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APPLIED INTELLIGENT SECURITY ARCHITECTURE CONTINUOUS DETECTION OF ENVIRONMENTAL DATA

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ABSTRACT

Purpose: This study, funded by the Ministry of Science and Technology – Bangsamoro Autonomous Region in Muslim Mindanao (MOST-BARMM), was conducted in 2024 to monitor the environmental conditions surrounding the MOST headquarters in Cotabato City, Philippines. The research aimed to enhance understanding of local weather dynamics and contextual environmental interactions within the MOST compound.

Approach: Utilizing an Internet of Things (IoT)–Knowledge-Based Architecture, the study developed an automated environmental monitoring system employing Arduino technology. Three monitoring stations were established: MOST Building Station (entrance), MOST 1 Station (rightmost side), and MOST Lab Station (rear side). The system integrated a third-party Semaphore SMS Gateway for mass alert reporting and employed its database as the working memory, following Konar's (2000) knowledge-based architecture framework.

Findings: It was found out that the null hypothesis—stating no significant differences exist between single-rule and multiple-rule activations in the inference engine regarding latency, accuracy, and coherence of system output—was accepted.

Research implications: The results demonstrate the feasibility and effectiveness of combining artificial intelligence (AI) and IoT for environmental monitoring. The developed system enables real-time data collection and automated reporting of temperature, humidity, ultraviolet (UV) index, ambient light, carbon dioxide (CO_2) concentration, vibration, and rainfall. The study provides a valuable model for BARMM-wide environmental monitoring initiatives and contributes to the growing field of AI-driven environmental intelligence systems.

Practical implications: The prototype developed in this study effectively demonstrated that the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) offers substantial strategic advantages for users, particularly the employees of MOST-BARMM, from the top management down to the staff, including political leaders. The intelligent system is designed to continuously provide timely updates via registered mobile numbers, delivering real-time information on various environmental parameters such as temperature, relative humidity, UV level, ambient light, CO_2 concentration, vibration, and rainfall occurrence within the compound. Furthermore, data collected in the system's database can be systematically analyzed to generate insights that support knowledge-based management and decision-making strategies.

Originality: The study titled "*Applied Intelligent Security Architecture on Continuous Detection of Environmental Data*" is an original research project conducted by the authors and funded by the Ministry of Science and Technology within the Bangsamoro regional headquarters compound in Cotabato City. The research is anchored on the concepts of Artificial Intelligence (AI) and the fundamental architecture of the Internet of Things (IoT). It employs a knowledge-based architectural framework to implement system intelligence within the software development process, drawing from the principles outlined by A. Konar (2000).

Keywords: *(Artificial intelligence (AI), Internet of Things (IoT), Knowledge-based system, Environmental monitoring, Smart automation, MOST-BARMM)*

INTRODUCTION

The authors, through research and development funded by the MOST-BARMM in 2024, developed an architecture that monitors the surroundings of the MOST Building. The significance of such an environmental monitoring automation is not only for security and health safety, but also to demonstrate to the constituents of the entire region that the Ministry can build its own Internet of Things (IoT) application leveraging artificial intelligence (AI) computing concept.

Initially, Zigbee technology (Previous study, 2020) was considered for its sensory function, but the system requires detection data to be transmitted directly to the cloud; the authors found IoT architecture to be a better solution. Also, the strength of the internet signal at every coordinate of the vast compound influenced them to leverage the one that fully supports IoT architecture. There were three chosen deployment locations. Each of them is a group of different sensors unique for that station: MOST entrance station: PIR, vibration, ambient light, temperature, humidity. MOST 1 station located at the right side of the Building: vibration, UV light, carbon dioxide, rain water, flame, temperature, humidity. MOST Lab Station, located at the back of the Building: PIR, vibration, ambient light, temperature, and relative humidity.

Knowledge-based architecture in artificial intelligence (AI) (A. Konar, 2000) was utilized to run the sensors in a synchronized manner, in real-time, sending alerts across the Ministry for threshold data to registered Mobile numbers in the cloud knowledge-based center (see Fig. 1).

HYPOTHESIS

H0: There are no significant differences between firing a rule at a particular time and firing multiple rules simultaneously, also at a specific time in the knowledge-based system's inference engine, as far as the following:

1. Latency
2. Accuracy and coherence of output directives/advices/device activations for BARMM compound constituents by the system's intelligence or KBS:
    - i) Alarm system
    - ii) Voice over
    - iii) Monitor-display system of BARMM
    - iv) The police/fire department received command/information
    - v) Actual device actuation
    - vi) Emergency sound

