A problem is that the adult mosquito can be very active, and thus from the moment you classified its sex until you manage to do something it may have moved or flown away.

Also having other mosquitoes in the field of view may obscure the vision sensor. Sorting at the pupa, may lead to large collateral damage (meaning many dead males).

SUMMARY OF THE INVENTION

The present embodiments may use a time when adult mosquitoes are still, in order to apply imaging and then pick the wanted insects or zap the unwanted insects. Such a time may be the time when the insect emerges from the pupa, or when the insects are cooled down to a temperature at which they are still. In both cases the insects are still for a period of time which is long enough to be identified by the imaging process and then either picked up or zapped as the imaging process is able to guide a robot arm to find the insect.

According to an aspect of some embodiments of the present invention there is provided a method for mechanical sex-sorting of mosquitoes by extracting a class of mosquitoes from unsorted mosquitoes, the method comprising:

obtaining said unsorted mosquitoes;

identifying individuals in a stationary phase, the stationary phase selected to be long enough to allow for identification;

obtaining images of individuals of said unsorted mosquitoes in a stationary phase;

electronically classifying said individuals from said images into at least one member of a group of classifications including male mosquitoes, female mosquitoes, and unclassified objects;

obtaining co-ordinates of individuals of at least one of said male mosquito and female mosquito classifications, said coordinates relating to a position in said stationary phase;

using a robot arm to reach an individual identified by ones of said obtained coordinates while said individual is in said stationary phase, to store or remove said individuals, thereby to provide sex-sorted mosquitoes.

In an embodiment, said classifying comprises using a trained neural network.

In an embodiment, said trained neural network comprises four or more layers.

In an embodiment, said obtaining images comprises obtaining successive frames, generating differences between said successive frames and using said differences to determine which individuals are in said stationary phase.

In an embodiment, said classifying comprises using a recurrent neural network (RNN).

In an embodiment, said unsorted insects are emerging pupae and said stationary phase is emergence.

In an embodiment, said unsorted insects are adults and said stationary phase is obtained by cooling said insects.

a camera configured to find individual mosquitoes on a stationary phase, the stationary phase selected to be long enough to allow for identification, the camera further configured to obtain images and coordinates of said individuals in said stationary phase;

a classifier, configured to electronically classify said individuals from said images into at least one member of a group of classifications including male mosquitoes, female mosquitoes, and unclassified objects;

a robot arm connected to said classifier and configured to reach an individual identified by ones of said obtained coordinates, the coordinates obtained while said individual is in said stationary phase, to store or remove said individuals, thereby to provide sex-sorted mosquitoes.

Unless otherwise defined, all technical and/or scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention pertains. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of embodiments of the invention, exemplary methods and/or materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and are not intended to be necessarily limiting.

Implementation of the imaging and directing of the robot arms in embodiments of the invention can involve performing or completing selected tasks manually, automatically, or a combination thereof. Moreover, according to actual instrumentation and equipment of embodiments of the method and/or system of the invention, several selected tasks could be implemented by hardware, by software or by firmware or by a combination thereof using an operating system.

For example, hardware for performing selected tasks according to embodiments of the invention could be implemented as a chip or a circuit. As software, selected tasks according to embodiments of the invention could be implemented as a plurality of software instructions being executed by a computer using any suitable operating system. In an exemplary embodiment of the invention, one or more tasks according to exemplary embodiments of method and/or system as described herein are performed by a data processor, such as a computing platform for executing a plurality of instructions. Optionally, the data processor includes a volatile memory for storing instructions and/or data and/or a non-volatile storage, for example, a magnetic hard-disk and/or removable media, for storing instructions and/or data. Optionally, a network connection is provided as well. A display and/or a user input device such as a keyboard or mouse are optionally provided as well.