



# *Program Title:* **ESTABLISHMENT OF THE INSTITUTE OF BIOMEDICAL ENGINEERING AND HEALTH TECHNOLOGIES (IBEHT)**

**Prof. NILO T. BUGTAI, PhD**

*Program Leader, Institute of Biomedical Engineering and Health Technologies  
Full Professor of Manufacturing Engineering and Management (MEM)  
De La Salle University, Manila Philippines*

*29 May 2019 | PICC – Pasay City Philippines*





## National Unified Health Research Agenda 2017-2022



### Global competitiveness and innovation in health

To promote research as a tool for creating novel solutions to existing and emerging health problems through technology development and innovation in fields of rapid advancement



Responsive health systems

Research to enhance and extend healthy lives

Holistic approaches to health and wellness

Health resiliency

Global competitiveness and innovation in health

Research in equity and health

**Diagnostics** | Development of diagnostic tests and devices for early detection and monitoring of premorbid conditions and diseases

**Drug discovery and development** | Research on the identification and standardization of natural products, and the development of drugs and vaccines for specific conditions (e.g., cancer, skin diseases, dengue and Zika) and multidrug-resistant infections, for production, local use, and international marketability

**Functional foods** | Research on food supplements and functional food development; and on commercialization, safety, regulation, and impact assessment of functional foods and food supplements

**Information and communication technologies for health** | Research on data science and E-health solutions for the integration of health information in recording and utilizing patient information, mapping of health risks and health resources, telemedicine, and health promotion

**Biomedical products and engineering** | Research on improvisation and local development of reliable, safe, and affordable biomedical devices for supportive and therapeutic care, for local health service provision and international markets

**"OMIC" technologies** | Generation of new knowledge about health and disease using genomics, proteomics, transcriptomics, and metabolomics

