

Insect Killing using Laser

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Abstract— Insects are intimately connected to human life and wellbeing, in both senses and flying insects are common vectors for transmission of pathogens and inflict significant harm to humans and agricultural production in many parts of the world. In old method insects' detection, counting and killing is performed by sticky traps which are manually done, and these kinds of method are expensive and time consuming. We are developing an inexpensive optical sensor that uses a low-powered laser beam to detect flying insects from distance. While our ideas may have implications for monitoring beneficial insects, our more immediate objective is to use classification techniques to provide accurate real time counts of disease vectors down to the species/sex level. In this work, we present some preliminary results of our research, conducted with three insect species. We discuss how we can augment the sensor with other sources of information in order to scale our techniques to classify a larger number of species.

Index Terms— LASER Shooting, Insect identification, Insect detection, Raspberry pi Camera.

I. INTRODUCTION

For all human history, insects have been intimately connected to our health and wellbeing. For example, mosquito-transmitted malaria has plagued mankind for at least tens of thousands of years. Flying insects are common vectors for transmission of pathogens and inflict significant harm to humans and agricultural production in many parts of the world on other hand insects pollinate at least two-thirds of all food consumed in the world. Insect detection, counting and killing is usually performed by sticky traps which are manually done, and these kinds of methods are expensive and time consuming. The main aim of this project is to develop an inexpensive optical sensor that uses a low powered laser beam to detect flying insect from distance. Our more immediate objective is to use classification technique to provide accurate real time counts of disease vector down to the species/sex level. Our objective is to use inexpensive components such as laser pointer, phototransistor to build wing-beat sensor. In this method consumption of time is less and by using this the classification, detection, counting and killing can be performed in easy way.

II. LITERATURE REVIEW

Agricultural pest management can also be accomplished with LASER. Investigations have been done into the effectiveness of using lasers to kill or scare away pests. These experiments demonstrate the use of the thermal impact of the laser to harm or kill insects in laser-based pest management. Heat destroys the nearby exoskeleton and the interior tissue beneath it when the laser's irradiation intensity surpasses the epidermis's level of absorption.

Other laser methods are mostly used to treat adult pests, such flies, that cannot move on their own and require long-term irradiation. These pests are stored grain pests and pests that attack stored grains. The laser opening time for the control strategy, however, is only 1.117 s, and it directly effects larvae. With this strategy, crop killing can be accomplished.

III. THE PROGRAMMING AND SOFTWARE SPECIFICATIONS ARE

Python as the programming language

OpenCV library

Tensor flow platform

Jupyter ide and Pycharm ide

OPENCV: OpenCV is a Python package that enables the execution of image processing and computer vision operations. It offers a variety of capabilities, such as tracking, face recognition, and object detection.

In this project, we first use the OpenCV library to identify objects captured in real time by the camera, then we use the Tensor Flow platform to identify the desired object in the frame to create a machine learning/deep learning model. Once we have the necessary object, we need to train the AUR model with the aid of object tracking to direct the laser at the target.

IV. THE HARDWARE SPECIFICATIONS

We use the Raspberry Pi as an input and output device for our purpose, and we use the 4GB model because it functions like a little computer and is faster and more advanced than any other controller.

High resolution video and pictures of the bug on the soil are taken using a camera.

The Raspberry Pi receives the films and pictures taken by the camera module for processing and computation.

Servo motors, or "servos" as they are also known, are electronic devices and rotary or linear actuators that precisely rotate and push elements of a machine. In order to achieve a certain velocity or acceleration, servos are typically utilized for angular or linear position.

A laser diode is pointed at the bug using a servo motor.

A motor controller is used to drive the servo motor precisely and correctly. Close the loop on the system by continuously examining the encoder signal and applying a torque to the motor in order to regulate it is the responsibility of the servo motor controller, also known as the motion controller. Holding a particular position is the most basic variation of this.

The entire system we'll be using is battery powered. These alkaline batteries' lifespan is significantly shortened when used in digital cameras or other high-drain gadgets. The battery lasts a lot longer in laser pointers since they use significantly less power.

When using a laser diode to kill insects, focus it on the target and begin. Fiber optic communications, laser pointers, laser printing, laser scanning, and light beam illumination are just a few of the many applications for laser diodes, the most widely used form of lasers. Laser diodes can be utilized as general lighting by using a phosphor like that found in white LEDs.

To identify flying insects at a distance, we are creating a low-cost optical sensor that makes use of a laser beam. Despite the potential benefits of our theories for monitoring beneficial insects, our current focus is on using classification algorithms to offer precise real-time counts of disease vectors. We have developed a laser system automated by machine vision for eliminating and discouraging moving insect pests, which is an improvement over our previous strategy. The inherent dangers of off-target laser exposure are reduced by using the laser more quickly and selectively with machine vision guidance to locate things more precisely. A Jetson Nano single-board computer that uses deep learning techniques (neural networks) for this gadget controls the laser beam using galvanometer mirrors.

V. CURRENT LIMITATIONS

Understanding the spatiotemporal dynamics of insects is necessary for these techniques to function well. Traps are typically placed across the area to be monitored to detect insects. A typical kind of trap uses a sticky substance that never dries out and traps any insects that walk or land on it. These traps must be routinely gathered and manually examined by an expert. The main issue is that this process is costly in terms of resources and labor and causes a delay between the placement of the trap and its inspection. Even while this delay may just be a week, an adult mosquito can live for more than half that time.

VI. PURPOSED SOLUTION

In order to identify flying insects at a distance, we are creating a low-cost optical sensor that makes use of a laser beam. Despite the potential benefits of our theories for monitoring beneficial insects, our current focus is on using classification algorithms to offer precise real-time counts of disease vectors. We have developed a laser system automated by machine

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VII. SUMMARY

According to the study, laser irradiation is a physical control approach for insects. The most effective set of operating parameters for enhancing insect control performance was discovered by analyzing the 450 nm laser's controlling effect on insects and investigating the components that influence lasers (laser power, irradiation area, laser opening time, and irradiation location).

Following were the primary findings of the study:

1. The following was the best combination for obtaining the highest comprehensive score: Middle abdomen is the area that will be exposed to the laser's radiation; its size is 6.189 mm²; the laser's opening time is 1.177 s.
2. To confirm the experiment, the best combination determined by the observations was utilized. the antifeedant percentage of insects decreased after 24 hours, according to the results.
3. The experimental settings combined were appropriate for 1st to 5th instar insect life cycles, and the death rate of the 5th instar larvae at 36 hours was also 100%.

The findings demonstrate the effectiveness of laser irradiation as a non-contact, high-efficiency physical control technique for insects. The field evaluation of the control impact of laser irradiation against insects is necessary even though the high anti feedant percentage and mortality rate are excellent indicators of laser field success. We still need to learn more about how to apply this technology in processing facilities or in the field.

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