The Development Control System Digital Signage on the Bus via IoT Technology

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Abstract

The development control system digital signage on the BUS via IoT Technology This research aims to 1) develop a prototype for a digital signage control system on the bus with the technology internet of things; 2) provide a convenient way to users about reporting in the path of the bus as Specify GPS location, and; 3) develop a digital signage control systems to synchronize videos on buses, which can manage digital signage information via the Internet of Things technology. The researcher uses Raspberry Pi 3 to control the operation of the system with NodeJS platform, JavaScript language, MySQL database and GPS Module to locate the bus. A prototype technology has developed for testing before use. From the prototype system development, it can handle the problem of video synchronization and security, content expression, and the stability of the multimedia data transmission system to digital signage at a good level according to the evaluation criteria. By having experts evaluate the performance of the software and service users assess user satisfaction. There is a system performance evaluation from software experts is at a good level ($\bar{x}$ = 4.12, S.D. = 0.32) and the results of the satisfaction of users are at a good level ($\bar{x}$ = 3.99, S.D. = 0.63). In sum, it can be concluded that the system can achieve to set objectives.

Keywords: Digital signage, Internet of Things, NodeJS platform

Introduction

Internet technology has played a great role in our daily life, no matter what we do and where. Around us, we are always connected to the Internet. From the Thailand 4.0 model for driving Thailand towards prosperity. [1] Stability and sustainability in the 4th digital group and Digital & IoT- Embedded Technology, and sustainable tourism in Asia with a technology-driven mechanism with four main technologies, one of four aspects: Internet of Things. [2] Things that can be communicated and connected through both wired and wireless communication protocols. Various devices have methods for identification enable us to be aware of the environment, interact and work together. Communication ability of thing will lead to innovation and many new services. For example, sensors in the home detect the movement of residents and signal the order to turn on / off the light switch in different rooms with or without people, the device measures vital signs of patients /elderly and send information to medical personnel or send a message to call the emergency unit or ambulance, etc.

However, if everything is connected by the internet will bring many benefits that will have a positive effect on human life in terms of convenience and speed. Since all technology devices can communicate with each other to be most convenient for users, the Internet of things is useful in many areas. A good example is digital advertising media nowadays. [3] The media is necessary in that public relations is required anywhere and anytime for consumers to easily see and needs to be thoroughly implemented in every area through interesting points of installation for digital signage. Good examples of this is in public transport such as BTS sky trains, buses, public buses or the van, etc.

Digital signage is a sub-segment of electronic signage. Digital displays use technologies such as LCD, LED, projection and e-paper to display digital images, video, web pages, weather data, restaurant menus, or text. They can be found in public spaces, transportation systems, museums, stadiums, retail stores, hotels, restaurants and corporate buildings, etc., to provide wayfinding, exhibitions, marketing and outdoor advertising. [4] They are used as a network of electronic displays that are centrally managed and individually addressable for the display of text, animated or video messages for advertising, information, entertainment and merchandising to targeted audiences. [5]

Digital signage displays use content management systems. [6] Digital media distribution systems which can either be run from personal computers and servers or regional/national media hosting providers. In many digital sign applications, content must be regularly updated to ensure that the correct messages are being displayed. This can either be done manually as and when needed, through a scheduling system, using a data feed from a content provider. Whenever the display, media player and content server are located apart there is a need for audio-video wiring between the display and the media player and between the media player and the content server. The connection from media player to display is normally a VGA, DVI, HDMI or Component video connection. Sometimes this signal is distributed over Cat 5e, where 6 cables using transmitter and receiver baluns allowing for greater distances between display and player and simplified wiring. The connection from media player to the content server is usually a wired Ethernet connection although some installations use wireless WIFI networking, however, research shows this can lead to problems adjusting the synchronization of the videos. [7] Considering security, expression of the content, and stability of the system the transmission of multimedia data to digital signage because the bus will always keep moving. Therefore, to bring multimedia information installed or have updated advertising content will have to take a long time because there are many buses on each route.

