Notification about the transfer of the semiconductor business

The semiconductor business of Panasonic Corporation will be transferred on September 1, 2020 to Nuvoton Technology Corporation (hereinafter referred to as "Nuvoton"). Accordingly, Panasonic Semiconductor Solutions Co., Ltd. will come under the umbrella of the Nuvoton Group, with the new name of Nuvoton Technology Corporation Japan (hereinafter referred to as "NTCJ").

In accordance with this transfer, semiconductor products will be handled as NTCJ-made products after September 1, 2020. However, such products will be continuously sold through Panasonic Corporation.

Publisher of this Document is NTCJ.
If you would find description “Panasonic” or “Panasonic semiconductor solutions”, please replace it with NTCJ.
※ Except below description page
“Request for your special attention and precautions in using the technical information and semiconductors described in this book”

Nuvoton Technology Corporation Japan
3D sensing technology for smart space

Panasonic Semiconductor Solutions Co., Ltd.

The product is under development. Product specifications described in this document are subject to change without notice for modification and/or improvement.
3D Sensing Technologies

NIR Light Source

Area Sensor

Object

Ranging Area

*NIR: Near Infra-Red

NIR Light Source

Illuminated Light

Reflected Light

Solid State Active Ranging Technology

Ranging

Light

Active

Passive

Stereo/Multi Vision

Scan-Lidar

Confocal

Sonar

Waves

Mechanical

Time Counting

Solid State LiDAR

Signals Ratio

Direct TOF

Indirect TOF

Triangulation

Time-Of-Flight

Structured Light

Light-cutting

*NIR: Near Infra-Red
### Feature comparison of ranging methods

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<tr>
<td><strong>Depth</strong></td>
<td>Ranging pixel~20um</td>
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<td>~ several thousands</td>
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<td><strong>Light resistance</strong></td>
<td>~ tens of thousands lx</td>
<td>~ hundreds of thousands lx</td>
<td>~ hundreds of thousands lx</td>
</tr>
</tbody>
</table>

*1 DOE : Diffractive Optical Element  
*2 SPAD : Single Photon Avalanche Diode  
*3 TDC : Time to Digital Converter

\[
Z = \frac{F \times D}{p \times n}
\]

\[
Z = \frac{C_0 \cdot T_P}{2} \cdot \left( \frac{A_1}{A_0 + A_1} \right)
\]

\[
Z = \frac{C_0}{2} (t_1 - t_0)
\]

Ranging pixel ~100um
Our Target applications

Information density, Light resistance + Depth accuracy

- Biometrics
- Skeleton detection
- State detection
- Action estimation
- Spatial recognition
- Obstacle detection

Indirect TOF (PSCS method)

Structured Light

Distance Z [m]

Direct TOF

Accuray (σ)

0.1 1 10 100
Introduction of Imaging LiDAR
(Under Development)
Sensing ambient space information for autonomous control in smart mobility

**Concept of Imaging LiDAR**

- **Sensing**
- **Detection data**
- **Meta data creation**

**Getting 2D, 3D image**
*without parallax and time lag*

- **3D data (Depth)**
- **2D data (BW, IR)**

**Mecha-less structure**
*Flash emission synchronized with sensing device*

**Performance complemented by AI**
*Interpolation technology of missing depth info by learning BW / IR / Depth data*

**Detailed understanding of objects**
*Object recognition using high density data*
- Object: Pole / chain, curb, white line, electric pole etc.

Panasonic Semiconductor Solutions Co., Ltd
Application example 1: **AGV** Carton size measurement/Autonomous driving/Storage

Carton size measurement

Passage

Recognize storage location

Box width: 29.3cm, Thick = 25.0cm, Height = 26.4cm
Application example 1: AGV Carton size measurement/Autonomous driving/Storage

Carton size measurement

Passage

Recognize storage location
Application example 1: AGV Carton size measurement/Autonomous driving/Storage

Carton size measurement

Passage

Recognize storage location
Application example 2: Drone Detecting people and locations at night (<1lx)

Depth image/
Human detection
※Photography in dark indoors

Top View
Counting the number of people

✓ Installation Conditions:
  Height 2.7m
  Angle of depression 20°
✓ Measurement environment:
  Dark Indoors 0.2Lx
Provide ease-of-use and value by metadata

**User**

**Industrial/FA Customers**

- Big Data
- Visualization
- Human friendly

**Value Creation**

**Device Supply**

**Provider**

**Sensing**

- Depth sensor

**Living/Logistics/mobility customers**

- Big Data
- Providing Meta data
  - State/Behavior/Emotion

**Intelligent sensing**

- Depth sensor
- General SoC+AI
- Specialized knowhow

**Know-how**

- Providing RAW Data
  - RGB/NIR/Depth

**User**

**Device Supply**

**Provider**

**Value Creation**

**Indusrtial/FA Customers**

- Big Data
- Visualization
- Human friendly

**Living/Logistics/mobility customers**

- Big Data
- Providing Meta data
  - State/Behavior/Emotion

**Intelligent sensing**

- Depth sensor
- General SoC+AI
- Specialized knowhow
Thank you

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