

## SPECIAL REPORT

# Solutions in Vision 2022 Survey Results

At the beginning of 2022, Vision Systems Design deployed its third “Solutions in Vision” survey to its readership. Overall, 515 participants answered questions about a variety of machine vision technologies and how often they use these technologies for the industries they serve. The list of applications for which vision/imaging technologies are used is continuously expanding. As new technologies emerge, vision/imaging system use extends well beyond the factory floor. As the data here indicate, some emerging technologies are more suited for some application areas than others, but vision/imaging’s continued importance to various processes is unquestioned.



Photo 154700963 © Suresak Petchang | Dreamstime.com

# Solutions in Vision Report: Applications and Emerging Technologies

by **Chris Mc Loone**

At the beginning of 2022, *Vision Systems Design* deployed its third “Solutions in Vision” survey to its readership. Overall, 515 participants answered questions about a variety of machine vision technologies and how often they use these technologies for the industries they serve. Respondents included systems integrators, OEMs, machine vision products and components distributors, research and development organizations, end users/manufacturers, and vendors/suppliers of machine vision components. The industries served by these companies (i.e., you) include:

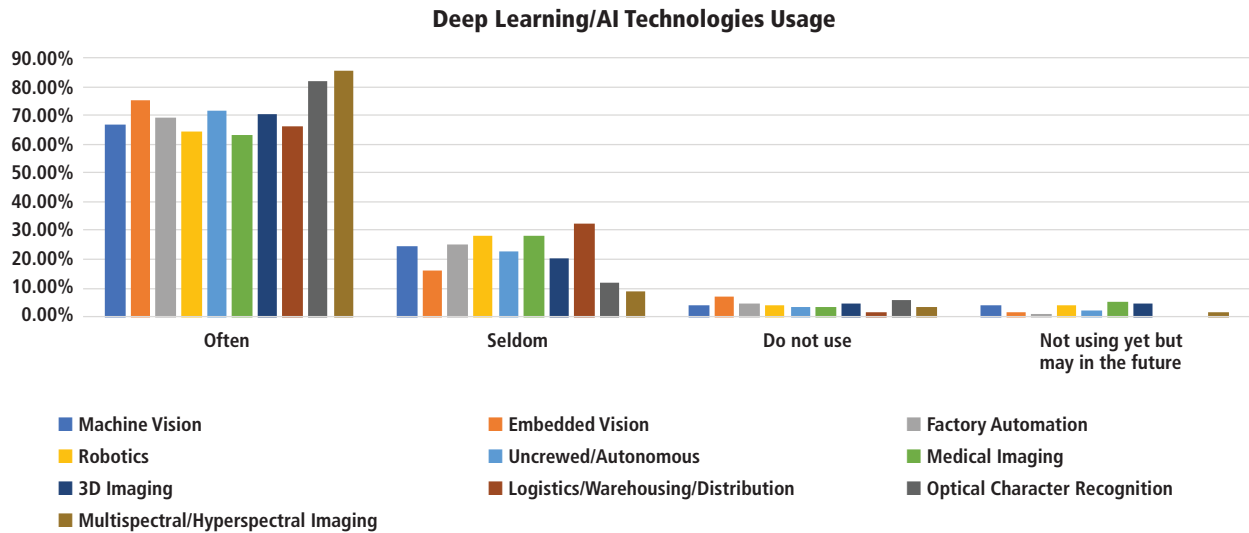
- Aerospace/Military/Defense
- Drones/Uncrewed
- Autonomous Robotics
- Agriculture/Environment
- Automotive
- Energy (Oil, Gas, Solar, Wind)
- Consumer Electronics
- Containers/Packaging
- Logistics/Warehousing/Distribution
- Food and Beverage
- Forestry/Timber
- General Manufacturing
- Medical/Medical Devices

- Pharmaceutical
- Plastics
- Semiconductors/Electronics
- Textile

Respondents answered the question: “For which applications do you design, develop, integrate, or manufacture machine vision products, vision systems, or vision subsystems?” This report focuses on the following applications:

- Machine Vision
- Embedded Vision
- Factory Automation
- Robotics
- Uncrewed/Autonomous
- Medical Imaging
- 3D Imaging
- Logistics/Warehousing/Distribution
- Optical Character Recognition
- Multispectral/Hyperspectral Imaging

This report covers how often respondents use different technologies for these 10 application areas and how important they find these technologies to design vision/imaging systems. The survey asked about emerging technologies that include: deep learning/artificial intelligence (AI), hyperspectral/multispectral/SWIR, high-speed imaging, embedded vision, and 3D imaging. It also covers technology challenges and solution viability for different end use areas.



## Factory Automation

Of those respondents who answered that they design, develop, integrate, or manufacture machine vision products, vision systems, or vision subsystems for factory automation applications, 69.14% said they often use deep learning/AI technologies, with 1.14% saying they are not using them yet but may in the future. Other responses included those who seldom use these technologies (25.14%) and 4.57% who do not use deep learning/AI technologies.

Regarding the importance of whether deep learning/AI technologies are important now and in the future, 56.44% said they are very important right now, 29.45% said they are somewhat important right now, 4.91% said they are not important, 7.98% said they are not important but will be very important in the future, and just 0.61% responded that they are not important but will be somewhat important in the future.

The next question covered hyperspectral/multispectral/SWIR technologies. For those who design systems for factory automation applications, 63.58% said they use these technologies often, followed by 24.86% who seldom use them, 6.94% who do not use these technologies, and 4.62% who don't use them now but may in the future. The majority of respondents (44.44%) said these technologies are very important right now, 39.87% said they are somewhat important right now, 4.58% said they are not important, 7.19% said they are not important but will be very

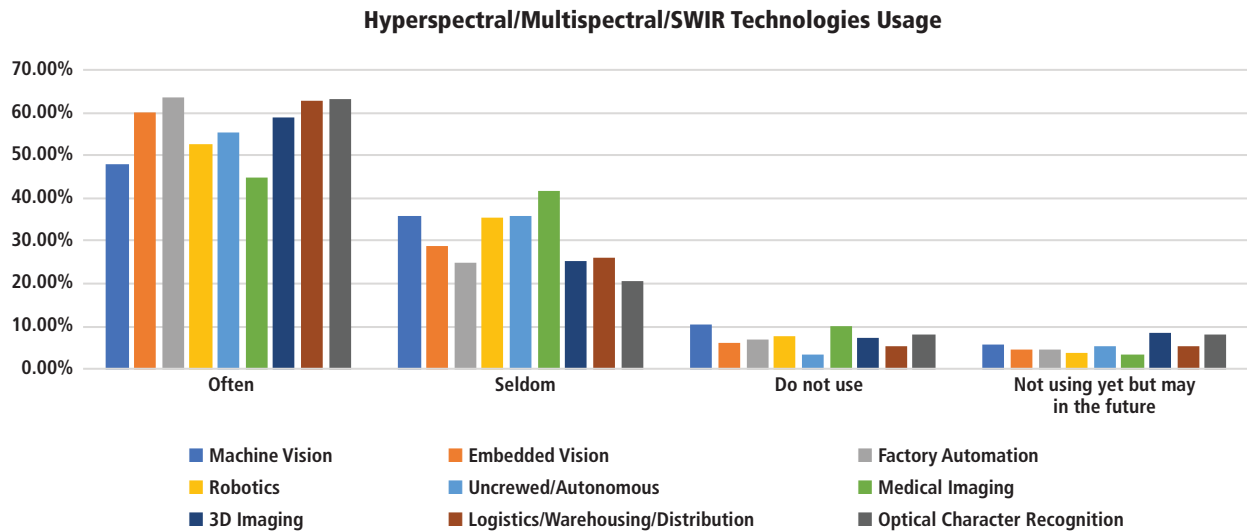
important in the future, and 3.92% responded that they are not important but will be somewhat important in the future.