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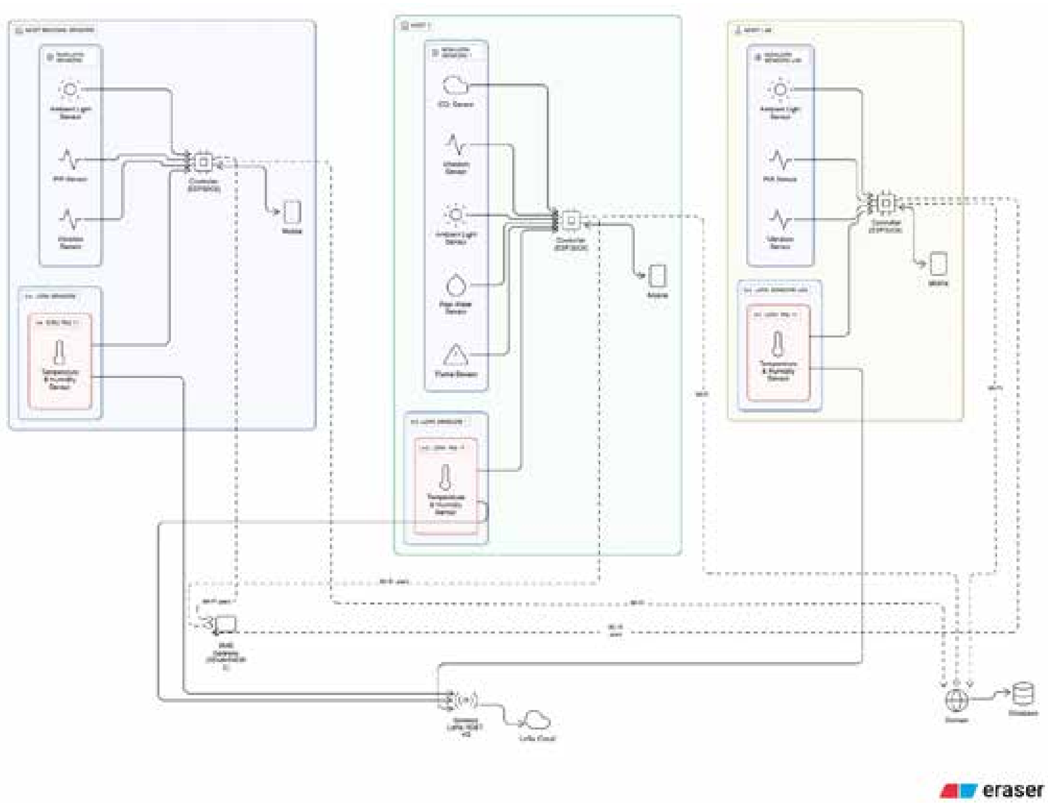
METHODS AND PROCEDURES

SYSTEM ARCHITECTURE

During the initiation phase of the R&D, the authors considered whether to use a wired, wireless, or hybrid approach for automation. Initially, Zigbee technology (Hayag, 2020) was considered. However, the authors ultimately chose an IoT architecture (Simone Cirani et al., 2019) over Zigbee for its ease of cloud programming and deployment. Figure 1 shows the general system architecture with three stations: the MOST entrance station, the MOST 1 station, and the MOST Lab Station. Each station is equipped with unique sensors developed by the authors (Industry Ready Solutions (n.d.)), as illustrated in Figs. 1 and 2.

The authors chose to design this flexible architecture to allow for future enhancement of its sensory capability. PIR, vibration, and ambient light sensors are connected through the ESP32C6 controller, while humidity and temperature sensors are connected through the LoRa tag11 transmitter (https://www.tzonetemperature.com/ (n. d.)) for the LoRa Gateway RD07-4G. This setup provides the option to use a paid LoRa cloud or remain connected through the domain preferred by the authors for economic reasons.



Fiigure 1: General Architecture of MOST-BARMM Security Intelligent Automation

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Figure 2: (Box) Set of sensors for each station deployed at MOST-BARMM: (a) Open top view showing hardware inside; (b) Front-side view with PIR, LoRa temp/humidity sensors, and UV light sensors; (c) Back-side view with system switch and pilot light

Furthermore, the system architecture supports the seamless integration of industry-standard LoRa technology sensors for various sensing purposes without requiring additional integration programming (https://www.tzonetemperature.com/). Data acquired from experimental non-LoRa sensors developed using Arduino technology (https://www.arduino.cc/education/university/) and from LoRa-based sensors can be consolidated through an ESP32-C6 controller into a unified database within the non-LoRa gateway domain.

Consequently, only LoRa sensors originating from Tag11 LoRa transmitters (https://www.tzonetemperature.com/) can automatically interface with the proprietary RD07-4G LoRa Gateway. As a strategy for future system enhancement, developers may consider utilizing the proprietary RD07-4G LoRa Gateway cloud service, which is offered at a cost of USD 24 per sensor per year.

THE INTELLIGENCE OF THE SYSTEM

This study anchored the knowledge-based architecture concept presented in Fig. 3.1, p. 75 of the book Artificial Intelligence and Soft Computing Behavioral and Cognitive Modeling of the Human Brain, Edn. 1 (A. Konar, 2000), implemented through the algorithms found in Figs. B-1 to B-8. This architecture requires the implementation of mechanisms for the decay of short-term memory (STM) and long-term memory (LTM) data, as further discussed in the same book on page 41. Mimicking human memory function is a requisite in AI. In actual practice, this strategy unloads both the primary and the secondary memories with data that are already fired, rendering the intelligent system efficient. This mechanism was implemented at the inference engine (IE) for both architectures' conflict resolver and working memory sections, or database add/delete (A. Konar, 2000):

1. Recency – take the data that arrived in working memory most recently, and find a rule that uses this data.
2. Specificity - use the most specific rule (the one with the most conditions attached).
3. Refractoriness - don't allow a rule to fire twice on the same data. With three stations deployed at the MOST Building, comprising fourteen sensors in total, it is unavoidable for detection concurrency. In this case, the automatic decaying of old data and adding new detection data are very strategic in the database (A. Konar, 2000).

DEPLOYMENT AND TESTING

Three locations within the MOST Building were selected for straightforward system deployment: the MOST Entrance Station, MOST 1 Station, and MOST Lab Station. Each site was equipped with an enclosed unit containing a varying number of sensors (see Figure

2). These sensor boxes were preconfigured and ready for use upon installation, capable of detecting ambient light, temperature, humidity, vibration, ultraviolet (UV) radiation, passive infrared (PIR) motion, and carbon dioxide (CO_2) levels from the environment.

The collected environmental data were transmitted via the ESP32C6 controller through cloud-based domains—namely, the developed gateway and the Semaphore Gateway—in accordance with the Internet of Things (IoT) concept (Cirani et al., 2019) (see Figure 1). Both gateways hosted the complete IoT knowledge-based application in parallel, including the database, production rules, and the inference engine (IE). The developed gateway facilitated 24-hour data recording and browsing access, while the Semaphore Gateway handled real-time detection of threshold data, sending alert notifications to system-registered mobile numbers within the Ministry.

