The First Idea of N-Aelads Technology

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---**ABSTRACT**--
The Aedes mosquito can grow rapidly which only takes about several days. One of the methods to eliminate the mosquitoes effectively is by killing the mosquitoes during the larvae stage.The main purposed of this product is to reduce the effort and time consumption for detecting the dengue larvae while reducing the number of dengue fever patients in all around the world. This product is originated by two combinationsof proposed vectors transmission reduction methods from World Health Organization (WHO) which are environmental management and chemical control respectively. Hence, this product contributes to generate a new dimension of Aedes control method that would be known as Aedes Technology Control Strategy. In this proposed system of Aedes larvae detection, the self-made hydrophone is used as a sensing element to detect the frequency of larvae in the water. Water means the environment of Aedes larvae to growth up while the focus area is the residential water storage tank. The difficulty of accessing the indoor larvae habitats of Aedes such as in water storage tank has been highlighted by WHO correspondingly. The hydrophone is using raw materials and can be immersed directly in the water. Thehydrophone can detect a slight stir in the water tank (sound wave frequency), the signals from hydrophone will be transmit to the switching circuit and processing unit. The processing unit transfers the signals to the data presentation unit which is represented by a strobe light while auto sprayer that consists of pesticide is diffused to the water in order to kill the larvae respectively. The pesticide Bacillus Thuringiensis (BT) type is used in this system because it is not affected the human body. In order to support green scheme that has been announced all around the globe, solar panel has been used to power up this system significantly. Thus, it could enhance the energy saving while contribute to the reduction of CO_2 emission accordingly. Nevertheless, others online power input can be plugged in order to power on the device. The successfully of this product commercialization would give some contributions to many countries in the world that has been affected by burden of dengue cases. Meanwhile introducing Malaysia as one of the innovative leading country to solve the dengue cases by using new proposed technology technique.

Keywords–*AedesLarvae Detector, hydrophone, Bacillus Thuringensis.*

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I. INTRODUCTION

Mosquitoes have been around since the prehistoric era. Their bites cause irritating and painful sensation during the feeding of female mosquitoes. Besides that, the mosquitoes can be dangerous to human and animals because there are a few mosquito species are carrying of fatal diseases such as chikungunya, malaria and dengue fever [1]. For an instance, the transmission of dengue fever by Aedes mosquitoes can prove fatal towards human and animals. Nowadays, the most deadly animal in the world is mosquito. It might seem impossible that something so tiny and weak can kill so many people, but it is true. By referring to the World Health Organization (WHO) statistic, mosquito bites can kill more than one million peoples every year [2]. Therefore, it is important to control and eliminate the Aedes mosquitoes from the early stages [3]. When the mosquitoes in adult stage, it is free to fly around and bites the human. Therefore, it is difficult to kill the mosquitoes when they are in adult stage. Hence, the best time to eliminate the mosquitoes is during the larval stage, when they are still in water and cannot fly freely in the air. Nowadays, as we know there are many methods to kill the mosquitoes such as chemicals, sprays at the affected area by Aedes and etc. But, by using the chemicals methods, it can harm the environment and marine life. It is a complicated process that takes a long time and difficult to know the right place where the mosquitoes have been live in the large of area, especially on murky place. Therefore, it is better to have specific methods or system that can cover a large area to control mosquito breeding.

In this work, aAedes larvae detector system is proposed which is a hydrophone sensor that use to detect the appearance of larvae sound wave in the water and pesticides as the output to kill the larvae simultaneously. This proposed system is capable to detect and kill Aedes larvae as well as reducing the effort and time consumption when detecting the dengue larvae in critical area such in water storage tank in residential area. It is hoped that this product will give an alternative technique to the community, in order to reduce cases of dengue and malaria fever which can kill the patients, which make them free from dengue.

