Computer Vision: A Detailed Review on Augmented Reality (AR), Virtual Reality (VR), Telehealth, and Digital Radiology

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Abstract

Computer vision have become progressively famous in supporting numerous impending creations since arising in the new year's. Their application and administrations are of extraordinary interest to specialist organizations, gadget designers, and clients. This paper recognizes computer vision from traditional informal community and gives an exhaustive review of computer vision with respect of their utilization, benefits, arrangement, and plan of the general framework design. First and foremost, computer vision and talk discussed with history and origin. We dissect and propose the use of computer vision in sports, well-being and medication, horticulture and cultivating, transportation and retail, and assembling. Presently, we propose a few benefits of computer vision. We show the effect of computer vision on banking, monetary help, capital market, and trade. Considering the current capacities of computer vision, we present eventual fate of computer vision as CV will be profoundly significant for self-driving vehicle or in facial acknowledgment. Then at that point, we talk about how augmented reality and practically reality work with computer vision as well as CV perceives things and illuminates VR hot-spot for better client responsive and complex. Computer vision and increased reality for online business taken under consideration. At the end, this chapter summarized and concluded for the needs of computer vision.

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7.1   Introduction

Computer vision is the science and innovation of machines that see a logical discipline (Malinowski et al. 2017). Computer vision is worried about the hypothesis and innovation for building fake frameworks that acquire data from pictures or mufti-faceted information. Computer vision assignments incorporate techniques for getting, handling, examining, and understanding computerized pictures, and extraction of high-layered information from this present reality to deliver mathematical or representative data as shown in Fig. 7.1.

7.2   Literature Review

With the headway of regular language handling and picture appreciation, more intricate and complex works are opening up. Our point is to exploit the furthest down the line advancements to drive the craft of addressing regular language inquiries into true pictures. This action incorporates a poll focused on the inquiry and the comprehension of the actual circumstance and the capacity of foreseeing word request. We check out the errand of responding to this inquiry in the genuine pictures set as Visual Turing Test. With the most recent advancement in visual

HOW COMPUTER VISION WORKS

ACQUIRING THE IMAGE

Acquiring the image Images, even large sets, can be acquired in real time through video photos or 3D technology for analysis

ANALYZING THE IMAGE

Deep learning models automate much of this process, but the models are often trained by first being fed thousands of labeled or pre-identified images.

APPLYING THE INSIGHTS

The final step is the interpretive step, where the deep learning model is deployed to score new image or video feed.

Fig. 7.1 Working of computer vision

depiction and normal language handling, we recommend "Ask Your Neurons"-an arranged, cooperative, cooperative answer for this issue (Malinowski et al. 2017).

Latest advances in computer vision have shown that visual elements learned by neural organizations prepared in object acknowledgment work utilizing in excess of 1,000,000 named pictures are useful in numerous PC visual capacities like semantic grouping, object discovery, and activity partition. However, object recognition is one of the many functions used in theory. For example, people use visual aids, understand the structure of a scene, and perform such tasks as moving around the earth. Is there anything special about the object recognition function or is it possible that useful visual presentations can be learned by other means of monitoring? Clearly, living things perform complex visual functions and are unlikely to require external recruitment in the form of millions of labeled models (Agrawal et al. 2015).

Computer vision research, image processing, and pattern recognition have made significant progress over the decades. Also, medical thinking has attracted increasing attention in recent years because of its important role in health care systems. Researchers have published a wide range of scientific and basic data that document the progress and use of health care in medical thinking (Gao et al. 2018).

As the study of these fields has stopped doctors from moving from the bench to the bedside, the Engineering Health Journal has begun publishing this special issue provided with advanced computer-assisted techniques, as well as reviewing articles that will encourage ongoing efforts to understand common problems in the field. The result is a collection of 15 documents already submitted by investigators (Tian et al. 2020).

