CARS2011

Section: CAR

ID: 0045

Abstract Title:
@font-face { font-family: "MS Mincho"; }p.MsoNormal, li.MsoNormal, div.MsoNormal { margin: 0in 0in 0.0001pt; font-size: 12pt; font-family: "Times New Roman"; }div.Section1 { page: Section1; } Improved User Interface for a Robotized Camera System Providing Infinite Number of Viewpoints for Telecoaching Emergency Procedures

Authors:
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Abstract Text:
@font-face { font-family: Arial; }@font-face { font-family: MS Mincho; }p.MsoNormal, li.MsoNormal, div.MsoNormal { margin: 0in 0in 0.0001pt; font-size: 12pt; font-family: Times New Roman; }div.Section1 { page: Section1; } **Purpose:** To compensate for the shortage of emergency specialists and to maintain quality of medical care in remote regions, we have developed a system allowing an expert to remotely provide real time coaching and assistance to a physician in performing emergency procedures on a polytraumatized patient. The system consists of two independently controllable mobile cameras, ceiling-mounted above a trauma stretcher. Each camera is installed at the end of a two degrees-of-freedom SCARA-type robot manipulator, and has pan-tilt-zoom (PTZ) and positioning capability over a 0.64 m^2 area. Its design is optimized to allow clearance for other medical equipments installed in the emergency room and to minimize dust accumulation and noise level. Compared to cameras fixed at static locations on the ceiling, this system provides an infinite number of viewpoints, making it possible to better visualize interventions on various anatomical regions on the patient and to compensate for potential visual obstructions caused by members of the medical team performing their duties around the stretcher.
Real-time communication (audio, video) exists between the on-site emergency physician (through a wireless headset) and the remote expert (through the video streams of the two cameras synchronized and displayed on a split widescreen display). Figure 1 illustrates the system with its initial user interface to position the point-of-view (POV) by moving the black dot and the region-of-interest (ROI) by moving the arrow head.

Figure 1 – Robotized camera system and its initial user interface

The quality of the user interface and the responsiveness of the system are two factors that have a direct impact on the expert's confidence in telecoaching without the stress caused by the complexity of the interface and the performance of the system. The user interface must be designed to minimize the operator's cognitive load and to direct attention on the intervention rather than on teleoperating the system. This study examines how to improve the user interface and the responsiveness of the system and to identify design specifications.

Methods: We developed a new user interface aimed at improving functionalities of the initial interface by adding the following features: control of POV (right click on the computer mouse) and ROI (left click on the computer mouse) directly on the video streams, automatic detection and repositioning of the POV when visual obstruction is detected, and automatic tracking of specified areas while repositioning the POV after obstruction has been detected. Figure 2 shows the improved, video-centric user interface developed. Trials were conducted with novice and robotic expert participants to evaluate ease of use of the video-centric interface compared to the initial interface. Each participant received a 45 minute training session on the different functionalities of both interfaces (initial and video-centric). Each participant was asked to visualize a scene while having to reposition the camera when visual obstruction occurred. The number of commands provided, the time required to reposition the cameras and the operator’s eye gaze directed toward different areas of the interfaces over time were measured. A questionnaire was also administered to each participant to evaluate their appreciation of the different functionalities of the interfaces.

Figure 2 – Improved, video-centric user interface

Results: Results suggest that:

i) expert and novice operators consider both interfaces as being user-friendly and easy to use;

ii) expert operators require less commands to position the cameras compared to novice operators when using the initial user interface, but such differences are not observed between the two groups when using the video-centric user interface;

iii) being able to control the cameras directly from the video feeds allows operators to keep their attention on the scene between 85% and 90% of the time (compared to 50% using the initial user interface);

iv) the ability and necessity to provide an infinite number of viewpoints while many healthcare workers are performing their duties during an emergency procedure;

v) the use of standard pan-tilt-zoom videoconference cameras that do not allow to reinitialize their stack of commands limits the velocity of the robot manipulators while changing the POV and keeping the ROI in the field of view of the cameras.

