An Autonomous System to Assess, Display and Communicate the Pain Level in Newborns

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Abstract—Pain is an issue that medicine considers of great importance. The treatment of pain and discomfort is essential during hospitalisation procedures, specially for newborn infants because, first, they are not able to communicate that they are in pain; and second large periods of pain or discomfort can lead to major issues. In order to assess the pain/discomfort suffered by patients, healthcare professionals use pain assessment scales: using physiologic parameters (e.g., heart beat, blood oxygen level, etc.) and observed behavioural parameters (e.g., cry, spasmodic movements, etc.) a value for pain is obtained. Current methods for pain assessment have some drawbacks, which could be overcome with the use of computerised systems.

With this aim, we present a system that automatically analyses the pain or discomfort levels of newborns. The proposed system allows the remote monitoring of newborns and raises alarms upon specific conditions. Hence, caregivers (e.g., nurses and their assistants) can act accordingly to help relieving the pain. Moreover, the remotely monitoring is also useful for parents, since they cannot stay close to their babies hospitalised in neonate Intensive Care Units.

I. INTRODUCTION

Thousands of infants are hospitalised in the neonatal Intensive Care Units (ICUs) during their first days or weeks of their life. Some of them are preterm newborns and some other are babies that may require a variety of medical attention. These patients, as in the case of adult patients, receive several invasive procedures (needle pricks for a blood test, tube insertions, surgeries, etc.). Consequently, during hospitalisation, patients may suffer from pain and, more generally, from discomfort.

According to the International Association for the Study of Pain, pain is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”. In the last decades, pain has attracted the attention of modern healthcare specialists. In 1996, James Campbell from the American Pain Society promoted the phrase “pain as the 5th vital sign” to elevate awareness of pain treatment among healthcare professionals. Campbell stated that: “Vital Signs are taken seriously. If pain were assessed with the same zeal as other vital signs are, it would have a much better chance of being treated properly. We need to train doctors and nurses to treat pain as a vital sign. Quality care means that pain is measured and treated”. Furthermore, discomfort situations (in which something disturbs one’s comfort) also frequently take place during hospitalisations. If patients communicate to their caregivers they are in discomfort, the personnel in the hospital proceeds accordingly, aiming at minimising the discomfort.

A. Pain and Discomfort in Newborn Infants

First, it is worth pointing out that, regarding newborns, a general thought in medicine was that they do not feel pain because their nervous systems are too immature. Fortunately, advances in medical disciplines demonstrated not only that newborns also feel pain and discomfort, but also have an increased sensitivity to pain and even hyperalgesia, which could lead to major disorders [1]. The medical community agrees in the importance of the treatment of their pain and discomfort [2], specially in neonatal ICUs.

Notwithstanding, communicating situations of discomfort or pain is not possible in newborn infants. In general, adults are able to specify whether they are feeling pain/discomfort during their hospitalisation, unless they suffer from any impairment or disability. Also, children above 4 years of age might clearly express where and how they are feeling the pain. Naturally, this is not feasible for infants under 4 years. In addition, note that children can even lie about pain or discomfort aiming at attracting attention.

![Fig. 1. Typical bedside monitor of physiologic parameters used in a neonatal unit.](image-url)

1http://www.iasp-pain.org

2http://www.jointcommission.org/topics/pain_management.aspx
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Also, storing the data in the patients database contributes to create a knowledge base that can attract the interest of the healthcare research community. Certainly, there is still room for improving the assessment of pain. For instance, in the case of newborns, the action of crying does not necessarily mean that the baby is suffering from discomfort or pain. Thus, the gathering of information related to the assessment of pain paves the way for contributing the pain assessment discipline.

Finally, we must address the issue of the relatives (i.e. the parents) of the hospitalised child. The impossibility of staying day and night close to their babies is certainly stressful. Providing them with a tool that allows remotely supervising their newborn’s wellness is essential for their well being.

In order to demonstrate the technical validity of our proposal we are developing a demonstrator through a project that involves researchers and practitioners from several fields, from medicine and nursing to computer vision and artificial intelligence. Using this prototype, we will conduct a test in a real clinical setting.

ACKNOWLEDGMENT

This work was partly funded by the Spanish Government through projects CONSOLIDER INGENIO 2010 CSD2007-0004 ARES and CO-PRIVACY TIN2011-27076-C03, by Recercaixa SIMPATIC, and by the Rovira i Virgili University through project 2013R2B-06 Sistema Automàtic de Suport a la Valoració del Dolor en Nounats Prematurs.

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