CHOOCH

AI ROI: COMPUTER VISION

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Executive Summary

As business leaders investigate the excitement surrounding artificial intelligence (AI), they continually find evidence of AI's massive return-on-investment (ROI) potential. In fact, McKinsey's 2020 survey on the state of AI cites examples from different industries where businesses attribute at least 20% of their earnings to AI. According to the survey: "Respondents in automotive and assembly as well as in healthcare services and pharmaceuticals and medical products are the most likely to say their companies have increased investment."

As more companies hear about these examples of AI success, enterprises are continually finding new and innovative ways to achieve enormous competitive advantages with AI in all business verticals – including data analytics, workflow efficiency, customer relationship management, and marketing. Now, with the latest advancements in computer vision technology, AI is bringing new ROI opportunities to an even wider range of industries and use-cases.

This white paper offers an in-depth examination of computer vision and the ROI opportunities that exist in different industries with a specific focus on the brick-and-mortar retail, healthcare, and construction industries. It also provides examples of how businesses are applying computer vision in their industries to save on operational costs, boost customer satisfaction levels, keep workers safe, and achieve better healthcare outcomes.

This document includes the following sections:

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It's important to note that the specific use-cases in this whitepaper are applicable to many industries. For example, construction sites have needs that are similar to warehouses in terms of safety equipment and theft detection. Furthermore, tracking inventory in the retail industry is similar to tracking inventory in the manufacturing sector.

Introduction to Computer Vision Technology

Before we discuss industry-specific ROI examples of computer vision, let's briefly introduce the topic of computer vision, describe how it works, and discuss general ROI benefits that enterprises receive when leveraging this technology.

A. What Is Computer Vision?

Computer vision refers to the ability of computer systems to "see" and perform visual tasks that used to require human sight. Traditionally, the visual AI field has been one of the most challenging areas of research in computer science. That's because computers do not see the way humans do. When a human looks at a photograph of the Eiffel Tower, he or she sees the Eiffel Tower. When a lab technician examines a magnified image of a blood sample, he or she sees the different types of cells in the sample. However, when a computer looks at these images, it only sees a smattering of pixels – each with a different number value that identifies the shade of color. In this respect, the field of computer vision involves teaching a computer to derive meaningful information from those pixels, something that humans do naturally.

Although neurologists still don't fully understand how humans see, computer scientists are successfully leveraging advanced AI and machine learning algorithms to teach computers how to see and interpret visual data with the same or greater success than humans. Once trained, these visual AI systems can perform a range of tasks that require visual analysis, monitoring, interpretation, and expert-level decision-making. Businesses are deploying this technology to accomplish a number of tasks that used to require human laborers. Moreover, these computer systems can perform their tasks more affordably – and with greater speed and accuracy – than humans.

B. How Does Computer Vision Work?

The latest computer vision technologies offer unparalleled speed and accuracy, in addition to the flexibility to apply to a wide variety of use-cases. Based in the cloud, these systems harness the near limitless computational power of modern cloud-based servers. This allows AI systems to rapidly ingest visual information, train visual AI and machine learning models, and test their success.

No visual AI strategy is complete without training. The best computer vision systems receive a base training that consists of ingesting hundreds of thousands or over a million images. In a facial authentication system, these images would be pictures of faces belonging to a diverse range of subjects. From this base training, developers can provide additional instruction to rapidly create new AI models for unique use-cases in industries like healthcare, inventory, laboratories, construction, etc.

Some visual AI technology can also generate a lightweight "Edge AI" system in the cloud. Developers can configure these Edge AI systems to integrate with any existing IoT infrastructure or on-premises configuration. Edge AI systems usually deploy automatically to the edge through cloud dashboards and APIs.

Ultimately, the practical use-cases for visual AI are endless, including systems for detecting vehicle types, facial authentication, patient identification, safety equipment checks, inventory counts, medical diagnoses, security monitoring, laboratory analyses, and more.

