Virtual and augmented reality: enhancing nurses' wound care management skills

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Attendance at study days, university courses or link nurse events can be difficult for wound care professionals due to time constraints caused by busy clinical environments. However, education is essential to ensure that clinical can safely identify, manage and evaluate care of a patient with wounds. The use of virtual reality (users are immersed in a fully artificial digital environment) and augmented reality (virtual objects are overlayed on the real-world environment) has been used to develop skills of surgeons, but to date little has been developed to enhance nurses' skills in managing wounds. The University of Huddersfield has a well-established computing school that is expert in developing technologies to be used in a range of environments. As such a collaboration has been developed between the Schools of Computing and Engineering and Human and Health Sciences to explore if virtual or augmented reality can be effectively developed to assist nurses in wound care management. Staff involved in this exciting project are Professor Karen Ousey, Jonathan Langley and Peter Waugh (final year students of computing). This editorial presents an overview of the project.

Wound care, and leg ulceration in particular, presents a myriad of potential problems in an environment where nursing staff are charged with the responsibility of a challenging diagnosis. In 2015, 420,000 of the 730,000 leg ulcers treated by the NHS were given no working diagnosis (Stanton et al, 2016). At a time when additional government funding is scarce, the price we pay for this mismanagement is a tragically inflated cost for the taxpayer comparable to that of managing obesity, around £5 billion in total (Guest et al, 2015).

There is clearly an ongoing issue with the identification and timely treatment of leg ulcers and damaged skin during the patients' healthcare journey both in primary and secondary settings. Not only is there a need for increased awareness amongst healthcare professionals but there is also a clear requirement for specialist education and training in the prevention and management of wounds throughout the healing process. The potential benefits of tackling this issue would not only be a higher quality of care for patients, preventing potential suffering, but also a saving in expenditure by healthcare institutions. Considering this, a very good question comes to mind: can modern technology offer any relief to these pressing issues?

PORTABLE WOUND CLASSIFICATION FOR MOBILE DEVICES

Machine learning, the darling of the computational bleeding-edge, is making inroads into everyday medicine in a big way. Through a process called 'deep learning' (in this instance), these impressive pieces of software can understand the world at an unprecedented level, paving the way for advancements in self-driving cars, artificial intelligence (AI)-assisted medical diagnosis and even helping keep your inbox clear from spam. The field of image classification, using AIs to process imagery and output an accurate taxonomy of the subject, has been an integral component in the rapid rise of robotics. With enough relevant training, these systems can pick up on the subtlest of differences with an astonishing level of accuracy. The logical question then becomes: is it possible to tailor such software to create an effective diagnostic aid for frontline healthcare staff and, if yes, how should such a tool be packaged?

Preliminary research highlighted the viability of using a standard mobile phone camera as an effective medium for such a diagnostic tool. Indeed, Portuguese researchers were able to create a bespoke wound area assessment tool for Android devices; demonstrating the capability of the mobile platform to extract meaningful features from a wound (Ivan and Nuno, 2015), albeit with conditional inaccuracies owning to variables like camera quality, image artefacts and lighting. They, however, were not harnessing any kind of machine learning power, relying instead on painstakingly crafted image processing procedures. 'Supervised' deep learning, alternatively, can train an image classifier by feeding it as many images of the two most prominent kinds of leg ulcers as can be collated. This is called 'supervised' learning because the data we use to train the classification models must be pre-classified by a human. Over extended periods of training, the software can pick up on the subtle visual differences inherent in the two kinds of leg ulcers. How accurate can such models be? This is largely dependent on two key factors.

- The proper classification of the source imagery: if we fail to accurately classify the source data then the model will confuse the two wound types
- The volume of source imagery: the wider the range of examples we can collect of varying severity on varying skin tones and in varied lighting conditions will aid the generated model's accuracy massively.

Our plan is to investigate and demonstrate the viability of mobile platforms to capably differentiate between leg ulcers. This could offer a simple and accessible tool to frontline staff to help expedite diagnosis of such ulcers, and if proven effective this kind of approach could be replicated for the diagnosis of a whole host of other wounds.

VIRTUAL REALITY TRAINING FOR FRONTLINE STAFF

Virtual reality is rapidly becoming an industry in and of itself. The capability of the latest wave of virtual reality headsets means that truly immersive virtual experiences are available for the first time in history. Now, more than ever, these headsets are being used for practical training; from crane operation to surgery. This virtual reality project will seek to create an easy-to-use, practical educational tool for training frontline healthcare staff in effective wound care procedures. The core tool will offer the following functionality with a view to solving the identified problems:

- Simulated wounds will be generated in real time scenarios, based on common parameters or selected from a pre-defined list. Users will be able to interact with this virtual environment to identify and treat the wound, using appropriate methods at any stage of a dynamic timeline.
- Feedback is essential to creating an effective learning experience for users and this will be provided through the mediums of haptics, vision and sound. The latest haptic and vision technologies will be used to get as close as possible to a real clinical experience. Stimulation using haptic feedback will mean that users will receive authentic sensory information such as resistance when applying pressure bandages or debriding wounds. An example of visual feedback will be that wounds will degenerate or fail to heal if inappropriate treatment solutions are chosen.
- The training tool will emulate the wound care treatment process at multiple stages. This will include simulation of the medical tools involved in that process such as debridement and bandaging solutions; A user will be able to interact with the entire treatment process, making decisions on what treatments are best suited to the situation and how care is applied.
- The emphasis of this training model will be on self-development. All interactions will be measured against a benchmark of ideal patient care and then presented to the user in a format that specifies areas for personal improvement.

Once the above is achieved the tool will be trialled in medical settings with the goal of improving patient care and reducing the financial burden of wound care. WUK

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