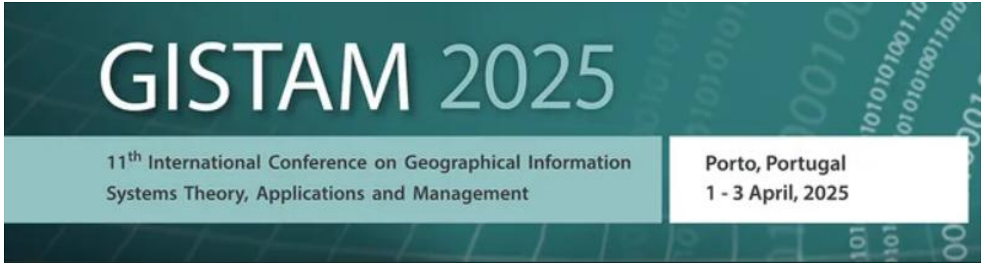
# Developing an IoT-Based Multi-Sensor System for Real- Time Fire Detection and Spatial Analysis to Improve Campus Safety

Universiti Kebangsaan Malaysia
*The National University of Malaysia*


GISTAM 2025

11th International Conference on Geographical Information Systems Theory, Applications and Management

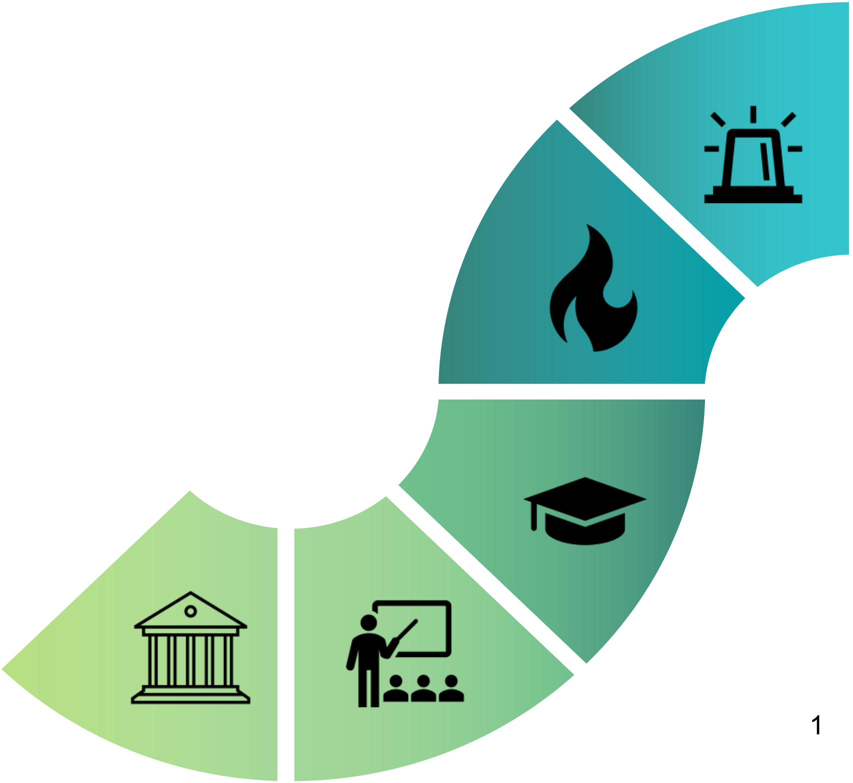
Porto, Portugal
1 - 3 April, 2025

*3rd April 2025 | Thursday*

*Vila Galé Porto Hotel, Porto, Portugal*

**Khairul Nizam Abdul Maulud**, Sarah Shaharuddin,
Syed Ahmad Fadhli Syed Abdul Rahman, Adi Irfan Che Ani

*Department of Civil Engineering, Faculty of Engineering & Built Environment,*
*Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia*



# PRESENTATION OUTLINE

1 INTRODUCTION TO UNIVERSITI KEBANGSAAN MALAYSIA

2 INTRODUCTION TO GEOSPATIAL APPLICATION IN UKM

3 PROBLEM STATEMENT

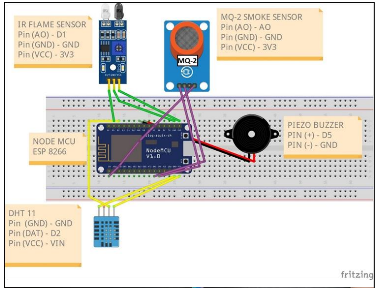
4 RESEARCH OBJECTIVES

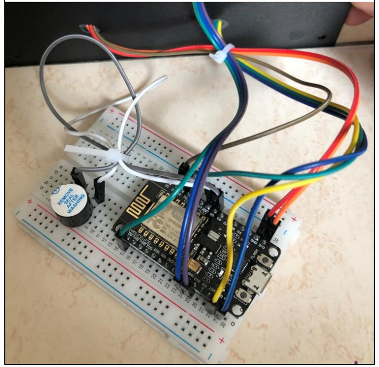
5 RESEARCH METHODOLOGY

6 FINDINGS

7 DISCUSSION

8 CONCLUSION


IR FLAME SENSOR
Pin (AO) - D1
Pin (GND) - GND
Pin (VCC) - 3V3
MQ-2 SMOKE SENSOR
Pin (AO) - AO
Pin (GND) - GND
Pin (VCC) - 3V3
MQ-2
NODE MCU
ESP 8266
NodeMCU
V1.0
PIEZO BUZZER
PIN (+) - D5
PIN (-) - GND
DHT 11
Pin (GND) - GND
Pin (DAT) - D2
Pin (VCC) - VIN
fritzing



Universiti Kebangsaan Malaysia (UKM) celebrates 55th year of establishment this year. UKM is identified as a Research University by the Government of Malaysia in 2007 (Under RMK 2006-2010).

# About Us

## VISION

UKM is committed to be ahead of society and time in leading the development of a learned, dynamic and moral society.

## MISSION

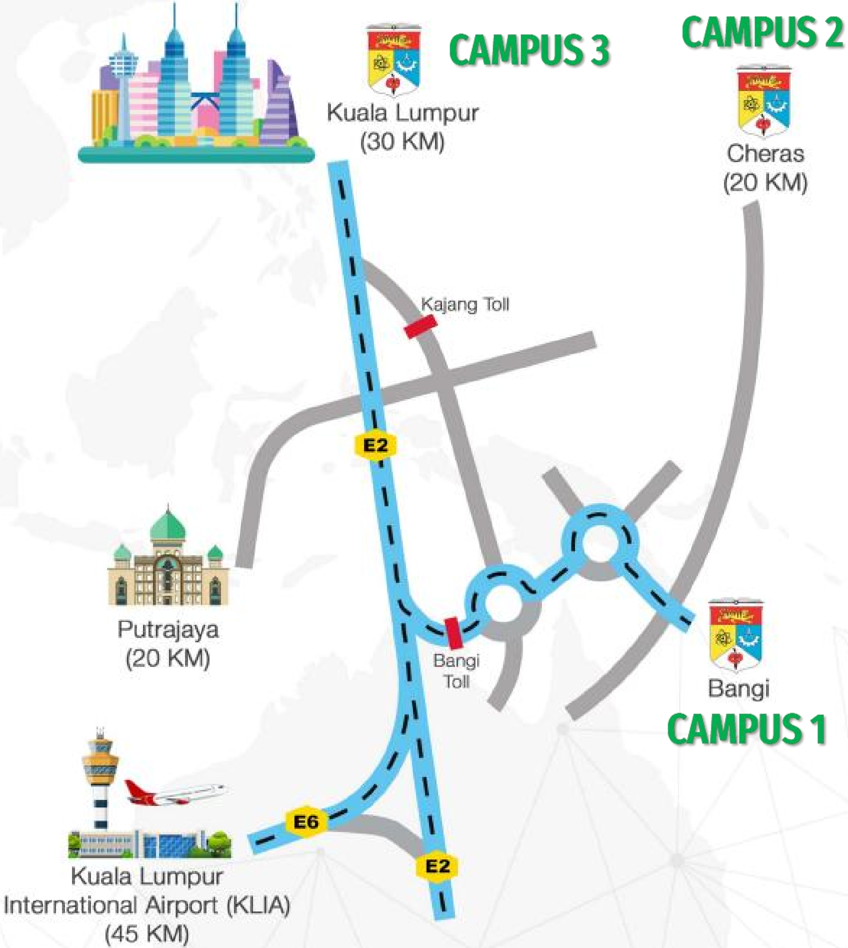
To be the learning centre of choice that promotes the sovereignty of Bahasa Melayu and internationalizes knowledge rooted in the National culture.

# Campus Location

**CAMPUS 1**

**CAMPUS 2**

**CAMPUS 3**


CAMPUS 3
Kuala Lumpur
(30 KM)
CAMPUS 2
Cheras
(20 KM)
Kajang Toll
E2
Putrajaya
(20 KM)
Bangi
Toll
Bangi
CAMPUS 1
E6
E2
Kuala Lumpur
International Airport (KLIA)
(45 KM)

Universiti
Kebangsaan
Malaysia
*The National University of Malaysia*

# UKM STRATEGIC PLAN T.E.R.A.S 2021-2025

**T** Bakat *(Talent)*

**E** Etika *(Ethics)*

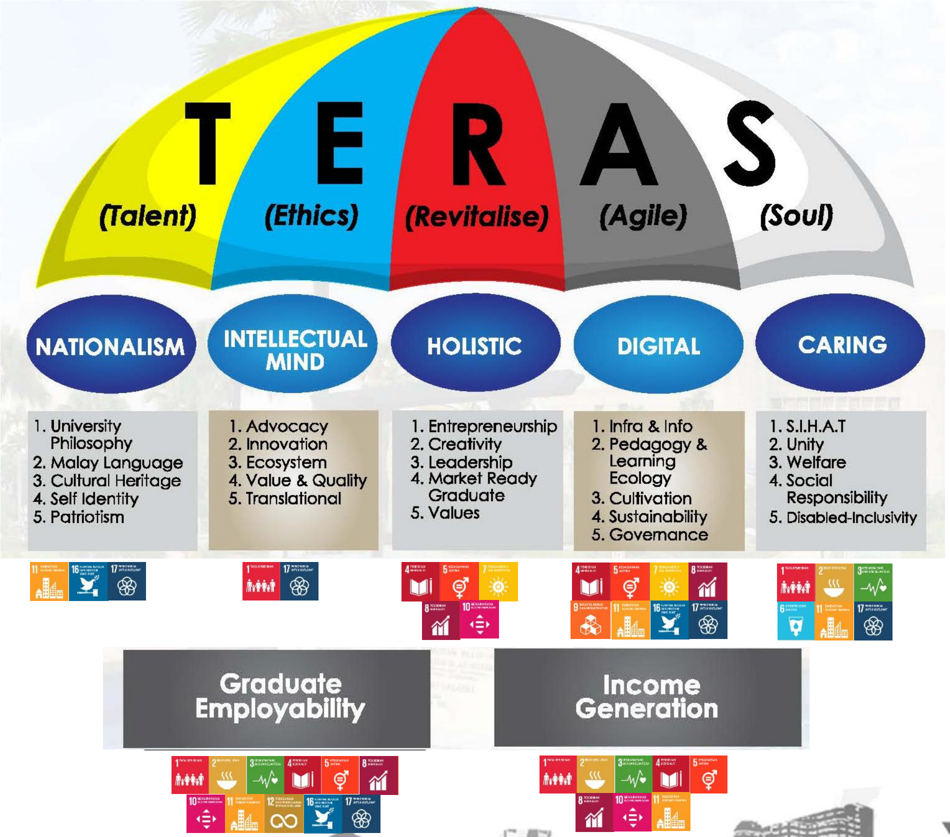
**R** Memperkasa *(Revitalise)*

**A** Tangkas *(Agile)*

**S** Jiwa *(Soul)*

T·E·R·A·S
Naratif Baharu UKM
Universiti Watan Kita
BICARA PERDANA
NAIB CANSELOR UKM
PROF. DATO' Ts. DR. MOHD EKHWAN HJ. TORIMAN
PELAN STRATEGIK T.E.R.A.S
UNIVERSITI KEBANGSAAN MALAYSIA
2021-2025
NARATIF BAHARU UKM
UNIVERSITI WATAN KITA

# MAPPING OF UKM STRATEGIC PLAN WITH SDG


T
E
R
A
S
(Talent)
(Ethics)
(Revitalise)
(Agile)
(Soul)

**NATIONALISM**

1. University Philosophy
2. Malay Language
3. Cultural Heritage
4. Self Identity
5. Patriotism

11
16
17

**INTELLECTUAL MIND**

1. Advocacy
2. Innovation
3. Ecosystem
4. Value & Quality
5. Translational

1
17

**HOLISTIC**

1. Entrepreneurship
2. Creativity
3. Leadership
4. Market Ready Graduate
5. Values

4
5
7
8
10

**DIGITAL**

1. Infra & Info
2. Pedagogy & Learning Ecology
3. Cultivation
4. Sustainability
5. Governance

4
5
7
8
9
11
16
17

**CARING**

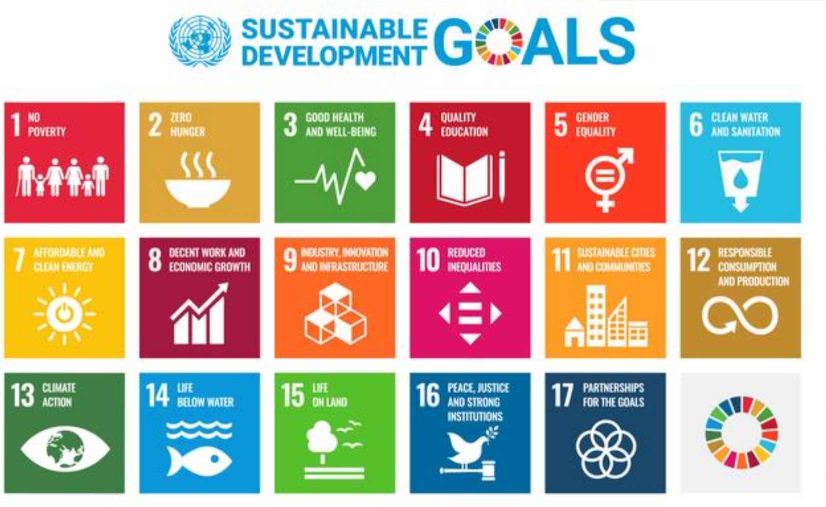
1. S.I.H.A.T
2. Unity
3. Welfare
4. Social Responsibility
5. Disabled-Inclusivity

**Graduate Employability**

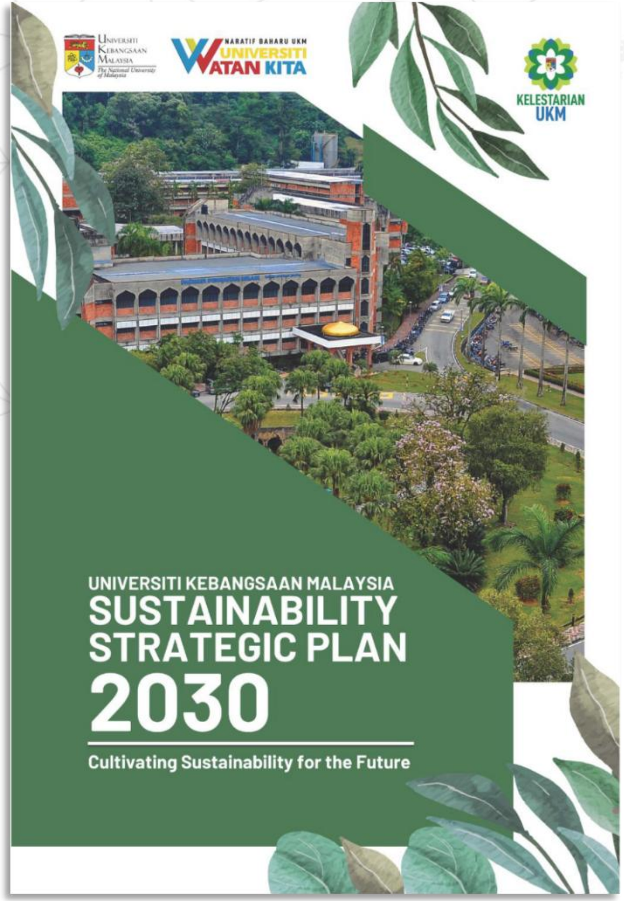
1
2
3
4
5
8
10
11
12
16
17

**Income Generation**

1
2
3
4
5
8
10
11


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

# Sustainability Strategic Plan Universiti Kebangsaan Malaysia 2030

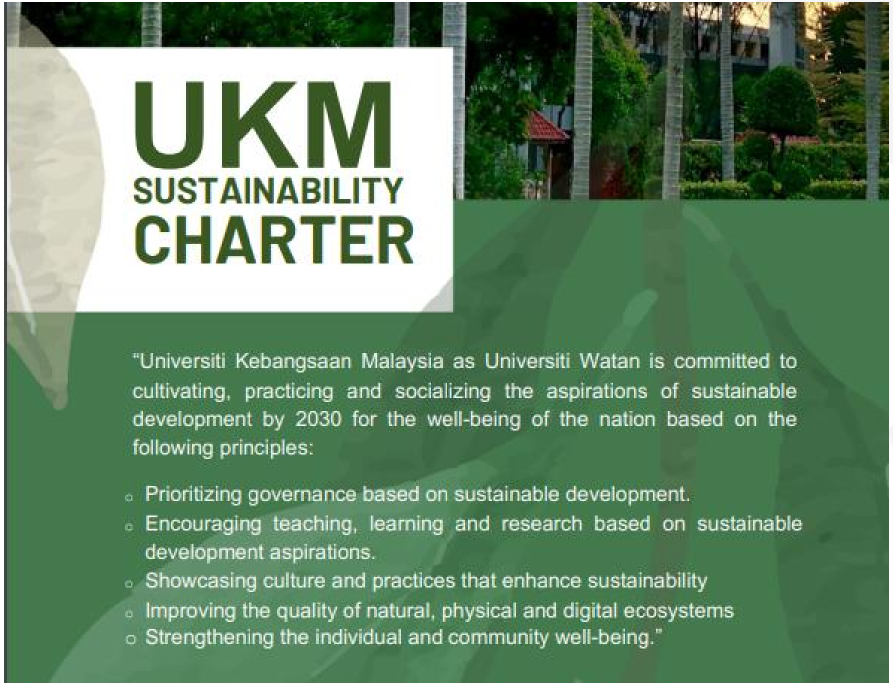


NARATIF BAHARU UKM
UNIVERSITI WATAN KITA

KELESTARIAN UKM

UNIVERSITI KEBANGSAAN MALAYSIA
SUSTAINABILITY STRATEGIC PLAN
2030

Cultivating Sustainability for the Future



## UKM SUSTAINABILITY CHARTER

"Universiti Kebangsaan Malaysia as Universiti Watan is committed to cultivating, practicing and socializing the aspirations of sustainable development by 2030 for the well-being of the nation based on the following principles:

- Prioritizing governance based on sustainable development.
- Encouraging teaching, learning and research based on sustainable development aspirations.
- Showcasing culture and practices that enhance sustainability
- Improving the quality of natural, physical and digital ecosystems
- Strengthening the individual and community well-being."

# 15
# Faculty

- Engineering and Built Environment
- Science and Technology
- Law
- Health Sciences
- Islamic Studies
- Economics and Management
- Information Science and Technology
- Social Sciences and Humanities
- Education
- Medicine
- Pharmacy
- Dentistry
- School of Liberal Studies (CITRA-UKM)
- GENIUS@Pintar National Gifted Centre
- Graduate School of Business

**SCAN ME !**

- Microengineering and Nanoelectronics
- Fuel Cell
- IR4.0
- Solar Energy
- Malaysian and International Studies
- Ethnic Studies
- Medical Molecular Biology
- Climate Change
- Environment and Development
- System Biology
- Islamic Civilization
- Malay World and Civilization

# 12
# Institute

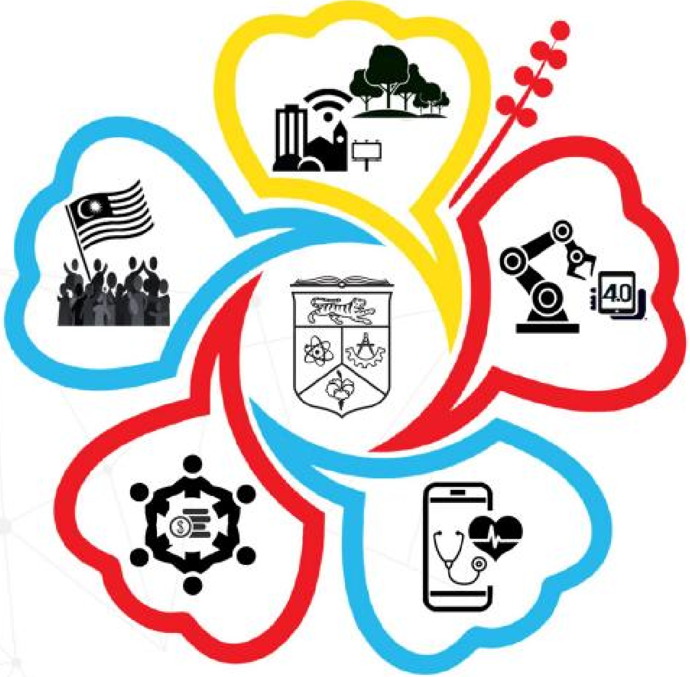
SCAN ME !

