

Design and Implementation of Embedded Digital Signage System

Dharmesh Dudakiya¹, Himanshu Bhimani²

*Electronics & Communication Department, Atmiya Institute of Science and Technology, Rajkot
Gujarat, India*

Abstract— Digital signage is an emerging new communication technology. It is expected to play an important role in today's dynamic world as digital signage displays timely information, while reducing the environmental costs associated with traditional printed signage. In this paper, it is aimed to develop a user-friendly, web-based, cheap, effective and compact sized digital signage system which can be controlled and modified by the users. Digital signage system design is based on various methods of using computer and television screens as well as other kinds of display devices in ways that are as efficient as possible to provide advertising and information to people in public areas. The goals of this study are broadcasting information, advertisements at display contents in public areas such as; subways, buses, malls, city squares and control these digital signs remotely.

Keywords— Signage, Distro, Front-End, Back-End

I. INTRODUCTION

Today, digital media is the most compelling platform to effectively reach employees, students, customers, and partners. This digital media is used to convey important information and messages such as news, training material, and information about upcoming or current events. Digital media is effective because it brings familiarity and closeness to modern communications.

Simple advantages of digital signage solutions are; being easy to reach a huge amount of people, integrating people with up-to-date information, reducing expenses, dynamic and effective advertisement, being easy to deliver information when it is necessary.

Advertising using digital devices is widely used today to promote products in commercial centers and cities. This is a replacement for paper based advertising mainly because of the reduced costs. In advertising there is also a trend to present to the customer personalized advertisements. This was done for years in the web space because user

preferences are analysed and corresponding advertisements will displayed.

This is not the case for traditional publicity displays, where large monitors are connected by TV cable and display the same content regardless of the local conditions where the advertising is taking place. The ARM market developed rapidly in the last couple of years, offering inexpensive computing solutions. It is the obvious choice to transform a device into a smart (internet enabled) device.

The proposed solution is to use the Raspberry Pi platform as an add-on to a classic TV set in order to transform it into a internet enabled device. The Raspberry Pi is used to control the local storage and display, and is able to communicate with a server in order to control the play and update the local content with the data received from the server. This solution is easy to implement, upgrade and allows for personalized advertisements.

The first part explains the system architecture, in second part the design of the two subsystems and communication between the two systems is discussed. The final part is dedicated to the implementation.

II. SYSTEM ARCHITECTURE

The system architecture was designed with a single server system and multiple client systems (that can be seen as agents controlled by the server).

The Client is a program capable of communicating with the server system, reading the server commands and the data. The client is able to operate independently when there is no network available based on the data last sent by the server and stored in internal memory of media player.

At the center of the implementation is the Raspberry Pi. Being reduced price and dimensions give advantage over other available systems. It is here where the Client subsystem runs. The ARM CPU operates at 700MHz, has LAN connectivity, and with the help of the GPU handles HD multimedia content, sent through HDMI or RCA connectors. The peak power requirements are low: 700mA at 5V, and usually the device's power consumption is much lower. Figure 1 shows the general block diagram of digital signage system consisting of main four parts: digital signage server, network (internet), Media players and digital displays.

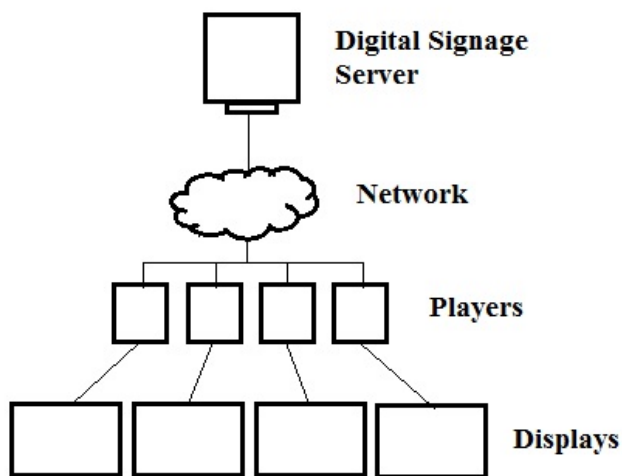


Fig. 1 Block Diagram of Digital Signage System

A. Types of Digital Signage

There are three main types of digital signage:

- Stand-alone Digital Signage
- Web-based Digital Signage
- IPTV-based Digital Signage

1) *Stand-alone Digital Signage* : It consists of a display and a computer without internet connectivity. The contents of the digital display(s) will be controlled by this computer. New display contents can be installed using a USB memory stick or other portable storage device. A simple stand-alone digital sign might only display a single fixed

display of content or it might change different parts of the display based upon a static schedule.