II. LITERATURE REVIEW

Aedesaegypti eggs counting system by using Ovitraps:

The behavior of Aedesaegypti is strictly urban, and it is rare to find of their eggs or larvae in water reservoirs in the forest. The Aedesaegypti eggs are laid millimeters above water surface (Fig. 1), in places such as empty cans, bottles, tires, gutters and pots of plants. The eggs of mosquito can resist up to one year without contact with the water. Hence, when it rains, the water level rises, comes into contact with the eggs which hatch in just over 30 minutes. In only five to seven days, the larvae will go through with four different growing stages giving rise to a new mosquito. Then, the cycle of larvae depends on the breeding containing standing water for their development [4]. Therefore, in order to kill the mosquito, the dengue control should be done with attention to environmental hygiene, sanitation, and education communities. The methods use is Ovitraps on the statistical analysis of Aedesaegypti population grows [5], [6]. Ovitraps are special traps to collect the mosquito eggs. Each Ovitraps can collect more than 1000 eggs; therefore Ovitraps can contribute to the reduction of Aedesaegypti population. Next, every four weeks, the palettes are replaced with the new one. The former palettes are collected by health agents and taken to an Egg Count laboratory installed in each municipality. With a slow counting technique, palettes accumulate and the mosquito eggs start to fall out the palettes, which affects subsequent counting. The eradication of Aedesaegypti is considered practically impossible on account to population growth, occupation of the environment and the lack of infrastructure in large cities [7], [8].

Fig. 1: (a) Aedesaegypti mosquito, (b) the mosquito eggs, (c) its larvae stage

Laser-Based Mosquito Repelling Module:

The effective ways to protect human from killer mosquitoes, we need to study about the nature of the mosquito and its surrounding environment. First, one of study showed that high mud temperature in range of 40-48°C could reduce the viability of mosquito eggs [9]. Moreover, a higher mud temperature could almost stop the mosquito's eggs from hatching. Besides, the thermal stress in water also could affect the hatching rate from 9S% down to 1.6%. Next, a higher water temperature also produced smaller adult mosquitoes with infertility because the study shows that the mosquitoes prefer to stay on a moderate environmental temperature [10], [11]. For instances, mosquitoes show strong avoidance at high temperature of 30°C 10 times more intense than their avoidance at low temperature at woe and air temperature above 40°C could also kill the mosquito. In an optical point of view, a low optical power laser beam can be pinpointed to gradually eradicate the mosquito [12]. It is amazing that a very strong pulse ultraviolet or infrared laser equipped with a fast mosquito tracking and a fast laser scanning mechanisms can also instantly shoot down the mosquito or disable its important organs such as wings, eyes, and antennae [13]. Expanding this high energy pulse laser beam can create a wall of light for mosquito prevention with surprisingly little understanding about the reasons behind it. These laser-based concepts had a good performance but it required high-tech components such as a high-energy and power-hungry pulse laser, an image processing systems, and a fast laser scanning system.
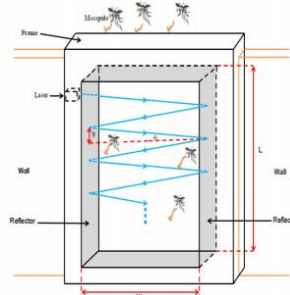

Fig. 2: Proposed laser-based mosquito repelling module

Using Ultrasonic for Detection of Larvae:

Mosquito larvae will sink down below the surface of water instinctively whenever they detect any disturbances in the water ripple. The theory behind the movement of the larvae is due to the change of resonant frequency of the breathing tube when the larvae are immersed in water and when the larvae are at the surface of the water. If ultrasound frequency matching the resonant frequency of the breathing tube of larva submerged in

water is emitted, then, the breathing tube of the larva will vibrate and this causes "discomfort" to the larva. To relieve this discomfort, the larva has to change the resonant frequency of its breathing tube and one way is by rising to the surface of water. Next, the PZT crystal will be submerged into the water thus a proper insulation essential. Silicone gel for aquariums proved to be a better solution in the end. Even so, for safety reason, the insulated PZT crystal was tested with multi-meter before every experiment to ensure that it is properly insulated. The hydrophone is used to detect the sound emitted from PZT crystal and it is connected to the charge amplifier to amplify the signal detected by hydrophone. When PZT crystal is generating ultrasound it is actually vibrating and the silicone gel protection will be broken after some time. The maximum amplitude of ultrasound frequency detected by hydrophone is only around 15 mV whereas the input voltage is 40 V. There is a significant reduction in sound strength as stated in [14]-[16].

