Design and Evaluation of a Real-Time Mobile Telemedicine System for Ambulance Transport

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A mobile telemedicine system was designed, implemented, and tested for en route neurological examinations which required evaluation of facial expressions and movement of arms and legs. The system uses multiple public wireless cellular phones to transmit video and patient biosignals from a moving ambulance and delivers to the desktop computer of the receiving physician. Tests and questionnaires completed by users indicated that it conveyed critical clinical information and it was adequate for conducting clinical examinations.

INTRODUCTION

Although voices have been the primary content transmitted, technological advances in wireless communications in recent years and those expected in coming years have put into focus non-voice data communications between moving ambulances and consulting physicians. We explored and evaluated the use of wireless technologies on two inter-facility critical care transport ambulances.

SYSTEM DESIGN

A mobile telemedicine system was designed with maximum use of existing commercial products[1] and public cellular phone networks. The system consists of two major components: mobile unit for ambulance installation and basestation for hospital intranet connection. Data containing video images and patient biosignals are transmitted separately from voice. The mobile unit allows pre-editing by ambulance users. Received video images and patient data are delivered to a desktop computer through a web-server with server-push technologies.

EVALUATION

Two ambulances were equipped with the mobile unit. The tests were conducted in Baltimore-Washington area using Sprint-Spectrum PCS networks. The images captured were set at 320x240 24-bit pixels, with JPEG compression of 30% quality. Four phones with digital data service were used, each with a nominal data rate of 9.6 kbps. An average of 882 bytes/sec was achieved.

Clinical performance. Clinical evaluation of the adequacy of image quality and frame rate was carried out using the task model of diagnosis of acute ischemic stroke[2], which requires a 14 step examination procedure called the NIH Stroke Scales (NIHSS) exam. Scoring NIHSS requires *audio* (verbal response), *still images* (facial expressions), and *video snippets* of 1-3 *sec* (gross motor activities). NIHSS exams were conducted on six patients during transports. Stroke specialists were able to score most of the items using the mobile telemedicine system.

Subjective experience. The opinions of the users of the mobile telemedicine system were surveyed on *interference* of regular tasks on ambulances and *efficacy* in providing valuable information. Two paramedics and two stroke specialists who had used the mobile telemedicine system answered the survey.

The operation of the mobile unit was judged to not compromise patient's safety, but was thought to pose an additional workload. The two stroke specialists thought that conducting neurological exam through the mobile telemedicine system was just like doing it face-to-face and transmission of the video images provided critical information for clinical evaluation.

CONCLUSIONS

The tests conducted so far provided initial evidence of clinical value of the mobile telemedicine system that transmits video, audio, and data from a moving ambulance to a receiving physician. Clinical evaluation in diagnosing stroke patients was satisfactory. The design architecture allows flexible, true desktop access by consulting physicians and has the potential to be valuable to many other patient care situations, such as trauma patient triage and transport.

REFERENCES

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