C. General ROI Benefits of Computer Vision for Workers and Organizations

In terms of general ROI benefits, computer vision technology seeks to eliminate the errors, inefficiencies, and other negative consequences that come from repetitive, visual job responsibilities by replacing the human labor required to complete these activities – while also saving time and money. In this way, computer vision frees employees to focus on more business-critical tasks, reduces labor burdens on organizations, and achieves better results with fewer human errors. By performing visual tasks faster, better, and more inexpensively than humans, computer vision dramatically reduces labor costs.

Compared to human workers doing the same tasks, computer vision offers the following advantages:

- Speeds up workflows and performs more of a given task within the same period of time.
- Achieves greater consistency and efficiency in visual inspections, resulting in fewer inspection errors.
- Relieves organizations of labor burdens, allowing employees to achieve more in less time.
- Automates repetitive, visually demanding tasks.
- Facilitates immediate scaling of visual task performance without the need to hire and train additional employees.
- Augments the ability of human workers to perform their tasks more successfully, efficiently, and productively.
- Dramatically reduces labor costs as it performs the same tasks for less money.
- Reduces the risk of injury and sickness by more efficiently identifying risks such as traffic flow inefficiencies that cause onsite collisions; slip-and-fall dangers that cause workplace injuries; office space density problems that lead to COVID-19 spread; and construction job site dangers.

To better understand the general ROI advantages of computer vision, consider this simple use-case example:

A visual job involves format checking and tagging images of celebrities based on the clothing they are wearing. A $25 per hour human worker requires minutes to analyze each image and input the name of the celebrity and the styles/brands of clothing the celebrity is wearing. By comparison, a visual AI system can similarly process these images in a matter of seconds. Moreover, visual AI can provide deeper metadata and additional information pertaining to lesser-known celebrities and clothing brands. Visual AI systems are also dramatically less expensive than the cost of human labor. These systems can usually process 1,000 images for $1, and they can do the job more accurately than their human counterparts. Finally, you can replicate these systems in the cloud to run concurrently – which means you can scale the system to complete more work in less time as required.

A final ROI benefit of computer vision is that AI systems do not suffer from boredom and burnout. By comparison, the longer human workers focus on mundane tasks, the more distracted and error-prone they become. In fact, research demonstrates that work-related boredom results in the following negative outcomes for workers and the businesses that employ them:

- Less effort from employees
- Reduced performance
- Greater chances of errors and mistakes
- Increased job dissatisfaction
- Rise in absenteeism
- More instances of employee turnover
- Increases in counterproductive work behavior
- Greater chances of work injuries

Because basic visual tasks are extremely monotonous, they are highly prone to these negative outcomes. Such tasks include monitoring live security video feeds, inspecting fill levels at bottling plants, counting cells under microscopes, monitoring forests for signs of fire, and countless other visually-oriented job responsibilities. By performing these tasks with greater detail, more efficiency, and less cost than humans, visual AI resolves the negative consequences of boring jobs to achieve impressive returns on investment.

In summary, computer vision technology allows organizations to perform visual tasks that require analysis, monitoring, and inspection without the need for human labor, with greater speed and consistency than humans, and for less money. Generally speaking, this offers significant ROI benefits by saving money on operational costs, boosting the quality and success of task performance, and reducing safety risks.

The ROI of Computer Vision in Specific Industries

In the sections that follow, we examine the return on investment for computer vision technology in specific industries. Again, the computer vision use-case examples apply to other industries as well. For example, visual AI facial recognition systems in construction can also improve rental property security systems. Moreover, visual AI analysis in a medical laboratory can similarly benefit industrial laboratories.

Below, you will find ROI information for visual AI in the following industries:

A. Construction industry
B. Healthcare industry
C. Brick-and-mortar retail industry

A. Construction Industry

Forethinking construction industry businesses are gaining tremendous ROI benefits with industry-specific computer vision solutions. In fact, despite the construction industry's reputation for delayed tech innovation, consulting firm McKinsey & Company recently highlighted artificial intelligence as "construction technology's next frontier". With 16% of construction firms leveraging AI solutions at this time, artificial intelligence has already gained a foothold in the industry, but there is still room for enormous AI growth in construction.

