UBC Faculty of Applied Science - Monash University Faculty of Engineering
Joint PhD

Project Title: Affordable and portable audio-visual system for neonatal health monitoring

Lead Supervisor:

<table>
<thead>
<tr>
<th>Name</th>
<th>University</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Faezeh Marzbanrad</td>
<td>Monash University</td>
<td><a href="mailto:faezeh.marzbanrad@monash.edu">faezeh.marzbanrad@monash.edu</a></td>
</tr>
<tr>
<td>Department: Electrical and Computer Systems Engineering</td>
<td>Email: <a href="mailto:faezeh.marzbanrad@monash.edu">faezeh.marzbanrad@monash.edu</a></td>
<td></td>
</tr>
</tbody>
</table>

Co Supervisor:

<table>
<thead>
<tr>
<th>Name</th>
<th>University</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Guy Dumont</td>
<td>University of British Columbia</td>
<td><a href="mailto:guyd@ece.ubc.ca">guyd@ece.ubc.ca</a></td>
</tr>
<tr>
<td>Department: Electrical and Computer Engineering</td>
<td>Email: <a href="mailto:guyd@ece.ubc.ca">guyd@ece.ubc.ca</a></td>
<td></td>
</tr>
</tbody>
</table>

Research Theme (check one):

- Biomedical Engineering and Robotics
- Materials
- Energy and Environment
- Smart Infrastructure

Objective: Outline the main objective of the project and what it will accomplish.

This research aims at developing an audiovisual mobile-health system as an affordable noninvasive solution to automatically monitor neonatal health, towards improving prediction, detection and management of health complications, particularly for premature neonates.

Project Description: Describe the project. Use diagrams or images if appropriate.

Around 3.3 million newborns die every year in the first four weeks of life, 99% of which occur in low- and middle-income countries*. Although in high income countries significant advances in neonatal intensive care have brought increased survivals, it has also resulted in increased risk of morbidity, such as chronic lung diseases with long-term impairments of lung function.

This research targets prediction and early detection of major causes of neonatal morbidities and mortalities including sepsis and respiratory distress, through developing affordable, portable and noninvasive modalities connected to a mobile device. Specifically, a novel audio-visual system can be developed for use in neonatal intensive care unit (NICU) and beyond, utilizing a digital stethoscope to record the chest sound and a camera to capture videos from neonates (Figure 1).

The research involves processing of the video recordings to detect the changes in color and volume of superficial vessels in each cardiac cycle, breathing motions and other micromovements for estimation of vital signs including heart rate or breathing rate, for real-time monitoring by the clinicians. These measurements also provide references for separation of heart sound and breath sound recorded from newborn’s chest. Each sound needs to be further processed to extract features for assessment of
respiration and cardiac activity. These parameters may include but not be limited to spectral, time-frequency and perceptual features for characterizing adventitious breath sounds, early signs of respiratory distress, heart murmurs and abnormal blood flow in major heart arteries.

Using a combination of audio-visual parameters, a clinical decision support system can be developed. Not only will it provide the clinician with a reliable, remote and unified access to the clinical parameters on a mobile device, but it will also facilitate clinical diagnosis by automated prediction and detection of health risks and diseases, such as sepsis, respiratory distress, patent ductus arteriosus and other cardio-respiratory conditions.


Figure 1 Schematic illustration of the neonatal mobile-health monitoring system in NICU.