Universiti Kebangsaan Malaysia
The National University of Malaysia

# 52
International Programmes

| | |
|---|---|
| 12 | Sciences and Humanities |
| 12 | Science and Technology |
| 8 | Health Sciences |
| 6 | Engineering and Built Environment |
| 5 | Islamic Studies |
| 4 | Information and Science Technology |
| 3 | Education |
| 1 | Law |
| 1 | Economics and Management |

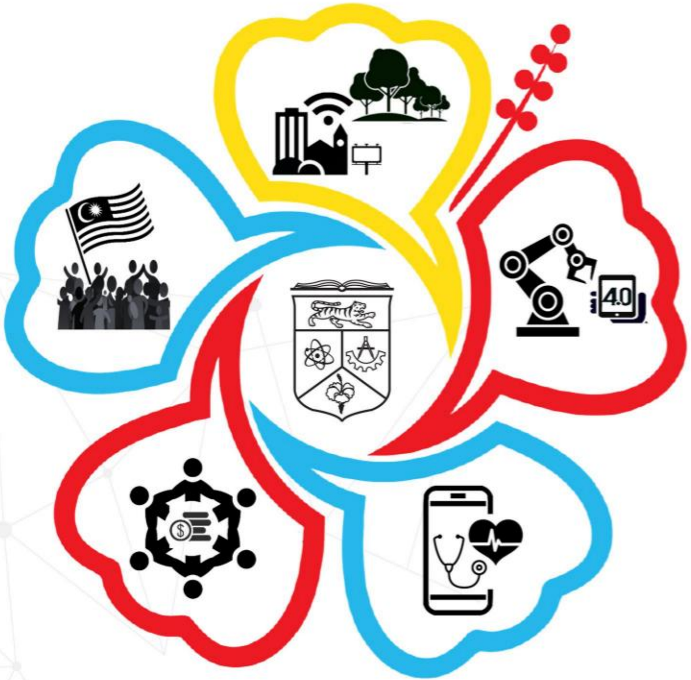
# Research Cluster @ UKM



1. Sustainable Resources, Environment and Smart Living
2. Digital and Frontier Technology
3. Health and Advanced Medicine
4. Social and Economic Transformation
5. Heritage and Civil Society

Universiti
Kebangsaan
Malaysia
The National University of Malaysia

# Research Cluster @ UKM



1. Sustainable Resources, Environment and Smart Living
2. Digital and Frontier Technology
3. Health and Advanced Medicine
4. Social and Economic Transformation
5. Heritage and Civil Society

# Living Labs

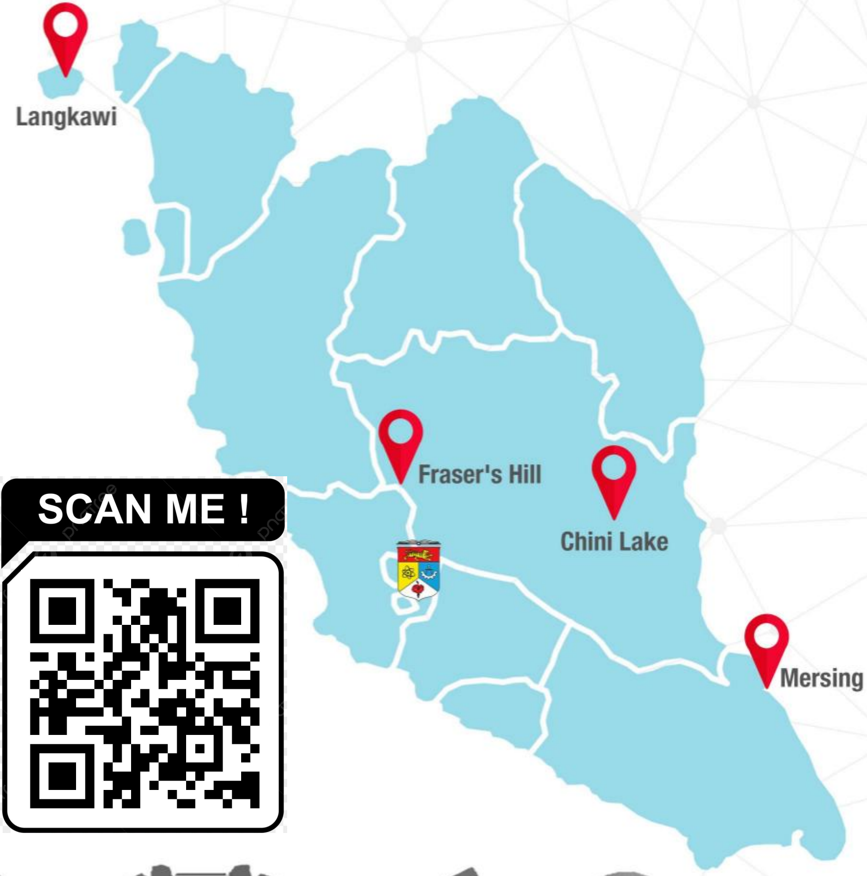
KILIM GEOFOREST PARK

Langkawi Research Centre

Tasik Chini Research Centre

Fraser's Hill Research Centre

Marine Ecosystem Mersing


Langkawi
Fraser's Hill
Chini Lake
Mersing

SCAN ME !

**#138**
QS WORLD UNIVERSITY RANKINGS

QS WORLD UNIVERSITY RANKINGS 2025
IN THE TOP 150 IN THE WORLD

**#28**
QS ASIA UNIVERSITY RANKINGS

QS UNIVERSITY RANKINGS ASIA
TOP 30
2024

**#244**
QS WORLD UNIVERSITY RANKINGS SUSTANABILITY

QS WORLD UNIVERSITY RANKINGS
SUSTAINABILITY
2024

**5** ★★★★★

QS STARS University Ratings
Overall
Teaching
Employability
Internationalization
Facilities

**#401 - 500**
THE WORLD UNIVERSITY RANKINGS

THE World University Rankings 2024

**#101**
THE ASIA UNIVERSITY RANKINGS

THE World University Rankings 2024 Asia

**#201 - 300**
Times Higher Education
Impact Rankings

**#1**
AppliedHE™
Public & Private University Ranking
ASEAN

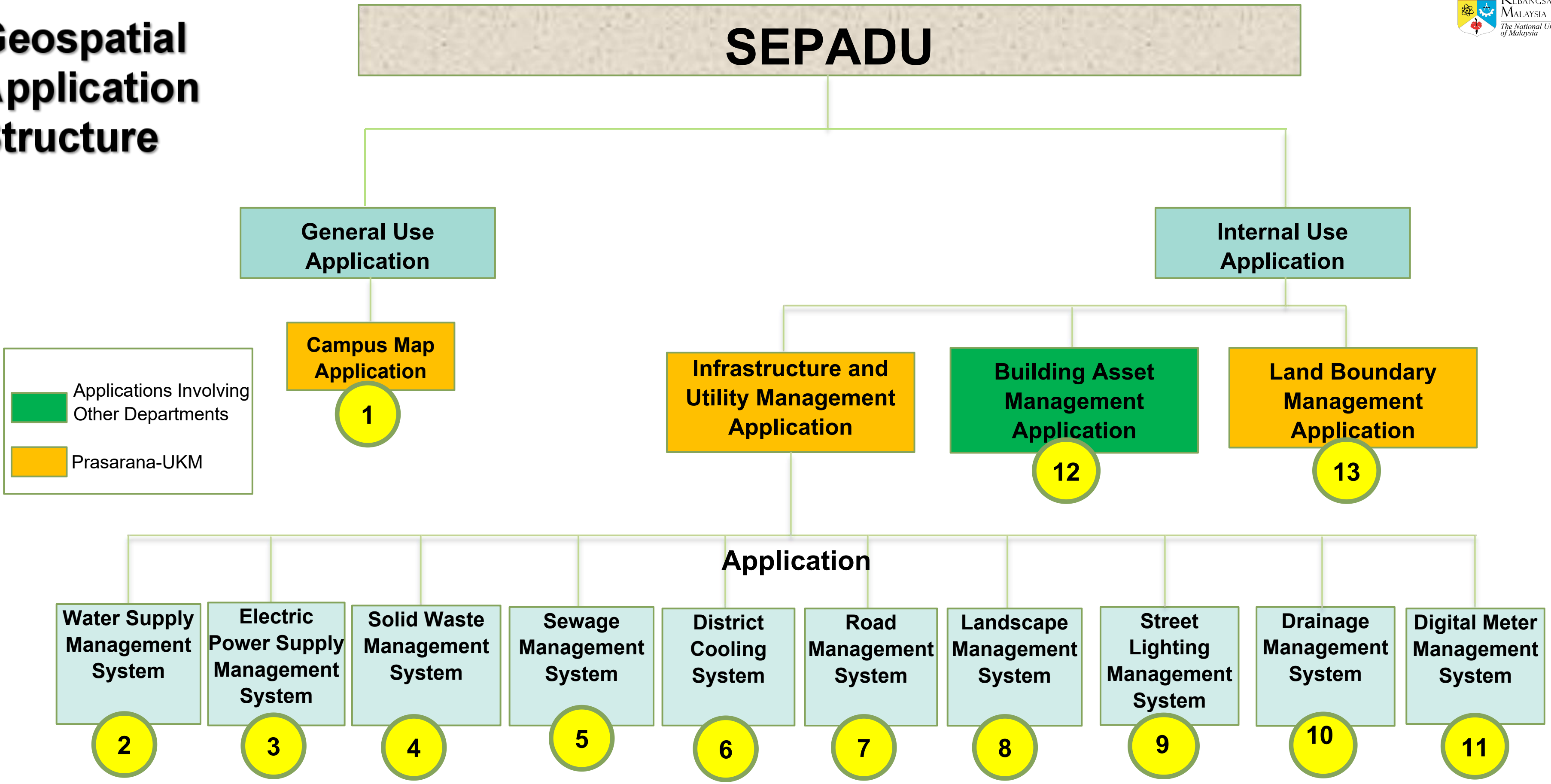
HURS
★★★★★+
Awarded 5 Stars+ Rating
Healthy University Rating System

UNIVERSITI KEBANGSAAN MALAYSIA
SCHOOL OF BUSINESS
SCIENCE AND HUMANITIES
FACULTY
OF HEALTH SCIENCES
UKM

# 3

# Geospatial Application @ UKM

# Geospatial Application Structure



**SEPADU**

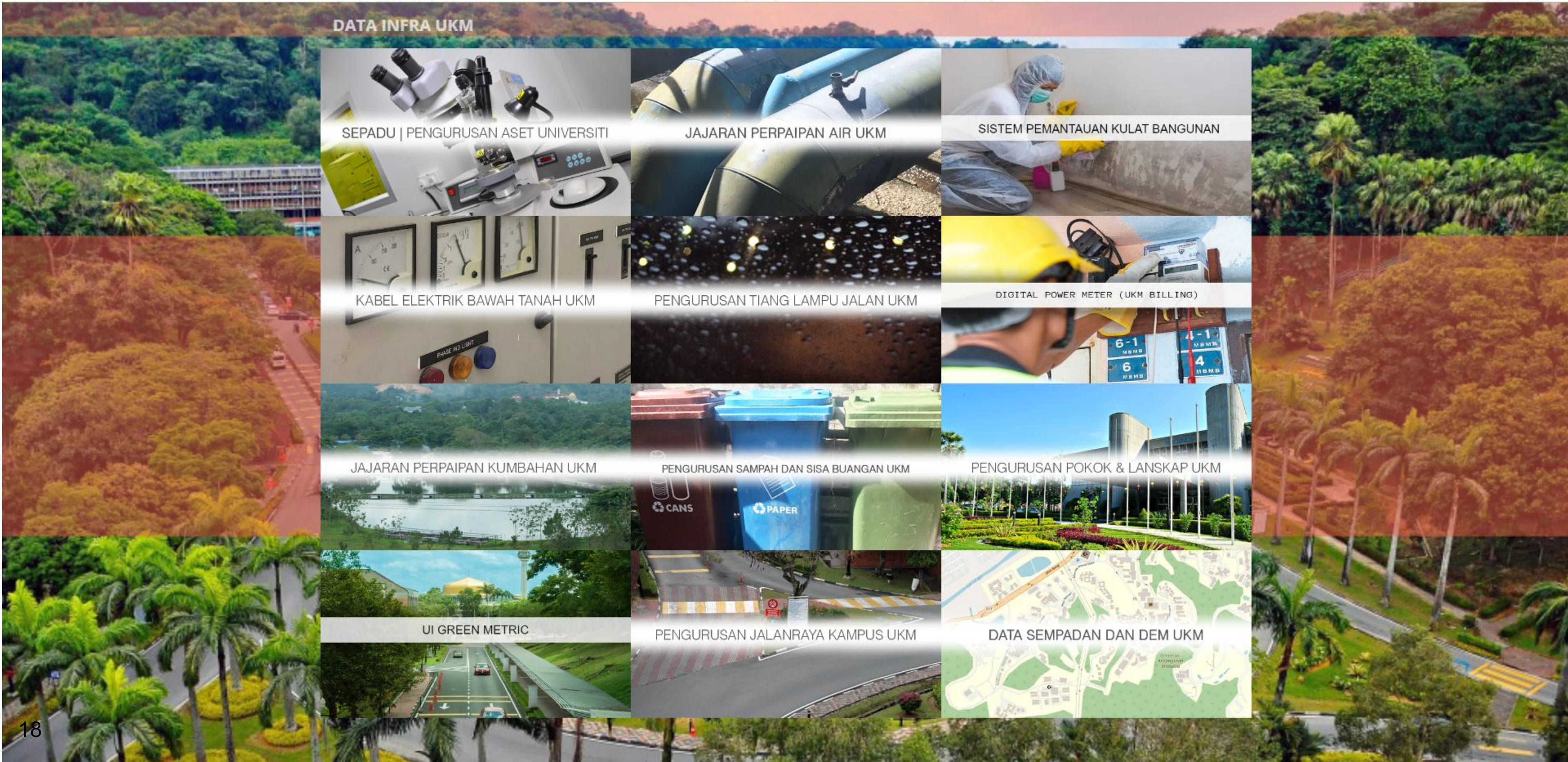
- General Use Application
  - Campus Map Application ①
- Internal Use Application
  - Infrastructure and Utility Management Application
    - Application
      - Water Supply Management System ②
      - Electric Power Supply Management System ③
      - Solid Waste Management System ④
      - Sewage Management System ⑤
      - District Cooling System ⑥
      - Road Management System ⑦
      - Landscape Management System ⑧
      - Street Lighting Management System ⑨
      - Drainage Management System ⑩
      - Digital Meter Management System ⑪
  - Building Asset Management Application ⑫
  - Land Boundary Management Application ⑬

🟩 Applications Involving Other Departments

🟧 Prasarana-UKM

# GIS Portal

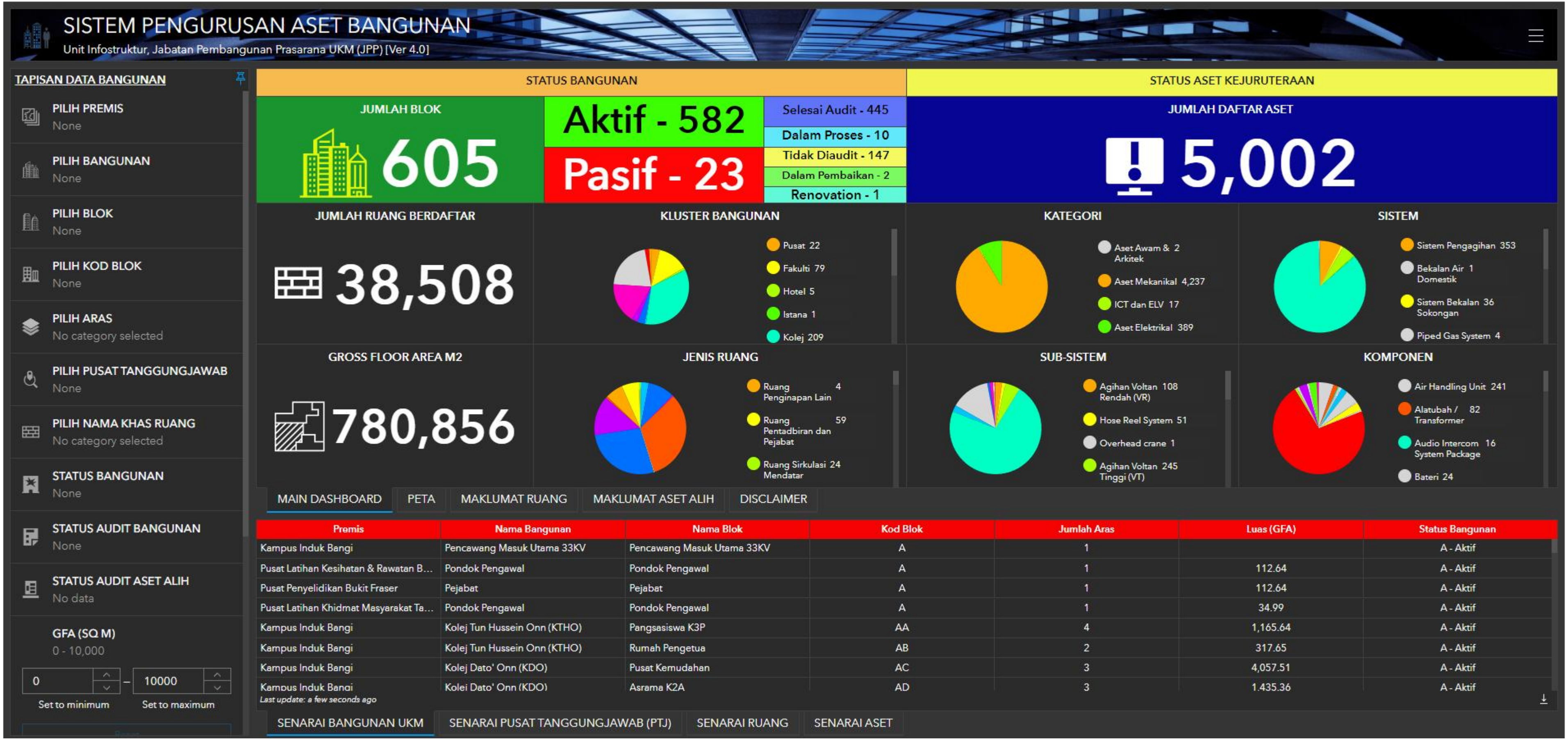
www.gis.ukm.my


DATA INFRA UKM
SEPADU | PENGURUSAN ASET UNIVERSITI
JAJARAN PERPAIPAN AIR UKM
SISTEM PEMANTAUAN KULAT BANGUNAN
KABEL ELEKTRIK BAWAH TANAH UKM
PENGURUSAN TIANG LAMPU JALAN UKM
DIGITAL POWER METER (UKM BILLING)
JAJARAN PERPAIPAN KUMBAHAN UKM
PENGURUSAN SAMPAH DAN SISA BUANGAN UKM
PENGURUSAN POKOK & LANSKAP UKM
UI GREEN METRIC
PENGURUSAN JALANRAYA KAMPUS UKM
DATA SEMPADAN DAN DEM UKM

# Building Asset Management Application Ver 4.0

- ✓ **Display of basic building information at UKM such as the total number of buildings, total registered spaces, total floor area, and total assets with verified locations.**
- ✓ **Display of the location of each building at UKM (map view).**
- ✓ **Display of floor plans for each building.**
- ✓ **Display of detailed information for each selected space, including information on engineering assets within the space.**
- ✓ **Display of detailed information for each asset, such as category, system, sub-system, and component.**
- ✓ **Filtering of desired spaces, for example:**
    - ❖ **Total number of meeting rooms at UKM**
    - ❖ **Total number of disabled-friendly (OKU) toilets at UKM**
    - ❖ **Filter of total assets in the Chancellery building**

# ASSET STATUS FOR UKM



SISTEM PENGURUSAN ASET BANGUNAN
Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]
MAIN DASHBOARD
PETA
MAKLUMAT RUANG
MAKLUMAT ASET ALIH
DISCLAIMER
SENARAI BANGUNAN UKM
SENARAI PUSAT TANGGUNGJAWAB (PTJ)
SENARAI RUANG
SENARAI ASET
Set to minimum
Set to maximum

**TAPISAN DATA BANGUNAN**

PILIH PREMIS: None
PILIH BANGUNAN: None
PILIH BLOK: None
PILIH KOD BLOK: None
PILIH ARAS: No category selected
PILIH PUSAT TANGGUNGJAWAB: None
PILIH NAMA KHAS RUANG: No category selected
STATUS BANGUNAN: None
STATUS AUDIT BANGUNAN: None
STATUS AUDIT ASET ALIH: No data
GFA (SQ M): 0 - 10,000
0 – 10000

**STATUS BANGUNAN**

JUMLAH BLOK: 605
Aktif - 582
Pasif - 23
Selesai Audit - 445
Dalam Proses - 10
Tidak Diaudit - 147
Dalam Pembaikan - 2
Renovation - 1

**STATUS ASET KEJURUTERAAN**

JUMLAH DAFTAR ASET: 5,002

**JUMLAH RUANG BERDAFTAR**: 38,508

**GROSS FLOOR AREA M2**: 780,856

| KLUSTER BANGUNAN | |
|---|---|
| Pusat | 22 |
| Fakulti | 79 |
| Hotel | 5 |
| Istana | 1 |
| Kolej | 209 |

| JENIS RUANG | |
|---|---|
| Ruang Penginapan Lain | 4 |
| Ruang Pentadbiran dan Pejabat | 59 |
| Ruang Sirkulasi Mendatar | 24 |

| KATEGORI | |
|---|---|
| Aset Awam & Arkitek | 2 |
| Aset Mekanikal | 4,237 |
| ICT dan ELV | 17 |
| Aset Elektrikal | 389 |

| SISTEM | |
|---|---|
| Sistem Pengagihan | 353 |
| Bekalan Air Domestik | 1 |
| Sistem Bekalan Sokongan | 36 |
| Piped Gas System | 4 |

