IoT BASED DIGITAL SIGNAGE BOARD USING RASPBERRY PI 3

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Abstract - *Internet of things (IoT) is a concept that considers pervasive presence in the environment of variety of objects that are interconnected through wireless or wired mediums having unique addressing schemes to communicate with each other to create new applications and reach common goals. Digital signage boards are an economical and advanced solution for today's static advertisement boards. The modern digital signage boards can be accessed and controlled remotely using internet. Digital signage system has advantages like reduced costs, integrating citizens with   up-to-date technologies, being easy to reach huge number of people, dynamic and effective advertisements, ability to deliver relevant information at proper time for proper mass. The proposed system will replace microcontroller based systems with raspberry pi which will drastically improve the performance and will consume less amount of power for operation.*

*Key Words***:** Internet of things, Raspberry pi, Digital signage board, web server, HDMI, Advertisements, Internet

1. INTRODUCTION

The network of digital displays that are centrally managed and addressable for targeted information and advertisements is known as digital advertising. The broadcasting of information can be done at road highways ,subways , buses, train and train station, shopping malls, city squires, hospital, conference hall, colleges and schools for displaying notice for student information and displaying all institutional information for visitors [1]. Digital signage technologies are becoming very popular between many different business domains. Companies use digital signage for many various purposes. Digital signage solutions are creating opportunity for customizing the information that they want to deliver. Main usage purposes of digital signage are announcements, advertising and promoting products, entertainment, public information systems such as live traffic details, news, headlines, weather, and menu information such as digital menu boards with information on pricing [2]. Sensors and technologies allow digital signage boards to adapt to context such as time and location, many options appear to catch the audience's attention. Such features are called contextual signage[3].

2. LITERATURE REVIEW

The Internet of Things is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and other connected devices. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure With every breath technological entrepreneurs take, a new idea is pitched. Keeping up with these everyday breakthroughs can be tough. In less than 10 years we have witnessed the launch of yet a new wave, Web 3.0. Components of this breakthrough are still new and not many people are familiar with these concepts. In order to seize the opportunity to inform individuals, we developed a digital signage board system that is focused on the area of Internet of Things. Internet of Things is a vision that was introduced in 2009. This vision encompasses the idea of connecting all devices and gadgets to the internet. The Internet of Things is truly changing our world. It is enhancing our lives, businesses, health and society as a whole by developing products which would ease our life. It is estimated that by 2020, 50 billion devices will be connected to the internet [4].
While the traditional print advertisements in newspapers and magazines have witnessed a decline that threatens the existence of print news media outlets, and interest in interactive advertisement on web, mobile and other innovative media the advent of affordable, interconnected, high-definition flat digital displays has enabled content providers, including advertisers, to replace static screens by timely targeted content delivered to the audience [5].

3. PROPOSED SYSTEM : METHODOLOGY

The main aim of this research is to design and develop a digital signage system which can display advertisements as well as real time useful data like live traffic details, weather updates, news, etc and can be controlled remotely. The system consists of raspberry pi 3 which will act as the heart of the system, a node.js web server to host the front end as well as backend web interface. The Digital display is connected to raspberry pi using HDMI, no additional hardware is required for using display with raspberry pi 3. Raspberry pi 3 is connected to router and that router will provide internet to raspberry pi 3 so that