Objective

1. Develop a prototype for digital signage control system on the bus with the internet of things (IoT) technology.
2. Provide convenience to user reporting in the path of the bus as specified with GPS location.
3. Develop digital signage control systems using the synchronization of videos on buses to be able to manage digital signage information via the Internet of Things technology.

Expected benefits

Administrators can use the digital signage control system to synchronization of video on the bus so they can manage digital signage information through the Internet of Things technology.

Users see advertising media. And know the report on the bus route as specified by GPS location.

Conceptual Framework.

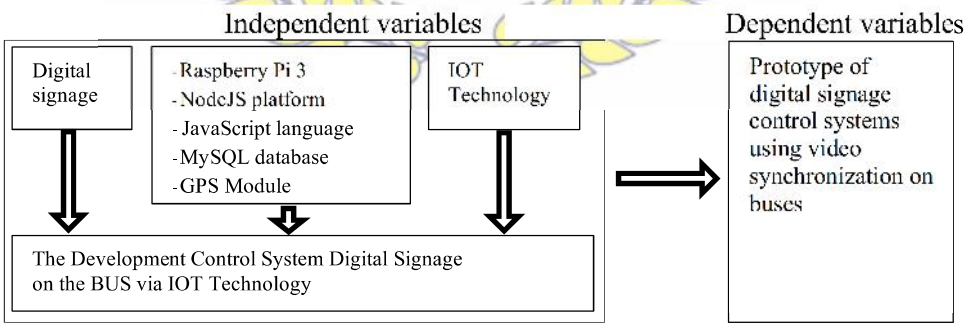

Figure 1 Diagram conceptual framework Digital signage control system

Figure 1 Diagram shows the Conceptual Framework. The Development Control System Digital Signage on the BUS via IOT Technology which consists of 3 independent variables. 1) Theories related to the system Digital signage. 2) Tools and technology used in the development of both Software and Hardware Raspberry Pi 3, NodeJS platform, JavaScript language, MySQL database and GPS Module. 3) The technology used to connect the data. These ultimately lead to the dependent variable, the prototyping of digital signage control systems using video synchronization on public transport.

Research Methodology

The researcher used the guidelines for the research process by using the SDLC methodology models are the frameworks used to design, develop and test the software project. The SDLC models are a set of procedures which are to be followed during the software development process. These SDLC

models make sure that software development is according to the needs of the client/customer [8] and ensure follows these following steps:
Analysis: The existing system is evaluated. Deficiencies are identified. This can be done by interviewing users of the system and consulting with support personnel.
Use case diagram a key concept of use case modelling is that it helps us design a system from the end user's perspective. It is an effective technique for communicating system behavior in the user's terms by specifying all externally visible system behavior.