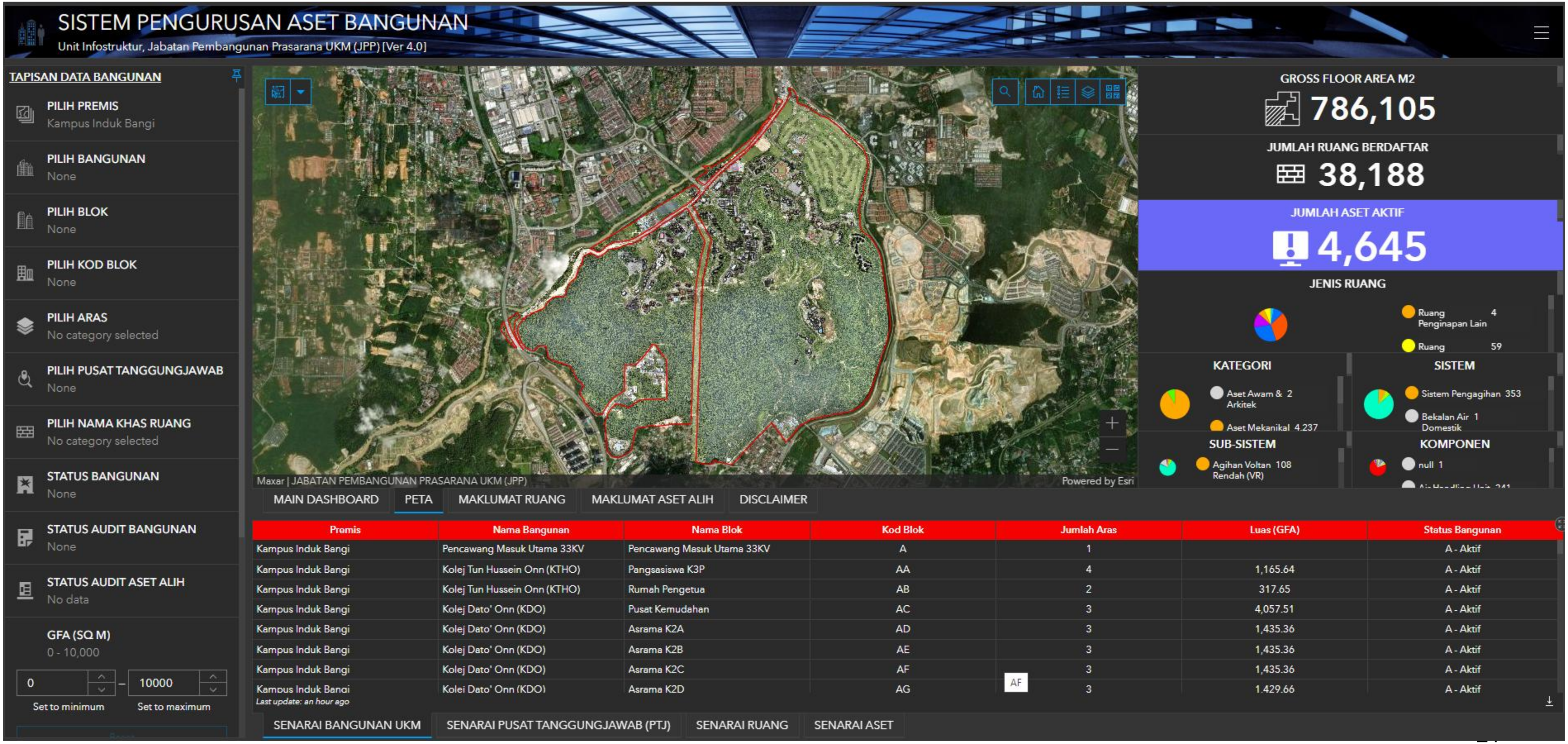
| SUB-SISTEM | |
|---|---|
| Agihan Voltan Rendah (VR) | 108 |
| Hose Reel System | 51 |
| Overhead crane | 1 |
| Agihan Voltan Tinggi (VT) | 245 |

| KOMPONEN | |
|---|---|
| Air Handling Unit | 241 |
| Alatubah / Transformer | 82 |
| Audio Intercom System Package | 16 |
| Bateri | 24 |

| Premis | Nama Bangunan | Nama Blok | Kod Blok | Jumlah Aras | Luas (GFA) | Status Bangunan |
|---|---|---|---|---|---|---|
| Kampus Induk Bangi | Pencawang Masuk Utama 33KV | Pencawang Masuk Utama 33KV | A | 1 | | A - Aktif |
| Pusat Latihan Kesihatan & Rawatan B… | Pondok Pengawal | Pondok Pengawal | A | 1 | 112.64 | A - Aktif |
| Pusat Penyelidikan Bukit Fraser | Pejabat | Pejabat | A | 1 | 112.64 | A - Aktif |
| Pusat Latihan Khidmat Masyarakat Ta… | Pondok Pengawal | Pondok Pengawal | A | 1 | 34.99 | A - Aktif |
| Kampus Induk Bangi | Kolej Tun Hussein Onn (KTHO) | Pangsasiswa K3P | AA | 4 | 1,165.64 | A - Aktif |
| Kampus Induk Bangi | Kolej Tun Hussein Onn (KTHO) | Rumah Pengetua | AB | 2 | 317.65 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Pusat Kemudahan | AC | 3 | 4,057.51 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2A | AD | 3 | 1,435.36 | A - Aktif |

*Last update: a few seconds ago*

# GROSS FLOOR AREA



SISTEM PENGURUSAN ASET BANGUNAN
Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]
TAPISAN DATA BANGUNAN
Maxar | JABATAN PEMBANGUNAN PRASARANA UKM (JPP)
Powered by Esri
MAIN DASHBOARD
PETA
MAKLUMAT RUANG
MAKLUMAT ASET ALIH
DISCLAIMER
SENARAI BANGUNAN UKM
SENARAI PUSAT TANGGUNGJAWAB (PTJ)
SENARAI RUANG
SENARAI ASET

**PILIH PREMIS**
Kampus Induk Bangi

**PILIH BANGUNAN**
None

**PILIH BLOK**
None

**PILIH KOD BLOK**
None

**PILIH ARAS**
No category selected

**PILIH PUSAT TANGGUNGJAWAB**
None

**PILIH NAMA KHAS RUANG**
No category selected

**STATUS BANGUNAN**
None

**STATUS AUDIT BANGUNAN**
None

**STATUS AUDIT ASET ALIH**
No data

**GFA (SQ M)**
0 - 10,000

0 – 10000
Set to minimum Set to maximum

**GROSS FLOOR AREA M2**
786,105

**JUMLAH RUANG BERDAFTAR**
38,188

**JUMLAH ASET AKTIF**
4,645

**JENIS RUANG**

| | |
|---|---|
| Ruang Penginapan Lain | 4 |
| Ruang | 59 |

**KATEGORI**

| | |
|---|---|
| Aset Awam & Arkitek | 2 |
| Aset Mekanikal | 4,237 |

**SISTEM**

| | |
|---|---|
| Sistem Pengagihan | 353 |
| Bekalan Air Domestik | 1 |

**SUB-SISTEM**

| | |
|---|---|
| Agihan Voltan Rendah (VR) | 108 |

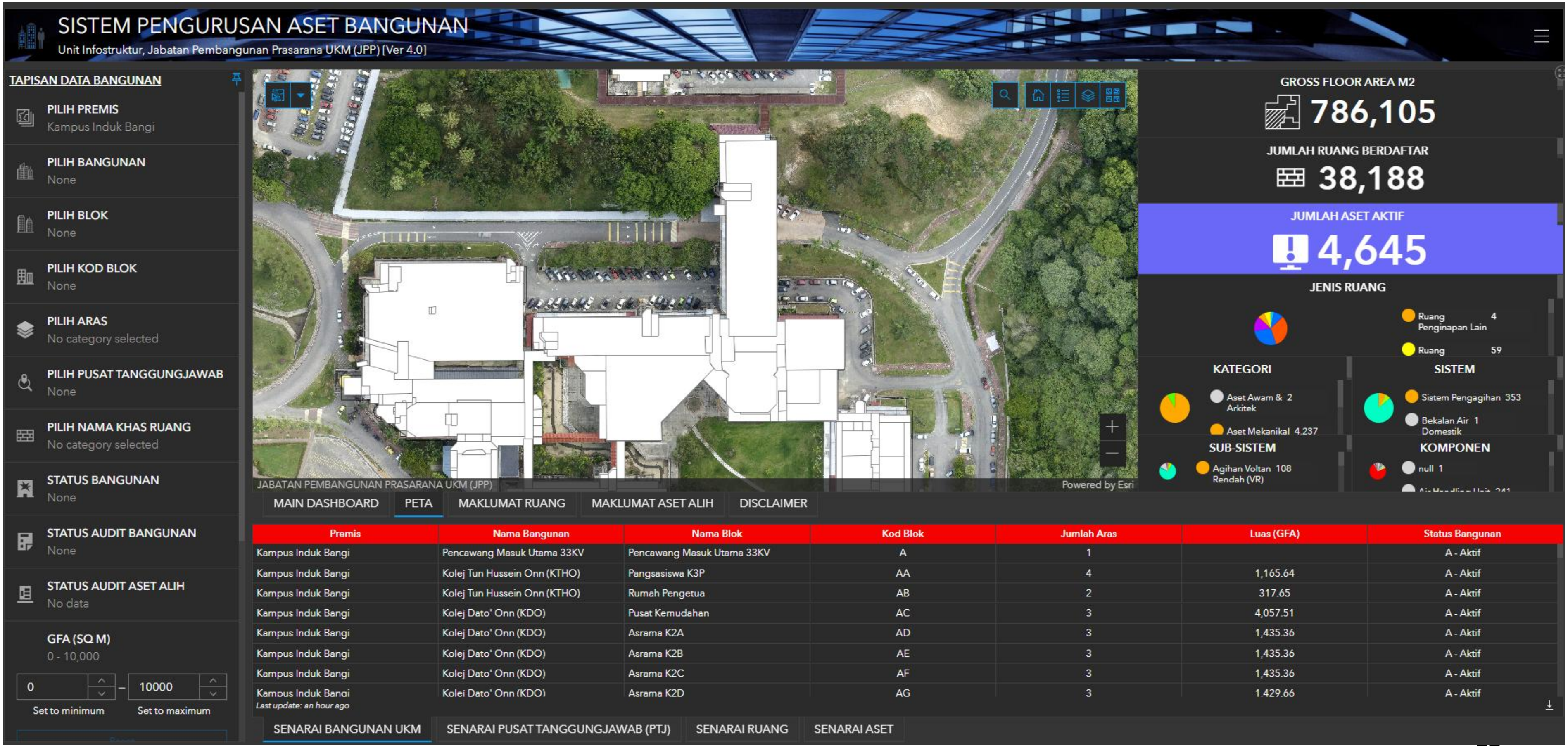
**KOMPONEN**

| | |
|---|---|
| null | 1 |

| Premis | Nama Bangunan | Nama Blok | Kod Blok | Jumlah Aras | Luas (GFA) | Status Bangunan |
|---|---|---|---|---|---|---|
| Kampus Induk Bangi | Pencawang Masuk Utama 33KV | Pencawang Masuk Utama 33KV | A | 1 | | A - Aktif |
| Kampus Induk Bangi | Kolej Tun Hussein Onn (KTHO) | Pangsasiswa K3P | AA | 4 | 1,165.64 | A - Aktif |
| Kampus Induk Bangi | Kolej Tun Hussein Onn (KTHO) | Rumah Pengetua | AB | 2 | 317.65 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Pusat Kemudahan | AC | 3 | 4,057.51 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2A | AD | 3 | 1,435.36 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2B | AE | 3 | 1,435.36 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2C | AF | 3 | 1,435.36 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2D | AG | 3 | 1,429.66 | A - Aktif |

*Last update: an hour ago*

# GROSS FLOOR AND LAYOUT



SISTEM PENGURUSAN ASET BANGUNAN

Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]

**TAPISAN DATA BANGUNAN**

**PILIH PREMIS**
Kampus Induk Bangi

**PILIH BANGUNAN**
None

**PILIH BLOK**
None

**PILIH KOD BLOK**
None

**PILIH ARAS**
No category selected

**PILIH PUSAT TANGGUNGJAWAB**
None

**PILIH NAMA KHAS RUANG**
No category selected

**STATUS BANGUNAN**
None

**STATUS AUDIT BANGUNAN**
None

**STATUS AUDIT ASET ALIH**
No data

**GFA (SQ M)**
0 - 10,000

0 – 10000

Set to minimum — Set to maximum

JABATAN PEMBANGUNAN PRASARANA UKM (JPP)

Powered by Esri

**GROSS FLOOR AREA M2**
786,105

**JUMLAH RUANG BERDAFTAR**
38,188

**JUMLAH ASET AKTIF**
4,645

**JENIS RUANG**

| | |
|---|---|
| Ruang Penginapan Lain | 4 |
| Ruang | 59 |

**KATEGORI**

| | |
|---|---|
| Aset Awam & Arkitek | 2 |
| Aset Mekanikal | 4,237 |

**SISTEM**

| | |
|---|---|
| Sistem Pengagihan | 353 |
| Bekalan Air Domestik | 1 |

**SUB-SISTEM**

| | |
|---|---|
| Agihan Voltan Rendah (VR) | 108 |

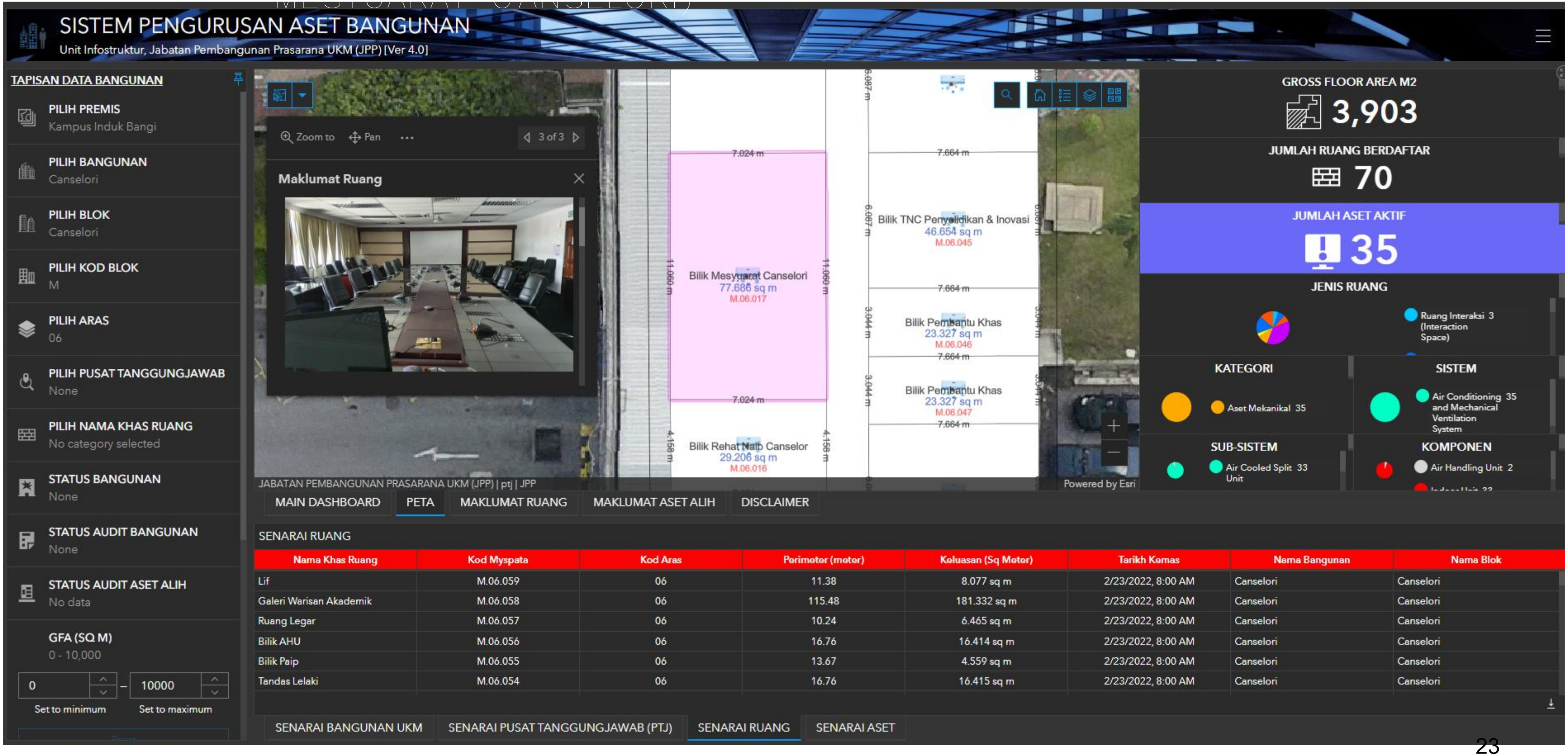
**KOMPONEN**

| | |
|---|---|
| null | 1 |
| Air Handling Unit | 241 |

| Premis | Nama Bangunan | Nama Blok | Kod Blok | Jumlah Aras | Luas (GFA) | Status Bangunan |
|---|---|---|---|---|---|---|
| Kampus Induk Bangi | Pencawang Masuk Utama 33KV | Pencawang Masuk Utama 33KV | A | 1 | | A - Aktif |
| Kampus Induk Bangi | Kolej Tun Hussein Onn (KTHO) | Pangsasiswa K3P | AA | 4 | 1,165.64 | A - Aktif |
| Kampus Induk Bangi | Kolej Tun Hussein Onn (KTHO) | Rumah Pengetua | AB | 2 | 317.65 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Pusat Kemudahan | AC | 3 | 4,057.51 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2A | AD | 3 | 1,435.36 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2B | AE | 3 | 1,435.36 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2C | AF | 3 | 1,435.36 | A - Aktif |
| Kampus Induk Bangi | Kolej Dato' Onn (KDO) | Asrama K2D | AG | 3 | 1,429.66 | A - Aktif |

*Last update: an hour ago*

# DETAILS LAYOUT INFORMATION - SPACE


Zoom to
Pan
3 of 3
Maklumat Ruang
7.024 m
11.060 m
Bilik Mesyuarat Canselori
77.686 sq m
M.06.017
4.158 m
Bilik Rehat Naib Canselor
29.206 sq m
M.06.016
7.664 m
6.087 m
Bilik TNC Penyelidikan & Inovasi
46.654 sq m
M.06.045
3.044 m
Bilik Pembantu Khas
23.327 sq m
M.06.046
Bilik Pembantu Khas
23.327 sq m
M.06.047
JABATAN PEMBANGUNAN PRASARANA UKM (JPP) | ptj | JPP
Powered by Esri
MAIN DASHBOARD
PETA
MAKLUMAT RUANG
MAKLUMAT ASET ALIH
DISCLAIMER
SENARAI BANGUNAN UKM
SENARAI PUSAT TANGGUNGJAWAB (PTJ)
SENARAI RUANG
SENARAI ASET
Set to minimum
Set to maximum

SISTEM PENGURUSAN ASET BANGUNAN

Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]

TAPISAN DATA BANGUNAN

**PILIH PREMIS**
Kampus Induk Bangi

**PILIH BANGUNAN**
Canselori

**PILIH BLOK**
Canselori

**PILIH KOD BLOK**
M

**PILIH ARAS**
06

**PILIH PUSAT TANGGUNGJAWAB**
None

**PILIH NAMA KHAS RUANG**
No category selected

**STATUS BANGUNAN**
None

**STATUS AUDIT BANGUNAN**
None

**STATUS AUDIT ASET ALIH**
No data

**GFA (SQ M)**
0 - 10,000

0 – 10000

GROSS FLOOR AREA M2
3,903

JUMLAH RUANG BERDAFTAR
70

JUMLAH ASET AKTIF
35

JENIS RUANG
Ruang Interaksi (Interaction Space) 3

KATEGORI
Aset Mekanikal 35

SISTEM
Air Conditioning and Mechanical Ventilation System 35

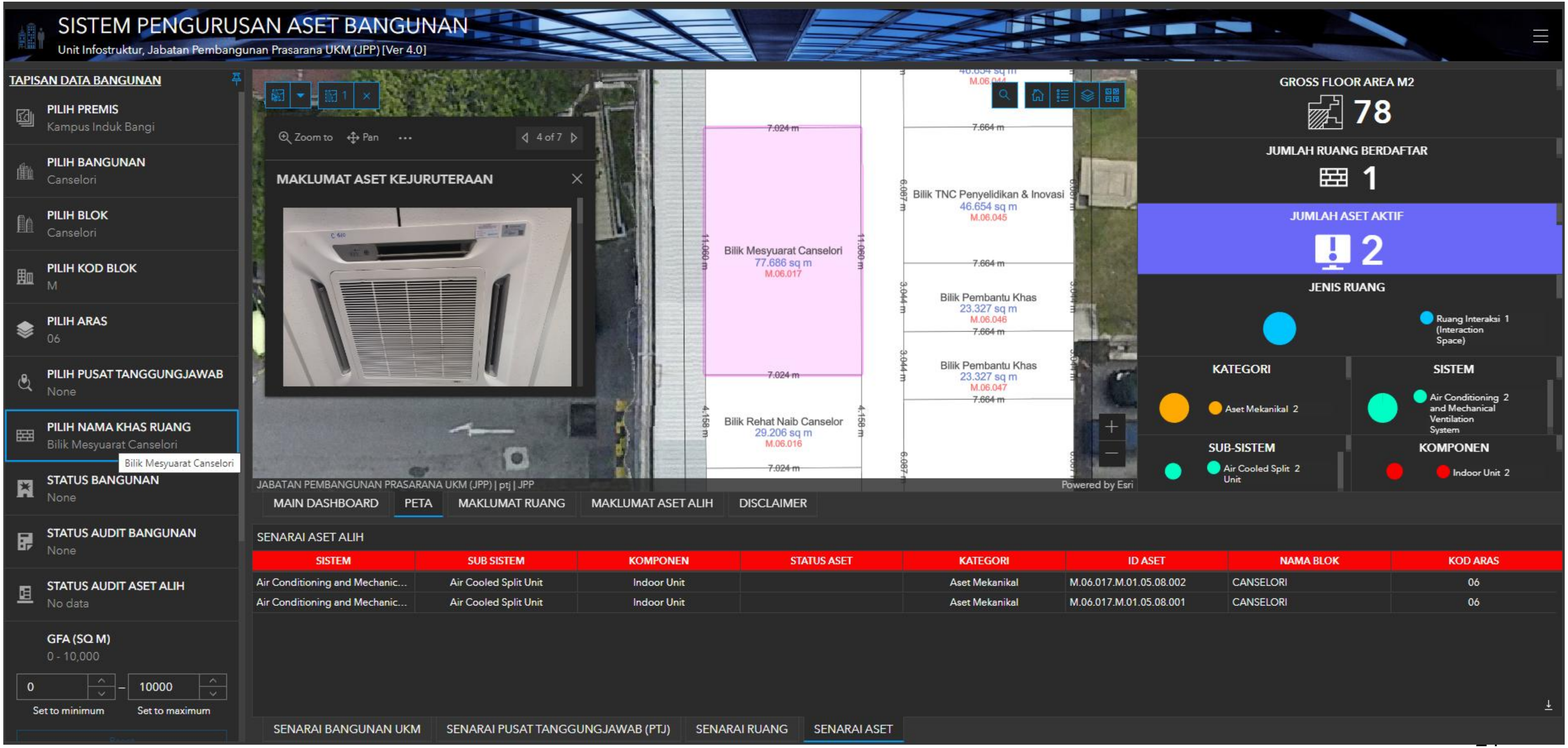
SUB-SISTEM
Air Cooled Split Unit 33

KOMPONEN
Air Handling Unit 2

SENARAI RUANG

| Nama Khas Ruang | Kod Myspata | Kod Aras | Perimeter (meter) | Keluasan (Sq Meter) | Tarikh Kemas | Nama Bangunan | Nama Blok |
|---|---|---|---|---|---|---|---|
| Lif | M.06.059 | 06 | 11.38 | 8.077 sq m | 2/23/2022, 8:00 AM | Canselori | Canselori |
| Galeri Warisan Akademik | M.06.058 | 06 | 115.48 | 181.332 sq m | 2/23/2022, 8:00 AM | Canselori | Canselori |
| Ruang Legar | M.06.057 | 06 | 10.24 | 6.465 sq m | 2/23/2022, 8:00 AM | Canselori | Canselori |
| Bilik AHU | M.06.056 | 06 | 16.76 | 16.414 sq m | 2/23/2022, 8:00 AM | Canselori | Canselori |
| Bilik Paip | M.06.055 | 06 | 13.67 | 4.559 sq m | 2/23/2022, 8:00 AM | Canselori | Canselori |
| Tandas Lelaki | M.06.054 | 06 | 16.76 | 16.415 sq m | 2/23/2022, 8:00 AM | Canselori | Canselori |

