ردیف	بازنویسی شده به زبان انگلیسی	ترجمه فارسی	متن مقاله
.1	The rapid progress of autonomous vehicle (AV) technology has attracted the attention of researchers, engineers, policymakers, and the general public. At the core of AV development are sensors that provide perception and decision-making capabilities within dynamic driving environments.	پیشرفت سریع فناوری وسایل نقلیه خودران (Autonomous Vehicle - AV) توجه پژوهشگران، مهندسان، سیاست‌گذاران و عموم مردم را به خود جلب کرده است. در مرکز توسعه‌یAV ، حسگرهایی قرار دارند که امکان درک (Perception)و تصمیم‌گیری (Decision-Making)را در محیط‌های رانندگی پویا فراهم می کنند	The rapid advancement of autonomous vehicle (AV) technology has captured the attention of researchers, engineers, policymakers, and the public. Central to AV development are sensors that enable perception and decision-making within dynamic driving environments.
.2	Among these sensors, camera sensors play a crucial role as the main source of visual perception in AV systems. Cameras capture high-resolution, real-time images of the vehicle's surroundings and provide essential visual data for the accurate detection and classification of various objects.	در میان این حسگرها، حسگرهای دوربین نقش حیاتی ایفا می‌کنند، چرا که منبع اصلی درک بصری (Visual Perception)در سامانه‌های AV محسوب می‌شوند. دوربین‌ها تصاویر با وضوح‌بالا و بلادرنگ از محیط اطراف وسیله نقلیه ثبت می‌کنند و داده‌های بصری حیاتی را برای تشخیص (Detection)و طبقه‌بندی (Classification)دقیق انواع اشیاء فراهم می‌سازند.	Among these, camera sensors play a vital role as the primary source of visual perception in the AV systems. Cameras capture real-time high-resolution images of the vehicle's surroundings, providing crucial visual data for the accurate detection and classification of various objects.
.3	By utilizing advanced object detection algorithms, cameras support a wide range of AV functionalities such as lane keeping and path planning by continuously monitoring lane markings and changes in road structure. This allows the vehicle to maintain its position within lanes and make informed decisions regarding trajectory and maneuvering, thereby improving overall road safety and traffic flow.	با بهره‌گیری از الگوریتم‌های پیشرفته‌ی تشخیص اشیاء (Advanced Object Detection Algorithms)، دوربین‌ها به طیف گسترده‌ای از قابلیت‌های AV از جمله حفظ خطوط حرکتی (Lane Keeping)و برنامه‌ریزی مسیر (Path Planning)کمک می‌کنند؛ بدین صورت که به طور مداوم خطوط جاده و تغییرات در ساختار مسیر را پایش می‌نمایند. این امر به وسیله نقلیه امکان می‌دهد موقعیت خود را در داخل خطوط حفظ کرده و تصمیمات آگاهانه‌ای در خصوص مسیر حرکت (Trajectory)و مانوردهی (Maneuvering)اتخاذ کند، و در نتیجه، ایمنی کلی جاده و جریان ترافیک را ارتقا دهد.	By leveraging advanced object detection algorithms, cameras contribute to various AV functionalities such as lane keeping and path planning by continuously monitoring lane markings and changes in road layout. This enables the vehicle to maintain its position within lanes and make informed decisions regarding trajec- tory and maneuvering, thereby enhancing overall road safety and traffic flow.

.4	Furthermore, camera sensors assist in path planning by detecting obstacles, traffic signs, and other entities, allowing the vehicle to adjust its trajectory accordingly and navigate complex traffic scenarios.	حسگرهای دوربین با شناسایی موانع، تابلوهای راهنمایی و سایر عناصر، به برنامه‌ریزی مسیر (Path Planning) کمک می‌کنند و امکان می‌دهند وسیله نقلیه مسیر خود را بر اساس آن‌ها تنظیم کرده و در سناریوهای پیچیده ترافیکی حرکت کند.	camera sensors contribute to path planning by identifying obstacles, traffic signs, and other entities, enabling the vehicle to adapt its trajectory accordingly and navigate complex traffic scenarios.
.5	Depth estimation is another key capability of camera sensors, enabling autonomous vehicles to accurately perceive the distances of surrounding objects. Through advanced image processing techniques, cameras can provide depth perception, enhancing the vehicle’s spatial awareness and obstacle avoidance capabilities.	برآورد عمق (Depth Estimation) یکی دیگر از قابلیت‌های کلیدی حسگرهای دوربین است که امکان می‌دهد وسایل نقلیه خودران فاصله‌ی اشیاء اطراف را به دقت درک کنند. با استفاده از تکنیک‌های پیشرفته‌ی پردازش تصویر (Advanced Image Processing Techniques)، دوربین‌ها می‌توانند درک عمق (Depth Perception) را فراهم کرده و آگاهی فضایی وسیله نقلیه و توانایی‌های اجتناب از موانع (Obstacle Avoidance) آن را افزایش دهند.	Depth estimation is another key capability of camera sensors, enabling AVs to perceive the distances of surrounding objects accurately. Through advanced image processing tech- niques, cameras can provide depth perception, enhancing the vehicle’s spatial awareness and obstacle avoidance capabilities.