Residual bioefficacy of diflubenzuron (Dimilin®) against larvae of Aedesaegypti (Linnaeus) in Kuala Lumpur, Malaysia:

Aedesaegypti (Linnaeus) is a cosmo-tropical mosquito as well as the most important domestic vector for dengue and urban yellow fever [17], [18]. There are several approaches can use to control the mosquito populations: biological control, physical control, chemical control, source reduction and integrated vector management [19]. Although there are many options to control the mosquitoes, the applications of chemical are still in primary strategy. The important role in the control of insect vectors of disease since early 20th century is insecticides. The using of Insect growth regulators (IGRs) to control the Aedes and other mosquito is increase. Insect growth regulator is a substance that interferes with the normal development or growth of insects and these compounds are often selective and do not persist in the environment [20]. Dimilin® (diflubenzuron), 1-(4-chlorophenyl)-3-(2, 6-difluorobenzoyl) urea, is an insect growth regulator that inhibits the synthesis of chitin and hence interferes with molting. Mosquito larvae treated with diflubenzuron fail to completely shed the old cuticles or molt, or have soft weak cuticles that cannot protect them, and die soon after ecdysis in the pupal stage or during eclosion of adults [21]. Diflubenzuron WP has been used to control mosquito larvae since the mid-1970 at the WHOPES (WHO Pesticide Evaluation Scheme) recommended dosages of 25- 100 glha. Unfortunately, the remarkable ability of insect population to evolve resistance to every class of insecticide that has been developed often leaves control programs with few insecticides option [22]. Robertson & Pope and Ogg et al. reported that freezing and excess heat can shorten the shelf life of insecticides and direct sunlight also will degrade the insecticides [23]. [24]. However, the degradation rate of the insecticide by sunlight and heat in this trial was not studied and remained unknown. The Dimilin® WP formulation mixed well with the water and did not give rise to any turbidity in the water. However, due to the mode of action of IGR, the treated larvae will still be present and alive and this may discourage use of IGR in the control of the Aedes larvae. This is because in certain countries, the presence of Aedes larvae is ground for the enforcement officers to take legal action against the house owners in spite of the application of IGR in the containers, since the larvae are still active until affected by the chemical later on. Thus, the user and the enforcer should be educated on the use of IGR [25].

III. METHODOLOGY

In this study, since the product use the stand alone power source of solar. The flow functionality of the product is divided into 2 parts which are power supply flow chart and the measurement flow chart. The product used solar source in way to power the functionality of sensor to detect the larvae of the mosquito. The flow chart sequences of the power supply are explained as Figure 3 below:
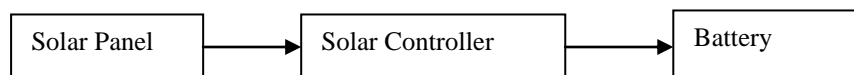
Solar Panel → Solar Controller → Battery

Fig. 3: Process Flow of the power supply

A. Solar *Panel*

The product use solar panel in order to function. The solar panel produces the maximum voltage of 18V, maximum current of 1.11A and 20W of power.

B. Solar Controller

The solar controller circuit is used to control the charging and discharging of the battery. Below is the schematic of the solar controller circuit:
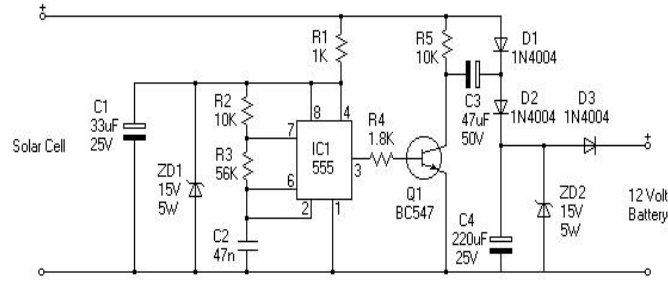
Fig. 4: Solar controller circuit

The rundown of the circuit, D3 stops current from flowing out of the battery and back into the circuit. The purposed of putting D3 is to prevent from the losses while battery is charging. Meanwhile, the zener diode 2 (ZD2) will clamp the voltage at 14.3V. If the batteries are fully charge, the solar panel will try to bring them above 14.3V. So, the ZD2 will give the protection to the charged battery where to avoid the battery from over charging. Pretty much the rest of the circuit is a capacitive doubling charge pump into C4. The other capacitors and resistor are used to charge up the voltage whereby the timer 555 is functional as the hard switch. Except for the R4, it is used to produce the small amounts of current that will flow at the base of BJT, and then BJT can operate well. This operational circuit is very important in order to protect the lifespan of the battery.