2) *Web-based Digital Signage* : In this type of digital signage, the contents of the signage/display can be directly controlled by a local web browser. All the contents on the display(s) can be easily controlled by users/administrators from anywhere on the network that is able to reach this device.

3) *IPTV-based Digital Signage* : In the IPTV approach all of the contents are distributed by a streaming IPTV media server. In this approach contents such as video, graphics, animations, images files, and web contents are directly distributed from a central media server to media players attached to networked displays. This approach is very suitable for a large number of displays that will display only a limited number of different streams of content.

III. DESIGN AND IMPLEMENTATION

A. Goals & Methods

The main focus and objective of this paper was to design, develop, and evaluate a hardware /software solution based on a PC, to control and display different web contents (or other dynamic information) on digital displays. Instances of this system could be located at different locations. A user or administrator will specify some content or dynamic information that is to be displayed on a certain digital display for a specified time and for a specific period of time.

The approach that has been selected is to follow the web based approach. This approach was selected to meet goal of removing the single point of failure of a television (be it analog or IPTV) based system.

The centralized management system is implemented as a web server; hence it can be accessed through a web browser. Based on access controls, dynamic web contents can be sent to different digital displays based on the list of pages assigned to each of these clients (i.e., the PCs with web browsers connected to displays). An

administrator or other authorized employee can specify the schedule (a playlist), i.e., a list of URLs or web dynamic information to be displayed by specific displays along with the specified schedules, e.g date, time, and duration of the content information on each display. The digital display management software can manage the different schedules for each display.

We also needed two other applications SOAP (Simple Object Access Protocol) server and SOAP client. SOAP server to retrieve all the relevant information from the database and download the content to the client machine. Each client (PC attached with display) has a SOAP client and a web server. The SOAP client will take all the requested data from the web service and will store it in a XML file. Later this saved XML data will be used to schedule the output to be shown on display.

B. Software

1) Operating Systems :

There are several open source distributions (distros) available on Raspberry Pi's web page. The recommended distro is Raspbian, which is used in our project. Raspbian is a Linux based Debian distro, it can run on Raspberry Pi's ARM processor. There is a six main Linux distros which can run on the Pi. These six main distros are: Raspbian, Pidora, Openelec, Raspbmc, Risch OS and Arch Linux.

2) *Application Software* : Digital display and management software are based on an open source software package called MRBS (Room Booking System). MRBS is a web application written in PHP and MySQL for booking meeting rooms, but here its used to book a digital sign's display slot to display different contents.

The database structure contains four database tables. The table `mrbs_area` represents and manages different areas where different types of displays can be added to each area. The table `mrbs_display` stores information about the different displays (such as their IDs, names, and locations). The table `mrbs_entry` contains entries with an entry id, start time, end time, the description of the contents,

content type, and pointer to the contents. The last table `mrbs_repeat` stores the repeat time and date for when the contents will be displayed.

Here the MRBS software was used as base, for the following reasons:

- It is easy to use and is both simple and reliable.
- It is open source.
- It has a user friendly web interface.
- Saved a lot of time while the implementation phase. It satisfied most of our requirements for the server side user interface software.

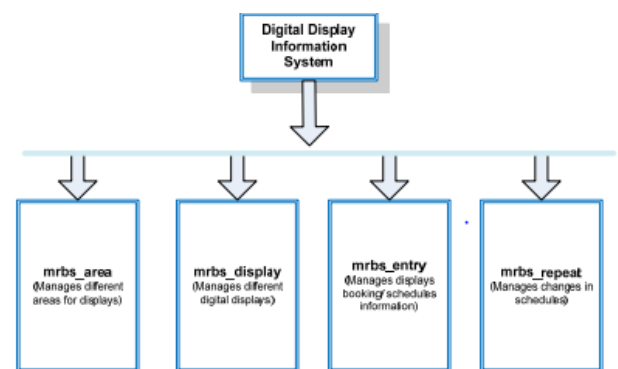


Fig. 2 Database table structure of the Digital Display Information System

Figure 3 shows the architecture of our digital signage system (as both designed and implemented). The system made up of a differentially located client-server architecture where the client first sends requests for the web service, the web service then requests data from the scheduling database and will sends back to client, the client then format and displays the content using a local browser. Different clients requests to the server containing the id of their display, and receive the content that this client is scheduled to display. All clients communicate directly with server and do not need to communicate with each other. Thus the clients are independent and not interdependent, so the failure of any client will not affect the other clients or the server.

