SECONDARY VIDEO MONITOR DISPLAY

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Abstract

Our client would like to reproduce the image on his Welch Allyn Propaq Encore machine that records a patient's vital signs. Acceptable reproduction methods include a small video screen such as those found in vehicle entertainment centers, or preferably, in the form of a wearable cathode ray tube (CRT). This latter approach projects an image in the user's peripheral vision. Contacting the manufacturer only leads to financial problems and lack of a network acuity port on the machine means a solution consisting of a number of custom devices. We have developed housing for the Propaq that allows a reproducible image onto any monitor via a small camera that is placed directly in front of the screen.

Problem Statement

Output information from an in-flight Propaq Monitor (EKG, pulse oximetry, BP) must be reproduced on a readily accessible secondary screen. Acceptable reproduction methods include a small video screen such as those found in vehicle entertainment centers, or preferably, in the form of a wearable CRT. This latter approach projects an image in the user's peripheral vision.

Background & Motivation

The UW Med Flight team uses the Propaq Encore model 206-EL from Welch Allyn to monitor a patient's vital signs such as electrocardiogram, respiration, heart rate and blood pressure. The Propaq Encore 206-EL is certified for use in rotary and fixed wing aircraft by the U.S. Air Force Armstrong Laboratories.

Placement of the Propaq has caused problems for Dr. Abernethy, a doctor at the UW Hospital working in the Med Flight department. The Med Flight technician must have immediate visual access to properly monitor the patient's vital signs. However, there is nowhere in the helicopter to safely secure the Propaq with the display in the visual field of the technicians while allowing for immediate relocation of the patient and Propaq. If the Propaq is placed at eye level without an attachment of some type, any movement of the helicopter could cause the Propaq to become a projectile, endangering either the patient or the technicians. Instead, the Propaq must be placed on the helicopter floor with a secondary monitor to output the data from the device at the technicians' eye level. This design ensures the safety of the flight crew as well as the patient.

Final Design

The final design must take into consideration two crucial factors – obtaining video output from the Propaq and designing an accessible secondary monitor – because these two aspects are dependent upon one another (i.e. the monitoring option depends on the type of video output).

The constructed prototype combines the method of obtaining direct video output with any type of secondary display using standard video input to effectively reproduce the Propaq monitor. This allows the user to select an appropriate secondary display based on personal preference, space constrictions, power availability, and budget limitations.

The Propaq housing, constructed of Plexiglas, serves as a secure mounting unit and provides protection against any potentially damaging external forces. Each side (left/right) is custom-fitted to allow external components to remain connected to the Propaq while the prototype is in use. The top lid is hinged permitting the Propaq unit to be easily placed in, or removed from, the housing. When in use, the top lid latches onto locking mechanisms located on each side of the housing, securing the Propaq in place.

The video output is provided by a snake-camera mounted to a copper L-Bracket, which is fastened to a metal arm extending from the underside of the Propaq housing unit. The camera is firmly secured by a metal brace that prevents the camera from being dislodged from its correct mounting position. The metal arm extends a distance of 24.13 cm from the Plexiglas housing to the location of the camera mount, allowing the camera viewing angle to encompass the entire Propaq monitor.

Working in conjunction with the Propaq housing, the spring system allows the set-up to function in either a horizontal or vertical position. Eyehooks located on either side of the housing provide attachment points for two 9.55 lb springs. These springs allow the Propaq to remain suspended in the vertical position while in operation and do not require an excessive amount of force to adjust. A hinge located on the base of the Plexiglas housing supplies a fixed point of rotation upon which the Propaq may be repositioned. This permits the attending physician(s) to quickly and easily view the original Propaq screen if needed.

The video output produced by the prototype is extremely flexible in that it allows for any type monitoring system using standard video input to be utilized. Because of this flexibility, the design is not constrained to a specific set-up, and may be formatted to fit the specifications and preferences of each individual user.

