

# iAMR: Intelligent Auto-Dispenser Mosquito Repellent System

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**Abstract.** Dengue fever has become an increasingly significant health threat worldwide. Currently, due to lack of specific treatment or vaccine against dengue, vector control, which is available in many forms, remains a key strategy for dengue fever prevention. Hence, we introduce an iAMR: Intelligent Auto-Dispenser Mosquito Repellent, an innovative system in line with “Industry 4.0” concept where it includes current trend of automation and data exchange. It also includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing. The iAMR solves the issues of when to spray (by auto-spray using sensor) and long live batteries (with LORAWAN technology). When combined with the mini aerosol (X’MOS), it provides an even more effective mosquito control. This all-in-one system ensures a mosquito-free environment in your home. The iAMR device relies on the microcontroller and sensor in order to operate the intended spraying task. The microcontroller used is an IoT based device called ESP8266 which is a WiFi-embedded microcontroller that utilized standard everyday WiFi band frequency which is at 2.4 GHz. A DC geared motor sensor for dispenser device is used. The main contribution of iAMR is to monitor and track for the mosquito repellent (X’MOS) to be refilled. The implementation shows the iAMR system able to update the level of each X’MOS in iAMR devices which reducing the cost of manual human checking for X’Mos refill.

**Keywords:** dengue, auto-dispenser, mosquito repellent, motor sensor, ESP8266 microcontroller

## 1. Introduction

Dengue fever is a mosquito-borne tropical disease caused by the dengue virus from *Aedes aegypti* mosquito. The dengue symptoms are detected starting in three to fourteen days after infection. Dengue is severe and may affect infants, young children and adults, but seldom causes death. Because of its severity, the global efforts are always put in urgent matters. Many products on preventing dengue have been used in the market. In this paper, we introduce the auto-spray dispenser specially made for combating *Aedes* mosquito that constitutes to dengue disease. This work is a collaboration between

higher academic institutions and the industry that is directly involved in this vector-borne disease. The objective of this research is to provide a solution for fighting Aedes that is a main contributor of dangerous dengue disease by applying IOT technology. Research on Industry 4.0 or IR4.0 is trending for Z generation. Many emerging domains of fields especially medical, engineering, agriculture, marine and fisheries, automotive and computing and robotics require the demanding technologies to replace labor operational energy and cost.

The rest of the sections includes Section 2 for our related works on smart iot dispensing system, Section 3 illustrates our iAMR projects, Section 4 explains the experimentation being done, Section 5 describes on the result and discussion and Section 6 recapitulates the conclusion and future works.

## **2. Related Works**

Agricultural Robot (Agribot) is developed by [1] that capable of doing activities of ploughing, seed dispensing, fertilizing and harvesting. They utilized the Arduino UNO microcontroller with the Wifi module whereas the other components include DC motor (control the wheels), stepper motor (control the seeds), relay board (control various activities) and a pump motor for an automatic flush and shut-off spraying and spreading the fertilizer. Effort by [2] proposed a wireless robot with various sensors for measuring different environmental parameters. The robot is developed with Raspberry Pi 2 model B hardware for executing the whole process. The main feature is to execute tasks such as moisture sensing, scaring birds and animals, spraying pesticides, moving forward or backward and switching ON/OFF electric motor. The work by [3] aims at providing the Automated Medical Aid due to the high rate of death as the results of poor hospitality and medical services by the authority. The project used the components such as Raspberry Pi 3, temperature sensor (DS18B20), Load cell to measure weight, load cell amplifier (HX711), that is a 24 bit analog to digital converter (ADC), a pulse sensor to measure the heart rate, pressure sensor, servo motor for a vending machine with 360 degree rotation and SG9U SERVO that can rotate in 180 degree of rotation.

The four modes of communications define in [4] are wireless system, power line systems, hardwired systems and internet protocol systems. The authors developed the prototype of Smart Home Controlled System (SHCS) using Arduino IDE platform (APC220 wireless module and Ethernet W5100) and sensors like ultrasonic, Passive InfraRed (PIR) sensor, gas and temperature sensor. The experimental results show SHCS was successfully tested in the prototype as well as real environment. The results indicate very low error percentage and has improved the traditional home since the SHCS can be controlled through IOT or smartphone. The next section illustrates our iAMR in detail with the components that we use during project development.

