



3D Machine Vision

3D machine vision is a fast and accurate technology used to capture physical details of an object. With the digitized 3D scan data, the dimensions of any object including; surface area, volume, and feature size can be extracted. Structured light is a method of 3D scanning where a series of patterns are projected upon an object and a camera or sensor detects distortions of the patterns. Image processing and triangulation algorithms then convert these distortions into a 3D point cloud, which can be used directly for analysis of the object or easily exported to a variety of CAD modeling formats

TI DLP technology enables programmable structured light designs for portable and high resolution applications. DLP systems can produce non-contact, highly accurate 3D data in real-time, facilitating 3D machine vision.

Features and Benefits

- **Fast, programmable pattern rates up to 32 kHz**
 - Acquire 3D scan data in real-time on moving objects.
 - Optimize scan speed and accuracy for multiple objects and environments using adaptive pattern sets.
- **Precise depth capture**
 - Achieve measurement accuracy to sub μm level.
- **Digital switching using reflective, reliable MEMS micromirrors**
 - Consistent performance over time and temperature with minimal sensitivity to color and environment.
- **Active illumination with LEDs, lasers, or lamps**
 - Multiple wavelengths for scanning a wide range of materials.
 - Enables strong low light performance.

DLP Solutions for 3D Machine Vision

DLP chipsets are available with different DMD (Digital Micromirror Device) sizes, pixel pitches, resolutions, and wavelength capabilities. The best choice for a DLP chipset can depend on the size of the scanning volume, pattern speed and system form factor. The table at the end of this document includes chipset offerings varying in resolution, speed and size. Higher resolution DMDs allow for a larger point cloud. High speed DMDs increase throughput with faster pattern speeds. Smaller DMDs allow for small form factor solutions.

Benefits for Integrators OEMs

- **Design Flexibility:** Address volume, resolution, and system size requirements with a wide range of DLP chipsets.
- **Application Breadth:** Ideal for use in factory automation, industrial robotics, medical and intraoral/dental scanning, industrial metrology, and biometrics.

Example Applications

- Factory automation
- Industrial robotics
- Medical imaging
- Dental scanning / intraoral scanning (IOS)
- Industrial metrology
- Biometrics

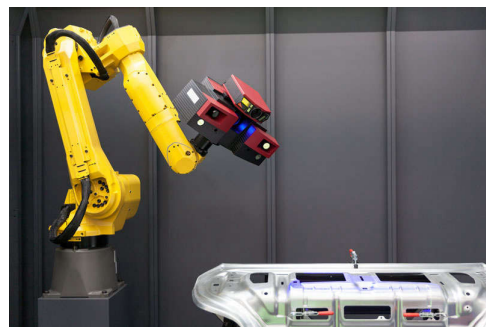


Figure 1. 3D Scanner Mounted on Robotic Arm

Evaluation Modules

Accelerate your design cycle by evaluating DLP technology with a broad selection of evaluation modules (EVMs). Our portfolio of EVMs offer a compelling combination of resolution, brightness, pattern speed, and programmability of DLP technology.

TI provides [free software and firmware downloads](#) allowing developers to easily create, store, and display high-speed pattern sequences through USB based application programming interface (API) and easy-to-use graphical user interface (GUI).

To find an EVM, visit:

[DLP® products design & development | TI.com](#)

System Block Diagram

The DLP solution for 3D machine vision is shown in the diagram. DLP technology enables 3D machine vision capabilities by providing single or multiple camera 3D image capture. The system utilizes a DMD as a spatial light modulator and a DMD controller to provide high-speed control of the micromirrors. TI LED drivers provide illumination for the DMD to project the image. From power management to embedded processors to support the system, TI's vast portfolio provides a complete system solution to create your ideal 3D machine vision design.

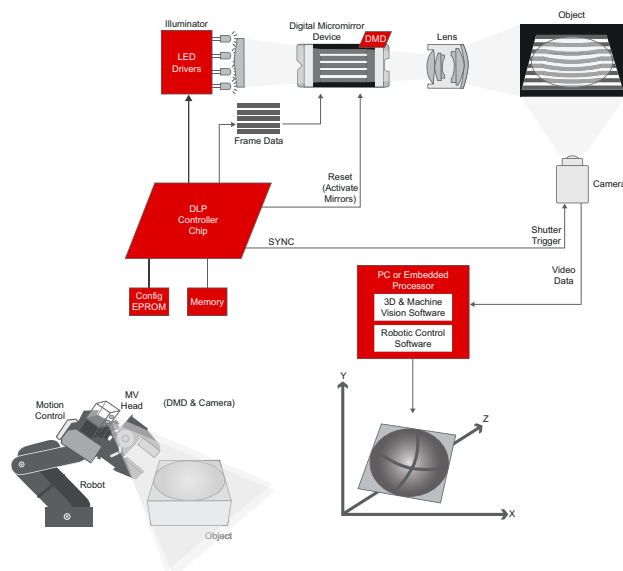


Figure 2. System Block Diagram

Reference Designs and Ecosystem Support

There are several reference designs and third party modules to empower developers with a framework to build accurate 3D scanners and 3D machine vision systems. Reference designs include schematics, block diagrams, bills of materials, design files, software, and test reports. The reference designs and third party modules range from projection subsystems to full 3D scanner designs.

To learn more, visit [Advanced Light Control Reference Designs](#), [Explore Our Third-Party Solution Providers](#), and [Optical Module Maker Search Tool](#).

Table 1. DLP Chipsets for 3D Machine Vision

Product or Part number	Operating Wavelength	Micromirror Array Size	Pattern Rate, Binary (max) (Hz)	Array Diagonal (in)	Controller Part Number	EVM
DLP2010LC	Visible	854 x 480	2487	0.2	DLPC3470	BENANO-3P-C2100
DLP3010LC	Visible	1280 x 720	2487	0.3	DLPC3478	DLP3010EVM-LC
DLP4500NIR	Infrared	912 x 1140	4225	0.45	DLPC350	DLPNIRSCANEV M
DLP4500	Visible	912 x 1140	4225	0.45	DLPC350	DLPLCR4500EVM
DLP4710LC	Visible	1920 x 1080	2487	0.47	DLPC3479	DLP4710EVM-LC
DLP5500	Visible	1024 x 768	5000	0.55	DLPC200	DLPLCR55EVM
DLP650LNIR	Infrared	1280 x 800	12500	0.65	DLPC410	DLPNIRSCANEV M
DLP6500FLQ	Near-UV	1920 x 1080	11574	0.65	DLPC900	DLPLCR65NEVM
DLP6500FYE	Visible	1920 x 1080	11574	0.65	DLPC910	DLPLCR65EVM
DLP670S	Visible	2716 x 1600	9523	0.67	DLPC900	DLPLCR67EVM,
DLP7000	Near-UV	1024 x 768	32552	0.7	DLPC410	DLPLCR70EVM,
DLP9000X	Near-UV	2560 x 1600	14989	0.9	DLPC910	DLPLCR90XEVM
DLP9000	Near-UV	2560 x 1600	9523	0.9	DLPC900	DLPLCRC900DE VM
DLP9500	Near-UV	1920 x 1080	23148	0.95	DLPC410	DLPLCR95EVM

Feature	DLP Structured Light	Laser Scanning	Stereo Vision
Pattern Rate	Up to 32kHz	Low	N/A
Accuracy	Sub-micron	High	Low
Flexibility	User-programmable by software	Limited (Fixed Hardware)	Limited (post-processing)
Form Factor	Compact to large	Large	Compact

* Prestored patterns are column-repeat or row-repeat (1D) patterns

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