Module- 2

myDAQ

AUDIENCE

- Developers using LabVIEW with NI data acquisition hardware to create data acquisition applications
- Users familiar with the DAQ Assistant or basic NI-DAQmx code that want to expand their programming capabilities
- Users new to PC-based data acquisition and signal conditioning

PREREQUISITES

- LabVIEW Core 1 Course or equivalent LabVIEW experience

NI PRODUCTS USED

- LabVIEW
- NI-DAQmx
- Analog input, Analog output, and Digital I/O Modules

After attending this course, you will be able to:

- Develop integrated, high-performance data acquisition systems that produce accurate measurements
- Acquire data from sensors, such as thermocouples and strain gages, using NI data acquisition hardware
- Apply advanced understanding of LabVIEW and the NI-DAQmx API to create applications
- Eliminate measurement errors due to aliasing and incorrect signal grounding
- Initiate measurements using hardware and software triggering
- Acquire and generate single-point and buffered analog waveforms
- Acquire and generate digital signals
- Use signal conditioning to improve the quality of acquired signals
- Synchronize multiple data acquisition operations and devices

IoT

The IoT Will Change the World

The world economy will greatly change in the next decade as new Internet-enabled applications are rolled out. Some of these applications are likely to be disruptive and innovative as well as have a large economic impact. This will affect many industries and sectors, as already seen in consumer sectors like hotels (Airbnb) and taxis (Uber).

This trend is also noticeable in the industry, for example, Germany's Industry 4.0 initiative. Within Industry 4.0 or the Industrial IoT (IIoT), the focus is on integration and better use of existing technologies. In this sense, industry, machines, products, and people are all digitally connected. Manufacturers are mass producing bespoke products in quantities of one. Intelligent software in the cloud connects enterprise IT systems with the operational world, machines, devices, and sensors to control and optimize production flow.

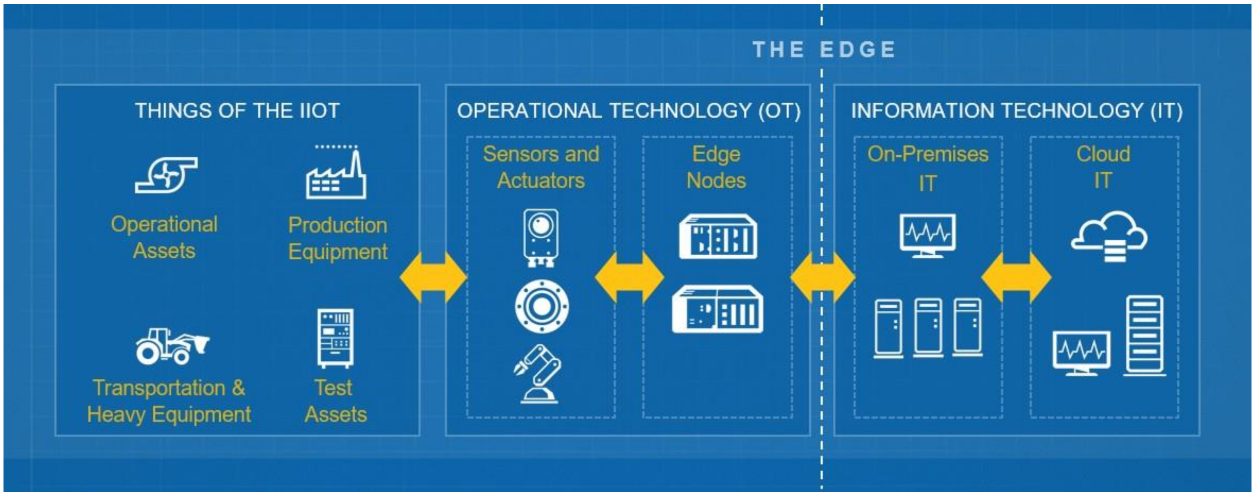


Figure 1 – Common Architecture of the Industrial IoT: Intelligent Edge Nodes Connect Sensors, Actuators and Devices to IT Systems

