International Journal of Control and Automation
Vol.8, No.8 (2015), pp.171-180
http://dx.doi.org/10.14257/ijca.2015.8.8.18

Development of the Visualization Tool for the Automatic Variable Message Generator of VMS Emulator System

Jung-Sook Kim[1]

[1] *Division of Smart IT, Kimpo University*
Gimpo-si, Geyonggi-do, Korea
kimjs@kimpo.ac.kr

Abstract

A VMS (Variable Message Signs) has the different sizes and various shapes according to the city scene and the kinds of road and it has to be displayed by variable message on the display device panel in real-time. So, VMS manufacturers must produce the different products each order made. In addition that, they should test and check the correct operation to each VMS order made goods using the variable message frame. That is very time and workers consuming and a VMS emulator with automatic variable message generator system using visualization tool is necessary. In this paper, we implement the visualization tool for the VMS emulator with automatic variable message generator which can generate the data fields that consists of the variable and different message frame and can generate many kinds of window controls in order to input the valid data value for the instances of data field easily using the visualization tool.

Keywords: *Visualization tool, VMS Emulator system, Automatic variable message generator system, Variable message signs (VMS), Intelligent transportation system (ITS), Client/Server model, Scheduling policy*

1. Introduction

Intelligent transportation systems (ITS) are advanced applications which, without embodying intelligence as such, aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks. To be effective, an intelligent transportation system must provide the correct real-time traffic-related information using a variable message signs. A variable message sign, often abbreviated VMS, is an electronic traffic sign often used on roadways to give travelers information about special events. Such signs warn of traffic congestion, accidents, incidents, roadwork zones, or speed limits on a specific highway segment. In urban areas, VMS are used within parking guidance and information systems to guide drivers to available car parking spaces. They may also ask vehicles to take alternative routes, limit travel speed, warn of duration and location of the incidents or just inform of the traffic conditions. The information comes from a variety of traffic monitoring and surveillance systems. It is expected that by providing real-time information on special events on the oncoming road, VMS can improve vehicles' route selection, reduce travel time, mitigate the severity and duration of incidents and improve the performance of the transportation network [1-7]. However, VMS has the different sizes and various shapes according to the city scene and the kinds of road and it has to be displayed by variable size message on the display device panel according to the predefined scheduling policy in real-time. And the VMS manufacturers have to produce the different products each order made. In addition that, they should test and check the correct operation to each VMS order made goods using the variable message frame. But, they don't have the test data and they must go an operational data center or a

ISSN: 2005-4297 IJCA

transport institute to get the test data. That is very time and workers consuming. In order to that solve the problem, a VMS emulator system with automatic variable message generator system is necessary. The VMS emulator system with automatic variable message generator system has the following functions; 1) generates the data fields for the variable message frame; 2) filled out the valid data value into data field that has various data types and variable data sizes; 3) communication method from server to client vice versa; 4) scheduling policy and method in real-time. In this paper, we design and implement the visualization tool for the VMS emulator with automatic variable message generator which can generate the data field which consists of the variable message frame and can generate many kinds of window controls in order to input the valid data value for the instances of data field easily using the visualization tool. As the result, a manufacturer of VMS does not need to go the field or data center to get the variable message frame for testing the VMS order made goods.

The structure of this paper is as follows. Section 2 briefly introduces related works. Section 3 describes the visualization tool of the VMS emulator system with automatic variable message generator system and section 4 presents its implementation and results details. Finally, the conclusions are drawn and the future study is discussed in section 5.

