Saving Newborn Lives at Birth through Machine Learning

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Every year over 3 million infants die within one (1) month of life (World Health Organisation, 2016). Birth (or perinatal) asphyxia has been identified by the United Nations as one of the top 3 causes of newborn mortality (United Nations, 2013; World Health Organisation, 2016). Birth asphyxia refers to the inability of a newborn to establish regular respiration after birth. It results to shortage of oxygen supply to the brain (hypoxia), which in turn may cause impairment of physiological functions and ultimately death, if untreated.

In most developed countries, routine evaluation of newborns for asphyxia is carried out at birth, primarily via analysis of cord blood gases. Blood gas analysis is a costly procedure requiring electricity, expensive equipment, and expert handling – most of which are lacking in countries of the global south. Consequently, birth asphyxia is responsible for over 1.2 million newborn deaths annually and an equal number of severe life-long conditions such as cerebral palsy, deafness, and different degrees of damage to the Central Nervous System (World Health Organisation, 2005).

Even in the industrialized world where diagnosis via blood gas analysis is feasible, infants who present late onset of asphyxia, post birth, are a high risk population. This is because in most cases an alarm can only be raised when the visual signs of the condition (such as pale limbs) begin to emerge – at which point neurological deficits may have already set in. Thus, there is pressing need for a diagnostic mechanism which is affordable, accessible and timely.

This work discusses progress in the development of a system for diagnosing asphyxia via the infant cry. "Crying in babies is a primary communication function, governed directly by the brain, and any alteration on the normal functioning of the babies' body is reflected in the cry." (Reyes-Galaviz and Reyes-Garcia, 2004). In the case of asphyxia, this is even more pronounced because the same region of the brain controls both speech and breathing. Thus, impact on one is also reflected in the other.

We demonstrated via a retrospective study that the infant cry provides rich source of information about the physiological state of a newborn. In particular, leveraging techniques from automatic speech recognition, we combined features extracted as coefficients of the mel frequency spectrum (MFC) with support vector machines to obtain a classifier that can identify asphyxiating babies with sensitivity and specificity as high as 85% and 89%, respectively (Onu, 2014).

The use of the infant cry as input for diagnosis of asphyxia presents significant economic, social and clinical benefits. Concretely, by incorporating our learned model into a mobile phone application, we are able to provide a prototype solution which is non-invasive (requiring only cry rather than blood), low-cost (about 95% cheaper than clinical alternative), requires little or no skill to operate and delivers results in a timely manner (in under 15 seconds).

We further discuss the design of a prospective multi-institutional study between Canada and Nigeria, through which we aim to acquire a larger and more diverse dataset, while also validating the performance of existing system in a dynamic clinical setting.

References

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