Not surprisingly, when it comes to high-speed imaging, 68.79% of factory automation respondents said they often use high-speed imaging with 24.28% reporting they seldom use high-speed imaging. Respondents also reported that they do not use it (3.47%) and that they don't use it now but may in the future (3.47%). A high percentage (60.25%) said high-speed imaging is very important right now, with 29.81% saying it is somewhat important right now. Then the percentage dropped considerably for those answering that it is not important (2.48%) before going back up to 6.83% for those saying it is not important but will be very important in the future. The percentage of respondents who answered that it is not important but will be somewhat important was 0.62%.

For high-speed imaging, the survey also asked what type respondents use. Of those who answered the question, 43.48% said they use high-speed video cameras, 21.74% use line scan cameras, 33.54% use high-speed interface cameras (10GigE, 25 GigE, CXP 2.0, fiber, PCI Express, etc.), and 1.24% said they are not using high-speed imaging products.

Embedded vision technologies were covered next, with 54.34% reporting they use embedded vision technologies often, 36.42% reporting seldom use, 6.94% saying they do not use these technologies, and 2.31% saying they are not using these technologies now but may in the future.

For whether or not these technologies are important to those designing for factory automation applications, the pattern changed. The percentage for those answering that these technologies are very important right now is 36.94%, but this time the percentage went up for those answering somewhat important right now (38.22%). Only 2.55% said not important, but 21.66% said they are not important but will be very important in the future. The percentage of those who answered not important but that it will be somewhat important in the future came in at 0.64%.



Finally for factory automation, respondents answered the same questions for 3D imaging technologies. The highest percentage (46.51%) of respondents answered they use 3D imaging technologies often, with the closest percentage thereafter being 44.77% for those who seldom use the technologies. The percentage of those designing for factory automation applications who do not use 3D imaging technologies is 5.23%, and the percentage of those not using these technologies yet but may in the future is 3.49%.

Regarding these technologies' importance, 42.68% said these technologies are very important right now, 29.30% said they are somewhat important right now, 2.55% responded that they are not important, 19.11% said they are not important but will be very important in the future, and 6.37% said they are not important but will be somewhat important in the future.

## Machine Vision

Of those respondents who answered that they design, develop, integrate, or manufacture machine vision products, vision systems, or vision subsystems for machine vision applications, 66.9% said they use deep learning/AI technologies often, with 24.83% saying they seldom use these technologies. Smaller and

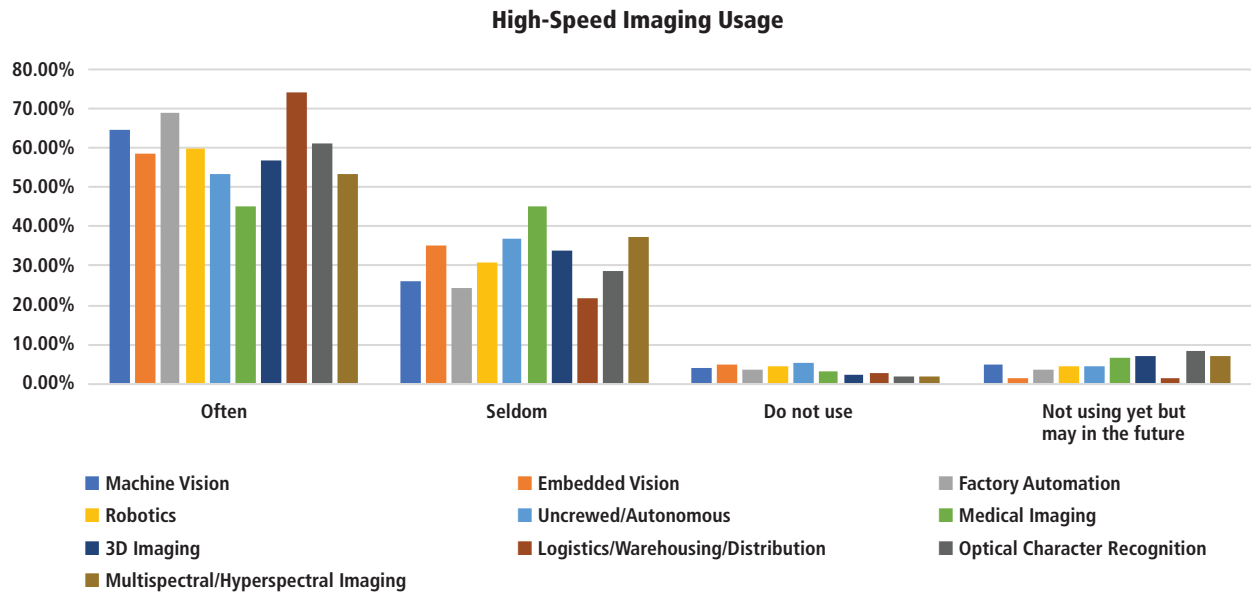
equal percentages said they do not use these technologies (4.14%), and the same percentage (4.14%) said they don't use these technologies now but may in the future.

64.89% of respondents said these technologies are very important right now, 27.48% said they are somewhat important now, 1.53% responded that they are not important, 4.58% said that they are not important but will be very important in the future, and 0.76% said they are not important but will be somewhat important in the future.

For hyperspectral/multispectral/SWIR imaging technologies, 47.89% of respondents said that they use these technologies now, and 35.92% said they seldom use them. 10.56% said they do not use them at all, and 5.63% said they do not use them now but may in the future.

These technologies are still relatively new, and no one knows the full breadth of applications for which they can be used yet. That said, those who are using these technologies for machine vision applications indicate that 43.70% consider these technologies very important right now, 39.50% consider them somewhat important right now, with 6.72% saying these technologies are not important but will be very important in the future, and 7.56% saying these technologies are not important but will be somewhat important in the future.

Again, this section is covering those who answered that they design systems for machine vision applications. For high-speed imaging, 64.79% of respondents said they use it often, and 26.06% said they seldom use high-speed imaging. Respondents who do not use high-speed imaging for their machine vision applications make up 4.23% of respondents; those not using now but possibly in the future make up 4.93% of respondents. For designers of systems for machine vision applications, high-speed imaging is very important right now for 58.14% of respondents, and 34.88% find it somewhat important right now. The percentage of respondents who do not find it important is 2.33%, with "not important but will be very important in the future" at 3.10%, and "not important but will be somewhat important in the future" at 1.55%.



The percentage of respondents employing high-speed video cameras is 41.86%, and the percentage for line scan cameras is 23.26%. The percentage of respondents using high-speed interface cameras (10GigE, 25 GigE, CXP 2.0, fiber, PCI Express, etc.) is 34.11%, and only 0.78% reported that they are not currently using high-speed imaging products.

As with those designing vision/imaging systems for factory automation applications, embedded vision technologies are being adopted for machine vision applications. For embedded vision technologies, 54.23% use them often, 32.39% seldom use them, 7.75% do not use them, and 5.63% say they aren't using them now but may in the future.