2 Related Works

A. Intelligent Transportation System

Intelligent transportation systems (ITS) are advanced applications which, without embodying intelligence as such, aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks. Although ITS may refer to all modes of transport, EU Directive 2010/40/EU (7 July 2010) defines ITS as systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport. Intelligent transport systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitor applications, such as security CCTV systems; and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information; bridge de-icing (US deicing) systems; and the like. Additionally, predictive techniques are being developed to allow advanced modelling and comparison with historical baseline data. Recent advances in vehicle electronics have led to a move towards fewer, more capable computer processors on a vehicle. A typical vehicle in the early 2000s would have between 20 and 100 individual networked microcontroller/Programmable logic controller modules with non-real-time operating systems. The current trend is toward fewer, more costly microprocessor modules with hardware memory management and Real-Time Operating Systems. The new embedded system platforms allow for more sophisticated software applications to be implemented, including model-based process control, artificial intelligence, and ubiquitous computing. Perhaps the most important of these for Intelligent Transportation Systems is artificial intelligence [1].

A. Variable Message Signs

A variable- (also changeable-, electronic-, or dynamic-) message sign, often abbreviated VMS, CMS, or DMS, and in the UK known as a matrix sign, is an electronic traffic sign often used on roadways to give travelers information about special events. Such signs warn of traffic congestion, accidents, incidents, roadwork zones, or speed

limits on a specific highway segment. In urban areas, VMS are used within parking guidance and information systems to guide drivers to available car parking spaces. They may also ask vehicles to take alternative routes, limit travel speed, warn of duration and location of the incidents or just inform of the traffic conditions. A complete message on a panel generally includes a problem statement indicating incident, roadwork, stalled vehicle etc.; a location statement indicating where the incident is located; an effect statement indicating lane closure, delay, etc. and an action statement giving suggestion what to do traffic conditions ahead. These signs are also used for AMBER Alert and Silver Alert messages. In some places, VMSes are set up with permanent, semi-static displays indicating predicted travel times to important traffic destinations such as major cities or interchanges along the route of a highway. The information comes from a variety of traffic monitoring and surveillance systems. It is expected that by providing real-time information on special events on the oncoming road, VMS can improve vehicles' route selection, reduce travel time, mitigate the severity and duration of incidents and improve the performance of the transportation network [2-4].

3 Visualization tool for the Automatic Variable Message Generator

A. System Structure

The VMS emulator system with automatic variable message generator is composed of client/server model. The client is various information services panel such as VMS and PMS and the server is for controlling the system and it supports the seven functions which are a message processor, a message generator, a message sender, a job configurator, a job scheduler, a message configurator, and a message logger. The following figure 1-A and 1-B show the VMS emulator system structure with automatic variable message generator system.