For operational efficiency, the authors subscribed to the Semaphore Internet-Based Short Messaging Service (SMS) Gateway (*SMS Gateway Philippines - SMS API | Semaphore*, n.d.) to enable large-scale message dissemination at a rate of ₱0.50 per message, offering an economical alternative to the standard SIM-based rate of ₱1.00 per message. All communications and sensor interactions were managed through the ESP32C6 controller interface (see Figure 1).

Actual testing was limited to May 5. 2025 deployment. (see figures 3, 4, 5, 6).

Table 1: MOST1 Station detection test data during deployment

Location	Sensor	Value	Timestamp
MOST_1	MOST_1_temperature	29.000	2025-05-05 13:41:54.000000
MOST_1	MOST_1_humidity	65.000	2025-05-05 13:41:54.000000
MOST_1	MOST_1_pir	0.000	2025-05-05 13:41:54.000000
MOST_1	MOST_1_tilt	1.000	2025-05-05 13:41:54.000000
MOST_1	MOST_1_ultraviolet	0.000	2025-05-05 13:41:54.000000
MOST_1	MOST_1_humidity	64.000	2025-05-05 13:42:16.000000
MOST_1	MOST_1_humidity	65.000	2025-05-05 13:43:15.000000
MOST_1	MOST_1_humidity	66.000	2025-05-05 13:43:25.000000
MOST_1	MOST_1_humidity	67.000	2025-05-05 13:43:34.000000
MOST_1	MOST_1_pir	1.000	2025-05-05 13:43:34.000000
MOST_1	MOST_1_tilt	0.000	2025-05-05 13:43:34.000000
MOST_1	MOST_1_humidity	68.000	2025-05-05 13:43:42.000000
MOST_1	MOST_1_pir	0.000	2025-05-05 13:43:42.000000
MOST_1	MOST_1_temperature	30.000	2025-05-05 13:43:56.000000
MOST_1	MOST_1_humidity	69.000	2025-05-05 13:44:06.000000
MOST_1	MOST_1_tilt	1.000	2025-05-05 13:44:14.000000
MOST_1	MOST_1_humidity	68.000	2025-05-05 13:44:35.000000
MOST_1	MOST_1_humidity	67.000	2025-05-05 13:44:44.000000
MOST_1	MOST_1_humidity	66.000	2025-05-05 13:44:55.000000
MOST_1	MOST_1_humidity	65.000	2025-05-05 13:45:03.000000
MOST_1	MOST_1_humidity	64.000	2025-05-05 13:45:14.000000
MOST_1	MOST_1_humidity	63.000	2025-05-05 13:45:25.000000
MOST_1	MOST_1_humidity	62.000	2025-05-05 13:45:33.000000
MOST_1	MOST_1_humidity	61.000	2025-05-05 13:46:50.000000
MOST_1	MOST_1_humidity	62.000	2025-05-05 13:48:15.000000
MOST_1	MOST_1_humidity	61.000	2025-05-05 13:48:24.000000
MOST_1	MOST_1_temperature	29.000	2025-05-05 13:49:27.000000

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Table 2: MOST Lab Station detection test data during deployment

Location	Sensor	Value	Timestamp
MOST_LABORATORY	most_lab_temperature	31.1	2025-05-05 12:58:18.000000
MOST_LABORATORY	most_lab_humidity	64.000	2025-05-05 12:58:18.000000
MOST_LABORATORY	most_lab_light	0.930	2025-05-05 12:58:18.000000
MOST_LABORATORY	most_lab_gas	0.050	2025-05-05 12:58:18.000000
MOST_LABORATORY	most_lab_rain	2.680	2025-05-05 12:58:18.000000
MOST_LABORATORY	most_lab_fire	0.000	2025-05-05 12:58:18.000000
MOST_LABORATORY	most_lab_light	0.940	2025-05-05 12:58:24.000000
MOST_LABORATORY	most_lab_gas	0.040	2025-05-05 12:58:24.000000
MOST_LABORATORY	most_lab_light	0.950	2025-05-05 12:58:33.000000
MOST_LABORATORY	most_lab_rain	2.700	2025-05-05 12:58:33.000000
MOST_LABORATORY	most_lab_light	0.980	2025-05-05 12:58:40.000000
MOST_LABORATORY	most_lab_rain	2.680	2025-05-05 12:58:40.000000
MOST_LABORATORY	most_lab_fire	1.000	2025-05-05 12:58:40.000000
MOST_LABORATORY	most_lab_light	0.950	2025-05-05 12:58:49.000000
MOST_LABORATORY	most_lab_rain	2.690	2025-05-05 12:58:49.000000
MOST_LABORATORY	most_lab_fire	0.000	2025-05-05 12:58:49.000000

Table 3: MOST Entrance Station detection test data during deployment

Location	Sensor	Value	Timestamp
most	most_temperature	29.000	2025-05-05 12:12:48.000000
most	most_humidity	65.000	2025-05-05 12:12:48.000000
most	most_humidity	64.000	2025-05-05 12:15:38.000000
most	most_light	0.000	2025-05-05 12:15:38.000000
most	most_temperature	33.000	2025-05-05 12:58:08.000000
most	most_humidity	57.000	2025-05-05 12:58:08.000000
most	most_light	2.000	2025-05-05 12:58:08.000000

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Table 4: Data captured in real-time at the combined MOST Lab, MOST 1, and MOST Stations during deployment as recorded in the semaphore SMS database.