# DETAILS LAYOUT INFORMATION - AIRCOND



SISTEM PENGURUSAN ASET BANGUNAN
Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]

TAPISAN DATA BANGUNAN

PILIH PREMIS: Kampus Induk Bangi
PILIH BANGUNAN: Canselori
PILIH BLOK: Canselori
PILIH KOD BLOK: M
PILIH ARAS: 06
PILIH PUSAT TANGGUNGJAWAB: None
PILIH NAMA KHAS RUANG: Bilik Mesyuarat Canselori
STATUS BANGUNAN: None
STATUS AUDIT BANGUNAN: None
STATUS AUDIT ASET ALIH: No data
GFA (SQ M): 0 - 10,000
Set to minimum: 0
Set to maximum: 10000

MAKLUMAT ASET KEJURUTERAAN

Zoom to
Pan
4 of 7
7.024 m
Bilik Mesyuarat Canselori
77.686 sq m
M.06.017
11.060 m
Bilik Rehat Naib Canselor
29.206 sq m
M.06.016
4.158 m
7.664 m
Bilik TNC Penyelidikan & Inovasi
46.654 sq m
M.06.045
6.087 m
Bilik Pembantu Khas
23.327 sq m
M.06.046
3.044 m
Bilik Pembantu Khas
23.327 sq m
M.06.047
JABATAN PEMBANGUNAN PRASARANA UKM (JPP) | ptj | JPP
Powered by Esri
MAIN DASHBOARD
PETA
MAKLUMAT RUANG
MAKLUMAT ASET ALIH
DISCLAIMER

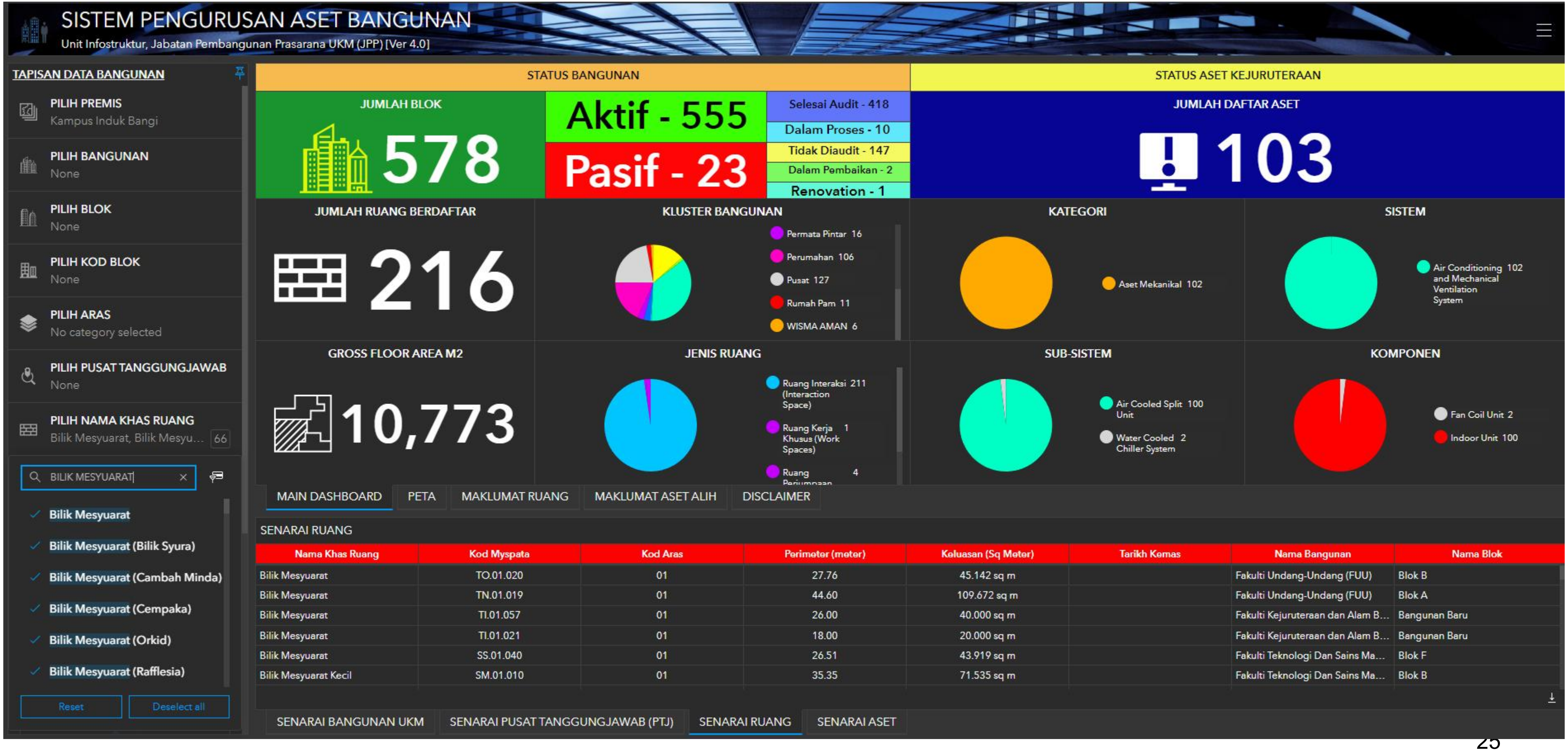
GROSS FLOOR AREA M2: 78
JUMLAH RUANG BERDAFTAR: 1
JUMLAH ASET AKTIF: 2
JENIS RUANG: Ruang Interaksi (Interaction Space) 1
KATEGORI: Aset Mekanikal 2
SISTEM: Air Conditioning and Mechanical Ventilation System 2
SUB-SISTEM: Air Cooled Split Unit 2
KOMPONEN: Indoor Unit 2

SENARAI ASET ALIH

| SISTEM | SUB SISTEM | KOMPONEN | STATUS ASET | KATEGORI | ID ASET | NAMA BLOK | KOD ARAS |
|---|---|---|---|---|---|---|---|
| Air Conditioning and Mechanic... | Air Cooled Split Unit | Indoor Unit |  | Aset Mekanikal | M.06.017.M.01.05.08.002 | CANSELORI | 06 |
| Air Conditioning and Mechanic... | Air Cooled Split Unit | Indoor Unit |  | Aset Mekanikal | M.06.017.M.01.05.08.001 | CANSELORI | 06 |

SENARAI BANGUNAN UKM
SENARAI PUSAT TANGGUNGJAWAB (PTJ)
SENARAI RUANG
SENARAI ASET

# ASSET



SISTEM PENGURUSAN ASET BANGUNAN

Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]

TAPISAN DATA BANGUNAN

**PILIH PREMIS**: Kampus Induk Bangi
**PILIH BANGUNAN**: None
**PILIH BLOK**: None
**PILIH KOD BLOK**: None
**PILIH ARAS**: No category selected
**PILIH PUSAT TANGGUNGJAWAB**: None
**PILIH NAMA KHAS RUANG**: Bilik Mesyuarat, Bilik Mesyu... 66

BILIK MESYUARAT

- ✓ Bilik Mesyuarat
- ✓ Bilik Mesyuarat (Bilik Syura)
- ✓ Bilik Mesyuarat (Cambah Minda)
- ✓ Bilik Mesyuarat (Cempaka)
- ✓ Bilik Mesyuarat (Orkid)
- ✓ Bilik Mesyuarat (Rafflesia)

Reset
Deselect all

STATUS BANGUNAN

JUMLAH BLOK 578

Aktif - 555
Pasif - 23

Selesai Audit - 418
Dalam Proses - 10
Tidak Diaudit - 147
Dalam Pembaikan - 2
Renovation - 1

STATUS ASET KEJURUTERAAN

JUMLAH DAFTAR ASET 103

JUMLAH RUANG BERDAFTAR 216

GROSS FLOOR AREA M2 10,773

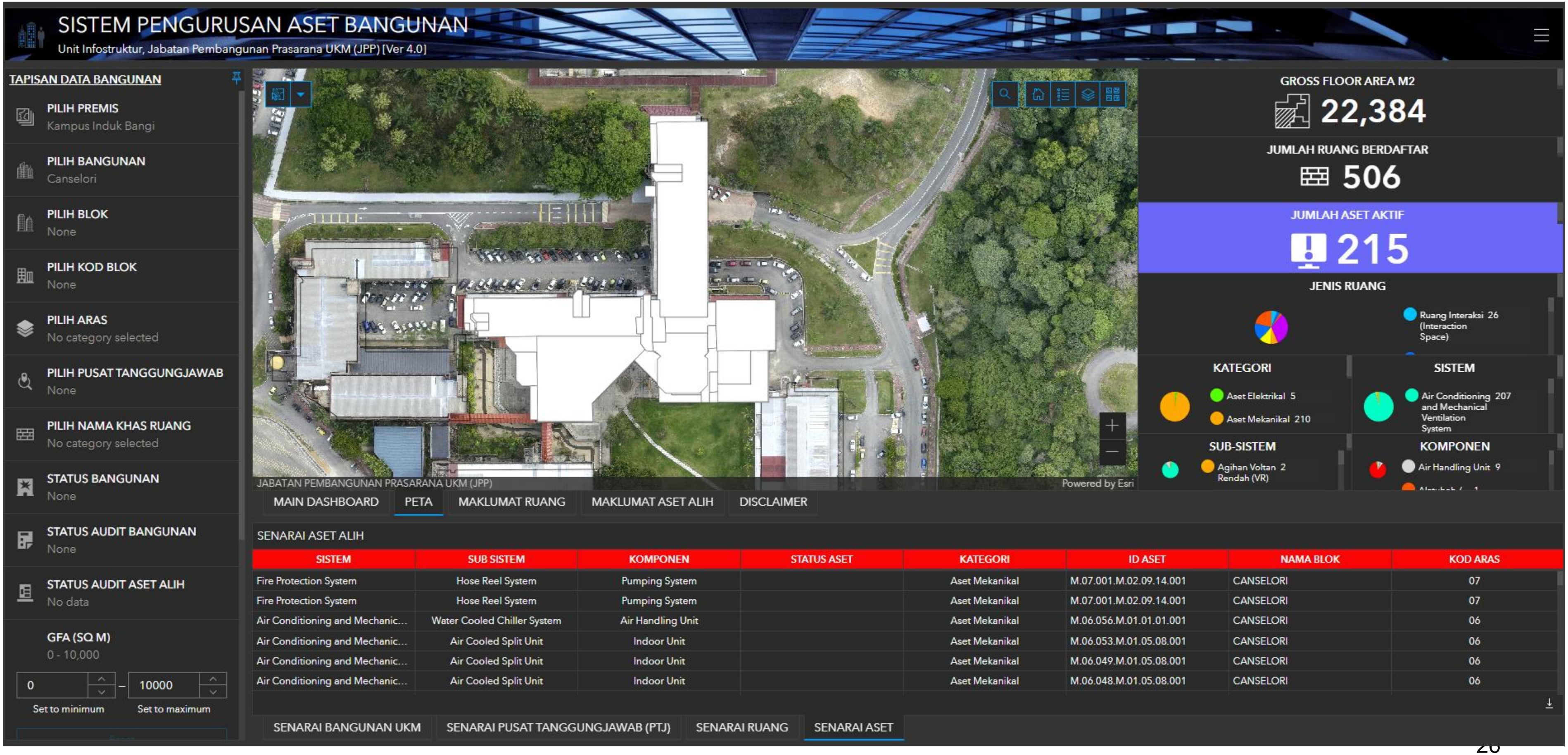
KLUSTER BANGUNAN
Permata Pintar 16
Perumahan 106
Pusat 127
Rumah Pam 11
WISMA AMAN 6
JENIS RUANG
Ruang Interaksi (Interaction Space) 211
Ruang Kerja Khusus (Work Spaces) 1
Ruang Perjumpaan 4
KATEGORI
Aset Mekanikal 102
SISTEM
Air Conditioning and Mechanical Ventilation System 102
SUB-SISTEM
Air Cooled Split Unit 100
Water Cooled Chiller System 2
KOMPONEN
Fan Coil Unit 2
Indoor Unit 100
MAIN DASHBOARD
PETA
MAKLUMAT RUANG
MAKLUMAT ASET ALIH
DISCLAIMER

SENARAI RUANG

| Nama Khas Ruang | Kod Myspata | Kod Aras | Perimeter (meter) | Keluasan (Sq Meter) | Tarikh Kemas | Nama Bangunan | Nama Blok |
|---|---|---|---|---|---|---|---|
| Bilik Mesyuarat | TO.01.020 | 01 | 27.76 | 45.142 sq m | | Fakulti Undang-Undang (FUU) | Blok B |
| Bilik Mesyuarat | TN.01.019 | 01 | 44.60 | 109.672 sq m | | Fakulti Undang-Undang (FUU) | Blok A |
| Bilik Mesyuarat | TI.01.057 | 01 | 26.00 | 40.000 sq m | | Fakulti Kejuruteraan dan Alam B... | Bangunan Baru |
| Bilik Mesyuarat | TI.01.021 | 01 | 18.00 | 20.000 sq m | | Fakulti Kejuruteraan dan Alam B... | Bangunan Baru |
| Bilik Mesyuarat | SS.01.040 | 01 | 26.51 | 43.919 sq m | | Fakulti Teknologi Dan Sains Ma... | Blok F |
| Bilik Mesyuarat Kecil | SM.01.010 | 01 | 35.35 | 71.535 sq m | | Fakulti Teknologi Dan Sains Ma... | Blok B |

SENARAI BANGUNAN UKM
SENARAI PUSAT TANGGUNGJAWAB (PTJ)
SENARAI RUANG
SENARAI ASET

# DETAILS LAYOUT INFORMATION - AIRCOND


SISTEM PENGURUSAN ASET BANGUNAN
Unit Infostruktur, Jabatan Pembangunan Prasarana UKM (JPP) [Ver 4.0]
TAPISAN DATA BANGUNAN
JABATAN PEMBANGUNAN PRASARANA UKM (JPP)
Powered by Esri
MAIN DASHBOARD
PETA
MAKLUMAT RUANG
MAKLUMAT ASET ALIH
DISCLAIMER
SENARAI BANGUNAN UKM
SENARAI PUSAT TANGGUNGJAWAB (PTJ)
SENARAI RUANG
SENARAI ASET
Set to minimum
Set to maximum

**PILIH PREMIS**: Kampus Induk Bangi
**PILIH BANGUNAN**: Canselori
**PILIH BLOK**: None
**PILIH KOD BLOK**: None
**PILIH ARAS**: No category selected
**PILIH PUSAT TANGGUNGJAWAB**: None
**PILIH NAMA KHAS RUANG**: No category selected
**STATUS BANGUNAN**: None
**STATUS AUDIT BANGUNAN**: None
**STATUS AUDIT ASET ALIH**: No data
**GFA (SQ M)**: 0 - 10,000
0 – 10000

GROSS FLOOR AREA M2: 22,384
JUMLAH RUANG BERDAFTAR: 506
JUMLAH ASET AKTIF: 215

JENIS RUANG
- Ruang Interaksi (Interaction Space) 26

KATEGORI
- Aset Elektrikal 5
- Aset Mekanikal 210

SISTEM
- Air Conditioning and Mechanical Ventilation System 207

SUB-SISTEM
- Agihan Voltan Rendah (VR) 2

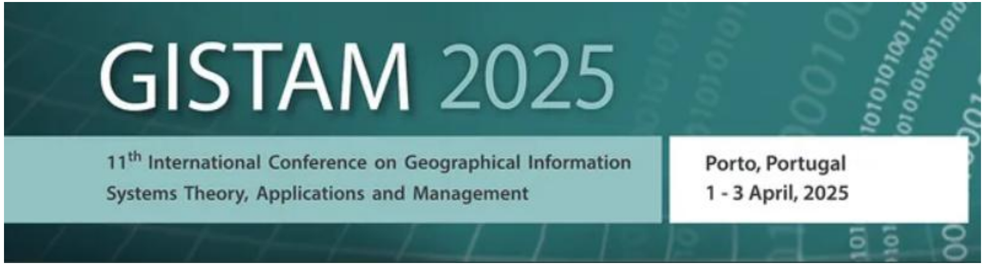
KOMPONEN
- Air Handling Unit 9

SENARAI ASET ALIH

| SISTEM | SUB SISTEM | KOMPONEN | STATUS ASET | KATEGORI | ID ASET | NAMA BLOK | KOD ARAS |
|---|---|---|---|---|---|---|---|
| Fire Protection System | Hose Reel System | Pumping System |  | Aset Mekanikal | M.07.001.M.02.09.14.001 | CANSELORI | 07 |
| Fire Protection System | Hose Reel System | Pumping System |  | Aset Mekanikal | M.07.001.M.02.09.14.001 | CANSELORI | 07 |
| Air Conditioning and Mechanic... | Water Cooled Chiller System | Air Handling Unit |  | Aset Mekanikal | M.06.056.M.01.01.01.001 | CANSELORI | 06 |
| Air Conditioning and Mechanic... | Air Cooled Split Unit | Indoor Unit |  | Aset Mekanikal | M.06.053.M.01.05.08.001 | CANSELORI | 06 |
| Air Conditioning and Mechanic... | Air Cooled Split Unit | Indoor Unit |  | Aset Mekanikal | M.06.049.M.01.05.08.001 | CANSELORI | 06 |
| Air Conditioning and Mechanic... | Air Cooled Split Unit | Indoor Unit |  | Aset Mekanikal | M.06.048.M.01.05.08.001 | CANSELORI | 06 |

# Geospatial Research Development @ UKM

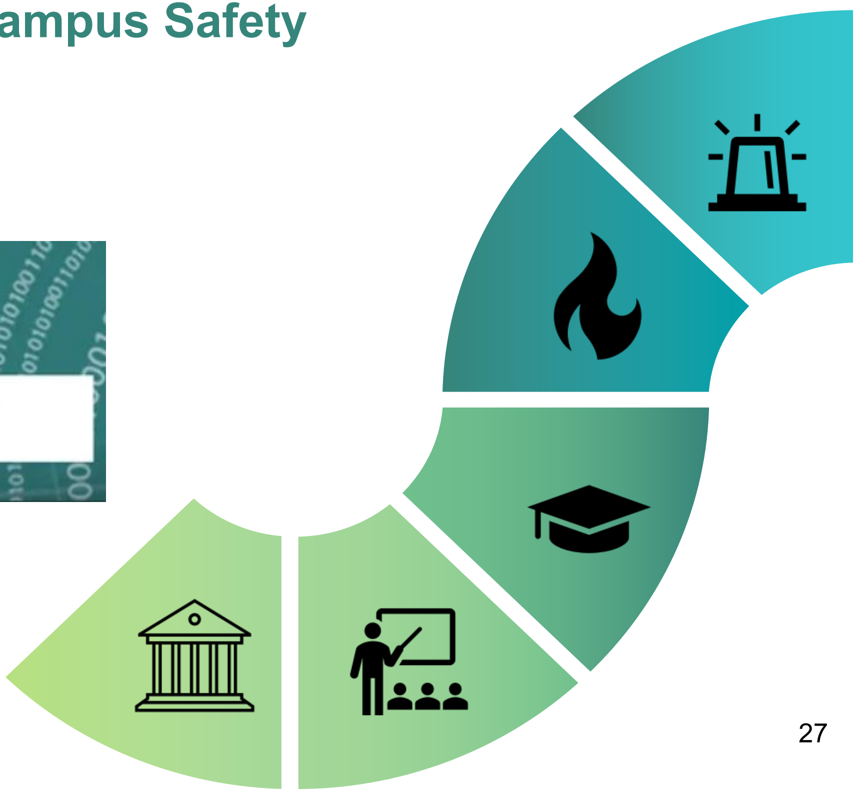
## Developing an IoT-Based Multi-Sensor System for Real- Time Fire Detection and Spatial Analysis to Improve Campus Safety



GISTAM 2025

11th International Conference on Geographical Information Systems Theory, Applications and Management

Porto, Portugal
1 - 3 April, 2025



# 1 - PROBLEM STATEMENT

**WHY**

Hazardous incidents on campus grounds

**WHY**

Capabilities and limitations of the existing and conventional fire alarm systems

**WHAT?**

Contributing factor led to fire incidents on campus

**WHAT?**

Current fire safety efforts in Malaysia's campus buildings and smart campus elements related to fire safety

**HOW**

Proposed solutions and expanding the idea

- MOHE, 2021 reports - 589 hazardous incidents
- Primary limitations of the traditional fire alarm system

# 2 - RESEARCH OBJECTIVES

## RO1

To identify the smart integrated and automated solution for indoor fire hazard detection and notification in a campus building

## RO2

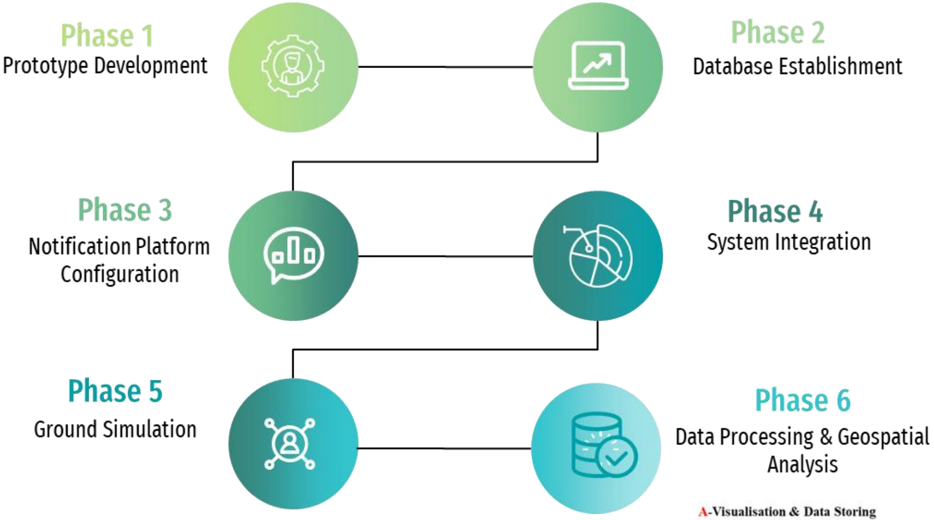
To establish the integration of IoT-based sensors and notification platforms for indoor fire hazards detection and notification purposes in a campus building

## RO3

To evaluate the sensing information or sensor data acquired from the sensor using **geospatial-based analysis**

# 3 - RESEARCH METHODOLOGY

This research involves a **systematic study** and is **structured into six phases**, each of which aligns with and addresses all three research objectives.