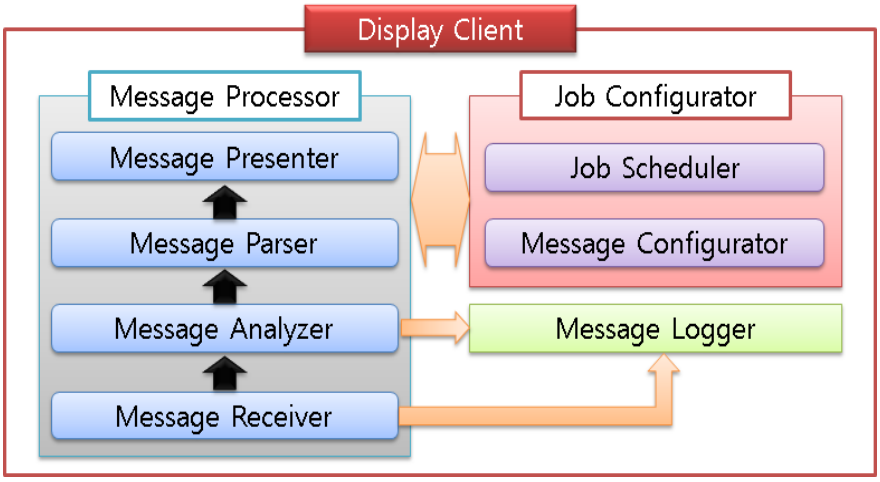

Figure 1-A. Client of A VMS Emulator

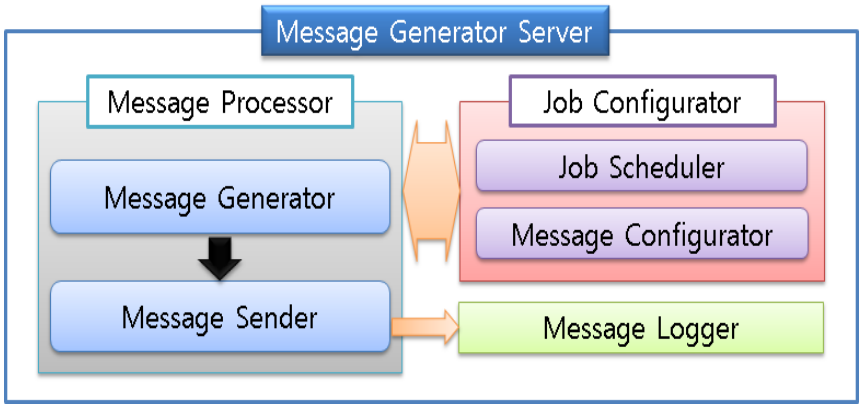

Figure 1-B. Server of A Vms EMULATOR

B. Visualization Tool for the Automatic Variable Message Generator

The automatic variable message generator system has the following functions; 1) generate the data fields for the variable message frame; 2) filled out the valid data value into data field that has various data types and variable data sizes. To be effective, a VMS must communicate a meaningful message that can be read and understood by motorists within a very short time period. And message design involves recognition of the basic principles for the following: 1) Message content refers to specific information displayed on a VMS. 2) Message length refers to rather the number of words or the number of characters and spaces in a VMS message. 3) Message load refers to the amount of information in the total message, usually expressed in terms of units of information. 4) Unit of informational refers to the answer to a question a motorist might ask. 5) Message format refers to the order and arrangement of the units of information on a VMS [2]. In order to generate the variable message frame automatically, we must set the data fields which consists of the message frame on the table in database using visualization tool. An example message frame contains many data fields such as STX, LOCAL ID, FRAME NO, TOTAL FRAME NO., MAIN OPCODE, SUB OPCODE, DATA SIZE, DATA, and CRC. The figure 2 shows the examples of the variable message frame. As you can see in figure 2, the each message frame has a variable and different message frame that has the variable data length and the different data fields. In addition that, the sequence of the data fields is arranged according to each order made goods. Also, the valid instance values of any data field of the message frame are composed of the complex data type. And generating of the general message frame and the filled out of the instance values of the data filed of the message frame are difficult. As a result, we developed the automatic variable message generator of VMS emulator system using visualization tools. At first, if you want to generate the variable message frame then you can set the necessary parameters of the message frame which are a frame name, the names of data fields, the data length, data type, and etc to the parameter setting window dialog. After that, you must fill out the valid instance values of data fields of the message frame using window controls such as a textbox, a comboBox, a checkbox, a RadioButton, and etc easily.

SENDER IP	DESTINATION IP	CONTROLLER KIND	CONTROLLER STATION NUMBER	CONTROLLER NUMBER	TOTAL LENGTH	OPCODE	DATA FILED
16	16	2	2	2	4	1	N

STX	OPCODE	FRAME NUMBER	TOTAL FRAME NUMBER	DATA SIZE	DATA	CRC – 16	ETX
1	1	1	1	3	N	2	1

Figure 2. Examples of the Variable and Different Message Frame

C. VMS Emulator System

The VMS emulator system for the variable message signs is composed of client/server model. The client is various information services panel such as VMS and PMS and the server is for controlling the system and it supports the seven functions which are a message processor, a message generator, a message sender, a job configurator, a job scheduler, a message configurator, and a message logger. And the VMS emulator with automatic variable message generator system has the following functions; 1) generate the data fields for the variable message frame; 2) filled out the valid instance value into data field that has various data types such as primitive or complex data type and variable data sizes; 3) communication method from server to client vice versa; 4) scheduling policy and method in real-time. The scheduler operates on schedule. So, it makes the events according to scheduling policy. And you must establish the efficient scheduling policy. After that, you can set the required condition parameters to operate the scheduler. If the condition of the scheduler is time interval, then you must set the starting time and the time interval. The VMS are playing increasingly important roles in attempts to improve highway safety, operations, and use of existing facilities. VMSs are traffic control devices used for traffic warning, regulation, routing and management, and are intended to affect the behavior of drivers by providing real-time traffic-related information. The real-time information not only benefits individual drivers and the responsible transportation agency, but also the general public. Motorists are interested in reaching their destinations as safely as possible without undue delays. The transportation agency is interested in utilizing the available highway capacity of the corridor or network and to improve safety and mobility. The general public desires satisfaction of its demands for safe transportation with the least possible adverse environmental impacts due to noise and air pollution. And VMSs are programmable traffic control devices that can usually display any combination of characters to present messages to motorists.

