RimaTech ltd.™

460 Westview St. #610, Coquitlam, B.C., V3K 6C9 Canada
rima-tech@sfu.ca
Tel/Fax: (604) 421-6542
URL: *http://rimatech.cjb.net*

October 16th, 2000

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, BC
V5A 1S6

Re: ENSC 340 Project Multi-Display Video Adaptor Functional Specifications

Dear Dr. Rawicz,

The enclosed document, Multi-Display Video Adaptor (MVA) Functional Specifications, outlines the requirement specifications for our system. Our project is to design a Multi-Display Video Adapter that is compatible with any computer system, can be attached to any computer externally, and is able to display an image on four monitors.

This document outlines the framework on which we will base our design. It describes in detail the desired behavior and functionality of the MVA and its subsystems.

Rima Tech Inc. consists of five motivated and hardworking third-year engineering students: Sahar Khalili, Kaveh Eskandar-Afshari, Shabnam Abedi-Moghaddam, and Golnaz Sanaie-Fard. If you have any question or concerns about this report, feel free to contact me by phone at 421-6542 or by e-mail at skhalili@sfu.ca.

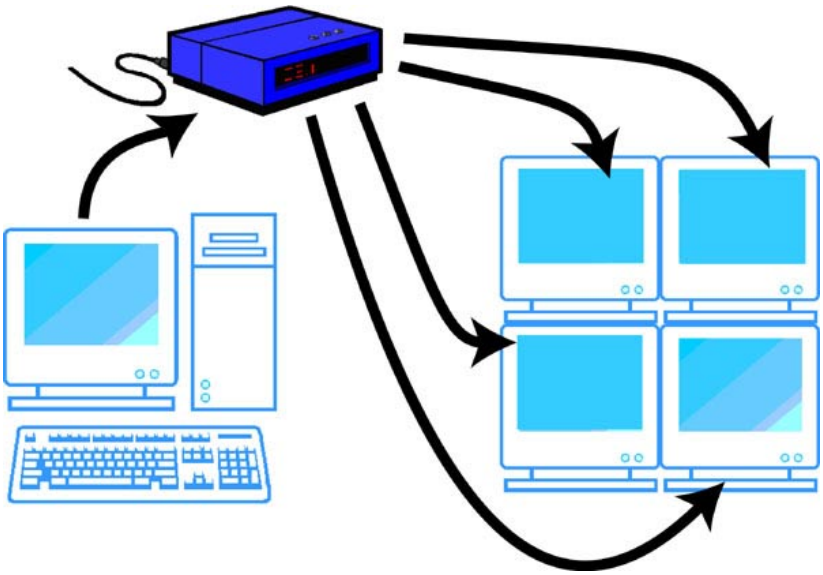
Sincerely,
Sahar Khalili, President and CEO

Rima Tech Inc.

Enclosure: ENSC 340 Multi-Display Video Adaptor Functional Specifications

RimaTech ltd.

Functional Specification for a Multi-display Video Adapter



Submitted by:
Sahar Khalili
Amir Jodar
Shabnam Abedi Moghaddam
Golnaz Sanaie-Fard
Kaveh Eskandar Afshari

Contact:
Amir Jodar
Rima Tech Ltd.
rima-tech@sfu.ca
http://rimatech.cjb.net
460 Westview St. Apartment 610
Coquitlam, B.C.
V3K 6C9 Canada

Submitted to:
Andrew Rawicz
School of Engineering Science
Simon Fraser University

Steve Whitmore
School of Engineering Science
Simon Fraser University

Date:
October 15, 2000

Executive Summary

In today's era of communications, many applications exist that require visual media. These applications include display systems used in company presentations, advertisements, CAD designs, airport stations, concerts, and award shows. The need for large displays with high quality image and resolution led to the development and marketing of video cards capable of displaying video output on more than one screen. However, there are considerable disadvantages associated with these video cards: high price, difficult installment, and non-compatibility with many computer systems.

Rima Tech proposes an external device which functions in the same way as other similar products on the market, but is affordable, compatible with different computer operating systems, and is as user-friendly as possible. Our user-friendly interface will allow people with different levels of education to use this product, but will also reduce maintenance time.

Multi-Display Video Adaptor (MVA) is a hardware-based system (for prototyping). The hardware will detect and convert the input video signal and generate the appropriate output signal using the embedded digital logic.

