



P2EI-WEALTH (Physiological and Psychological Edge Intelligence WEArable LoRa Health) System for Remote Indigenous Community and Disaster Recovery Operation

Presented by:

Dalilah Ghaffa

Wireless Lab, Universiti Kebangsaan Malaysia (UKM)



Universiti Kebangsaan Malaysia, UKM Bangi Faculty of Engineering & Built Environment



INTRODUCTION:

In the era of IoT and beyond, the urban and suburban population health monitoring transitions to use of wearables and intelligent health support systems. Unfortunately, the indigenous people and search and rescue operators who are often in remote and dangerous vicinities cannot benefit from the advantages due to limited connectivity, often caused by the lack of infrastructure. Furthermore, current wearables have only provided physiological measurements but not psychological which is a growing concern worldwide. In this project, a novel integrated IoT wrist-wearable with physiological and psychological biosensors are proposed with complementary activity, environmental, and position sensors to provide alerting situations and localization data relevant to the indigenous people and disaster recovery operations. The system will be empowered by edge intelligence and wireless LoRa-link to an in-vehicle or stationary data center. With this solution, the medic or emergency medical service (EMS) personnel will be able to know the real-time condition and able to decide of any intervention.

PROJECT MEMBERS:



DR. ASMA' ABU-SAMAH
Universiti Kebangsaan Malaysia



PROF. IR. DR. ROSDIADEE NORDIN
Universiti Kebangsaan Malaysia



ASSOC. PROF. DR. NOR FADZILAH ABDULLAH
Universiti Kebangsaan Malaysia



MR. MOHD RADZI AB RAHIM
URM Tasik Chini Research Centre



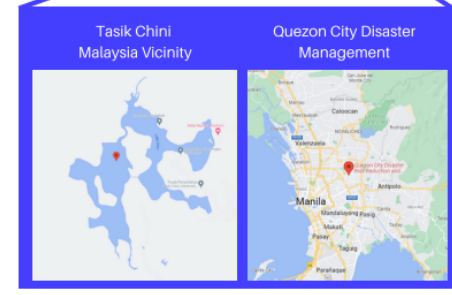
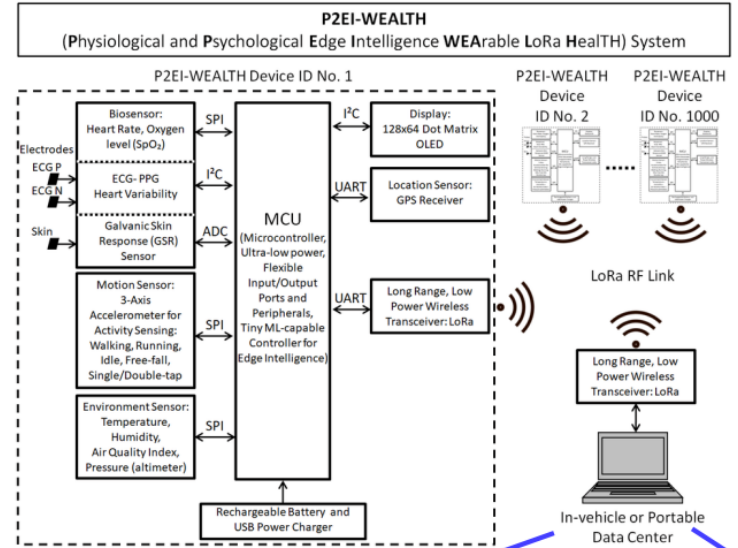
DR. JENNIFER C. DE LA CRUZ
Mapúa University, Philippines



