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Review On 3D Image Generation Using Interpolation and Triangulation Methods on ARM-9 Processor Based Single Board Computer Platform

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Abstract:

In this modern world of technology, now a day people widely use microprocessor rather than microcontroller because microcontroller becoming more complex circuitry to build applications [1]. As arm-9 runs at 400MHz frequency, it is much faster than any other microcontroller and also have high speed data transfer rate.

Now a day people using many applications on their android, ios, windows based OS phones. It is also being a madly craze to capture images and giving extra effects to those images using many different applications available for OS(operating system). One such effect called "3D effect" widely used now a day by people. Hence to support such extra effects and high definition images, CMOS Camera (OV9650) is none other than a best option to use for capturing images.

Android is popular with technology companies who require a ready-made, low-cost, customizable and lightweight operating system for high tech devices. Despite being primarily designed for phones and tablets, it also has been used in televisions, games consoles, digital cameras and other electronics. Also linux which is real time operating system is being used in embedded system to run such type of application based on image.

Hence based on above two idea a novel approach has been developed for generation of application which convert 2D image into 3D image based on ARM-9 development board- SBC2440, by installing OS in ARM-9 board. Then interface CMOS VGA/Higher version camera with SBC 2440 and capture images.

Key words: Image, ARM-9 Processor, Interpolation, Triangulation, Operating System (Android & Linux), CMOS Camera, Installation, Interfacing.

I. Introduction

An image (from Latin: imago) is an artifact that depicts or records visual perception, for example a two-dimensional picture, that has a similar appearance to some subject – usually a physical object or a person, thus providing a depiction of it[9]. Images may be two-dimensional, such as a photograph, screen display, and as well as a three-dimensional, such as a statue or hologram.

A digital image is a numeric representation (normally binary) of a two-dimensional image. Depending on whether the image resolution is fixed, it may be of vector or raster type.

Without qualifications, the term "digital image" usually refers to raster images also called bitmap images.

Raster images have a finite set of digital values called picture, elements or pixels. The digital image contains a fixed number of rows and columns of pixels. Pixels are the smallest individual element in an image, holding quantized values that represent the brightness of a given color at any specific point.

Vector images resulted from mathematical geometry (vector). In mathematical terms, a vector consists of point that has both direction and length. Often, both raster and vector elements will be combined in one image; for example, in the case of a billboard with text (vector) and photographs (raster).

1.1. Interpolation

Image interpolation is an important image processing operation applied in diverse areas ranging from computer graphics, rendering, editing, medical image reconstruction, to online image viewing. Image interpolation techniques are referred in literature by many terminologies, such as image resizing, image re-sampling, digital zooming, image magnification or enhancement, etc[5]. Basically, an image interpolation algorithm is used to convert an image from one resolution (dimension) to another resolution without loosing the visual content in the picture.

1.2. Triangulation

The basic idea of the algorithm is that a triangle meeting the conditions has been generated firstly, and then the points satisfying the conditions have been found in different directions based on each edge.

A new triangle will be generated and all the points will be covered based on a new triangle to around.

The key of algorithm is the growth of each new triangle. While the key of the growth of triangle is expanding on each side, which is concentrated in points, looking for a qualified point and a new triangle is created this point.

1.3. ARM-9 Processor

ARM9 is an ARM architecture 32-bit RISC CPU family. With this design generation, ARM moved from a von Neumann-architecture (Princeton architecture) to a Harvard architecture with separate instruction and data buses (and caches), significantly increasing its potential speed. Most silicon chips integrating these cores will package them as modified Harvard architecture chips, combining the two address buses on the other side of separated CPU caches and tightly coupled memories.

There are two subfamilies, implementing different ARM architecture versions.

1.4. Key Improvements Over ARM-7

Decreased heat production and lower overheating risk.

Clock frequency improvements.

Shifting from a three-stage pipeline to a five-stage one lets the clock speed be approximately doubled, on the same silicon fabrication process.

