

# Implementation of Context-aware Digital Signage System based on Mobile CPU Platform

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## Abstract

If a digital signage system is operated in PC mounted in the Window OS then the implementing price is very high. For resolving this problem we used the Smartphone mounted in ARM Cortex family of multi-core processor-based mobile platform. We developed a low-power low-cost digital signage system and a remote content management program based on web server. This system manages advertising content to a remote control device anywhere using remote control technology.

**Keywords:** Context-Aware, Digital Signage System, Mobile Platform, Mobile Service

## 1. Introduction

The hardware platform of digital signage is a common industrial PC. In the case of the Industrial PC has been a high-power, high price, low reliability pointed out as a problem. At this time, the software platform is using an OS of Microsoft's Windows series. The software platform also high prices, and requires a high-end of the system for proper operation of the software.

Therefore, to solve the above problems, we have developed a digital signage system of the mobile platform of the low-power low-cost using the ARM Cortex family multi-core processors applied in Smartphone. This system remotely controls the advertising terminal any time, anywhere using remote control technology. And we develop a web-based remote content management server for the managing server programs and contents. In particular, we take advantages of the XML-based SMIL (Synchronized Multimedia Integration Language) to design and play various multimedia contents freely. The SMIL client program is based on Android mobile platform. Naturally, we were able to develop a mobile platform-based hardware and software interfaces. And we combine ultra-low power digital signage system into mobile platform.

## 2. Context-aware Digital Signage System

Digital signage was not as effective as it could be for the following reasons:

- Lack of fresh, relevant content.
- Inefficient troubleshooting and support.
- Long waits for provisioning.
- Noncompliance with Cisco branding guidelines.

Content left up too long became outdated. In some locations, screens were blank for part of the day. Field sales offices sometimes waited weeks for a digital sign, and then had to wait longer for content and IT staff were not familiar with all of the display types in different locations, which complicated troubleshooting. What's more, displays in different locations had different aspect ratios, which meant that content might be truncated at the sides.

So we needed a collaborative effort to solve those problems and suggested context-aware digital signage system as following Figure 1.

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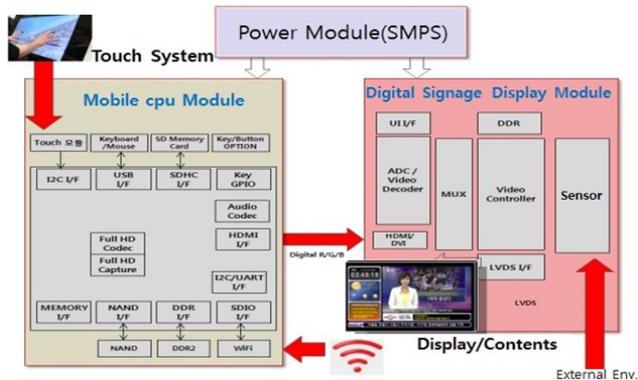


Figure 1. The whole system layout.

System configuration is divided into five parts.

- Developing the digital signage system development including the display
- Design and implementation of hardware interface optimized for low-power mobile platform
- Implementation of the service model for acquiring the surrounding circumstances information such as GPS information, temperature, weather using sensors
- Interface development for the touch sensor
- Software interface design and implementation to be ported to Android OS.

The main configuration of the system, there are two modules.

The first module is a module automatically created. This gives content-providers a dedicated authoring tools and content prescribed by the framework to generate automatically based on SMIL 2.0.

Another thing is the module to create a user-specific customized SMIL content with reference to the user information stored in user information database.

This program provides relevant global, regional, and local news and information in a brief, visually stimulating format. Also the system increases user’s awareness and involvement with both global and local events and initiatives.

With regard to this technology, a company called Big Eye is developing a commercial tool for stereoscopic and multi-view content creation and editing. TU Media, the company is also developing a commercial tool for authoring and editing 3D data for the 3D data from the satellite DMB service environment. Hyundai IT supports a variety of different types of display and the appearance and design, and provides an integrated solution, such as the operating solution and content.

Advantech (Taiwan’s company) was developed recently Zytronic’s Projected Capacitive Technology-based digital signage available touch interactive features using sensor technology in abroad where the company was to maximize the interactive advertising by using a 42-inch touch screen.

The Cisco® Digital Media System is a suite of applications for digital signage, desktop video, and Enterprise TV. All three applications share a single web-based management interface, reducing management overhead.

## 2.1 The Signage System

### 2.1.1 Dynamic SMIL Contents Generation Module

Dynamic SMIL content generation module is a module for generating a dynamic SMIL content based on the template generated by the user information and SMIL dedicated authoring tool. Using SMIL dedicated authoring tool created the template, adding the media content that matches the user information obtained from the database on the thus created template to dynamically generate the SMIL content.

