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Multimedia-Based Highway Information System (MMHIS) Enhancements and Support

Kelvin C.P. Wang, Xuyang Li, Robert P. Elliott

Final Report

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MULTIMEDIA-BASED HIGHWAY INFORMATION SYSTEM (MMHIS) ENHANCEMENTS AND SUPPORT

PROJECT OBJECTIVES

The MMHIS is a system that allows an end-user to view a digitized video of a particular highway in a window on their computer screen, with the corresponding data for that particular location shown in other windows. The other windows include a site data window, which displays information from the Highway Inventory, Job Record, Accident, and Pavement Management databases, and two graphical windows indicating roughness and rutting data.

The objectives of this project were:
1. Conversion from an MPEG-based system to a JPEG-based system, which will allow use of the system on any computer in the Arkansas Highway and Transportation Department (AHTD) instead of a limited number of specialized workstations. This will eliminate the duplication of effort between Pavement Management and MMHIS staff.
2. Provide the end-user the ability to print the video frame for distribution to field personnel.
3. Provide the capability to customize the data displayed.
4. Provide flexibility in the database design to allow additional data and imagery to be added to the system.
5. Provide technical support in the statewide implementation process.

FINDINGS

The findings of the research determined that:
1. It is feasible to digitize JPEG imagery from the videotapes and utilize them in the MMHIS
2. The conversion of the MMHIS to JPEG imagery will reduce the network bandwidth required by the system.
3. JPEG imagery can be utilized on any computer without additional add-in cards, reducing costs and maintenance of the MMHIS.
4. JPEG-based imagery will facilitate the ability to print the image easily.

RESULTS

The MMHIS has been implemented at the AHTD Central offices and various District offices that are connected to the Central Office via fiber optics. As of January 1, 2003, over 100 computers are now able to access the system. Computer Services Division of the AHTD installs the MMHIS as a standard application on the majority of the new computers. Servers are being installed in remote offices in order to provide them with access to the routes for which they are responsible. The Federal Highway Administration has requested the installation of MMHIS on their computer system.

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16. Abstract

In 1995, Arkansas State Highway and Transportation Department (AHTD) initiated a study (TRC 9606) on pavement management, which led to the development of the Multimedia based Highway Information System (MMHIS) and the completion of the second project (TRC 9904) for MMHIS implementation. The primary goal of this project (TRC 0202) was to improve on certain features of MMHIS, add several functions, and provide technical support in the statewide implementation process of MMHIS. A revised user interface in the Windows environment allows users to view accident data, bridge information, job status, roadway inventory and other items. Even though the key features of the new MMHIS remain similar to the MMHIS completed with project TRC 9904, the refinements made in this project make MMHIS more user friendly and more productive in AHTD' operational environment.

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Project Abstract

In 1995, the Arkansas State Highway and Transportation Department (AHTD) initiated a study (TRC 9606) on pavement management, which led to the development of the Multimedia-based Highway Information System (MMHIS) and the completion of the second project (TRC 9904) for MMHIS implementation. The primary goal of this project (TRC 0202) was to improve on certain features of MMHIS, add several functions, and provide technical support in the statewide implementation process of MMHIS. The major modification accomplished during this project was the conversion of the MMHIS from an MPEG-based system into a JPEG-based system. This allows the AHTD to utilize the same video format used in Roadware's Surveyor™ software to be used in the MMHIS, saving the AHTD time spent digitizing two different formats and conserving electronic video storage space. Even though the key features of the new MMHIS remain similar to the MMHIS completed with project TRC 9904, the refinements made in this project make MMHIS more user friendly and more productive in AHTD's operational environment.

Acknowledgement

Introduction

In 1995, the Arkansas State Highway and Transportation Department (AHTD) contracted with the University of Arkansas to develop a pavement management system (TRC 9606). As a result of this project, a Multimedia-based Highway Information System (MMHIS) was developed. MMHIS allows the end-user to view a digital video of a highway section on the computer screen with corresponding site data for this location. Additional features of the MMHIS include the display of the corresponding roughness and rutting data as collected by AHTD's ARAN data vehicle, and a graphical display of pavement distress.