the remote accessibility can take place. Real time data like news, weather and live traffic is extracted from internet using data scraping techniques wherein the system makes http calls to the application programming interface (API) and the API returns required data in json format ,which has to be beautified to process and display on the signage board. Features like uploading new advertisement or deleting old advertisements can be done via the control panel. To access the control panel ,user needs to enter his username and password. If username and password is not present then the user can register a new account and get valid username and password . After getting access to the control panel user can control the number of advertisements to display, the time to display an advertisement, the time to display real time traffic dashboard, the location of which live traffic details are required, etc. Images uploaded or deleted from the control panel will have a real time effect on the advertisement slide show without refreshing ,this is achieved by using the concept of threading in node.js .The block diagram of the system is shown in Figure-1.
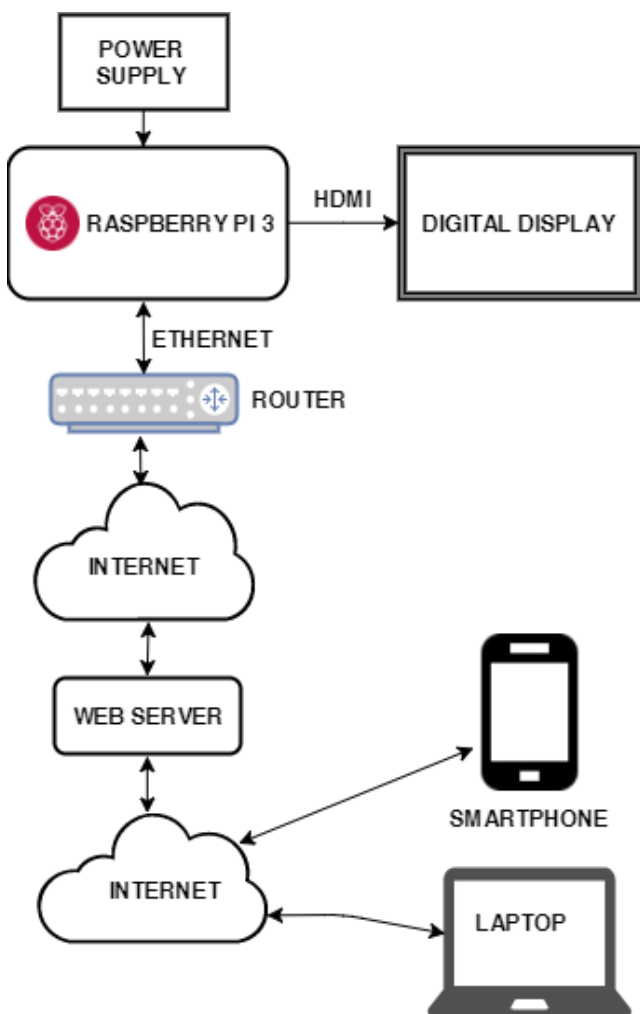

Fig -1: Block Diagram of System

4. DEVELOPMENT STAGES

The development of this system took place in 4 stages,

1. Research
2. Back-end Development
3. Front-end Development
4. Testing and Implementation

4.1 *Research*

Research is one of the most vital stage for development of any system. We researched about the current technologies used for building digital signage boards and its market trends. We decided to build an digital signage solution for very end user. We didn't develop a standalone application as it won't work on other software platforms and also because it's not scalable. So we decided to use web application for building digital signage board as web application can run on any device on which internet connection can be provided. Besides, update and new release of application are more simple and user friendly in web development.

4.2 *Back-end Development*

The back-end development of the system includes a node.js web server, a control panel webpage from which the digital signage board can be controlled. The technologies required for developing backend are node.js ,angular.js ,JavaScript. Node.js and angular.js are the frameworks to be used with JavaScript. The image uploaded on the control panel page is stored on the web server and from there the image is used for the slideshow on the front end of the system.

4.3 *Front-end Development*

The front-end development is done using HTML5 and CSS. CSS is used in this study to customize the front–end. CSS; in other words Cascading Style Sheet defines how to display HTML elements [6]. Cascading Style Sheets customize fonts, colors, margins, lines, height, width, background images, advanced positions and many other things. CSS gives us the advantage of controlling the layout of multiple documents from a single style sheet.
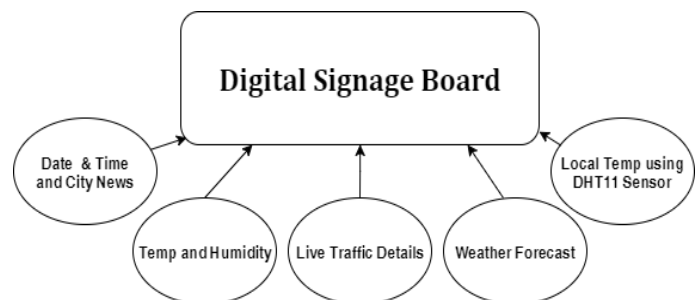

Fig -2: Data scraping Techniques

Data scraping techniques are used to display the web extracted information on the digital board. Along with temperature and humidity data from internet, a local DHT11 sensor is also used to display the exact local temperature and humidity at that specific location. All the required web data is extracted using web API's which can be accessed by using API key which is provided by the service provider of the web API.

