

# **A Portable Highway-Railroad Grade Crossing Surveillance System for Operational and Safety Studies**

## **Final Report**

**Prepared for the Florida Department of Transportation  
Rail Office**

**By The University Of Florida  
Transportation Research Center**

**June 2003**

**Development and Deployment of a Portable  
Highway-Railroad Grade Crossing Surveillance  
System**

**Volume I:  
A Portable Highway-Railroad Grade Crossing Surveillance  
System for Operational and Safety Studies**

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## **PREFACE**

The Florida Department of Transportation (FDOT) Contract BD243 addresses an immediate requirement for a study of traffic and train operations at three highway-railroad grade crossing sites in central Florida. This requirement is accompanied by a longer term need to develop a simple video surveillance system by which FDOT personnel can conduct similar studies in the future on short notice, and for a specific study to be performed at five locations in a railroad corridor in south Florida.

The results of the project are presented in a series of three volumes:

- Volume I: A Portable Highway-Railroad Grade Crossing Surveillance System for Operational and Safety Studies
- Volume II: Video Based Studies of Flexible Traffic Separators at Highway-Railroad Grade Crossings
- Volume III: Video Based Studies of Highway-Railroad Grade Crossings in the South Florida Railroad Corridor

This document contains Volume I of the series. It describes the components of the surveillance system used to collect the data for the study described in Volume II. Installation instructions and deployment guidelines are provided for each component.

## **ACKNOWLEDGEMENTS**

The University of Florida Transportation Research Center (TRC) conducted this study. The overall effort was coordinated by Prof. Ken Courage, with significant technical support from Mr. Byungkon Ko. Mr. H. Michael Dowell, P.E. was the FDOT technical coordinator.

## **DISCLAIMER**

The opinions and findings expressed in this document are those of the authors and not necessarily those of the Florida Department of Transportation or any other government agency.