This document introduces and defines the various functional blocks of the MVA system and its subcomponents. In addition, it discusses the operational, physical, environmental, and safety performance specifications of the system.

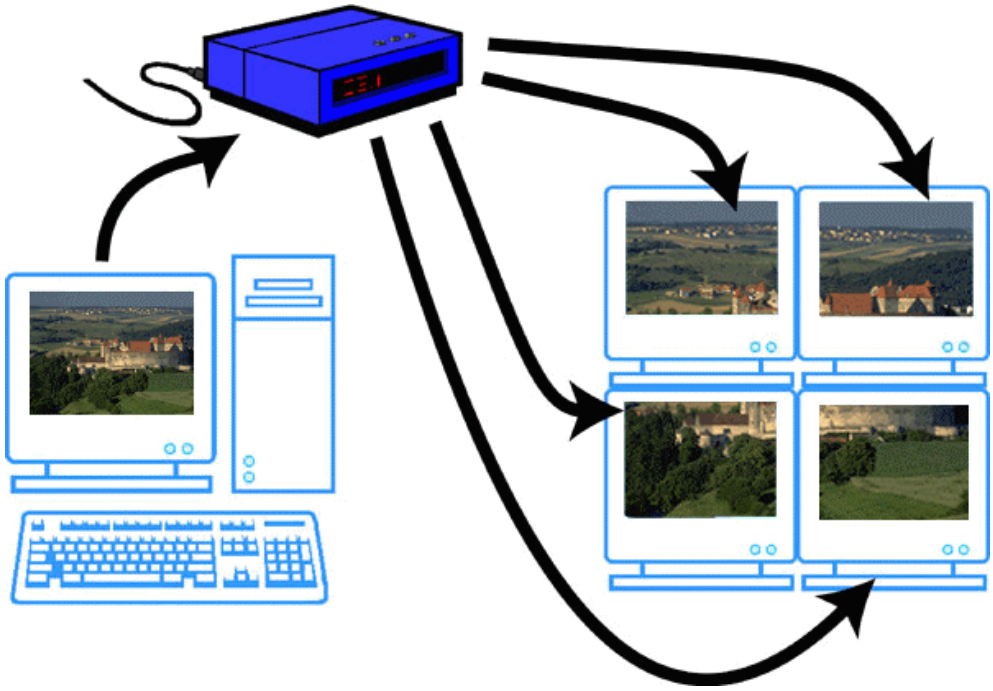


Figure 1 Overview diagram of the system

460 Westview St. #610, Coquitlam, B.C., V3K 6C9 Canada
rima-tech@sfu.ca
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460 Westview St. #610, Coquitlam, B.C., V3K 6C9 Canada
rima-tech@sfu.ca
Tel/Fax: (604) 421-6542
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Introduction

There are many situations where the viewers of a screen must see the real-time changes to the image continuously. Command centers, control rooms, communications hubs, presentation rooms, simulation systems, emergency operations, and telecommunications systems are some of the applications that require displays larger than the normal size.

Presently, there are multi-display graphics cards on the market, which display the output of a computer on multiple monitors. The effectiveness of these cards is limited, because they are fairly expensive and are software dependent. This means you need to install a new graphics card on your computer and make major installations. Furthermore, you must also be running windows 98 or higher.

The MVA (Multi-display Video Adapter) module, aims to overcome these deficiencies by making a completely software independent module that is easily connected to the RGB analog outputs of any computer and magnifies the image onto four monitors regardless of the computer's operating system.

The purpose of this document is to describe the functional requirements of the MVA device, and the deliverables of Rima Tech Limited to its customers. The intended audience for this document is Dr. Andrew Rawicz, Mr. Steve Whitmore, the design engineers of Rima Tech Ltd., and various external third party design consultants.

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Background

We are living in the era of information and information demands communication, which eventually requires some visual display format. Many applications today require multi-display interfaces, and the only solution available is a larger display. Table 1 shows the different categories of solutions to the multi-display dilemma. All these solutions have their limitations and all are very expensive.