The proposed solution is not confined to any particular type of organization; rather it could be

deployed by any organization – ranging from a setting with a single display to a distributed organization with thousands of displays. In this digital signage system, the contents of the display are controlled directly by a local web browser. As we are using open source software as the basis for our digital signage system, anyone can mold it to their needs.

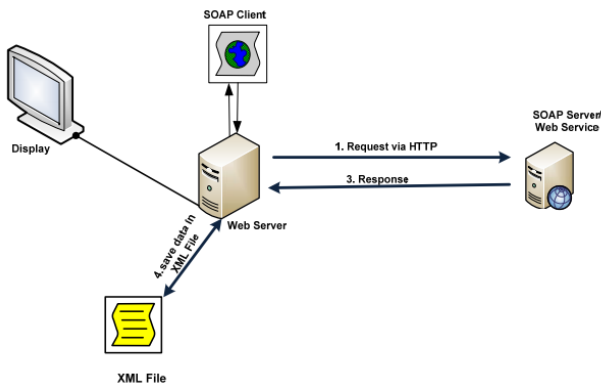


Fig. 3 Architecture of the Digital Signage System

All the contents on the displays can be easily controlled by users/administrators from anywhere on the network that is able to reach this device (either directly or through a proxy). However, this has not been evaluated or studied in any detail. It represents an area where future work is needed.

CONCLUSIONS

In this paper we have designed, developed, and evaluated a hardware & software solution based on a PC, to control and display different web contents (or other dynamic information) on digital displays

located at different locations. The system is based upon a set of open source software packages and a few modifications to one of the packages. The system meets our original design goals. On the surface the system appears to be an efficient and scalable way to display dynamic contents via digital displays according to a specified schedule.

REFERENCES

- [1] C. Bauer, "Interactive Digital Signage – An Innovative Service and Its Future Strategies", in *proceedings of International Conference on Emerging Intelligent Data and Web Technologies (EIDWT)*, pp. 137-142, 7-9 September 2011.
- [2] Taner Arsan, Alp Parkan and Hakkı Konu, "Design And Implementation Of Remotely Managed Embedded Digital Signage System", *International Journal of Computer Science, Engineering and Applications (IJCSEA)* Vol.4, No.3, June 2014.
- [3] J.V. Harrison and A. Andrusiewicz, "Using wireless networks to enhance narrowcasting in public spaces", in *Proceedings of Consumer Communications and Networking Conference (CCNC)*, pp. 600–604, Jan. 2004.
- [4] Lars-Ingemar Lundstrom, *Digital Signage Broadcasting: Content Management and Distribution Techniques*, Focal Press Media Technology Professional, 2008.
- [5] Keith Kelsen, *Unleashing the Power of Digital Signage*, Focal Press Media Technology Professional, 2010.
- [6] Jimmy Schaeffler, *Digital Signage*, Focal Press Media Technology Professional, 2008.
- [7] Roy Want & Bill N. Schilit, "Interactive Digital Signage", *Computer*, Vol. 45, No. 5, pp. 21-24, May 2012.
- [8] MRBS: Introduction, last access at 25/12/2014.
<http://mrbs.sourceforge.net/>
- [9] Wikipedia [WWW], last access at 02/01/2015.
http://en.wikipedia.org/wiki/Digital_Signage.
- [10] Yi-Ting Lee, Chia-Hung Lien, Hung, A., Jhe-Hong Ren & Ting-Kai Chang, (2012) "Design of a low cost interactive digital signage", 2012 IEEE 1st Global Conference on Consumer Electronics (GCCE), Tokyo, pp 120-124.
- [11] Maik Schmidt, *Raspberry Pi - A Quick Start Guide*, 2012.
- [12] W. Jason Gilmore, *Beginning PHP and MySQL from Novice to Pro*, 2010