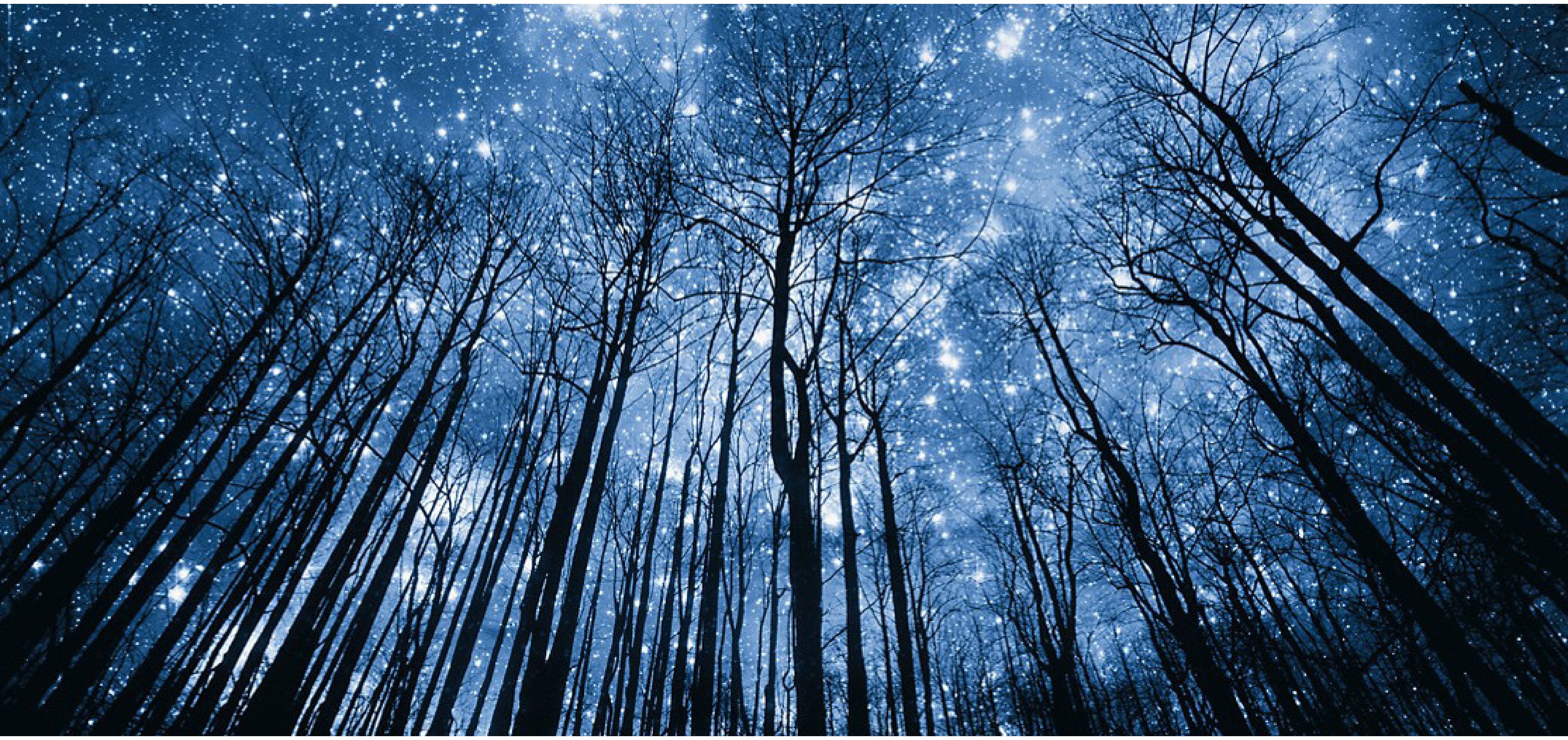
COMPUTER VISION FOR DAILY TASKS



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Introduction

Imagine having a computer view and perceive the environment just as well as human eyes do. In some cases, it might even turn out to be more analytical based on the application it's been deployed to and the training accuracy of the model. Imagine having a watchful guardian viewing and analyzing real time endless footages to detect intrusion activity or other environmental changes, tailored to the use case, which alerts you in real time with a descriptive activity log, if any eventful change is detected. Or, imagine working with mere air gestures to summon commands to your computer system or smart device and performing the task seamlessly. Computer Vision along with AI/ML makes it all possible.

What is Computer Vision?