As for computer vision specifically, what pain-points are construction industry companies using this technology to overcome? Two important computer vision ROI examples for the construction industry relate to:

- Construction safety risks
- Theft and vandalism

Construction Safety Risks

The perennial challenge that puts the health of construction workers at risk – while constantly threatening construction profits – are the inherent dangers of the industry. Simply put, construction jobs are some of the most dangerous occupations that exist. Job site workers commonly face the risk of injury and death as soon as they show up for work.

The risks and dangers at construction sites include:

- Machinery accidents
- Slips and falls
- Falling debris
- Flying particles
- Structure collapses
- Scaffolding accidents

- Physical strain
- Heat exhaustion
- Electrocution
- Chemical burns

The U.S. Department of Labor reports that construction workers suffer from over 150,000 nonfatal injuries and illnesses per year in the United States. More tragically, 21% of U.S. workplace fatalities in 2018 (1,008 deaths) happened in the construction industry. Approximately 59% of these fatalities were caused by:

- Falling accidents
- Being struck by objects
- Electrocution
- Machinery and equipment injuries

The successful enforcement of workplace safety regulations and the proper use of safety equipment is key to preventing serious and fatal injuries at construction worksites. The following statistics from NYU's protective equipment standard illuminates the clear relationship between serious injuries and failure to use protective equipment:

- Only 16% of workers who suffered head injuries were using hard hats (even though 40% were required to wear them at the time of injury).
- Only 1% of about 770 workers who suffered face injuries were using facial protection.
- Only 23% of workers who suffered foot injuries were using safety shoes/boots.
- Only 40% of workers who suffered eye injuries were using eye protection.

Deploying computer vision technology at construction sites can help construction firms enforce safety regulations, encourage workers to use safety equipment, and prevent injuries and deaths. For example, trained AI object recognition models can instantly detect whether workers are wearing protective equipment like hard hats, masks, eye protection, and vests. Trained computer vision models can even detect when a worker suffers a serious fall, speeding up the notification of first-aid teams. By reporting non-compliant employees to construction site managers, computer vision systems can profoundly improve job site safety regulation

enforcement – while simultaneously providing a visual record that employees are complying with regulations.

Computer vision at construction sites offers the dual ROI benefits of preventing serious injuries and deaths while at the same time preventing OSHA fines resulting from safety compliance failures. The technology also helps reduce the devastating financial consequences of construction site shutdowns, which frequently happen for investigative purposes following a serious worksite accident. Here's an excellent video of computer vision construction safety models in action.

Theft and Vandalism

Theft and vandalism are additional challenges that continually cut into construction industry business profits. Construction sites often suffer from theft and vandalism of items like:

- Lumber
- Metals
- Tools
- Supplies
- Appliances
- Heavy equipment
- Unfinished structures

According to the National Equipment Register, criminals steal approximately $300 million to $1 billion worth of construction equipment each year. This results in massive financial losses that degrade ROI figures for construction businesses.

Financial losses and business setbacks related to theft and vandalism include:

- Costs associated with stolen and/or damaged property
- Time delays and additional labor required to repair damages
- Construction slowdowns while workers wait for replacement tools and equipment
- Increases in the cost of insurance policies
- Administrative burdens related to filling out insurance paperwork, filing claims, and completing police reports

Deploying computer vision security solutions at construction sites can dramatically reduce instances of theft and vandalism. This is especially valuable after hours when humans are not present to guard the security of a construction site. Computer vision solutions are also valuable for construction sites in remote areas where humans cannot guard the location 24 hours a day.

Trained computer vision security models can complete the following tasks for construction sites with near-perfect accuracy:

- Identify vehicles that arrive on-site and capture their license plates
- Detect property boundary breaches by people and vehicles
- Detect fire and use infrared cameras to recognize fire hazards
- Use facial recognition technology to determine whether someone entering/exiting the site is an authorized employee or intruder

This computer vision technology offers clear and obvious advantages to any construction business that wants to reduce instances of theft and vandalism.