Following the law of special relevance, we identify four major domains covered in paper. First is the analysis of healthcare imaging images, secondly computer-assisted analytics and therapeutic analytics, thirdly the basic algorithms of medical imaging, and lastly focuses on medical machine learning algorithms. Here, we provide a review of these published papers.

Computer vision is a field that includes making a machine "see." This innovation utilizes the camera and the PC rather than the natural eye to recognize, track, and measure the greatness of the handling of picture handling. With the advancement of computer vision, such advances have become generally utilized in the field of horticultural robotization and assume a significant part in its turn of events (Doersch et al. 2015).

This audit sums up and breaks down advancements and difficulties throughout the course of recent years and thinks about future open doors and possibilities for leading the most recent insightful reference. Through examination, it is observed that the accessible innovation can help in the computerization of limited scope agribusiness to accomplish the advantages of minimal expense, high productivity, and high precision (Kontschieder et al. 2015).

Nonetheless, challenges remain. To begin with, innovation will keep on venturing into new areas of activity later on, and there will be numerous mechanical issues that should be survived. It is critical to assemble large informational collections. Second, with the quick improvement of agricultural robotization, the interest for experts will keep on developing. In the long run, the force of related innovation in

different complex conditions will likewise be bound to the chal-focal points (Caicedo and Lazebnik 2015).

Through examination and conversation, we accept that later on, PC innovation will be coordinated with savvy advances like escalated learning innovation, applied to all parts of horticultural item the executives in view of huge scope informational index, generally used to take care of current agrarian issues to work on financial execution, normal and practical farming framework (Pers and Kovacic 2000).

How can one write a work that aims to promote the presentation of images, for example, objects, when there is nothing labeled? This paper aims to provide the same "self-contained" format of image data: visual function that includes predicting the context of a pool. Sample random dots in one of the eight location settings, and introduce each pair in the machine reader, without providing details about the actual locations within the image (Mihailidis et al. 2004).

The algorithm should predict the formation of one episode related to another. Our basic assumption is that to do well in this work requires an understanding of scenes and objects, that is, a good demonstration of this work will require the removal of objects and parts of them in order to think about their place relative to the place. "Things," after all, have many parts that can be obtained independently (Hoff et al. 1996).

We are acquainting another methodology with advancing trees separated by the abilities to gain proficiency with the portrayal of profound (neural) networks inside endpoints. We join the two universes through a reliable and separated dynamic model, which coordinates the arrangement of stowed away introductions in the secret pieces of a profound organization (Jarvis 1983).

The proposed model contrasts from regular profound organizations in that the choice woodland gives last expectations and varies from traditional choice timberlands by presenting objective making, joining and worldwide execution of leaf isolation and limit. Our examination technique contrasts well and other inside and out craftsmanship models in a huge picture division capacity like ImageNet (Kress and Cummings 2017).

We present a successful procurement model for gathered things. The model is explicit to a specific class and permits the specialist to zero in on chosen regions to recognize the right area of the objective item. This specialist figures out how to incapacitate the limiting box utilizing a straightforward momentary activity, fully intent on deciding the particular area of the objective items that follow the higher reasoning. The proposed nearby specialist is prepared utilizing top to bottom solidification studies, and kept an eye on the Pascal VOC 2007 site for neighborhood exercise (Ungureanu et al. 2020).

The introduction of a computer-assisted viewing program for the next team games is presented. Several photo processing and tracking methods are described, as well as camera measurement and lens distortion adjustment. The release of this program contains spatio-temporal trajectories for athletes, which can be performed and processed by sports professionals. In some critical cases, the tracking process should be interrupted manually. In order to correct missed tracking, personal

monitoring is required. Some test results have also been introduced (Rauschnabel et al. 2017).

This paper examines the utilization of PC vision in dispersed well-being frameworks, especially in making a sharp regular passionate specialist that assists more established grown-ups with dementia during day-to-day existence. A total outline of the methods utilized in this model, just as the outcomes from the main tests finished utilizing the new hearing specialist, is given. A conversation of the outcomes acquired up until this point, including pre-improvement and advancement issues and the reception of this innovation in far-reaching medical services, is being examined (Bin et al. 2020).

