

## Overview

**TES 3D Surround View (TSV)** is the latest technology of driver assistance systems with vehicle cameras. Designed to increase safety and comfort through improved situation awareness it supports the principle of accident avoidance. TSV meets the rising demand for a simple and robust system for automotive, industrial and safety markets.

The **TSV** technology is offered as software component (Library) for various embedded platforms and operation systems.

By enabling the use of modern standard 3D acceleration GPUs it provides a high level of performance and portability while minimizing system resources usage, in particular CPU load. It utilizes the generic industry proven OpenGL (ES) API for main rendering tasks and adapts easily to a range of hardware platforms.

Besides the well known Top View or Bird View, i.e. a single viewing perspective from exactly above the vehicle, **TSV** supports any viewer position and viewing angle from outside of the vehicle, i.e. full 360° Surround View. The viewing position can be changed on the fly or any number of predefined viewing positions is possible.



**TSV** builds on years of experience in surround view technology and offers a very high level of flexibility and customizability to cope with specific application and system requirements often found in special vehicle applications such as construction machines.

Designed for integration in modern embedded real-time video processing systems and providing well defined interfaces it integrates easily within the customers software system, e.g. from video input and application layer point of view. The multi-platform architecture allows porting to any operating system.

**TSV** is highly efficient and supports a wide range of video input options, from analog (CVBS) through digital and network connected cameras.

## Technology Details

### System Features

- Almost completely GPU based
  - No CPU load in steady state
  - Only minimal usage of CPU while switching view
  - Easily integrates into existing products where the GPU is underused
- Multi-threaded operation
  - Separate thread for **TSV** Core

- Separated memory
- Asynchronous operation
- Eliminates unnecessary screen redraws
- Scalability and portability throughout the entire design
  - OS agnostic
  - Scales from single-core embedded CPU to multi-core Desktop PC
  - Adapts the graphics quality to available resources
- Bandwidth reduction techniques
  - Uses hardware extensions to avoid data copying
  - Optimized for low throughput DDR memory
- Layered structure
  - Allows integration of any video source
  - Provides interface for external sensors

### Rendering

- Takes advantage of OpenGL (ES) 2.0 rendering features
- High render quality
  - Texture filtering
  - High polygon count
  - High definition camera support
  - Seamless stitching through quality blending
- Dynamic environment model, changeable on-the-fly
- Animated and freely adjustable observer positions
- Freely exchangeable 3D vehicle model

### Integration

- Low resource consumption
- No window system required
- Small **TSV** Core library written in C
- Reference **TSV** Demo and Evaluation Application based on **TSV** Core as with application source code in C++
- HMI independent architecture
- Camera system agnostic
- No limit on camera count (within platform resource constraints)

### Resource Usage

The actual resource usage of **TSV** depends highly on the camera and display systems used and the 3D model complexity.

A typical example includes:

#### **Case 1**

*TSV with 4 IP MJPEG cameras, combined 80Mbit data rate @30 fps and 1Mpx resolution. Low polygon car model, 1280x1024 screen resolution at 60Hz refresh rate. Implemented on i.MX6 Quad.*

- **GPU Usage**
  - 3-6 GFlops (proportional to pixel amount depicted on screen)
- **RAM Bandwidth**
  - 4\* 2 MB/s Read/Write (4 cameras MJPEG data)
  - 4\* 45 MB/s Read/Write (4 cameras RAW data)
  - 120 MB/s Write, 240Mb/s Read (frame buffer & display)
  - **300 MB/s Write, 420MB/s Read in TOTAL**
- **RAM Consumption**
  - 4\* 10 MB for camera data buffers
  - 2 MB for 3D environment and car model
  - 18 MB for camera video textures
  - **60 MB in TOTAL**

### **Case 2**

*TSV with 4 analog cameras, PAL resolution @30 fps. Low polygon car model. 800x480 screen resolution at 50Hz refresh rate.*

*Implemented on i.MX6 Solo*

- **GPU Usage**
  - 3-6 GFlops (Proportional to pixel amount depicted on screen )
- **RAM Bandwidth**
  - 4\* 15 MB/s Read/Write (4 cameras RAW data)
  - 45 MB/s Write, 73Mb/s Read (frame buffer & display)
  - **105 MB/s Write, 133 MB/s Read in TOTAL**
- **RAM Consumption**
  - 2 MB for 3D environment and car model
  - 4 MB for camera video textures
  - **6 MB in TOTAL**

## **Sales & Marketing Contact**

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