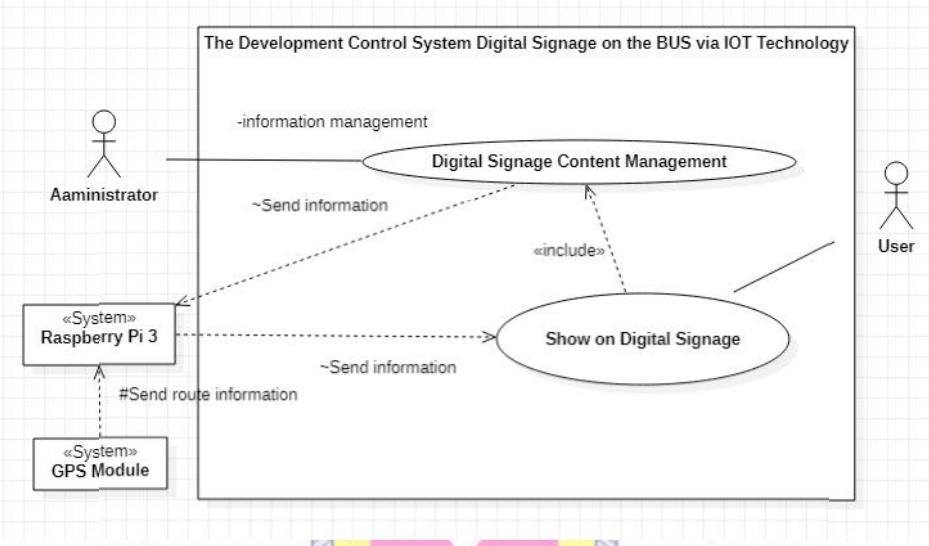

Figure 2 Use case diagram Digital signage control system

Figure 2 The process works as follows: Administrator manages digital signage information. The server sends information to System Raspberry Pi3 then send the information to digital signage screen the user sees data. Another part the System GPS Module send data to the System Raspberry Pi3 to show the location path.

Plan and requirements: The new system requirements are defined. In particular, the deficiencies in the existing system must be addressed with specific proposals for improvement. Other factors defined include needed features, functions and capabilities. The researcher has planned the system design as follows.

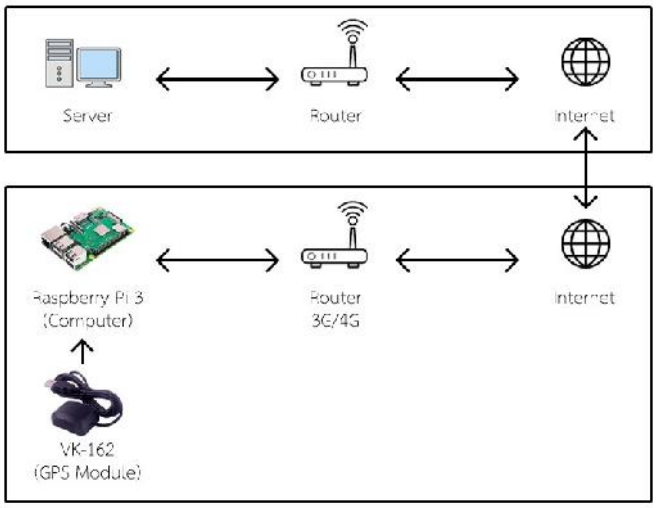

Figure 3 Design diagram Digital signage control system

Figure 3 Planning of operations in terms of controls it consists of a server that the administrator uses to communicate and send information to the Raspberry Pi3. There is a GPS module sending data

to the System Raspberry Pi3. Hardware devices include LED / LCD TVs, Raspberry Pi3, GPS modules and the internet on the BUS.

Design: The proposed system is designed. Plans are laid out concerning the physical construction, hardware, operating systems, programming, communications and security issues.

Hardware development tools 1) LED / LCD TV 2) Raspberry Pi3 3) GPS modules 4) Computer PC 5) Internet Network

The development in the client-server, software used in system development 1) NodeJs is software used to run scripts. 2) Mysql database 3) ExpressJs is a framework for displaying web pages for users. 4) Socket.io is a framework for connecting to other devices in real-time.

Development: The new system is developed. The new components and programs must be obtained and installed. Users of the system must be trained in its use.

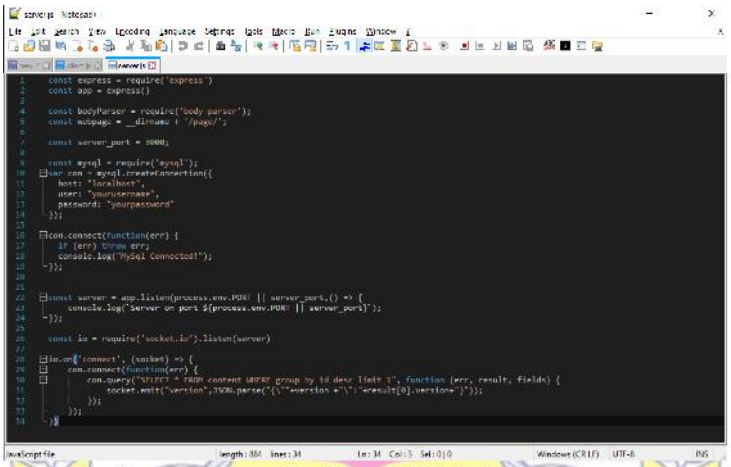

Figure 4 Coding programs for Server Digital signage control system

Figure 4. Program coding for a digital signage control server can be described as follows

1-2 Declare variables and call the express module.

