Introduction

In 2009, there were some leading manufactories have released their pico projectors into the consumer electronics market (Figure-1). These pico projectors are pocket size and well developed by some application specific integrated circuit (ASIC) image processors. They mainly used for entertaining purposes. On the other hand, use the ARM processor is an alternative way to develop the pico projector. The ARM-based pico projector can easily be integrated into other ARM-based products (eg, Smartphone and Pocket Video Players).

Aims and Objectives

This project aims to implement a prototype of pico projector under the ARM9 development platform. The ARM920T processor embedded with Linux Kernel 2.6.29. The Liquid Crystal On Silicon (LCOS) panel (Figure-2) is directly connected to the LCD Controller of the ARM920T processor. The projection images were transmitted to the LCOS panel from the Linux Framebuffer.

There are the main objectives of this project:
1) To transmit images data to the LCOS panel in 50 MHz Pixel Clock and 120 Hz Frame Rate by the ARM920T processor.
2) Support DC transformer or Li-Ion battery as voltage supply.
3) Embedded with Graphical User Interface (GUI) (eg, Qtopia).
4) Support SD card input.
5) Support BMP, JPG and MPEG files input.
6) Interact with the projection images by mouse or touch screen.

Methodology

As showing in Figure-3, the input power source can use either DC transformer or battery. The Power Management Module steps up and steps down the input power source to appropriate voltages by switching topologies. The LCOS Panel is connected to the LCD Controller of the ARM9 Development Board. The display images will form on the LCOS panel continuously. They will be projected onto the flat object by the Optical Engine Module. Users can interact with the projection images by a finger touch screen or mouse. The ARM9 Development Board supports SD card input for displaying the photo and video files.

On the other hand, the framebuffer is an abstraction for the graphic hardware. All display images will be transferred into the framebuffer. Then the framebuffer will transmit the display images to the LCOS panel under the well-defined clocks signals.

Results

The advantages of the ARM-based Pico Projector:
1) Easy for advanced development of a design (eg, Improve to 1024x786 LCOS panel or MIPI interface), only need to change the definitions of a new hardware to the framebuffer by rebuilding the Linux Kernel. Do not need to change a new image processor.
2) Enable to embed a GUI (eg, Qtopia, WinCE or Android).
3) Embedded with Graphical User Interface (GUI).
4) Support SD card input.
5) Support BMP, JPG and MPEG files input.
6) Interact with the projection images by mouse or touch screen.

The disadvantages of the ARM-based Pico Projector:
1) The circuit board is more complex.
2) Support DC transformer or Li-Ion battery as voltage supply.
3) Embedded with Graphical User Interface (GUI).