MR. REGINALD JUAN M. MERCADO
GTek Enterprise, Philippines



MR. XARXES C. ALEJOS
GTek Enterprise, Philippines



Background

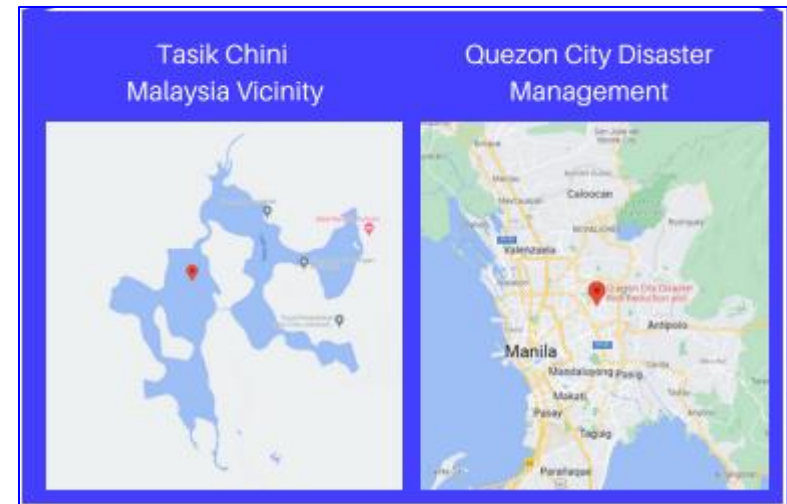
1. The indigenous people and the rescue operators in remote & dangerous vicinities cannot profit from the use of intelligent wearable health support system due to limited connectivity.
2. Current wearables have multiple measurements from Physiological and Psychological sensors but not supported by edge-intelligence to be analysed together.
3. Current wearables are for individual purposes and not for common monitoring & intervention purposes.

Targets

1. Working P2EI-WEALTH prototype using LoRa connected to a portable data center.
2. Edge Intelligence model for the physiological and psychological measurements & correlation establishment.

Test & analysis using 2 use cases:

1. Remote indigenous area (Tasik Chini, Malaysia)
2. Disaster recovery operation (Quezon City, Philippines)



Wearable IoT+ML Device



LoRa

Remote Data Center



Provides Data to Data Center:

- **Physiological:** HR, SpO2, ECG, Temp
- **Psychological:** Galvanic Skin Response, GSR
- **Motion:** Walking, Running, Idle, Free-fall, Single/Double Tap
- **Environmental :** Temp, Humidity, Air-Quality, and Baro. Pressure
- **Location:** GPS Location Coordinates, Date and Time

Benefits: This real-time remote patient monitoring method will provide medical doctors, who are remotely located in the city, the needed medical data while a patient is still in the danger zone. This timely information would be helpful in assessing the health conditions and the preparation for the proper medical treatment for a victim.

GTek
ENTERPRISE

P2EI-WEALTH Wearable IoT + TinyML Device

Bio-sensing: Heart Rate, Oxygen level (SpO₂), ECG-PPG, Psychological Readings (GSR + ML)

Solar-Battery Combo, USB Power Charger

OLED Display

GPS Receiver



LoRa



Activity Sensing:
Walking, Running, Idle,
Single/Double-Tap

Environmental Sensing: Temperature,
Humidity, Air Quality Index, Pressure
(altimeter)

