IoT Compliant HD Digital Signage Controller Design using Raspberry Pi

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ABSTRACT

In this paper we present IoT compliant HD Digital Signage Controller design using Raspberry Pi. Nowadays, the digital signage system have gained increasing popularity and rapidly growing communications medium that offers a wide range of exciting ways with customers, enhance brand awareness, increase sales and margin uplift by replacing the traditional static signage system. This paper presents a cost-effective IoT based HD Digital Signage Controller (DSC) using R-Pi computer that can use various kinds of displays in order to make the system as efficient and affordable as possible to provide advertisement or other relevant information to people in public areas. The system is designed in such way the information about surrounding related place is taken through sensors and directly uploaded to the internet, and thus can be accessed anytime and displayed on screens by using Raspberry Pi that serves as controller in the system. The design and implementation of the system developed by using python programming language and its hardware consists of sensors, Arduino, Raspberry Pi 3 model B board and the displays. The main targets of this study are build a cost effective Digital Signage system as well as broadcasting information at display contents in public areas and control those digital signs.

Key Words : Internet of Things (IoT), Digital Signage Controller (DSC), High Definition (HD), Raspberry-Pi (R-Pi).

I. Introduction

Generally digital signage is a new concept that requires to define several concepts in order to make the successful system. Digital signage itself it is a set of methods used to display a dynamic multimedia content in public places which is known as electronic signage or narrowcasting. Networks of digital signs have been deployed in order to deliver informative content to captive audiences through displayers.

Recently, digital signage one of technologies that is used in spreading and digital contents to different public points over the central main controller by interacting with a number of people at once. The main role of that digital signage is for attracting prospects' attention in heavy traffic points and distribute the proper updated information at proper time [1]. Mainly the digital signage divided into two parts such as interactive digital signage and non-interactive digital signage. However, the fundamental aspect of digital signs is the interactivity. The user interaction technics in in the digital signage system take in buttons, touch screens, gesture interaction with cameras (2D camera, depth cams or 3D and Kinect) as well as mobile phones [2]. In large, the interactive digital signage corporate the advertisement and the promotion of the product, announcement and communications. The inventors of digital signage, defined the digital signage as the real-time dynamically changing, digitized multi-media distribution or one source to one or multiple zones display devices at the same time [3]. The main concept of digital signage system is all about sending system interface of contents and referring to information source, in order to draw the attention of targeted segmentation based on the function to be controlled by the central controller board [4]. Raspberry Pi (R-Pi) has the ability to interact with the outside world and has been used in a wide array of digital projects works. Particularly for digital signage related various implementations has developed using Raspberry-Pi such as info-Beamer, TargetR, PiWall, UCVIEW and others [5].

The Raspberry Pi, which is considered as the central controller of the des system design presented in this paper,

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is a Linux-based, low cost, credit card computer with General Purpose Input/output (GPIO) pins and that plugs into TV and a keyboard [6]. The Raspberry-Pi board is also a small computer that can be used in several applications that the desktop PC does, particularly playing High- Definition (HD) videos. Technically, the main purpose of using the Raspberry-Pi in the designed system of digital signage is that the Raspberry-Pi architecture is based on the Broadcom BCM2835 SoC (System on Chip) that features an ARM CPU together with a video core IV GPU [7].

Internet of Things (IoT) for digital signage is all about the interaction of objects that contain embedded technology with the internal states or external environment, whereby when controlled objects can sense and communicate, it changes and display the information at the right place as well as at the right time. Thus is valuable in various domain such as energy grids, emergency exit signage for safety, transportation systems⋯ By considering the typical application, when the fire detection sensor is linked to the alarm and that alarm is also connected to the digital signage screens that instructs people to the best exit route.

Table 1. Raspberry Pi versions and specification

	Raspberry Pi 1 Model B	Raspberry Pi 2 Model B	Raspberry Pi 3 Model B
Capacity of Processor	700MHz	900MHz quad-core ARM cortex-A7 CPU	1.2GHz 64-bit quad-core ARMv8 CPU
Internal Memory (RAM)	512MB	1GB	1GB
Card slot type	SD Card	MicroSD card slot	MicroSD card slot
USB port	2 ports	4 ports	4 ports
Ethernet port	100 Mb Ethernet port	100	10/100 Ethernet
Video interface	HDMI	Full HDMI port	Full HDMI port
Bluetooth	No	No	Yes (Bluetooth 4.1)
WLAN	No	No	2.4 GHz 802.11n wireless
CSI & DSI	Yes	Yes	Yes

II. Description of designed digital signage system

This paper present the design of IoT enabled digital signage display device controlled by Raspberry Pi device. The designed system can be autonomously able to display the content from subsystems consists of sensors and digital signage server. By referring to the related work about digital signage system design, the main target in this paper is to design IoT based cost-effective, flexible and resized digital signage system by using Raspberry Pi 3 model B. With its built-in wireless connectivity, Raspberry Pi 3 model B positioned as a low-cost hub for IoT device that fit to be used for designing easy available, reasonable performance digital signage system. The implementation of this design illustrated in figure 1, can brings practical solutions to digital signage sector.