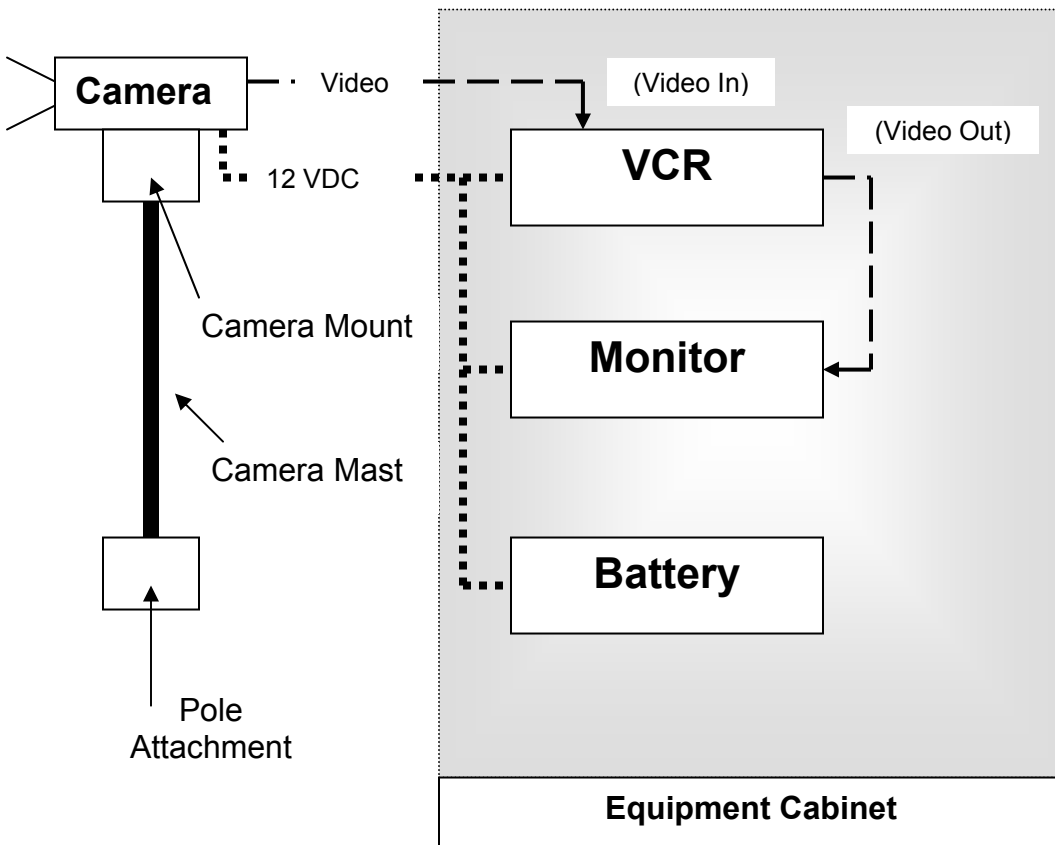
## INTRODUCTION

The Florida Department of Transportation (FDOT) has identified a requirement for a simple video surveillance system by which FDOT personnel can conduct studies of traffic and train operations at highway-railroad grade crossing sites on short notice. This document describes the development of such a system. It also provided instructions for system deployment.

## SYSTEM DESCRIPTION

A generic diagram of the video surveillance system configuration is shown below. The system development involved the following tasks:

- Choosing the proper equipment for each of the components to meet the specific needs of railroad grade crossing studies,
- Integrating the components into a readily deployable package and
- Documenting the components in terms of their procurement details and installation instructions.



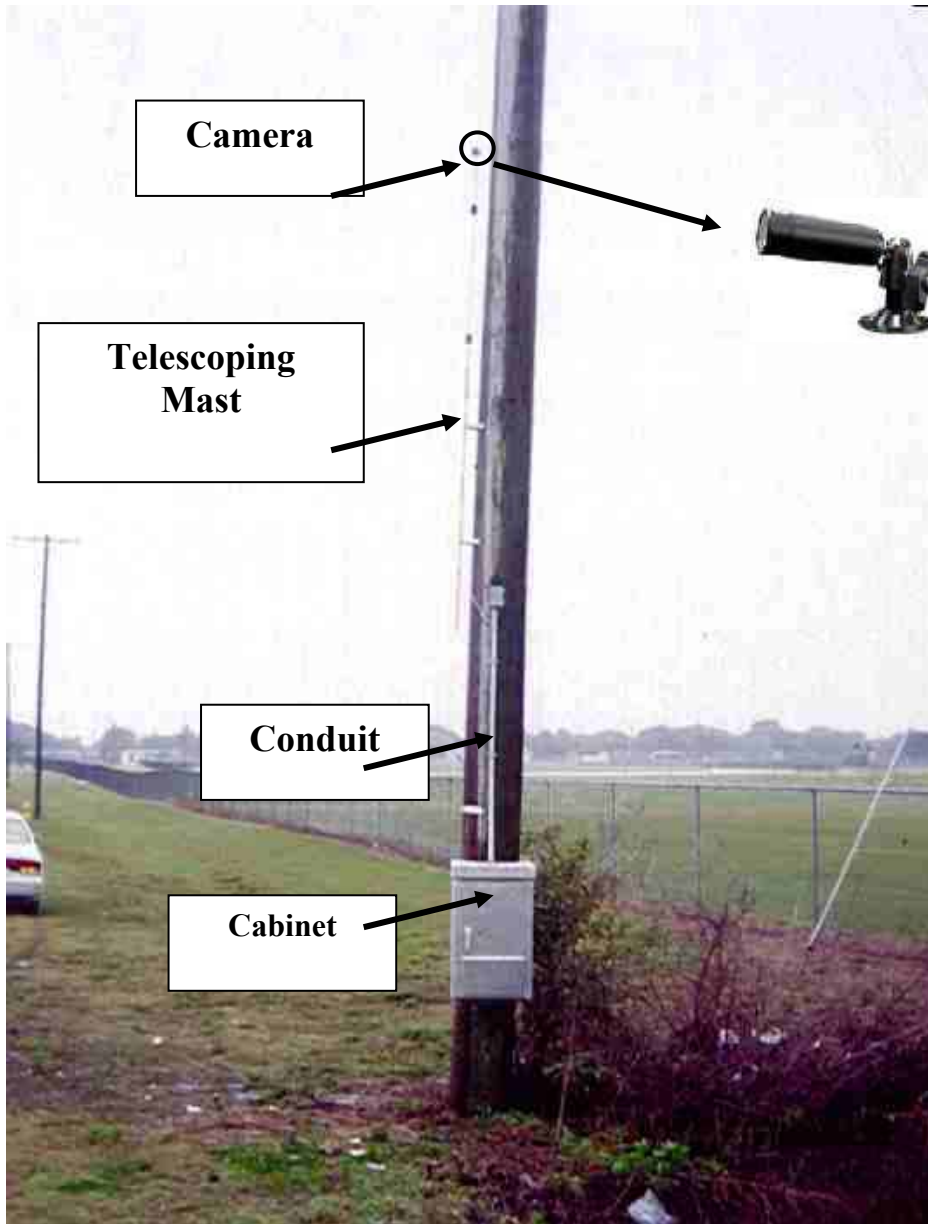
**Video Surveillance System Components**