**Phase 1**
Prototype Development

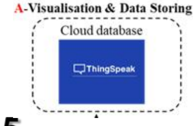
**Phase 2**
Database Establishment

**Phase 3**
Notification Platform Configuration

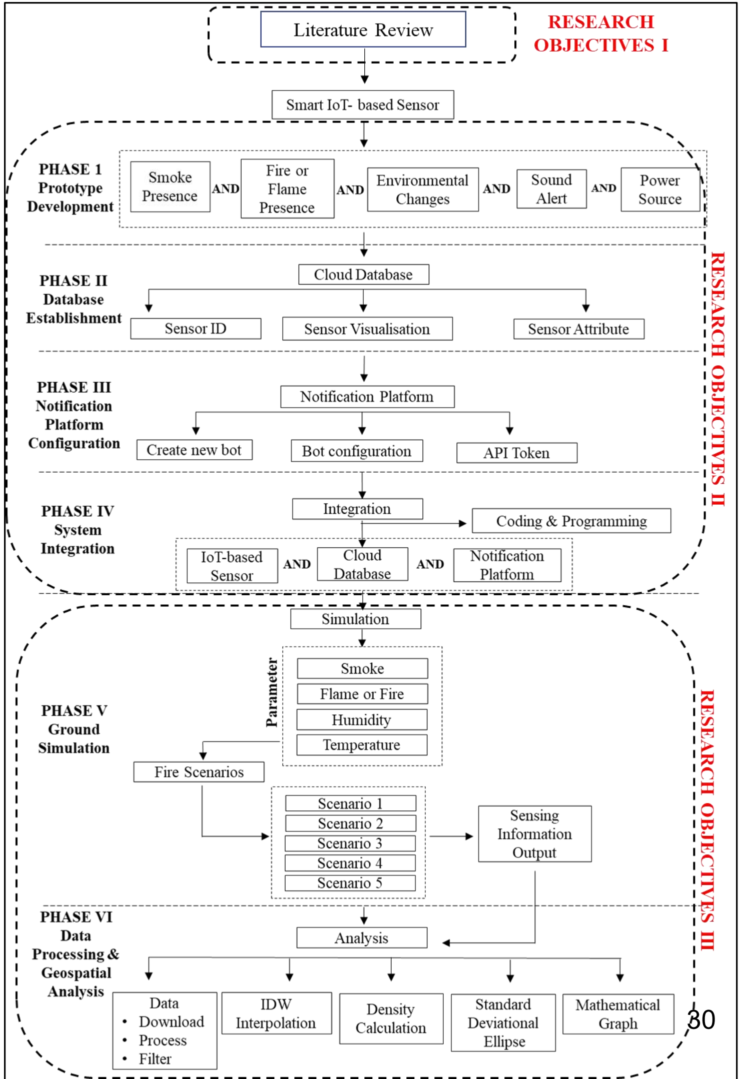
**Phase 4**
System Integration

**Phase 5**
Ground Simulation

**Phase 6**
Data Processing & Geospatial Analysis

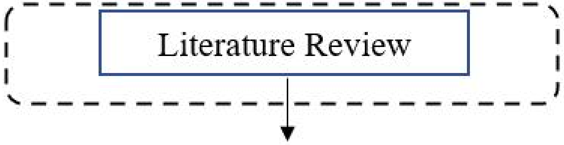

A-Visualisation & Data Storing
Cloud database
ThingSpeak

B - Hardware
IoT- based sensor

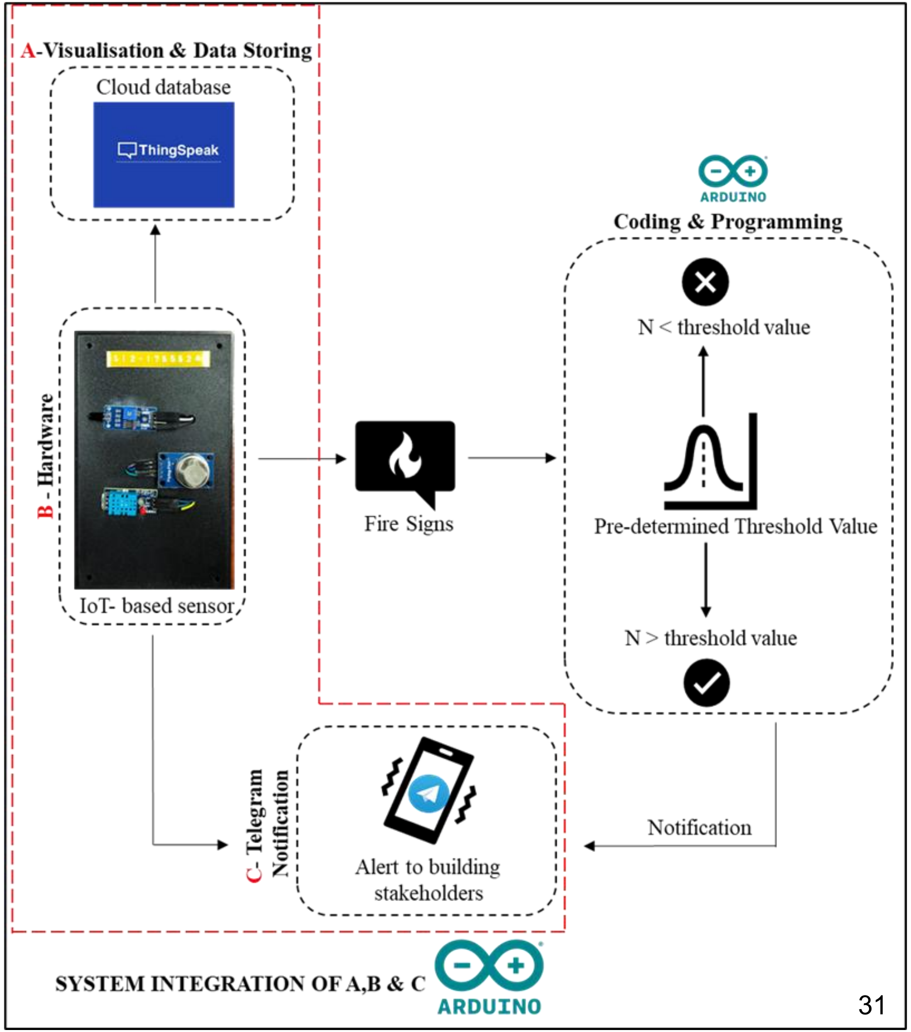

Literature Review
RESEARCH OBJECTIVES I
Smart IoT- based Sensor
PHASE 1 Prototype Development
Smoke Presence
AND
Fire or Flame Presence
AND
Environmental Changes
AND
Sound Alert
AND
Power Source
RESEARCH OBJECTIVES II
PHASE II Database Establishment
Cloud Database
Sensor ID
Sensor Visualisation
Sensor Attribute
PHASE III Notification Platform Configuration
Notification Platform
Create new bot
Bot configuration
API Token
PHASE IV System Integration
Integration
Coding & Programming
IoT-based Sensor
AND
Cloud Database
AND
Notification Platform
Simulation
PHASE V Ground Simulation
Parameter
Smoke
Flame or Fire
Humidity
Temperature
Fire Scenarios
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5
Sensing Information Output
RESEARCH OBJECTIVES III
PHASE VI Data Processing & Geospatial Analysis
Analysis
Data
• Download
• Process
• Filter
IDW Interpolation
Density Calculation
Standard Deviational Ellipse
Mathematical Graph

# 4 – FINDINGS

**Research Findings for RO 1 = Proposed system architecture**

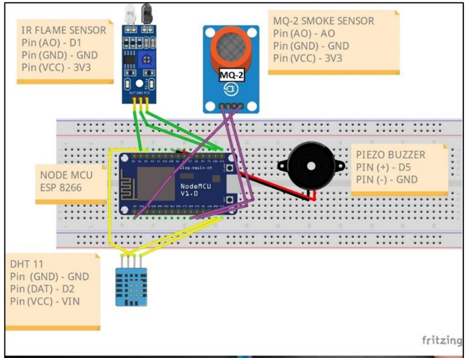

Literature Review

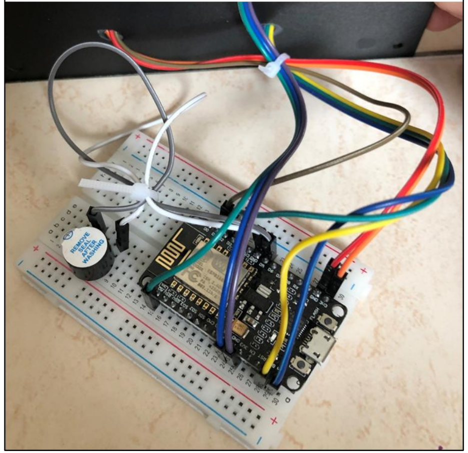
**RESEARCH OBJECTIVES I**

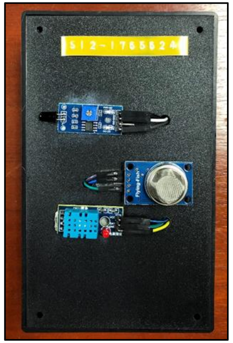

A-Visualisation & Data Storing
Cloud database
ThingSpeak
B - Hardware
IoT- based sensor
Fire Signs
ARDUINO
Coding & Programming
N < threshold value
Pre-determined Threshold Value
N > threshold value
Notification
C- Telegram Notification
Alert to building stakeholders
SYSTEM INTEGRATION OF A,B & C
ARDUINO

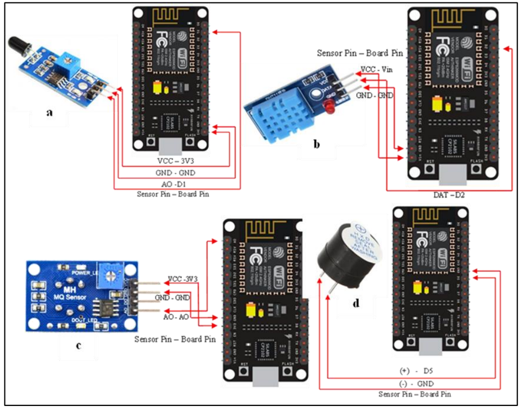
# 4 – FINDINGS

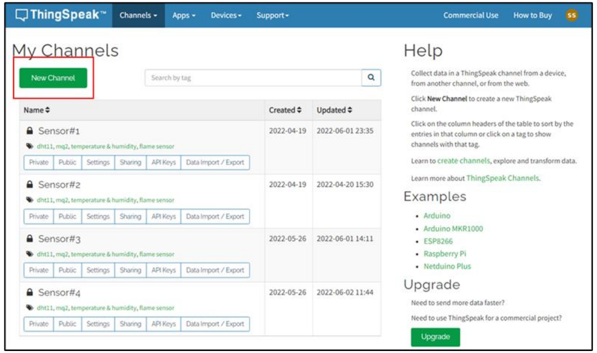
## Components of the Device


IR FLAME SENSOR
Pin (AO) - D1
Pin (GND) - GND
Pin (VCC) - 3V3
MQ-2 SMOKE SENSOR
Pin (AO) - AO
Pin (GND) - GND
Pin (VCC) - 3V3
MQ-2
NODE MCU
ESP 8266
PIEZO BUZZER
PIN (+) - D5
PIN (-) - GND
DHT 11
Pin (GND) - GND
Pin (DAT) - D2
Pin (VCC) - VIN
fritzing






a
VCC – 3V3
GND - GND
AO -D1
Sensor Pin – Board Pin
b
Sensor Pin – Board Pin
VCC - Vin
GND - GND
DAT –D2
c
VCC -3V3
GND - GND
AO - AO
Sensor Pin – Board Pin
d
(+) - D5
(-) - GND
Sensor Pin – Board Pin


ThingSpeak™
Channels
Apps
Devices
Support
Commercial Use
How to Buy
New Channel
Search by tag

My Channels

| Name | Created | Updated |
|---|---|---|
| Sensor#1<br>dht11, mq2, temperature & humidity, flame sensor<br>Private Public Settings Sharing API Keys Data Import / Export | 2022-04-19 | 2022-06-01 23:35 |
| Sensor#2<br>dht11, mq2, temperature & humidity, flame sensor<br>Private Public Settings Sharing API Keys Data Import / Export | 2022-04-19 | 2022-04-20 15:30 |
| Sensor#3<br>dht11, mq2, temperature & humidity, flame sensor<br>Private Public Settings Sharing API Keys Data Import / Export | 2022-05-26 | 2022-06-01 14:11 |
| Sensor#4<br>dht11, mq2, temperature & humidity, flame sensor<br>Private Public Settings Sharing API Keys Data Import / Export | 2022-05-26 | 2022-06-02 11:44 |

Help

Collect data in a ThingSpeak channel from a device, from another channel, or from the web.

Click New Channel to create a new ThingSpeak channel.

Click on the column headers of the table to sort by the entries in that column or click on a tag to show channels with that tag.

Learn to create channels, explore and transform data.

Learn more about ThingSpeak Channels.

Examples

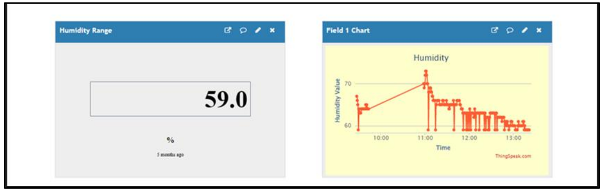
- Arduino
- Arduino MKR1000
- ESP8266
- Raspberry Pi
- Netduino Plus

Upgrade

Need to send more data faster?

Need to use ThingSpeak for a commercial project?

Upgrade

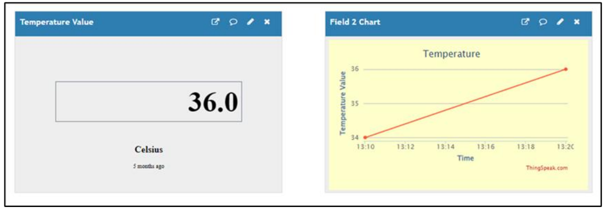

Humidity Range

59.0

%

5 months ago

Field 1 Chart

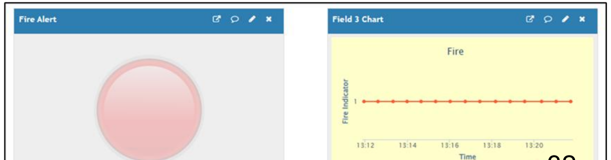

Temperature Value

36.0

Celsius

5 months ago

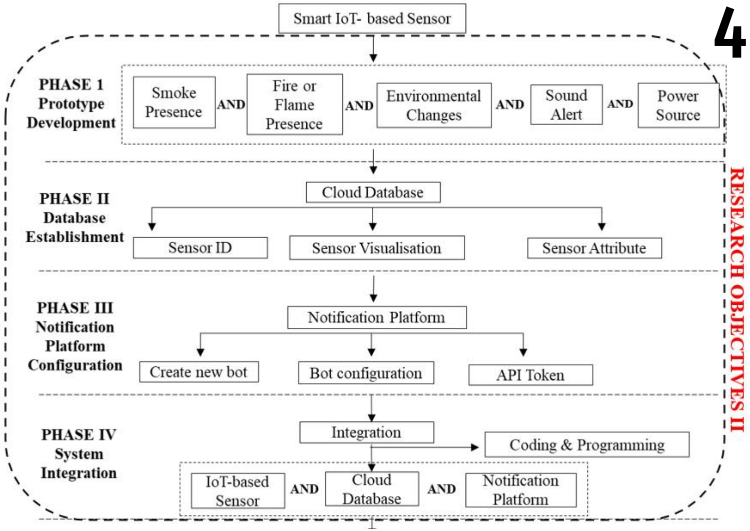
Field 2 Chart


Fire Alert

5 months ago

Field 3 Chart

# 4 – FINDINGS



Smart IoT- based Sensor

**PHASE 1 Prototype Development**

Smoke Presence AND Fire or Flame Presence AND Environmental Changes AND Sound Alert AND Power Source

**PHASE II Database Establishment**

Cloud Database

Sensor ID | Sensor Visualisation | Sensor Attribute

**PHASE III Notification Platform Configuration**

Notification Platform

Create new bot | Bot configuration | API Token

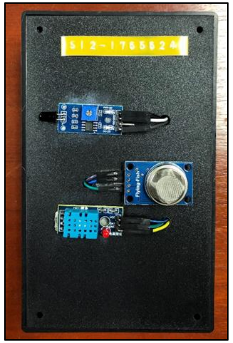
**PHASE IV System Integration**

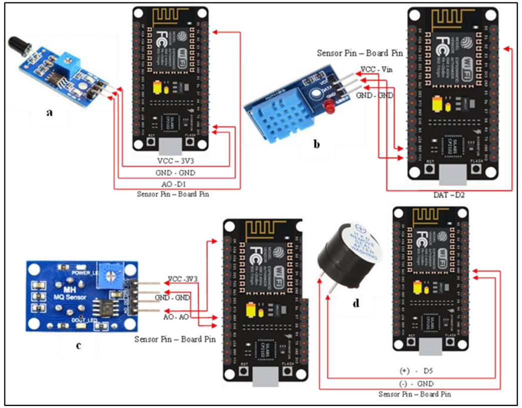
Integration → Coding & Programming

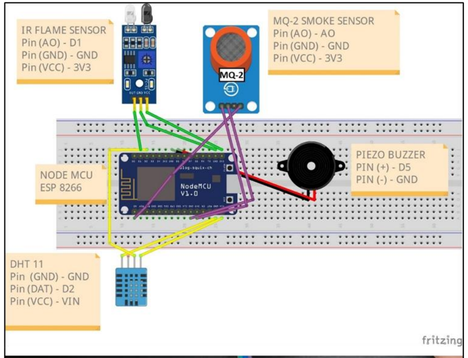
IoT-based Sensor AND Cloud Database AND Notification Platform

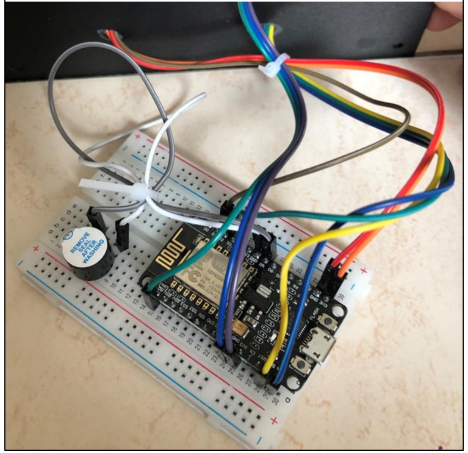
**RESEARCH OBJECTIVES II**

## Research Findings for **RO** 2 = Phase I

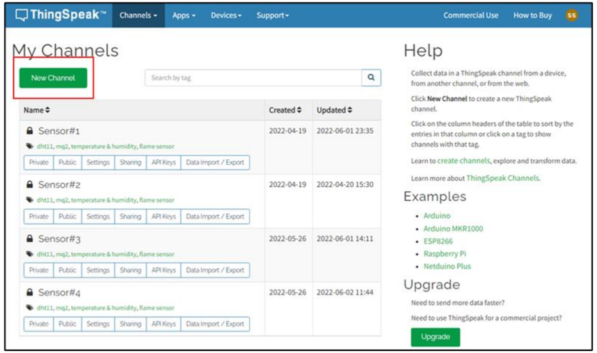

512-1765524


a
VCC – 3V3
GND - GND
AO -D1
Sensor Pin – Board Pin
b
Sensor Pin – Board Pin
VCC - Vin
GND - GND
DAT –D2
c
MH
MQ Sensor
VCC -3V3
GND - GND
AO - AO
Sensor Pin – Board Pin
d
(+) - D5
(-) - GND
Sensor Pin – Board Pin


IR FLAME SENSOR
Pin (AO) - D1
Pin (GND) - GND
Pin (VCC) - 3V3
MQ-2 SMOKE SENSOR
Pin (AO) - AO
Pin (GND) - GND
Pin (VCC) - 3V3
MQ-2
NODE MCU
ESP 8266
NodeMCU V1.0
PIEZO BUZZER
PIN (+) - D5
PIN (-) - GND
DHT 11
Pin (GND) - GND
Pin (DAT) - D2
Pin (VCC) - VIN
fritzing



## Research Findings for **RO** 2 = Phase II


ThingSpeak™
Channels
Apps
Devices
Support
Commercial Use
How to Buy
SS
New Channel
Search by tag
Private
Public
Settings
Sharing
API Keys
Data Import / Export
Upgrade

My Channels

| Name | Created | Updated |
|---|---|---|
| Sensor#1<br>dht11, mq2, temperature & humidity, flame sensor | 2022-04-19 | 2022-06-01 23:35 |
| Sensor#2<br>dht11, mq2, temperature & humidity, flame sensor | 2022-04-19 | 2022-04-20 15:30 |
| Sensor#3<br>dht11, mq2, temperature & humidity, flame sensor | 2022-05-26 | 2022-06-01 14:11 |
| Sensor#4<br>dht11, mq2, temperature & humidity, flame sensor | 2022-05-26 | 2022-06-02 11:44 |

Help

Collect data in a ThingSpeak channel from a device, from another channel, or from the web.