ROI of computer vision for the Construction Industry

Considering the above applications for computer vision deployment, it's easy to understand how computer vision technology achieves the following ROI benefits for construction firms:

- **Reduced operational costs:** By reducing the chances of injury and death at construction sites, construction firms lower the cost of insurance premiums, reduce the risk of lawsuits, lower the chance of safety regulation fines, and reduce the risk of a construction site shutdown following a serious accident. Moreover, by reducing the chances of vandalism and theft, construction firms prevent the costs of stolen and damaged property and prevent the delays and additional labor required to repair damage.
- **Increased productivity:** Computer vision technology improves job site productivity by reducing the chances of injuries and illnesses that require employees to take sick leave. It also prevents delays related to workers waiting for the replacement of stolen equipment. Moreover, it reduces the threat of a job site closure, which may be required to investigate a serious injury or accident.

- **Better security:** computer vision technology boosts construction site security through its capacity to monitor site perimeters, identify the faces of people entering and exiting the property, and identify vehicles that enter and exit the property. This helps to reduce the costs associated with theft and vandalism.

Reduced operational costs, increased productivity, and better security are just some of the ROI benefits that construction firms can receive from leveraging the power of computer vision. Ultimately, the earliest adopters of this "next frontier" in construction technology will not only protect their workforce from unnecessary injuries, but they will also benefit from enormous competitive advantages.

B. Healthcare Industry

When medical providers leverage AI technology – including the use of computer vision solutions, machine learning analysis, and other AI-powered tools – healthcare companies can achieve clear and impressive ROI benefits. These benefits are connected to fewer medical errors, lower insurance premiums, better patient experiences, improved patient outcomes, and a significant reduction in operational costs. Best of all, computer vision in the healthcare industry could literally save your life or the life of someone you love.

What pain-points are healthcare providers overcoming with computer vision specifically? For one, healthcare businesses can use the same visual AI technology that monitors the use of safety equipment in the construction industry. During pandemic conditions, computer vision identifies medical staff who are not using appropriate face masks, eye protection, gloves, and other safety equipment.

Below, we'll look at the following computer vision ROI examples for healthcare:

- Patient misidentification errors
- Misdiagnosis and delayed diagnosis errors

Patient Misidentification Errors

Patient misidentification errors are frighteningly common in today's healthcare industry. According to a 2016 study from the Ponemon Institute, 86% of nurses, physicians, and IT practitioners claim to have personally witnessed or known of a patient misidentification error.

Why do these errors happen? Patient misidentification errors are frequently the result of medical staff shortages when healthcare practitioners are overburdened with too many responsibilities. These errors also happen because of language barriers, similar patient names, and time pressures.

Medical staff identify and resolve most patient misidentification errors before they turn into serious problems. However, if they do not identify the error soon enough, patient misidentification can lead to devastating consequences, including death. Dangerous outcomes resulting from misidentification errors include:

- Patients taking the wrong medications and suffering from allergic reactions or other complications
- Patients receiving the wrong diagnostic test results and incorrect treatments
- Patients receiving the wrong surgeries

Misidentification errors are also economically expensive for medical providers and insurance companies. For example, the Ponemon Institute reports that hospitals suffer from approximately $17.4 million in losses per year due to denied insurance claims related to patient misidentification mistakes. Individual institutions also face millions of dollars in personal injury and malpractice claims related to patient injuries from misidentification.

Fortunately, healthcare businesses can significantly reduce instances of patient misidentification by integrating real-time, AI-powered facial recognition systems into their practices. These computer vision systems help authenticate patients and healthcare professionals to safeguard against misidentification errors. This technology can recognize thousands of different faces in a fraction of a second with a high degree of accuracy.

These systems also protect the privacy of patients and providers through advanced encryption technology.

Lastly, the ability of these facial recognition systems to recognize healthcare providers boosts the security capabilities of hospitals. For example, a facial identification system can notify hospital security if it detects an unauthorized person in a high-security area.

Misdiagnosis Errors

Another dangerous and costly healthcare challenge relates to misdiagnosis errors. These medical mistakes affect approximately 12 million Americans each year, causing an estimated 40,000 to 80,000 deaths annually.