4 Declare a variable and call the body-parser module.

5 variable declaration to store the path specifying the website file location

7 variable declaration to specify the port number

9 declare variables and run the mysql module.

10-14 variable declaration and configuration values for database connection

16-19 Use the connect function to check the database connection situation.

22-24 declare variable and use listen function by assigning port number from 7

26 Declare a variable and run the socket.io module.

28 – 34 when other devices are connected To extract data from the database. Then send back to the version box

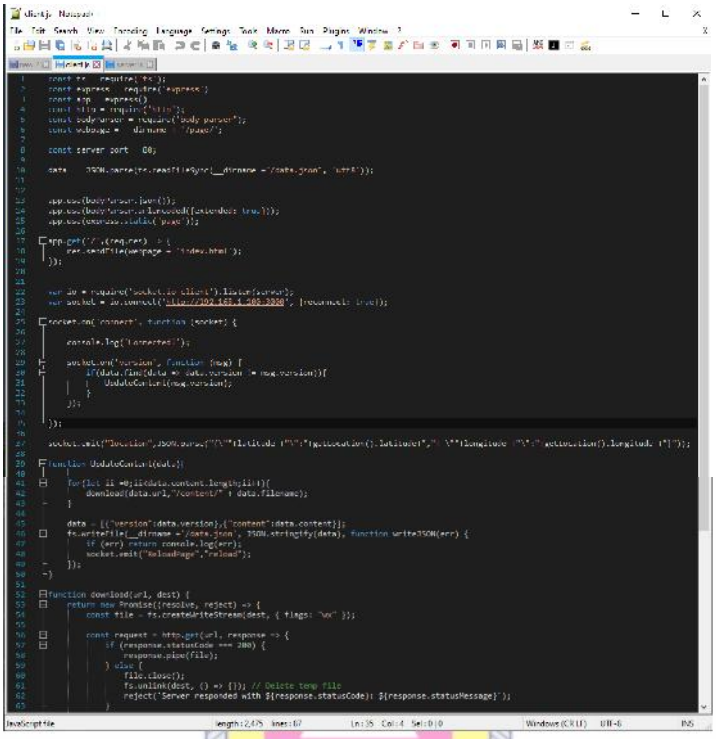

Figure 5 Coding programs for Client Digital signage control system

Figure 5 Coding programs for Client Digital signage control system is described as follows

1	declare a variable and call the fs module
2-3	Declare variables and call the express module.
4	Declare a variable and run the http module.
5	Declare a variable and call the body-parser module.
6	variable declaration to store the path specifying the website file location
8	variable declaration to specify the port number
10	Declare a variable and read the data in the data.json file.
13-15	Assign values to the express module.
17-19	When requesting via http, the webpage of the index.html file will be sent back.
22	declare a variable and call the module socket.io-client
23	variable declaration and make a connection to the server
25-35	once the server can be connected Connect to the version box and check if the ad set version is up to date. If not, call the function to update the ad set version.

Testing: All aspects of performance must be tested. If necessary, adjustments must be made at this stage. Tests performed by quality assurance (QA) teams may include systems integration and system testing.

To evaluate the effectiveness of the developed system, the developer used Black Box testing method to test the correctness of Input and Output of the system. The main method of evaluating the effectiveness of the system is the use of questionnaire to evaluate the effectiveness of the program. The steps in building the evaluation tools are 1) study the information about designing the questionnaire 2) selecting questions that are appropriate to the situation.