.6	Image segmentation is an additional task performed by camera sensors, in which the visual scene is divided into semantically meaningful regions, facilitating robust object detection and classification.	تقسیم‌بندی تصویر (Image Segmentation) نیز وظیفه‌ی دیگری است که توسط حسگرهای دوربین انجام می‌شود، که در آن صحنه‌ی بصری به مناطق معنایی قابل‌تفسیر (Semantically Meaningful Regions) تقسیم می‌شود و این امر تشخیص و طبقه‌بندی اشیاء (Object Detection and Classification) قوی‌تر را تسهیل می‌کند.	Image segmentation is an additional task performed by camera sensors, wherein the visual scene is segmented into semantically meaningful ous elements within its field of view, facilitating robust object detection and classification, regions.
.7	This segmentation allows the autonomous vehicle to distinguish between various elements within its field of view, which is essential for safe navigation. Moreover, camera sensors play a crucial role in perception fusion, integrating data from multiple cameras positioned around the vehicle	این تقسیم‌بندی (Segmentation) به وسیله نقلیه خودران امکان می‌دهد بین عناصر مختلف در میدان دید خود (Field of View) تمایز قائل شود، امری که برای رانندگی ایمن (Safe Navigation) ضروری است. علاوه بر این، حسگرهای دوربین نقش حیاتی در ادغام درک محیط (Perception Fusion) ایفا می‌کنند؛ بدین صورت که داده‌های حاصل از چندین دوربین قرار	This segmentation enables the AV to distinguish between various elements within essential for safe navigation. Moreover, camera sensors play a crucial role in the fusion of its field of view, facilitating robust object detection and classification, essential for safe navi- perception, integrating

	to construct a comprehensive situational awareness map. This fusion enhances the vehicle's understanding of its surroundings and provides a basis for robust object detection and classification, which is essential for safe navigation.	گرفته در اطراف وسیله نقلیه را ترکیب کرده و یک نقشه‌ی جامع از وضعیت محیط (Comprehensive Situational Awareness Map)ایجاد می‌کنند. این ادغام، درک وسیله نقلیه از محیط اطرافش (Vehicle's Understanding of Its Surroundings)را تقویت می‌کند و پایه‌ای برای تشخیص و طبقه‌بندی قوی اشیاء (Robust Object Detection and Classification)فراهم می‌آورد که برای رانندگی ایمن حیاتی است.	data from multiple cameras positioned around the vehicle to con- gation. Moreover, camera sensors play a crucial role in the fusion of perception, integrating struct a comprehensive situational awareness map. This fusion enhances the vehicle's data from multiple cameras positioned around the vehicle to construct a comprehensive understanding of its surrou
.8	This fusion enhances the vehicle's understanding of its surroundings, enabling it to make informed decisions in real time. In addition to external perception, camera sensors also contribute to cabin monitoring and provide essential data regarding passenger behaviors and status. Figure 1 illustrates the main roles of cameras and their systems in autonomous vehicles.	این ادغام (Fusion) درک وسیله نقلیه از محیط اطرافش را تقویت می‌کند و امکان می‌دهد تا تصمیمات آگاهانه را به صورت بلادرنگ (Real-Time Decisions)اتخاذ کند. علاوه بر درک محیط خارجی(External Perception) ، حسگرهای دوربین در نظارت بر کابین (Cabin Monitoring)نیز نقش دارند و داده‌های حیاتی درباره‌ی رفتارها و وضعیت سرنشینان (Passenger Behaviors and Status)فراهم می‌کنند. شکل ۱ نقش‌های اصلی دوربین‌ها و سامانه‌های مرتبط با آن‌ها در وسایل نقلیه خودران را نشان می‌دهد.	This fusion enhances the vehicle's understanding of its sur- roundings, enabling it to make informed decisions in real time. In addition to external In addition to external perception, camera sensors also contribute to cabin monitoring and perception, camera sensors also contribute to cabin monitoring and provide essential data provide essential data for passenger behaviors and status. Figure 1 lists the main roles of for passenger behaviors and status. Figure 1 lists the main roles of cameras and their cameras and their systems in AVs. systems in AVs.