Realizing the potential of MMHIS to provide AHTD with a system that can greatly enhance the ability of a designer or planner to quickly resolve questions regarding a roadway feature without conducting a field inspection, AHTD in 1998 funded another project to implement the MMHIS (TRC-9904). By the second half of 2000, the initial implementation of the MMHIS at AHTD headquarters had been successful, even though the implementation was limited in scope. Eleven engineering workstations were connected to the MMHIS server throughout the Department.

In 2001, the AHTD funded a third project to further enhance the MMHIS and convert the video subsystem from MPEG-2 video to JPEG images. Utilization of JPEG images allowed the addition of several features such as the ability to print the current frame, play the video in reverse, and single frame advance and reverse. It also utilizes the same imagery required by Roadware's Surveyor™ software eliminating duplication of effort while reducing the storage requirements of the imagery.

The MMHIS completed in this project has several enhancements. MMHIS is more flexible for data archiving and displaying. Newly added utilities make the MMHIS more robust and user friendly.

Basic Features of the MMHIS

On the hardware side, MMHIS uses the AHTD network to communicate with the data server, which stores the databases and images for the highways. Each client workstation has the MMHIS system installed. Special hardware is not needed for either the server or the clients, unlike the previous system, which required MPEG-based decoder cards in each of the client machines.

On the software side, MMHIS is a collection of modules that work with each other to form an integrated operating environment. It is a normal Microsoft Windows NT/2000/XP application that also runs on Windows 9x. However, Windows 9x is not recommended because of system restrictions on multitasking and multithreading. The Microsoft Windows NT class system is the platform for MMHIS. At the AHTD, the standard operating environment is the Windows 2000 platform with some workstations running Windows 98.

The highway data is stored in Microsoft Access databases. Open Database Connectivity (ODBC) is used as the database access method. The highway right-of-way images are stored in JPEG files and indexed into a JPEG index file, which points to the individual images. As in the previous version of MMHIS, the images are linked to the corresponding data through frame numbers. This linkage allows the system to display the data that corresponds to the current image being displayed.

Even though the system has undergone some changes behind the user interface, the operation of MMHIS remains the same as in the previous versions. The user can query a route and section by selecting the route, section, direction, year, and logmile of that specific location. The system displays the highway data, the right-of-way image, and graphs for roughness and rutting in separate windows. Because of the change in the video format, MMHIS now allows the user to run the video both forward and backward at different speeds. The user can also print the current frame. Queries can be saved and reopened in MMHIS. Other user-interface elements remain unchanged:

- the graph window can be dragged to move the location to a different mile/kilometer;
- the site data can be displayed in a user-defined format which the MMHIS saves until the user changes the format;
- the font and sizes can be changed;
- the video slider can be dragged to a different location and all of the data is updated to reflect the new location;
- new locations can be specified precisely using the same interface as before.

Enhancements to the MMHIS

- Support was added for a three-camera high-resolution (1300x1030 pixels) system that will provide the user the ability to view the front, left, or right side images when this capability is added to the ARAN data collection vehicle.
- Video images can be "fit-to-window" allowing laptops or other small displays to display the full JPEG image.
- Video images, when displayed without the "fit-to-window" option active, can be dragged around in the video window by clicking and holding the left mouse button while dragging the image. This feature is required when viewing high-resolution (1300x1030 pixels) images.
- An install program was created for the MMHIS to allow more efficient installation by Department personnel.
- The MMHIS utilizes JPEG images instead of MPEG-2 video.
- The MMHIS can print the current image.
- The efficiency of the video module is improved.
- The video can be played at different speeds both forward and backward.
- The video can be stepped through frame-by-frame.
- The video frame can be displayed in its native size (to improve efficiency) or stretched to the window's size to fit the users display device.
- Scaling has been added to the graphing modules. The current scale and the maximum value for the section are displayed on the caption bar of the windows.
- Tick marks have been added to the graph display.
- The behavior of the Enter key has been changed for the index-building module. The new behavior allows the author to use the enter key to advance to the next field.
- The rounding tolerance has been enhanced so that errors caused by unit conversions are eliminated.
- The default unit has been changed from "Metric" to "English."

Data Synchronization

The data synchronization method is unchanged from the previous version of MMHIS. On the authoring side, because of the inconsistent nature of the data sources, bridge points and other known locations such as the junctions of state highways are used as reference points for data synchronization. The creation of the indexes is achieved by interpolating the data points between bridges and other known locations.