In terms of importance, 38.21% answered that embedded vision technologies are very important to them right now, while 47.97% said they are somewhat important right now, and 4.07% said they are not important. The percentage of respondents answering that embedded vision technologies are not important but will be very important in the future is 8.94%, and only 0.81% said that it is not important now but will be somewhat important in the future.

Finally for machine vision applications, respondents were asked about 3D imaging technologies. 48.94% of respondents said that they use 3D imaging technologies



often, 40.43% said they seldom use 3D imaging technologies, 4.26% said they do not use 3D imaging technologies, and 6.38% said they are not using them but may in the future.

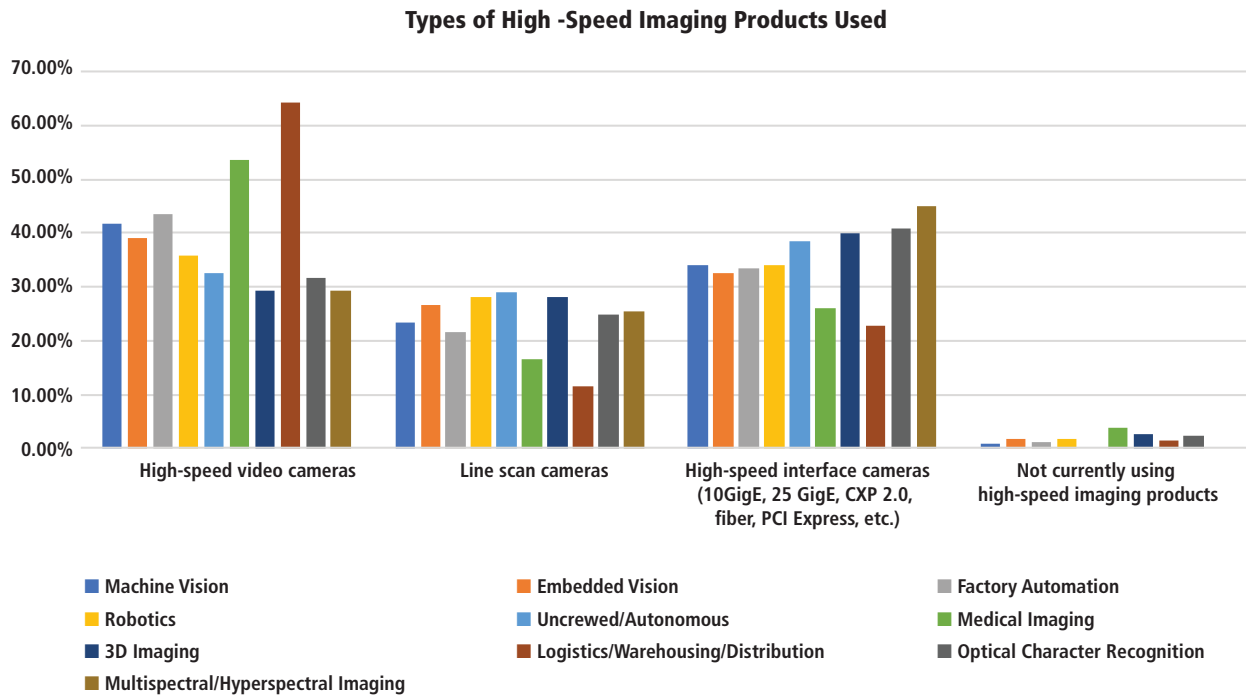
43.65% of respondents said 3D imaging technologies are very important right now, 38.85% said these technologies are somewhat important right now, 2.38% said they are not important, 14.29% said they are not important but will be very important in the future, and 0.79% said they are not important but will be somewhat important in the future.

### Robotics

Robotics, especially in North America, have experienced tremendous growth, especially as the demand for automation increases. Vision systems are often part of robotics systems. For those respondents who answered that they design vision/imaging systems for robotics applications, 64.39% said they often use deep learning/AI technologies, and 28.03% said they seldom use these technologies. Those who said they do not use these technologies and those who don't use them now but may in the future both came in at 3.79%.

The importance of deep learning/AI technologies to these respondents, of course, varied. The percentage of those who consider these technologies very important right now was 56.67%, and for those who consider them somewhat important right now it was 31.67%. 2.50% of respondents did not consider these technologies important at all, with 6.67% indicating they are not important but will be very important in the future, followed by 1.67% who think they are not important but will be somewhat important in the future.

Considering the applications that include robotics off the factory floor, it is not surprising that 52.71% of respondents designing systems for robotics applications answered that they use hyperspectral/multispectral/SWIR technologies often. Although 35.66% said they seldom use these technologies, 3.88% said they



do not use them now but may in the future, with 7.75% saying they do not use these technologies.

The data for importance coincide with use habits: 43.86% of respondents say these technologies are very important right now, 29.82% say they are somewhat important right now, 4.39% say they are not important, 13.16% say they are not important but will be very important in the future, and 8.77% say they are not important but will be somewhat important in the future.

Respondents were also asked whether they use high-speed imaging in their designs for robotics applications. Of the respondents, 59.69% said they use high-speed imaging often, with 31.01% saying they seldom use it. Those who do not use high-speed imaging for robotics applications made up 4.65% of the respondents, and 4.65% said they do not use high-speed imaging now but may in the future.

Of those who design for robotics applications, 57.01% said high-speed imaging is very important right now, and 35.90% said it is somewhat important right now, although 9.40% said it is not important but will be very important in the future.

5.13% answered that it is not important but will be somewhat important in the future, and 2.56% said it is not important.

The type of high-speed imaging used by those designing for robotics applications was highest for high-speed video cameras (35.90%) followed by 34.19% for those using high-speed interface cameras (10GigE, 25 GigE, CXP 2.0, fiber, PCI Express, etc.), 28.21% using line scan imaging, and 1.71% saying they do not use any type of high-speed imaging.

Embedded vision technologies also play a role for those designing vision/imaging systems for robotics applications, with 49.61% saying they use these technologies often, 37.21% saying they seldom use them, 8.53% responding that they do not use them, and only 4.65% saying that they don't use them yet but might in the future.

About the importance of these technologies, 48.12% answered that they are somewhat important right now, with 34.82% saying they are very important right now. 10.71% said they do not find these technologies important but that they will be very important in the future, with 4.46% saying they are not important, and 1.79% saying they are not important but will be somewhat important in the future.

No matter the type of robot, 3D imaging is commonly used for object avoidance, bin picking, and other areas for robotics applications. Survey findings reflect this in that 58.14% of respondents designing vision/imaging systems for robotics applications said they use 3D imaging technologies, although 35.66% said they seldom use 3D technologies. Only 3.88% said they do not use these technologies, and just 2.33% said they are not using them now but may in the future.

Understandably, 48.76% of respondents in this application area stated that 3D imaging technologies are very important right now. One group (9.92%) said they are not important but will be very important in the future. 3D imaging technologies are somewhat important right now for 36.36% of respondents, with 0.83% saying that these technologies are not important but will be somewhat important in the future;

4.13% of respondents in this application area said 3D imaging technologies are not important.