Table 1 Multi-display Market

Category	**Device**	**Minimum System requirements**	**Installation**	**Cost**
Dual Monitor Video Card	Matrox G200 (Dual Monitor)	- PCI bus. - Pentium 133 with 32 MB of RAM. - Win 98/2000/NT4.0/NT3.5.1 and Linux	Hardware Installation Driver setup	$ 728.99
Quad monitor Video Card	Matrox G200 (Quad Monitor)	- PCI bus. - Pentium 133 with 32 MB of RAM. - Win 98/2000/NT4.0/NT3.5.1 and Linux	Hardware Installation Driver setup	$ 1020.99
Video Wall	16 TV video wall	Requires 16 TV sets	System is installed by the company or a professional technician	$ 5,000.00 plus the costs of TVs
Large screen TV	Mitsubishi WS-73905 75” TV	Standard TV input	Standard TV installation	$ 15,000.00
Large screen LED panel	Concert Large screen LED panels	Requires video converter, and controller system	System is installed by the company or a professional technician	Over $20,000
Multi-display Video Adapter	RimaTech MVA	Supports any PC	No installation required	~ $300.00

Video Cards are relatively cheaper, but their system requirements are more demanding, therefore, narrowing their market to high end PCs. Other video solutions are much more expensive and require a professional for installation and operation.

In contrast, our solution will be much more economical, requires no internal installation, and is compatible with any computer operating system. The fact that the output of the device can be either monitors or TVs expands our market tremendously. Since monitor to TV modulators are already available in the market, we will have this as an optional part of the project.

460 Westview St. #610, Coquitlam, B.C., V3K 6C9 Canada
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System Description (Specification)

Overview

The unit will accept SVGA (Super Video Graphics Array) signal from a computer as input, processes the signal, and generates 4 SVGA outputs each containing a quarter of the input signal.

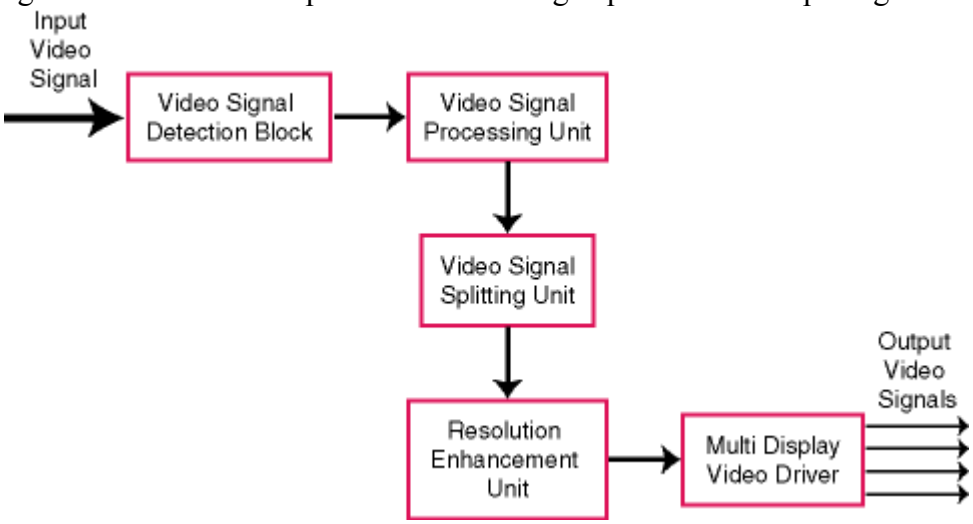

Figure 2 System Block Diagram

Basically, the system specifications are as follows:

- Acquire SVGA signal as input.
- Enhance resolution while generating the output.
- Process the signal using hardware (FPGA1).
- Output four SVGA signals to four monitors.
- All monitors will have an 800x600 resolution.
- Power is provided using an AC adapter.
- Have an on/off switch
- Be economically affordable

Optional System Functions

The following are specifications, which will be implemented if time permits.

- The system can be adapted to have NTC outputs, which go to four TVs instead of four monitors.
- Since our system already has four SVGA outputs to four monitors, it would be useful if the user could have the choice to display the original image on all four monitors. There are products in the market, which are designed to only have this functionality; therefore, addition of this specification might take more time than what we have in this course.

[1] Field Programmable Gate Array

460 Westview St. #610, Coquitlam, B.C., V3K 6C9 Canada
rima-tech@sfu.ca
Tel/Fax: (604) 421-6542
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Signal Acquisition

When the computer is asked to display a colored image on the monitor, it will define the intensity of the three colors (red [R], green [G], and blue [B]) for all pixels. It will also generate two digital data signals, which define end of line (horizontal sync) and screen refresh (vertical sync). It then sends this information to the monitor through 15 lines. (Red, Green, Blue, Red_ground, Green_ground, Blue_ground, H_sunc, V_sync, and the rest are through monitor signals from input) Figures 2 and 3 show a sample of the information sent to the monitor.