# Biomedical Products and Engineering

## Suggested priority technologies for 2017-2022:

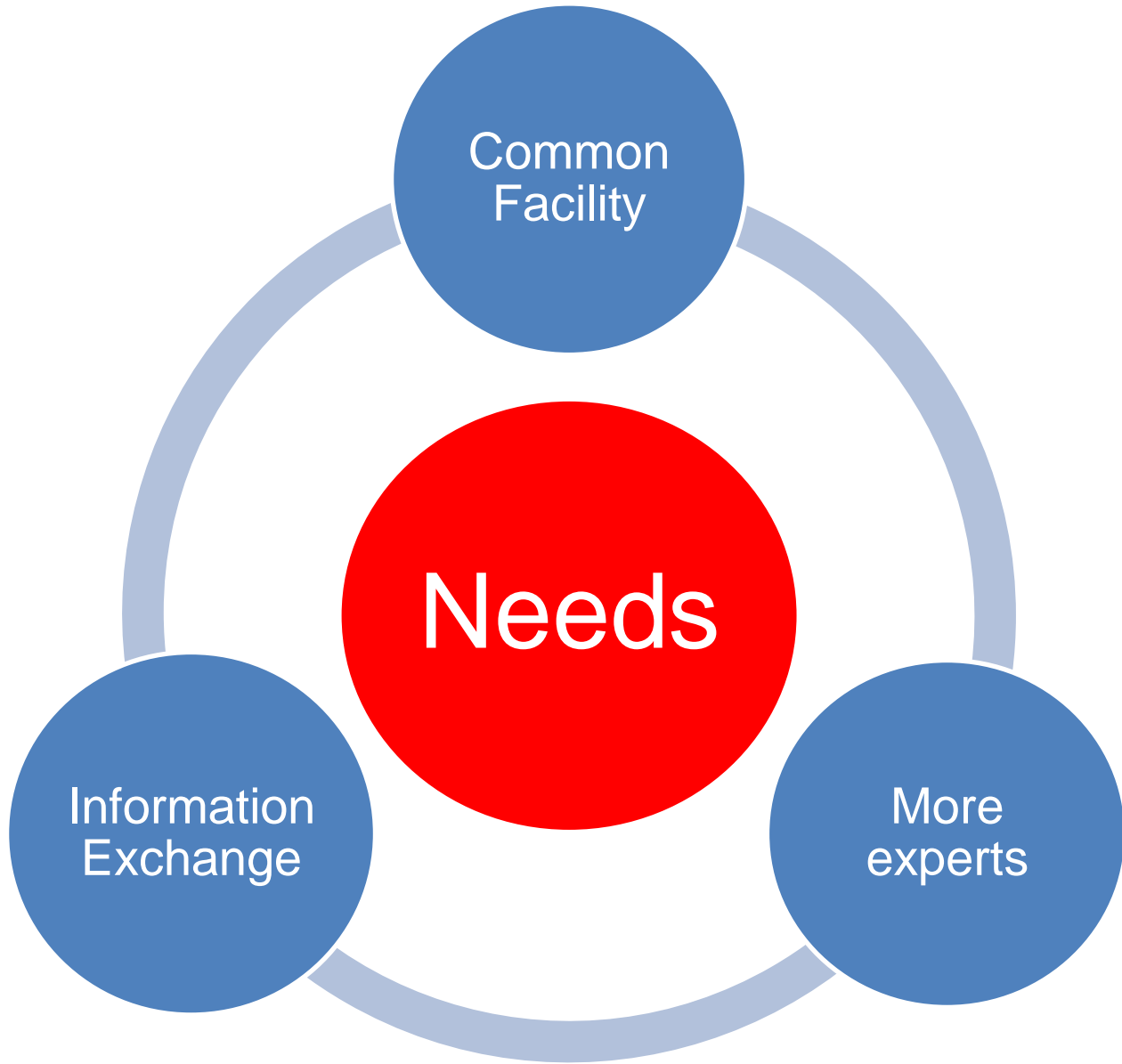
NUHRA 2017-2022

- *Hemodialysis devices/consumables i.e., dialysis membrane (filters)*
- *Silicon chest tubes, drainage bottles (pleural effusion)*
- *Wound care product/devices e.g., occlusive dressings, air mattresses*
- *Orthopedic surgery*
- *Non-invasive ventilator for adults*
- *Portable oxygen concentrator*
- *Rapid testing devices for infectious diseases (dengue, malaria, HIV, TB)*
- *Spinal disorders*
- *Hospital air filters (e.g. abaca-type filters)*
- *Primary care and postoperative care*
- *Hospital waste management equipment*
- *Personal protective equipment*
- *Ventilator (respiratory failure support)*
- *Prosthesis (artificial body part replacement)*
- *Minimally invasive surgical procedures and devices*
- *Rehabilitation devices and equipment*
- *Assistive technologies for PWD*
- *LED operating room lights*
- *Anaesthesia machine*