### **Embedded Vision**

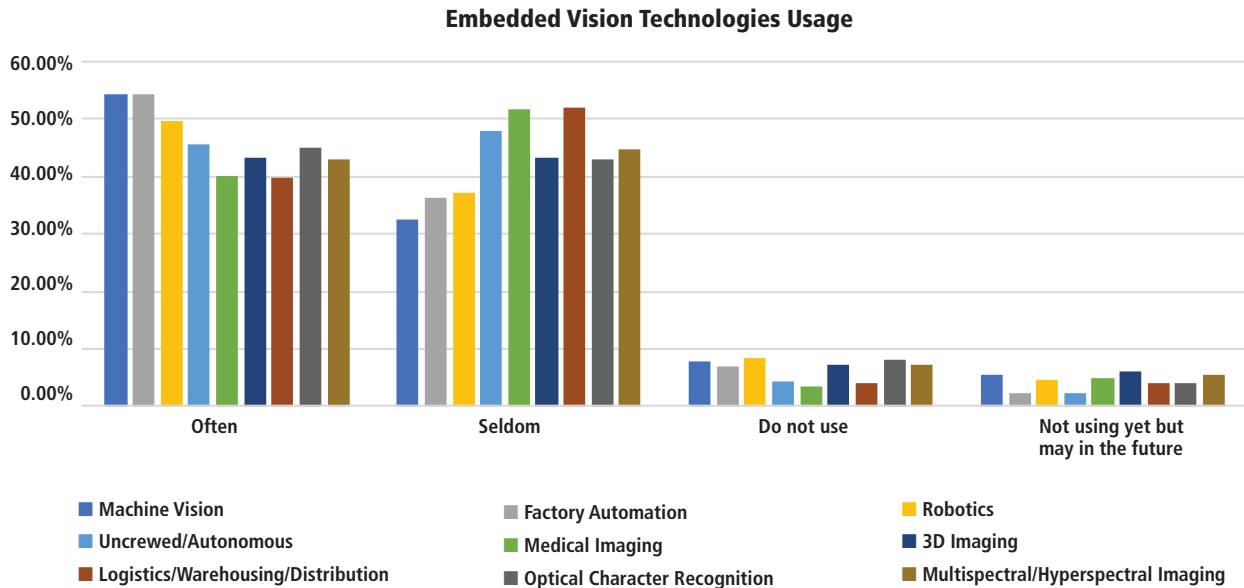
Embedded vision has been a growing area in the vision/imaging market and it continues to expand. Of respondents who said they design systems for embedded vision applications, 75.19% said they use deep learning/AI technologies often, with 16.28% responding that they seldom use these technologies, and 6.98% responding that they do not use these technologies for embedded vision applications at all. Only 1.55% responded that they don't use them now but may in the future.

These technologies are very important right now to 53.39% of respondents, with 38.14% responding they are somewhat important right now, and 4.24% responding they are not important. Additionally, 1.69% responded they are not important but will be very important in the future, with another 1.69% responding that they are not important but will be somewhat important in the future.

For hyperspectral/multispectral/SWIR technologies use, 60.16% responded they use these technologies for embedded vision applications, while 28.91% responded they seldom use them. Just 4.69% responded they don't use these technologies now but may in the future, and 6.25% responded they do not use them.

The responses regarding the importance of these technologies for embedded vision applications coincide with their use, with 50.88% of respondents saying these technologies are very important right now, 28.95% saying they are somewhat important right now, 7.89% saying they are not important, 9.65% saying they are not important but will be very important in the future, and 2.63% saying they are not important but will be somewhat important in the future.

For those respondents designing systems for embedded vision applications, 58.59% said they use high-speed imaging often, 35.16% said they seldom use high-



speed imaging, with 4.69% saying they do not use high-speed imaging, and 1.56% responding they don't use it now but may in the future.

Percentages for high-speed imaging's importance were close, with 45% of respondents saying they think it is very important right now and 40% saying they consider it somewhat important right now. The next highest percentage was 10% for those responding that it is not important but will be very important in the future, followed by 2.50% responding it is not important, and 1.67% saying it is not important but will be somewhat important in the future.

The greatest percentage of respondents said they use high-speed video cameras (39.17%), followed by high-speed interface cameras (34.11%), line scan cameras (23.26%), and 0.78% responding they don't use high-speed imaging products.

3D imaging technology use is also high for embedded vision application respondents, with 57.48% saying they use it often, 33.07% saying they seldom use it, 7.09% saying they do not use it, and 2.36% saying they do not use it now but may in the future.

When those designing systems for embedded vision applications were asked how important 3D imaging technologies are, 56.14% said they are somewhat important

right now, followed by 34.21% responding it is very important right now. 2.63% said it is not important, and 6.14% said it is not important but will be very important in the future.

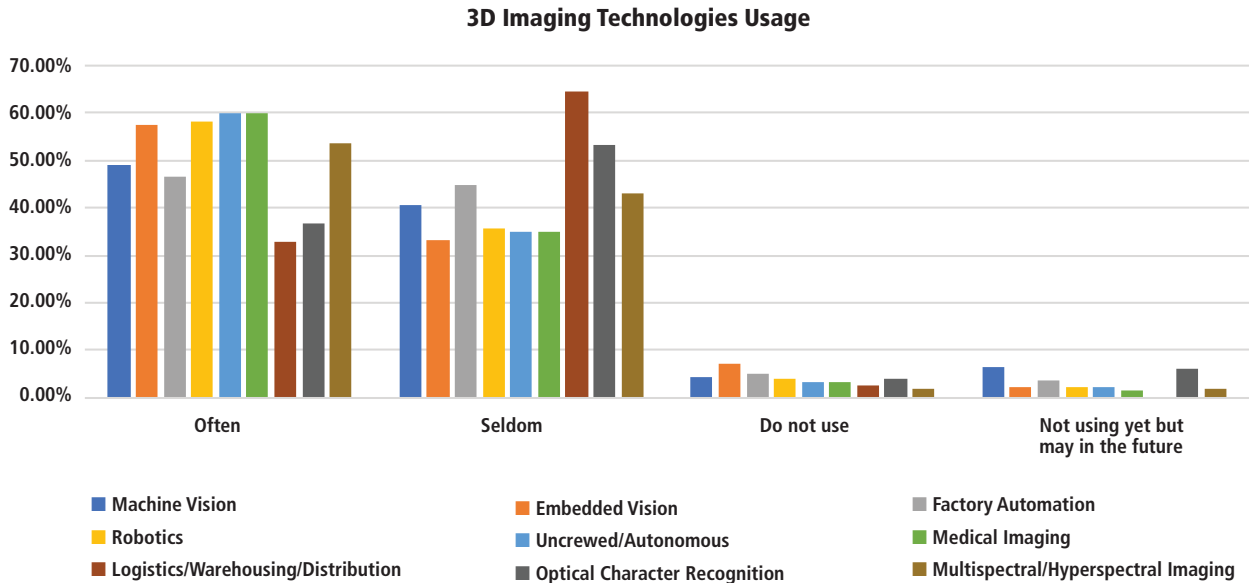
### Uncrewed/Autonomous

Vision technologies are helping enable a variety of autonomous systems from autonomous vehicles to AMRs used in warehousing applications. Regarding deep learning/AI technologies use, 71.74% of respondents designing vision systems for uncrewed/autonomous applications said they use these technologies often, with 22.83% responding that they seldom use these technologies. Remaining respondents said they do not use these technologies (3.26%), and 2.17% said they do not use these technologies now but may in the future.

Most respondents felt that these technologies are very important right now (52.87%) and somewhat important right now (36.78%). Some (5.75%) said these technologies are not important, and 2.30% said they are not important but will be very important in the future, followed by 1.15% saying these technologies are not important but will be somewhat important in the future.