Dynamic content is generated SMIL module consists of the following modules.

- Module to import the template file to access the SMIL content database
- reading and parsing a template file, a module for storing the result of parsing the data structure
- Module to import user information to access the user information database
- The module to combine the media data and to identify objects that match the user information stored in the data structure and content one dynamically generate content SMIL.

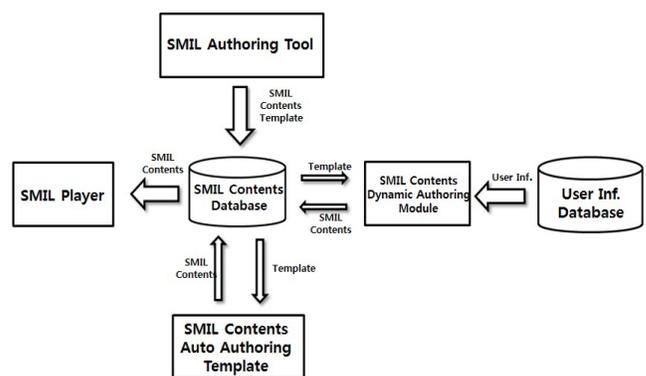
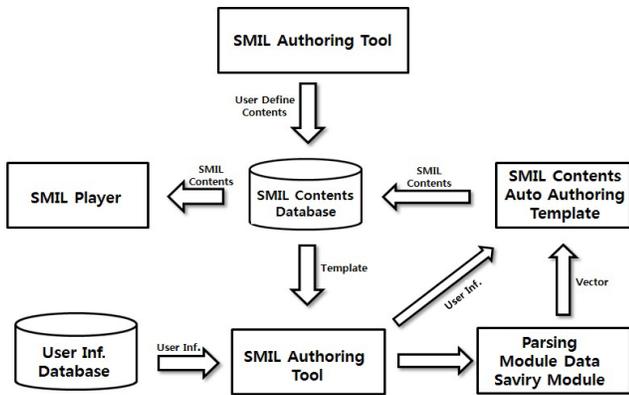


Figure 2. The whole system architecture.



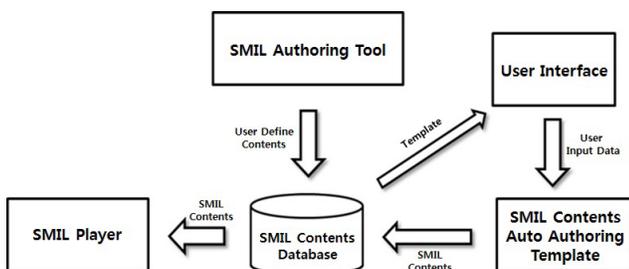
**Figure 3.** Dynamic contents generation module flowchart.

### 2.1.2 SMIL Authoring Tool

Be based on SMIL Authoring Tool is SMIL 2.0. The tool is designed as an integrated interface to manage all the tags and the tag so that the properties provided by SMIL 2.0 SMIL content service provider can easily author a SMIL content. SMIL content produced by authoring tool is automatically stored in the database may SMIL content to the client service.

### 2.1.3 SMIL Contents Automatically Generated Template

The default interface for SMIL gives automatic content generation module generates a SMIL content automatically by entering a media object to play in the framework SMIL content providers are pre-built as a web page. Structure-specific module is a module for generating each user interface to enter a custom template that is generated by the module and SMIL dedicated authoring tool that automatically generates a SMIL content with user interface generation module and the user’s input of a web page is configured.

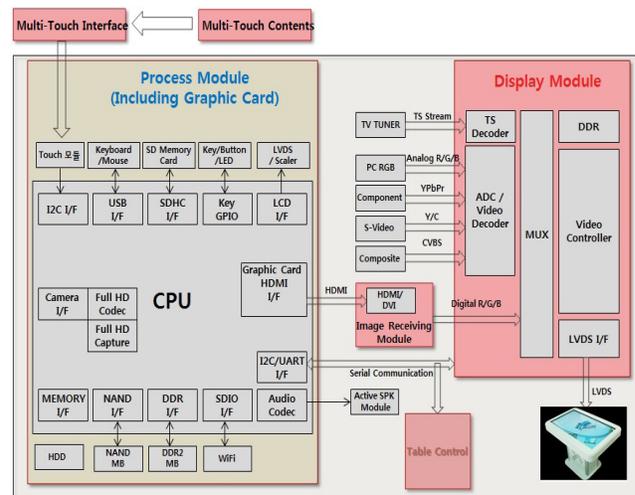


**Figure 4.** SMIL contents automatically generated template.

### 2.1.4 SMIL Player

A SMIL content database has been built, the server in the automatic or dynamic generation module reproduces the SMIL document created and stored in a streaming manner. Has been developed based on the SMIL 2.0, and uses the Java technology-based multimedia support JMF (Java Media Framework) for transmission and reception and representation of the multimedia object. Only the SMIL player is in a remote multimedia objects are included in the SMIL content, the real-time transport protocol to play a multimedia object, RTP (Real-time Transport Protocol), streaming format using the RTSP (Real-Time Streaming Protocol) should be received by.