Table 1: Summary of materials and respective expenses

Item	Supplier	Quantity	Price
3/8" Foam Tape	Home Depot	1	$2.37
3/4" Foam Tape	Menards	1	$2.78
1" Corner Brace	Home Depot	4 @	$1.69
25" Upright Bar	Home Depot	1	$4.97
3" Round Hinge	Home Depot	1	$1.29
Plexiglas	Home Depot	1	$12.99
Handle	Home Depot	1	$2.39
Springs	Home Depot	1	$2.67
Mounting Hardware	Home Depot	8 @	$0.98
	Menards	2 @	$0.67
Roller Catch	Home Depot	2 @	$0.69
1" Hinge	Menards	1	$1.48
LCD Monitor	N/A	1	$70 - $500
Snake Camera	Supercircuits	1	$220
Total			**$338.26 – $768.26**

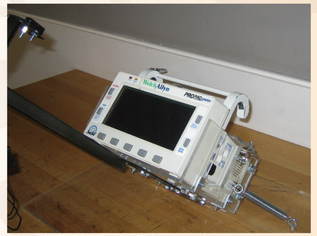

Figure 1: Plexiglass housing for Propaq monitor

Figure 2: Photograph of camera holder

Figure 3: Picture of functional prototype. Video display by way of an LCD projector.

Design Requirements

When operating in the helicopter, the proposed prototype must not interfere with the output of the Propaq monitor. Furthermore, the product must not interfere with the portability of the Propaq monitor. However, the prototype may also require a cable extension from the Propaq that connects the two monitors and allows for visual reproduction within the helicopter.

Because the space inside of the helicopter is limited, it must be organized for safe and efficient patient delivery. Thus, the final product must not contain any loose wires that may interfere with the normal treatment of a patient in the helicopter. Weight must also be taken into consideration during prototype design because the client does not want a product that is as bulky as the Propaq. Also, the patient must not be endangered from this proposed design by electromagnetic radiation or excessive cables. Our client does not want to deal with an additional power source other than the Propaq. Thus he has requested that the device have its own power supply. This machine will be stored in a facility that operates at 25 degrees Celsius and must endure helicopter heights and changing cabin temperatures.

Finally, one must take cost into consideration during the brainstorming process. Our client has requested that the final device does not exceed the price of a Propaq. These monitors from Welch Allyn can cost approximately $5,000 and Dr. Abernethy would like a total expected cost much less than this value.

Future Work

One of the most important remaining tasks is to add functionality to the Propaq housing so that it can attach to the floor of our client's helicopter. The proposed method of implementing this is to use existing rails located on the helicopter floor. These rails are conveniently located alongside the seat of the flight physician, and support custom-made clips, allowing the Propaq housing to be held in a variety of different positions.

In order to mount a secondary monitor to the helicopter cabin, a method for attachment must be devised. The video output from the camera would be used and connected to wherever the LCD monitor is placed. This could be on the back wall of the helicopter, which also contains the previously mentioned rails. A rotating arm may be implemented to allow multiple viewing angles for this secondary monitor. Finally, our goal is to acquire feedback from the client after real world testing.

References

Flip-down LCD Monitor. Date Accessed: 22 Feb 2006 http://electronics.comparesite.com/shop/get_by_t-view.htm.

Information Display Systems. Video, Inc. Date Accessed: 14 Feb 2006. http://www.vidcoinc.com.

Medical Monitoring Products & Services. Welch Allyn. Date Accessed: 27 Jan 2006. http://www.welchallyn.com.

National Society of Professional Engineers Code of Ethics. Date Accessed: 21 Feb 2006. http://www.nspe.org/ethics/eh1-code.asp.

Rotating Bracket. LCD Monitor Wall Mounts. Date Accessed 22 Feb 2006. http://www.avdeals.com/peerlessmounts/DLCD100S.htm.

US Patent Database. Date Accessed: 12 Feb 2006. http://www.uspto.gov/patft/

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