## Functional Requirements

The characteristics of railroad grade crossing sites that influenced the choice of components are summarized as follows:

- The rural nature of these sites suggests that AC power will seldom be available and should not be a requirement for system deployment.
- Because of the power constraint, all equipment must operate on 12VDC.
- Standard marine (deep cycle) batteries are the most practical choice for supplying the required power.
- The requirement for easy deployment precludes the installation of a dedicated pole for mounting the camera. Therefore the installation must depend on an existing pole.
- Wooden utility poles are almost always available at railroad grade crossing sites, except in highly urbanized areas. The camera attachment method should therefore be developed with wooden poles in mind, but it must be flexible enough to accommodate any type of pole.
- While it is clearly desirable to activate the recording process only when train arrivals are detected, constraints imposed by the railroad precluded this option and continuous recording of the video signal was adopted reluctantly.
- Time lapse recording is desirable to minimize the frequency with which video tapes must be changed. Considering power requirements and the ability of an observer to identify the passage of a train with time-lapse compression, a 24 hour recording interval was chosen. A standard marine battery is able to provide approximately 36 hours of continuous operation, thereby giving some slack time for a daily tape replacement schedule.
- Some variation is to be expected in the placement of available poles with respect to the crossing location. Therefore, the camera field of view must be adjustable to some extent.
- While it might be desirable to have continuous zoom capability in a camera lens, the size and weatherproof housing requirements for zoom lenses would preclude a simple attachment of a small camera to an available pole. It was determined that the field of view requirements could best be met by providing two cameras, with the appropriate camera to be selected at the time of installation.
- Camera resolution is important at railroad grade crossing sites because it is usually necessary to be able to see the entire crossing with a single camera. Monochrome video cameras have a higher resolution than color cameras. Therefore monochrome cameras were used in the system described in this document.

A photograph of a typical railroad grade crossing surveillance system field installation is shown below. This specific system shown in this photograph was installed on the highway right of way approximately 100 feet from a railroad grade crossing in Hillsborough County.



## SYSTEM COMPONENTS

Each of the system components will now be described in more detail. Where possible, the source of each component and specific part numbers will be mentioned. This information is given to facilitate the replacement of components and for the development of additional systems in the future. The mention of a specific component or source does not imply endorsement of that component or source. The system was designed to use generic components that are available from multiple sources.

### Cameras

The cameras are small, inconspicuous and weatherproof. Two cameras were chosen, including a wide-angle lens camera with a 90° field of view and a 75° field of view bullet camera. The camera choice will be dictated by the location of available utility poles. If the pole is located very near the crossing, the wide angle camera is preferred. Both cameras feature an electronic iris that automatically adjusts to specific light levels. Both cameras provide a standard NTSC composite video signal and use industry standard connectors for both the power (12VDC) and video signals.



### Camera Mast

The camera mast consists of a telescoping extension pole commonly used for painting and cleaning attachments. This device is widely available from retail hardware and home improvement stores.