Show 100 entries Search:

SENDER NAME	RECIPIENT	MESSAGE	COST	LENGTH	SOURCE	TYPE	LENGTH	STATUS	DATE
ProfondoR	639153386388	⚠ HIGH TEM...	1	86	Api	Single	86	Sent	2025-05-05 3:08 pm
ProfondoR	639153386388	⚠ UV ALERT...	1	70	Api	Single	70	Sent	2025-05-22 6:58 am
ProfondoR	639177034385	⚠ HIGH TEM...	1	86	Api	Single	86	Sent	2025-05-05 2:58 pm
ProfondoR	639458527155	⚠ HIGH TEM...	1	86	Api	Single	86	Sent	2025-05-05 3:08 pm
ProfondoR	639458527155	⚠ UV ALERT...	1	70	Api	Single	70	Sent	2025-05-22 6:58 am
ProfondoR	639662317370	⚠ ALERT...Loc	1	72	Api	Single	72	Sent	2025-05-05 12:51 pm
ProfondoR	639922354703	⚠ HIGH TEM...	1	86	Api	Single	86	Sent	2025-05-05 2:57 pm
ProfondoR	639954794401		1	0	Webtool	Single	0	Refunded	2025-05-05 2:11 pm
ProfondoR	639954794401	⚠ ALERT...Loc	1	72	Api	Single	72	Sent	2025-05-05 12:51 pm
ProfondoR	639954794401	⚠ HIGH TEM...	1	86	Api	Single	86	Sent	2025-05-05 3:08 pm
ProfondoR	639954794401	⚠ HIGH TEM...	1	86	Api	Single	86	Sent	2025-05-05 2:57 pm
ProfondoR	639954794401	⚠ TILT ALER...	1	45	Api	Single	45	Sent	2025-05-05 2:36 pm
ProfondoR	639954794401	⚠ TILT ALER...	1	78	Api	Single	78	Sent	2025-05-05 2:40 pm
ProfondoR	639954794401	⚠ TILT ALER...	1	45	Api	Single	45	Sent	2025-05-05 2:20 pm
ProfondoR	639954794401	⚠ UV ALERT...	1	70	Api	Single	70	Sent	2025-05-22 6:58 am

Showing 1 to 15 of 15 entries Previous 1 Next

RESULTS, FINDINGS AND DISCUSSIONS

Considering the null hypothesis" *H0: there are no significant differences between firing a rule at a particular time and firing multiple rules simultaneously at a specific time in the knowledge-based system's inference engine as far as the following*":

1. LATENCY.

Discussion:

Based on the IoT and Knowledge-Based Building Security Automation System, the experimental results demonstrated effective real-time multi-sensor data synchronization across three monitoring stations. Simultaneous detection events were observed on May 5, 2025, involving humidity, temperature, PIR, Tilt, light, gas, and rain sensors, indicating stable and concurrent data acquisition. The study further established that employing a semaphore database as the Working Memory (WM), as recommended in Konar's cognitive knowledge-based model (2000), significantly enhanced system responsiveness compared to the conventional domain database. This configuration enabled direct bulk SMS alert broadcasting via the ESP32-C6 controller, efficient real-time threshold detection, and automatic alert generation. Additionally, the system successfully incorporated short-term and long-term memory decay algorithms alongside conflict resolution mechanisms, aligning with knowledge-based architectural principles. Overall,

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the architecture exhibited robust performance in maintaining continuous data flow and intelligent decision-making, even under simultaneous multi-sensor load conditions.

DETAILED ARTICULATION

I) SIMULTANEOUS MULTI-SENSOR DATA DETECTION

The study reports multiple detection events occurring almost at the same time across three different monitoring stations:

Table 5: Multiple detection events occurring simultaneously in three different stations

Station	Timestamp	Rows (Data Index)	Sensors Detected Simultaneously
MOST 1 Station	20250505, 13:41:54	Rows 1–4	Humidity, Temperature, PIR (motion), Tilt
MOST Lab Station	20250505, 12:58:18	Rows 1–5	Humidity, Temperature, Light, Gas, Rain
MOST Entrance Station	20250505, 12:58:08	Rows 5–7	Temperature, Humidity, Light

II) KNOWLEDGE-BASED SYSTEM (KBS) IMPLEMENTATION

The system uses a Knowledge-Based Architecture inspired by A. Konar (2000), which models cognitive processes found in human intelligence — specifically working memory (WM), short-term memory (STM), and long-term memory (LTM).

Key finding:

Using a semaphore database as Working Memory (WM) performs more effectively than relying on the domain database for real-time decision handling.

This makes sense because:

- Semaphore databases are good for handling synchronization and concurrent access.
- Acting as WM allows it to buffer, prioritize, and dispatch sensor events immediately while preserving consistency.
- The domain database (long-term repository) is more suitable for historical data or offline analysis and visualization.

III) SYSTEM PERFORMANCE

The setup achieved:

- Bulk SMS broadcasting through the ESP32-C6 microcontroller based on real-time sensor activity.
- Real-time threshold detection and alert generation.
- STM/LTM data decay algorithms to emulate memory aging and maintain data relevance.
- Conflict resolution rules, following Konar's KBS design principles, ensure priority-based response when multiple sensor alerts occur simultaneously.

This setup mimics cognitive reasoning — using STM for current sensor events, LTM for learned thresholds/knowledge, and WM for current session operations.

IV) CONNECTIVITY AND ONLINE PERFORMANCE

It was noted:

"The domain database performs real-time only when the browser is online."

That means:

- The domain database is part of a web-based or cloud-dependent system.
- The local semaphore database ensures the IoT system continues to function even offline, offering resilience and continuous automation without network dependency.

INTERPRETATION IN CONTEXT

This implementation demonstrates an intelligent IoT-Knowledge-Based architecture that satisfies real-time automation requirements using a biologically inspired model.

Table 6: The human-like intelligence of the system resulting from the implementation of IoT-Knowledge-Based architecture

Component	Function	Inspired by
Semaphore DB (WM)	Real-time event handling	Human Working Memory
STM Algorithm	Temporary storage + decay	Cognitive short-term recall
LTM Algorithm	Persistent learned rules	Human long-term knowledge
Conflict Resolution	Decision-making	Cognitive reasoning
ESP32C6 Controller	Sensory interface	Neural sensory system

IN ESSENCE

The system effectively:

- Detects multi-sensor data simultaneously and processes it efficiently.
- Uses cognitive AI architecture (A. Konar, 2000) to manage real-time operations.
- Combines IoT hardware, smart databases, and AI-based knowledge structures for autonomous and adaptive building security automation.