Click **New Channel** to create a new ThingSpeak channel.

Click on the column headers of the table to sort by the entries in that column or click on a tag to show channels with that tag.

Learn to create channels, explore and transform data.

Learn more about ThingSpeak Channels.

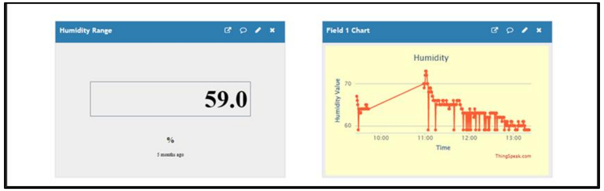
Examples

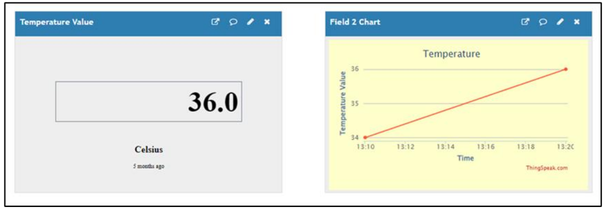
- Arduino
- Arduino MKR1000
- ESP8266
- Raspberry Pi
- Netduino Plus

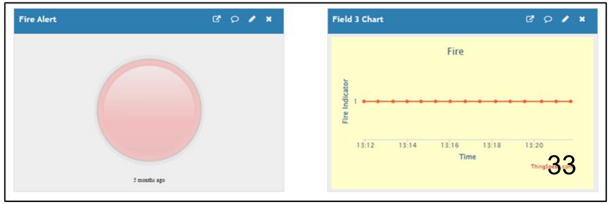
Upgrade

Need to send more data faster?

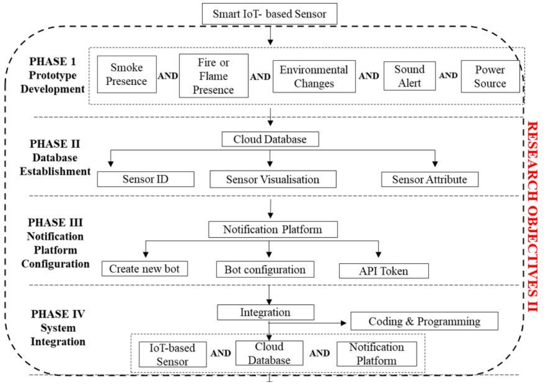
Need to use ThingSpeak for a commercial project?


Humidity Range
59.0
%
5 months ago
Field 1 Chart
Humidity
Humidity Value
70
60
10:00
11:00
12:00
13:00
Time
ThingSpeak.com

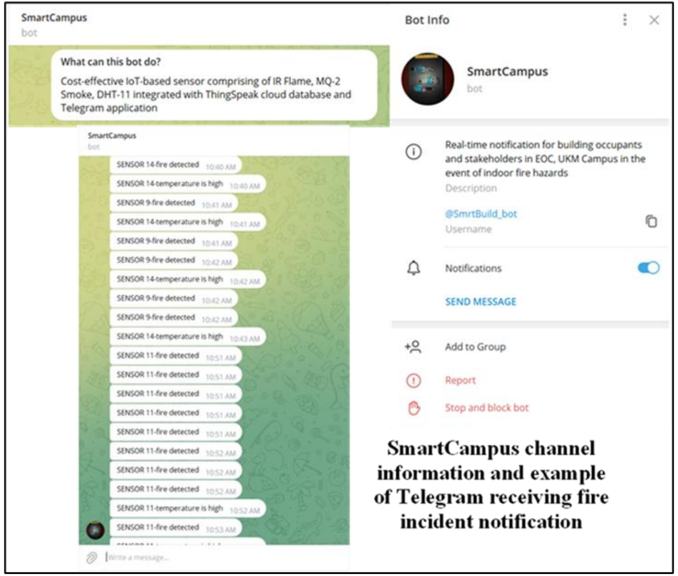

Temperature Value
36.0
Celsius
5 months ago
Field 2 Chart
Temperature
Temperature Value
36
35
34
13:10
13:12
13:14
13:16
13:18
13:20
Time
ThingSpeak.com


Fire Alert
5 months ago
Field 3 Chart
Fire
Fire Indicator
1
13:12
13:14
13:16
13:18
13:20
Time
ThingSpeak.com

# 4 – FINDINGS


Smart IoT- based Sensor
PHASE 1
Prototype
Development
Smoke
Presence
AND
Fire or
Flame
Presence
AND
Environmental
Changes
AND
Sound
Alert
AND
Power
Source
PHASE II
Database
Establishment
Cloud Database
Sensor ID
Sensor Visualisation
Sensor Attribute
PHASE III
Notification
Platform
Configuration
Notification Platform
Create new bot
Bot configuration
API Token
PHASE IV
System
Integration
Integration
Coding & Programming
IoT-based
Sensor
AND
Cloud
Database
AND
Notification
Platform
RESEARCH OBJECTIVES II

## Research Findings for RO 2 = Phase III


SmartCampus
bot
Bot Info
SmartCampus
bot
Description
Username
Notifications
SEND MESSAGE
Add to Group
Report
Stop and block bot
Write a message...

**What can this bot do?**

Cost-effective IoT-based sensor comprising of IR Flame, MQ-2 Smoke, DHT-11 integrated with ThingSpeak cloud database and Telegram application

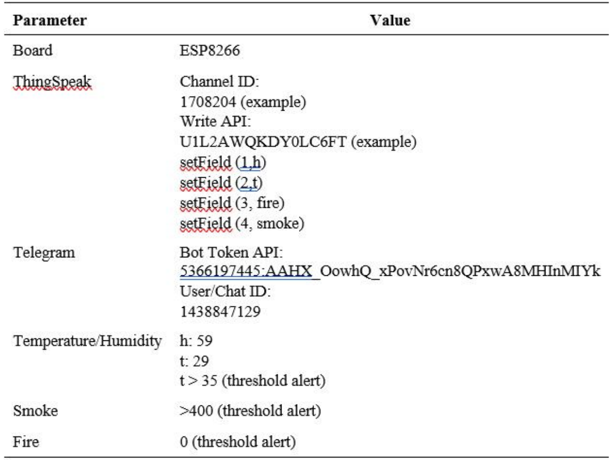
Real-time notification for building occupants and stakeholders in EOC, UKM Campus in the event of indoor fire hazards

@SmrtBuild_bot

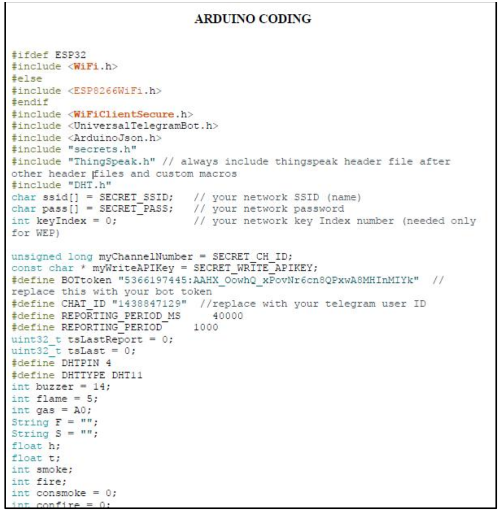
SmartCampus
bot

SENSOR 14-fire detected 10:40 AM
SENSOR 14-temperature is high 10:40 AM
SENSOR 9-fire detected 10:41 AM
SENSOR 14-temperature is high 10:41 AM
SENSOR 9-fire detected 10:41 AM
SENSOR 9-fire detected 10:42 AM
SENSOR 14-temperature is high 10:42 AM
SENSOR 9-fire detected 10:42 AM
SENSOR 9-fire detected 10:42 AM
SENSOR 14-temperature is high 10:43 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:52 AM
SENSOR 11-fire detected 10:52 AM
SENSOR 11-fire detected 10:52 AM
SENSOR 11-temperature is high 10:52 AM
SENSOR 11-fire detected 10:53 AM

**SmartCampus channel information and example of Telegram receiving fire incident notification**



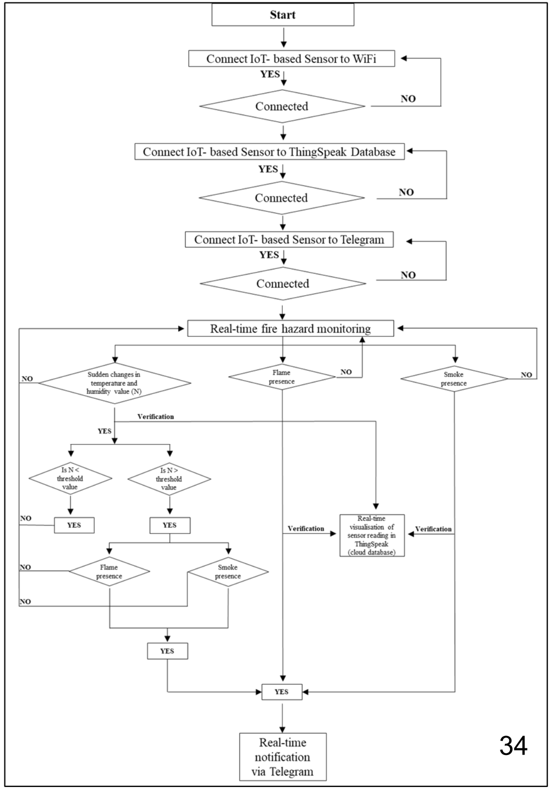
| Parameter | Value |
|---|---|
| Board | ESP8266 |
| ThingSpeak | Channel ID:<br>1708204 (example)<br>Write API:<br>U1L2AWQKDY0LC6FT (example)<br>setField (1,h)<br>setField (2,t)<br>setField (3, fire)<br>setField (4, smoke) |
| Telegram | Bot Token API:<br>5366197445:AAHX_OowhQ_xPovNr6cn8QPxwA8MHInMIYk<br>User/Chat ID:<br>1438847129 |
| Temperature/Humidity | h: 59<br>t: 29<br>t > 35 (threshold alert) |
| Smoke | >400 (threshold alert) |
| Fire | 0 (threshold alert) |



**ARDUINO CODING**

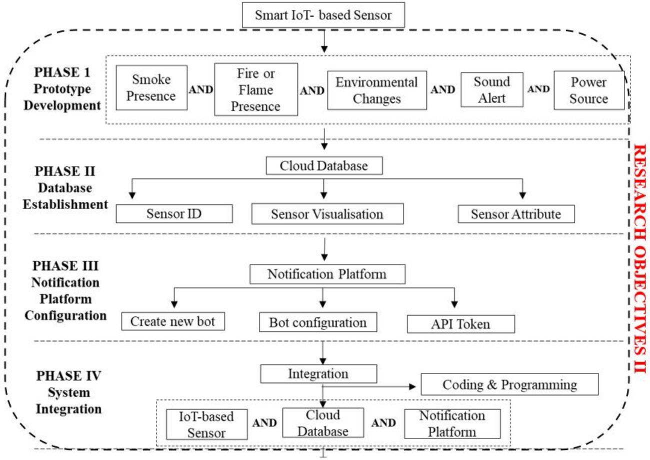
```
#ifdef ESP32
#include <WiFi.h>
#else
#include <ESP8266WiFi.h>
#endif
#include <WiFiClientSecure.h>
#include <UniversalTelegramBot.h>
#include <ArduinoJson.h>
#include "secrets.h"
#include "ThingSpeak.h" // always include thingspeak header file after
other header files and custom macros
#include "DHT.h"
char ssid[] = SECRET_SSID;   // your network SSID (name)
char pass[] = SECRET_PASS;   // your network password
int keyIndex = 0;            // your network key Index number (needed only
for WEP)

unsigned long myChannelNumber = SECRET_CH_ID;
const char * myWriteAPIKey = SECRET_WRITE_APIKEY;
#define BOTtoken "5366197445:AAHX_OowhQ_xPovNr6cn8QPxwA8MHInMIYk"  //
replace this with your bot token
#define CHAT_ID "1438847129"  //replace with your telegram user ID
#define REPORTING_PERIOD_MS     40000
#define REPORTING_PERIOD    1000
uint32_t tsLastReport = 0;
uint32_t tsLast = 0;
#define DHTPIN 4
#define DHTTYPE DHT11
int buzzer = 14;
int flame = 5;
int gas = A0;
String F = "";
String S = "";
float h;
float t;
int smoke;
int fire;
int consmoke = 0;
int confire = 0;
```

## Research Findings for RO 2 = Phase IV


Start
Connect IoT- based Sensor to WiFi
YES
Connected
NO
Connect IoT- based Sensor to ThingSpeak Database
YES
Connected
NO
Connect IoT- based Sensor to Telegram
YES
Connected
NO
Real-time fire hazard monitoring
Sudden changes in temperature and humidity value (N)
NO
Flame presence
NO
Smoke presence
NO
Verification
YES
Is N < threshold value
Is N > threshold value
NO
YES
YES
Verification
Real-time visualisation of sensor reading in ThingSpeak (cloud database)
Verification
NO
Flame presence
Smoke presence
NO
YES
YES
Real-time notification via Telegram

# 4 – FINDINGS

## Complete solution for Research Findings for RO 2


Smart IoT- based Sensor

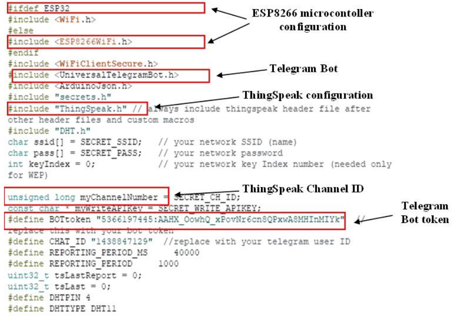
**PHASE 1**
**Prototype Development**
Smoke Presence AND Fire or Flame Presence AND Environmental Changes AND Sound Alert AND Power Source

**PHASE II**
**Database Establishment**
Cloud Database
Sensor ID
Sensor Visualisation
Sensor Attribute

**PHASE III**
**Notification Platform Configuration**
Notification Platform
Create new bot
Bot configuration
API Token

**PHASE IV**
**System Integration**
Integration
Coding & Programming
IoT-based Sensor AND Cloud Database AND Notification Platform

RESEARCH OBJECTIVES II

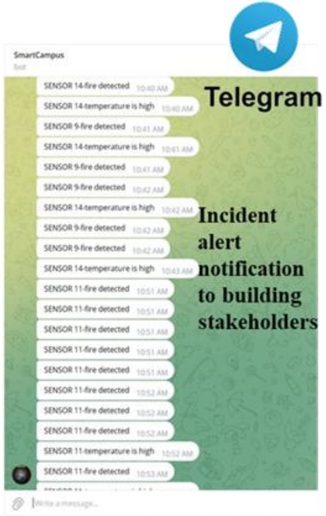


```
#ifdef ESP32
#include <WiFi.h>
#else
#include <ESP8266WiFi.h>
#endif
#include <WiFiClientSecure.h>
#include <UniversalTelegramBot.h>
#include <ArduinoJson.h>
#include "secrets.h"
#include "ThingSpeak.h" // always include thingspeak header file after
other header files and custom macros
#include "DHT.h"
char ssid[] = SECRET_SSID;   // your network SSID (name)
char pass[] = SECRET_PASS;   // your network password
int keyIndex = 0;            // your network key Index number (needed only
for WEP)

unsigned long myChannelNumber = SECRET_CH_ID;
const char * myWriteAPIKey = SECRET_WRITE_APIKEY;
#define BOTtoken "5366197445:AAHX_OowhQ_xPovNr6cn8QPxwA8MHInMIYk"  //
replace this with your bot token
#define CHAT_ID "1438847129"  //replace with your telegram user ID
#define REPORTING_PERIOD_MS     40000
#define REPORTING_PERIOD    1000
uint32_t tsLastReport = 0;
uint32_t tsLast = 0;
#define DHTPIN 4
#define DHTTYPE DHT11
```

R E A L - T I M E

**Ground Simulation (fire and smoke incident)**

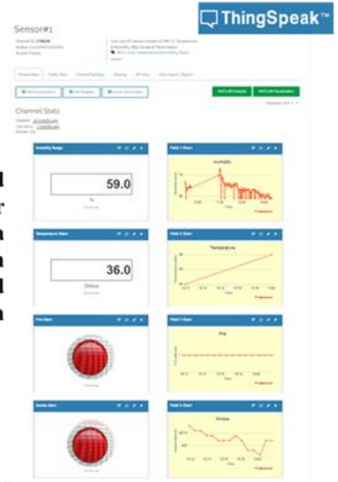
Smoke and fire presence detected



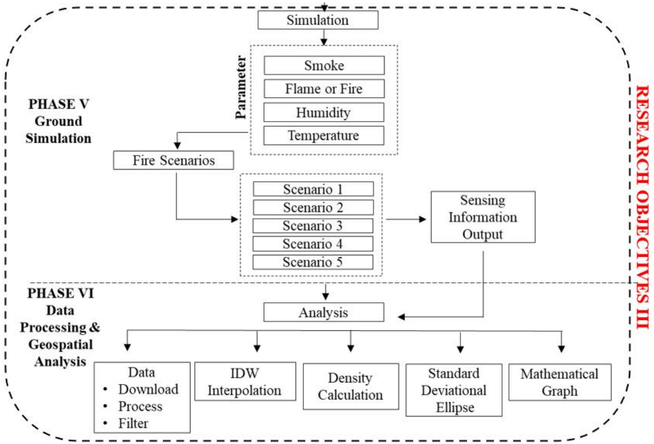
SENSOR 14-fire detected 10:40 AM
SENSOR 14-temperature is high 10:40 AM
SENSOR 9-fire detected 10:41 AM
SENSOR 14-temperature is high 10:41 AM
SENSOR 9-fire detected 10:41 AM
SENSOR 9-fire detected 10:42 AM
SENSOR 14-temperature is high 10:42 AM
SENSOR 9-fire detected 10:42 AM
SENSOR 9-fire detected 10:42 AM
SENSOR 14-temperature is high 10:43 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:51 AM
SENSOR 11-fire detected 10:52 AM
SENSOR 11-fire detected 10:52 AM
SENSOR 11-fire detected 10:52 AM
SENSOR 11-temperature is high 10:52 AM
SENSOR 11-fire detected 10:53 AM