Respondents designing for uncrewed/autonomous applications said they often use hyperspectral/multispectral/SWIR technologies (55.43%) and seldom use them (35.87%). The smallest percentages of respondents said they do not use these technologies (3.26%) or don't use them now but may in the future (5.43%).

The importance of these technologies for those designing for uncrewed/autonomous applications was 44.05% for those considering them very important right now, 34.52% for those finding them somewhat important right now, 8.33% for not important, with 8.33% responding that they are not important now but will be very important in the future, and 4.76% saying they are not important but will be somewhat important in the future.



Respondents indicated that they use high-speed imaging often (53.26%) or seldomly (36.96%), with 5.43% indicating they do not use high-speed imaging, and 4.35% said they do not use it now but may in the future.

Regarding this technology’s importance, the highest percentage (45.78%) of respondents said that high-speed imaging is somewhat important right now, with 38.55% saying it is very important right now. Respondents indicating it is not important but will be very important in the future came in at 10.84%, with 2.41% saying it is not important but may be somewhat important in the future, and 1.20% saying it is not important.

High-speed interface camera usage came in with the highest percentage of use (38.55%), followed by 32.53% responding they use high-speed video cameras. Line scan camera usage had the third highest percentage of use, according to the survey, at 28.92%.

Uncrewed/autonomous applications may seem like natural implementations for embedded vision, but 47.83% of respondents said they seldom use these technologies vs. 45.65% who said they use these technologies often. Only 4.35% said

they do not use these technologies, and 2.17% said they are not using them now but may in the future.

Although the highest percentage of respondents said they seldom use these technologies, 43.02% said they consider these technologies very important right now, with 39.53% saying they consider them somewhat important right now. The third highest percentage, 10.47%, said these technologies are not important but will be very important in the future, and just 1.16% said they are not important but will be somewhat important in the future.

Finally, the survey again asked about 3D imaging technologies for these applications, and 59.78% of respondents said they use them often, 34.78% said they seldom use them, 3.26% said they do not use them, and 2.17% said they don't use them now but may in the future.

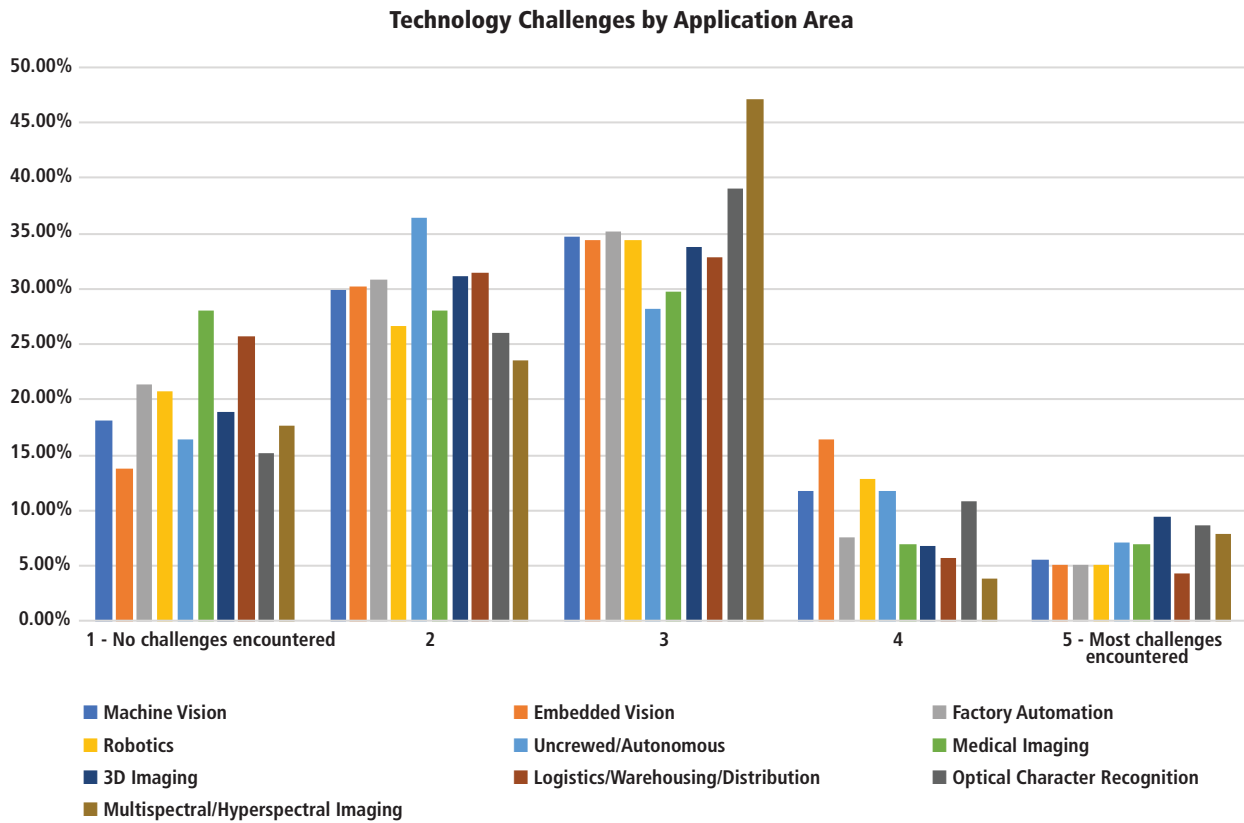
The majority of respondents for this application area said these technologies are very important right now (51.72%), with 33.33% responding that these technologies are somewhat important right now. The smallest percentage was for not important but will be somewhat important in the future (2.30%), with 3.45% saying that these technologies are not important but will be very important in the future, and 8.05% said these technologies are not important.

### **3D Imaging**

3D imaging is another application area that reports high usage of deep learning/AI technologies. For example, 70.24% of respondents who design for these applications reported that they use these technologies often, with 20.24% reporting they seldom use these technologies, and 4.76% each reporting that they do not use the technologies or do not use them now but may in the future.

Concurrently, 60.53% of respondents consider these technologies very important right now, and 32.89% responded that they find these technologies somewhat





important right now. However, 5.26% did respond that they do not consider them important but that they will be very important in the future.

Multispectral/hyperspectral/SWIR technologies, according to respondents, are used often (59.04%) or seldom used (25.43%), with 7.23% not using these technologies for 3D imaging applications and 8.43% responding that they are not using them now but may in the future.

Fifty percent responded that they consider these technologies very important right now, and 28.57% said they consider them somewhat important right now. Ten percent said that they do not consider them important but that they will be very important in the future, and 10% also replied that they do not consider them important but that they will be somewhat important in the future. Only 1.43% said they do not consider them important.

For 3D imaging applications, 56.63% of respondents said they use high-speed imaging often, with 33.73% saying they seldom use it. 7.23% are not using it but may in the future, and 2.41% said they do not use it.

Respondents considered high-speed imaging very important right now (42.67%), somewhat important right now (37.33%), not important but very important in the future (13.33%), not important but somewhat important in the future (4%), and not important (2.67%).

Like uncrewed/autonomous applications, the highest percentage of respondents (40%) said they use high-speed interface cameras for high-speed imaging, followed by 29.33% using high-speed video cameras, and 28% saying they use line scan cameras. Only 2.67% said they do not use high-speed imaging.

For embedded vision technologies use, 43.37% replied they use often and, again, 43.37% said they seldom use these technologies for 3D applications. 7.23% said they don't use these technologies, and 6.02% said they are not using them now but may in the future.