C. Battery
The battery is also known as the 'battery bank'. The purpose of used battery in this product is to ensure that the operational circuit of the sensor can perform well by gaining constant continuous power supply. This is because the 'renewable source' of solar cannot be accessed by all day long.
The input for flow chart is solar source; meanwhile the output is power supply that produces by the battery, in order to power the measurement circuit.
In measurements, there consist of several elements. The flow chart sequences of the measurement are explained as Figure 5 below:
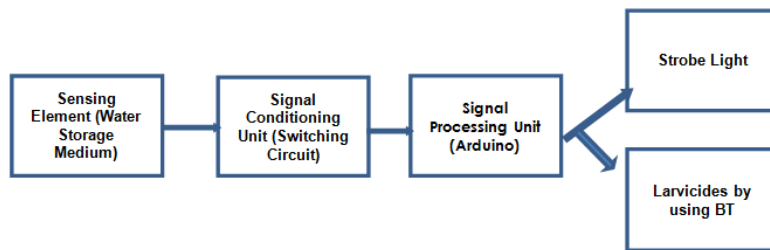

Fig. 5: The block diagram for the sensor

A. Hydrophone
The hydrophone that implant in this study is used self-made hydrophone which it develop by the raw materials. This hydrophone is functioned as sensor to detect the small movement under water. The equipment that need to build this hydrophone are a meter of bundling microphone wire, a mic condenser, a tube of rubber gloves, a cable tie and mineral oil. The soldered wire of microphone wire with mic condenser first is place inside the rubber gloves filling with the mineral oil. Then, the rubber gloves are sealed with the cable tie to avoid from water mixing with the mineral oil. The use of the rubber gloves instead of bottle is to increase the sensitivity of the sensor to detect the small movement in the water.

B. Switching Circuit
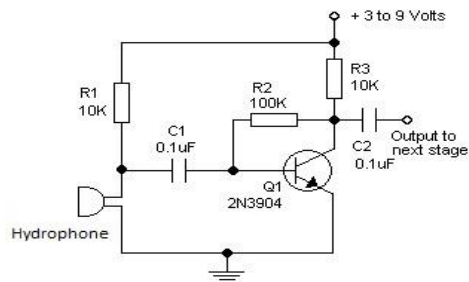Below are the configuration of switching circuit that applied as the signal conditioning element:

Figure 6: Configuration of switching circuit

In Figure 6, the hydrophone precisely produce very small amount of voltage. Thus, it gives difficulty to signal processing interpreted the data. In the circuit configuration show that the resistor and capacitor used to amplify the input voltage that produces by hydrophone so that it meet requirement for signal processing performed. The BJT used in the circuit is act as the switching to complete the circuit. The output that produces by the circuit then connected to the arduinouno for further processing.

C. Arduino Uno

The arduinounohas played role as the signal processing elements. By receiving the data from the amplifier circuit, then the data is interpreted by the coding that burn in arduinouno. Below are coding that implant in arduinouno to run the functionality of the proposed product:

```
intsensorPin = A0; //read values
intledPin = 13; // select the pin for the LED
intsensorValue = 0; // variable to store the value coming
intautoSpray = 12;

void setup() {
pinMode(sensorPin, INPUT);
pinMode(ledPin, OUTPUT);
pinMode(autoSpray, OUTPUT);
Serial.begin(9600);
}
void loop() {
sensorValue = analogRead(sensorPin); // read the value
Serial.println(sensorValue); // print de value

if (sensorValue>223) { //compare the value
digitalWrite(ledPin, HIGH);
digitalWrite(autoSpray, HIGH); //turn the led on
delay(5000); //wait 50ms
digitalWrite(ledPin, LOW);
digitalWrite(autoSpray, LOW); //turn the led off
}
}
```

The functionality of the signal processing is followed by the coding sequences that burn inside arduinouno.

