VULKAN APPLICATION
TENTATIVE IDEA

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Vulkan Application

- As a kind of computer graphic API, like OpenGL, Vulkan widely used in 3D animation, 3D game, and 3D movie field
- Indeed, Vulkan has updated many of OpenGL’s capabilities
- Furthermore, compared to OpenGL, Vulkan has greater advantages in HMI (Human-Machine Interface) application

3D HMI System

- HMI means Human-Machine Interface
- A branch of computer graphic
- Monitor and control the machine actions
- Continuous collection of signal values

Figure 1. ROCKWELL HMI

HMI System Configuration in Plant

- HMI system is the “face” of an industrial production line
- Deal with a lot of input and output signals at the same time
- A developed HMI system can be the communication center station among Main PLC, L2 Computer, and Signal Machine PLCs

Figure 2. NIPPON Steel Project
Platform of 3D HMI

- Vulkan API can be used between GPU and 3D HMI application software.
- Compared to OpenGL API:
  1. Vulkan is designed for Multithreading.
  2. Vulkan uses Graphics Pipeline for "State" preset.
  3. Vulkan need much less user hand holding.
  4. Vulkan never "LOCK".
- Vulkan API is ideal for application software which has heavy load of signals input and output.

Figure 3. SIEMENS HMI

**gl_Vetex gotten from Real World**

<table>
<thead>
<tr>
<th>Item (e.g.)</th>
<th>Image (Sample)</th>
<th>Mechanical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller</td>
<td><img src="Sample" alt="Roller" /></td>
<td>Display the machine sizes and positions accurately on HMI screen.</td>
</tr>
<tr>
<td>Solution Tank</td>
<td><img src="Sample" alt="Solution Tank" /></td>
<td>Tracing the welding-point position.</td>
</tr>
<tr>
<td>Edge Mask</td>
<td><img src="Sample" alt="Edge Mask" /></td>
<td>Detail values of machine size and position can get from process designers.</td>
</tr>
<tr>
<td>Rectifier</td>
<td><img src="Sample" alt="Rectifier" /></td>
<td></td>
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<tr>
<td>Pipe</td>
<td><img src="Sample" alt="Pipe" /></td>
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</tbody>
</table>

Shader Task 1

- Display the position change:
  - Limit Switches
  - Continue Move (Motor Speed)
- Mechanical actions are simple movements:
  - Forward/Backward
  - Open/Close
  - Up/Down
  - Rotation

Shader Task 2

- Display the solution concentration distribution
- Analog signals need be traced and recorded
- The changing analog signals will be shown to operators in real-time

Water

*Medicine*?

Pump

LT: Level Signal Transmitter
TT: Temperature Signal Transmitter
CT: Concentration Signal Transmitter
Shader Task 3

- Display the temperature distribution

- Temperature distribution in the 3D space inside the furnace will influence the shape of steel strip which is passing inside the furnace.

Sealed Furnace
TT: Temperature Signal Transmitter

Shader Task 4

- Display temporary test calculation

- Sometimes, temporary calculations need to be programmed on HMI platform and only show the results on HMI screens.
- And, these test calculations must work independently without bothering the normal PLC signal communication.

Test Calculation

Shader Task 5

- Display trending curves

- What happened in the specific timing?
- That is why we need Vulkan API to communicate with GPU.

Precise Timing

Thank you!