4. Implementation and Results

We have implemented the visualization tool for the VMS emulator with the automatic variable message generator which can generate the data fields that consists of the variable message frame and can generate many kinds of window controls in order to input the valid data value for the instances of data field easily using the visualization tool. The figure 3 shows a window dialog for setting the parameters to generate the frame name which consists of variable message frame at first. As you can see in figure 3, you could generate the variable message frame automatically and easily because you just put several parameters and click the buttons in a window dialog which is for setting the parameters using visualization tool. As a result, the variable message frame is generated what you want to be

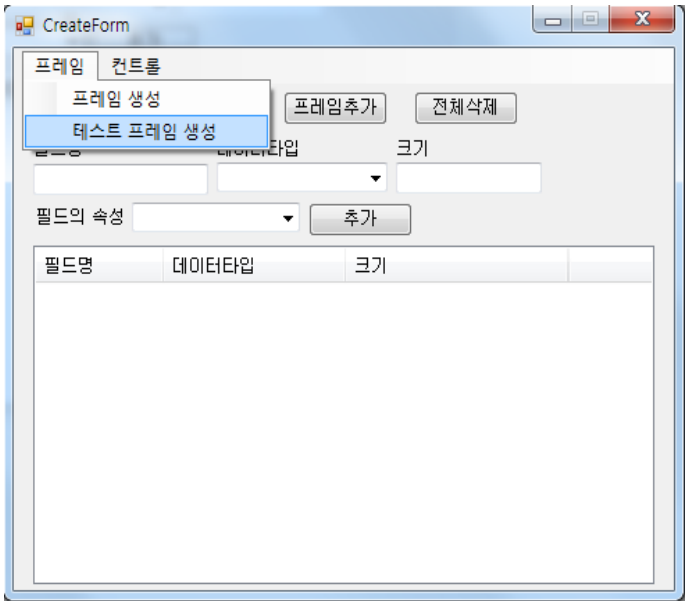

Figure 3. A Parameter Setting Window

The middle of the following figure 4 shows a ComboBox which contains the instance lists of data field. At first, the user selects a data field in a table. That data field has the complex data type for the instance value and the user move the mouse focus to the ComboBox. After that, the user selects the data field list in the ComboBox for generating the window control for the input of the valid instance values of the data field on the window dialog.

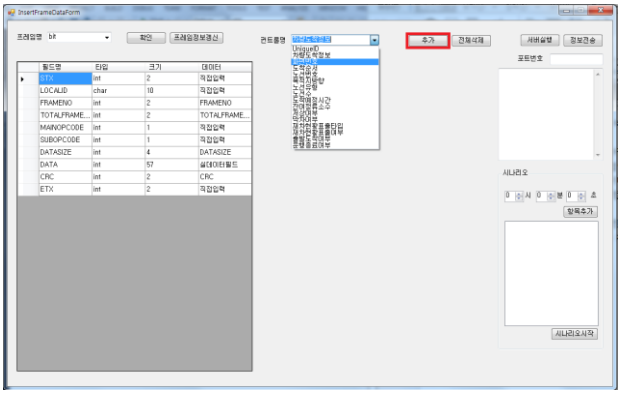

Figure 4. Visualization Tool for the Input of the Valid Data

As you can see in figure 5, you can set the parameters as many you need for generating window control of visualization tool. The kinds of parameter are a control type such as a RadioButton, a TextBox, a CheckBox, a ComboBox and etc, the number of control, a name of control, the size of control, and a data type of control.