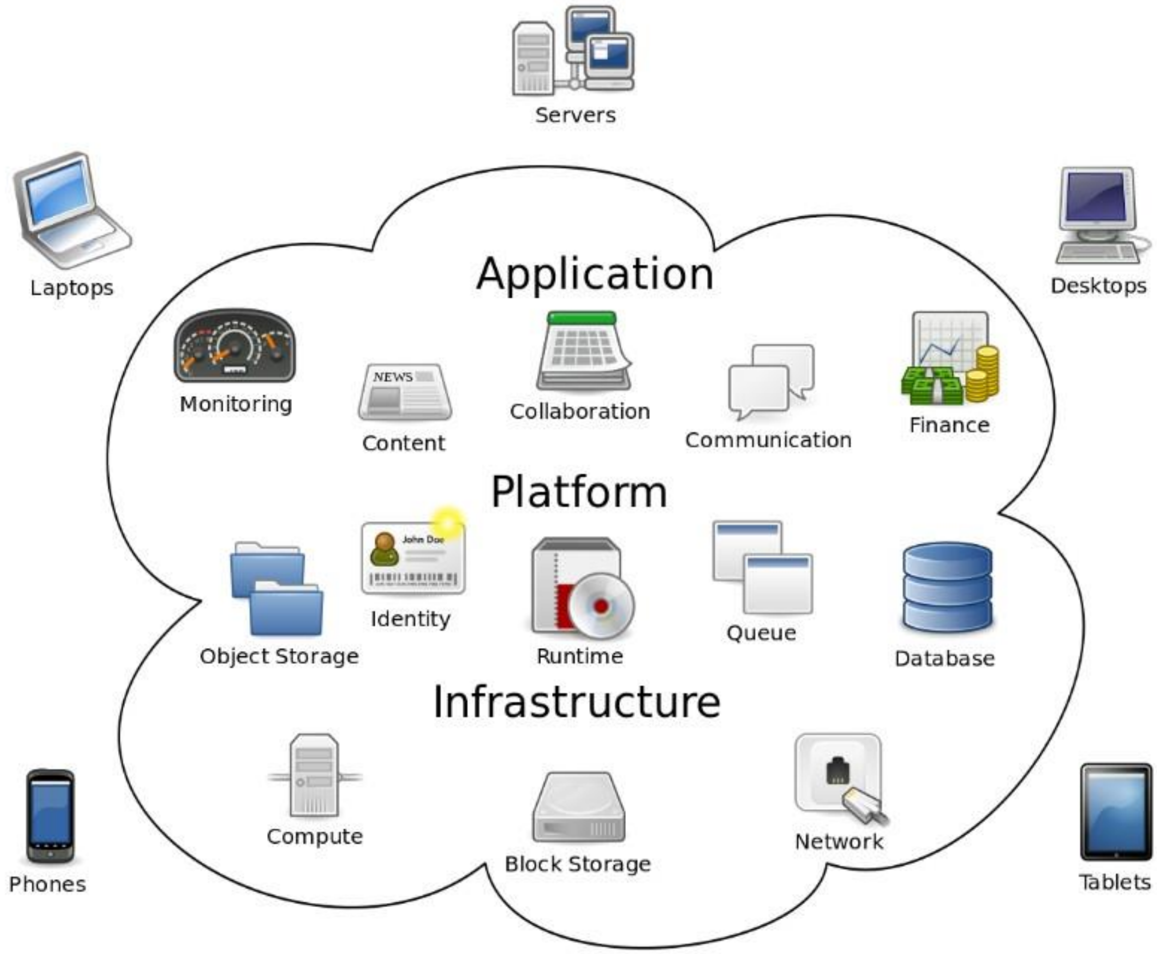
Because of the decrease in cost of connectivity, processing devices and sensors adoption of IIoT has grown tremendously. Sensor data can be captured and preprocessed close to the machines by a smart edge device such as a CompactRIO or a PXI automated test system. The edge device can send the data in real time to the virtual world (IT cloud platform) where it can be stored, monitored, and analyzed or trigger an action.

The value of the IIoT is not in the connectivity of the devices, but in what a company unlocks from the stream of data the smart devices supply. Cloud computing platforms and their services help provide this insight.

Many significant challenges need to be taken into account when implementing an IoT solution. Challenges such as standardization, interoperability, Big Analog Data™ handling, security, and privacy. It is important to be aware of these challenges and give special care to security. Security is a crucial component for any IoT application. IIoT devices should enforce a strong security policy and be updated regularly with the latest security patches. To learn more about best practices for security on CompactRIO and receive the latest security announcements from NI, visit ni.com/support/security. All cloud computing platforms securely send and receive data, use strong authentication and authorization methods, and use encryption. The majority also have audit capabilities.

Cloud Computing

Cloud computing refers to a flexible way of delivering hardware, software, or data resources via the network on a user's request. This is opposite to the use of running a software application on a local computer.



