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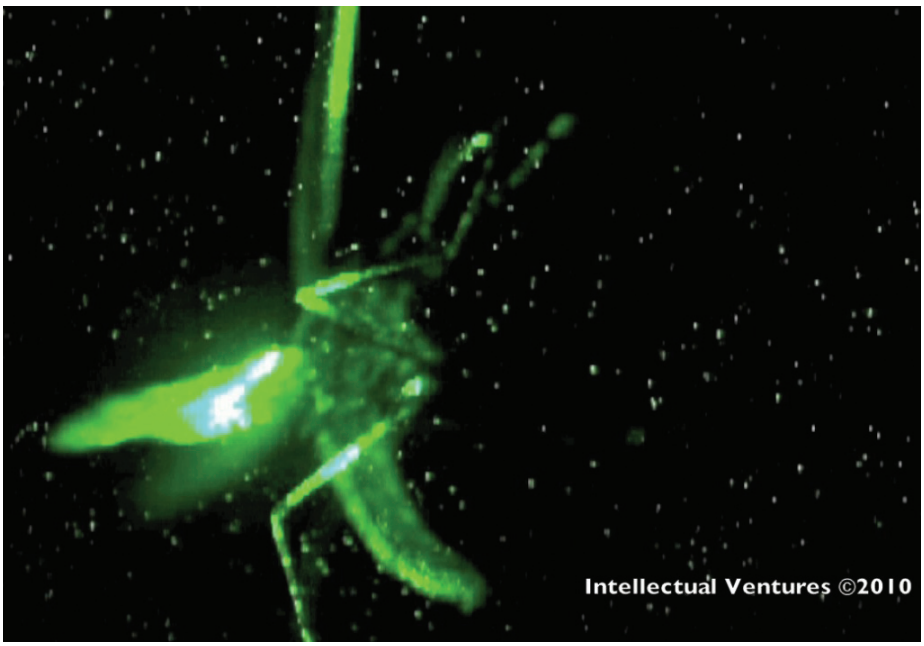
CASE STUDY

TAKING THE FIGHT AGAINST MALARIA DIRECTLY TO THE MOSQUITO



With the ability to record at almost 7,000 fps in 720p high-definition, the Vision Research Phantom v12.1 digital camera enabled Intellectual Ventures to reveal detail unseen to the human eye, never forcing the research team to sacrifice resolution for speed.

WHEN IT'S TOO FAST TO SEE, AND TOO IMPORTANT NOT TO®

VISION RESEARCH'S PHANTOM® CAMERAS TAKE THE FIGHT AGAINST MALARIA DIRECTLY TO THE MOSQUITO

Despite being preventable and curable, malaria is one of the world's most troubling epidemics. While it is not a disease that's close to home for those living in the United States, it tragically is for roughly 40 percent of the world's population. According to experts, Malaria is estimated to cause 300-500 million clinical cases and over 1 million deaths each year, most of which are children and most of which occur in Africa. Most alarming is that every 45 seconds a child in Africa dies of malaria.

With such grave statistics highlighting the impact that this disease has on humans every year, the need to act swiftly has never been greater. While efforts to date targeting the spread of malaria have been good - including treatment, bed nets, and insecticides - they haven't been enough to eradicate this disease and have a significant impact on reversing the amount of infections and deaths moving forward. This is where human ingenuity, innovation, technology and the inventors at Intellectual Ventures (*www.intellectualventures.com*) come into play.

In 2007, Bill Gates, in relation to the work being done at the Bill and Melinda Gates Foundation, approached Intellectual Ventures with quite a challenge – design new technologies which could be used to help fight and eradicate malaria. Recognized as the global leader in invention and innovation, part of Intellectual Ventures' mission is to develop inventions that address global issues, so this was a challenge that the company's dedicated research team was glad to accept. Intellectual Ventures' approach to eradicating malaria has included advancements in the diagnosis and treatment of the disease, the creation of artificial diets to kill mosquitoes and prevent the spread of infected blood, as well as an epidemiological modeling program designed to help monitor and better understand the spread of malaria in key areas of the world. As high-tech and advanced as these approaches are in the fight against malaria, the most prominent of Intellectual Ventures' inventions to help eradicate the disease is the photonic fence, a solution that leverages an advanced tracking system and lasers in killing mosquitoes.