### Camera Mount

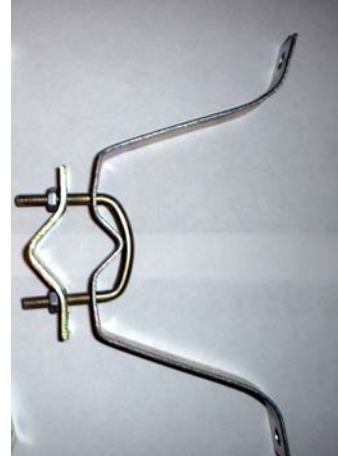
The camera mount has a standard coarse thread on the bottom for attachment to the telescoping mast. The camera mount is the only component that was custom fabricated. The parts used in this component are all readily available from hardware stores, and the fabrication task was limited to assembling these components with simple screw fasteners.

Separate mountings are provided for both cameras. Normally only one camera will be used at a give site.



## Pole Attachment

The pole attachment consists of a standard TV antenna mast mounting device commonly available from home improvement stores and consumer electronics stores that sell TV antennas. The specific attachment provided with the system will mount the mast to a flat wall or a wooden utility pole. Other custom devices are available from the same stores for other mounting applications.



## Conduit

A short section of 3/4" PVC conduit is provided to protect the cable leaving the cabinet from vandalism. The cable leaves this conduit through a standard electrical box located out of reach at approximately 10 to 12 feet above the ground.



## Videocassette Recorder (VCR)

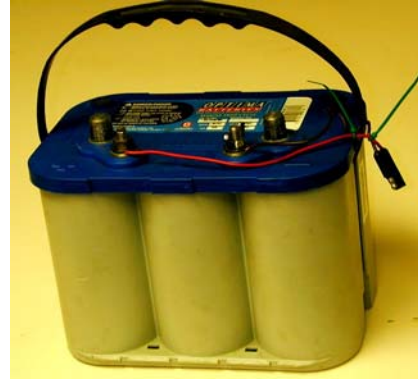
A 24-hour time-lapse videocassette recorder, powered by 12 VDC is provided with the system. The 24 hour recording duration is achieved with a standard T160 video tape, which provides 8 hours of operation with a conventional VCR. The time lapse feature offers continuous recording at 1/3 of the speed of a conventional recorder. The slow speed results in a slight degradation of the video signal compared to standard speeds, but the video quality remains adequate for highway-railroad grade crossing applications.





## Battery Power

Battery power (12 VDC) is supplied by a standard marine battery available from stores that sell batteries, automotive supplies or marine supplies. Two batteries are provided with the system to permit one battery to be charging while the other is in service. The 55 ampere-hour rating was the maximum obtainable in a standard size battery. This size battery will power the system in continuous recording for approximately 36 hours. Charging time is typically 6-8 hours.



The useful life of this type of battery is approximately 2-3 years. If replacement is required or if additional surveillance systems are fabricated a deep cycle marine battery with sealed compartments should be chosen.

## Monitor

A 5" flat screen LCD monitor is attached to the rear panel of the cabinet. The monitor is required to obtain proper orientation of the camera upon installation, and to ensure periodically that the complete video system is working. The monitor has separate inputs for power (12 VDC) and video (Standard RCA connector).



## Carrying case

All of the surveillance equipment except for the telescoping mast, conduit and cabinet have been packed into a heavy duty PVC carrying case of the type normally used to hold photographic equipment. Each item has been placed in its own position within the protective foam of the carrying case.



## Cabinet

The VCR, battery and monitor are housed inside a 24H x 14W x 14D cabinet (NEMA Type 3R) that is capable of being transported in the trunk of most vehicles. This cabinet is attached to a utility pole by 1/4" lag screws. A single cable carries the 12 Volt DC power and video signal between the camera, battery and VCR.

The cabinet contains a shelf cut from standard home closet shelving stock. A wiring harness with switches to control power to the VCR, camera and monitor is attached to the shelf.



