# Project title: Digital Twin of a Scalable & Modular Companion Robot for PICU/NICU patients to address Social Isolation

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## Aim of the project

The aim of the project is to create the Digital Twin of a Companion Robot for NICU & PICU hospital settings to understand how infants & toddlers in long term care can be relieved from the effects of social isolation and separation anxiety, towards the development of a human-centred Scalable & Modular Robot Companion device prototype that provides tactile support and telepresence to families.

## Project description

Human beings are social species by nature that rely on companionship for survival. However, infants and toddlers experiencing long stays in NICUs & PICUs respectively are often exposed to stressful situations like separation anxiety, isolation, pain, and uncertainty (Burnett, 2011; Lund, 2012). Comfort for any baby while receiving care in a hospital is a huge need because families are unable to physically be present with their child or the infant could be isolated due to being bed-bound (Browne, 2016). A sudden change of environment and loss of parental/familial support (Welch, 2016) can be causes of extreme vulnerability and social isolation (Givrad et al., 2021). Evidence links perceived social isolation with risks of developing adverse health consequences including depression, poor sleep quality, impaired executive function, accelerated cognitive decline, poor cardiovascular function, and impaired immunity at every stage of life (Grunau, 2013). Furthermore, having an infant child admitted in the NICU can be a particularly harrowing experience for the families as well. Parents have reported major concerns of stress due to their inability to hold or care for their child or be available during pain inducing moments (Shaw et al., 2006).

Socially Assistive Robots are physically embodied agents with partial autonomy that help establish engagement with human beings and have been found to provide companionship for children through sensory support to help stimulate brain development via sight, sound, and touch. To that end, we would like to establish the hypothesis that assistive Robots can be used to provide tactile support for isolated infants in NICUs & PICUs.

However, infants are admitted to the intensive care units for a variety of reasons including prematurity, sepsis, and respiratory distresses making it challenging to gain physical access to them at the hospitalsfor developing any interventions due to concerns of being unsanitary thereby issues with ethical clearances. While there are existing virtual platforms, such as LookIt (Scott at al. 2017) and Amazon Mechanical Turk (Tran et al., 2017), that are being implemented to replace the conduction of standard infant habituation studies with using looking-time procedures to

understand their mental processes (Oakes, 2010), but despite demonstrating feasibility with such methods (Scott & Schulz, 2017 ; Rhodes et al. 2020), these platforms are currently unmoderated and large portions of data are typically excluded due to procedural problems or technical errors, especially in regards to the infant position in the videos. Thus, a Digital Twin has the potential to solve these problems by modelling virtual replicas of infants in intensive care conditions at inaccessible settings to design and validate tactile robotic device interventions and furthermore test it on modelled subjects to ensure that is it fit for adequate use on actual infants.

Therefore, this research project is the first to explore the efficacy, design, and usage of a Digital Twin for NICU/PICU settings towards the development of a Scalable & Modular Companion Robotic device prototype that can emulate tactile soothing support such as nesting for infants, while allowing for families to stay connected with them remotely through telepresence.

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