.9	In addition to their primary functions, cameras offer a cost-effective and lightweight solution compared to alternative sensor technologies such as LiDAR and radar. This affordability facilitates the widespread adoption and deployment of autonomous	علاوه بر وظایف اصلی خود، دوربین‌ها در مقایسه با فناوری‌های جایگزین حسگر مانند LiDAR و رادار(Radar) ، یک راه‌حل کم‌هزینه و سبک‌وزن(Cost-Effective and Lightweight Solution) ارائه می‌دهند. این قابلیت اقتصادی (Affordability)باعث تسهیل پذیرش و به‌کارگیری گسترده فناوری وسایل نقلیه خودران (Widespread Adoption and	In addition to their primary functions, cameras offer a cost-effective and lightweight In addition to their primary functions, cameras offer a cost-effective and light- solution compared to alternative sensor technologies such as LiDAR and radar. This weight solution

compared to alternative sensor technologies such as LiDAR and radar. affordability facilitates widespread adoption and deployment of AV technology, paving the This affordability facilitates widespread adoption and deployment of AV technol	Deployment of AV Technology) می‌شود و مسیر توسعه‌ی این فناوری را هموار می‌کند.	vehicle technology, paving the way for its development.	
Having said that about the functions of cameras, reaching the highest level of AV development, “full automation” requires vehicles to detect every object in their sur- Having said that about the functions of cameras, reaching the highest level of AV rounding environment under all conditions and scenarios with no less than human-like development, “full automation” requires vehicles to detect every object in their sur- behavior.	با توجه به نقش‌های دوربین‌ها، رسیدن به بالاترین سطح توسعه وسایل نقلیه خودران، یعنی «خودران کامل Full) (Automation)، مستلزم آن است که وسایل نقلیه بتوانند تمامی اشیاء موجود در محیط اطراف خود را در تمام شرایط و سناریوها با سطح عملکردی حداقل مشابه انسان شناسایی کنند.	Having highlighted the functions of cameras, achieving the highest level of autonomous vehicle development, “full automation” requires vehicles to detect every object in their surrounding environment under all conditions and scenarios with performance at least comparable to that of humans.	10
Achieving this level is still very challenging during adverse weather, which rounding environment under all conditions and scenarios with no less than human-like presents significant challenges for camera sensors, impacting their abilities to capture clear behavior. Achieving this level is still very challenging during adverse weather, which and reliable images of the environment. Weather conditions such as rain, snow, fog, and presents significant challenges for camera sensors, impacting their abilities to capture clear sandstorms pose significant challenges for camera sensors, and the key challenges include: and reliable images of the environment.	رسیدن به این سطح هنوز در شرایط آب و هوایی نامساعد (Adverse Weather) بسیار چالش‌برانگیز است، چرا که این شرایط چالش‌های قابل‌توجهی برای حسگرهای دوربین (Camera Sensors) ایجاد می‌کنند و بر توانایی آن‌ها در ثبت تصاویر شفاف و قابل‌اعتماد (Clear and Reliable Images) محیط تأثیر می‌گذارند. شرایط آب و هوایی مانند باران، برف، مه و طوفان‌های شنی (Rain, Snow, Fog, and Sandstorms)، چالش‌های مهمی برای حسگرهای دوربین ایجاد می‌کنند و از جمله چالش‌های کلیدی می‌توان اشاره کرد به:	Achieving this level is still very challenging during adverse weather, which presents significant challenges for camera sensors and affects their ability to capture clear and reliable images of the environment. Weather conditions such as rain, snow, fog, and sandstorms pose major challenges for camera sensors, and the key challenges include:	11

Weather conditions such as rain, snow, fog,			
Reduced visibility: adverse weather conditions often lead to reduced visibility, impair- sandstorms pose significant challenges for camera sensors, and the key challenges include: ing the effectiveness of camera sensors in capturing clear images of the environment. • Reduced visibility: adverse weather conditions often lead to reduced visibility, impair- Rain, snow, and fog can obscure the field of view, making it challenging for cameras to ing the effectiveness of camera sensors in capturing clear images	کاهش دید :(Reduced Visibility) شرایط آب و هوایی نامساعد اغلب منجر به کاهش دید می‌شوند و اثرگذاری حسگرهای دوربین در ثبت تصاویر شفاف از محیط را مختل می‌کنند. باران، برف و مه می‌توانند میدان دید (Field of View)را مسدود کنند و کار دوربین‌ها را برای ثبت تصاویر دقیق دشوار سازند.	Reduced Visibility: Adverse weather conditions often lead to reduced visibility, impairing the effectiveness of camera sensors in capturing clear images of the environment. Rain, snow, and fog can obscure the field of view, making it challenging for cameras to capture accurate images.	12