The disliked truth of the citizens we see is the term used to portray frameworks in which computer created data is put away in reality; for instance, by utilizing the showcase displayed in the title. The client of this application can in any case see and communicate with this present reality, yet have extra significant data, like depictions of key highlights or directions for performing visual undertakings, set on the planet. For instance, a computer can distinguish and join to photograph casings, marks, and a program (Chen et al. 2018).

The artworks are enlisted in certifiable items and give off an impression of being "painted" on those objects. Expanded reality frameworks can be utilized to make useful assets for undertakings like investigation, creation, and route. One of the basic requirements of the disliked truth of citizens we see is seeing and finding genuine articles according to the human head (Khor et al. 2016).

Exact enrollment is needed to glue illustrations more precisely than genuine items. At the Colorado School of Mines, we have fostered a genuine citizen framework that we see utilizing head-mounted cameras and computer seeing strategies to precisely record the scene. The current framework distinguishes and tracks a bunch of pre-introduced targets set in true articles. The program dissects the design and shows countless drawings utilizing the title show. This paper depicts the plan of the program and portrays the computer acknowledgment strategies utilized (Pottle 2019).

A lot of interest has been shown, among PC and public-put together examination with respect to advanced mechanics, in the accessibility of extensive information to help bunch investigation prompting remote (simple) assurance of rectification and occupying space for three-layered incorporation. This paper looks at the different strategies for getting general degree and gives a thought of their viability and blunders with regard to PC hypothesis studies (Milgram and Kishino 1994).

7.3 Applications of Computer Vision

7.3.1 Computer Vision in Sports

7.3.1.1 Sports Production
Fully robotized sports creation offices are made with profound getting the hang of, including zoom in and container outs that are actually equivalent to human-drove creation. Rather than utilizing photographic artists, PC vision, it is utilized to recognize the places of the players and the ball to zero in on those components relying upon what is being seen (Peugnet et al. 1998).

7.3.1.2 Player Tracking
Videos or live drawings, are intended to be perceived edge by outline. The player's activities not set in stone by seeing examples between an individual's body developments and remaining between outlines. This permits you to examine a competitor's presentation, practice progress, or survey a competitor's exhibition (Hughes et al. 2005).

7.3.1.3 Ball Tracking
Similarly, following the ball is made more straightforward by utilizing a PC vision that recognizes the anticipated ball way utilizing the AR and tossing the camera where the ball will be before it gets there (Rokhsaritalemi et al. 2020).

7.3.2 Computer Vision in Health and Medicine

Computer vision applicable in health care like cancer detection, cell classification, movement analysis, mask detection, and tumor detection as shown in Fig. 7.2. Some the above-mentioned areas are discussed below (Parveau and Adda 2018; Benligiray et al. 2019; Rohs 2007).

Fig. 7.2 Uses of computer vision in healthcare
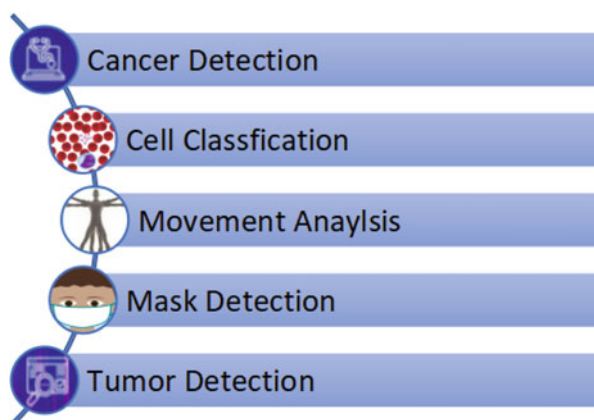
7.3.2.1 Cancer Detection

AI is coordinated into the clinical business for purposes like skin disease discovery. Picture identification permits researchers to choose little contrasts among harmful and non-carcinogenic pictures.