## Items Not Provided

All of the items required for conducting videotaped traffic studies at highway-railroad grade crossings are provided with the system. The only additional items that you will need are a ladder and some common tools for attachment of the system components to the pole at the site

# INSTALLATION INSTRUCTIONS

The steps in setting up the surveillance system are as follows

## **Before taking the equipment to the site:**

1. Visit the site to select the pole for installation of the equipment. If permission from another agency will be required for the use of the selected pole, you should obtain pictures and other details required for the Pole Permission Application. Please refer to Attachment B for a reproducible blank copy of the application form.
2. If the pole is not a standard wooden utility pole, determine how you will attach the camera mast to the pole. Several choices of TV antenna mounting devices are available for pole mounting purposes.
3. Obtain permission from the owner of the pole for the installation, if necessary. See the blank pole permission application form included in Attachment B.
4. Obtain any special hardware needed to satisfy unique installation requirements.
5. Locate all items required for field installation and be sure that you are taking everything with you.
6. Make sure that you are familiar with the operating instructions for all of the equipment. If you have not operated the equipment before, it's a good idea to set it up in the office before going out into the field.
7. Check the 12 volt battery to make sure it is charged.

## **B. At the site:**

1. Identify the pole for installation of the equipment.
2. **LOOK UP TO BE SURE THAT THERE WILL BE NO WIRES OF ANY TYPE THAT COULD BE TOUCHED BY THE CAMERA MAST DURING INSTALLATION.**



3. Unpack all of the equipment and tools to prepare for installation

4. Determine the camera placement. The camera should be positioned for a clear view of the tracks with no part of the pole in the field of view. Be sure that no other equipment on the pole will cause any installation problems. Also be sure that there is a secure footing for the ladder directly below the point at which the mast support must be attached.
5. Determine the cabinet placement. Normally, the cabinet will be located 90 degrees around the pole from the camera mast to facilitate ladder placement for access to the camera mast. The cabinet should also be placed on the side of the pole away from the passing traffic if possible. It is a good idea to keep the cabinet within 36 inches of the ground to facilitate battery replacement.

6. Attach the angle bracket to the pole to support the cabinet during installation



7. Place the cabinet on the angle bracket and hold it in place until it is secure.



8. Install the lag screws in the predrilled holes in the cabinet to secure the cabinet to the pole.



9. Pull the video/power cable through the conduit leaving about 3 feet protruding from the lower end.

10. Install the VCR and battery in the cabinet. Connect them to the labeled power and video connectors. Turn on all of the control switches.
11. Before you install any of the camera support or cabling, connect the camera to the video and power cable and turn on all equipment to verify that you are getting a video signal. Do not proceed with any of the subsequent steps until you are satisfied that the system is functioning properly.
12. When you have verified that the system is functioning, turn off all of the control switches in the cabinet.
13. Place the conduit head box in an approximate position on the pole and hold it there during installation.

14. Pass the video/power cable from the bottom of the conduit through the fitting at the top of the cabinet and insert the bottom end of the conduit into this fitting.



15. Attach the conduit head to the pole with screws
16. Attach the lower camera mast support to the pole about 1 foot above and about 90 degrees around the pole from the conduit head box.
17. Attach the upper camera mast support about 2 feet directly above the lower camera mast support. Use the camera mast itself to ensure the correct positioning of the upper camera mast support.
18. Install the camera head on top of the camera mast support.



19. Choose the camera you wish to use and attach it to the camera head. Connect the video/power cable to the camera. Fasten the video/power cable to the camera head with a cable tie for strain relief.
20. Fasten the video/power cable to the upper tube of the camera mast with a cable tie. Do not fasten the cable to the lower tube yet.
21. Position the vertical angle of the camera for the proper field of view using your best guess. This will be an initial setting subject to adjustment later.
22. Insert the camera mast into the U bolts in the camera mast support with the telescoping joint in the camera mast just above the. Leave the U bolts loose enough to allow the camera mast to be raised later.
23. Determine the height for the final camera position. Raise the upper section of the telescoping mast to achieve this height after the lower section has been raised such that its lower end will be about 1 foot below the lower camera mast support.
24. Raise the lower section of the camera mast support until its lower end is about 1 foot below the lower camera mast support.
25. Turn all of the control switches on and observe the image from the camera.
26. Rotate the camera mast support in the U bolts until the camera has the proper horizontal positioning.
27. If the initial vertical positioning needs adjustment, lower the camera mast and make whatever adjustment you feel is required. Raise the camera back into position and check the field of view again. Keep repeating this step until you have achieved the desired field of view.
28. Tighten the U bolts until the camera mast is secure, taking care not to rotate the mast during this process.
29. Secure the loose section of the video/power cable to the camera mast using cable ties. You are now ready to begin the surveillance studies.