ment. Rain, snow, and fog can obscure the field of view, making it challenging for or snow accumulation on camera lenses, leading to distortion, blurring, or occlusion cameras to discern objects and obstacles accurately. of captured images. This accumulation can degrade image quality and hinder object • Water droplets and snow accumulation: rain and snow can result in water droplets detection and recognition capabilities	قطرات آب و تجمع برف (Water Droplets and Snow Accumulation): باران و برف می‌توانند باعث ایجاد قطرات آب یا تجمع برف روی لنزهای دوربین شوند که منجر به تحریف، تاری یا انسداد (Distortion, Blurring, or Occlusion)تصاویر ثبت‌شده می‌گردد. این تجمع می‌تواند کیفیت تصویر (Image Quality)را کاهش داده و توانایی تشخیص و شناسایی اشیاء (Object Detection and Recognition Capabilities)را مختل کند.	Water Droplets and Snow Accumulation: Rain and snow can cause water droplets or snow accumulation on camera lenses, leading to distortion, blurring, or occlusion of captured images. This accumulation can degrade image quality and hinder the object detection and recognition capabilities.	13
Fog and haze: foggy conditions create a hazy atmosphere that reduces contrast and sion of captured images. This accumulation can degrade image quality and hinder clarity	مه و غبار :(Fog and Haze) شرایط مه‌آلود باعث ایجاد جو غبارآلود (Hazy Atmosphere)می‌شوند که کنتراست و وضوح تصاویر دوربین را کاهش می‌دهد و تشخیص و مکان‌یابی اشیاء (Object Detection and	Fog and Haze: Foggy conditions create a hazy atmosphere that reduces contrast and clarity in camera images, hindering object detection and localization. The	14

in camera images, hindering object detection and localization. The presence of object detection and recognition capabilities. fog and haze makes it difficult for cameras to distinguish objects from their background, • Fog and haze: foggy conditions create a hazy atmosphere that	(Localizationرا مختل می‌کند. وجود مه و غبار موجب می‌شود که دوربین‌ها اشیاء را از پس‌زمینه خود تشخیص دهند (Distinguish Objects from Their Background)با دشواری بیشتری انجام دهند.	presence of fog and haze makes it difficult for cameras to distinguish objects from their background.	
Glare and reflections: glare from wet road surfaces or reflective surfaces can cause clarity in camera images, hindering object detection and localization. The presence reflections in camera images, resulting in overexposed or washed-out images. Glare of fog and haze makes it difficult for cameras to distinguish objects from their back- and reflections can obscure important visual information, making it challenging for ground, compromising the reliability of AV perception systems. AVs to navigate safely in adverse weather conditions. • Glare and reflections: glare from wet road surfaces	تابش خیره‌کننده و بازتاب‌ها (Glare and Reflections): تابش خیره‌کننده از سطح جاده‌ی مرطوب یا سطوح بازتاب‌دهنده می‌تواند باعث بازتاب‌ها در تصاویر دوربین شود و تصاویر را بیش از حد روشن یا محو (Overexposed or Washed-Out)کند. تابش خیره‌کننده و بازتاب‌ها می‌توانند اطلاعات بصری مهم را پنهان کنند و رانندگی ایمن وسایل نقلیه خودران در شرایط آب و هوایی نامساعد را دشوار سازند و قابلیت اطمینان سامانه‌های درک محیط (Reliability of AV Perception Systems)را کاهش دهند.	Glare and Reflections: Glare from wet road surfaces or reflective surfaces can cause reflections in camera images, resulting in overexposed or washed-out images. Glare and reflections can obscure important visual information, making it challenging for AVs to navigate safely in adverse weather conditions and compromising the reliability of AV perception systems.	15
Sand and dust particles: sandstorms and dusty conditions can lead to the accumulation reflections in camera images, resulting in overexposed or washed-out images. of sand and dust particles on camera lenses, obstructing the field of view and degrad- Glare and reflections can obscure important visual information, making it chal- ing	ذرات شن و گرد و غبار (Sand and Dust Particles): طوفان‌های شنی و شرایط پر از گرد و غبار می‌توانند منجر به تجمع ذرات شن و گرد و غبار روی لنزهای دوربین شوند، که میدان دید (Field of View)را مسدود کرده و کیفیت تصویر (Image Quality) را کاهش می‌دهد. این تجمع ذرات	Sand and Dust Particles: Sandstorms and dusty conditions can lead to the accumulation of sand and dust particles on camera lenses, obstructing the field of view and degrading image quality. This accumulation of particles can compromise the	16

image quality. This accumulation of particles can compromise the performance of lenging for AVs to navigate safely in adverse weather condition	می‌تواند عملکرد سامانه‌های حسگر و تشخیص اشیاء در AV را به خطر بیندازد.	performance of sensor and object detection systems in AVs.	