Conclusion: It is feasible to provide improved situation awareness while minimizing cognitive load for an emergency room telehealth system using robotized cameras, by allowing control of the cameras directly from the video feeds and and automating some of its positioning functionalities. This requires the operator base station able to i) process the images (either by sending them using TCP/IP or using images sent through a videoconferencing system), and ii) reinitialize the stack of PTZ commands of the cameras to synchronize POV and ROI control when camera repositioning is required.

fig.1

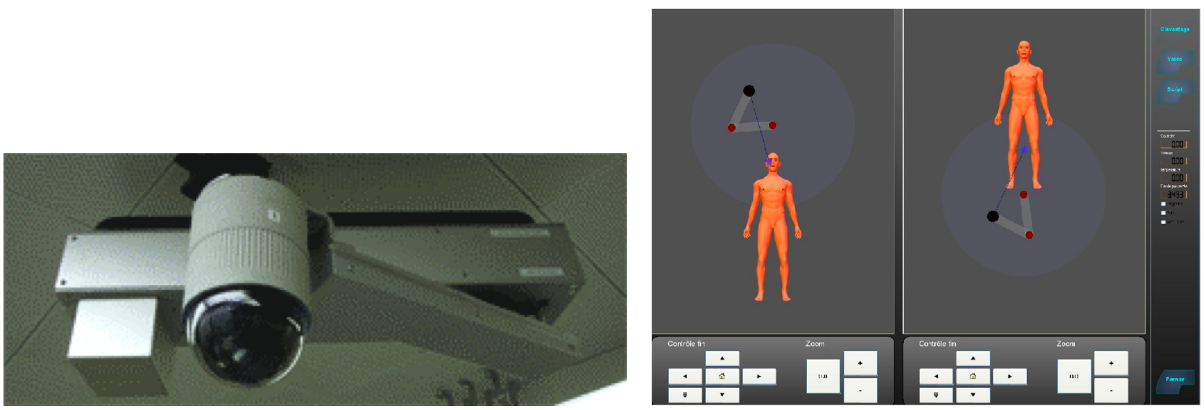
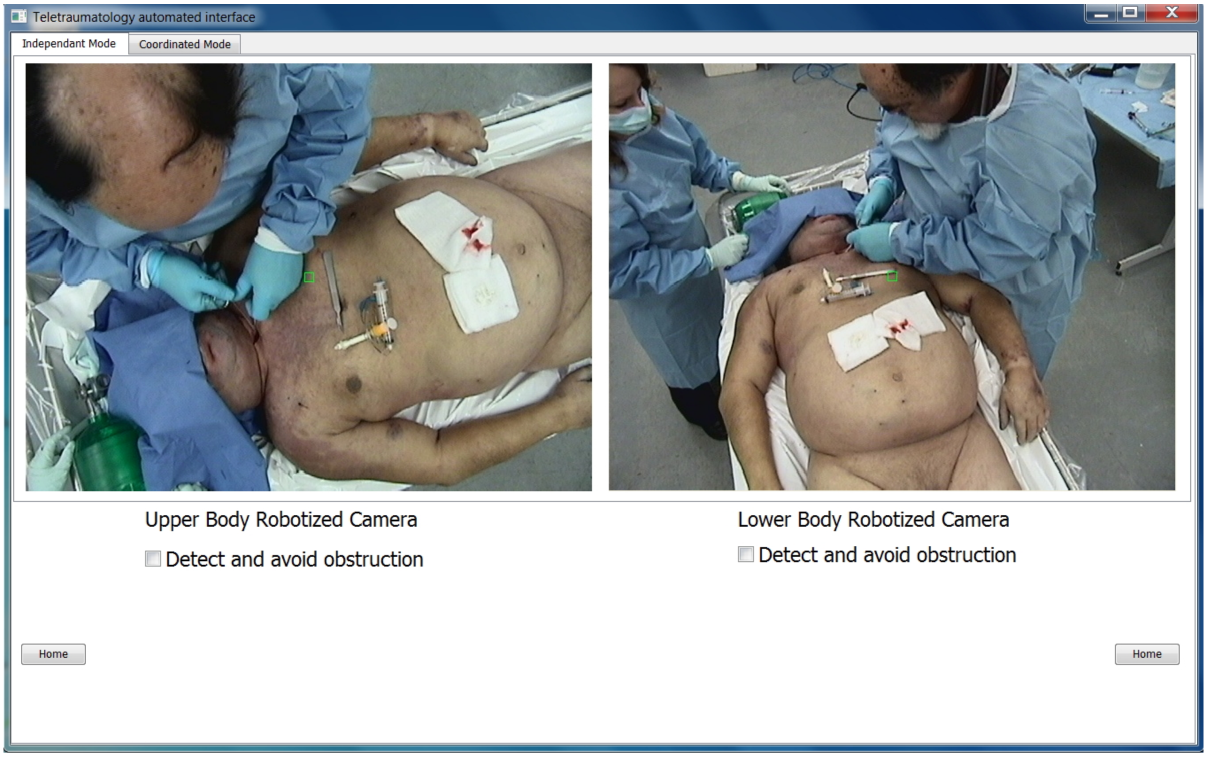


fig.2


Teletraumatology automated interface
Independant Mode
Coordinated Mode
Upper Body Robotized Camera
Detect and avoid obstruction
Lower Body Robotized Camera
Detect and avoid obstruction
Home
Home