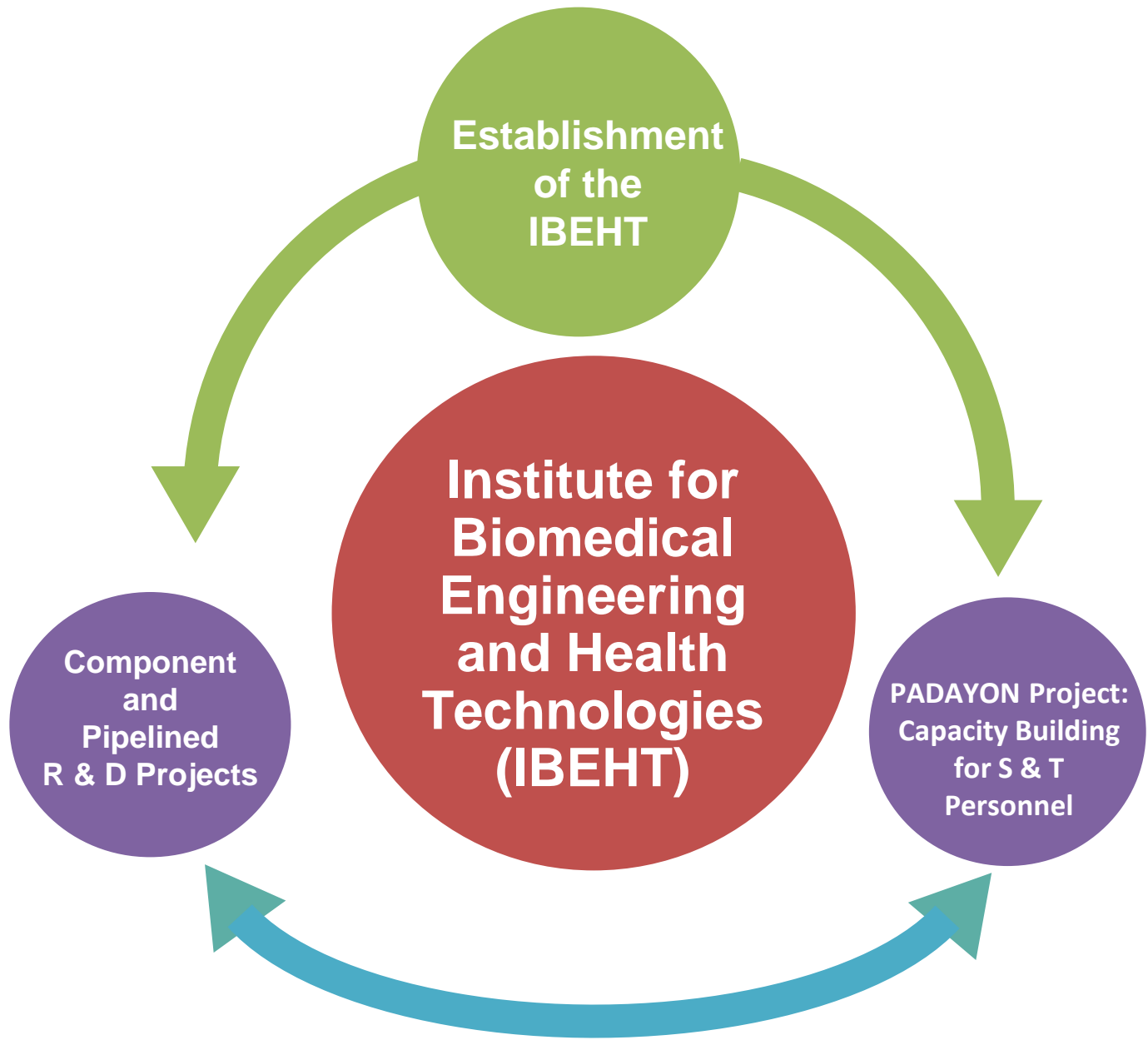
# CURRENT AVAILABLE FACILITIES

Services Needed for Biomedical Devices and Current Available Agencies			
Testing required	MIRDC	EPDC	Private sector
Electrical testing	×	×	✓
Mechanical testing	×	×	×
Electromagnetic compatibility testing	×	✓	×
Calibration	×	×	×
Manufacturing services (Fabrication)	✓	✓	✓
Maximum torque	×	×	×
Energy consumption and limitation	×	×	×
Durability	×	×	×
Component Lifecycle	×	×	×
Cleaning Chemical Compatibility	×	×	×

# FRAMEWORK OF IBEHT



# FRAMEWORK OF IBEHT



## **MISSION-VISION:**

- *The Institute of Biomedical Engineering and Health Technologies (IBEHT) is a multidisciplinary and interdisciplinary research community dedicated to improve the health and quality of life, providing education and training to scientists, researchers and students for the Filipinos and the society.*

## **By 2022, the IBEHT will be:**

- *At the forefront of biomedical devices innovation and research in the Philippines, producing ground-breaking and disruptive technologies for biomedical devices and equipment.*
- *Recognized nationally as the go-to-centers for scientists, engineers and innovators focusing on researches for biomedical devices and hospital equipment in the Philippines.*

# Draw together researchers, enhance their skills and accelerate product development.

- A **One-Stop-Shop** for information and support infrastructure on biomedical devices and equipment in the Philippines.
- A **Lab-to-Market Roadmap** for R&D projects under the research priority areas of the National Unified Research Agenda (NUHRA) to be submitted to DOST-PCHR for funding.
- A **Go-to-Centers** such as **Calibration Center**, **Safety Testing Center**, and **Commercialization Center** for scientists, engineers and innovators focusing their researches on biomedical devices and hospital equipment.
- **Supported by DOST-PCHR** for three (3) until Feb. 2022. At same time, **DLSU will provide the space in Laguna Campus** as well as to appoint the **Head of IBEHT** and its staff.
- Eventually, IBEHT will be offering **MSc and PhD in Biomedical Engineering** degree program **by research**.