**Incident alert notification to building stakeholders**

**Dashboard for sensor data aggregation and visualisation**



# 4 – FINDINGS


Simulation

Parameter

Smoke

Flame or Fire

Humidity

Temperature

PHASE V Ground Simulation

Fire Scenarios

Scenario 1

Scenario 2

Scenario 3

Scenario 4

Scenario 5

Sensing Information Output

PHASE VI Data Processing & Geospatial Analysis

Analysis

Data
- Download
- Process
- Filter

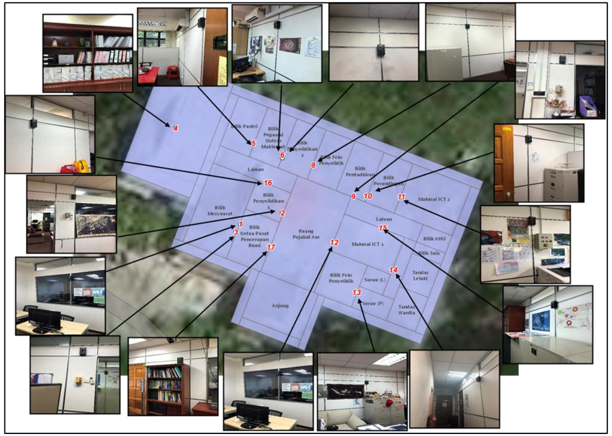
IDW Interpolation

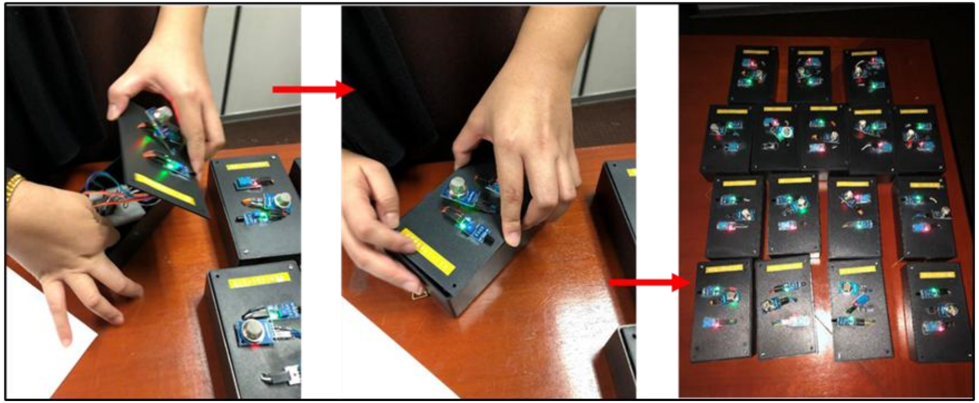
Density Calculation

Standard Deviational Ellipse

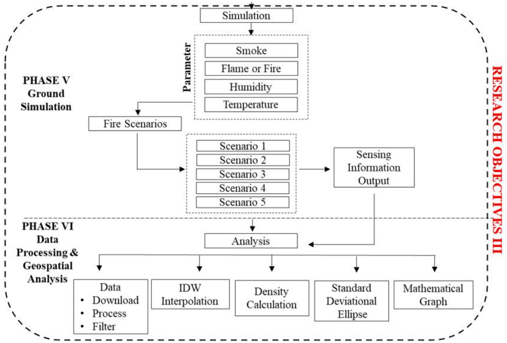
Mathematical Graph

RESEARCH OBJECTIVES III

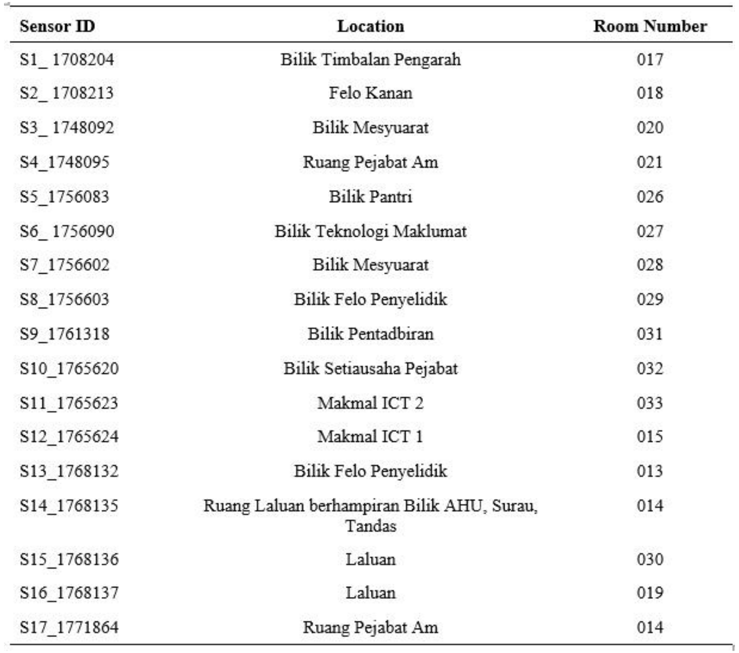

Bilik Pantri
Bilik Pegawai Sistem Maklumat
Bilik Penyelidikan 2
Bilik Felo Penyelidik
Bilik Pentadbiran
Bilik Perundingan
Makmal ICT 2
Laluan
Bilik Penyelidikan 1
Bilik Mesyuarat
Bilik Ketua Pusat Pencerapan Bumi
Ruang Pejabat Am
Laluan
Makmal ICT 1
Bilik AHU
Bilik Suis
Bilik Felo Penyelidik
Surau (L)
Surau (P)
Tandas Lelaki
Tandas Wanita
Anjung
1
2
3
4
5
6
8
9
10
11
12
13
14
15
16
17



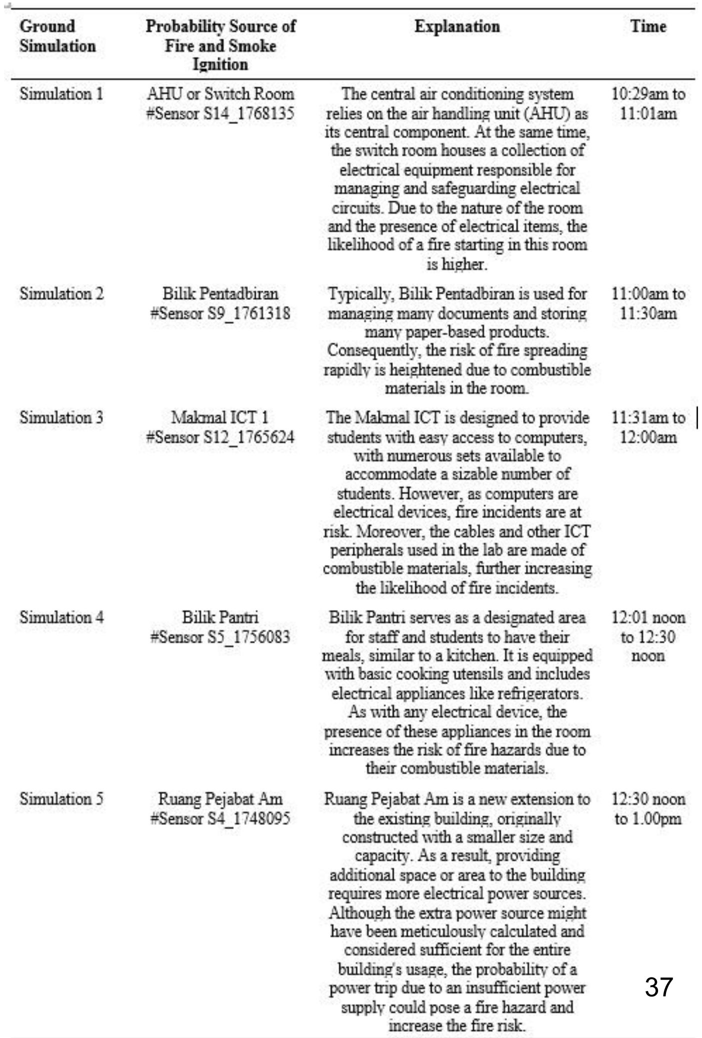
# 4 – FINDINGS


Simulation
Parameter
Smoke
Flame or Fire
Humidity
Temperature
PHASE V
Ground
Simulation
Fire Scenarios
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5
Sensing
Information
Output
RESEARCH OBJECTIVES III
PHASE VI
Data
Processing &
Geospatial
Analysis
Analysis
Data
• Download
• Process
• Filter
IDW
Interpolation
Density
Calculation
Standard
Deviational
Ellipse
Mathematical
Graph

## **5** types of Simulation



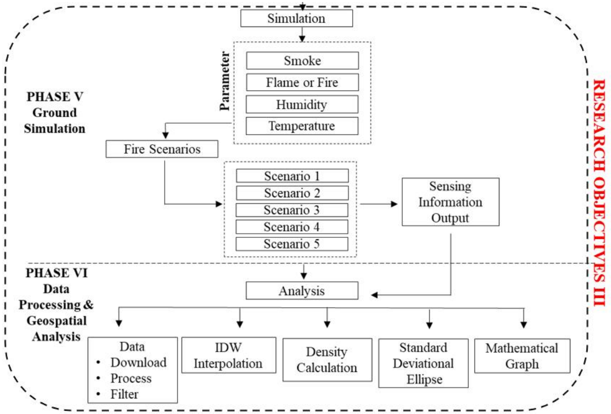
| Sensor ID | Location | Room Number |
|---|---|---|
| S1_ 1708204 | Bilik Timbalan Pengarah | 017 |
| S2_ 1708213 | Felo Kanan | 018 |
| S3_ 1748092 | Bilik Mesyuarat | 020 |
| S4_1748095 | Ruang Pejabat Am | 021 |
| S5_1756083 | Bilik Pantri | 026 |
| S6_ 1756090 | Bilik Teknologi Maklumat | 027 |
| S7_1756602 | Bilik Mesyuarat | 028 |
| S8_1756603 | Bilik Felo Penyelidik | 029 |
| S9_1761318 | Bilik Pentadbiran | 031 |
| S10_1765620 | Bilik Setiausaha Pejabat | 032 |
| S11_1765623 | Makmal ICT 2 | 033 |
| S12_1765624 | Makmal ICT 1 | 015 |
| S13_1768132 | Bilik Felo Penyelidik | 013 |
| S14_1768135 | Ruang Laluan berhampiran Bilik AHU, Surau, Tandas | 014 |
| S15_1768136 | Laluan | 030 |
| S16_1768137 | Laluan | 019 |
| S17_1771864 | Ruang Pejabat Am | 014 |



| Ground Simulation | Probability Source of Fire and Smoke Ignition | Explanation | Time |
|---|---|---|---|
| Simulation 1 | AHU or Switch Room #Sensor S14_1768135 | The central air conditioning system relies on the air handling unit (AHU) as its central component. At the same time, the switch room houses a collection of electrical equipment responsible for managing and safeguarding electrical circuits. Due to the nature of the room and the presence of electrical items, the likelihood of a fire starting in this room is higher. | 10:29am to 11:01am |
| Simulation 2 | Bilik Pentadbiran #Sensor S9_1761318 | Typically, Bilik Pentadbiran is used for managing many documents and storing many paper-based products. Consequently, the risk of fire spreading rapidly is heightened due to combustible materials in the room. | 11:00am to 11:30am |
| Simulation 3 | Makmal ICT 1 #Sensor S12_1765624 | The Makmal ICT is designed to provide students with easy access to computers, with numerous sets available to accommodate a sizable number of students. However, as computers are electrical devices, fire incidents are at risk. Moreover, the cables and other ICT peripherals used in the lab are made of combustible materials, further increasing the likelihood of fire incidents. | 11:31am to 12:00am |
| Simulation 4 | Bilik Pantri #Sensor S5_1756083 | Bilik Pantri serves as a designated area for staff and students to have their meals, similar to a kitchen. It is equipped with basic cooking utensils and includes electrical appliances like refrigerators. As with any electrical device, the presence of these appliances in the room increases the risk of fire hazards due to their combustible materials. | 12:01 noon to 12:30 noon |
| Simulation 5 | Ruang Pejabat Am #Sensor S4_1748095 | Ruang Pejabat Am is a new extension to the existing building, originally constructed with a smaller size and capacity. As a result, providing additional space or area to the building requires more electrical power sources. Although the extra power source might have been meticulously calculated and considered sufficient for the entire building's usage, the probability of a power trip due to an insufficient power supply could pose a fire hazard and increase the fire risk. | 12:30 noon to 1.00pm |

UNIVERSITI
KEBANGSAAN
MALAYSIA
*The National University of Malaysia*

# 4 – FINDINGS


Simulation
Parameter
Smoke
Flame or Fire
Humidity
Temperature
PHASE V
Ground
Simulation
Fire Scenarios
Scenario 1
Scenario 2
Scenario 3
Scenario 4
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Sensing
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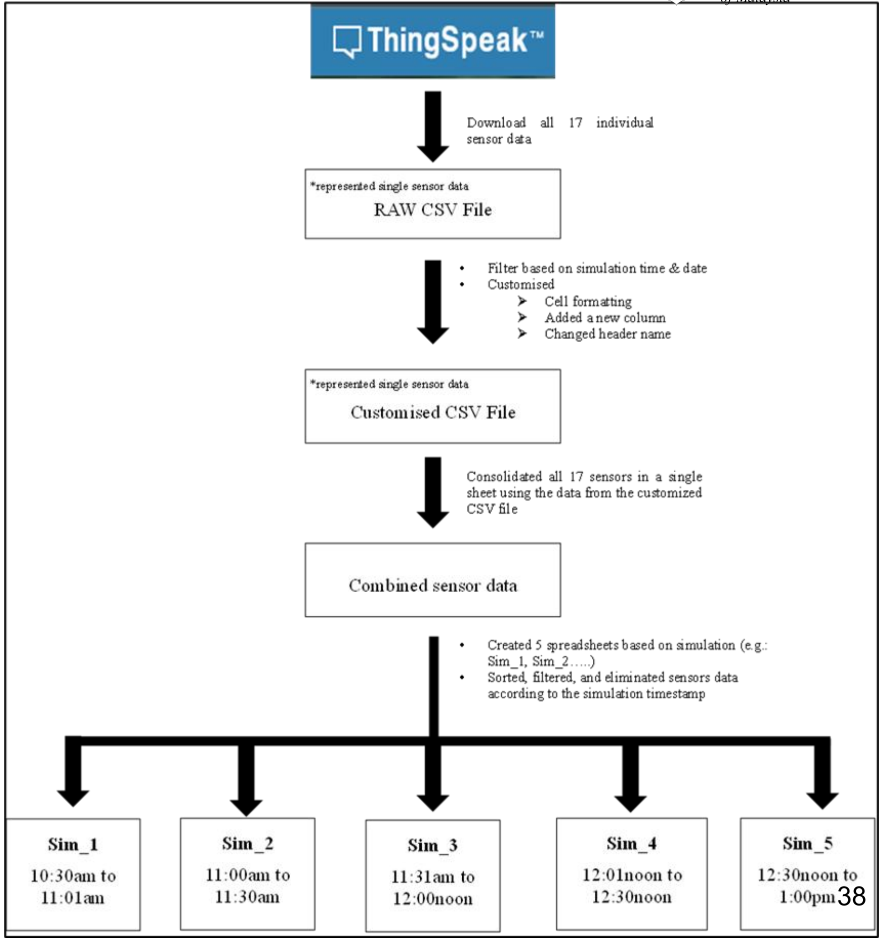
Output
RESEARCH OBJECTIVES III
PHASE VI
Data
Processing &
Geospatial
Analysis
Analysis
Data
Download
Process
Filter
IDW
Interpolation
Density
Calculation
Standard
Deviational
Ellipse
Mathematical
Graph

## Geospatial Data Analysis

| Projects | Type of analysis | Data | Data Naming Convention |
|---|---|---|---|
| Simulation01 | IDW Interpolation<br>Density Estimation<br>SDE<br>Mathematical Graph | Customised CSV File<br>Standalone Tables in ArcGIS<br>IPI Building Footprint<br>IPI Building Border<br>Sensor Location | Table: Simulation_01 & Sensor_Location<br>IPI.shp<br>IPI_Mask.shp<br>Sensor_Location.shp |
| Simulation02 | | | |
| Simulation03 | | | |
| Simulation04 | | | |
| Simulation05 | | | |

## Data Processing Flow


ThingSpeak™

Download all 17 individual sensor data

*represented single sensor data
RAW CSV File

- Filter based on simulation time & date
- Customised
  - Cell formatting
  - Added a new column
  - Changed header name

*represented single sensor data
Customised CSV File

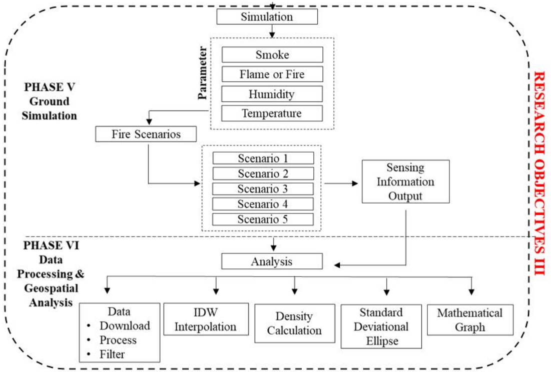
Consolidated all 17 sensors in a single sheet using the data from the customized CSV file

Combined sensor data

- Created 5 spreadsheets based on simulation (e.g.: Sim_1, Sim_2…..)
- Sorted, filtered, and eliminated sensors data according to the simulation timestamp

| Sim_1 | Sim_2 | Sim_3 | Sim_4 | Sim_5 |
|---|---|---|---|---|
| 10:30am to 11:01am | 11:00am to 11:30am | 11:31am to 12:00noon | 12:01noon to 12:30noon | 12:30noon to 1:00pm |

# 4 – FINDINGS



PHASE V Ground Simulation

Simulation

Parameter

Smoke

Flame or Fire

Humidity

Temperature

Fire Scenarios

Scenario 1

Scenario 2

Scenario 3

Scenario 4

Scenario 5

Sensing Information Output

PHASE VI Data Processing & Geospatial Analysis

Analysis

Data
- Download
- Process
- Filter

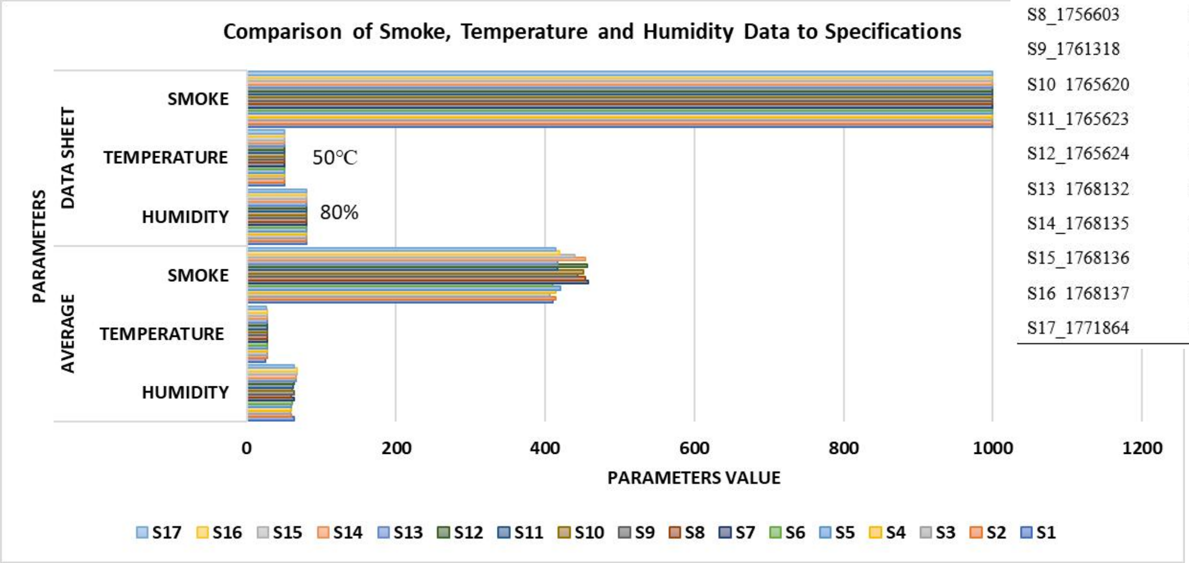
IDW Interpolation

Density Calculation

Standard Deviational Ellipse

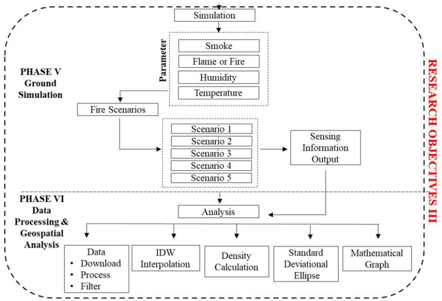
Mathematical Graph

RESEARCH OBJECTIVES III



Comparison of Smoke, Temperature and Humidity Data to Specifications

| Sensor | Average | | | Flame /Buzzer | Data Sheet Specification | | |
|---|---|---|---|---|---|---|---|
| | Humidity (%) | Temperature (°C) | Smoke (ppm) | | Humidity (%) | Temperature (°C) | Smoke (ppm) |
| S1 1708204 | 64 | 25 | 410 | Yes | 20-80% /±5% | 0-50℃/±2℃ | 300 – 10,000 ppm |
| S2_ 1708213 | 60 | 27 | 414 | | | | |
| S3_ 1748092 | 58 | 28 | 406 | | | | |
| S4 1748095 | 59 | 27 | 414 | | | | |
| S5_1756083 | 60 | 27 | 420 | | | | |
| S6_ 1756090 | 61 | 27 | 410 | | | | |
| S7 1756602 | 64 | 28 | 458 | | | | |
| S8_1756603 | 60 | 28 | 454 | | | | |
| S9_1761318 | 64 | 27 | 444 | | | | |
| S10 1765620 | 61 | 28 | 451 | | | | |
| S11_1765623 | 62 | 27 | 416 | | | | |
| S12_1765624 | 64 | 27 | 457 | | | | |
| S13 1768132 | 66 | 27 | 417 | | | | |
| S14_1768135 | 66 | 27 | 454 | | | | |
| S15_1768136 | 67 | 27 | 4401 | | | | |
| S16 1768137 | 67 | 28 | 419 | | | | |
| S17_1771864 | 64 | 26 | 414 | | | | |