Although "use often" and "seldom use" percentages are the same, 43.06% consider embedded vision technologies somewhat important right now while 33.33% said they are very important right now. 16.67% said they are not important but will be very important in the future, and 6.94% said they are not important.

### **Logistics/Warehousing/Distribution**

Vision/imaging technologies are getting farther and farther away from the factory floor. One area that is seeing more use is logistics/warehousing/distribution. Of respondents, 66.22% said they use these technologies often, with 32.43% saying they seldom use them, and 1.35% saying they do not use them.

Accordingly, 44.44% of respondents said these technologies are very important right now, with 36.11% saying they are somewhat important right now, 15.28% saying

they are not important but will be very important in the future, and 1.39% each for not important but somewhat important in the future and not important.

For frequency of using multispectral/hyperspectral/SWIR technologies in systems for logistics/warehousing/distribution applications, 63.01% said they use these technologies often, and 26.03% responded they seldom use these technologies. 5.48% of respondents said they do not use these technologies, and the same percentage said they don't use them now but may in the future.

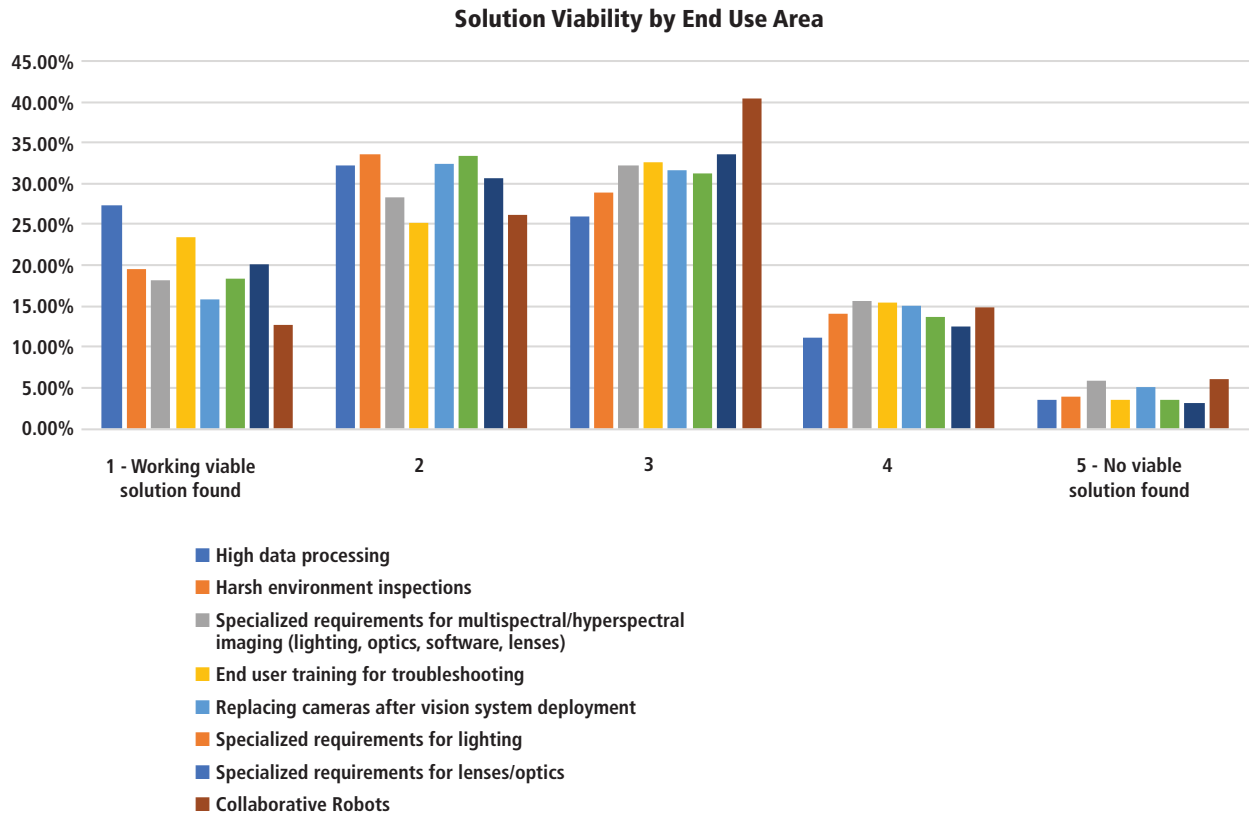
For these applications, 41.54% of respondents said these technologies are very important right now, and 30.77% answered that they are somewhat important right now. 24.62% said they are not important but will be very important in the future, with 3.08% saying they are not important but will be somewhat important in the future.

A high percentage of respondents (73.97%) said they use high-speed imaging often with 21.92% saying they seldom use it. Just 2.74% responded that they do not use high-speed imaging, and 1.37% said they are not using it now but may in the future.

Concurrent with usage percentages, 67.14% consider high-speed imaging very important right now, 17.14% said it is somewhat important right now, 2.86% do not consider high-speed imaging important, and 11.43% said it is not important but will be very important in the future.

High-speed video cameras came in at 64.29% for the type of high-speed imaging respondents are using. The second highest percentage was 22.86% for high-speed interface cameras, followed by 11.43% for line scan cameras, and 1.43% saying they are not using high-speed imaging for logistics/warehousing/distribution.

For embedded vision technologies, the highest percentage of use frequency was 52.05% saying they seldom use these technologies, with 39.73% saying they often use these technologies for these applications. The same percentage, 4.11%, responded they do not use these technologies as well as for not using yet but may in the future.



37.31% of respondents said these technologies are not important but will be very important in the future. 31.34% responded they are very important right now, with 28.36% saying they are somewhat important right now, and 1.49% saying they are not important.

Use frequency for 3D imaging technologies followed the same pattern with the highest percentage (64.38%) saying they seldom use these technologies for logistics/warehousing/distribution followed by 32.88% saying they often use these technologies, and 2.74% saying they do not use these technologies.

About one third of respondents did consider these technologies very important right now (35.21%), and 19.72% said they are not important but will be very important in the future. However, 28.17% said they are not important but will be somewhat important in the future, and 15.49% said they are somewhat important right now.

### Medical Imaging

Another area away from the factory floor where vision/imaging technologies are gaining traction is medical imaging. Use of the emerging technologies in this report is mixed.

Of respondents designing systems for this application, 63.33% said they use deep learning/AI technologies often, with 28.33% saying they seldom use these technologies, 3.33% saying they do not use them, and 5% saying they do not use them now but may in the future.

Regarding these technologies' importance, 54.55% said these technologies are very important right now, and 34.55% said these technologies are somewhat important right now. The same percentage (5.45%) said these technologies are not important and that they are not important but will be very important in the future.

For hyperspectral/multispectral/SWIR technologies, 45% said they use these technologies often, 41.67% said they seldom use these technologies, with 10% saying they do not use them, and 3.33% saying they do not use them now but may in the future.

Regarding the importance of these technologies for medical imaging applications, 38.46% said these technologies are very important right now, 30.77% said they are somewhat important right now, and 19.23% said they are not important but will be very important in the future. The smallest percentages were for those answering that these technologies are not important (3.85%), and those answering that they are not important but will be somewhat important in the future (7.69%).

The same percentage of respondents (45%) answered that they use high-speed imaging often or that they seldom use high-speed imaging. Only 3.33% said they do not use high-speed imaging, and 6.67% said they do not use it now but may in the future.