7.3.2.2 Cell Classification

Machine Learning is relied upon to altogether speed up the method involved with diagnosing sicknesses according to colon disease effectively and economically after creation (Mihailidis et al. 2004).

7.3.2.3 Tumor Detection

Cerebrum growth should be visible on MRI filters and is regularly recognized utilizing profound neural organizations. Cancer-based programming that utilizes profound learning is significant for the clinical business since they can recognize growths with high exactness to assist specialists with making their determination. New techniques are continually being created to expand the exactness of these findings.

7.3.2.4 Development Analysis

Neurological and outer muscle issues, for example, seizures, balance issues, and acquisitions can be identified utilizing PC-based vision and profound learning models without a doctor examination. Patient estimation vision applications that investigate patient developments assist doctors with viewing as tolerant more straightforward with expanded exactness (Limmer et al. 2016; Seo et al. 2011; Dash et al. 2018).

7.3.2.5 Cover Detection

Companies like Uber have created PC vision, utilized in their versatile applications to decide if travelers are wearing a veil. Frameworks like these unveil transportation more secure during such situations (Gao et al. 2018).

7.3.3 Computer Vision in Agriculture and Farming

7.3.3.1 Absconds in Agriculture

Defective item can be recognized while utilizing AI calculations. Calculations are furnished with a great deal of detail and are prepared to distinguish the distinction between a ready and a harmed item.

7.3.3.2 Counting

An enormous number of items can be taken care of through a reasoning framework that can count the number of things on the scene. This permits ranchers to realize the amount they are cultivating and permit them to ascertain the amount they should charge for the items.

7.3.3.3 Plant Recognition (Fig. 7.3)

Projects can be utilized to distinguish plants and creatures at the species level from a client produced picture. Ranchers can now effectively distinguish weeds and bugs with this PC vision application.

7.3.3.4 Animal Monitoring

Animals can be seen utilizing novel strategies that have been prepared to distinguish the sort of creature and its activities. There are many utilizations for creature cultivation in agribusiness, where domesticated animals can be checked from a distance to identify illness, changes in conduct, or breed. Also, agrarian and untamed life researchers can securely notice natural life from a good way.

7.3.3.5 Farm Automation

Technologies, for example, gathering, seed planting, and weed control robots, autonomous work vehicles, and robots to screen ranch conditions and utilization of manures can build usefulness with work shortages (Hajek et al. 2018).

7.3.4 Computer Vision in Retail and Manufacturing (Fig. 7.4)

7.3.4.1 Customer Tracking

Strategically positioned counting gadgets all through the store can gather information on AI processes regarding where clients invest their energy, and for how long. Client investigation can work on the comprehension of stores and furthermore work on primary productivity.

7.3.4.2 Individuals Counting

Computer Vision calculations are prepared with information guides to observe individuals and consider them become identified. Such people including the innovation is helpful in stores, to gather information about the accomplishment of their stores and can be utilized in cases connected with COVID-19, where a predetermined number of customers are just permitted in the store simultaneously (Young and Smith 2016).
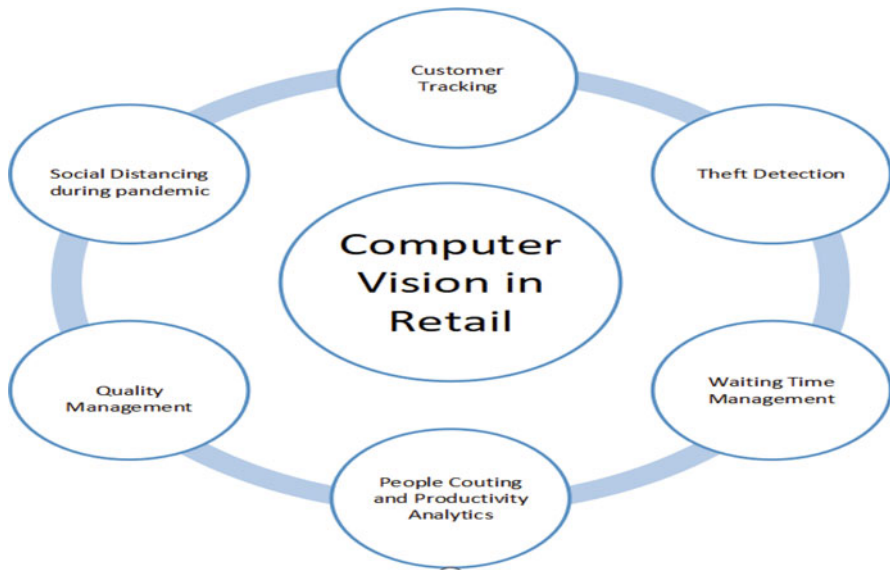
7.3.4.3 Thief Detection