Sand and dust particles: sandstorms and dusty conditions can lead to the accumu- • Dynamic lighting conditions: adverse weather conditions can cause rapid changes in lation of sand and dust particles on camera lenses, obstructing the field of view and lighting conditions, including variations in brightness, contrast, and color temperature. Camera systems must adapt to these dynamic lighting conditions to maintain accurate degrading image quality. This accumulation of particles can compromise the per- perception of the environment and ensure reliable object detection and recognition.formance of camera sensors, affecting the reliability of AV perc	شرایط نوری پویا (Dynamic Lighting Conditions): شرایط آب و هوایی نامساعد می‌توانند منجر به تغییرات سریع در شرایط نوری شوند، از جمله تغییرات در شدت روشنایی، کنتراست و دمای رنگ (Brightness, Contrast, and Color Temperature). سامانه‌های دوربین باید با این شرایط نوری پویا (Dynamic Lighting Conditions) سازگار شوند تا درک دقیق محیط (Accurate Perception of the Environment) حفظ شده و تشخیص و شناسایی اشیاء (Reliable Object Detection and Recognition) تضمین گردد.	Dynamic Lighting Conditions: Adverse weather conditions can cause rapid changes in lighting conditions, including variations in brightness, contrast, and color temperature. Camera systems must adapt to these dynamic lighting conditions to maintain accurate perception of the environment and ensure reliable object detection and recognition.	17
Sensor calibration: adverse weather conditions may necessitate adjustments to camera • Sensor calibration: adverse weather conditions may necessitate adjustments to camera calibration parameters to compensate for changes in lighting, visibility, and sensor per- calibration parameters to compensate for changes in lighting, visibility, and sensor formance. Ensuring accurate sensor calibration is essential for maintaining the reliabil- performance. Ensuring accurate sensor calibration is essential for maintaining the ity and effectiveness of camera sensors in	کالیبراسیون حسگر (Sensor Calibration): شرایط آب و هوایی نامساعد ممکن است نیازمند تنظیم پارامترهای کالیبراسیون دوربین باشد تا تغییرات در نور، دید و عملکرد حسگر (Lighting, Visibility, and Sensor Performance) جبران شود. اطمینان از کالیبراسیون دقیق حسگر (Accurate Sensor Calibration) برای حفظ قابلیت اطمینان و کارایی حسگرهای دوربین در شرایط آب و هوایی نامساعد ضروری است.	Sensor Calibration: Adverse weather conditions may necessitate adjustments to camera calibration parameters to compensate for changes in lighting, visibility, and sensor performance. Ensuring accurate sensor calibration is essential for maintaining the reliability and effectiveness of camera sensors in adverse weather conditions.	18

adverse weather conditions. reliability and effectiveness of camera sensors in adverse weather conditions.			
Reliability and robustness: adverse weather conditions pose reliability and robustness • Reliability and robustness: adverse weather conditions pose reliability and robustness challenges for camera sensors, requiring them to continue functioning effectively challenges for camera sensors, requiring them to continue functioning effectively in in harsh environmental conditions. Ensuring the durability and resilience of cam- harsh environmental conditions. Ensuring the durability and resilience of camera era sensors is crucial for the safe and reliable operation of AVs in adverse weather	قابلیت اطمینان و مقاومت (Reliability and Robustness): شرایط آب و هوایی نامساعد چالش‌هایی برای قابلیت اطمینان و مقاومت حسگرهای دوربین ایجاد می‌کنند و نیازمند آن هستند که این حسگرها در شرایط محیطی سخت به طور مؤثر عمل کنند. اطمینان از دوام و تاب‌آوری حسگرهای دوربین (Durability and Resilience of Camera Sensors) برای عملکرد ایمن و قابل‌اطمینان وسایل نقلیه خودران در شرایط آب و هوایی نامساعد حیاتی است.	Reliability and Robustness: Adverse weather conditions pose challenges to the reliability and robustness of camera sensors, requiring them to continue functioning effectively in harsh environmental conditions. Ensuring the durability and resilience of camera sensors is crucial for the safe and reliable operation of AVs in adverse weather.	19