An effort is initiated to present a holistic conceptual approach of an IOT system development and implementation to enhance bathroom safety [5]. The components that could be used as suggested are leak detection sensor to detect leakage at floor, digital light/LUX sensor to measure intensity of light radiation, voice detection sensor to detect acoustic and noise signals, pressure sensor to detect magnitude of contact pressure that able to detect person's status using toilet and bath tub, positional sensor (GYRO/Accelerometer/Magnetometer) to detect tilt, pitch and inclination, motion sensor to detect movement or water flow sensor to detect water leakage. The paper demonstrates tremendous potential IOT especially for bathroom safety for elderly.

## **3. Project Description**

In this section we discuss how the iAMR project is initiated with the collaboration of the product component from industry.

### *3.1. Project background*

The iAMR project is a blended technology of auto spray dispenser, Aedes mosquito repellent and IOT equipment. The iAMR Dispenser is a product manufactured by DrMOS Healthcare Sdn. Bhd, the X'MOS spray is an Aedes Mosquito Repellent from On Team Network Sdn. Bhd. while the IOT equipments are ESP8266 WiFi-embedded microcontroller and the motor sensor. The components used are the iMOS dispenser with X'MOS spray, Node MCU ESP8266 Module as the Arduino microcontroller, DC Geared Motor for pressing the spray lid and the LoRaWAN [6] gateway for data transmission in cloud environment. These components are depicted in Figure 1 to Figure 4.



**Figure 1.** The iMOS dispenser and the X'MOS in iAMR project



**Figure 2.** Node MCU ESP8266 Module



**Figure 3.** DC Geared Motor – 12V (10 to 1000 RPM)



**Figure 4.** LoRaWAN gateway

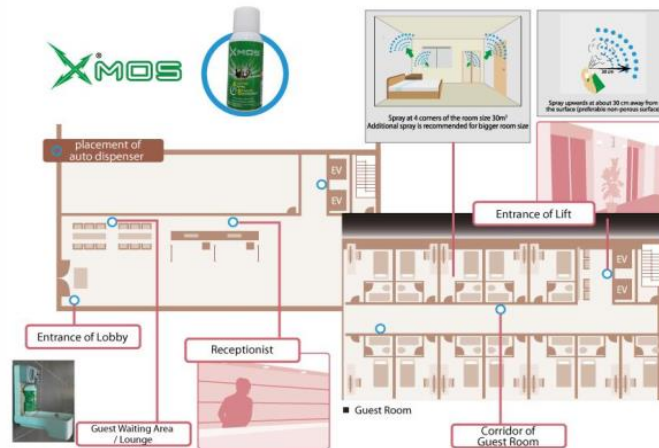
### 3.2. Setting Area for iAMR installation

After installing the iAMR, customers can enjoy the life without mosquitoes at home. Most wonderful of iAMR is, after a period of use, all the insects in the house, including cockroaches and ants, will stay away from home. For a 250ml of X'MOS, it could cover up to 300 ft. But it depends on the spraying frequency with the setting area of the location (room, living room or office area). The proposed setting time and area location of these combination is given in Table 1.

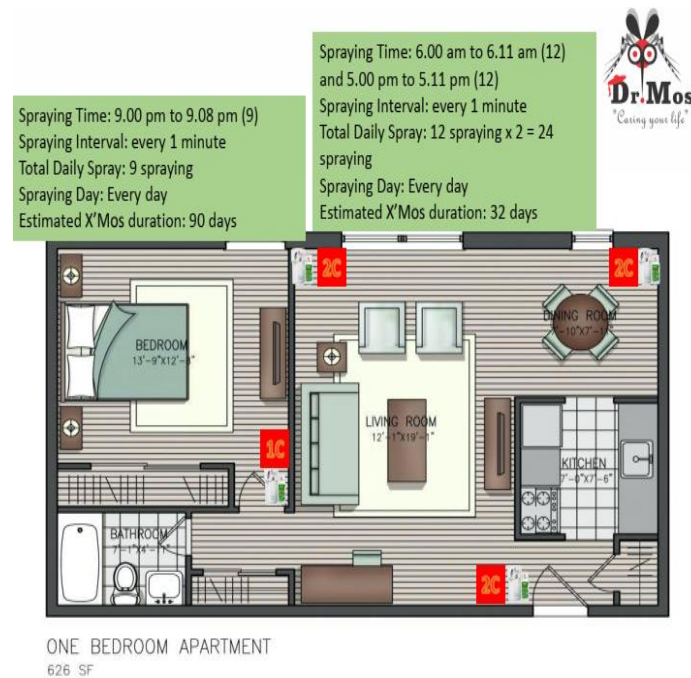
**Table 1.** Proposed setting for iAMR spray interval