1. Accuracy and coherence of output directives/advices/device activations for BARMM compound constituents by the system's intelligence or KBS:

2. Alarm system

Discussion:

This study found that the system demonstrated a high degree of reporting accuracy, particularly when MOST 1 Station detected threshold readings of ultraviolet (UV) light along with other critical parameters from the various monitoring stations. These detections were successfully transmitted in real time via SMS to registered mobile numbers, confirming the reliability of the system's automated alert mechanism. Additional test results further validated the system's ability to deliver timely and accurate SMS reports for threshold events across multiple sensors and stations, as illustrated in Figure 6.

VOICE OVER

Discussion:

The researchers have limited this to SMS only and found it effective and economical.

MONITOR THE DISPLAY SYSTEM OF BARMM.

Discussion:

This study has leveraged the clients' smartphone display screens to make the information available anytime, anywhere, and found it practical and effective.

THE POLICE/FIRE DEPARTMENT RECEIVED COMMAND/INFORMATION.

Discussion:

The authors can actually register phone numbers of the Police/Fire department at the knowledge-based system (KBS) center for inclusion of SMS ALERTS, but this is an option left to MOST.

ACTUAL DEVICE ACTUATION

Discussion:

For security and regulatory considerations, the authors have deferred the full implementation of this feature for future research, as it would require formal authorization from the appropriate BARMM government agencies. For example, a water-level sensor integrated into one of the monitoring stations is designed to detect critically low water levels in the waste management facility and automatically activate a solenoid valve to restore the water supply. Once the optimal water level is achieved, the same sensor deactivates the valve to prevent overflow. All related operations are intended to be reported in real time through a bulk SMS–based Semaphore database integrated within the knowledge-based system architecture (https://semaphore.co/). However, implementing this automation protocol would necessitate close coordination with facility personnel and careful consideration of administrative and technical compliance requirements. Therefore, this feature is recommended for further exploration in subsequent studies to ensure both operational reliability and regulatory alignment.

EMERGENCY SOUND

Discussion:

For practical reasons, this feature is limited to SMS alerts only using the Semaphore platform (https://semaphore.co/), which the authors found to be both practical and effective.

Following the development and deployment of the system, the authors determined that the null hypothesis of the study was accepted. Specifically, the hypothesis stating that there are no significant differences between the firing of a single rule at a particular time and the simultaneous firing of multiple rules at a specific time within the knowledge-based system's inference engine, in terms of latency as well as the accuracy and coherence of output directives, advisories, and device activations for BARMM compound constituents was supported by the results.

CONCLUSIONS

The study revealed that Figures 3 (MOST 1 Station), 4 (MOST Lab Station), and 5

(MOST Entrance Station) recorded multiple simultaneous sensor detections on May 5, 2025. Specifically, readings were captured at 13:41:54 for humidity, temperature, PIR, and tilt sensors; at 12:58:18 for humidity, temperature, light, gas, and rain sensors; and at 12:58:08 for temperature, humidity, and light sensors. Despite the concurrent detections, no latency issues were observed within the knowledge-based inference engine. This finding confirms that the ESP32-C6 controller is capable of handling up to eighteen analog-digital converter/digital-analog converter (ADC/DAC) sensor types simultaneously (see Fig. 1).

System accuracy and coherence were attributed to the seamless interaction between the sensory-motor subsystem and the knowledge-based subsystem—two integral components of the overall system architecture (see Fig. 1 and Figures B-1 to B-8). The sensory-motor subsystem captures and transmits environmental data, which is then evaluated by the knowledge-based subsystem against predefined production rules to trigger corresponding actions. Once the threshold conditions are met, SMS alerts are automatically generated and transmitted via the Semaphore SMS gateway (Semaphore, n.d.), ensuring timely and reliable information dissemination.

Overall, the experimental findings confirm that the proposed IoT-based knowledge architecture for intelligent security effectively enables continuous environmental monitoring within the MOST-BARMM headquarters. The prototype demonstrates high reliability, responsiveness, and scalability, positioning it as a strong model for potential application across other regional facilities.

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Above all, to God be the glory.

APPENDICES

List of Figures with their Captions

A. HARDWARE CIRCUIT DESIGNS

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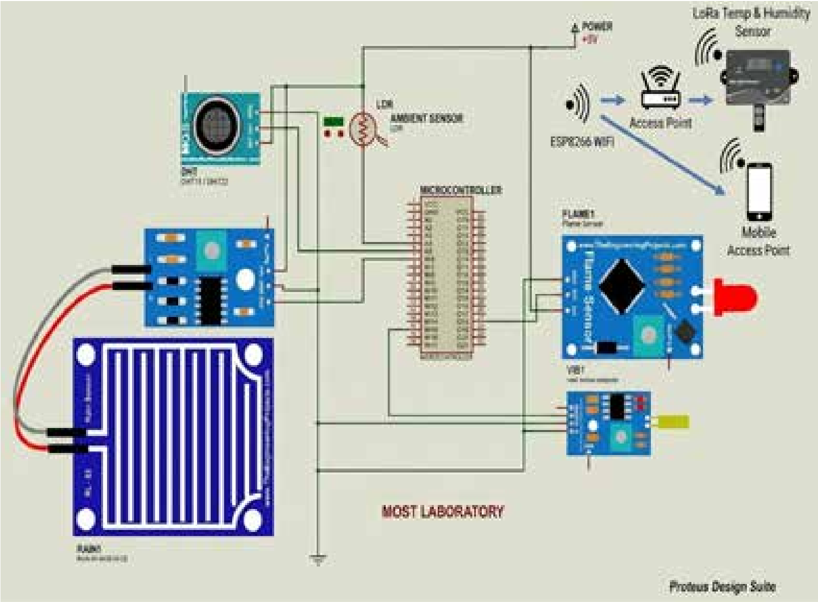