Computer vision is a branch of artificial intelligence (AI) that enables computers and systems to extract useful information from digital photos, videos, and other visual inputs, as well as to conduct actions or make suggestions based on that data. While AI allows computers to think, computer vision allows them to see, watch, and comprehend.

Human vision is similar to computer vision, with the exception that people have a head start. Human vision benefits from lifetimes of context to teach it how to distinguish objects, how far away they are, if they are moving, and whether something is incorrect with a picture.

Computer vision teaches computers to execute similar tasks, but using cameras, data, and algorithms rather than retinas, optic nerves, and a visual brain, it must do it in a fraction of the time. Because a system trained to check items or monitor a production asset can assess hundreds of products or processes per minute, detecting faults or issues that are invisible to humans, it may swiftly outperform humans.

Computer Vision in Transportation

Every smart city – or any area of human settlement for that matter – must have an abundance of three characteristics: livability, workability, and sustainability. The structures and amenities that enable residents to live comfortable, clean, healthy, and safe lives contribute to a smart city's livability quotient. Furthermore, communication and mobility networks that make it easier for residents to commute to and from work, enhance employment opportunities, and make it easier to start and grow businesses boost the workability of such communities. Finally, a smart city's long-term viability is determined by how effectively it employs technology to reduce energy consumption, pollution, and accidents.

According to the CDC, roughly 1.35 million people are killed or injured in motor vehicle accidents each year, with nearly 3,700 people dying every day. Pedestrians, cyclists, and motorcyclists account for a significant portion of these fatalities. Poor visibility, driver weariness, a lack of attention, and mechanical failure, among other variables, all contribute to such incidents. Data receptor sensors deployed on highways and busy streets, as well as motor vehicles, are part of a smart transportation network. These sensors, along with computer vision-powered CCTV cameras, can offer vehicle drivers real-time information about how near their cars are to people, stationary structures, or other vehicles.

This information is initially gathered autonomously by smart cameras in a hyper-connected smart city. It may then be sent to cars that are linked. A motorist might slow down or take a different route once the data is received in their vehicle's infotainment system. Computer vision algorithms can anticipate possible accident systems ahead of time, reducing preventable errors.

Vehicles today have dynamic picture capture and processing as standard features. Vehicles in smart cities require computer vision systems to ensure the safety of occupants and pedestrians. Additionally, governments and other public bodies can use the visual data gathered and processed by computer vision software to develop smart community projects.

Autonomous Vehicles

Autonomous vehicles are no longer science fiction. Thousands of engineers and developers across the world are testing self-driving vehicles and increasing their dependability and safety.

Computer vision is used to recognise and categorise things (such as road signs or traffic signals), construct 3D maps, and estimate motion, all crucial in the development of autonomous cars. Self-driving cars gather data from sensors and cameras about their surroundings, evaluate it, and behave accordingly.

Computer vision methods, including pattern recognition, feature extraction, object tracking, and 3D vision are used by researchers working on advanced driver assistance system (ADAS) technology to produce real-time algorithms that aid driving activities.

Components of smart driving with autonomous vehicles:

Object Recognition: On the road, there are a variety of moving and immovable items such as people, other cars, traffic signals, and more. The car must recognise diverse things in order to avoid mishaps or crashes while travelling. Sensors and cameras are used by autonomous cars to collect data and create 3D maps. This makes it easier to recognise and detect items on the road while driving, as well as keeping passengers safe.

Making a 3D Map: The vehicle's cameras can collect pictures in real time. To construct a 3D map, computer vision employs real-time photographs. Autonomous cars can use 3D maps to discern the driving area for risk-free driving and to choose other routes in the event of a forecasted accident. For passengers, this makes driving simple and accident-free.

Airbag Inflator: Computer vision constantly decodes data from the environment. It can foresee potential collisions or accidents. It is able to release airbags ahead of time to protect occupants in the event of an inevitable accident. The safety of the passengers is of paramount importance, and computer vision can ensure this.

Car Tracking: To determine if the automobile on the road is the same as previously, computer vision use bounding box detention and complicated algorithms. This is important for tracking and predicting the conduct of other drivers, as well as making driving safer.

Detection of lane lines: In the case of self-driving vehicles, cutting lanes can be disastrous. Segmentation techniques are used in computer vision using Deep Learning technology to recognise lane lines and stay in the designated lane when self-driving. It can also recognise bends and twists on the road, ensuring that its passengers have a safe ride.