4.3 *Testing and Implementation*

The front-end display of the digital signage board is done on the chromium browser which is installed on the Raspbian pixel operating system in raspberry pi 3 to obtain an exclusive display on the browser , kiosk mode is used.

The Sensor is calibrated to read values after every 10 seconds as initially it requires to attain thermal equilibrium state to sense accurate temperature and humidity.
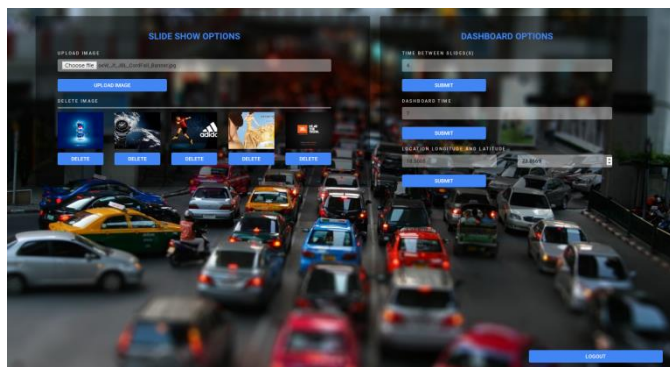

Fig -3: Control Panel

Figure-3 shows the screenshot of the control panel used in the back end of the digital signage board. We can also observe the current displaying advertisements in the control panel. The Control panel can be accessed by any device connected to the internet only with valid login credentials. The Figure-4 shows the real time traffic dashboard along with live traffic conditions as well as weather updates with current city news in the footer.
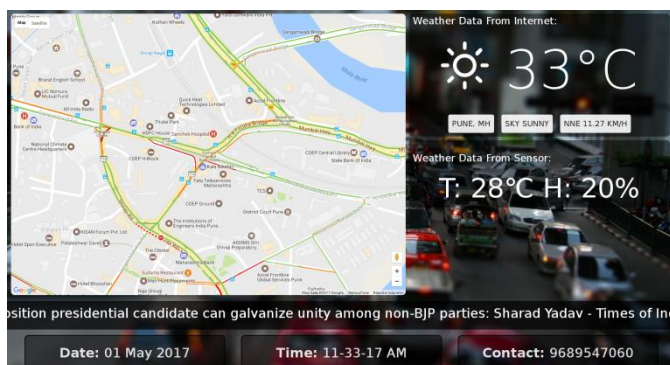

Fig -4: Traffic Dashboard

The front-end of the digital signage board will be a advertisement slideshow along with the traffic dashboard being displayed after every 3rd advertisement for a finite duration of time .The requests such as change time interval of the advertisements , time interval for traffic dashboard , location update for traffic data is being accepted on the control panel webpage and is passed on to the server. Server then updates the required variables and passes the value to the traffic dashboard. The passing of values from one webpage to another webpage becomes easy with the use of web servers.Figure-5 shows the advertisement display on the signage board.

Fig -5: Advertisement Board

Raspbian pixel OS needs a username and a password from user to log into the operating system. This phase removed, because it is improper for end user therefore, changes are made in terminal by using some scripts and the path of the webpage to be opened at startup is given in rc.local file which will execute the digital signage board code immediately after the operating system is booted at startup.

The Raspberry Pi 3 Model B is third generation model that maintains the same popular board format as the Raspberry Pi 2 and Raspberry Pi B+, but boasts a faster 1.2GHz 64Bit SOC, and on board WiFi and Bluetooth. The Raspberry Pi 3 has a Broadcom BCM2835 system on a chip (SOC), which includes an ARM11 700 MHz processor, VideoCore IV GPU. It does not include a built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage, with the Model B+ using a Micro SD. The Foundation provides Debian and Arch Linux ARM distributions for download. The Raspberry Pi 3 has an identical form factor to the previous Pi 2 and has complete compatibility with Raspberry Pi 1 and 2. It is recommended to use a 2.5A Power Supply with the Raspberry Pi 3.[7]

5. CONCLUSIONS

As the technology is advancing every passing day the display board systems are moving from static boards display to digital signage display. An efficient, effective, fast and cheap remotely managed embedded Digital Signage System architecture is designed, implemented, developed using raspberry pi 3 and web application. The

strength of our work lies not only in developing a compact size embedded digital signage systems, but also in implementing it within the reach of current hardware and software engineering technology. There are large number of applications for the system developed which can transform the advertising and marketing industry.

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