Figure 5. Control Window

The figure 6 shows the result of the window control generation such as the CheckBox and a ComboBox using visualization tool for filling the instance values of the data fields which have the complex data type.

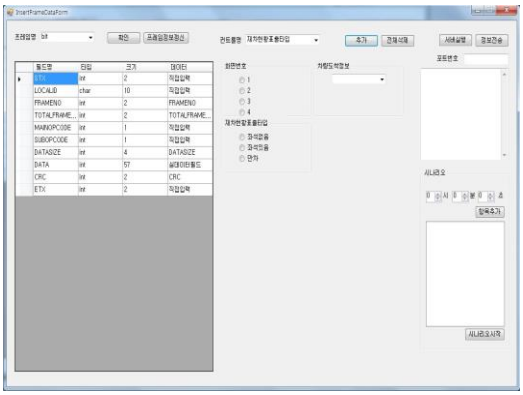

Figure 6. The Result Window Dialog

The figure 7 shows a window dialog for setting the parameters to generate the variable message frame efficiently. This result is for BIS (Bus Information System).

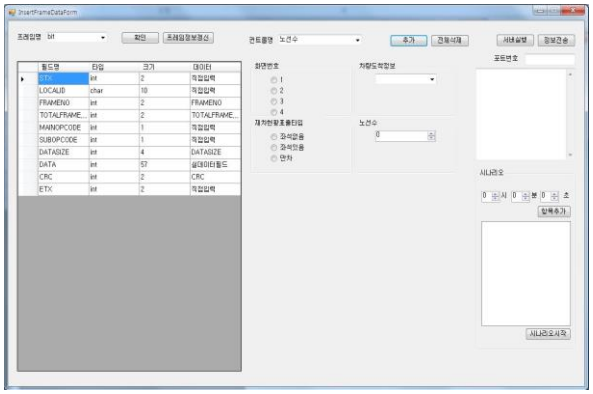

Figure 7. A Parameter Setting Window

Permanently mounted VMSs are used primarily for the following applications: Caused by random, unpredictable incidents such as crashes, stalled vehicles, spilled loads; or caused by temporary, preplanned activities such as construction, maintenance, or utility operations; Caused by acts of nature such as fog, floods, ice, snow, and etc; Problems associated with special events; Operational features such as high occupancy, reversible,

exclusive or contraflow lanes and certain design features such as drawbridges, tunnels, ferry services. VMSs can be an effective tool for communicating with motorists. However, displaying messages that are too long for motorists to read at prevailing highway speeds or that are too complex or inappropriately designed leading to motorist confusion, can adversely affect both traffic flow and the transportation agency's credibility. Also, for a specific type and design of VMS, the available message exposure time dictates the maximum length of message that can be displayed for a given highway operating speed. As you can see figure 8, you can generate the variable message frame automatically and easily because you just put several parameters and click the buttons in a window dialog which is for setting the parameters. As a result, the variable message frame is generated what you want to be.

Figure 8. Result of Input of Instance Values

The bottom of left-side of the figure 9 shows the connection of a client and a server of the VMS emulator. The top of left-side of the figure 9 shows the client which is displaying the message on the panel. The message on the panel is received from the server of VMS emulator. The server generates the messages and sends them to the client using TCP/IP socket connection.