The Photonic Fence: Fighting Malaria with Lasers

Intellectual Ventures takes pride in its out-of-the-box thinking, and with inventors on staff who were directly involved with the Star Wars defense program of the 1980s, shooting down mosquitoes in mid-air using lasers was a concept that many quickly backed and felt had a very real chance for success as an applicable solution in the eradication of malaria. Instrumental in the beginning stages of the development of the photonic fence was the understanding of just how mosquitoes fly, and crucial to this research was the use of the Vision Research Phantom v12.1 digital high-speed camera.

"The Phantom v12.1 is a fantastic camera and an essential component in many of Intellectual Ventures' research projects," said 3ric Johanson, project scientist with Intellectual Ventures. "In regard to our malaria research, the use of this camera provided a number of revelations and gave us the ability to visualize things which have never been seen before, specifically relating to the flight characteristics of mosquitoes. By leveraging the speed and resolution of the v12.1, the Intellectual Ventures team was able to capture some impressive ultra-slow motion video which revealed that a mosquito moves through the air in a manner that's more akin to swimming than flying."

Intellectual Ventures' research team leveraged the performance of the Phantom v12.1 to analyze the extremely fast movements of a mosquito during flight. The physical movement of mosquitoes was recorded using an auto-trigger, which would commence the Phantom v12.1 to begin recording when a mosquito was detected entering the frame. Additionally, a technique known as particle image velocimetry (PIV) was used to gain a better understanding of the effect that a mosquito's wings has on the surrounding air.

The Phantom v12.1 is ideally suited for PIV applications thanks to its advanced, high-resolution timing system. The Phantom v12.1 yields a timing resolution of better than 20 nanoseconds and offers a frame synchronization signal through a dedicated BNC for easier cabling and increased signal integrity. A 500 nanosecond straddle time and no image lag also made the Phantom v12.1 an invaluable tool throughout this phase of the photonic fence research.

By using tiny suspended droplets of water which were illuminated by a green planar laser, Intellectual Ventures' researchers were able to get a clear and decisive understanding of

Phantom v12.1 - Sideview

the impact that a mosquito's wing movement has on the surrounding air. As a mosquito moved its wings, the illuminated water droplets would follow the flow dynamics of the surrounding air, allowing researchers to visualize the unique signature left by the insect. The Phantom v12.1 digital high-speed camera recorded these movements at speeds up to 6,000 frames-per-second (fps), providing the Intellectual Ventures team with data that would prove to be instrumental in the development of the tracking and laser system employed by the photonic fence.

* Click here for a high-speed video recorded by the Phantom v12.1, utilizing PIV to analyze the movement of a mosquito's wings: *www.visionresearch.com/go/mosquito*

The Result: Death by Lasers

As described by Intellectual Ventures, the photonic fence is essentially a fence made out of light. The photonic fence uses a series of LED lamps on fence posts which beam light at adjacent fence posts up to 100 feet (30 meters) away; the light would then hit strips of retroreflective material and bounce straight back toward the illuminator. A camera on each fence post monitors the reflected light for shadows cast by a hapless insect flying through the vertical plane of light.

When an invading insect is detected, software developed at Intellectual Ventures Lab identifies it by training a non-lethal laser beam on the bug, using that illumination to estimate the insect's size and also to measure how fast its wings are beating. Using this method, the system can not only distinguish among mosquitoes, butterflies, and bumblebees, but it can even determine whether a mosquito is male or female. This is useful because only female mosquitoes bite humans.