Way back in **2000**, DLSU started the Biomedical Devices research...

Academic Year 2003-2004 - DLSU offered a specialization on **Biomedical Engineering** under the Manufacturing Engineering and Management (MEM) Program up to present.

DLSU has won several **awards** in biomedical projects, to name a few:

1. **Robotic Arm Rehabilitation** – National Grand Winner in Philippine Association for Technological Education (PATE) Best Undergraduate Engineering Design in 2010
2. **Laparoscopic Instrument / Robotic Articulating Laparoscopic Instrument** - Gold Prize Winner in the Intel Asia Pacific Challenge in 2011
3. **Robotic Leg Rehabilitation** - Gold Prize Winner in the Intel Asia Pacific Challenge in 2012

Academic Year **2021-2022**, DLSU will offer the **Bachelor of Science in Biomedical Engineering (BSc BME)** and **Master of Science in Biomedical Engineering (MSc BME)**

# On-going R&D Project



## LAPARA Project: Robotic Articulating Laparoscopic Instrument



BIOMEDICAL DEVICES  
INNOVATION AND E-HEALTH  
RESEARCH GROUP



St. Luke's  
Medical Center  
Quezon City - Global City

PROPONENT: **Prof. NILO T. BUGTAI, PhD**  
Lead Researcher: **FRANCIS MUNSAYAC, JR. III, MSc**  
Funding Agency: **DOST-PCHRD**  
Approved Budget: **PhP 14,637,396.00 million**

Implementing Agency: **De La Salle University, Manila Philippines**  
Cooperating Agency: **St. Luke's Medical Center | Adventist Medical Center Manila**  
Project Duration: **18 months: AUGUST 2018 – MARCH 2020**  
Project Stage: **PHASE 1 – Prototype Development and Safety Tests**

### PROBLEM

The current design of manual laparoscopic devices inhibits the movement of the surgeon where the range of motion of the device is restricted to only two degrees of freedom. In addition, a typical surgical operation lasts for at least two hours. Studies have shown that prolonged use of the manual laparoscopic tools can lead to musculoskeletal injuries such as neuropathy and back pain. In contrast, robotic laparoscopic devices such as Da Vinci, compared to conventional laparoscopic tools, have proven themselves by providing a better experience but at a higher cost.

### SOLUTION / EXPECTED OUTPUT

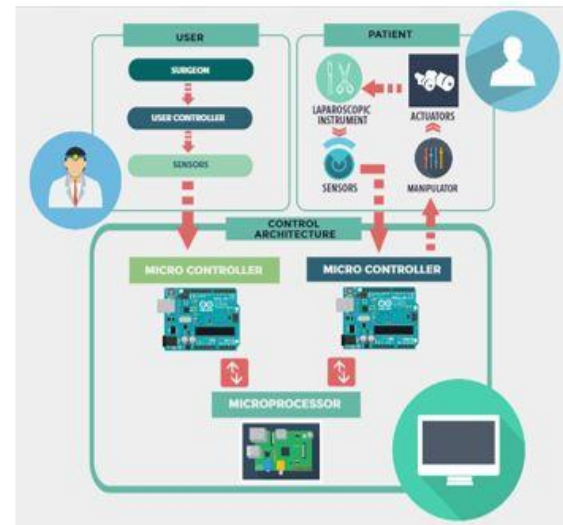
The project aims to fabricate prototypes that will improve maneuverability and ease of use for the surgeons by adding supplementary degrees of freedom. Specifically, it aims to fabricate one (1) working prototype featuring the following:

- Capable of at least 4- Degree of Freedom
- Shaft diameter of not more than 12 mm
- Capable of a grasping mechanism
- Test on a pig model
- Design of different end effectors for different surgical purposes

### METHODOLOGY



### CONCEPTUAL FRAMEWORK



# On-going R&D Project



## AGAPAY Project: Robotic Exoskeletons for Upper Extremity Rehabilitation



PROPONENT: **Prof. NILO T. BUGTAI, PhD**  
 Lead Researchers: **AIRA R. ONG, MSc | Engr. VOLTAIRE DUPO, MSc**  
 Funding Agency: **DOST-PCHRD**  
 Approved Budget: **PHASE 2: PhP 6,184,110.43 million**  
**PHASE 1: PhP 6,390,663.00 million**