Cloud computing

Machine learning

Deep Learning Overview

Deep Learning is a mathematical method to find patterns and make decisions by training neural networks with large amounts of data to make decisions like is a part is detected? What is it? Is it “good” or “bad? Where it is located? The initial training will take time and many images, but the benefit is that the model you develop can be trained to make decisions in a variety of conditions without having to define the decision criteria.

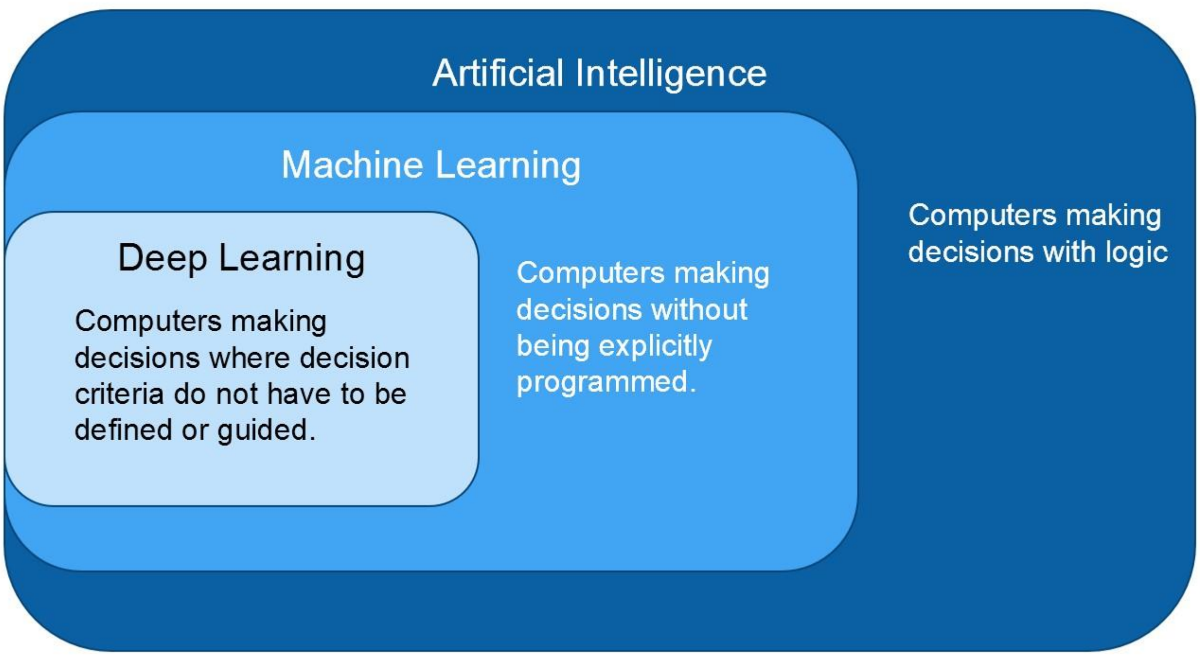


Figure 1: *Deep Learning is Subset of Machine Learning*

Machine vision tools already take advantage of Machine Learning. To understand the differences between Machine Learning and Deep Learning let’s think about an identification problem. On a production line you want to understand whether a finished part is ready to ship or if it has a defect. To do this, you might create a region of interest around the part, determine an ideal template (or several templates) and compare against them to determine a pass or fail. This method allows you to quickly perform a pass/fail inspection on a part where the parameters for "good" and "bad" can be limited by a region of interest and a template (or several templates). You did not explicitly program the parameters, but we are using the template to help the algorithm determine what features of the part are most important for determining a match.

With a deep learning approach, neural networks with multiple layers are used, each layer and neuron are analyzing subsets of the image -- attempting to find patterns for what makes the part "good" or "bad" and rather than comparing against a template, hundreds of labeled good and bad images are analyzed by the network and the decision criteria are determined during this training. As the network learns it will automatically define and weight the features of the image that are most important for making the decision.

There are many tools for training deep learning models. The Vision Development module currently supports TensorFlow-an open source tool from Google that helps develop Deep Learning Models for a variety of applications and requirements. The Vision Development Module helps you deploy these deep learning models on NI Hardware, so you can use the capabilities of LabVIEW to acquire the image, pass it to the model, and then interface with your inspection architecture or hardware based on the results. You can learn more about getting started with TensorFlow here.

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Using Deep Learning

Deep Learning is useful in vision applications when the pass or failure conditions are difficult to define, or the environmental complexity is high because of changing lighting or inspection orientations. Maybe there are slight variations in the parts that you want to inspect, or the location or orientation of the part could change image to image. In these cases, it would be worth the time and effort of generating and training a deep learning model to gain accurate insight. These insights can be divided into three categories:

Detection: Is the object present?
Classification: What is the object?
Segmentation: Where is the object?