On the playback side, the system constantly monitors the current image being displayed. It checks the index and finds the corresponding data records for the current image. The system retrieves all the related data (including PMS, roadway inventory, bridge, accident, and job record data) and organizes them in a user-friendly format.

System Administrator Operations

Template database tables were provided to assist the system administrators in authoring the databases for the MMHIS. The system administrators copy these templates to new tables and populate them with data for the new routes. The procedure for populating the new tables is exactly the same as in the previous versions.

Launching the MMHIS

The user double clicks on the MMHIS icon on the desktop to launch MMHIS. The program opens the main window as illustrated below.
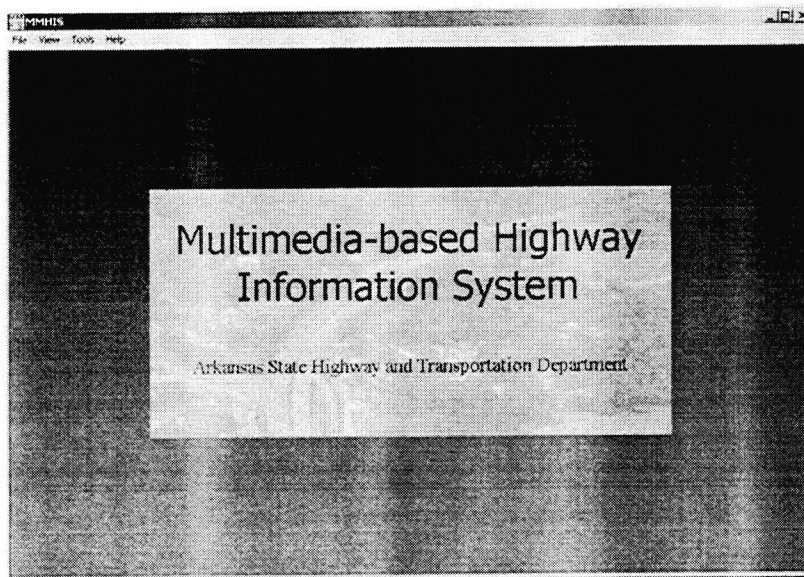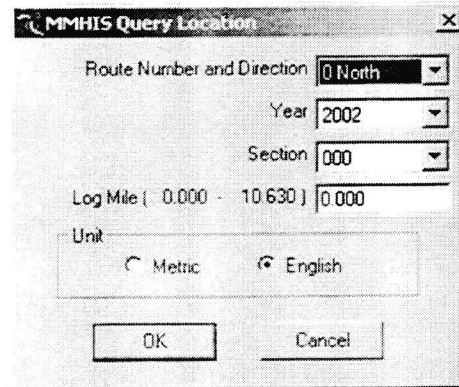
CONDUCTING A QUERY

To query the MMHIS, the user should follow these steps:

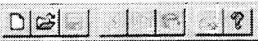### 1. Opening a new query.

Select from the menu *File | New*. The following MMHIS Query Location window will appear on the screen.


Select the route number and direction, year, section and the logmile corresponding drop-down lists. The log mile will be in the unit specified by the unit selector shown at the lower part of the window. Click OK after everything is specified. The system will open the database and the corresponding video file if the data for the specified location can be queried. If the location does not have complete data sets saved in the database, specifically, if the pavement management system data and the roadway inventory data are missing, the query will not continue. The following message is shown instead.
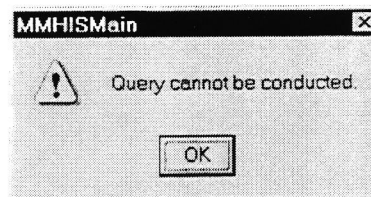
Hitting OK will return to the main window of MMHIS.

Note: The first button on the toolbar can be used as a shortcut of the above menu selection to conduct a new query. If the toolbar is not displayed in the window, use the menu item *View | Toolbar* to display it.