Only 1.85% of respondents said high-speed imaging is not important but will be somewhat important in the future, although 12.96% answered that it is not important but will be very important in the future. Just 3.70% said they do not consider high-speed imaging important. The two largest percentages were 44.44% answering that high-speed imaging is very important right now, followed by 37.04% responding that it is somewhat important right now.

For medical imaging applications that use high-speed imaging, 53.70% of respondents said they are using high-speed video cameras, 16.67% said they are using line scan cameras, 25.93% said they are using high-speed interface cameras, and 3.70% said they are not using high-speed imaging.

Embedded vision technologies usage for these applications varied, with 51.67% of respondents saying they seldom use these technologies and 40% saying they use them often. A low percentage (5%) said they do not use them now but may in the future, and 3.33% said they do not use them.

Respondents' answers regarding the importance of this technology were in line with usage responses. The highest percentage of respondents (47.47%) answered that this technology is somewhat important right now, with 30.91% responding that this technology is very important right now and 20% answering that this technology is not important but will be very important in the future. Only 1.82% of respondents said the technology is not important.

Finally for medical imaging applications, 60% of respondents answered they use 3D imaging technologies often, with 35% saying they seldom use these technologies, 3.33% saying they do not use them, and 1.67% saying they do not use them now but may in the future.

Regarding importance, the percentages of those responding that they consider these technologies very important right now (42.11%) and somewhat important right now (40.35%) were very close, with 5.26% responding these technologies are not important, 10.53% saying they are not important but will be very important

in the future, and just 1.75% saying they are not important but will be somewhat important in the future.

### **Multispectral/Hyperspectral Imaging**

This application area had the highest percentage of respondents (85.71%) saying that they often use deep learning/AI technologies when designing systems for this area. Of the remaining selections, 8.93% said they seldom use these technologies, 3.57% said they do not use these technologies, and 1.79% said they are not using them now but may in the future.

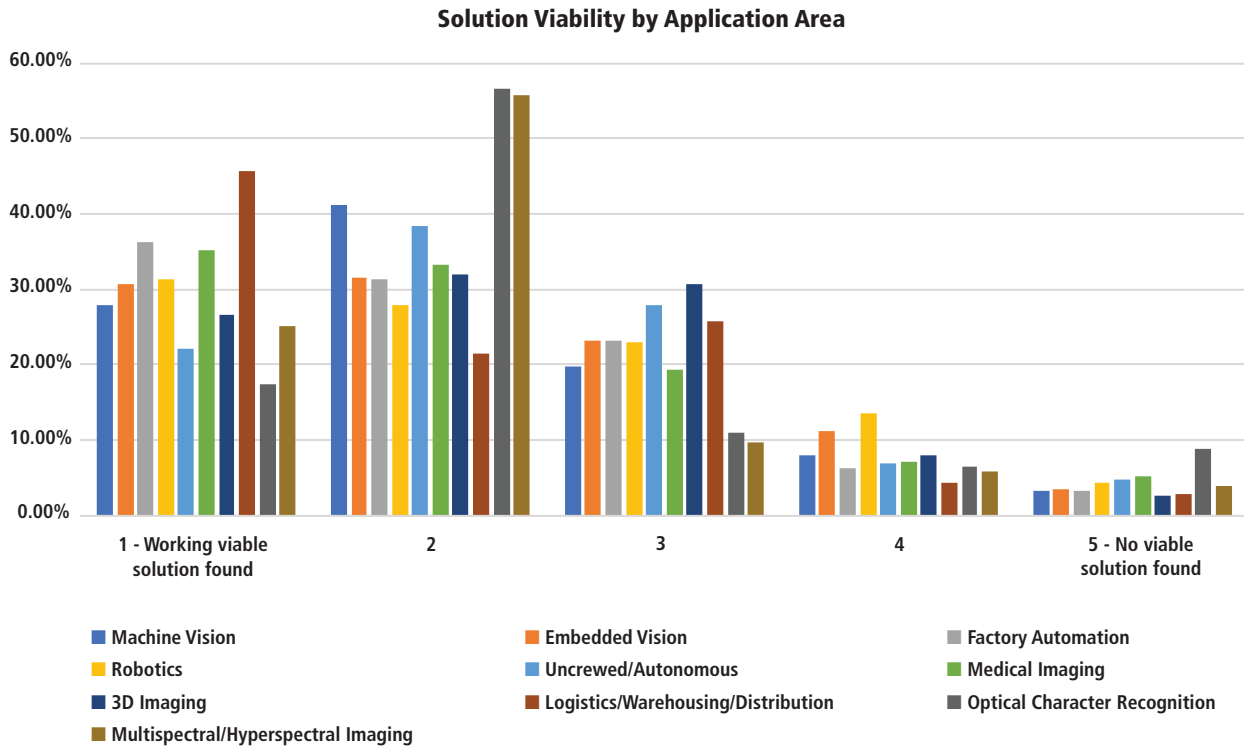
Regarding importance, 77.36% of respondents said that they consider these technologies very important right now, and 20.75% answered they consider these technologies somewhat important right now.

53.57% of respondents said they use high-speed imaging often, with 37.50% indicating that they seldom use high-speed imaging. Of the remaining responses, 1.79% indicated they do not use high-speed imaging, and 7.14% said they do not use it now, but may in the future.

In terms of importance, 56.86% of respondents said high-speed imaging is very important right now, 21.57% said high-speed imaging is somewhat important right now, and 19.61% said high-speed imaging is not important now but will be very important in the future.

The highest percentage of respondents (45.10%) said they use high-speed interface cameras for high-speed imaging in this application area, followed by 29.41% for high-speed video cameras, and 25.49% for line scan cameras.

According to the survey results, embedded vision technologies are being used for multispectral/hyperspectral applications, with 42.86% of respondents saying they use these technologies often, 44.64% responding that they seldom use these



technologies, 7.14% answering that they do not use these technologies, and 5.36% responding that they do not use these technologies now but may in the future.

Only 16.33% of respondents said that these technologies are very important right now, with 53.06% replying that these technologies are somewhat important right now. 4.08% said that these technologies are not important, and 24.49% said they are not important but will be very important in the future.

For 3D imaging technologies, 53.57% of respondents for these applications said they use these technologies often, 42.86% said they seldom use these technologies, 1.79% said they do not use them, and another 1.79% said they do not use them now but may in the future.

53.70% of respondents said these technologies are very important right now, followed by 22.22% saying they are somewhat important right now, 20.37% saying they are not important now but will be very important in the future, and 1.85% saying they are not important now but will be somewhat important in the future.



## Optical Character Recognition

Optical character recognition (OCR) is an area that has been benefitting from emerging technologies. In many cases, these technologies can be used to enhance OCR applications.

For example, 82% of respondents who design for these applications responded that they use deep learning/AI technologies often, and only 12% said they seldom use them. An even smaller percentage (6%) said that they do not use these technologies.

Only 4.26% of respondents said that these technologies are not important but will be somewhat important in the future, with 6.38% responding that they are not important. 61.70% said they are very important right now, and 25.53% said they are somewhat important right now.

For multispectral/hyperspectral/SWIR technology use for these applications, 63.27% said they use these technologies often, and 20.41% said they seldom use them, with 8.16% saying they do not use them and 8.16% saying they don't use them now but may in the future.

Although the greatest percentage of respondents said they are using these technologies often, 46.34% said these technologies are somewhat important right now, while 24.39% said they are very important right now. Still, only 2.44% replied that they are not important, with 19.51% saying they are not important but will be very important in the future and 7.32% saying they are not important but will be somewhat important in the future.