Figure A-1: MOST Laboratory Station Module Sensory Motors

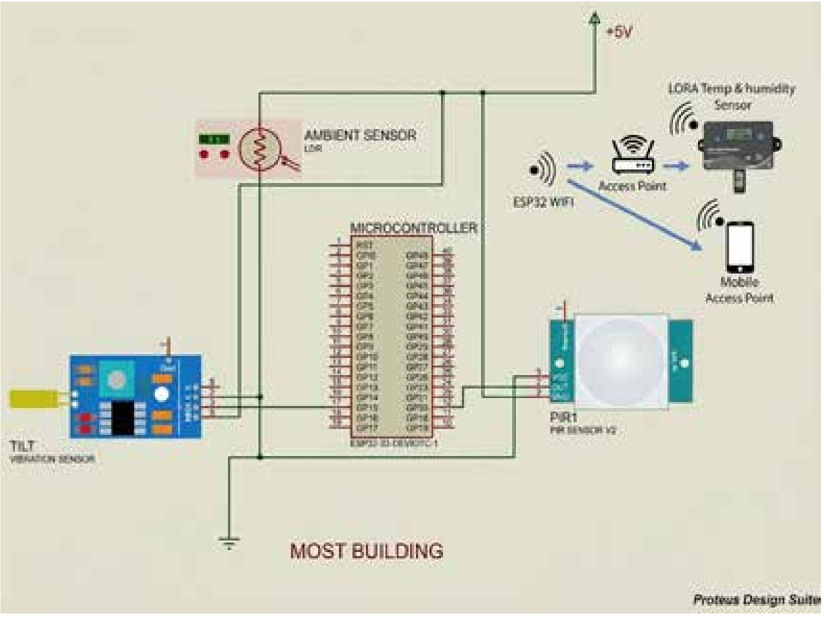

Figure A-2: MOST Building Station Module Sensory Motors

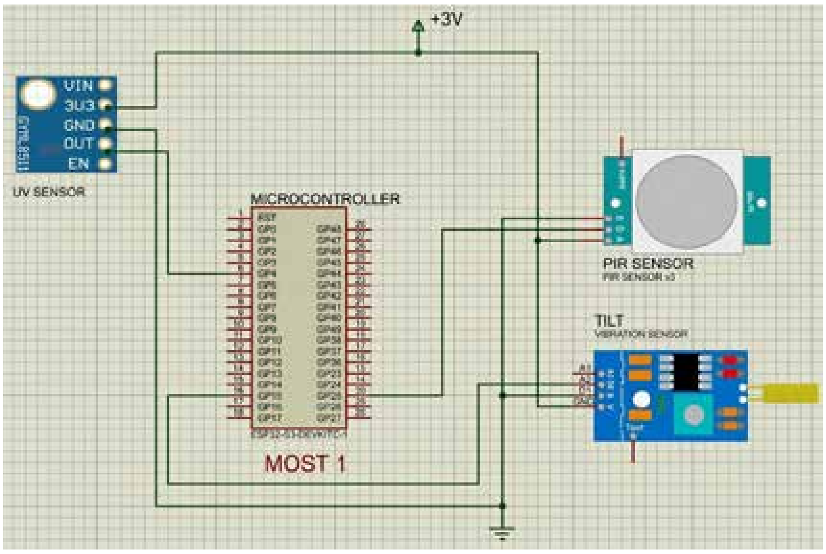

Figure A-3: MOST1 Station Module Sensory Motors

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B. SENSORY MOTOR ALGORITHMS

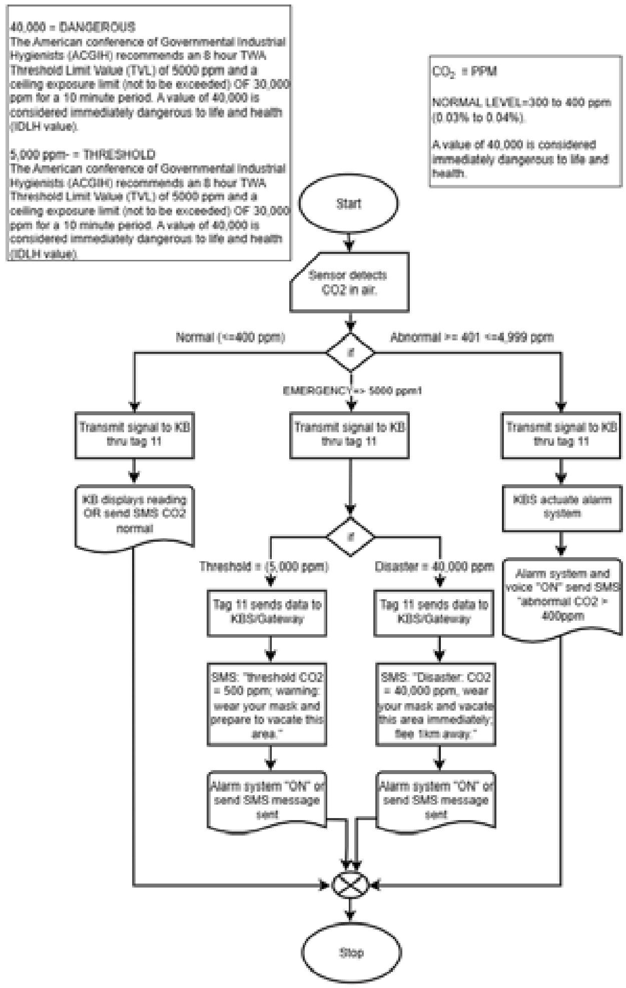

Figure B-1. CO2 Sensor Algorithm

