

Smart Wearable Sensing Technologies for healthcare applications

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"Advancing health through technological innovation"

MISSION

- Identify clinical unmet needs & challenges
- Innovate health solutions & technologies
- **Incubate** to bring healthtech from bench to bedside
- Impact on patients, doctors & society

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iHealthtech Institute for Health Innovation & Technology



New Engineering in Medicine Building, E7



MD6 – Centre for Translational Medicine, NUS

Emerging Role of Al in Healthcare



contributed articles

Industry experiences on the data challenges of Al and the sali for a data ecosystem for industrial enterprises.

BY CHRISTOPH DEGER

There Is No Al Without Data

C Gröger, CACM 2021

ARTIFICIAL INTELLIGENCE (AI) has evolved from hype to reality over the past few years. Algorithmic advances in machine learning and deep learning, significant increases in computing power and storage, and huge amounts of data generated by digital transformation efforts make AI a game-changer across all industries.⁸ AI has the potential to radically improve business processes with, for instance, real-time quality prediction

etc. applies the second sec

Mempine the grain personal of A2 and the surge instantinumles in A4 reactancies price antidentiation by dedication in surgerprises, A4 have next add dedicated as other personance in inducation personal, the parts bestmens of inducation personal, the parts or A4 embedded by tachness instand or A4 embedded by tachness instand on the optimization of selected marks as the optimizations of selected marks in the optimizations of selected marks in the tachness constitution the training framework, doubt fact tangent on the training marks for the installing on a server in inducation marks for the installing on a server in the assessments for the installing on a server in the marks of the installing on a server in the second marks for the installing on a server in the marks of the installing on a server in the second marks for the installing on a server marks of the installing of the second second marks of the second second second second second second marks of the second second second second second second marks of the second second second second second second marks of the second second second second second second marks of the second second second second second second second marks of the second seco

In general, is is soften needed to be data perspanation and data quality are lary for M and data analytics, as there is no AI without data. This has been an instancious the early-daty of business intelligence (BI) and data excellences in the server, the manifold data challenges of M in industrial enterprises go far beyond detecting and repairing dirty data. This attuck proloandly investi-

key insights

- Bangete AF's great polositial, the trainers of teaturential enterprises to tell yet AL enterprised. AF is there is an invalue factore, teading to a polygist and factoregeneous outerprise data landscinge that tenths the samprohemologic application of AL.
- Bata shullanges, such is -tota management, data democratication, and data generation. constitution the major obviceles to leveraging Al and griter beyond ensuring data quality, comprising diverse respects such is metadata management, data architecture, and data exemptific.
- The presented data ecceptum for industrial enterprises addresses these challenges and comprises near weducers, data platforms, data

...there is no Data without Technology!





Wearable data collected can help us understand our health, health risks & how our health can be managed.

Use of Medical Wearables







https://www.grandviewresearch.com/





Motivation

Flexible Sensors

- Wearable
- Imperceptible

Appl 1 - Biomedical

- Disease diagnosis
- Health monitoring

Appl 2 - Health Metaverse

- Medical Training
- Rehabilitation





Gao, Yu, Yeo & Lim et al, Advanced Materials, 2019.



Diabetes – Towards Zero Amputation

The Fight Against Diabetes: A Worrying Trend





You could face long-term complications, which can affect your quality of life

If left untreated or poorly managed, it can lead to:



 National Health Survey, 2010, Singapore Citizens and Permanent Residents | 2. Phan TP, Alkema L, Tai ES, et al. Forecasting the burden of type 2 diabetes in Singapore using a demographic epidemiological model of Singapore. BMJ Open Diabetes Research and Care 2014;2:e000012. doi:10.1136/ bmjdrc-2013-000012 | 3. Figures estimated and extrapolated from National Health Survey, 2010 | 4. Saw Swee Hock School of Public Health, Singapore Citizens and Permanent Residents, aged 18 years and above

www.moh.gov.sg/budget2016



Sole Smart ... with Smart Insole

Smart Sole for Diabetic Ulcer





Flexosense – Towards Zero Amputation







NUS Startup, 2016

Awards & Recognition





IES Prestigious Engrg Achievement Award 2016

JT Award, TechPlanter 2016

Pier 71 Smart Port Challenge Award 2022

First Prize, Modern Aging Competition 2016

Winner, IDTechEx Launchpad, Berlin, Germany, 2017

IES Prestigious Engineering Achievement Award 2016

ASEAN Outstanding Engineering Achievement Award 2016

Merit Award, Engineering Medical Innovation Global Competition 2016



ASEAN Outstanding Engrg Achievement Award 2016



First Prize, Modern Aging Competition 2016



Winner, IDTechEx Launchpad, Germany, 2017









INTRODUCTION IN THE HEART OF ASIA, SINGAPORE HAS ONE OF THE FASTES GROWING INNOVATION ECOSYSTEMS IN THE WORLD.