Vendors can distinguish dubious conduct, for example, meandering or getting to limited regions utilizing PC vision calculations that freely examine area.

Fig. 7.3 General steps applied to plant disease identification

Fig. 7.4   Computer vision in retail

7.3.4.4 Waiting Time Analytic

To protect impatient customers with endless waiting lines, marketers use line acquisition technology. Line detection uses cameras to track and calculate the number of customers in line. Once the customer limit has been reached, the system sounds an alert for clerks to open a new checkout (Katiyar et al. 2015).

7.3.4.5 Social Distance

To guarantee that well-being measures are followed, organizations use distance testing gear. The camera tracks the development of the representative or client and utilizations profundity sensors to screen the distance between them. Contingent upon their position, the framework draws a red or green circle around an individual.

7.3.4.6 Productivity Analytics

Product examination tracks the effect of work environment changes and how representatives use their time and assets, and utilize an assortment of devices. Such information can give important bits of knowledge into using time productively, work joint efforts, and worker efficiency.

7.3.4.7 Quality Management

Quality administration frameworks guarantee that the association addresses the issues of clients by clinging to its strategies, methodology, directions, inner cycles to accomplish the full degree of consumer loyalty (He et al. 2018).

7.4 Advantages

There are many advantages to use computer vision, whether in everyday life or at work. From saving lives to studying the world and how it works, computer vision helps us find answers to these questions quickly (Niehorster et al. 2017).

These advantages are as follows:

1. *Simpler and Fast Processes*: You will actually want to test and check your items rapidly, as visual checks are supplanted by quicker and faster computers.
2. *Reliability*: Contrary to the natural eye, cameras and computers do not tire. The human component is taken out; you will not see a fluctuating devotion in view of how your regulators dozed that day or anytime.
3. *Accuracy*: Your end results will be, on account of computer imaging, faultless.
4. *Wide range of uses*: From manufacturing plants to the clinical business, one can apply similar program to an assortment of errands performed at your assembling organization (from quality investigation by following the stockpile of merchandise to the last conveyance estimation in the delivery cycle), which diminishes the expense of additional preparation of new framework faculty.
5. *Cost reduction*: You will save time for individuals and gear and take out terrible items. You will actually want to shut down your representatives from the control division to different capacities and further develop your picture with clients by diminishing the mistake rate on conveyance.

7.4.1 Impact of Computer Vision

7.4.1.1 Financial Services (Fig. 7.5)
The computer vision for monetary administrations will fill in as an innovation that is more impressive than problematic innovation. While monetary assistance players will further develop how they might interpret PC vision, they will not be diverted by

Fig. 7.5 Impact of computer vision on financial sector

the beginning of PC seeing, rather they will purchase their own product. Contrasted with different styles generally centered around the fintech wave 5 years' prior, the idea of PC vision has a reasonable number of novices (Cruz-Neira et al. 1992).