The source of the informative contents are from Digital Signage Subsystem (DSS) which consists of various sensors connected to Arduino board. The sensors detect the related surrounding parameters and saved to the signage system server platform by using Arduino Wi-Fi shield. The digital sensors give the a digital output suitable for Raspberry Pi, and for analog sensors are connected to analog to digital conversion in order to be interfaced to the Raspberry Pi. From the system design shown above the raspberry Pi fetches the information form digital signage server wirelessly. The implementation of a prototype digital signage display using Raspberry Pi 3 Model B has customized serial communication port through GPIO interface to connect objects. It has different functions to use directly for digital signage without converters which are implemented on Raspbian. The storage system uses a 32 GB micro SD card, which is divided into two partitions, one is for operation system (Raspbian) and the other is for signage content data.

Compare to the previous versions of Raspberry Pi boards, the Raspberry Pi 3 model B has a big gap of 50% more processing power and quad core 64bit processor. Thus results in high performance for both display resolution and video resolution which the main key for digital signage system design. The following chat shows the results tests performance of various version of Raspberry Pi Boards that run at 1280x1024 display resolution and 240p, 360p, 480p as video resolution.
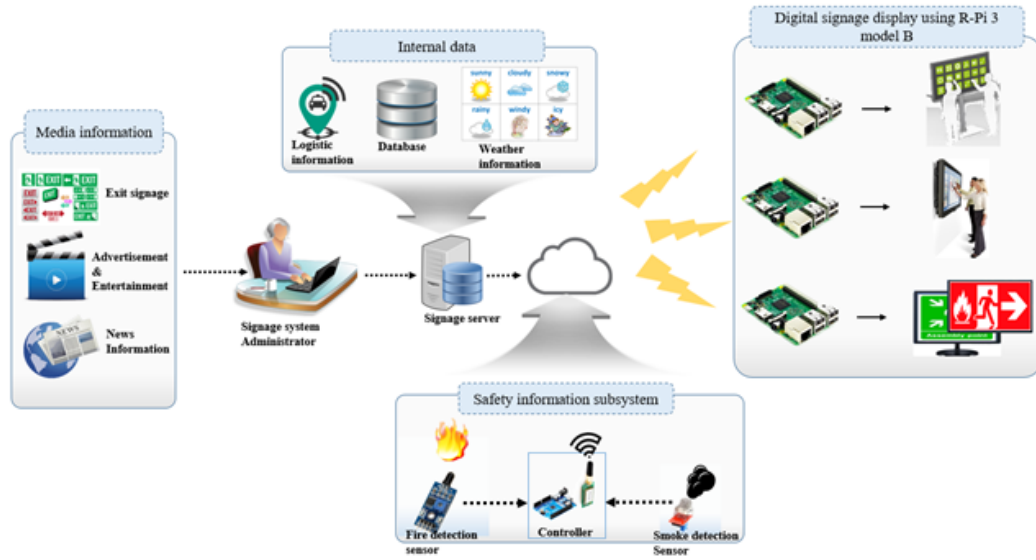
Figure 1. Architectural system design of IoT compliant digital signage using R-Pi 3 model B
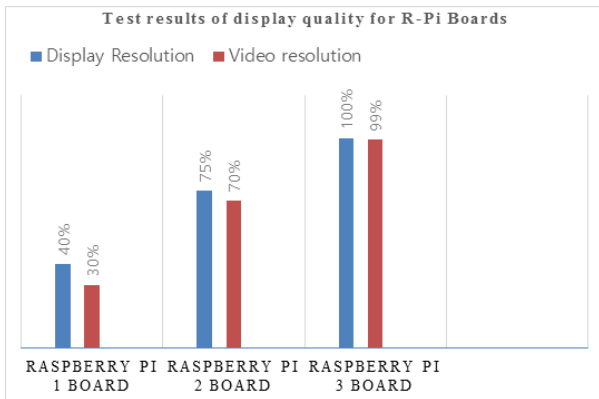

Figure 2. Video quality test results for Raspberry Pi Boards

Ⅳ. Application and limitations

The Raspberry Pi is the controller of digital signage of choice for IoT based digital signage system design proposed in this paper. It was selected because of its validity, reliability and affordable that support its use. For the particular design presented in this paper. Raspberry Pi 3 model B has a super application to be turned into IoT device whereby it connects various objects for communication of each other. The design presented in paper can applied in various areas of smart device used in public places such as advertisement, entertainment, tourism, etc.

Ⅵ. Conclusion

In this research work presented in this paper we have successfully designed and implemented IoT based HD Digital Signage system using Raspberry Pi 3 model B. The main purpose of this research is to design a cost-effective and flexible digital signage system. In this paper, we explained the architectural design and illustrated the performance of the controller functionality. The result shows that the digital signage system using Raspberry Pi 3 Model B as embedded board has better qualitative performance (by considering its specifications) compared to the previous digital signage system using Raspberry Pi versions. As future will be based on designing and implementation of multiple digital signage display using Raspberry Pi.

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