Implementing Agency: **De La Salle University, Manila Philippines**  
 Cooperating Agency: **Philippine General Hospital**  
 Project Duration: **18 months: DECEMBER 2017 – JUNE 2019**  
 Project Stage: **PHASE 2 – Safety Tests and Preclinical Studies**

### PROBLEM

The current design is a 12 degrees-of-freedom (DOF) system that accounts for shoulder, elbow, wrist and finger movements. An effective design requires the device to be reliable, user-friendly, safe to use and manufactured in a cost effective way.

The device is actuated using high power servo motors attached to an adjustable frame. Real-time biofeedback system is integrated to record neuromuscular activity using surface electromyography (sEMG). The robotic exoskeleton arm can perform active and passive motion exercises through gamification techniques using integrated haptics and a graphical interface.

### SOLUTION / EXPECTED OUTPUT

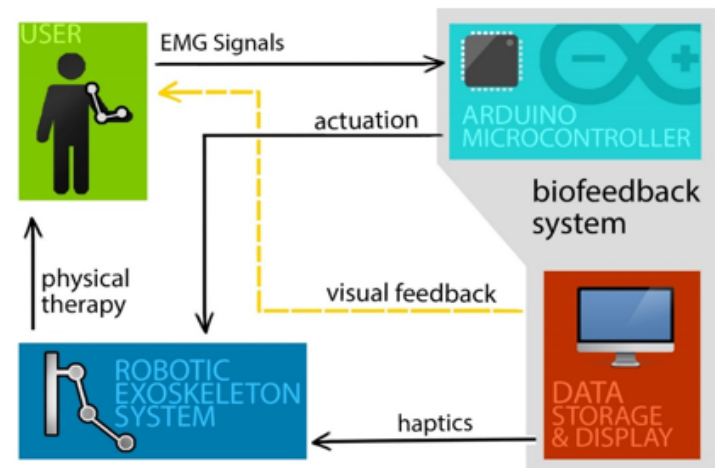
The project successfully completed the requirements for Phase 1 and is currently working on its Phase 2 with the following activities and deliverables:

- Reproduce three (3) replicates of the final design prototype and demonstrate the safety, feasibility and effectiveness
- Establish and develop protocols for the upper extremity robotic exoskeleton safety testing while taking into consideration existing international standards for its therapy program and individual functions/exercises
- Produce a technical manual and user guide for potential users
- Perform safety tests on the prototypes based on the developed protocol and specified by the International Standards

### METHODOLOGY



### CONCEPTUAL FRAMEWORK





# Robotic Rehabilitation for the Trunk and Lower Extremity



BIOMEDICAL DEVICES  
INNOVATION AND E-HEALTH  
RESEARCH GROUP



Project Leader: **Prof. NILO T. BUGTAI, PhD**  
Lead Researcher: **EDWIN D. SUBIDO, JR., MSc**  
Funding Agency: **DOST-PCHRD**  
Estimated Budget: **PHP 24,567,288.94**

Implementing Agency: **De La Salle University, Manila Philippines**  
Cooperating Agency: **De La Salle Medical and Health Sciences Institute**  
Duration: **18 months: DECEMBER 2018 – MAY 2020**  
Project Stage: **PHASE 1 – Prototype Development**

## PROBLEM

There is a lack of manpower (i.e. therapists) and equipment for lower limb rehabilitation in the Philippines that would cater to stroke patients. Currently, nearly every medical center in the country who provides rehabilitation are doing the traditional, manual therapy that is laborious, physically-demanding, and repetitive for the therapist especially with mobilizing (i.e. lifting, pulling, and pushing) patients who have a motor grade of 0-2, other neurologic deficits, and other deconditioned patients.

## SOLUTION / EXPECTED OUTPUT

### Publications.

- At least two (2) conference papers

### Products.

- One (1) working prototype (2 units) of a rehabilitation device for the lower extremity with at least 5-dof and an Android-based software for controlling the device
- A GUI-based gamification software for rehabilitating patients
- Real-time database management and monitoring of the patient's data, and control of the device via wireless communication

### Patents.

- Patent Disclosures.