Why does medical misdiagnosis occur? Here are the common causes:

- Overconfidence of human doctors
- Simple mistakes and errors in judgment
- Fragmentation of care across multiple providers
- Time pressures and staffing shortages resulting in hurried patient exams
- Physician or medical provider incompetence
- Lost or mismatched patient samples and diagnostic results
- Malfunctioning diagnostic equipment
- A failure of healthcare workers to adhere to commonly-accepted medical procedures
- The boredom and monotony of visual tasks often leads to errors and oversights

Human analysts and physicians are not perfect, and unfortunately, diagnosis errors are inevitable. In the field of radiology, successful diagnosis depends heavily upon the perception and decision-making skills of trained physicians who must assess medical images visually to detect, categorize, and monitor diseases. Medical professionals have to make these judgment calls under a high degree of ambiguity where the smallest oversight can result in devastating consequences.

To make matters worse, radiologic technologists – and other diagnostic professionals – are bearing the brunt of increasingly higher workloads,

more time pressures, and staffing shortages. According to projections from the U.S. Bureau of Labor Statistics, between 2018 and 2028, the number of available radiologic and MRI technologists in the United States will increase by 9% (or 23,300 additional professionals). However, this will not keep up with the rapid growth in radiological imaging data. Simply put, there will not be enough radiologic technologists available to satisfy the diagnostic needs of the healthcare industry in the years ahead.

This is where advanced computer vision technology can help. In recent years, researchers have determined that current digital pathology imaging data is of sufficient quality to produce reli-able diagnoses from digital images only. This is paving the way for groundbreaking advancements in the use of computer vision technology in the medical field for diagnostic purposes. Now, a trained visual AI system can quickly recognize complex patterns in medical imaging data to offer quantitative – not just qualitative – diagnostic evaluations.

For many use-cases, computer vision diagnoses are more accurate than diagnoses rendered by human readers. A recent study in the journal Nature found that visual AI systems provided more accurate results than humans when analyzing mammography images for signs of breast cancer. The visual AI systems in the study achieved the following:

- An absolute reduction of 5.7% and 1.2% in false positives
- An absolute reduction of 9.4% and 2.7% in false negatives.
- The AI system outperformed the average human reader (in a study that examined the results of six human readers) by an absolute margin of 11.5%.
- When working with a human partner to provide “double-readings” of the images that human readers are analyzing, the AI systems reduced the workload of human readers by 88%.

In addition to the above study, another investigation showed that a medical AI neural network trained on images of lung X-rays was able to diagnose COVID-19 cases with 98% accuracy.

Not only is it possible for AI systems to achieve a higher degree of diagnostic success, but AI systems are also faster than human readers. Compared to human radiologists – who can evaluate approximately one diagnostic image per 3 to 4 seconds – a visual AI system is capable of

processing and evaluating images at speeds that are orders of magnitude faster (and at a dramatically lower cost). These systems are also scalable, so duplicate systems can analyze images concurrently to achieve tremendous speed advantages.

At the end of the day, computer vision technology does not replace human readers. Rather, it reduces instances of medical misdiagnosis by providing another set of "eyes" to analyze patient health data and medical imagery. Moreover, these systems can achieve a comparable – if not better – degree of accuracy than humans alone. By reducing the workload of human readers by as much as 88%, visual AI tools free up radiological technologists and other diagnosticians to devote their time to more critical and sensitive tasks.

ROI of computer vision for the Healthcare Industry

The return on investment for computer vision in the healthcare industry is priceless in terms of its ability to save lives and achieve better patient outcomes. It also brings significant financial benefits. These ROI factors include:

- **Fewer patient misidentification liabilities:** AI-powered facial recognition systems achieve near-perfect results when guaranteeing the identities of patients and medical providers.
- **More accurate diagnoses:** With another set of artificially intelligent eyes reviewing medical records – and quickly offering highly accurate diagnosis recommendations – medical providers will benefit from a significant reduction in the risk of making a diagnosis error.
- **Better medical outcomes:** With more accurate diagnostic results for more patients, healthcare organizations can improve the medical outcomes for many of their patients.
- **Reduced operational costs:** With fewer misidentification and misdiagnosis errors, healthcare organizations benefit financially from lower insurance premiums, fewer malpractice claims, and fewer denied insurance claims.
- **Better security:** Healthcare facial recognition systems will also ensure that only authorized employees can access patients and restricted areas. This reduces instances of theft and boosts the overall security of healthcare facilities

Many healthcare organizations have already begun to embrace the ROI benefits of using computer vision in their medical practices. According to a 2020 survey, 59% of healthcare executives project that they will receive a full return on their medical AI investments in less than three years.