Pession NATIONAL CEOGRAPH

28 Feb 2023







1-D Microtubular Sensors – Towards "invisible" sensing

1-D Microfluidic Tubular Sensor



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Xi W et al, PNAS, 2017 5 patents filed

Multiple Applications



Rehabilitation



Respiration Monitoring

Vital Signs Monitoring



Pulse Measurements

Healthcare Training



Smart Fitness







InfinityGlove[™] - Gesture Recognition



iHealthtech Institute for Health Innovation & Technology

Rehabilitation

Gaming control





Virtual reality training



Human machine interaction



Medical Training Game





Awards & Honors

2018 **Top 100 Science Spinoffs**

THIN AS A HUMAN HAIR MICROFIBER SENSOR FOR REAL-TIME HEALTHCARE DIAGNOSIS

Scientists from Singapore have created an ultra-thin microfiber sensor for real-time healthcare diagnosis. This sensor is highly sensitive, simple and low-cost to mass manufacturing. The device is thin as a human hair and can be used even for the treatment of varicose veins and venous ulcers. Furthermore, its characteristics make it the ideal material for wearable electronics.



Though only as that as i

The researcher's group from the National University of Singapore, led by Professor Lim Chave Teck, invented a feature excedibre sensor for real-time diagnosis. The thickness of this device is as the thickness of the



上海交大梁绕波副教授和新加坡国立大学Lim Chwee Teck教授:研 发柔性微管获开拓性进展





柔性微莹的发明人。从左至右: 斯望博士 (新加坡国立大学),Chwee Teck Lim教 授(新加坡面立大学), 真晓波副教授(上海交通大学)和孔放博士(新加坡·麻省 理工学院联合研究中心)



Many Medical Monitoring Uses for Ultrathin Microfiber Sensor Number 18, 201

New applications are being discovered for wearable devices in the medical arena as evidenced by the increasing use of microfluidic devices incorporating conductive liquid metals as wearable pressure and strain. spraces. However, must do not sufficiently conform to stor, or are uncombutable to user

A soft, flexible and sheltchable microfiber sensicr developed at National University of Singapore (NUS) may provide an ultra-thin solution for real-time healthcare monitoring and diagnosis. Simple and cost-effective to produce, the sensor conforms well to skin curvature and features excellent electrical conductivity and mechanical deformability



which are often bulky and may not provide instantaneous feedback. As our sensor functions like a conductive thread, it can be easily adven into a plove which can be worn by doctors to

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from research organization





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Science News

Smart, ultra-thin microfibre sensor for real-time healthcare monitoring and diagnosis

Date: November 16, 2017

- Source: National University of Singapore
- Summary: A soft flexible and sitestriable microfibre sensor has been developed for real-line tealthcare monitoring and diagnosis. The novel sensor is highly sensitive and ultra-thin with a diameter of a strand of human hair. It is also simple and cost-effective to mass produce.

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GOLD AWARD

is presented to

Ya Longtong

for an outstanding research presentation in the Graduate category at the BES 11th Scientific Meeting on Saturday, 28th May 2817

James

Prof. James Gob Cho Hong President, Biomedical Engineering Society (Singapore)







Media Coverage







The Straits Times, 22 Aug 2020



THE STRAITS TIMES



Asian Insider, Sept 2020



ChannelNewsAsia, 21 Aug 2020



CNA Documentary "Game Nation", 10 Jan 2021

HaptGlove – Wireless Pneumatic Glove for Haptic Feedback in the Metaverse



NUS Startup



VR Scenarios









The Health Metaverse



Award & Media Coverage

• IES Prestigious Engineering Achievement 2022







Lianhe Zaobao, Mar 2023









Wearable Technologies – Ultimate Aim





- Heartbeat
- Motion
- Steps
- Blood pressure
- ECG
- ...

- Health records
- Wearable data
- Patient generated health data
- ...

- Early detection/diagnosis of diseases
- Deep-learning algorithms for personalized therapy
- Monitoring of treatment
- Medical training
- ...

Wearables for Healthcare – Ultimate Aim



but also increase life expectancy

and healthspan."

Acknowledgements



J C Yeo (NUS)



W Xi (NUS)



L T Yu

(NUS)

X B Gong

(SJTU)



R H Soon







J M Qi

(NUS)

(NUS)



JC Teoh

(NUS)

YJ Gao (NUS)

K Du (MTPL)



Thank You !







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