Cycle count improvements. Many unmodified ARM7 binaries were measured as taking about 30% fewer cycles to execute on ARM9 core.

Faster loads and stores; many instructions now cost just one cycle. This is helped by both the modified Harvard architecture (reducing bus and cache contention) and the new pipeline stages.

2. Software

- **Android**

Android is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers. Initially developed by Android, which Google backed financially and later bought in 2005, Android was unveiled in 2007 along with the founding of the Open Handset Alliance a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. The first Android-powered phone was sold in October 2008.

- **Linux**

Linux was originally developed as a free operating system for Intel x86-based personal computers. It has since been ported to more computer hardware platforms than any other operating system. It is a leading operating system on servers and other big iron systems such as mainframe computers and supercomputers.

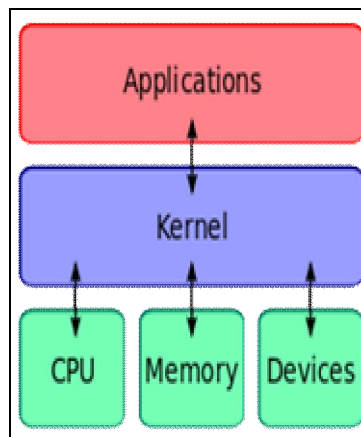


Figure 1: Kernel Supportive System

- **Kernel**

In computing, the kernel is a computer program that manages input/output requests from software and translates them into data processing instructions for the central processing unit and other electronic components of a computer. The kernel is a fundamental part of a modern computer's operating system. When a computer program (in this case called a process) makes requests of the kernel, the request is called a system call. Various kernel designs differ in how they manage system calls (time-sharing) and resources. For example, a monolithic kernel executes all the operating system instructions in the same address space to improve the performance of the system. A microkernel runs most of the operating system's background process in user space, to make the operating system more modular and, therefore, easier to maintain.

3. CMOS Camera

Comparing with traditional CCD image sensor, CMOS image sensors using CMOS technology can integrate the pixel array and peripheral circuits (such as the image sensor core, single-clock, all the sequential logic, programmable functions and A / D converter) in a chip, with a small size, light weight, low power consumption, programming convenience, easy to control and so on. Embedded Linux is a better embedded operation system, which has portable, strong network function and excellent GNU compile tools as well as free open source characters. S3C2410 is a 32 bits embedded processor that based on an ARM920T core with integrated MMU and abundant internal resources. Because of low cost, high performance and the Video4linux (short for V4L) support on Linux program, CMOS camera is easy to integrate to embedded system.

Complementary-metal-oxide semiconductor (CMOS) is a technology for constructing integrated circuits. CMOS technology is used in microprocessors, microcontrollers, static RAM and other digital logic circuits. CMOS technology is also used for several analog circuits such as image sensors (CMOS sensor), data converters, and, highly, integrated transceivers for many types of communication. Frank Wanlass patented CMOS in 1963 (US patent 3,356,858).

An image sensor is a device that converts an optical image into an electronic signal. It is used mostly in digital cameras, camera modules and other imaging devices. Early analog sensors were video camera tubes; most currently used are digital charge-coupled device (CCD) or complementary metal-oxide-semiconductor (CMOS) active pixel sensors.