C. Brick-and-Mortar Retail Industry

Retail stores are leveraging computer vision strategies to overcome retail industry pain points and achieve a significant return on their AI investment. As of 2019, only 3% of retailers were using computer vision technology. However, 40% plan to begin or finish their computer vision deployments in the next two years. Moreover, Juniper Research projects that global retail spending on AI will increase from $2 billion per year in 2018 to $7.3 billion per year in 2022.

Many AI technologies in the retail industry utilize machine learning, deep learning, visual search, and advanced computer vision solutions. These solutions can create heat maps, offer real-time AI and ML insights, and leverage the potential of big data more effectively.

What pain-points are retailers overcoming with computer vision? Two important sources of computer vision ROI for brick-and-mortar retailers relate to the reduction of:

- Out-of-stock items
- Employee theft and shoplifting

Product Inventory and Out-of-Stock Items

Brick-and-mortar retail stores face the challenge of consistently maintaining a sufficient inventory of products in stock. According to a 2018 study, the average out-of-stock rate was 8% for U.S. retail stores. The biggest problem with high out-of-stock rates is that they cause a decrease in sales, consumer satisfaction, and customer loyalty. In fact, Harvard Business Review found that 21-43% of customers will search out another store when their chosen store doesn't have the item they want. On average, abandoned sales resulting from out-of-stock items cause retailers to suffer annual losses of approximately 4%.

Computer vision solutions are helping overcome the retail challenges related to out-of-stock items. Dedicated computer vision technology can analyze video and images of store shelves to (1) notify employees when shelves are out of stock and (2) alert employees when shelves require better arrangements to make specific products more visible. These computer vision strategies are helping retailers reduce their out-of-stock rates and improve their customer retention figures.

Walmart has already experimented with computer vision strategies that use "shelf-scanning robots" that search for product supply irregularities. These kinds of AI-powered robots offer better awareness of out-of-stock items while freeing up human employees to focus on restocking shelves and providing the best customer service.

Finally, retail warehouses are potentially dangerous workplaces where employees may need to don specific safety equipment, hardhats, eye protection, and more. Here, retail businesses can leverage the same computer vision technology that detects a failure to wear safety equipment in construction and healthcare.

Shoplifting and Employee Theft

Another common challenge for brick-and-mortar retail stores is theft. While a lot of inventory shrinkage relates to damage and expiration, shoplifting accounts for 33% of this shrinkage. Employee theft accounts for another 33.1%.

Unfortunately, current theft prevention strategies are not adequate to completely prevent this kind of shrinkage, and the majority of shoplifting crimes go entirely unnoticed. According to a survey of shoplifters, the average shoplifter is only caught about once out of every 48 times. However, the most jaw-dropping statistic of all is the fact that shoplifting causes over $15 billion in U.S. retail losses each year.

One of the most common factors that lead to retail theft is a lack of restrictions in employee-only zones like stockrooms, offices, and break rooms. To reduce theft, retailers need to prevent shoppers and outside individuals from entering these areas. They also need to ensure that employees can still access these areas while also maintaining a close watch on employee activities.

Computer vision solutions for retail loss prevention are helping brick-and-mortar retailers like this. These technologies leverage the power of computer vision, machine learning, and advanced video analytics deployed on "edge AI" devices. Edge computing devices are devices that remain close to the actual source of the data instead of on remote servers that run in the cloud.

This computer vision tech for loss prevention offers significant advantages over traditional video surveillance strategies and traditional security measures that rely entirely on human security personnel. For example, computer vision facial recognition systems can scan the faces of customers as they enter a retail location and immediately identify known shoplifters. These solutions are also capable of distinguishing between retail employees, managers, and outside individuals who may or may not be authorized to enter a restricted area.