GTEK
ENTERPRISE

P2EI-WEALTH Wearable IoT + TinyML Device

MCU:
Dual Core ARM
Cortex-M0+ @
133MHz. Edge
Impulse
supported MCU
for TinyML

GSR Sensor

Motion Sensor:
Walking,
Running, Idle,
Free-fall

Micro USB

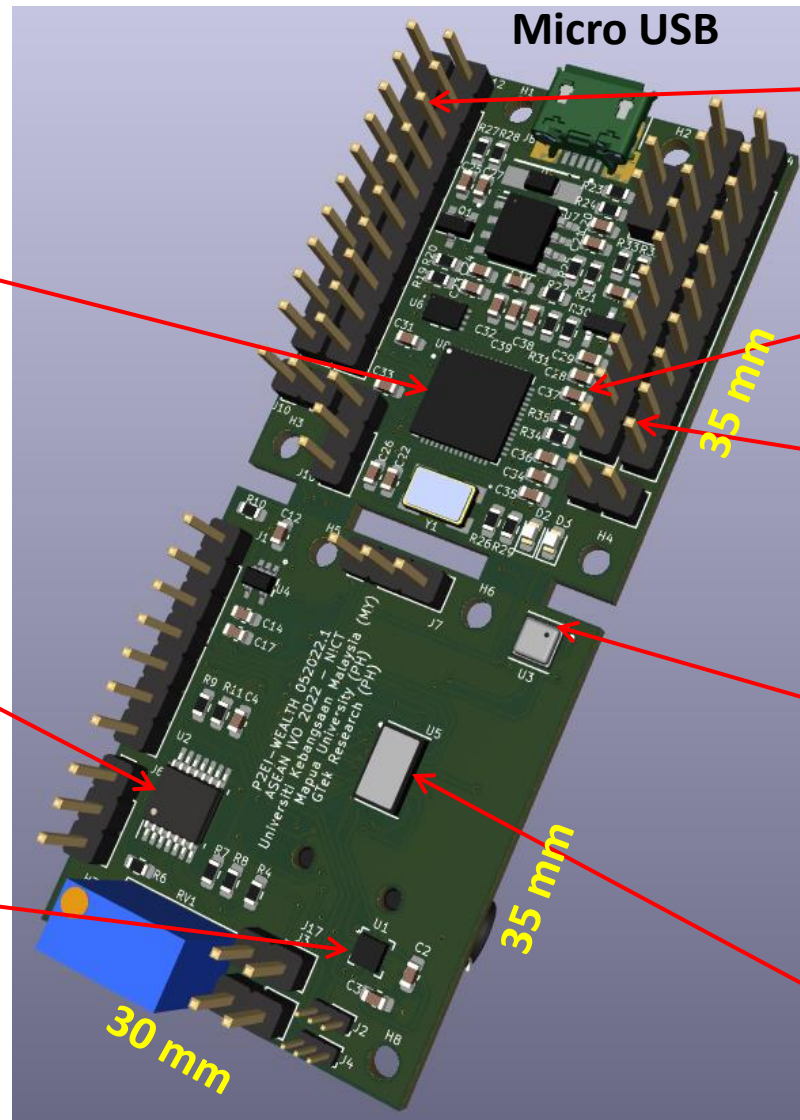
LoRa:
400/800/900
MHz

OLED 128x64

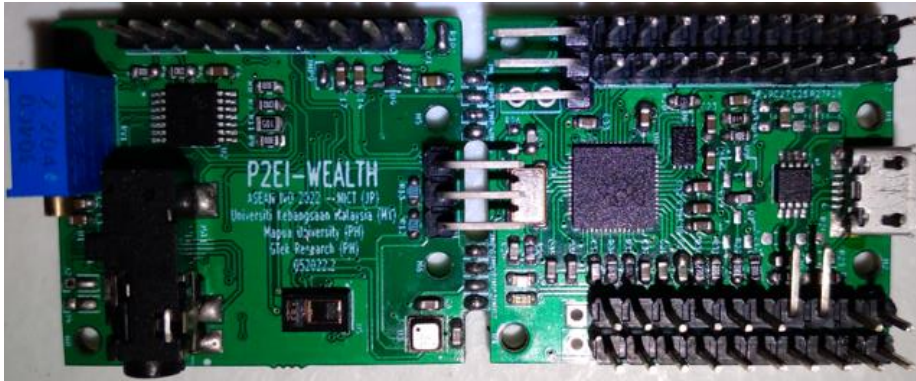
GPS Receiver

**Environment
Sensors: Air
Quality,
Humidity,
Pressure, and
Temperature**

Biosensor:
ECG, SpO2,
Heart-Rate

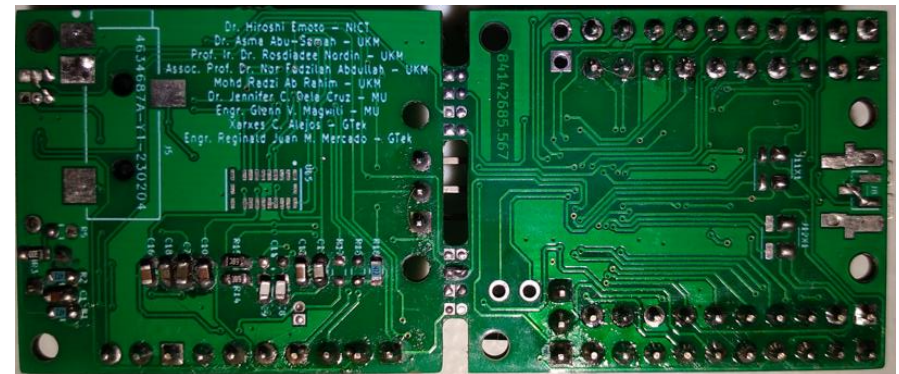


P2EI-WEALTH Wearable IoT + TinyML Actual Device



Top Layer of Sensors Board

Bottom Layer of Sensors Board



Top Layer of Communications Board



P2EI-WEALTH Remote Indigenous Community Operations at Chini Lake

Elderly, Pregnant, Sick, and Injured Patients Benefit from the P2EI-WEALTH Solution