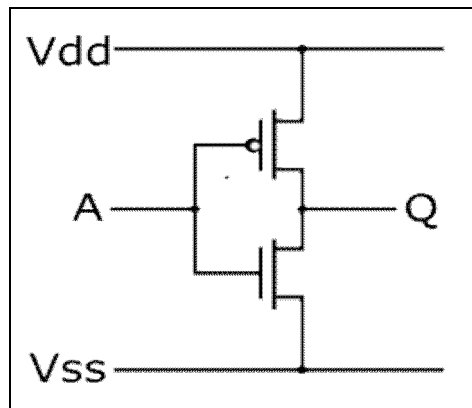


Figure 2: CMOS Sensor

4. Result

- **Installation of Operating System**

This is the setup picture of ARM-9 processor

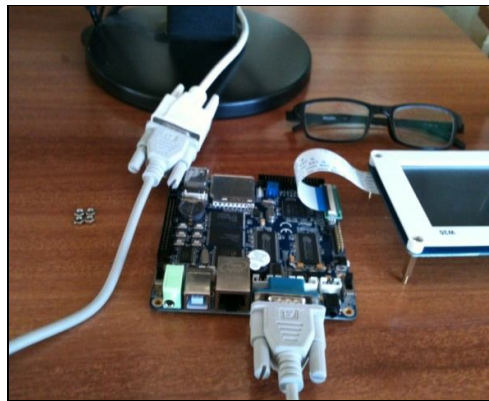


Figure 3: Setup of Arm-9 Processor

- **Android installation**

First put the memory switch into bios mode, then open DNW window > serial port > connect

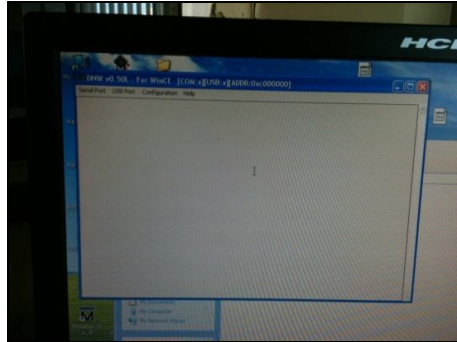


Figure 4: DNW Window Before Connection

and then switch on power supply of SBC2440

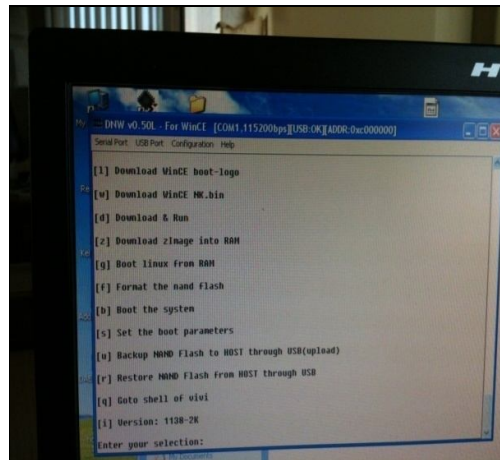


Figure 5: DNW Window After Power On

Now upload kernel by pressing 'k' followed by transmitting zImage file.

Also Upload the yaffs file style using "y" on terminal, and upload from dnw the "mini2440T35_android.img".

Last step, upload the supervivi for android to make them available at boot time using "v" command and upload the "supervivi-128M" via dnw tool.

This is the result.



Figure 6: Android Installed

- **Linux Installation**

Now for linux operating system we have to forward zImage_W35, filesystem yaffs2_file & vboot. To do those recompilation of the kernel, i'm using virtual machines running ubuntu on windows. The windows still needed to upload the binary image files using windows tool. To make the Ubuntu available for developing kernel install as follow:

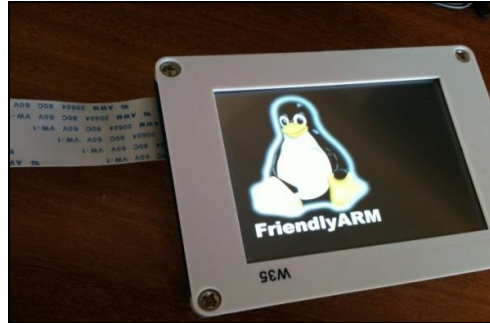


Figure 7: Linux installed

Now interface a camera we get image on screen.



Figure 8: Image Captured

5. Conclusion

Successfully by doing this literature, OS have installed into processor and then image was generated by interfacing CMOS camera on it. Hence now image have been captured, then by processing that image and carry out data points. Now use those points, to generate a resized and clear 3D image by interpolation algorithm & triangulation method.

6. Future Scope

The work done in this phase will be extended in application programming based on two methods:

- Interpolation algorithms
- Triangulation method

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