### People Services.

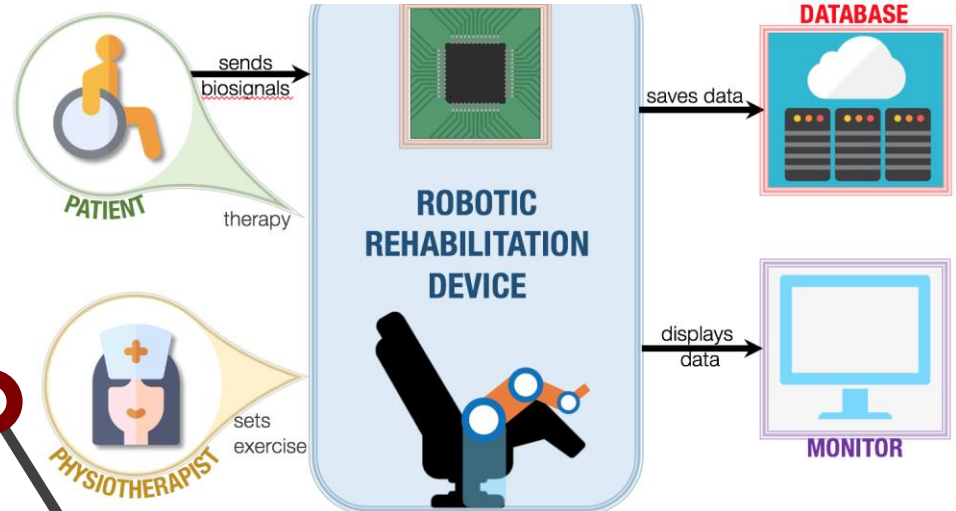
- This robotic device will be managed by a medical professional who will be trained to operate the device.

### Places and Partnerships.

- MOU with De La Salle Medical and Health Sciences Institute, Dasmarias, Cavite

## METHODOLOGY

## CONCEPTUAL FRAMEWORK



# On-going R&D Project



## DOE Project: Development of a Wearable Goat Peak Estrus Sensor



BIOMEDICAL DEVICES  
INNOVATION AND E-HEALTH  
RESEARCH GROUP



**PROPONENT:** Prof. NILO T. BUGTAI, PhD  
**Lead Researcher:** DANICA MITCH M. PACIS, MSc  
**Funding Agency:** DOST-PCAARRD  
**Approved Budget:** PHP 7,955,901.04 million

**Implementing Agency:** De La Salle University, Manila Philippines  
**Cooperating Agency:** Cagayan Valley Small Ruminants Research Center, Isabela State University  
**Project Duration:** 24 months: JANUARY 2019 – DECEMBER 2021  
**Project Stage:** PHASE 1 – Prototype Development and Preclinical Studies

### PROBLEM

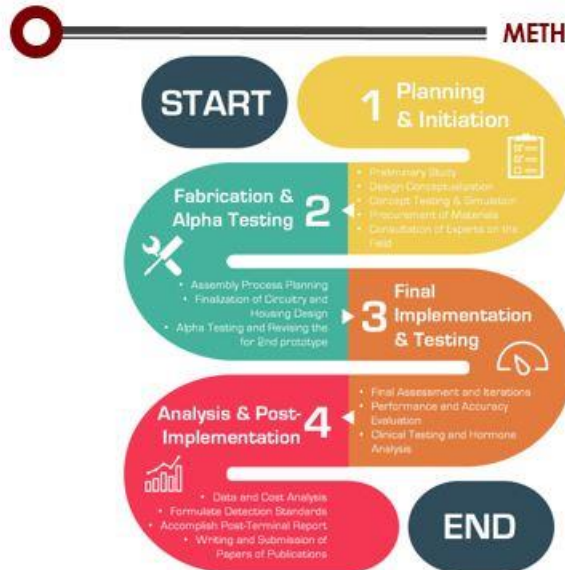
Existing devices for monitoring estrous cycles of does focus on properties prone to changes caused by external factors and apply the single-parameter analysis approach thus, become subject to error. Furthermore, the increasing demand for goats will lead to time-consuming and labor-intensive individual and herd estrous monitoring. Therefore, a wearable sensor is needed to wirelessly send information on the relevant properties from the vaginal fluid that will dictate the status of estrous cycle of each goat to a computer software operated by the breeder.

