Baby mannequin could provide better medical training to evaluate cyanosis on newborns

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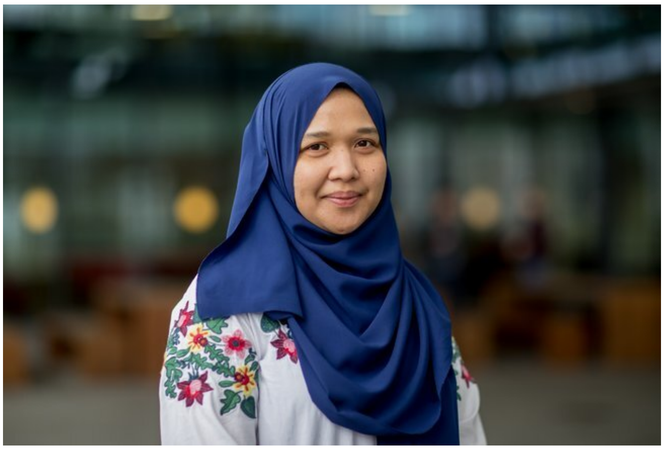

Nur Fatihah Azmi. Credit: Eindhoven University of Technology

Cyanosis, a blue coloration around the mouth and lips area, always relates to a low level of oxygenated blood in the body. Newborn infants normally have cyanosis between three to five minutes after birth and become pink when the oxygen saturation rises above 85% when measured by the pulse oximeter. A fast and accurate cyanosis evaluation and further treatment need to be taken as a cyanosed baby is potentially in a critical situation. Ph.D. candidate Nur Fatihah Azmi developed a cyanosis baby mannequin, that can change color, to optimize the quality of cyanosis recognition in neonatology's training in the near future.

Medical trainees utilize a color-assessment scoring system known as the Apgar scoring method introduced by Dr. Virginia Apgar in 1952. However, when the instrumental measurement is inaccessible, unreliable, or not reproducible, a skin color evaluation in training sessions is needed. The training in assessing cyanosis coloration is important in newborn's simulation research. The envisaged cyanosis baby simulator can be part of a simulator for resuscitation. If resuscitation is succeeded, the cyanosis will disappear. Otherwise, the cyanosis stays.

Measuring cyanosis from baby images in the hospital

Azmi developed a cyanosis baby mannequin, which can change color from cyanosis to non-cyanosis, within the correct color ranges between three to five minutes, in a correct dimensions and shape, including the safety issues of an actuating working principle. She based the observer model of cyanotic skin on the optical properties of human skin layers. The incoming light will propagate into the skin layers, hit the blood cell which comprises of oxyhaemoglobin and deoxyhaemoglobin. The light will be reflected and reach human eyes and the brain will interpret the color.

Because of this theoretical approach, which has high uncertainties and too many assumptions, in the next approach Azmi measured the cyanosis from baby images in real setting in the hospital. She quantified the cyanosis color from the photographs of babies right after the C-section by photographing the calibrated MacBeth colorchecker next to the baby on the procedure table under the same lighting condition. She computed the correction matrix and gathered the color values of the cyanosis and non-cyanosis baby in CIELAB color space.

Optimize neonatology's training

Azmi explored the first cyanosis actuator mannequin by the actuation method of the 3D print photochromic PLA using a low-voltage ultraviolet

LED. She based the final design on the Heuristic Design Principle which turned the 3D printed head into a practical cyanosis simulator using the Philips Hue as the cyanosis actuator. She developed a dynamic and adaptive cyanosis actuator and simulated the 3D printed baby's head with a correct color in a correct timing, demonstrated both in real-time and in a screen visualization.

The efforts in integrating technologies, medical experts and designers for a physiologically realistic cyanosis simulator can optimize the quality of cyanosis recognition in neonatology's training in the near future. According to Azmi, the training in assessing cyanosis colouration is important in newborn's simulation research and it's important to be aware of the subjectivity of human visual perception.

More information: Nur Fatihah Binti Azmi defended her PhD thesis titled Designing Colour Changing Actuation for Realistic Cyanosis in a Baby Manikin on 3 May 2021. Supervisors were: Prof. L.M.G. Feijs (TU/e), dr. ir. F.L.M. Delbressine (TU/e) and dr. P. Andriessen (MMC, Veldhoven). Other main parties involved: UTEM, Maleisië and Ministry of Malaysia Education.

Provided by Eindhoven University of Technology
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