7.4.2 Insurance

Computer vision innovation will enormously affect protection transporters. In the first place, transporters will profit from better UX because of full fields that incorporate data separated from pictures. The greatest effect will be on direct composition, and arrangements with a specific worth, quality, and granular danger. For transporters who are delayed to embrace PC seeing innovation, they may accidentally compose risky or false approaches without their insight. Moreover, as these transporters can evaluate granular danger, their best clients will leave transporters who can charge a part of the danger, as protection costs will be lower for okay clients. This could leave sluggish transporters with a high-hazard business book, without the danger appraisal devices they keep.

7.4.3 Capital Markets

With the progression of geospatial information and computer vision representation innovation, we can follow worldwide action at large and recreated levels, at a phenomenal rate. With the innovation accessible in the present business world, financial backers, market analysts, and legislatures can pursue a comparable direction in US markets, straight up to the dealer, by following vehicles in parking areas. Mutual funds utilize this information to observe a line in deals designs, worldwide water protection, worldwide oil stockpiling, neediness creation, and financial markers at the public level.

7.4.4 Commerce

Amazon's biggest retailer is a forerunner in the advertising of PCs, and applications in the business, especially in the Amazon Go store close to the organization's base camp. Amazon Go is an alpha rendition of the top rated retail location, which opened in 2017. The store has no leave booklets, and on second thought purchasers just come in, take what they need, go out. Amazon began utilizing the Amazon Go brain store over 4 years prior, as a way to "push the limits of PC review and AI to construct a store where clients can essentially take what they need and leave." Amazon Go depends on "PC deceivability, profound understanding abilities, and tactile availability, such as getting into self-driving vehicles" (Wu et al. 2013).

7.4.5   Banking

A large number of the natural product hanging in the banks is in the administrative center, particularly law requirement, paid records, records, and branch organizations. Inside the consistence, the PC idea will change the Know Your Customer (KYC) process, which is now in progress in Europe at banks like BBVA, where clients can open a record through cell phone with a selfie and video call. Rather than depending exclusively on data with rehashed names and birthday celebrations, according to a PC viewpoint, banks can plainly distinguish who they are managing in a business. In the administrative center, where significant archives are accessible, PC vision will further develop precision, increment access, and diminish the time needed to perform errands. In branch organizations, PC seeing innovation can screen client sentiments and move client data to work on over the long run (Pers and Kovacic 2000; Mihailidis et al. 2004; Hoff et al. 1996; Jarvis 1983).

7.5   Future of Computer Vision

Considering today's computer-aided viewing skills, it would be hard to believe that there are so many benefits and advantages that technology has yet to discover. This may also be due to the lack of effective results of in-depth research (Bin et al. 2020; Chen et al. 2018; Khor et al. 2016; Pottle 2019).

As with all programs, the computer concept faces the problem of lack of good technology and therefore has many problems such as:

1. While it works well, it is not clear when it comes to its internal functioning.
2. One of the reasons why the concept of a computer is so challenging is that when machines see images, they see themselves as numbers representing individual pixels and as a result see the world in a way that a person cannot yet see a computer.
3. Computer vision requires foreign technology such as Learning Machine to process data in video format. This has led to many decisions made in the computer vision community over the decades being perceived as decisions forced on them by the absence of computer resources. This has led to a greater focus on individual images than video.
4. Object locality and acquisition is a computer vision problem where, when given an image, the algorithm has to determine the locations of one or more targeted objects, extracting individual binding boxes from an image or video frame that currently cannot function properly.
5. Image classification (Fig. 7.6) is used in a variety of applications (medical, robotic, satellite image analysis, etc.) to not only understand the locations of objects in photos and video frames, but to accurately map the boundaries between different objects in the same image. The computer viewing algorithm has the difficulty of marking certain parameters of a different object without being given many details of the same information.
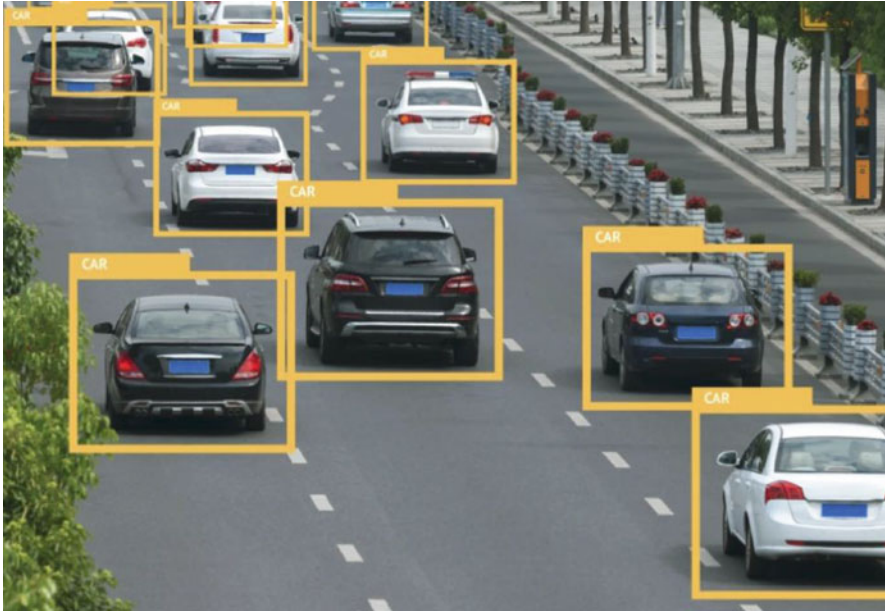
Fig. 7.6 Image recognition (Singh et al. n.d.)

However, these problems are solved by combining external technologies such as artificial intelligence and machine learning. At the moment these cannot be calculated by any computer vision algorithm unless it has overcome a few challenges, the main of which is the demolition of the black AI box.

The future of computer vision therefore has undergone a slight transformation into a further refinement of implementation such as (Malinowski et al. 2017; Agrawal et al. 2015; Gao et al. 2018):

1. *Self-Driving Cars*: While some technologies may help self-imposed vehicles to detect and avoid obstacles, computer vision enables them to learn road signs and follow higher traffic rules. Driving can be converted into a visual problem and solved using Computer Vision.
2. *Facial recognition and biometric*: Facial recognition and biometric scanning systems also use computer scanning technology to identify people for security purposes. Advanced use of facial and biometric recognition includes business or business programs that use different aspects of the human body to verify ownership.
3. *Image Caption*: Image captioning may be the use of a computer concept that we may all be familiar with. Social media platforms like Facebook and Instagram use in-depth reading skills to identify user-generated content. These algorithms can be made more effective in distinguishing not only humans from animals and

inanimate objects but also identifying humans according to their facial character-
istic (Singh et al. n.d.).

4. *Law and order*: Computer view can be used to scan live or recorded images to
   assist law enforcement and security officials with important information. For
   example, computer viewing can be used to scan live images in a public place to
   identify dangerous objects such as guns or to identify suspicious behavior or
   movements that may indicate any illegal human activity, depending on historical
   details. With progressive development, computer vision can be used to scan
   crowds to highlight the presence of any people who are interested or wanted by
   the relevant authorities.

5. *Manufacturing*: The manufacturing sector is among the sectors that have seen
   widespread use of automation and robotics. As the transition from more produc-
   tive units to fully automated production, they will need to use more sophisticated
   systems to monitor industrial processes and outcomes. Computer Vision can be
   used to test products made for errors and inconsistencies. Therefore, it can
   eliminate the need for human testing in the production line.

7.6   AR, VR and What CV Means to Them

VR immerses a person in the physical world by reviving their true presence through
the senses. This promotion can be obtained from a source of content and hardware
such as headsets, treadmills, gloves, and more.

