Paper–Based Medical Ubiquitous Computing

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ABSTRACT

We present a new approach to clinical workplace computerization that departs from the window–based user–interface paradigm. NOSTOS is an experimental computer–augmented work environment designed to support data capture and teamwork in an emergency room. NOSTOS combines multiple technologies, such as digital pens, walk–up displays, headsets, a smart desk, and sensors to enhance an existing paper–based practice with computer power. The physical interfaces allow clinicians to retain mobile paper–based collaborative routines and still benefit from computer technology. The requirements for the system were elicited from situated workplace studies.

THE NOSTOS ENVIRONMENT

NOSTOS is an experimental ubiquitous computing healthcare environment. Figure 1 shows part of NOSTOS. Essentially, we replaced the traditional GUI of an exiting Computer-Based Record System[1] with a number of physical interfaces. The idea was to develop a hybrid system that maintains *dual representations* (i.e., digital and physical representations) of the same document, folder, and sticker note. Computer augmentation of the previously established routines was achieved by combining digital paper technology, walk–up displays, headsets, a smart desk, and sensor technology in a distributed software architecture to digitize the ordinary paper forms, folders, and desks.

Digital Paper Interface. A fundamental feature of NOSTOS is the digital paper interface. The clinicians use a digital pen and special paper forms[2] (i.e., the Anoto system) to record medical data directly into the computer domain and control system functions. Moreover, the digital pen has a Bluetooth transceiver that transmits wirelessly the pen strokes to the computer domain for processing. To interact with the system, users employ the digital pen to write and check boxes on the paper forms (Figure 2). The user must verify that the input has been correctly interpreted by the system to maintain information consistency between the electronic and physical documents. NOSTOS provides feedback for this purpose in two ways: through walk–up displays in the physical environment and by radio–enabled headsets. For example, users walk–up to a nearby display and can verify that information about a medication written on the form has been correctly converted to text by NOSTOS.
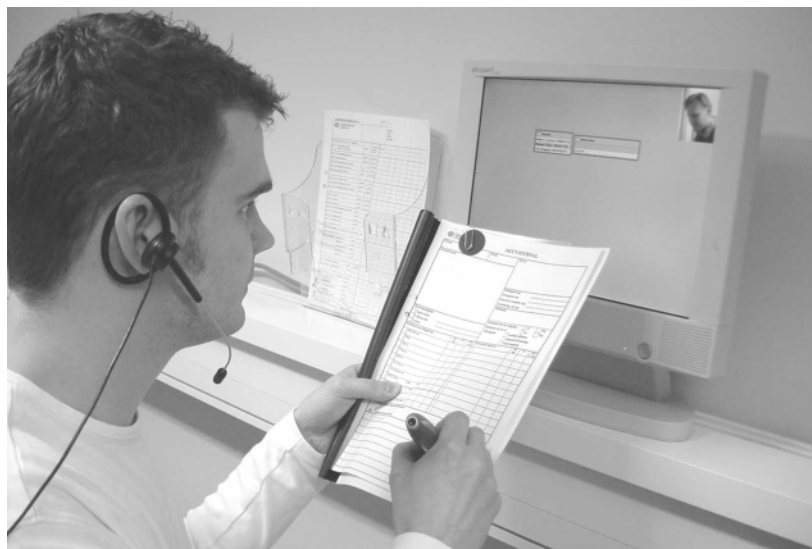

FIGURE 1. Users interact with NOSTOS by means of digital pens and special paper applications. Walk–up displays and mobile headsets provide feedback from the system.
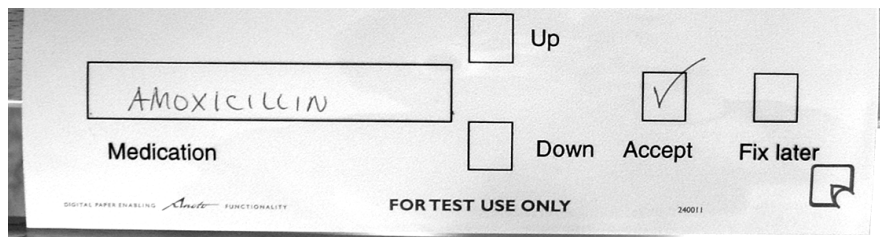
FIGURE 2. Part of an experimental paper–based interface with special paper widgets.

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