The evaluation of the effectiveness of the program is done by software experts and potential users. The software experts are 5 programmers who had experiences in programming, The steps in conducting evaluation are 1) invite the evaluators to trial out the program and test the evaluation form and schedule the testing date 2) start using the system and test the various aspects as outlined in the evaluation form 3) if there is mistake in the system, make suggestions to the developer and make improvements. Program Effectiveness Evaluation Criteria There are 5 criteria for program effectiveness evaluation conducted by the software experts: 1) Evaluation of system function from user experiences 2) Evaluation of user's demand 3) Evaluation of program function 4) Evaluation of program result 5) Evaluation of program safety.

The researcher uses 5 level rating-scale to evaluate the effectiveness of the program – both qualitatively and quantitatively, and the rating from program testers should rank over 4 to accept that the program is effective in real use condition. The 5 rating scale can be divided as follows: 4.50 – 5.00 as very good, 3.50 – 4.49 as good, 2.50 – 3.49 as mediocre, 1.50 – 2.49 as low, and 1.00 – 1.49 as lowest. The criterion to accept the effectiveness of the developed system would be based on the average score of the specialist group and general user group, the score should average around good level (score 3.50 – 4.49) to

accept that the system is effective in real-use condition.

Deployment: The system is incorporated in a production environment. This can be done in various ways. The new system can be phased in, according to application or location, and the old system gradually replaced. In some cases, it may be more cost-effective to shut down the old system and implement the new system all at once.

Maintenance: This step involves changing and updating the system once it is in place. Hardware or software may need to be upgraded, replaced or changed in some way to better fit the needs of the end-users continuously. Users of the system should be kept up-to-date concerning the latest modifications and procedures.

Research Results

System Development: The development control system digital signage on the BUS via IOT technology. The prototype has been developed by developing software and hardware which the system can do as follows:

When the BUS to station Control System Digital Signage In bus Will search for WIFI signal When the connection is successful. The software will connect to the server to check the version advertising content. If there is an ad version available on an older Bus Digital Signage. Please download the new set of advertisement data to the device. When the ad set data update is complete the software will reload the page to display the new display. If a new ad set is updated while still connecting to the server the software will immediately start updating the new advertising data. As for the server side administrators can manage, update, edit, and add creative sets. But cannot remove the ads removed.

In the system administrator section develop digital signage control systems using the synchronization of videos on buses to be able to manage digital signage information via the Internet of Things technology. Figure 6

Figure 6 Management interface Digital signage control system for administrators

In the next section is the content management page explanations for administrators.

Figure 7 Management content Digital signage for administrators

Provides convenience for reporting bus route users as specified in the GPS location and users can see the digital signage content in which the researcher tested the Bangkok-Pak Chong route show a screen showing bus routes, show a map Retrieved from the Google API, Shows the date, time display, distance and duration near the parking spot, and shows the information needed to display The font style runs at the bottom of the screen. Figure 8

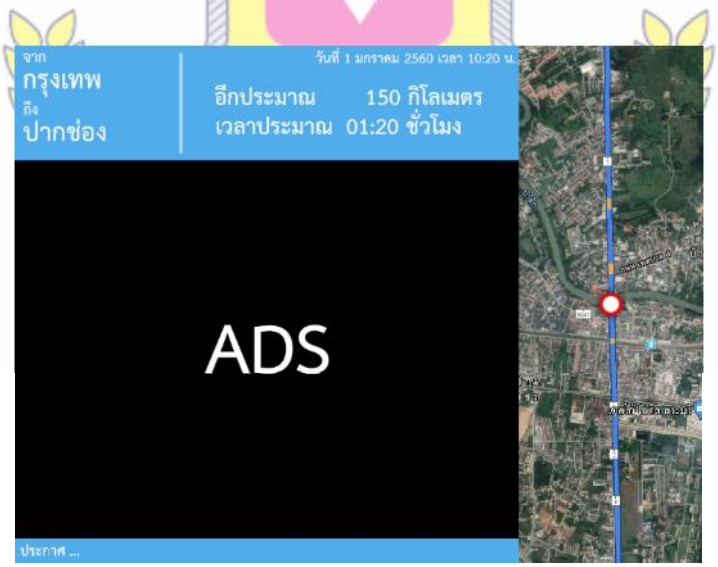

Figure 8 Screen display for users

Evaluation of the system effectiveness: The evaluation of system effectiveness based on 2 groups of evaluators: 1) 5 Software experts who are experienced programmers and 2) 20 user the result of the evaluation can be summarized as shown in table 1 and 2