### SOLUTION / EXPECTED OUTPUT

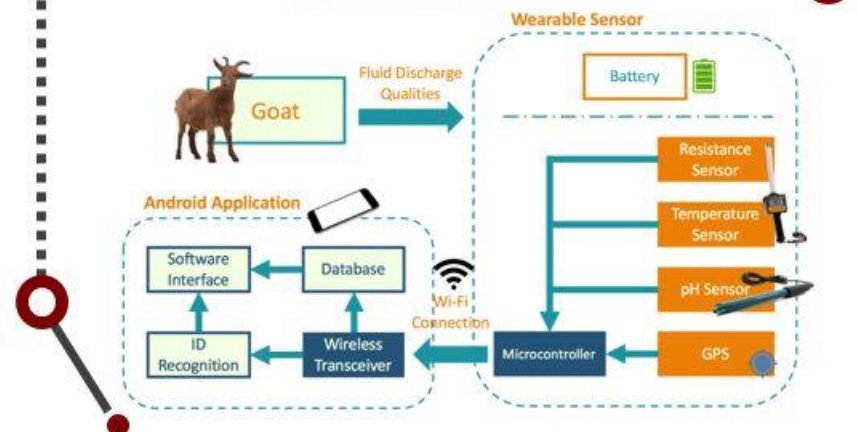
An impervious wearable wireless intra-vaginal monitoring sensor prototype for goat peak estrus detection

- Products:
  - One (1) working prototype of the wearable sensing device with integrated electronic connection platform; the housing is accomplished through rapid prototyping.
  - One (1) Android mobile phone application design that can receive and display the data transmitted from the wearable sensor
- Patents: Wearable device, integration and use of sensors
- Publications: Two (2) conference papers and high-impact journal publications
- Places and Partnerships: MOU with Cagayan Valley Small Ruminants Research Center (CVSRR), Isabela State University

### METHODOLOGY



### CONCEPTUAL FRAMEWORK



# PADAYON Project: On-going

## Capacity Building for S&T Personnel in Biomedical Devices Innovation and Research

### Capacity Building

Postgraduate Scholarships

Research Fellowships

Community Development

MSc in Biomedical Engineering

PhD in Biomedical Engineering

Research Staff/  
Faculty Foreign Fellowships  
(2 per year for 12 weeks)

Local Training by Foreign Experts  
(2 per year for 2 weeks)

Seminars, Conferences, Events and Societies

# PADAYON Project: On-going



## International Postgraduate Scholarships on Biomedical Engineering Degree



### FIRST YEAR IMPLEMENTATION

#### (10) Masters

1 year fully-funded scholarship for MSc degree in foreign university

Tuition and Bench Fees / Consumables

Living Allowance

Return service to the country

#### (10) PhD

3 years fully-funded scholarship for PhD degree in foreign university

Tuition and Bench Fees / Consumables

Living Allowance

Return service to the country

# Pipelined R&D Projects

## A. BIOMECHANICS AND REHABILITATION ENGINEERING

*Human and Biological Robotics is an emerging research area that uses the framework of robotics to understand the control principles evolved by biological sensorimotor systems, and apply this knowledge to create novel robotic devices that can truly help humans.*

*Research in this area includes:*

- *Prosthetics, Orthotics and Artificial Limbs*
- *Motor Control and Neuroprosthetics*
- *Assistive Technologies for the Elderly and PWD*
- *Design of Neuro and Neuro-inspired technologies*
- *Materials Development for Micro and Nano-particles*

COMPONENT R&D PROJECTS:

1. **TAYÔ Project:** *Robotic rehabilitation for the lower extremity (**On-going**)*
  - *Collaborator: De La Salle Medical and Health Sciences Institute*
2. **BIONIC Project:** *Development of a Wearable Below-Knee Artificial Limb Exoskeleton, Designed for Foot Injury Support, Rehabilitation and Prosthetics (**proposal for submission to PCHRD in June 2019**)*
  - *Collaborators: University of San Jose – Recoletos and Cebu Doctors University Hospital*



