



Portable Desktop Magnifier

Introduction

This case study showcases Mistral's expertise in providing product design services in the consumer electronics market. Mistral was approached by a leading Original Device Manufacturer (ODM) that specializes in providing highly intuitive and intelligent technology solutions for people with visual impairments. Mistral's concept-to-deployment design and engineering services helped in realizing the customer's vision of the product and bringing it quickly to the market.



“ The handheld unit is used to capture images when the user is on the move and can be docked to a custom desktop with HDMI display to provide magnification ”

The Customer

The customer is a company providing technology enabled products that aims to empower people with visual impairment. The company's key aim is to: provide customers with greater independence through technology.

The Requirement

The customer approached Mistral to design, implement and develop the portable (handheld) entity of the Portable Desktop Magnifier. The handheld unit, in addition to other smart functionalities like location provision using GPS and Internet access using Wi-Fi, would be used to capture images that need magnification when the user is on the move. It can then be docked to a custom desktop, (developed by the customer) to provide magnification. On docking the handheld unit to the desktop, the handheld unit would drive the HDMI display of the desktop, providing the user with a high resolution display of the data captured using the handheld unit.

Solution Provided

Mistral has provided design support during the entire development cycle of the product: from design to production. This includes: hardware design, porting of Linux and Android for the hardware, middleware development, product qualification and production support.

The product is based on Texas Instruments OMAP4460 SoC. The initial design and development was done around a reference platform, the OMAP4460 Pandaboard. Mistral used this development platform as a reference design, customized and designed a small form-factor prototype and developed the entire solution to meet this requirement.

The team at Mistral assessed the product through independent verification and validation across different stages of the product development including pre-certification tests and FCC Class B pre-qualification tests. The Mistral engineering team also integrated third party software to support the on-board camera interfaces on the handheld unit.

The Challenges

- ▶ **Display with LCD:** The LCD panel used SPI for initialization and this called for many non-standard configurations in order to bring up the support for display with LCD.

- ▶ **Peripheral Boot:** In order to maintain the device cost requirements, it was decided that the device would involve only one storage medium - a Micro SDXC card. In conventional Android devices, there is a non-removable storage media (for the firmware) and a removable Micro SD card. The removable Micro SD card is used to program system software to the non-removable media during production or recover the system in a failure scenario.

In this case, since the Micro SD card was concealed and not removable, programming the device during production was a challenge. OMAP's peripheral boot feature was used to initialize and program the firmware into the device. Peripheral boot involves downloading the firmware binary images from a Host PC over the USB interface and then programming it to the Micro SD on the device. If the software on the device gets corrupted, this also serves as the recovery mechanism.

- ▶ **Media and firmware on same device:** In conventional Android devices, there is a non-removable storage media (for the firmware) and a removable Micro SD card for Media (Music, Videos, images captured from Camera). With only one storage device in this design, part of the Micro SD card had to be dedicated for Media files. This called for making changes in Android to detect the Media partition and initialize it with VFAT file system during system initialization and programming.
- ▶ **Dual display with LCD and HDMI:** When the handheld unit is docked to the desktop unit, the system needs to switch the active displays - from LCD on the handheld to the HDMI on the desktop. Existing solutions on the OMAP4460 platform did not support this in an efficient way. Mistral's engineering team had to bring in significant changes to Android HAL to ensure proper switching between LCD and HDMI displays.
- ▶ **Firmware Upgrade OTA:** The Wi-Fi enabled handheld device can download a firmware upgrade package and apply it to the system. Android provides a platform for performing firmware upgrade using Over-the-Air (update package downloaded over Wi-Fi), which was ported for the handheld platform.

- ▶ **Fuel Gauge Calibration:** The device uses a built-in fuel gauge present on the Power Management IC (PMIC). The capabilities of the fuel gauge are limited and using an external, more capable fuel gauge was ruled out in order to meet the device cost. Supporting all Android events for battery monitoring called for making significant changes in the battery device driver.
- ▶ **Power Management:** As the handheld device is battery-powered, power management was a critical requirement. The OMAP4 Linux kernel provides a basic interface for power management and this was ported to the system. Mistral engineering team worked closely with the silicon provider (TI) to address low level issues related to power management and system stability.

Key Achievements

- ▶ Obtaining a battery life of 100 hours with the handheld device in standby mode and 4 hours with the handheld in continuous operational mode (with both cameras active) highlights the effectiveness of the power management
- ▶ Cleared the EMI/EMC tests specified by FCC in the first design run
- ▶ Switching off the display from LCD on the handheld to the 1080p HDMI on the desktop when the handheld device is docked to the desktop
- ▶ Integration of multiple rigid, flexi and rigi-flex PCBs into the design.

Customer Benefits

- ▶ **Reuse:** Using OMAP4 Pandaboard as the base platform for initial design facilitated in bringing up a prototype quickly, which in turn enabled early software development and testing.
- ▶ **Quicker time-to-market:** Mistral's engineering team has vast experience in power management and embedded product development; this saved valuable development time facilitating quicker time-to-market value for the customer.
- ▶ **End-to-end product development:** Mistral being a single source for hardware and software expertise allowed the client to obtain a complete end-to-end solution with a fast turnaround. This helped the customer by preventing co-ordination with and between multiple vendors and helped immensely in getting the product to market faster.



Mistral Solutions Pvt. Ltd.,
No.60, 'Adarsh Regent',
100 Ft. Ring Road,
Domlur Extension, Bangalore - 560 071
Tel: +91-80-3091-2600
Fax: +91-80-2535-6440
E-mail: info@mistralsolutions.com

Mistral Solutions Inc.,
4633 Old Ironsides Drive,
Suite 410,
Santa Clara, CA 95054 USA
Phone: +1-408-705-2240
Fax: +1-408-987-9665
E-mail: usa@mistralsolutions.com

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