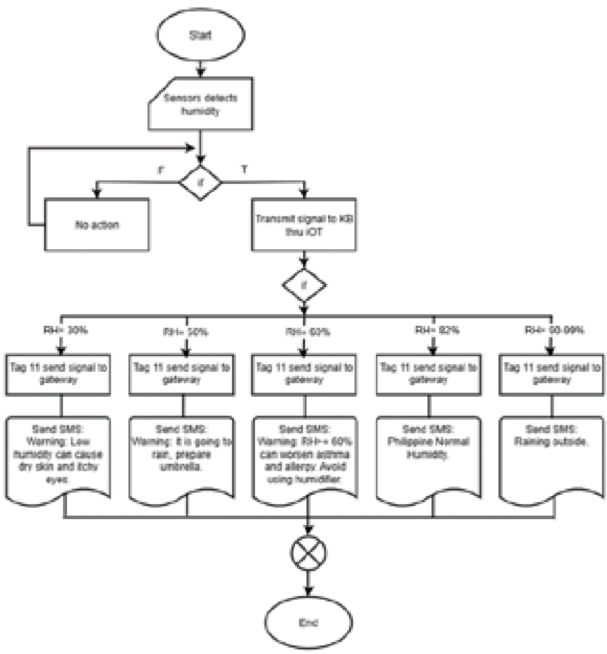

Figure B-2. Humidity Sensor Algorithm

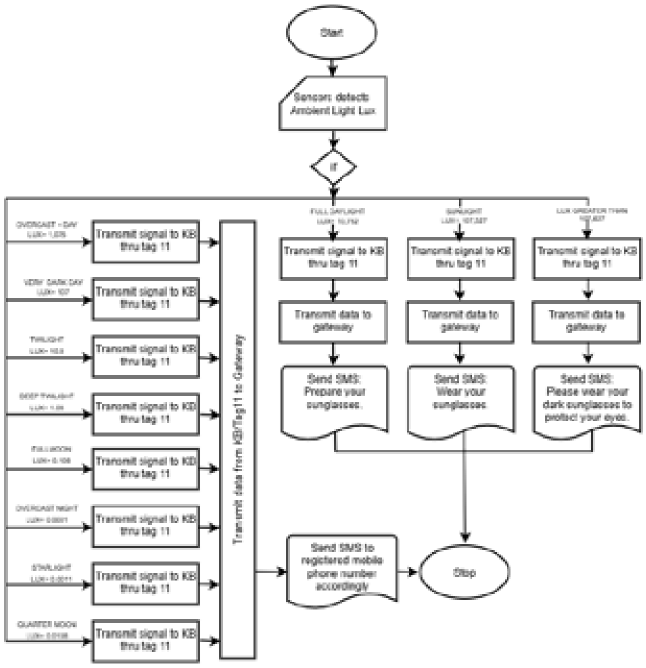

Figure B-3: Ambient Light (Lux) Algorithm

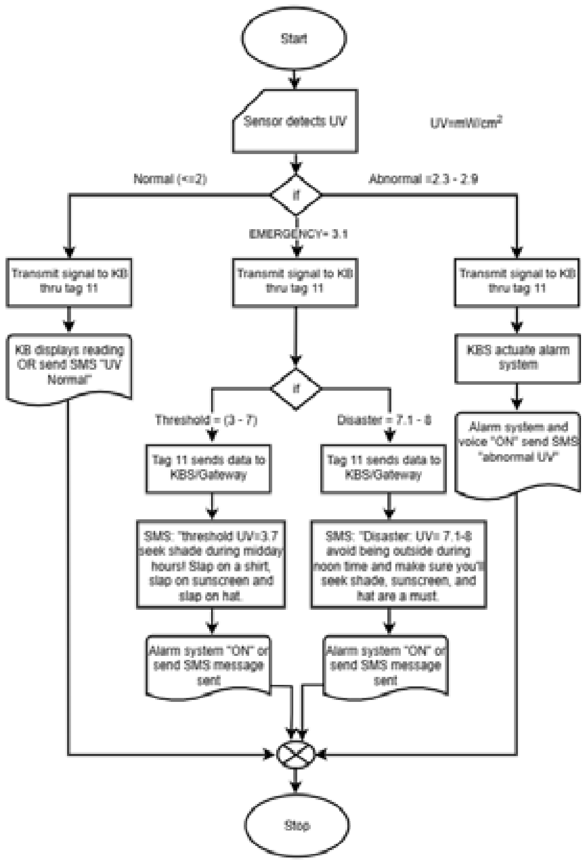

Figure B-4: UV Light Sensor Algorithm

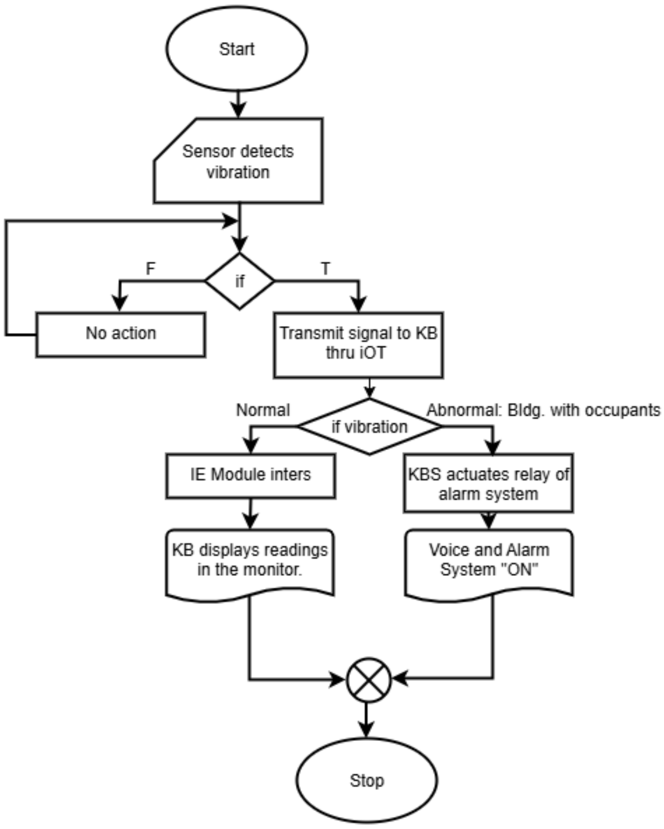

Figure B-5: Algorithm: Outdoor Vibration Sensor/Accelerometer

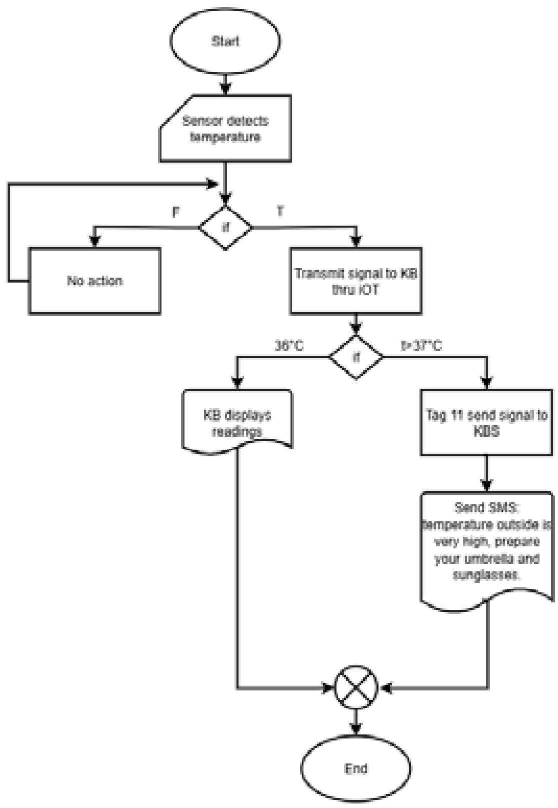