Computer Vision supports powerful virtual reality realities like SLAM (simulta-
neously mapping), SFM (architecture from motion), human body tracking and
tracking tracking.

Using cameras and sensors, these functions help VR systems analyze the user's
environment and locate the headset. Thus, computer vision and virtual reality work
together to make products more complex and user-friendly (Hoff et al. 1996).

The unpopular truth of the tax collectors we see has the power to instill fear in us
by transforming the world into a reality. In fact, computer-based AR is overlapping
images or sounds in the physical realm of the real world. And it all starts with a
computer perspective. A computer view (CV) of unpopular reality for taxpayers that
we see enables computers to discover, operate, analyze, and understand digital
videos and images. By looking at an object and its appearance, location and settings,
it identifies what the object is. Simply put this is, how Instagram identifies your
friends with photo tags, how to log into your bank account with your own eyes, and
how to get yourself a wreath on Snacomputerhat (Niehorster et al. 2017).

When you look at the pictures, you see your face, while the computer view sees
the data. Machine learning, a data analysis method, embedded in the AR application
relieves the pain of object discovery. A CV refers to maps from photos or videos. It
learns the geometry of your face, captures bright spots and also considers global
facts about a person's face such as measuring marks, mimic facial muscles, etc.

7.7 Computer Vision and Augmented Reality for E-Commerce

Recently, AR has made it possible for retailers to showcase their products in real-time. IKEA was one of the first to roll out an AR application (Fig. 7.7) that enabled buyers to visualize products within their homes. Today, more and more retailers are utilizing AI software to elevate the shopping experience and ease purchasing decisions for their clients (Hajek et al. 2018).

The same goes for online clothing stores. The technology enables shoppers to virtually try on clothes and find their perfect fit. Nowadays, the number of online stores unveiling their fitting rooms by an app is growing. For now, computer vision-based augmented reality has been proven efficient in providing a better customer experience, improving brand perception and boosting sales.

7.8 Conclusion

In this chapter, a detailed discussion on various technological aspects of computer vision, AR, VR, and telehealth has made. Various applications domain and their technological growth toward modern research have pointed out as well. Through the merits and demerits of each technological aspect one can choose for better application and findings. Use of CV in various telehealth like cancer, tumor detection emphasis healthcare and digital health. Future of computer vision can attract researchers as well as manufacturer to promote their funds and invention.
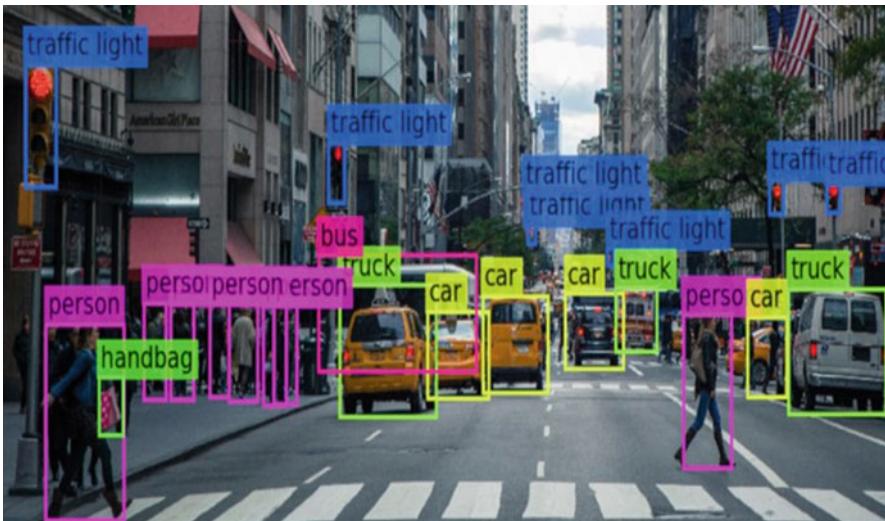
Fig. 7.7 Data labeling for Computer Vision (Singh et al. n.d.)

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