation of AI enables drone vendors to use data from sensors attached to the drone to collect and implement visual and environmental data.



VII. HOW DO AI-BASED DRONES WORK?

AI-based drones rely largely on computer vision. This technology enables drones to detect objects while flying and allows the analysis and recording of information on the ground.

Computer Vision

Computer vision works through high-performance, onboard image processing performed with a neural network. Neural networks enable drones to perform object detection, classification, and tracking. This information is combined in real-time to enable drones to avoid collisions and locate and track targets.

To implement neural networks in drones, researchers must first train the machine learning algorithms to recognize and correctly classify objects in a wide variety of contexts. This is done by feeding specially marked images into the algorithm.These images teach the neural network which traits classes of objects have and how to differentiate one type of object from another. More advanced neural networks continue learning without supervision during operation, improving detection and analysis with use.

Sensors

The other important components for AI-based drones are sensors. Sensors are used to collect all the data that is processed by drone systems, including visual, positioning, and environmental data. This data is then fed to machine learning models to determine how a drone should respond to environmental conditions, what objects it should prioritize or avoid, and where it can fly to.

Real-Time Data

AI enables real-time data streams to be processed in-flight. This provides continuous feedback to operators and internal systems, enabling automatic corrections of flight operations or wholesale automation. This ability to apply data in real-time is especially useful when drones are used to assess areas that are unsafe for humans. AI enables drones to adapt to conditions that humans cannot. It can also enable operators to capture information that might be missed by human operators such as small movements in dark areas.

Improving Human Operation

When AI is built into drone systems it can be used to measure the efficiency of operators and collect data on operating conditions. This data can then be leveraged to develop training programs for operators. By identifying the traits that make for skilful operation, drones can be operated more safely and efficiently. Additionally, by simulating difficult conditions, AI programs can teach operators how to minimize damage to drones or loss to equipment, improving purchaser ROI.

VIII. CONCLUSION

These technologies are a great asset to humans that tend to speed up tasks and processes along with a guaranteed level of precision and accuracy, and therefore this is what makes them useful and important tool. AI makes to learn from experience, adjust to new inputs and perform human-like tasks. Using these technologies, computers can be trained to accomplish specific tasks by processing large amount of data and recognizing patterns in the data.

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