**Attachment A**  
**Video Surveillance System Component Specifications**

*Note: This information is given to facilitate the replacement of components and for the development of additional systems in the future. The mention of a specific component or source does not imply endorsement of that component or source. The system was designed to use generic components that are available from multiple sources.*

<b>Component</b>	<b>Model Identification</b>	<b>Source</b>
Cameras	WPC-27F (Wide angle) WBC-230HL (Normal)	SCS, Inc. <a href="http://www.spycameras.com">http://www.spycameras.com</a>
Camera mount	N/A	Fabricated from parts readily available from hardware stores
Camera mast	N/A	Standard telescoping extension pole for painting and cleaning attachments
Camera mast attachment	Magnavox M61410 Antenna wall mount	Available from stores that sell outdoor TV antennas
Conduit and junction boxes	N/A	Available from hardware stores
Equipment cabinet	NEMA Type 3R Min 14" x 14"x 24"	E Box 101 Air Park Industrial Blvd Alabaster AL 35007 (205) 663 9189
Equipment cabinet shelf	N/A	Standard Closet Maid 12" shelving, cut to 14" length.
Marine battery	Optima SC34DM 55 Ampere-hours	Interstate Batteries
VCR	Sanyo SRT2400DC	SpyTown <a href="http://www.spytown.com">http://www.spytown.com</a>
Video Monitor	Part Number 205-400	Parts Express <a href="http://www.partsexpress.com/">http://www.partsexpress.com/</a>
Carrying Case	Pelican #1550	Available from photographic equipment stores.

**Attachment B**  
**Pole Permission Request Form**



**Florida Department of Transportation  
Request To Install a Temporary Traffic Study Camera  
On A Utility Pole Or Structure**

**From:** \_\_\_\_\_

**To:** \_\_\_\_\_

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\_\_\_\_\_

To accommodate a proposed traffic study, the Florida Department of Transportation hereby requests permission to install a temporary traffic study camera on the pole or structure described in the following pages.

The study is being carried out for FDOT by \_\_\_\_\_

The study agency contact is \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Site Description and Installation Details

City/County/District \_\_\_\_\_

Railroad \_\_\_\_\_

Highway \_\_\_\_\_

Location and Type of Pole or Structure: \_\_\_\_\_

Pole Identification Reference \_\_\_\_\_

Traffic Study Description: Continuous videotape monitoring of the crossing warning devices to observe the use and misuse of these devices

Proposed Installation Date: \_\_\_\_\_

Approximate Duration: \_\_\_\_\_ Days (Notification will be given in advance of the proposed removal date)

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### Details of Proposed Installation

(See Drawing and Photograph)

**Cabinet:** Standard NEMA Type 3R equipment cabinet (24H x 14W x 14D) with keyed lock, attached to Wood pole with 1/4" lag screws.

**Equipment:** The cabinet will contain one video cassette recorder (VCR) and 12VDC battery. A single cable will carry the 12 VDC power and video signal between the camera, battery and VCR. The camera will be a small and inconspicuous weatherproof unit as illustrated in the photograph

**Camera Mounting:** The camera will be mounted on a telescoping mast of nominal 1" diameter. The mast will be attached to the pole by means of standard TV antenna mast mounting brackets. The maximum camera height will be 18 ft above ground level. The bottom of the mast will be minimum 8 ft above ground level. The cable between the camera and cabinet will be enclosed in 3/4" PVC conduit to a minimum of 10 ft above ground level. Above that level, it will be secured to the outside of the telescoping mast.

**Operation:** The equipment will be operated continuously while the study is in progress. Videotapes and batteries will be changed as necessary.