D. Strobe light

Strobe light is used in the project to indicate the movement of the water. It played main role for the data presentation element. To power the strobe light, it needs at least 12V of power supply. Since arduinouno only produce 5V, relay is used to switch the connection of strobe light to 12V power supply so that it can perform the alarm of Aedes larvae detector.

E. Automatic sprayer

Automatic sprayer is used to kill the Aedes larvae in the water. When the sensor detects the movement in the water, the arduinouno will be sent the signals to the strobe light and automatic sprayer to take the actions as the strobe light will be turn ON and the automatic sprayer will be triggered on and spray the pesticide into the water. The suitable pesticide that used for control larvae Aedes is Bacillus Thuringiensis (B.t). This pesticide must be eaten by insects to be effective and works by interfering with digestion. Insects are most sensitive to B.t. when they are larvae, an immature life stage. This pesticide is not effect to human body after ingested a B.t pesticide. So this pesticide is suitable perform in auto spraying. In this study, both power supply and measurement system are working together synchronously. The purpose of solar panel is that to make the operation system can be stand alone.

IV. RESULTS & DISCUSSION

By used multimeter, the solar controller has given readout pictured of voltage at 14 V and current at 0.2 A. The best readout that it ever gives is 13.8 V for voltage and 0.32 A for current. It means that the maximum power output that can produce by the solar controller is 4.4 Watt. From this solar controller, the energy that produces by the solar panel is charging the battery. The purpose of placed solar controller between the solar panel and battery is to control the charging rate of battery so that the battery won't receive excessive power when charging.
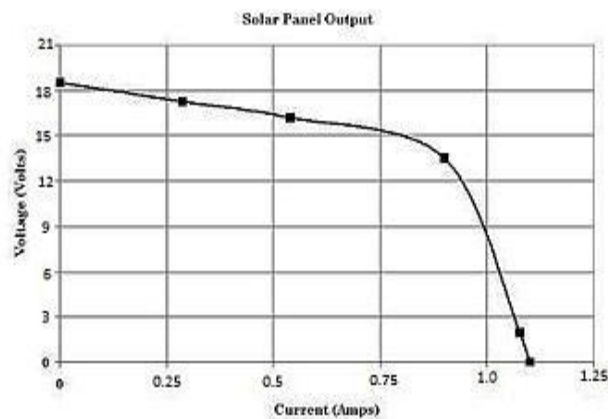
Fig. 7: Graph of voltage against current.

Figure 7 above shows the solar panel output. It shows the descending of the voltage as the current increase. It means that the voltage of the solar panel will be least when it produces high value of current.
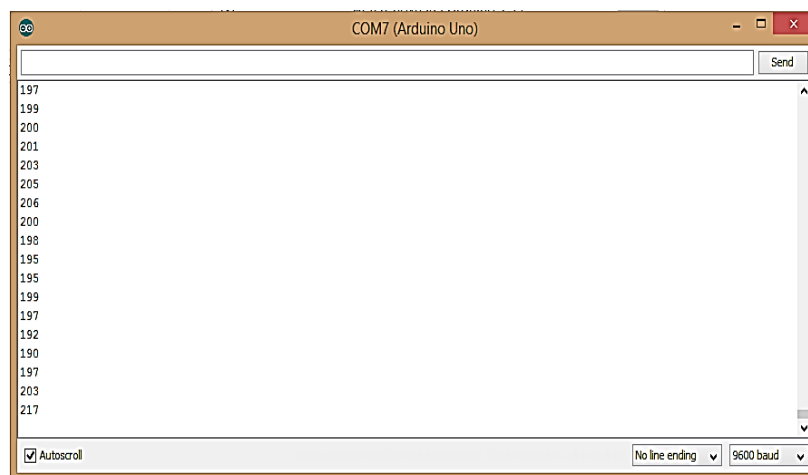

Fig. 8: Serial Monitor Analogue read.