61.33% of respondents said they use high-speed imaging often, and 28.57% said they seldom use it. Only 2.04% of respondents designing systems for OCR applications said they do not use high-speed imaging, and 8.16% said they do not use it now but may in the future.

56.82% of respondents indicated that these technologies are very important right now, with 13.64% saying they are somewhat important right now, another

13.64% saying they are not important but will be very important in the future, 9.09% indicating they are not important, and 6.82% responding that they are not important but will be somewhat important in the future.

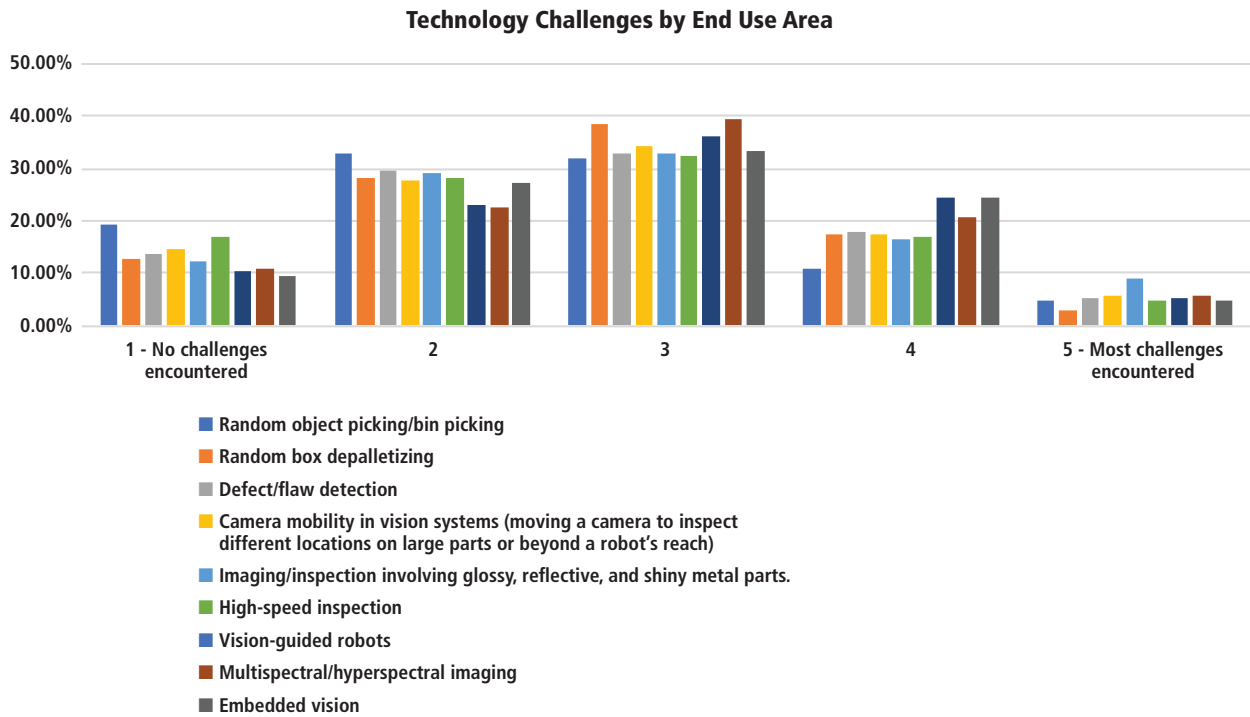
The highest percentage of respondents (40.91%) said they use high-speed interface cameras for high-speed imaging, and 31.82% said they use high-speed video cameras, 25% said they use line scan cameras, and 2.27% said they are not using any high-speed imaging products.

The percentages for those who use embedded vision technologies often and those who seldom use them were very close, with 44.90% saying they use them often and 42.86% saying they seldom use them. 8.16% said they do not use embedded vision technologies for OCR applications, and 4.08% said they are not using them now but may in the future.

Although the highest percentage of respondents said they seldom use embedded vision technologies, 60.47% said that these technologies are somewhat important right now vs. 25.58% indicating they are very important right now. Only 2.33% indicated these technologies are not important, and 11.63% said they are not important but will be very important in the future.

Finally, for 3D imaging technology use for OCR applications, 53.06% indicated they seldom use these technologies, 36.73% said they use these technologies often, 6.12% said they are not using them now but may in the future, and 4.08% said they do not use them.

Of those saying they design systems for OCR applications, 38.64% said that 3D imaging technologies are very important right now, 29.55% said 3D imaging technologies are somewhat important right now, 2.27% said they are not important, 27.27% said they are not important but will be very important in the future, and 2.27% said they are not important but will be somewhat important in the future.



## Technology Challenges

The 2022 Solutions in Vision survey also asked about technology challenges for specific types of end uses. Respondents were asked to indicate the level of technology challenges encountered for various end uses, on a scale of 1 to 5, where 1 represented no challenges encountered, and 5 represented most challenges encountered. End uses included random object picking/bin picking; random box depalletizing; defect/flare detection; camera mobility in vision systems (moving a camera to inspect different locations on large parts or beyond a robot's reach); imaging/inspection involving glossy, reflective, and shiny metal parts; high-speed inspection; vision-guided robots; multispectral/hyperspectral imaging; and embedded vision. Overall, most respondents across all the applications covered above scored each end use in the 2-3 range. However, certain end uses did represent greater challenges to respondents, and, naturally, some represented the fewest challenges.

For example, of those answering 1 (no challenges encountered), the highest percentage was 19.21% for random object picking/bin picking. The smallest

percentage for an answer of 1 was 9.43% for technology challenges for embedded vision. At the opposite end, for those answering 5 (most challenges encountered), the highest percentage for the most challenges encountered was 9.15% for imaging/inspection involving glossy, reflective, and shiny metal parts, and the lowest percentage was 3.09% for random box depalletizing.

For those answering 3 (middle of the range), the highest percentage was 39.47% for multispectral/hyperspectral imaging, and the lowest was 31.88% for random object picking/bin picking.

### **Solution Viability**

The survey also asked respondents to indicate how viable a solution they found to challenges including high data processing requirements (deep learning, high-speed vision, 3D imaging), harsh environment inspections, specialized requirements for multispectral/hyperspectral imaging (lighting, optics, software, lenses), end user training for troubleshooting, replacing cameras after vision system deployment, specialized requirements for lighting, specialized requirements for lenses/optics, and collaborative robots. The range was 1 (working viable solution found) to 5 (no viable solution found).

Similar to technology challenges, respondent's ratings fell into two areas, mostly 2-3. The highest percentage for "working viable solution found" was 27.27% for high data processing requirements (deep learning, high-speed vision, 3D imaging). The lowest percentage for "working viable solution found" was 12.61% for collaborative robots. At the other end of the scale, the highest percentage for "no viable solution found" was 6.09% for collaborative robots, and the lowest percentage was 3.04% for specialized requirements for lenses/optics. In the 2-3 range, the highest percentage was again for collaborative robots, 40.43% for answering 3 and the lowest percentage was 25.11% for end user training for troubleshooting (answered 2).

### Looking Ahead

The list of applications for which vision/imaging technologies are used is continuously expanding. As new technologies emerge, vision/imaging system use extends well beyond the factory floor. As the data here indicate, some emerging technologies are more suited for some application areas than others, but vision/imaging's continued importance to various processes is unquestioned.