Once the photonic fence establishes a valid target, safety checks are performed to ensure no unintended object is in view, and a more powerful laser that zaps the mosquito is engaged, causing death either by damage to its DNA (an unconfirmed hypothesis by Intellectual Ventures) or by overheating. The energy levels and light frequencies used are not capable of damaging human tissue, but even so, Intellectual Ventures engineers have built in safeguards that ensure that the system doesn't fire when anything much larger than a mosquito is in the photonic fence.

* Click here for a high-speed video recorded by the Phantom v12.1, showing a mosquito being zapped in mid-air by the Intellectual Ventures photonic fence: *www.visionresearch.com/go/mosquito*

What's most impressive about the system is that it can be constructed from existing parts found in common household consumer electronics devices such as laser printers, Blu-ray disc writers, camcorders, and video game consoles. In fact, according to Intellectual Ventures, the working prototype of the photonic fence was constructed almost entirely from parts purchased second-hand on eBay and similar Web sites. The ability to utilize off-the-shelf technologies is an important component of the photonic fence as Intellectual Ventures' goal was to design a system that would be cost-effective and affordable enough for deployment in the mass-market sector as well as developing countries most effected by malaria.

** Photos & Video – Ryan Smith, courtesy of Intellectual Ventures*

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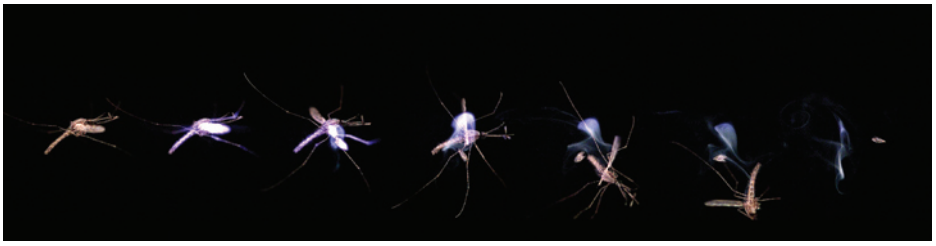
The Benefits of Digital High-Speed Video

The speeds at which these events unfold are extremely fast, taking place in roughly 1/10th of a second – faster than the blink of an eye – and further underscore the important role that high-speed video played in the research and development behind Intellectual Ventures' photonic fence.



"We were also impressed by the versatility of the v12.1," said Johanson. "The camera offers a number of triggering options which we were able to utilize in ensuring that we captured exactly the sequences we needed, a feature which proved to be invaluable especially when analyzing the effects of various levels of lethal and non-lethal photonic energy concentrated on the mosquitoes. The ability to quickly and easily offload these images also gave our team the ability to move quickly, which in our field is extremely valuable."

With the ability to record at almost 7,000 fps in 720p high-definition, the Vision Research Phantom v12.1 digital camera enabled Intellectual Ventures to reveal detail unseen to the human eye, never forcing the research team to sacrifice resolution for speed. With such resolution and frames to work with, Intellectual Ventures was not only able to better understand just how mosquitoes fly, but was also able to fine-tune the effectiveness and performance of the laser system in the way it targeted and eliminated a mosquito in mid-flight, putting the world one step closer to eradicating malaria for good.

About Vision Research:

Vision Research designs and manufactures high-speed digital imaging systems used in applications including defense, automotive, engineering, science, medical research, industrial manufacturing and packaging, sports and entertainment, and digital cinematography for television and movie production.

The Wayne, N.J.-based company prides itself on the sensitivity, high-resolution and image quality produced by its systems, robust software interfaces, and reliability and versatility of its camera family – all which continue to stand as benchmarks for the high-speed digital imaging industry.

Vision Research digital high-speed cameras add a new dimension to the sense of sight, allowing the user to see details of an event *when it's too fast to see, and too important not to®*. For additional information regarding Vision Research, please visit *www.visionresearch.com*.

Vision Research is a business unit of the Materials Analysis Division of AMETEK Inc., a leading global manufacturer of electronic instruments and electromechanical devices.

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