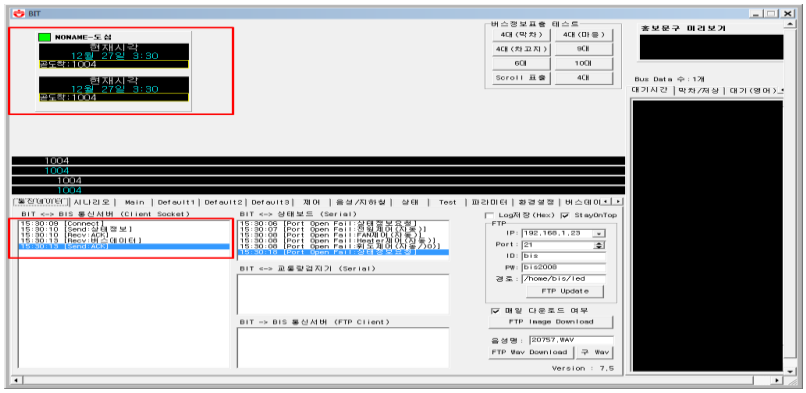

Figure 9. A VMS Emulator

The scheduler operates on schedule. So, it makes the events according to scheduling policy. And you must establish the efficient scheduling policy. After that, you can set the required condition parameters to operate the scheduler. If the condition parameter is time interval, then you must set the starting time and the time interval. The figure 10 shows the real-time scheduling results for displaying message on the client panel. As you can see in figure 10, starting time is 5 pm and the time interval is 5 minutes.

Figure 10. Scheduler of the VMS Emulator

5. Conclusions and Future Work

The VMS emulator with automatic variable message generator system has the following functions; 1) generate the data fields for the variable message frame; 2) filled out the valid instance value into data field that has various data types such as primitive or complex data type and variable data sizes; 3) communication method from server to client vice versa; 4) scheduling policy and method in real-time. In this paper, we design and implement the visualization tool for the VMS emulator with automatic variable message generator which can generate the data field that consists of the variable message frame and can generate many kinds of window controls in order to input the valid data value for the instances of data field easily using the visualization tool. As the result, a manufacturer of VMS does not need to go the field or data center to get the variable message frame for testing the VMS order made goods. VMS has the different sizes and shapes according to the city scene and it has to be displayed by different message on the display panel in real-time. And VMS manufacturers must produce the different products each order. The VMS emulator system with automatic variable message generator is composed of client/server model. The client is various information services panel such as VMS and PMS and the server is for controlling the system and it has the seven functions which are a message processor, a message generator, a message sender, a job configurator, a job scheduler, a message configurator, and a message logger. In the future work, we will study the efficient real-time scheduling policy and method for the VMS emulator.

Acknowledgments

This work (Grants No. C0146186) was supported by Business for Cooperative R&D between Industry, Academy, and Research Institute funded Korea Small and Medium Business Administration in 2013. And this paper is a revised and expanded version of a paper entitled “Development of the Visualization Tool for the Automatic Variable Message Generator” presented at CST2015, Suzhou (China), 23-25, April, 2015.

References

[1] .http://en.wikipedia.org/wiki/Intelligent_transportation_system#Emergency_vehicle_notification_systems
[2] http://en.wikipedia.org/variable-message_sign
[3] Operations office of travel management, “Changeable Message Sign Operation and Messaging Handbook,” Federal Highway Administration, **(2009).**
[4] Jung-Sook Kim, “Development of the VMS Emulator System“, International Journal of Control and Automation, Vol. 7, No. 11, pp. 323-330, **(2014)**

[5] Y. J. Joo, C. H. Ham, "Quality Control Scheme of GIS – based Bus Network for Stabilization of BIS – Focusing on Real-time Public Transportation Information ", Journal of KOGSIS, Vol. 20, No. 1, pp. 33-41, **(2012**).
[6] O. H. Kwon, Y. L. Jang, S. Y. Go, S. G. Baik, "The Development of Traffic Information Service System for Underground Highway", Proc. 2011, No. 2, pp. 165-171, **(2011)**
[7] J. H. Kim, H. Jin, S. C. Kim, "Design of Adaptive Vehicular Agents Model", International Journal of Control and Automation, Vol. 7, No. 7, pp. 415-422, **(2014)**

Author

Jung-Sook Kim, she received the B.S., M.S., and Ph.D. degrees in computer engineering from Dongguk University, Seoul, Korea in 1993, 1995 and 1999, respectively. She is a professor in school of Smart IT at Kimpo University. Her research interests include in the fields of intelligent systems, IT convergence, and distributed and parallel system.