Simulation
Parameter
Smoke
Flame or Fire
Humidity
Temperature
PHASE V
Ground
Simulation
Fire Scenarios
Scenario 1
Scenario 2
Scenario 3
Scenario 4
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Standard
Deviational
Ellipse
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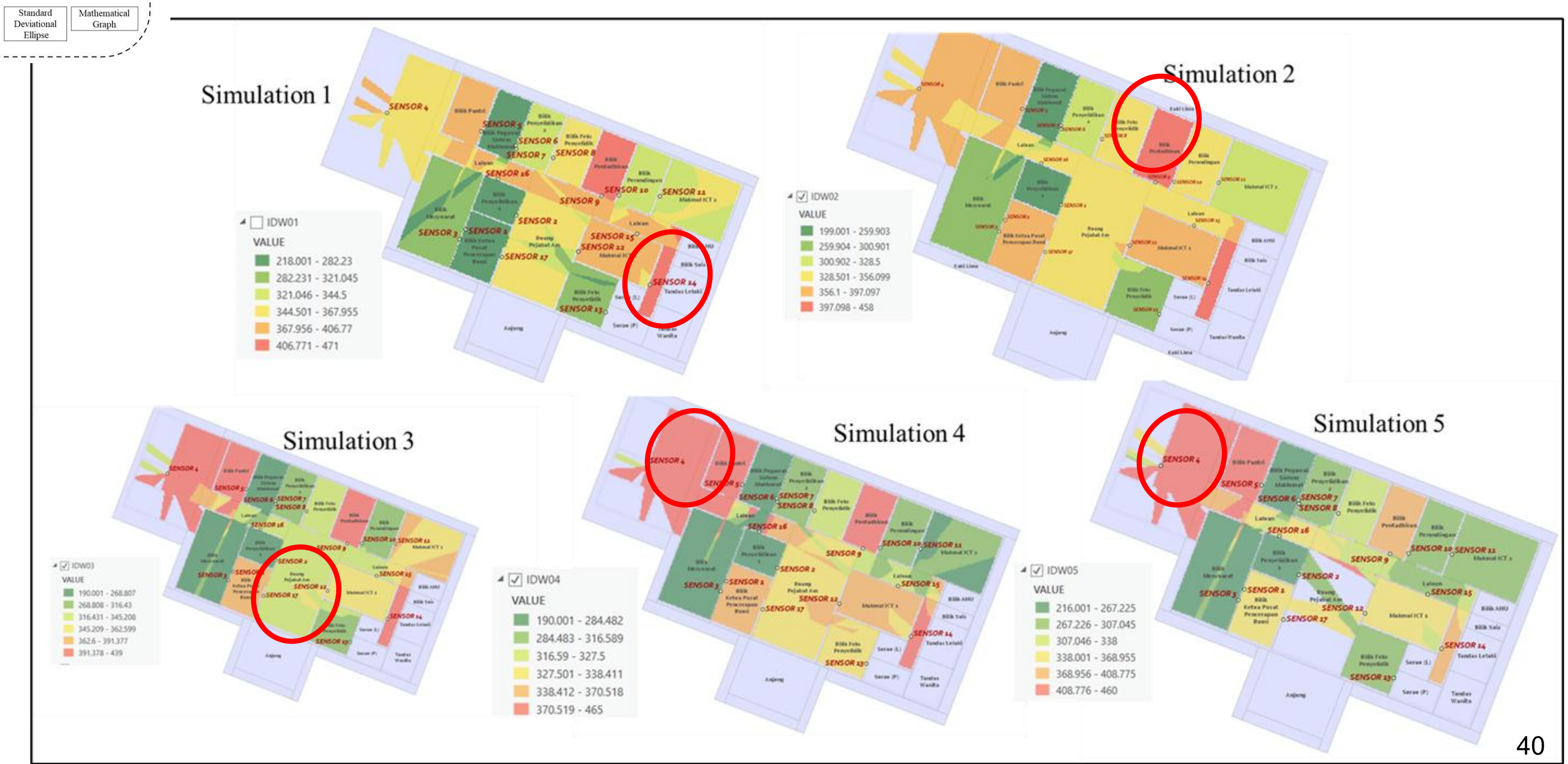
Graph

# 4 – FINDINGS

University Kebangsaan Malaysia
The National University of Malaysia

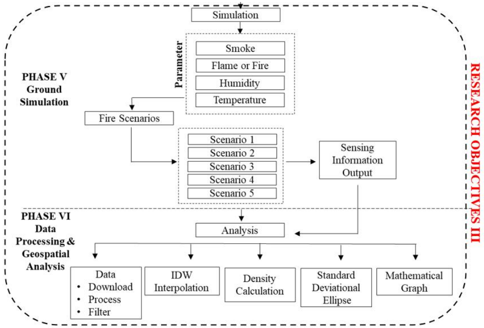
## Interpolation analysis for spatial assessment of the smoke dispersion across the building


Simulation 1
IDW01
VALUE
218.001 - 282.23
282.231 - 321.045
321.046 - 344.5
344.501 - 367.955
367.956 - 406.77
406.771 - 471
Simulation 2
IDW02
VALUE
199.001 - 259.903
259.904 - 300.901
300.902 - 328.5
328.501 - 356.099
356.1 - 397.097
397.098 - 458
Simulation 3
IDW03
VALUE
190.001 - 268.807
268.808 - 316.43
316.431 - 345.208
345.209 - 362.599
362.6 - 391.377
391.378 - 439
Simulation 4
IDW04
VALUE
190.001 - 284.482
284.483 - 316.589
316.59 - 327.5
327.501 - 338.411
338.412 - 370.518
370.519 - 465
Simulation 5
IDW05
VALUE
216.001 - 267.225
267.226 - 307.045
307.046 - 338
338.001 - 368.955
368.956 - 408.775
408.776 - 460

# 4 – FINDINGS

Universiti Kebangsaan Malaysia
The National University of Malaysia

## Spatial assessment for determining sensor density


Simulation

Parameter

- Smoke
- Flame or Fire
- Humidity
- Temperature

**PHASE V Ground Simulation**

Fire Scenarios

- Scenario 1
- Scenario 2
- Scenario 3
- Scenario 4
- Scenario 5

Sensing Information Output

**PHASE VI Data Processing & Geospatial Analysis**

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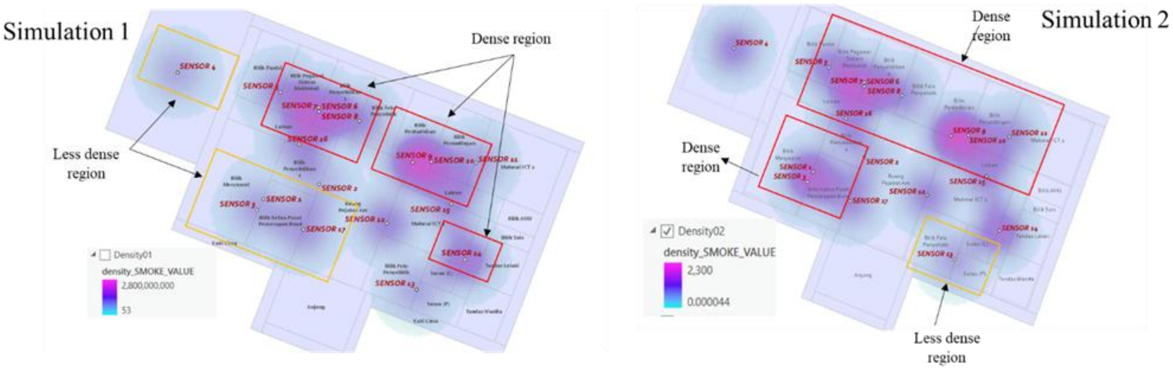
IDW Interpolation

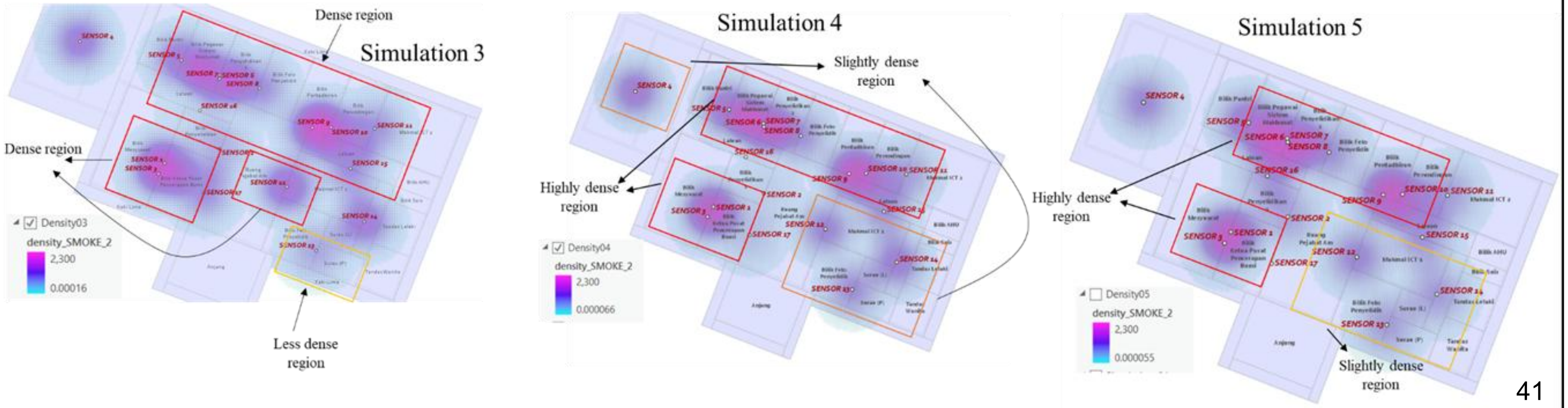
Density Calculation

Standard Deviational Ellipse

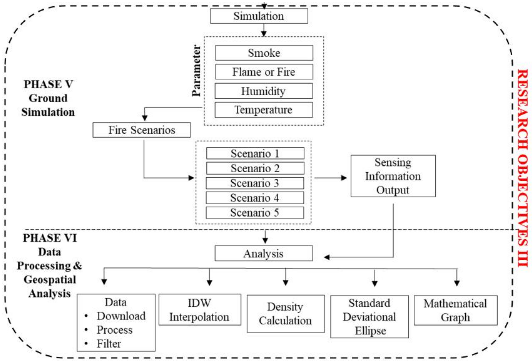
Mathematical Graph

RESEARCH OBJECTIVES III


Simulation 1
Dense region
Less dense region
☐ Density01
density_SMOKE_VALUE
2,800,000,000
53
Simulation 2
Dense region
Dense region
Less dense region
☑ Density02
density_SMOKE_VALUE
2,300
0.000044


Simulation 3
Dense region
Dense region
Less dense region
☑ Density03
density_SMOKE_2
2,300
0.00016
Simulation 4
Slightly dense region
Highly dense region
☑ Density04
density_SMOKE_2
2,300
0.000066
Simulation 5
Highly dense region
Slightly dense region
☐ Density05
density_SMOKE_2
2,300
0.000055

# 4 – FINDINGS



Simulation

PHASE V
Ground
Simulation

Parameter
Smoke
Flame or Fire
Humidity
Temperature

Fire Scenarios

Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5

Sensing Information Output

PHASE VI
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Processing &
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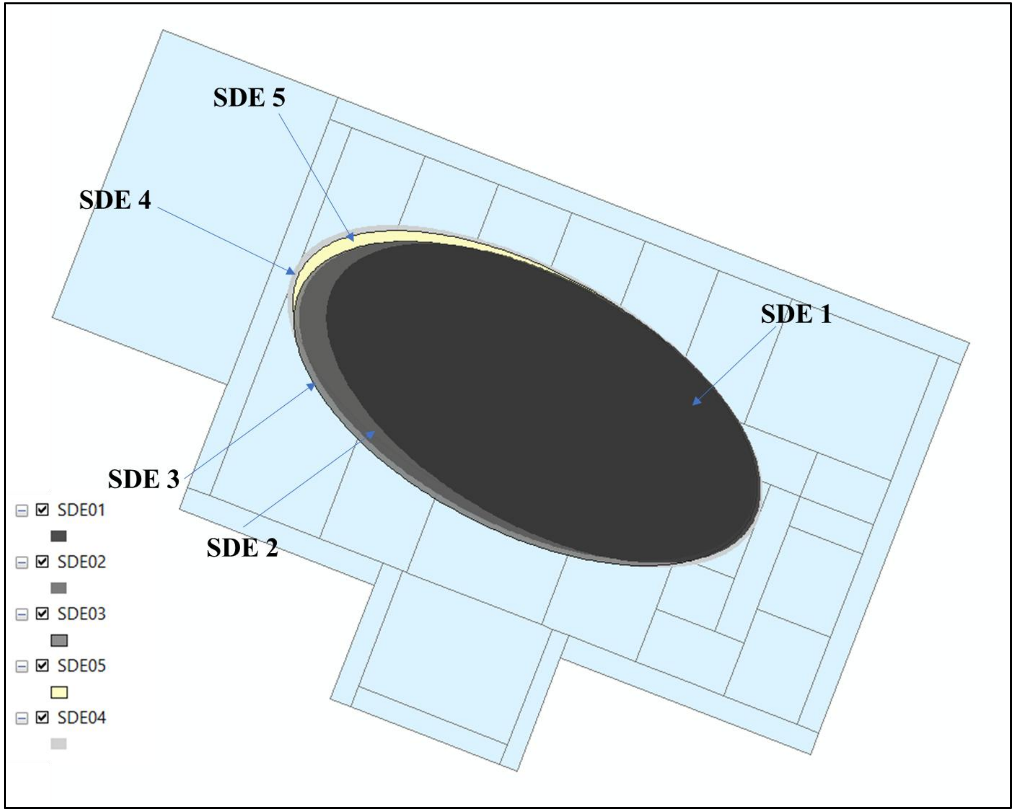
RESEARCH OBJECTIVES III

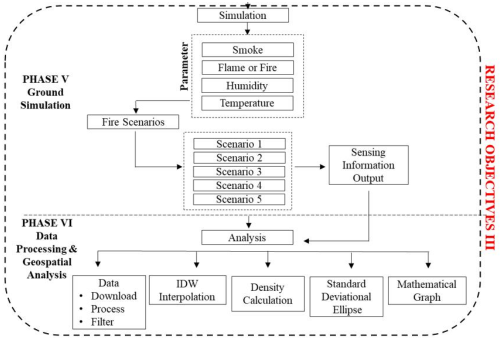
| Simulation | x-axis (m) | y-axis (m) | Rotational Angle (°) |
|---|---|---|---|
| 1 | 0.000086 | 0.000043 | 119.9 |
| 2 | 0.000089 | 0.000044 | 117.5 |
| 3 | 0.00009 | 0.000045 | 117.4 |
| 4 | 0.000094 | 0.000046 | 119.6 |
| 5 | 0.000089 | 0.000043 | 118.2 |

Sensor directional pattern using Standard Deviational Ellipse (SDE) analysis



SDE: measuring the trend for a set of points or areas to calculate the standard distance separately in the x-, y- and z-directions

# 4 – FINDINGS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Deviational
Ellipse
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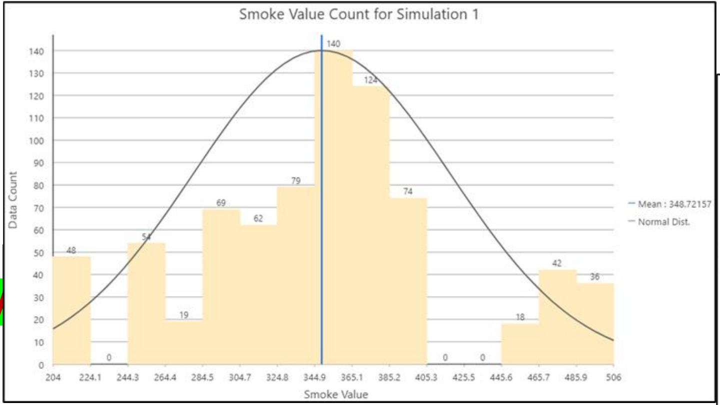
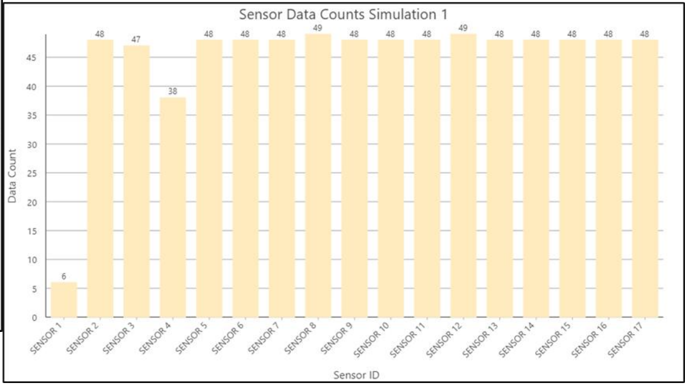
Research Findings for **RO** 3 = Phase V

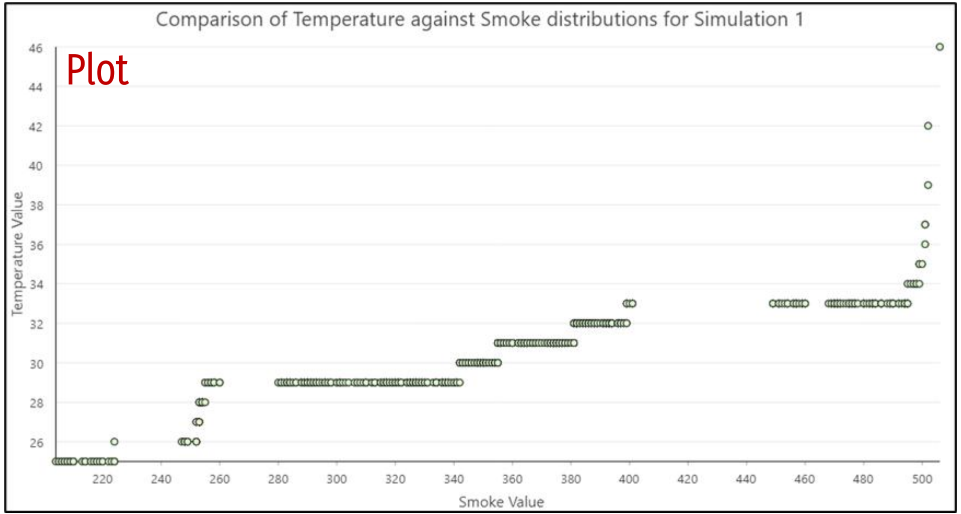
Mathematical Graph

istogram



ar Chart





| Simulation | Total Data Count | Mean | Median | Standard Deviation | Frequent Smoke Value | Data Loss |
|---|---|---|---|---|---|---|
| 1 | 765 | 348.7 | 350 | 69.3 | 344.9 – 365.1 | Sensor 1: 6<br>Sensor 4: 38 |
| 2 | 719 | 337.8 | 345 | 64.0 | 343.1 – 361.2 | Nil |
| 3 | 712 | 340.8 | 333 | 72.4 | 317.6 – 338.9 | Sensor 16: 12 |
| 4 | 654 | 340.7 | 328 | 58.7 | 285.3 – 304.6 | Sensor 2: 15<br>Sensor 16<br>Sensor 17: 23 |
| 5 | 700 | 321.3 | 307 | 57.6 | 295.7 – 313.0 | Sensor 4:34<br>Sensor 14: 34<br>Sensor16: 38<br>Sensor 17 |

# 5 –DISCUSSION

Based on findings obtained from the study, it can be observed that:

01

Sensor performance was tested via functionality test, results were within the datasheet range.

02

This research has confirmed the effectiveness of the MQ2 smoke sensor, DHT11 sensor, ThingSpeak, and Telegram.

03

The study reveals inconsistency in energy sources, indicating a specific investigation on the use of power banks and more stable sources can be conducted.

04

Smoke values from the raw and estimation methods were almost proportional to each other.

05

The density value indicates the sensor's smoke detection capability, which may vary based on its abilities.

06

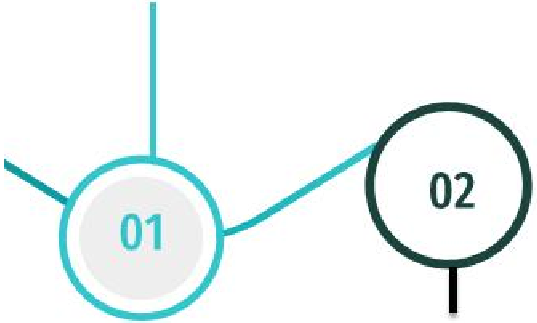
Slight differences were observed in the size of the smoke ellipse, but they were not significant for this study. This suggests that the ellipse is a suitable representation of the data for longer durations

07

IoT-based sensor prototypes could serve as a foundation for smart campus applications aligned with the safe campus framework.

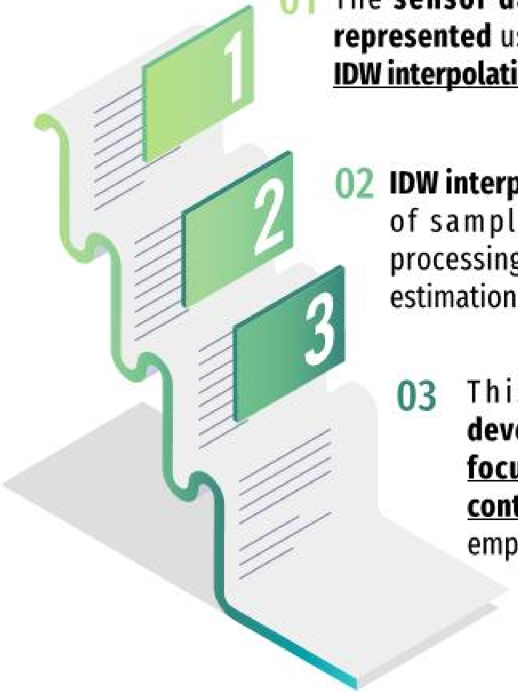
# 5 –DISCUSSION &CONCLUSION

Based on findings obtained from the study, it can be observed that:



Slight differences were observed in the size of the smoke ellipse, but they were not significant for this study. This suggests that the ellipse is a suitable representation of the data for longer durations

IoT-based sensor prototypes could serve as a foundation for smart campus applications aligned with the safe campus framework.



01 The **sensor data quality was measured** and **represented** using geospatial analyses involving **IDW interpolation**

02 **IDW interpolation**, which calculates the average of sample data points surrounding each processing cell, then able to perform the smoke estimation

03 This research **aimed to support the development of a smart campus framework, focusing** on **hazard mitigation in Malaysian context,** as the current smart campus concept emphasises management and learning.

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# Thank You
## *Terima Kasih*

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