# Pipelined R&D Projects

## B. MEDICAL DEVICES AND DIAGNOSTICS

*In the field of medical sensing, the need to capture diagnostic information in remote settings using low power disposable systems will be the key. Research in this field involves developing new biomedical engineering hardware and software approaches.*

Research in this area includes:

- *Minimally-invasive Diagnostics*
- *Sensors for Cell & Tissue engineering/Implanted Devices*
- *Point of Care (POC) Patient Monitors*
- *Medical Imaging*
- *Wireless Physiological Monitoring Technology and Chip Implementation Techniques on Biomedical Signal Processing*
- *Image Analysis Techniques and System Development (ultrasound and digital radiography)*

COMPONENT R&D PROJECTS:

1. **HANAP Project:** *Development of a handheld Apparatus with Novel Application for Pulmonary Tuberculosis. (**proposal for submission to PCHRD in June 2019**)*
  - *Collaborator: De La Salle Medical and Health Sciences Institute*
2. **SELLA Project:** *Head Operated Controllable Powered Wheelchair for Children with Spinal Cord Injury Using Mechatronics Approach (**proposal for submission to PCHRD in June 2019**)*
  - *Collaborator: De La Salle Medical and Health Sciences Institute*

# Pipelined R&D Projects

## C. INTELLIGENT SYSTEMS AND CONNECTIVITY FOR HEALTH TECHNOLOGIES

*Focused on the impact and implementation of e-Health, on patients' use of the internet, and online collaborative learning between patients and healthcare professionals. Our research work often leads us to develop novel intelligence systems.*

*Research in this area includes:*

- *Software and application development*
- *Healthcare management systems and databases*
- *Telehealth and telepresence technologies*
- *Tele-care information communication technology*

*COMPONENT R&D PROJECTS:*

1. **LAP-AR 360 Project:** *Laparoscopy-augmented Reality 360 Degrees*
  - *Collaborator: Adventist Medical Center Manila (**proposed to PCHRD for revision**)*
2. **MEDELI Project:** *Development of a GPS Guided Autonomous Delivery Drone (**proposal for submission to PCHRD in June 2019**)*
  - *Collaborator: De La Salle Medical and Health Sciences Institute*

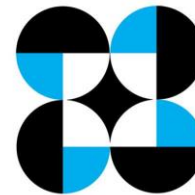
# 6 P's

- Publications.** *High-impact papers through the 1<sup>st</sup> Philippine National Conference on Biomedical Engineering (1<sup>st</sup> PNBEC)*
- Patents**
- People Services.** *International Postgraduate Scholarships on Biomedical Engineering degree program  
Local Faculty Development and Training*
- Places** *Establishment of a Go-to-Centers for Biomedical Engineering and Health Technologies in DLSU Laguna Campus*
- Policies.** *Recommendation of Regulations and Guidelines for Biomedical Devices and Hospital Equipment in the country*
- Partnerships.** *Collaboration public-private partnerships (e.g. Regional Health Research Consortia, universities, Biomed Society of the Philippines)*

# COLLABORATIONS



**BIOMEDIC PH**  
PHILIPPINE BIOMEDICAL DEVICE INNOVATION CONSORTIUM



DEPARTMENT OF SCIENCE AND TECHNOLOGY

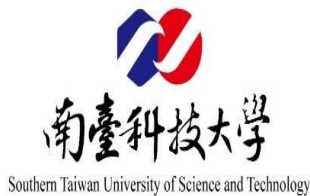
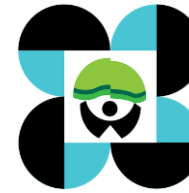
PHILIPPINE COUNCIL FOR HEALTH RESEARCH AND DEVELOPMENT




**AUCKLAND BIOENGINEERING INSTITUTE**

THE UNIVERSITY OF AUCKLAND  
NEW ZEALAND

Te Whare Wānanga o Tāmaki Makaurau



**Health Research and Development Consortium Region IV-A**



“Developing reliable, easy to operate, safe to use and affordable biomedical devices through the researches done by the Filipinos for the Filipinos towards a healthier Philippines”

“Creating new industries for biomedical devices and hospital equipment in the Philippines”

*~ Prof. Nilo T. Bugtai, PhD*



**THANK YOU VERY MUCH FOR  
LISTENING!**

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