A Data Center in the city collects in near real-time the health conditions (psychological (mind), physiological (body)), environmental, and location of a person wearing the P2EI-WEALTH.



LoRa-TinyML Network (up to 15km LOS)



P2EI-WEALTH Remote Disaster Recovery Operations

Disaster Victims and Emergency Rescuers Benefit from the P2EI-WEALTH Solution



LoRa-TinyML Network
(up to 15km LOS)



A Data Center in the city collects in near real-time the health conditions (psychological (mind), physiological (body)), environmental, and location of a person wearing the P2EI-WEALTH.

Gateway to
Internet



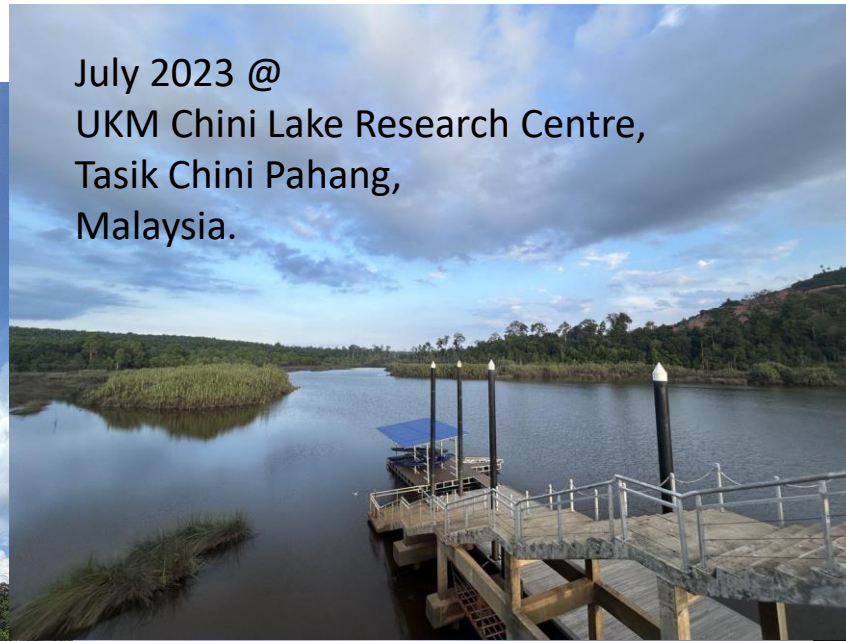
Mobile Data Center

P2EI-WEALTH Workshop



July 2023 @
Wireless Research Lab,
UKM Bangi,
Malaysia.

July 2023 @
UKM Chini Lake Research Centre,
Tasik Chini Pahang,
Malaysia.



Thank you!