Driving in low-light conditions: The light will vary according to the route, topography, and time of day. Normal and low light settings must be switched by self-driving cars. The pictures taken in low light are frequently fuzzy, making driving difficult and dangerous. With its algorithms, computer vision can detect low light conditions and react to them while driving.

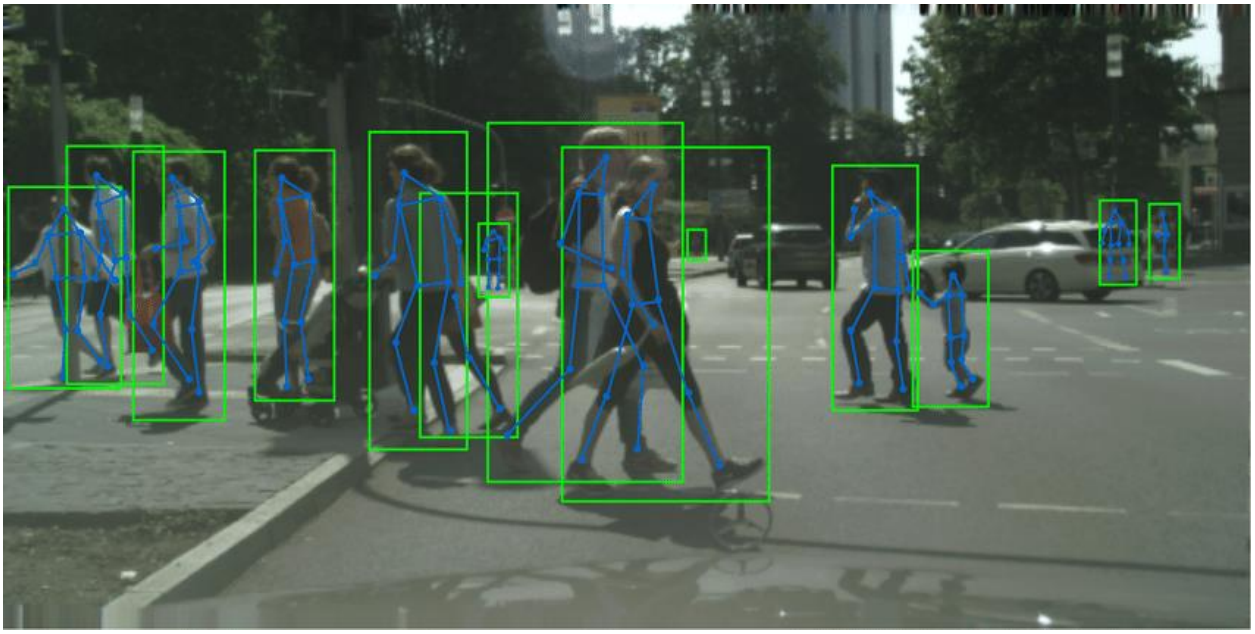
The "eye" of self-driving vehicles is computer vision using an AI-based algorithm. The primary goal of computer vision is to assure passenger safety and provide a seamless self-driving experience. The technology hasn't been finalised yet because there are still a few flaws to work out. However, with the current rate of technological advancement, a smart and trustworthy self-driving car employing computer vision will soon be seen on the roads.

Pedestrian Detection

Because of its potential influence on the design of pedestrian protection systems and smart cities, pedestrian detection and tracking has become a critical computer vision research topic.

It employs cameras to recognise and detect pedestrians in photos or videos, accounting for factors such as body attire and position, occlusion, illuminance in various settings, and background clutter.

Pedestrian detection has applications in autonomous driving, traffic management, and transit safety and efficiency, among others.



Traffic flow detection and analysis

Advancements in computer vision have also made it feasible to track and estimate traffic flow using drones and cameras. The algorithms can now reliably detect and count highway traffic as well as monitor and evaluate traffic density in urban areas (for example, at junctions), enabling better traffic management systems and improved road safety to be designed.

In the last few decades, exponential growth in traffic congestion at urban junctions has placed significant and difficult demands on computer vision algorithms and technical solutions. The goal of this idea is to provide a statistically-based method for determining traffic characteristics at congested urban junctions. In addition to precise tracking and counting of highway traffic, the algorithm has high efficiency for calculating vehicle count at a T-intersection with a high traffic density. For image processing, the system can be built on the Intel Open CV library.

Road Pothole Detection

Computer vision has also been used to detect defects and to assess the state of infrastructure by tracking changes in concrete and asphalt.

Automated Pavement Distress (PD) identification has been shown to improve road maintenance allocation efficiency while also lowering the probability of accidents.