ROI of Computer Vision for Retail

By optimizing inventory management, reducing theft, and contributing to more strategic business intelligence, computer vision for retail achieves the following ROI benefits:

- **Higher profits:** By reducing out-of-stock items, computer vision technology ensures that customers find the products they want (when they want them). This is particularly valuable now more than ever – as brick-and-mortar retailers face the mounting threat of shoppers turning to mobile apps and digital retail options. Moreover, it will help brick-and-mortar retail stores overcome an estimated 4% in lost sales annually.
- **Reduced inventory shrinkage and improved security:** Through AI video monitoring strategies and facial recognition technology, computer vision systems will significantly reduce two significant causes of inventory shrinkage: employee theft and shoplifting. AI video monitoring and facial recognition technology will also improve the physical safety of stores. With the capacity to immediately identify the faces of individuals who are known to pose a threat, retailers can contact authorities as soon as a potentially dangerous person arrives.

Higher profits, reduced inventory shrinkage, and improved security are just some of the ROI benefits that computer vision will provide to retail. In the years ahead, retailers can expect to see even more applications of this exciting technology in their industries.

Final Thoughts on ROI for computer vision

As you've seen in this white paper, computer vision technology offers the potential for enormous ROI benefits. Indeed, with the capacity of computer vision to perform monotonous inspections, visual analyses, detailed monitoring tasks, and expert medical evaluations – and perform them with greater accuracy, speed, and consistency than humans – we can understand how this technology is solving numerous industry-specific pain-points. More importantly, this technology is helping businesses earn more money, improve safety conditions, achieve better patient outcomes, and offer higher quality products and services to their customers.

At Chooch, we experience these ROI benefits of AI technology every single day. This makes us excited to see how brick-and-mortar retailers, construction firms, healthcare organizations, and businesses in other industries will be taking advantage of computer vision in the years ahead. If you'd like to know more about Chooch and its vision for cutting-edge AI, please visit our website.

References

The state of AI in 2020. (2020). McKinsey & Company. https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/global-survey-the-state-of-ai-in-2020

van Hooff, M. L. M., & van Hooft, E. A. J. (2014). Boredom at work: Proximal and distal consequences of affective work-related boredom. *Journal of Occupational Health Psychology*, *19*(3), 348–359. https://doi.org/10.1037/a0036821

Blanco, J. L., Fuchs, S., Parsons, M., & Ribeirinho, M. J. (2020, October 20). *Artificial intelligence: Construction technology's next frontier*. McKinsey & Company. https://www.mckinsey.com/business-functions/operations/our-insights/artificial-intelligence-construction-technologys-next-frontier

Shackleton, O. (2019, July 18). *Construction industry lacks in artificial intelligence integration*. Construction & Demolition Recycling. https://www.cdrecycler.com/article/construction-industry-lacks-artificial-intelligence/

Commonly used statistics | Occupational Safety and Health Administration. (n.d.). OSHA. Retrieved January 25, 2021, from https://www.osha.gov/data/commonstats

Environmental Health & Safety, New York University. (2005). *OSHA personal protective equipment standard* [E-book]. https://www.nyu.edu/content/dam/nyu/environmentalHealthSafety/documents/PPE_Packet_FY06.PDF

Chooch. (2020, December 26). *AI models for action detection: Computer vision can detect falls, improving safety with edge AI* [Video]. YouTube. https://www.youtube.com/watch?v=psX3mN65yJQ

Chooch. (2020, October 19). *Edge AI model: Training, management and mass deployment* [Video]. YouTube. https://www.youtube.com/watch?v=xdnKDzUkgVY

Environmental Health & Safety, New York University. (2005). *OSHA personal protective equipment standard* [E-book]. https://www.nyu.edu/content/dam/nyu/environmentalHealthSafety/documents/PPE_Packet_FY06.PDF

Chooch. (2021, January 5). *Computer vision: Smoke and fire detection and alerts with AI* [Video]. YouTube. https://www.youtube.com/watch?v=mpw-oIvjB70

Chooch AI. (n.d.). *Facial authentication system with liveness detection from chooch AI*. Chooch. Retrieved January 25, 2021, from https://chooch.ai/facial-authentication/

