ANNEX 2: NUS GRADUATE RESEARCH INNOVATION PROGRAMME (GRIP) – HIGHLIGHTS

Digital In-Vitro Fertilisation (IVF) Aspiration and Flushing Unit

Innovators: Ms Ng Cailin and Dr Liang Wenyu

Ms Ng Cailin graduated with a Bachelor of Engineering from NUS in 2004 and worked for a period of time before she embarked on her doctoral studies in NUS since 2015. After recovering from a life-threatening illness, Cailin was inspired to pursue biomedical research and this personal experience also became a strong motivation for her to carry out research that would benefit others. NUS GRIP offers her the opportunity to fulfil her wish.

Dr Liang Wenyu completed his Bachelor of Engineering in the China Agricultural University in 2010 and obtained his doctorate from NUS in 2014. He has been working as a Research Fellow in NUS since 2014.

In-Vitro Fertilisation (IVF) has been a great help to couples who are otherwise not able to have children naturally. The technique fertilises the egg externally through a series of treatments that includes extracting the egg from the mother's womb. The digital IVF Aspiration and Flushing Unit developed by Cailin and Wenyu addresses inefficiencies during the process of retrieving the eggs from the womb. The novelty of their invention lies in the ability to significantly improve the precise control of the temperature, enabling the eggs retrieved to be kept within an optimal temperature range. This is important as any variation outside this temperature range could affect the quality the egg, and hence the success rate of fertilisation. Their invention is also more compact, integrating several separate components into one unit, hence reducing clutter when used inside the operating theatre.

==========

Breath Analysis as a Fast and Non-Invasive Disease Diagnostic Technique

Innovator: Ms Jia Zhunan

Ms Jia Zhunan graduated with a Bachelor of Engineering from the Nanyang Technological University and is currently a doctoral student in NUS, where she has been working on diagnosis of illnesses through breath analysis. Zhunan is grateful for the scholarship to pursue her undergraduate studies in Singapore and she is now embarking on research that she hopes can help improve healthcare delivery in Singapore.

Acute myocardial infarction or 'heart attack' is a medical emergency where every minute counts. It is estimated that every 30 minutes of delay in treatment leads to an 8 per cent increase in mortality rate. Real-time breath analysis can potentially reduce mortality rate by improving the ability to diagnose this condition in minutes, compared to current diagnostic practices. Breath analysis is based on the principle that our exhaled breath contains volatile organic compounds (VOCs). Many diseases produce specific VOCs in exhaled breath that are unique to the disease and hence VOCs could be used as disease diagnostic markers. Zhunan collaborated with the National University Hospital on the use of breath analysis to detect lung cancer and tuberculosis. In these studies, a mass spectrometric approach was used to detect known VOCs that are specific to both medical conditions. Her work with Sengkang General Hospital has resulted in the development of a proprietary real-time breath sampler and analysis algorithm that can quickly diagnose acute coronary syndromes. This device could become an invaluable life-saving tool.

==========

NUSoil Nutrigel

Innovators: Dr Tan Wee Kee and Dr Zhu Jingling

Dr Tan Wee Kee obtained her Bachelor of Science and doctorate from NUS in 1999 and 2008, respectively. She is currently a Research Fellow at NUS. She had previously worked on aquaporins for water treatment and more recently, she has turned her attention to the use of soy waste for agriculture. Dr Zhu Jingling graduated from Wuhan University in China in 2008 and obtained her doctorate from NUS in 2012. She was awarded the NUS President Graduate Fellowship from 2011 to 2012 and is currently a Research Fellow at NUS.

The ability to retain moisture within the soil helps to ensure that trees, plants and crops are not water-starved, which could cause damage or even death of vegetation. This also guards against drought and intermittent dry periods. Wee Kee and Jingling have developed a patented gel material (NUSoil-NutriGel) that is able to keep water and nutrients within the gel. It will then gradually biodegrade in a controlled manner within the soil. The gel is made using okara, the by-product of the soy food industry, and is available at an affordable cost. This novel gel is suitable particularly for vegetable cultivation, gardening, urban agriculture, horticulture, and green buildings. Wee Kee and Jingling are also working on using the gel as carriers for useful groups of microbes to improve the properties of vegetation.

==========

Dynamic Adaptive Streaming over HTTP (DASH)

Innovator: Mr Abdelhak Bentaleb and Mr Praveen Kumar Yadav

Mr Abdelhak Bentaleb graduated with a Bachelor of Technology and Master of Science from the University of Bordj Bou Arréridj in Algeria. He started doctoral studies in the NUS School of Computing in 2015. Mr Praveen Kumar Yadav graduated with a Bachelor of Technology from Gautam Buddh Technical University in India and Master of Science from the National Institute of Technology in India. He started doctoral studies in the NUS School of Computing in 2016.

The exponential demand for high video quality has led to an explosive consumption of bandwidth, resulting in stalling and poor video quality, particularly when only one server is used and video download can only be done segment by segment, sequentially. Abdelhak and Praveen have come up with a parallel dynamic approach called Dynamic Adaptive Streaming over HTTP (DASH) which uses the user's existing multiple servers to download these segments in parallel. The approach takes advantage of servers that are not congested to relieve servers that are congested. Their approach is highly scalable and users can request and fetch video segments independently, maintaining their local playback state in a decentralised way, resulting in better quality video streaming.

A DASH system consists of two main entities: a DASH server and a DASH user. The DASH server stores videos that are divided into small segments (2–15 seconds) encoded at various levels and resolutions. These segments are then listed in a Media Presentation Description (MPD), which also includes information about the segments plus audio and subtitles. After an authentication phase, the client first fetches the MPD file of the video to be viewed and then issues HTTP requests for the segments sequentially based. The DASH server responds by sending the requested segments through HTTP. Their solution results in a higher quality video streaming that can benefit all Video-on-Demand (VoD) services for the user.

==========