Computer vision algorithms take the acquired picture data and analyse it to create autonomous fracture detection and classification systems that enable human-free focused rehabilitation and preventative maintenance.

Computer Vision in Healthcare

Medical imaging data is one of the most valuable sources of data.

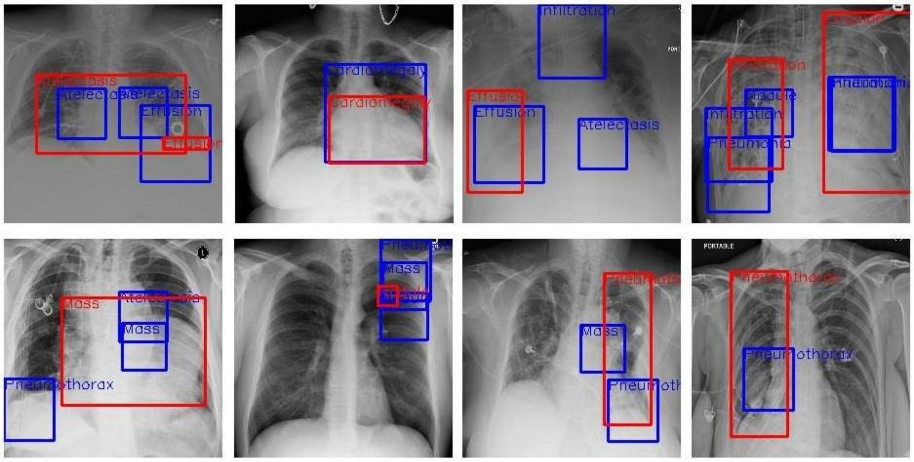
Doctors are compelled to spend hours manually reviewing patient data and doing administrative tasks if the appropriate technology is not in place. Fortunately, as time passed and technology progressed, the healthcare business became one of the first to adopt new automation technologies, such as computer vision.

Below are a few of the most widely used computer vision applications in healthcare.

X-ray examination

Computer vision may be used successfully in the context of medical X-ray imaging for treatment and research, MRI reconstruction, and surgery planning.

While most clinicians still use manual X-ray image processing to diagnose and treat ailments, computer vision can automate the process, enhancing both efficiency and accuracy. Modern image recognition algorithms can detect patterns in X-ray images that are too delicate for the human eye to detect.



MRI and CT scans and analysis

Computer vision is also commonly used to analyse CT and MRI data.

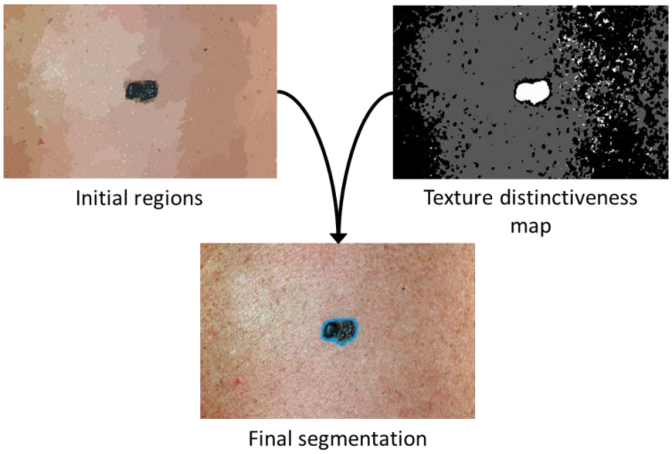
Computer vision is the key to improving patient outcomes, from building AI systems to evaluate radiological pictures with the same levels of accuracy as human doctors (while lowering illness detection time) to deep learning algorithms to boost the resolution of MRI scans.

Computer vision can aid clinicians in detecting tumours, internal bleeding, blocked blood arteries, and other life-threatening illnesses by analysing CT and magnetic resonance imaging (MRI) data. Because the robots can now recognise nuances that are imperceptible to the human eye, the automation of the process has proved to improve accuracy.

Identification of cancer

Comparing diseased and non-cancerous cells in photographs enables clinicians to detect abnormalities and alterations.

Using data MRI scans, automated detection enables speedier cancer diagnosis. Breast and skin cancer screening have previously been effectively implemented using computer vision.