Based on Figure 8, the serial monitor shows the analogue values of mic condenser perform in water, the serial monitor will reach up to certain value either increasing more than 215 sensor value. From serial monitor in Arduino Software, the mic condenser is detect the disturbance or voice in water around 217 analogue read. The mic condenser will trigger on at the output pin 12 and 13 in around 3.38 volts. By using a 3 volt DC relay connect to the output pin, the auto sprayer and the strobe light will turn on. Strobe light needs 12 volts while the auto sprayer needs 3 volts to trigger on. So the relay is suitable component to make the both equipment on. But since the output from Arduino is same, the current from the output pin Arduino cannot share for both equipment because it is supply small current. The coil of relay usually makes a small resistance to switch the circuit based on the condition either in normally close or normally open.

The circuits are basically changing the main idea because the performance of output in serial monitor is not stable. By placing the large size of capacitor to analogue read pin A0, the circuit is more stable for charging and discharging the input of circuit for analogue read. So the serial monitor will read the sensor more stable and then code for Arduino is easily to setting and control the whole circuit.

The relay will magnetize for half per minutes to hold the circuit for auto sprayer and strobe light functional. The strobe light is functional to display output for observer to detect the presence of larvae at reservoir tank for half per minutes. This device will turn on for 3 days because the larvae life on 4 days before transform to pupa. So the devices will functions based on this duration to detect the larvae. Then the auto spray will release the pesticide to tank reservoir to control the larvae Aedes.

Fig. 9: Hydrophone with different mechanism

The mic condenser perform usually operate in dry air condition, based on the experiment they are consist three type of design in mechanism to absorb the sound wave in more efficient and sensitivity because the 30 larvae Aedes only give around approximate 57.5kHz frequency. The sound wave perform in water is 4 times more than perform in dry air, so the design mic condenser in water must perform and synchronize with the sound of larvae Aedes to read the analogue signal in water. So the first experiment, the mic condenser are perform in a small plastic casing and immerse the mic condenser in water. The result for first design the mic condenser is damaged because the water is good conductor for electricity then the short circuit is occurred. Then the next experiment, the water are replacing with mineral oil referring past experiment, mic condenser are suitable immerse in mineral oil for absorb the sound of wave in water to make hydrophone. But the sensitivity for sound is low because the mechanism for hydrophone is not suitable when using a plastic case powder. Regarding from both experiment, the mechanism for sensor mic condenser must having a high sensitivity condition to detect the sound of wave in water. By replacing the plastic case powder with balloon or medical glove to make a sound wave can detect with high sensitivity. The objective the experiment achieved but the position mic condenser must be placing in small space in medical glove with mineral oil.
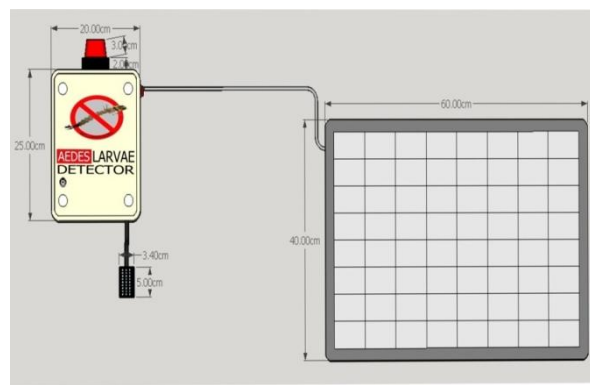

Fig. 10: Design Layout of the product

V. CONCLUSION

In this work, themethod to eliminate the mosquitoes effectively on larvae stage has been proposed properly. The successfully of this proposed technique will give some contributions to the community through reducing burden of facing dengue fever issue that can cause death. In order to get better result in future, the depth of water must be analyzedwhile extensive studies on what causes Aedes larvae to move up and down in the water have to be further explored accordingly. In the other hand, instead of using hydrophone to manipulate the movement of Aedes larvae in order for us to kill them, advanced technique can be used to detect mosquito larvae in murky waters by applying something similar to sonogram. Hydrophone is directed in the water and the echo is analyzed to check on the population of mosquito larvae in water bodies.

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