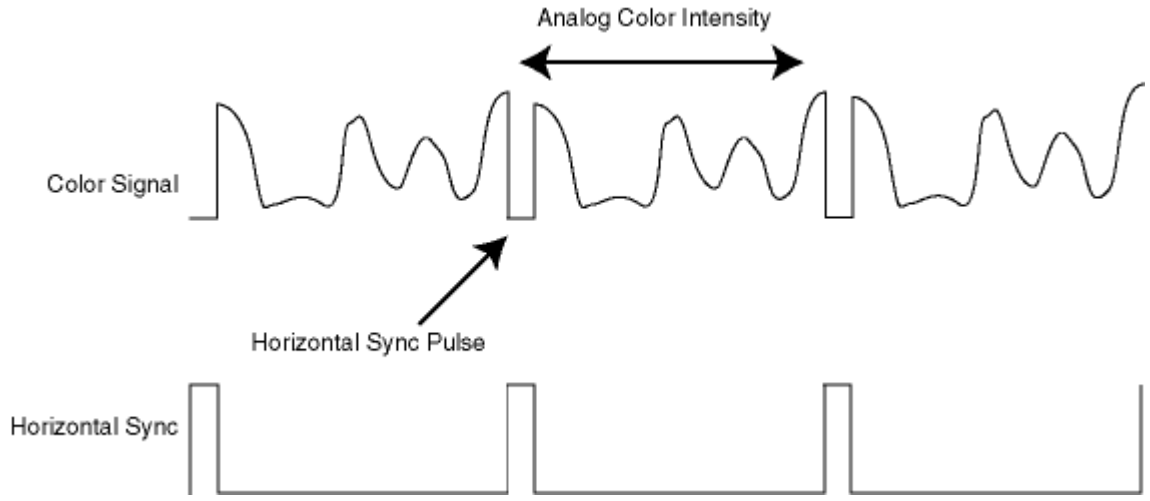

Figure 3 Sample RGB Signal

Figure 4 Sample Sync Signals

Since we will be processing this information later on, we need to hold the data for some time. Thus, the signal acquisition block performs the following tasks:

- Receives three analog and two digital inputs.
- Digitizes the three analog data lines at 40 MHz.
- Writes the three digital data signals into three short-term memory-chips.

460 Westview St. #610, Coquitlam, B.C., V3K 6C9 Canada
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Signal Processing

If we only split the image and show it on the monitors the resolution would become 400*300. As one can imagine this resolution is not satisfactory. In order to set 800*600 resolution the signal-processing block will have to average the data of neighboring pixels in order to fill in the gaps caused by splitting the image into four.

In short, the signal processing block:

- Reads data from the three memories containing data (one for each color);
- Interpolates the data, generating full 800*600 resolution data lines;
- Writes the produced full data in four memories (each going to one monitor).

Output Generation

The output generation block:

- Reads the digital data from the four memories and turns them into analog signals, thus generating the information line for each monitor;
- Generates the required horizontal and vertical synchs for proper displaying of the image.
- Passes the rest of the signals received from the input to the output.

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Requirements

Performance Requirements

Image Quality

The prototype device will be able to display the image with 800*600 resolution on each monitor, meaning with 1600*1200 overall resolution for the large screen.

Compatibility

The product will be compatible with any operating systems and any VGA/SVGA compatible computer and monitor. Our device will support the standard SVGA pin mapping.

Table 2 VGA/SVGA/XGA Connector Pin-Out

PIN#	SIGNAL	DESCRIPTION	
1	Red	(Analog)	
2	Green	(Analog)	
3	Blue	(Analog)	
4	Monitor	ID	Bit2
5	Ground	(Digital)	
6	Ground	(Red)	
7	Ground	(Green)	
8	Ground	(Blue)	
9	Not Used		
10	Ground	(Sync)	
11	Monitor	ID	Bit0
12	Monitor	ID	Bit1
13	Horizontal Sync		
14	Vertical Sync		
15	Not Used		

Physical Requirements

The overall enclosure shall be portable and pose minimal disturbance to both the system and the user. The enclosure shall be rigid and meet the physical requirements shown in Table 2.