Measurement of blood loss

A leading cause of death in childbirth is postpartum haemorrhage. Until recently, doctors had to make educated guesses on how much blood a patient lost after delivery. Thanks to computer vision, doctors can now assess blood loss during childbirth using an AI-powered technology that analyses photos (taken with an iPad) of surgical sponges and suction canisters. One of the institutions that used this equipment was the Orlando Health Winnie Palmer Hospital for Women and Babies. Doctors tend to overestimate the quantity of blood lost by patients after childbirth in a vast majority of instances, according to research.

Leveraging computer vision, medical experts can now detect blood loss more accurately, allowing them to treat patients more effectively.

Movement Analysis

Pose estimate has been used to help doctors diagnose neurological and musculoskeletal problems by analysing patient movement.

Although most techniques to human posture estimate are geared toward adults, this computer vision methodology has also been used for Medical Infant Motion Analysis. Doctors can predict neurodevelopmental abnormalities and prescribe relevant therapies at a young age by watching and measuring an infant's spontaneous movements. An automated motion analysis system can better record newborn body motions and detect irregularities.

Computer Vision in Manufacturing

The industrial industry has already embraced a wide range of automation systems centered on computer vision. It aids in the automation of quality control, reduced safety hazards, and development of production efficiency.

Some of the most prevalent computer vision applications in the manufacturing industry are:

Defect Detection

Large-scale manufacturing plants frequently fail to attain 100% flaw detection accuracy in their finished items.

Camera-based systems can gather real-time data, evaluate it, and compare the findings to a set of quality criteria using computer vision and machine learning techniques. This aids in more effective identification of macro and micro level problems in the production line, making the production process more error-free and lowering expenses.

Barcode and OCR

Because most items have barcodes on their packaging, object character recognition (OCR) – a computer vision method – may be used to identify, validate, convert, and translate barcodes into readable text automatically. The text on photographic labels or packaging is extracted and cross-checked against databases using OCR.

This technique aids in detection of incorrectly labelled items, provision of expiration dates, notification of product amount in the magazine, and tracking of packages at all phases of product creation.

Product assembly

World-class companies like Tesla have already implemented automated product assembly lines – the company reported automation of over 70% of their manufacturing processes.

Computer vision generates 3D modeling designs, guides robots and human workers, identifies and tracks product components, and helps maintain packaging standards.

Computer Vision for Construction

Computer vision technology is gaining traction in the construction industry, with applications such as personal protective equipment (PPE) detection, infrastructure asset inspection, workplace hazard identification, and predictive maintenance.

Some of the most well-known computer vision use cases in the construction industry are:

Maintenance prediction

Material deterioration and corrosion are typical in production environments, resulting in equipment deformation. If not managed appropriately, this procedure might cause production lines to stop and jeopardise worker safety.

Computer vision aids in monitoring machinery and equipment in order to detect maintenance issues and fix them before they become too serious.

Protective equipment detection

According to the National Institute for Occupational Safety and Health (NIOSH), over 2,000 work-related injuries occur every day in the United States alone, many of which may be avoided with the use of PPE.

Given enough representative training data, deep learning has enabled recognition of protective equipment in a variety of settings.

As a result, computer vision has been effectively employed to assure suitable safety and security requirements. In the event of an accident, AI-assisted systems aid in swiftly identifying and assessing incident severity, as well as responding fast by taking relevant steps.

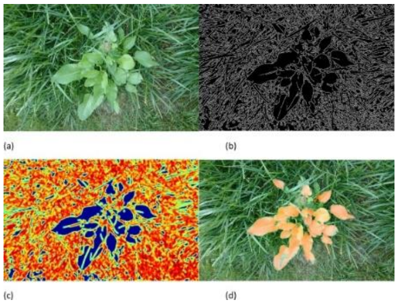
Computer Vision for Agriculture

AI models (including computer vision) have made significant contributions to the agricultural industry in areas such as crop and yield monitoring, automated harvesting, weather conditions analytics, animal health monitoring, and plant disease identification. Because of its automation and detecting capabilities, this technology has already established a firm footing, and its applications are only going to grow.

The following are some of the most common computer vision applications in agriculture.

Crop and yield surveillance

Crop growth monitoring has always relied on subjective human assessment and is neither timely nor reliable. Computer Vision enables continuous real-time plant growth monitoring and identification of changes in crops caused by malnutrition or illness.



Automatic weeding

Human labor is costly and inefficient when compared to automated solutions. Plus, traditional weeding methods include spraying pesticides, often contaminating neighboring healthy plants, water, or animals.

Computer vision facilitates intelligent detection and removal of weeds using robots (e.g. Ecorobotix or Oz), lowering costs and ensuring higher yield.

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