Table 1 shows evaluation of effectiveness by Software experts

Evaluation list	Evaluation		
	$\bar{x}$	S.D.	Results
1. Evaluation of system function	4.37	0.29	Good
2. Evaluation of user's demand	3.97	0.42	Good
3. Evaluation of program function	4.23	0.13	Good
4. Evaluation of program result	4.01	0.49	Good
5. Evaluation of program safety	4.04	0.31	Good
Overall	4.12	0.32	Good

The evaluation of the system effectiveness by software experts show that the overall effective is at the good level ($\bar{x}$ = 4.12, S.D. = 0.32), and the effectiveness in each of the evaluation criteria are at good level as follows: Evaluation of system function ($\bar{x}$ = 4.37, S.D. = 0.29) Evaluation of user's demand ($\bar{x}$ = 3.97, S.D. = 0.42) Evaluation of program function ($\bar{x}$ = 4.23, S.D. = 0.13) Evaluation of program result ($\bar{x}$ = 4.01, S.D. = 0.49) and Evaluation of program safety ($\bar{x}$ = 4.04, S.D. = 0.31) respectively.

Table 2 shows evaluation of effectiveness by users

Evaluation list	Evaluation		
	$\bar{x}$	S.D.	Results
1. Evaluation of system function	4.17	0.62	Good
2. Evaluation of user's demand	3.84	0.83	Good
3. Evaluation of program function	3.84	0.73	Good
4. Evaluation of program result	4.43	0.18	Good
5. Evaluation of program safety	3.69	0.81	Good
Overall	3.99	0.63	Good

The evaluation of the system effectiveness by users show that the overall effective is at the good level ($\bar{x}$ = 3.99, S.D. = 0.63), and the effectiveness in each of the evaluation criteria are at good level as follows: Evaluation of system function ($\bar{x}$ = 4.17, S.D. = 0.62) Evaluation of user's demand ($\bar{x}$ = 3.84, S.D. = 0.73) Evaluation of program function ($\bar{x}$ = 3.84, S.D. = 0.73) Evaluation of program result ($\bar{x}$ = 4.43, S.D. = 0.18) and Evaluation of program safety ($\bar{x}$ = 3.69, S.D. = 0.81) respectively.

Discussion and Conclusions

The development control system digital signage on the BUS via IOT Technology This research aims to: 1) Develop a prototype for digital signage control system on the bus with the technology internet of things. 2) Can provide convenience to user reporting in the path of the bus as Specify GPS location. 3) Develop digital signage control systems the synchronization of the videos on buses to be able to manage digital signage information via the Internet of Things technology. In terms of system development, the researcher uses the System Development Life Cycle (SDLC) and Unified Modelling Language (UML) in system design. Development tools researcher use the Raspberry Pi 3 to control the operation of the system. NodeJS platform, JavaScript language, MySQL database and GPS Module to use the location of the bus. Is a prototype technology development for testing before use. From the prototype system development, it can handle the problem of video synchronization and security, content expression, and the stability of the multimedia data transmission system to digital signage at a good level according to the evaluation criteria. By having experts evaluate the performance of the software and service users assess user satisfaction. In evaluating system performance researcher use Program Effectiveness Evaluation Criteria There are 5 criteria for program effectiveness evaluation conducted by the software experts: 1) Evaluation of system function from user experiences 2) Evaluation of user's demand 3) Evaluation of program function 4) Evaluation of program result 5) Evaluation of program safety. There is a system performance evaluation from software experts is at a good level ($\bar{x}$ = 4.12, S.D. = 0.32) and the results of the satisfaction of users are at a good level ($\bar{x}$ = 3.99, S.D. = 0.63). It can be concluded that the system can be used practically. Should improve the speed of the internet to increase the speed of data transfer, increase the storage capacity of the client.

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