A successfully opened query shows the site data in a window, the video in another window, and two additional windows showing roughness and rutting data in a graphical display. The following image shows a successful query.
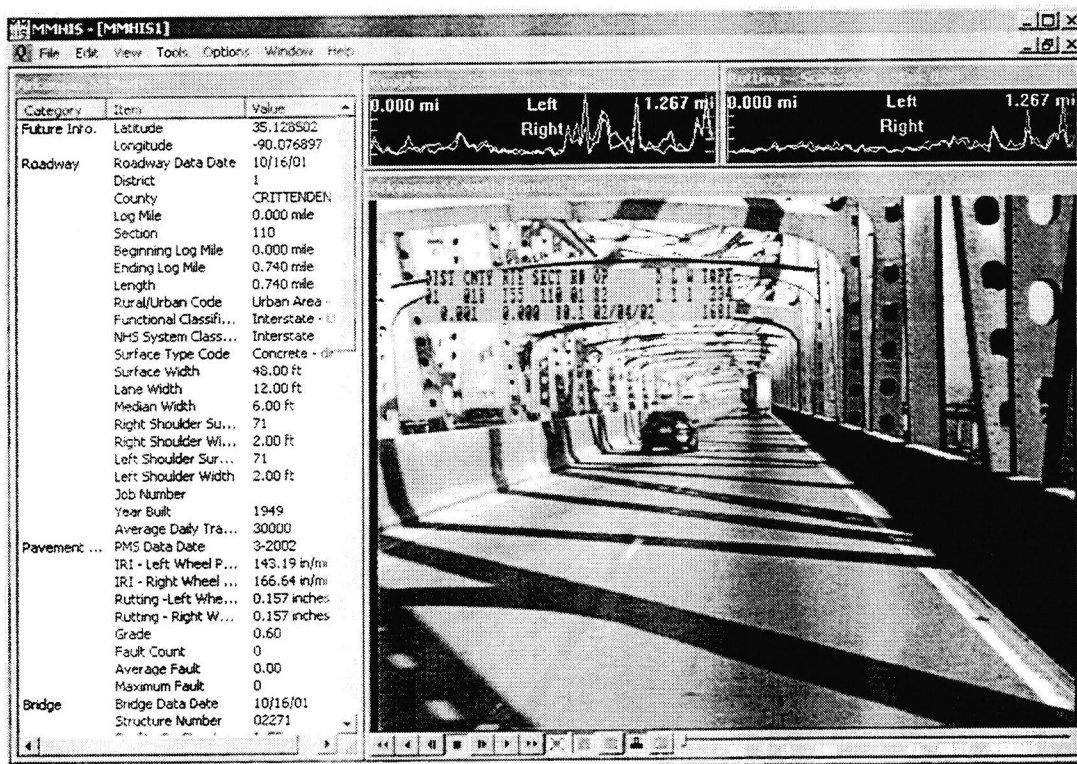
2. Changing the current location.

The vertical bar shown in the graphing windows represents the current location. Dragging this bar to another location will update all of the MMHIS display to reflect the new location. Dragging the slider bar at the bottom of the video window allows the user to change the current location to any point within the current section.

3. Changing site data display format.

The site data are grouped by category by default. The groups can be opened and closed by double-clicking on the category title. If a user-defined format is preferred, it can be defined and shown by using the context menu of the site data window. Right click on the window and choose from the context menu *Change Format | Define* to choose the fields to be displayed. Then choose *Change Format | User Defined* to change from categorized to the user-defined display.

The font used to display site data can be changed by using the command *Options | Choose Font...* or the context menu command *Choose Font....* The units used in the site data display can be changed by using the command *Options | Units | Metric* or *Options | Units | Imperial.*

4. Changing graph window options.

The graphs shown in the two graphing windows can be individually zoomed by using the commands *Options | Zoom Roughness Graph* and *Options | Zoom Rutting Graph.* The same functionality is also offered through the context menu of the two graphing windows by right clicking on either of the graphical windows.

CONCLUSION

The new JPEG-based MMHIS represents a major step forward in the process of applying digital technology to highway management. This project has been successfully implemented at AHTD offices in utilizing their current analog video data and site engineering data sets. Several key changes and improvements were made to the MMHIS. The following is a list of the major enhancements to the MMHIS.

- Support was added for a three-camera high-resolution (1300x1030 pixels) system that will provide the user the ability to view the front, left, or right side images when this capability is added to the ARAN data collection vehicle.
- Video images can be "fit-to-window" allowing laptops or other small displays to display the full JPEG image.
- Video images, when displayed without the "fit-to-window" option active, can be dragged around in the video window by clicking and holding the left mouse button while dragging the image. This feature is required when viewing high-resolution (1300x1030 pixels) images.
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