Highly Scalable TI DLP Technology for 3D Machine Vision

3D Machine Vision

3D machine vision is a fast and accurate optical technique 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. The point cloud 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 solutions 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.

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).
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.

Table 1. DLP Chipsets for 3D Machine Vision

<table>
<thead>
<tr>
<th>Digital Micromirror Device (DMD)</th>
<th>Micromirror Array Size</th>
<th># of Pixels (MP)</th>
<th># of Prestored Patterns</th>
<th>Max Pattern Rate (Prestored Patterns) (Hz)</th>
<th>Controller Part Number</th>
<th>Evaluation Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLP2010NIR</td>
<td>854 × 480</td>
<td>0.41</td>
<td>64*</td>
<td>2487 272</td>
<td>DLPC3470</td>
<td>DLPC3470</td>
</tr>
<tr>
<td>DLP2010LC</td>
<td>854 × 480</td>
<td>0.41</td>
<td>64*</td>
<td>2487 272</td>
<td>DLPC3470</td>
<td>DLPC2010EVM-LC</td>
</tr>
<tr>
<td>DLP3010LC</td>
<td>1280 × 720</td>
<td>0.92</td>
<td>51-64*</td>
<td>2487 272</td>
<td>DLPC3478</td>
<td>DLPC3010EVM-LC</td>
</tr>
<tr>
<td>DLP4950</td>
<td>912 × 1140</td>
<td>1.04</td>
<td>48 6</td>
<td>4225 120</td>
<td>DLPC350</td>
<td>DLPLCR4500EVM</td>
</tr>
<tr>
<td>DLP4710LC</td>
<td>1920 × 1080</td>
<td>2.07</td>
<td>60-64*</td>
<td>2500 437</td>
<td>DLPC3479× 2</td>
<td>DLPC4710EVM-LC</td>
</tr>
<tr>
<td>DLP5500</td>
<td>1024 × 768</td>
<td>0.79</td>
<td>960 120</td>
<td>5000 500</td>
<td>DLPC200</td>
<td>DLPC200</td>
</tr>
<tr>
<td>DLP6500</td>
<td>1920 × 1080</td>
<td>2.07</td>
<td>400 50</td>
<td>11574 1446</td>
<td>DLPC900</td>
<td>DLPLCR65EVM</td>
</tr>
<tr>
<td>DLP7000</td>
<td>1024 × 768</td>
<td>0.79</td>
<td>N/A</td>
<td>32552 4069 2034</td>
<td>DLPC410</td>
<td>DLPLCR70EVM</td>
</tr>
<tr>
<td>DLP5000YX</td>
<td>2048 × 1200</td>
<td>2.46</td>
<td>800 100 50</td>
<td>16100 2016 1008</td>
<td>DLPC900× 2</td>
<td>DLPLCR50XEVMM</td>
</tr>
<tr>
<td>DLP670S</td>
<td>2716 × 1600</td>
<td>4.35</td>
<td>400 50</td>
<td>9523 1190</td>
<td>DLPC900× 2</td>
<td>DLPLCR67EVM</td>
</tr>
</tbody>
</table>

* Prestored patterns are column-repeat or row-repeat (1D) patterns
IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (https:www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2021, Texas Instruments Incorporated