

# LASER-BASED DETECTION AND CLASSIFICATION OF MOSQUITOS

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- . 725,000+ deaths annually due to mosquitos
- . Over half the world population at risk (2018)
- . Half a billion people affected by Malaria, Dengue Fever and Zika every year



## Problems

- . Mosquitos are mobile with high reproductive capacity.
- . Prevailing diagnostic measures are slow.
- . Mosquito breeding sites are hard to track even for large organizations.

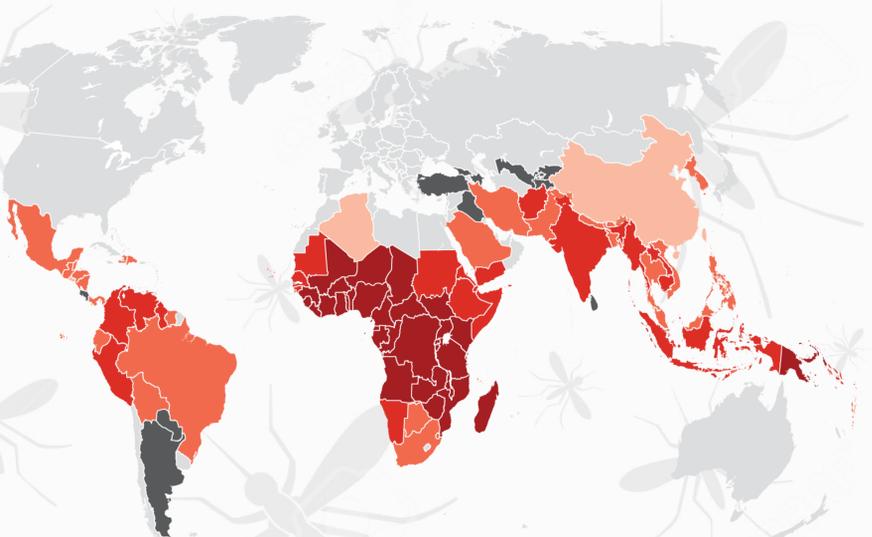


Figure 1: Global Map of Malaria Incidences (World Bank, 2015)

## Research Findings

Table 1: Research Findings

SN.	Observation	Inference
1	Different species of mosquitoes cause different diseases.	Determining the species of the mosquito is sufficient to determine the disease.
2	Each species has its characteristic wing beat frequency.	Knowing the wing beat frequency (WBF) is sufficient to know the species.
3	Infrared (IR) light is outside visible spectrum of mosquitoes.	IR Light can be used to detect mosquitoes without repelling them away.

“ The milestone of reducing case incidence and mortality rates by 20% by 2020 does not look attainable.”  
 - World Health Organization

## Solution

- . Autonomous system to attract, detect and classify mosquitoes based on their body size and wing beat frequency.

- . IR Diodes emit invisible laser beams in the infrared region.



- . NI MyRIO processes data to determine wing beat frequency.



- . NI MyRIO performs FFT and detects peaks in spectrum.

- . Lithium Polymer Battery allows durability per charge.



- . Power Distribution System ensures the compatibility of all components.

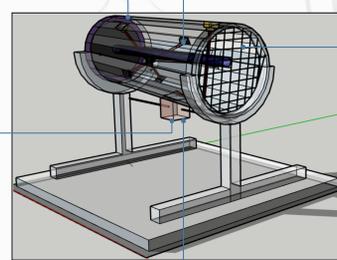
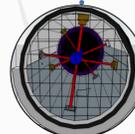


Figure 2: System Components and Design

- . High speed FDS photodiode records intercept patterns.



- . Patterns are due to the body and wing component of the mosquito.



- . Laser beam array is arranged to maximize interception.

- . Drone collects data periodically to minimize human intervention.



- . This allows off-site analysis to map WBF to species.

## Process

- . Mosquito intercepts the IR laser beam.



- . Signals in time are then captured and saved as frames.



- . Frequencies that are out-of-band are filtered using LPF.



- . The Fast Fourier (FFT) yields the signal's frequency spectrum.



- . Peak detection then yields the WBF and harmonics.



- . Lives are saved by preventing diseases.



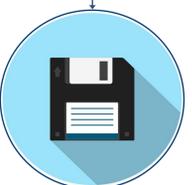
- . Pest Control is then notified for immediate action.



- . Data is mapped off-site to species and risk of disease.



- . Data is periodically transmitted to drone.



- . Data vector is saved to attached USB.

## Results and Evaluation

- . Time and Frequency domain response obtained by emulating mosquito movements.
- . The output is a steady voltage in the absence of a mosquito.
- . The body and wingbeat of the mosquito creates a pattern with a distinctive frequency spectrum.
- . WBF can be identified as 140 Hz for this sample.
- . Spectral Peaks are used to determine species of the mosquito and plot real-time evolving density map.

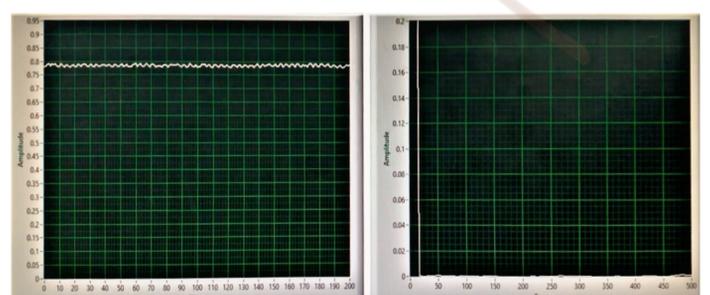


Figure 3(a): Waveform without Mosquito

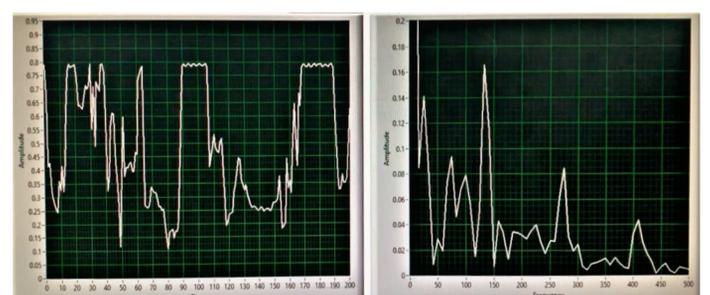


Figure 3(b): Waveform with Mosquito

Figure 3: Results in Time and Frequency Domain

### Strengths

- . Allows for real time, instantaneous classification.
- . New research avenues
- . A simple, scalable, and sustainable solution.

### Weaknesses

- . Battery to be replaced if no solar panel.
- . Sensitive to fluctuation in laser alignment.