## 2.2 Hardware



**Figure 5.** Hardware block diagram.

### 2.2.1 Multi-touch Interface Elements

**Table 1.** Multi-Touch Interface

No.	Main Options	Related Pictures	Verification Information
1	Simultaneous Touch Function Point		Make up points and coordinates
2	Touch Accuracy, Reliability		Determine the actual point
3	Multi-Touch Application		Validated in real-world applications
4	Touch Response Rate		Make touch response speed through drawing
5	High Definition, Visibility		Quality of the Table-top display

### 2.2.2 Multi-touch Interface Technology

While touch sensing is commonplace for single points of contact, multi-touch sensing enables a user to interact with a system with more than one finger at a time, as in chording and bi-manual operations. Such sensing devices are inherently also able to accommodate multiple users simultaneously, which is especially useful for larger interaction scenarios such as interactive walls and tabletops.

- Content: Multi-touch Interface Technology
- Purpose: Optimal Multi-Touch interface processing technology for user interaction
- Features: Multi-touch driver settings, Multi-touch calibration function, Multi-Touch Noise Reduction applies, Drawing and editing multi-touch sensing technology
- Configuration Technology: A key interface response time, accuracy considering technical and user interface data transfer technology.

### 2.2.3 Table Setting Display Technology

Since refining the FTIR (Frustrated Total Internal Reflection) sensing technique, we've been experimenting with a wide variety of application scenarios and interaction modalities that utilize multi-touch input information. These go far beyond the "poking" actions you get with a typical touch screen, or the gross gesturing found in video-based interactive interfaces. It is a rich area for research, and we are extremely excited by its potential for advances in efficiency, usability, and intuitiveness.

Our technique is force-sensitive, and provides unprecedented resolution and scalability, allowing us to create sophisticated multi-point widgets for applications large enough to accommodate both hands and multiple users.

- Content: Reliability reserved table display in the form of high-quality image-processing technology
- Purpose: Best table display systems offer
- Features: Slim/Compact Design (Weight reduction technology), High definition video processing, Ensuring visibility to optical bonding technology, Sealing for reliability, tempered screen surface treatment technology

- Configuration Technology: Optical bonding technology and high-resolution display circuit configuration technology

### 2.2.4 Multi-touch Content Software Interface Technology

- Content: Software API for multi-touch (Application Programming Interface) provides, Provide additional application implementation environment.
- Purpose: Architecture implementation that can flexibly respond to the functions required in the multi-touch content.
- Features: The customer has already a solution of the features required by external developers to provide customer-specific customized services to help you create a variety of additional features derived service topped, Independent API can be used in conjunction with, other services and the mash-up capable oriented open platform.
- Configuration Technology: API specifications API technology for implementing technology and scalability.

### 2.2.5 User Interface Design Technology

User Interface Design (UID) or user interface engineering is the design of websites, computers, appliances, machines, mobile communication devices, and software applications with the focus on the user's experience and interaction. The goal of user interface design is to make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals-what is often called user-centered design.

Good user interface design facilitates finishing the task at hand without drawing unnecessary attention to itself. Graphic design and typography are utilized to support its usability, influencing how the user performs certain interactions and improving the aesthetic appeal of the design; design aesthetics may enhance or detract from the ability of users to use the functions of the interface<sup>16</sup>. The design process must balance technical functionality and visual elements (e.g., mental model) to create a system that is not only operational but also usable and adaptable to changing user needs.

- Content: Each menu to enable inter-system information associated with possible usage of user / tree construction techniques

- Purpose: The basic menu, providing a service that meets the needs of the user to provide the tree
- Features: User-friendly and intuitive system operation
- Configuration Technology: Image rendering application and GUI design

### 2.2.6 Ergonomic Table Design Technology

Ergonomics is about designing for people, wherever they interact with products, systems or processes. We usually don't notice good design (unless perhaps, it's exceptional) because it gives us no cause to, but we do notice poor design. The emphasis within ergonomics is to ensure that designs complement the strengths and abilities of people and minimize the effects of their limitations, rather than forcing them to adapt. In achieving this aim, it becomes necessary to understand and design for the variability represented in the population, spanning such attributes as age, size, strength, cognitive ability, prior experience, cultural expectations and goals. Qualified ergonomists are the only recognized professionals to have competency in optimizing performance, safety and comfort.