Figure B-6: Temperature Sensor Algorithm

http://dx.doi.org/10.21622/ACE.2026.06.1.1825

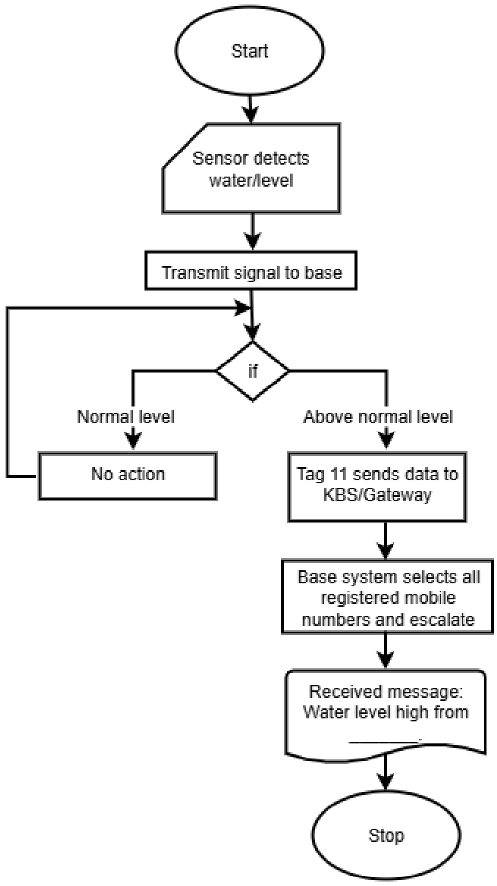

Figure B-7: Water /water level Sensor Algorithm

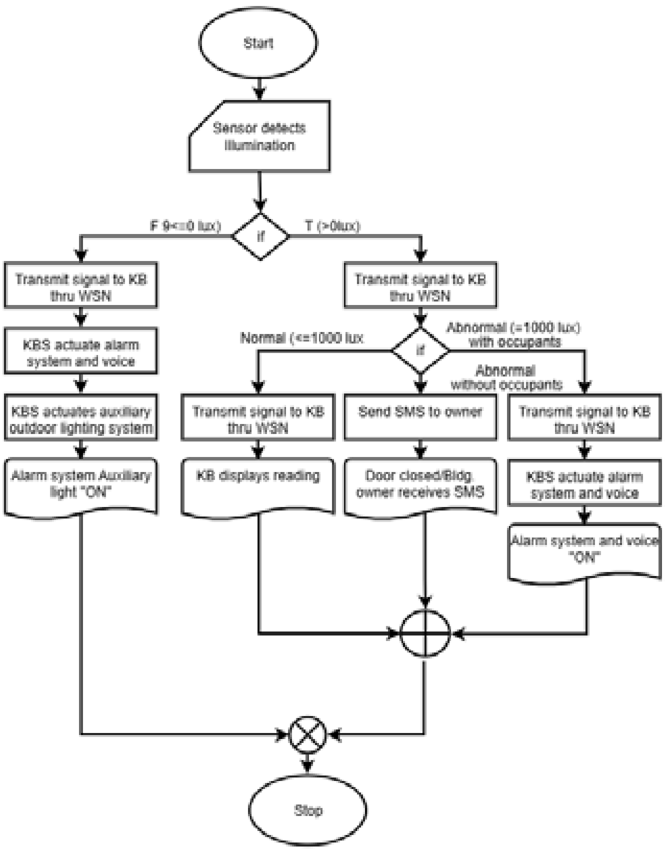

Figure B-8: Algorithm for Light Sensor Night Operation

http://dx.doi.org/10.21622/ACE.2026.06.1.1825

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