| Room Type<br>(No of iMos to be installed)                                         | Start Time                | End Time                  | Spray Interval                         | Xmos Exchange interval (day) |
|-----------------------------------------------------------------------------------|---------------------------|---------------------------|----------------------------------------|------------------------------|
| Living Room (1)                                                                   | A: 6.00 am<br>B: 5.00 pm  | A: 6.12 am<br>B: 5.12 pm  | 1 min (12 sprays)<br>1 min (12 sprays) | 33 days                      |
| Kitchen (1)                                                                       | A: 6.00 am<br>B: 5.00 pm  | A: 6.12 am<br>B: 5.12 pm  | 1 min (12 sprays)<br>1 min (12 sprays) | 33 days                      |
| Bed Room (1)                                                                      | A: 9.00 pm                | A: 9.12 am                | 1 min (12 sprays)                      | 66 days                      |
| Kindergarten/ day care<br>*entrance (1)<br>*back door (1)<br>*each class room (1) | A: 6.00 am<br>B: 12.00 pm | A: 6.12 am<br>B: 12.12 pm | 1 min (12 sprays)<br>1 min (12 sprays) | 33 days                      |
| Office<br>*entrance (1)<br>*back door (1)<br>*each room (1)                       | A: 6.00 am<br>B: 12.00 pm | A: 6.12 am<br>B: 12.12 pm | 1 min (12 sprays)<br>1 min (12 sprays) | 33 days                      |

Because of the manual operation, then a few precautions need to be undertaken to ensure the optimum effects (as referred in Figure 5 to Figure 7). The precautions include first, record the installation date, and pre-set X'MOS exchange date as reminder in dealer's smart phone calendar. Second, must check battery after 10 months. Third, must estimate the area of premises where 1 unit of iAMR for every 300 square feet. Fourth, to remind customer do not switch on the exhaust fan after the iAMR spraying time. And lastly, the iAMR should be set at the entrance (door) or near the window at about 6" (inches) from the ceiling.



**Figure 5.** The illustration of iAMR installation in a building



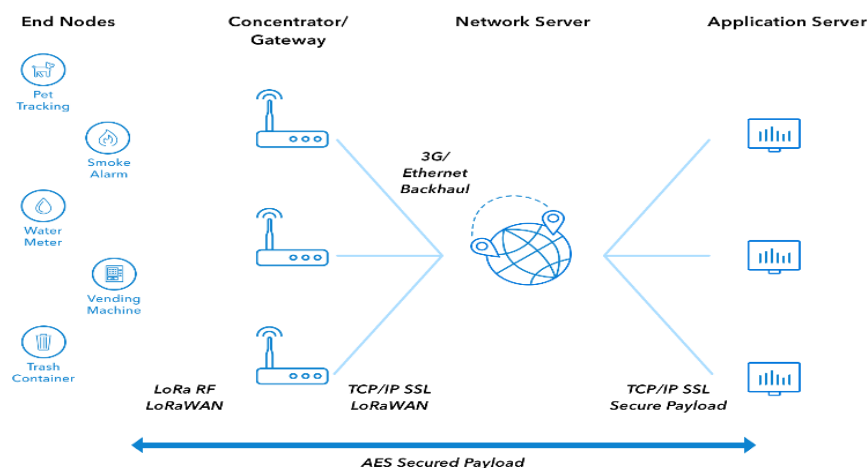
**Figure 6.** The illustration of iAMR installation in an apartment