- Content: Ergonomically designed for user comfort systematic mechanism
- Purpose: Mechanical design provides optimal considering the large number of concurrent user experience
- Features: Table height adjustment, swivel ring of the table function, TILT function when required user angle
- Configuration Technology: Mechanical stabilization design technology and system connection technology

## 2.3 Display Specifications

### 2.3.1 Samsung Display LTI460HN08

Samsung has launched the new LTI460HN08-0 with full HD resolution (1920×1080) in 16:9 format, super wide viewing angles, with LED backlight. The 46" is a new addition to the P-DID TFT range. Just like the CCFL version LTI460HN05 it has a brightness of 700cd/m<sup>2</sup>, but performs much better at the low temperature range.

The wide viewing angle of v/h 178°/178° allows for excellent readability from all sides. Moreover the LTI460HN08-0 is only 1.51cm in depth and a perfect choice for projects/designs where space is critical.

### 2.3.2 Specifications

- High contrast ratio & aperture ratio with the wide color gamut
- SVA (Super Vertical Align) mode

- Wide viewing angle ( $\pm 178^\circ$ )
- High speed response
- FHD (1920X1080) resolution (16:9)
- Edge LED BLU
- RoHS compliance (Pb-free)
- Low power consumption
- Data enable mode
- 2 Channel LVDS IF
- Landscape / Portrait type compatible

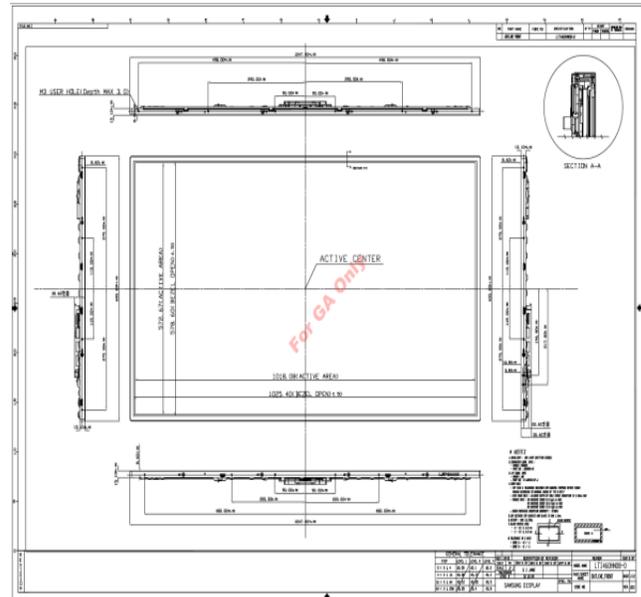


Figure 6. Mechanical specification (1).

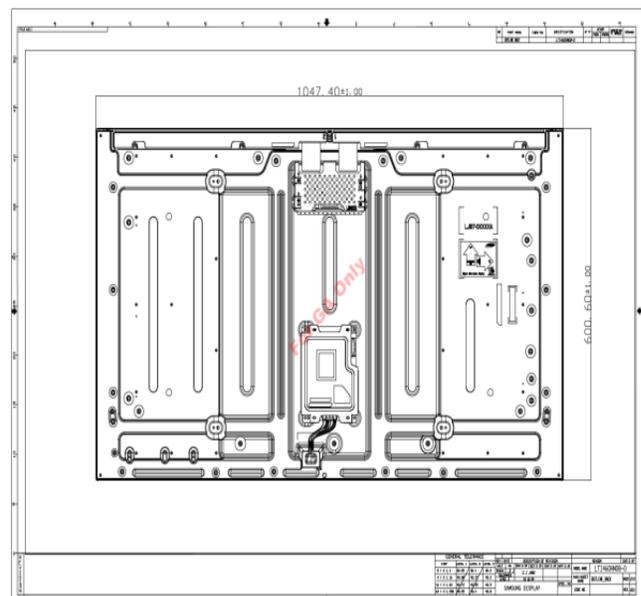


Figure 7. Mechanical specification (2).

## 2.4 System Performance

**Table 2.** System performance

1. Power Consumption (CPU module based on Mobile Device)	5.5W
2. Operating temperature	Celsius -10~60Degree
3. Resolution	1920*1080
4. Touch	16 points
5. Context-awareness Services Model	Sensing ambient light
6. S/W Function	Remote AS function

## 3. Discussion

If a digital signage system is operated in PC mounted in the Window OS then the implementing price is very high. For resolving this problem we used the Smartphone mounted in ARM Cortex family of multi-core processor-based mobile platform. We developed a low-power low-cost digital signage system and a remote content management program based on web server. This system manages advertising content to a remote control device anywhere using remote control technology.

## 4. Acknowledgment

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