When exploring object detection using convolutional neural networks (CNNs), we When exploring object detection using convolutional neural networks (CNNs), we encounter two primary approaches: one-stage and two-stage. The two-stage approach, encounter two primary approaches: one-stage and two-stage. The two-stage approach, pio- pioneered by the introduction of the Region-Based CNN (R-CNN) model in 2014, involves a neered by the introduction of the Region-Based CNN (R-CNN) model in 2014, involves a region proposal stage to identify regions containing objects, followed by feature extraction region proposal stage to identify regions containing objects,	هنگام بررسی تشخیص اشیاء (Object Detection) با استفاده از شبکه‌های عصبی کانولوشنی (Convolutional Neural Networks - CNNs)، با دو رویکرد اصلی مواجه می‌شویم: یک‌مرحله‌ای (One-Stage) و دومرحله‌ای .(Two-Stage) رویکرد دومرحله‌ای (Two-Stage) که با معرفی مدل Region-Based CNN (R-CNN) در سال ۲۰۱۴ پایه‌گذاری شد، شامل یک مرحله پیشنهاد ناحیه (Region Proposal Stage) برای شناسایی نواحی دارای اشیاء است و سپس استخراج ویژگی (Feature Extraction) و طبقه‌بندی اشیاء (Object Classification) روی آن‌ها انجام می‌شود	When exploring object detection using Convolutional Neural Networks (CNNs), we encounter two primary approaches: one-stage and two-stage. The two-stage approach, pioneered by the introduction of the Region-Based CNN (R-CNN) model in 2014, involves a region proposal stage to identify regions containing objects, followed by feature extraction and object classification	20

However, this method was slow due to processing each and object classification However, this method was slow due to processing each proposed region separately. Fast R-CNN, introduced the following year, improved the proposed region separately. Fast R-CNN, introduced the following year, improved the speed by passing the entire image through the CNN, generating a feature map for object speed by passing the entire image through the CNN, generating a feature map for object detection [3]. Faster R-CNN [4] was then introduced to further enhance the performance	با این حال، این روش به دلیل پردازش هر ناحیه پیشنهادی به‌صورت جداگانه کند بود. مدل Fast R-CNN که سال بعد معرفی شد، سرعت را با عبور تمام تصویر از شبکه CNN بهبود داد و نقشه ویژگی (Feature Map) برای تشخیص اشیاء (Object Detection) تولید کرد سپس Faster R-CNN معرفی شد تا عملکرد را بیش‌تر بهبود بخشد.	However, this method was slow due to processing each proposed region separately. Fast R-CNN, introduced the following year, improved the speed by passing the entire image through the CNN, generating a feature map for object detection Faster R-CNN was then introduced to further enhance performance.	21
significant advancement occurred in 2017 with the introduction of Mask R-CNN [5]. Mask A significant advancement occurred in 2017 with the introduction of Mask R-CNN. R-CNN adopts the Feature Pyramid Network (FPN) as its backbone [6] and introduces a Mask R-CNN adopts the Feature Pyramid Network (FPN) as its backbone [6] and in- novel phase to the detection process by generating a segmentation mask for each object. troduces a novel phase to the detection process by generating a segmentation mask for each object. On the other hand, the one-stage approach, first demonstrated by Redmon et al.	یک پیشرفت مهم (Significant Advancement)در سال ۲۰۱۷ با معرفی Mask R-CNN رخ داد Mask . R-CNNاز شبکه هرم ویژگی (Feature Pyramid Network - FPN)به‌عنوان ستون فقرات (Backbone) خود استفاده می‌کند و یک مرحله نوآورانه (Novel Phase)به فرآیند تشخیص اضافه می‌کند که شامل تولید ماسک تقسیم‌بندی (Segmentation Mask) برای هر شیء است .از سوی دیگر، رویکرد یک‌مرحله‌ای (One-Stage Approach)اولین بار توسط Redmon و همکاران نشان داده شد.	A significant advancement occurred in 2017 with the introduction of Mask R-CNN [5]. Mask R-CNN adopts the Feature Pyramid Network (FPN) as its backbone and introduces a novel phase to the detection process by generating a segmentation mask for each object. On the other hand, the one-stage approach was first demonstrated by Redmon et al.	22

23	The one-stage approach with the YOLO model encapsulates the entire detection process in a single pass through the CNN. YOLOv2 and subsequent iterations like YOLOv3 introduced a new backbone named Darknet-53 to the architecture. A new version of YOLO called YOLOv4 was then proposed, aiming to improve both accuracy and speed, and achieved notable improvements over its predecessors.	رویکرد یک‌مرحله‌ای (One-Stage Approachبا مدل YOLO ، کل فرآیند تشخیص را در یک عبور واحد از شبکه CNNجای می‌دهد YOLOv2 .و نسخه‌های بعدی مانند YOLOv3 یک ستون فقرات جدید به نام Darknet-53 به معماری اضافه کردند. نسخه‌ای جدید از YOLO با نام YOLOv4 سپس معرفی شد که هدف آن بهبود همزمان دقت و سرعت بود و پیشرفت‌های قابل‌توجهی نسبت به نسخه‌های قبلی به دست آورد.	with the YOLO model, encapsulates the entire detection process in a single pass through On the other hand, the one-stage approach, first demonstrated by Redmon et al. the CNN. YOLOv2 and subsequent iterations like YOLOv3 [8] introduced a new back- with the YOLO model, encapsulates the entire detection process in a single pass bone named Darknet-53 to the architecture. A new version of YOLO called YOLOv4 then through the CNN. YOLOv2 and subsequent iterations like YOLOv3 introduced a proposed aiming at improving both accuracy and speed and achieved notable improve- new backbone named Darknet-53 to the architecture. A new version of YOLO called ments over its predecessors.