**Figure 7.** The illustration of iAMR installation in a bungalow

### 3.3. iAMR Network Architecture

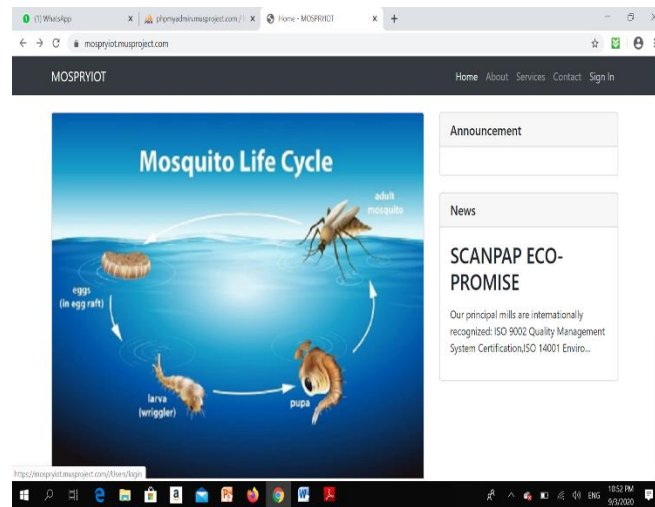
The LoRaWAN® is a Low Power, Wide Area (LPWA) networking protocol designed to wirelessly connect battery operated ‘things’ to the internet in regional, national or global networks, and targets key Internet of Things (IOT) requirements such as bi-directional communication, end-to-end security, mobility and localization services (refer to Figure 8). It is based on star-of-stars topology in which gateways relay messages between end-devices and a central network server. The gateways are connected to the network server via standard IP connections and act as a transparent bridge, simply converting RF packets to IP packets and vice versa. The wireless communication takes advantage of long range characteristics of the LoRaWAN physical layer, allowing a single-hop link between the end-device and one or many gateways. The LoRaWAN® band rates range from 0.3 kbps to 50 kbps [6].



**Figure 8.** LoRaWAN network architecture deploys for iAMR

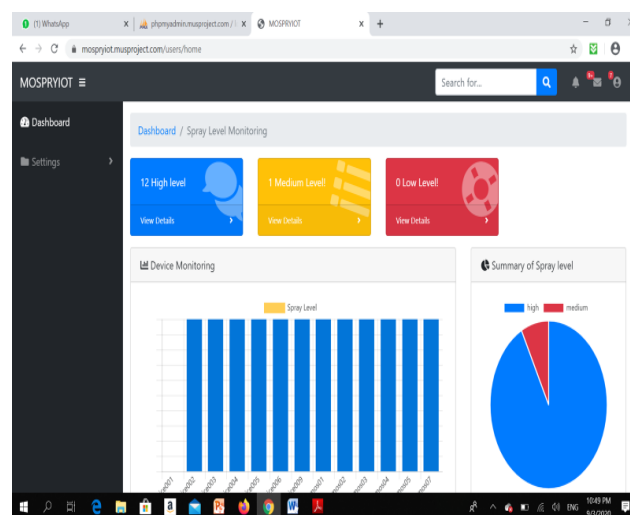
## 4. Experimentation

The iAMR system is developed with open source programming language which is Php and MySQL Database Management System with Xampp control engine. The URL is <https://mospriot.musproject.com>. The snapshot is given in Figure 9.



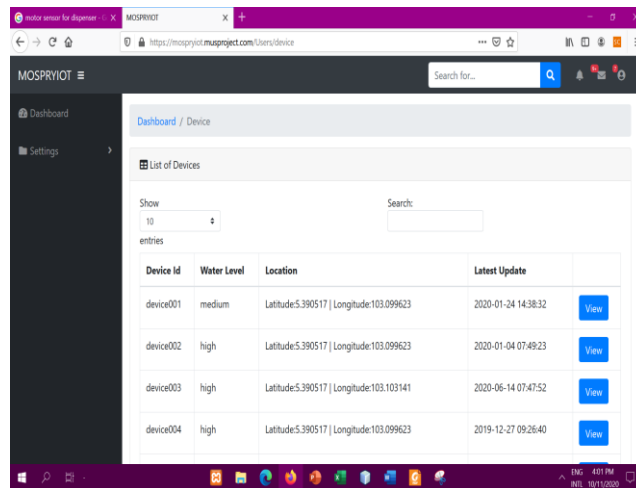
**Figure 9.** Main screen of iAMR system

When clicking on the dashboard, the status of X'MOS spray is forecasted using different color scheme i.e. Blue for high level of spray, Yellow that indicates the medium level of spray and Red in color for low level of liquid in X'MOS spray. This is shown in Figure 10.



