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="image1.png" alt="Roller Image" /></td>
<td>• Display the machine sizes and positions accurately on HMI screen</td>
</tr>
<tr>
<td>Solution Tank</td>
<td><img src="image2.png" alt="Solution Tank Image" /></td>
<td>• Tracing the welding-point position.</td>
</tr>
<tr>
<td>Edge Mask</td>
<td><img src="image3.png" alt="Edge Mask Image" /></td>
<td>• Detail values of machine size and position can get from process designers.</td>
</tr>
<tr>
<td>Rectifier</td>
<td><img src="image4.png" alt="Rectifier Image" /></td>
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<tr>
<td>Pipe</td>
<td><img src="image5.png" alt="Pipe Image" /></td>
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</tbody>
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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 to be traced and recorded
- The changing analog signals will be shown to operators in real-time

P: 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 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
Shader Task 5

- Display trending curves
- What happened in the specific timing?
- That is why need Vulkan API communicate with GPU

Thank you!