Ponemon Institute LLC. (2016). *2016 National Patient Misidentification Report*. http://promos.hcpro.com/pdf/2016-national-report-misidentification-report.pdf

Mastroianni, B. (2020, February 22). *Why getting medically misdiagnosed is more common than you may think*. Healthline. https://www.healthline.com/health-news/many-people-experience-getting-misdiagnosed

Radiologic and MRI Technologists : Occupational Outlook Handbook: : U.S. Bureau of Labor Statistics. (2020, September 1). U.S. Bureau of Labor Statistics. https://www.bls.gov/ooh/healthcare/radiologic-technologists.htm

McKinney, S. M., Sieniek, M., Godbole, V., Godwin, J., Antropova, N., Ashrafian, H., Back, T., Chesus, M., Corrado, G. S., Darzi, A., Etemadi, M., Garcia-Vicente, F., Gilbert, F. J., Halling-Brown, M., Hassabis, D., Jansen, S., Karthikesalingam, A., Kelly, C. J., King, D., … Shetty, S. (2020). *International evaluation of an AI system for breast cancer screening*. Nature, 577(7788), 89–94. https://doi.org/10.1038/s41586-019-1799-6

Ozturk, T., Talo, M., Yildirim, E. A., Baloglu, U. B., Yildirim, O., & Rajendra Acharya, U. (2020). Automated detection of COVID-19 cases using deep neural networks with X-ray images. *Computers in Biology and Medicine*, *121*, 103792. https://doi.org/10.1016/j.compbiomed.2020.103792

Hagland, M. (2020, October 20). *Optum report: Healthcare executives see strong ROI on artificial intelligence investments within three years*. Healthcare Innovation. https://www.hcinnovationgroup.com/analytics-ai/news/21160297/optum-report-healthcare-executives-see-strong-roi-on-artificial-intelligence-investments-within-three-years

Denman, T., & Grill-Goodman, J. (2019, March 29). *The brave new world of computer vision: 4 things retailers need to know*. RIS News. https://risnews.com/brave-new-world-computer-vision-4-things-retailers-need-know

Alaimo, D. (2018, February 1). *Retail spending on AI to reach $7.3B by 2022*. Retail Dive. https://www.retaildive.com/news/retail-spending-on-ai-to-reach-73b-by-2022/516170/

Team, A. (2019, October 3). *Retail Round-Up: Out-of-Stocks: Problems & Solutions*. Accelerated Analytics.

https://www.acceleratedanalytics.com/blog/2019/01/30/retail-round-up-out-of-stocks-problems-solutions/

Corsten, D., & Gruen, T. (2014, August 1). *Stock-Outs Cause Walkouts*. Harvard Business Review. https://hbr.org/2004/05/stock-outs-cause-walkouts

Weckesser, S. (2020, December 22). *The Five-Finger Discount: 35 Facts About Shoplifting in America*. Blue Water Credit. https://bluewatercredit.com/five-finger-discount-35-facts-shoplifting-america/

Turner, B. L. (2018, March 13). *Exactly What Is a Shoplifter and How Much Do You Know?* Loss Prevention Media. https://losspreventionmedia.com/exactly-what-is-a-shoplifter-and-how-much-do-you-know/

McCue, T. J. (2019, January 31). *Inventory Shrink Cost The US Retail Industry $46.8 Billion*. Forbes. https://www.forbes.com/sites/tjmccue/2019/01/31/inventory-shrink-cost-the-us-retail-industry-46-8-billion/?sh=7fa4b1e16b70

Goldsmith, J. (2020, October 9). *Loss Prevention: Retail AI Can Make Dramatic Improvements with Edge AI*. Chooch. https://chooch.ai/computer-vision/loss-prevention-retail-ai-can-make-dramatic-improvements-with-edge-ai/

Chooch AI. (2021b, January 23). *Edge AI for Embedded Computer Vision*. Chooch. https://chooch.ai/edge-ai/

Chooch AI. (2021b, January 23). *Facial Authentication System with Liveness Detection from Chooch AI*. Chooch. https://chooch.ai/facial-authentication/

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