**Figure 10.** The level of liquid in X'MOS spray

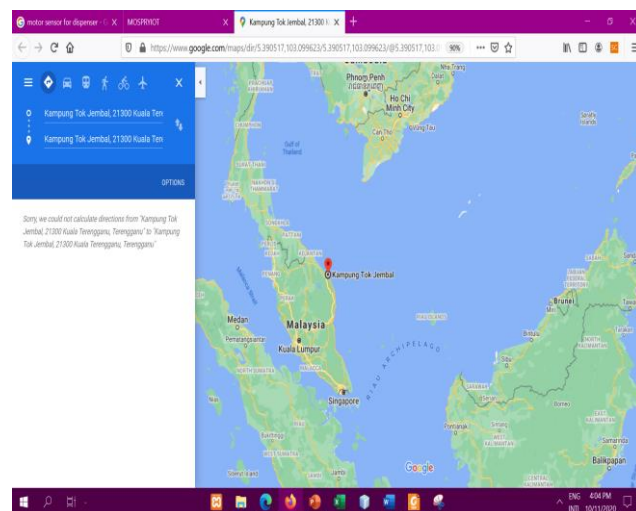
Basically, when the level is getting LOW by red color, then we can click on the View Details to see the location by longitude and latitude as in Figure 11. The details consist of device id (iAMR device id), the water level (in cm), the location, the date and time and the View button.



| Device Id | Water Level | Location                                 | Latest Update       |                      |
|-----------|-------------|------------------------------------------|---------------------|----------------------|
| device001 | medium      | Latitude:5.390517   Longitude:103.099623 | 2020-01-24 14:38:32 | <a href="#">View</a> |
| device002 | high        | Latitude:5.390517   Longitude:103.099623 | 2020-01-04 07:49:23 | <a href="#">View</a> |
| device003 | high        | Latitude:5.390517   Longitude:103.103141 | 2020-06-14 07:47:52 | <a href="#">View</a> |
| device004 | high        | Latitude:5.390517   Longitude:103.099623 | 2019-12-27 09:26:40 | <a href="#">View</a> |

**Figure 11.** Details location of the iAMR device

When we click on the View button it reaches us to this google maps page as in Figure 12.



**Figure 12.** Google Maps showing the iAMR exact device location

## 5. Result and Discussion

Our experimentation using LoRaWAN communication has achieved a success with a compact communication device can cover for long read range of communication data. This is attained by the iAMR dashboard where we can see the level of X'MOS spray and the battery are still on for a long period of time. On the other hand, the issue with the battery sustainability where the investigation is still continues on finding the right solution to sustain the long- lasting battery.

## 6. Conclusion

To resolve, we have two options i.e. first, we can use the battery in our iAMR or secondly, we can use direct current (DC) for the iAMR to continue its operation ability. Only when using DC, we have to investigate on the cost of the electricity bills charged from the usage. For future work, we would test on the different types of battery and try to come out with the cost analysis of electricity usage.

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### **References**

- [1] ArunaG G G and AnbuNivetha V 2017 Internet Of Things Based Innovative Agriculture Automation Using AGRIBOT *International Journal of Electronics and Communication Engineering* ISSN pp 2348-8549
- [2] Lokesh K K et al 2017 Internet of Things application for implementation of smart agriculture system 2017 *International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC)* IEEE pp 54-59
- [3] Kumar R and Rajasekaran M P 2016 January An IoT based patient monitoring system using raspberry Pi 2016 *International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE'16)* IEEE pp 1-4
- [4] Gunawan T S et al 2018 Performance evaluation of smart home system using internet of things *International Journal of Electrical and Computer Engineering* 8 no 1 pp 400
- [5] Koo D D et al 2016 An Internet-of-Things (IoT) system development and implementation for bathroom safety enhancement *Procedia Engineering* 145 pp 396-403
- [6] LoRa Alliance 2021 LoRawan from <https://lora-alliance.org/about-lorawan> Accessed on 27 May 2021