24	Detecting objects in challenging weather conditions is difficult because the quality of images degrades and visual features are compromised due to weather phenomena such as rain, fog, snow, and sandstorms. These conditions impact detection performance by diminishing scene lighting, reducing object visibility, and complicating the differentiation of objects from surrounding elements. Several papers have been published aiming to	تشخیص اشیاء در شرایط آب و هوایی چالش‌برانگیز (Challenging Weather Conditionsدشوار است، زیرا کیفیت تصاویر کاهش یافته و ویژگی‌های بصری تحت تأثیر پدیده‌های جوی مانند باران، مه، برف و طوفان‌های شنی قرار می‌گیرند. این شرایط بر عملکرد تشخیص (Detection Performance) تأثیر می‌گذارند، زیرا نور محیط کاهش می‌یابد، دید اشیاء محدود می‌شود و تمایز اشیاء از عناصر اطراف پیچیده‌تر می‌گردد. چندین مقاله منتشر شده‌اند که هدفشان ارائه راه‌حل‌های مناسب برای این مشکلات است.	Detecting objects in challenging weather conditions presents difficulties because the Detecting objects in challenging weather conditions presents difficulties because the quality of images degrades and visual features are compromised due to weather phenom- quality of images degrades and visual features are compromised due to weather phenom- ena like rain, fog, snow, and sandstorms. These conditions impact detection performance ena like rain, fog, snow, and sandstorms. These conditions impact detection performance by

by diminishing scene lighting, reducing object visibility, and complicating object differenti-diminishing scene lighting, reducing object visibility, and complicating object differentiation ation from surrounding elements. Several papers have been published aiming to propose suitable solutions. from surrounding elements.		propose suitable solutions for these issues.	
the authors studied adverse weather classification along with light level in the AV environment. To tackle the issue of perception under adverse weather and low light .the authors studied adverse weather classification along with light level in the conditions, where accuracy degradation is a significant concern, the authors introduced AV environment. To tackle the issue of perception under adverse weather and low light their own dataset. The dataset was designed to cover three types of weather (fog, rain, and conditions, where accuracy degradation is a significant concern, the authors introduced snow) and three levels of lighting (bright, moderate, and low), along with three street types their own dataset. The dataset was designed to cover three types of weather (fog, rain, and (asphalt, grass, and cobblestone).	نویسندگان به طبقه‌بندی شرایط آب و هوایی نامساعد (Adverse Weather Classification)همراه با سطح نور (Light Level)در محیط وسایل نقلیه خودران پرداختند. برای پرداختن به مسئله‌ی درک محیط تحت شرایط آب و هوایی نامساعد و نور کم (Perception under Adverse Weather and Low Light Conditions)، جایی که کاهش دقت (Accuracy Degradation) یک نگرانی مهم است، نویسندگان دیتاست خود را معرفی کردند (Introduced Their Own Dataset). این دیتاست به گونه‌ای طراحی شده بود که سه نوع آب و هوا (مه، باران و برف) و سه سطح روشنایی (نور زیاد، متوسط و کم) را پوشش دهد، همراه با سه نوع خیابان (آسفالت، چمن و سنگ‌فرش).	the authors studied adverse weather classification along with light level in the AV environment. To address the issue of perception under adverse weather and low light conditions, where accuracy degradation is a significant concern, the authors introduced their own dataset. The dataset was designed to cover three types of weather (fog, rain, and snow) and three levels of lighting (bright, moderate, and low), along with three street types (asphalt, grass, and cobblestone).	25

The processed images of the dataset contain three labels snow) and three levels of lighting (bright, moderate, and low), along with three street types related to the type of weather, lighting level, and street type. The authors used ResNet18 as (asphalt, grass, and cobblestone). The processed images of the dataset contain three labels their backbone and concluded that the system performed with low accuracy on the dataset related to the type of weather, lighting level, and street type. The authors used ResNet18 as and needed further enhancement.	تصاویر پردازش‌شده‌ی دیتاست شامل سه برچسب (Labels) مرتبط با نوع آب و هوا، سطح روشنایی و نوع خیابان هستند. نویسندگان از ResNet18 به‌عنوان ستون فقرات شبکه استفاده کردند و نتیجه گرفتند که سیستم عملکرد نسبتاً کمی در این دیتاست داشته و نیازمند بهبود بیشتر است.	The processed images of the dataset contain three labels related to the type of weather, lighting level, and street type. The authors used ResNet18 as their backbone and concluded that the system performed with relatively low accuracy on the dataset and required further enhancement.	26