When you are trying to gain this type of insight, the environment can get so complex that training deep learning algorithms to adapt to these changing conditions can save a large amount of development time and will be more accurate than machine vision tools like pattern matching. Plus, in some cases, building a model from scratch is not necessary. There are pre-built models available in the TensorFlow Model Zoo.

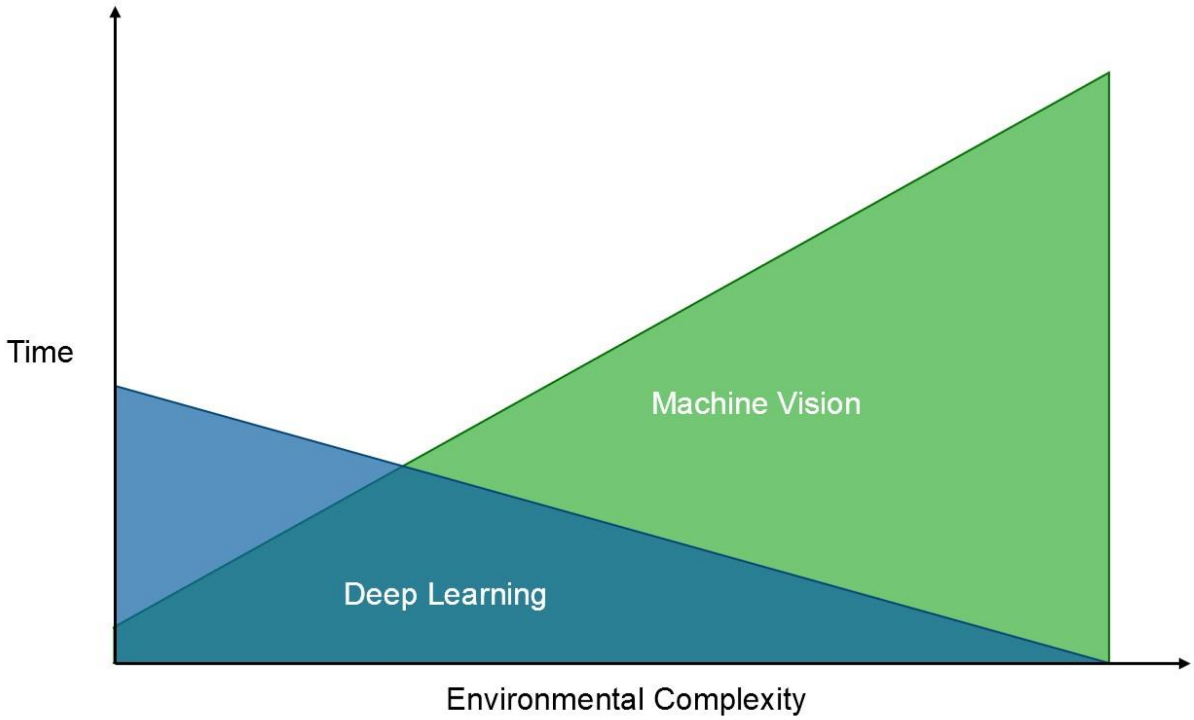

Figure 2: *Weighing Deep Learning Training Time over Machine Vision Development Time for Complex Problems*

Deep Learning requires training time and images (in many cases hours of training time over hundreds or thousands of images). If an object or feature can be quickly detected using a machine vision pattern matching algorithm, then machine vision is the right approach. However, when the complexity requires tens or hundreds of different templates or the environment cannot be controlled so that conditions like lighting or camera angle will not be constant then it will take more time to try to determine the features of the template that need to be highlighted in each situation. In these situations, using a Deep Learning model lets you analyze a previously un-analyzable image because of the complexity.

AS Aadhyaa Skills

Research & Development

Bio Medical Use cases

There are numerous applications of image analysis in the biomedical world, from microscopy to diagnostic imaging to motion analysis. LabVIEW plus NI's image acquisition tools and camera interface hardware make acquiring data from cameras simple. When combined with the specialized image analysis tools in the NI Vision Development Module, you can do some sophisticated image processing - and often all in real-time. Add the ability to synchronize measurements from other instruments and sensors with the video and you have a powerful programmable platform for performing research, developing a novel instrument or device, or the basis of a system for telemedicine or image-guided medical robotics.