Table 3 MVA Module Physical Requirements

Height:	10	cm	Maximum
Length:	35	cm	Maximum
Width:	25	cm	Maximum
Weight:	1.0	kg	Maximum

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Environmental Requirements
The MVA module will meet the environmental requirements listed in Table 3.

Table 4 MDA Module Environmental Require

Operating Temperature:	-20C to 60C
Shipping Temperature:	-10°C to 50°C
Heat Dissipation:	Minimal (pW range)
Humidity:	Full range of atmospheric humidity

Electrical Requirements
The MVA module will meet the electrical requirements listed in Table 4.

Table 5 MVA Module Electrical Requirements

Voltage:	15 V maximum
Power:	5 watts maximum

Safety Requirements
The MVA system will meet the following safety requirements.

Enclosure
The enclosure will have no sharp corners, edges, or points that would pose a danger to the user.

Electrical Isolation
All inputs and output ports of our device will be shielded and protected from external static voltage sources. The electrical isolation will be such that there is no risk of electrical shock from our device. All the I/O jacks are industry standards, so they will meet all the safety requirements.

Radiations
Since we are working with high frequencies, our device should meet all the requirements set by FCC. Our goal is to have our product tested for the standards provided in table 5 in order to get the CE mark for marketing our product in Europe.

Reliability Requirements

The MVA system will meet the following reliability requirements.

Accuracy
In order to produce an accurate image from the original image signal, we will use interpolation methods between each two lines of the screen. This method prevents loss of resolution in the larger images and produces a relatively accurate image.

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Durability

The prototype unit will be able to withstand some minor bumps, but the final product should be able to tolerate being dropped from a height of 1 meter. The unit will operate properly at temperatures from –20C to 50C. Our final product is guaranteed to work reliably for at least five years of daily use.

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Training

The MVA user will need minimal training, since all the setup is done automatically. The user will only need to plug in the device and turn it on. The only part of setup that might be confusing for the user is to plug the four consecutive outputs of the system to the correct arrangement of the four monitors. Numbering the output wires and monitors for the user will resolve this problem easily.

Potential System Limitations

The MVA system may be limited by the following factors:

- The MVA may be unable to update the screen fast enough if the image is changing faster than the designated level handled by our system. We can solve this problem by using larger memory-chips in the front-end of the device for future mass production.

- There may be some loss of resolution, which can be handled by using pixel interpolation methods in generating the image signals for larger screens.

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Prototype Testing

The following test plan describes the tests that our device will undergo in order to meet the main specifications. These tests are performed after the outputs of the device are connected to four monitors. The image on all four monitors should be checked with different types of images as the input of the device.

• *Image Resolution*: Each monitor displays one quarter of the original image. The image on each monitor should have the same resolution as the image on the other three monitors.

Figure 5 Normal Quad Output

Figure 6 Low resolution or Noisy output

• *Blank Screen*: At no time during the image processing should there be a blank screen on any of the monitors. Also, the image should cover the whole screen and no part of the screen should be left blank.

Figure 7 Normal Quad Output

Figure 8 Blank Output

• *Skew Image*: The images on all four monitors should be straight. No part of the image should be askew, stretched out or shortened.

Figure 9 Normal Quad Output

Figure 10 Skewed Output

• *Flickering Image*: The images should be tested on the level of flicker that appears on them and how noticeable it is.
• *Image Overlap*: After the output of the device is connected to the monitors, the monitors should be put together to make sure that no overlapping is done on the images and no part of the images is missing.
• *Shifted Image*: The images on all four screens should not be shifted to another monitor (shifted to the left, right, top, or bottom).

Figure 11 Normal Quad Output

Figure 12 Shifted Output

- *Voltage Test*: The device's voltage should be varied between the appropriate range and the image quality should be checked on the above criteria.
- *Temperature Test*: Since we don't have the appropriate facilities required on testing the temperature specifications of the device, we will assume that the product will function properly within the specified range of temperatures.

All the tests will be done with industry standard screen tests that ensure a good quality image.

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Conclusion

This document has discussed the functional considerations related to building an operational prototype for a Multi-display Video Adapter**.** RimaTech will adhere to these specifications when building the MVA system in hopes of developing a reliable and user-friendly system. The technology that is applied to the MVA system will also serve to act as a reference to future developments of multi-display adapter systems. By building this device, we hope to prove our concept and design a system that answers the need for large screen display systems in industry.

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* Note: The complete list of reverences for the project is available online at: http://rimatech.cjb.net