the authors address the challenges of AVs during adverse weather conditions, where typical perceptual models struggle. Existing research mainly focuses on classifying weather conditions; however, the authors studied the transitions between these types of Electronics 2024, 13, 3063 5 of 20 weather. They proposed a method to define and understand six intermediate weather transition states (cloudy to rainy, rainy to cloudy, sunny to rainy, rainy to sunny, sunny to foggy, and foggy to sunny).	نویسندگان به چالش‌های وسایل نقلیه خودران (AVs) در شرایط آب و هوایی نامساعد می‌پردازند، جایی که مدل‌های درک محیط معمولی دچار مشکل می‌شوند. تحقیقات موجود عمدتاً بر طبقه‌بندی شرایط آب و هوایی متمرکز هستند؛ با این حال، نویسندگان انتقالات بین این نوع شرایط آب و هوایی را مورد مطالعه قرار دادند. آن‌ها روشی پیشنهاد کردند تا شش وضعیت انتقالی میانی آب و هوا را تعریف و درک کنند :ابری به بارانی (Cloudy to Rainy) بارانی به ابری (Rainy to Cloudy) آفتابی به بارانی (Sunny to Rainy) بارانی به آفتابی (Rainy to Sunny) آفتابی به مه‌آلود (Sunny to Foggy) مه‌آلود به آفتابی(Foggy to Sunny)	The authors address the challenges of autonomous vehicles (AVs) during adverse weather conditions, where typical perceptual models struggle. Existing research mainly focuses on classifying weather conditions; however, the authors studied the transitions between these types of weather. They proposed a method to define and understand six intermediate weather transition states: Cloudy to Rainy Rainy to Cloudy Sunny to Rainy Rainy to Sunny Sunny to Foggy Foggy to Sunny	27

The approach involves interpolating intermediate weather transition data using a variation autoencoder, extracting spatial features with VGG (Visual Geometry Group) very deep convolutional networks, and modeling temporal distribution with a gated recurrent unit for classification. The authors proposed a new large-scale dataset called AIWD6 (Adverse Intermediate Weather Driving), and the results showed an effective weather transition model.	ین رویکرد شامل درون‌یابی داده‌های انتقال میانی آب و هوا (Interpolating Intermediate Weather Transition Data)با استفاده از Variational Autoencoder، استخراج ویژگی‌های مکانی (Spatial Features) با شبکه‌های کانولوشنی بسیار عمیق VGG (Visual Geometry Group)و مدل‌سازی توزیع زمانی (Temporal Distribution) با استفاده از Gated Recurrent Unit (GRU)برای طبقه‌بندی (Classification)است. نویسندگان یک دیتاست بزرگ مقیاس جدید با نام AIWD6 (Adverse Intermediate Weather Driving)پیشنهاد کردند و نتایج نشان داد که مدل انتقال آب و هوا کارآمد است (Effective Weather Transition Model).	The approach involves interpolating intermediate weather transition data using a Variational Autoencoder, extracting spatial features with VGG (Visual Geometry Group) very deep convolutional networks, and modeling temporal distribution with a Gated Recurrent Unit (GRU) for classification. The authors proposed a new large-scale dataset called AIWD6 (Adverse Intermediate Weather Driving), and the results showed an effective weather transition model.	28
the authors introduces a novel framework called WeatherNet, which employs four deep CNN models based on the ResNet50 architecture. WeatherNet autonomously extracts weather information from the input image and classifies the output into the right category. However, the drawback of the presented framework is the inability to share features, since the four models work separately.	نویسندگان یک چارچوب نوآورانه با نام WeatherNetمعرفی کردند که از چهار مدل عمیق CNN مبتنی بر معماری ResNet50بهره می‌برد . WeatherNet به‌صورت خودکار اطلاعات آب و هوا را از تصویر ورودی استخراج کرده و خروجی را در دسته‌بندی مناسب (Right Category)قرار می‌دهد. با این حال، نقطه ضعف این چارچوب ارائه‌شده، عدم توانایی در اشتراک‌گذاری ویژگی‌ها (Feature Sharing)است، زیرا چهار مدل به‌صورت جداگانه عمل می‌کنند.	the authors introduced a novel framework called WeatherNet, which employs four deep CNN models based on the ResNet50 architecture. WeatherNet autonomously extracts weather information from the input image and classifies the output into the right category. However, the drawback of the presented framework is the inability to share features, since the four models operate separately.	29
focuses on the significant impact of adverse weather conditions on urban traffic and highlights the importance of weather condition recognition for applications such as AV assistance and intelligent transportation systems. Leveraging advancements in deep learning, the paper introduces a new simplified	این مطالعه بر تأثیر قابل توجه شرایط آب و هوایی نامساعد بر ترافیک شهری تمرکز دارد و اهمیت شناسایی شرایط آب و هوایی برای کاربردهایی مانند سیستم‌های کمک به وسایل نقلیه خودران (AV Assistance) و سیستم‌های حمل و نقل هوشمند (Intelligent Transportation Systems)را برجسته	This study focuses on the significant impact of adverse weather conditions on urban traffic and highlights the importance of weather condition recognition for applications such as AV assistance and intelligent	30

	transportation systems. Leveraging advancements in deep learning, the paper introduces a new simplified model called ResNet15, a proposed version of the well-known ResNet50	می‌کند. با بهره‌گیری از پیشرفت‌های یادگیری عمیق(Deep Learning) ، مقاله یک مدل جدید و ساده‌شده با نام ResNet15معرفی می‌کند که نسخه پیشنهادی از ResNet50 مشهور [15] است.	model called ResNet15, a proposed version of the famous ResNet50.