Communitor

Smart Communities

Introduction

It is a well know fact that *Aedes aegypti* and *Aedes albopictus* (henceforth simply *Aedes*) mosquitoes are the main vector of numerous diseases, more conspicuously Dengue Fever, Yellow Fever, Zika and Chikungunya. The absence of effective vaccines for many of those diseases makes the vector control one of the most important ways to fight those illnesses.

One of the main challenge of vector control lies on the absence of trustworthy and timely data that can support the planning, measurement and assessment of effectiveness of the efforts. This lack of information makes the planning, the execution and the evaluation of control actions expensive and ineffective most of the time. A cheap and efficient way to provide such information would represent a significant improvement in control and decision making process.

A geographical information system that comprises the data of the population of the vector and the occurrence of disease cases would allow the prediction of disease outbreaks and to significantly improve the effectiveness of public authorities decision making, planning a resource allocation. It would also allow the population, once informed of such data, to actively engage in the process of government actions supervision and to perform the necessary duties of taking care of their own environment and residences.

Solution Proposed

The solution we propose consists on the use of ovitraps to monitor vector populations on a given area. This is a well know solution that has been in use for many years[1]. These traps consist in simple water containers distributed on the monitored area. The traps are georreferenced using simple GPS devices[2]. Inside those traps a wooden paddle allows the oviposition of the female mosquitoes, and the presence and density of *Aedes* population can be estimated from the number of eggs laid on a certain period of time. Usually the paddles are weekly collected and replaced for new ones, allowing the constant monitoring and generation of data[3] [4].

The heat maps generated from that input can thus be used to guide the control personnel activities, equipment allocation and resources use. They also create a temporal series of data, which allows the measurement of the effectiveness of the actions developed and the prediction of seasonal behavior of the vector populations. The better planning, measurement and assessment of actions saves time, money and allows the reduction of disease numbers and outbreaks, specially when

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[1]REITER, AMADOR, COLON. Enhancement of the CDC ovitrap with hay infusions for daily monitoring of Aedes aegypti populations. (http://www.ncbi.nlm.nih.gov/pubmed/2045808)

[2]SILVEIRA Jr. Pontos e linhas, pontes e retalhos: as experiências de implantação de tecnologias no domínio geográfico na vigilância vetorial para a dengue, em Recife e Santa Cruz do Capibaribe – PE. Recife: FIOCRUZ, 2010. (http://www.arca.fiocruz.br/handle/icict/10892)

[3]MORATO, TEIXIERA, GOMES, BERGAMASCHI, BARRETO. Infestation of Aedes aegypti estimated by oviposition traps in Brazil. Rev Saúde Pública 2005;39(4):553-8 (www.fsp.usp.br/rsp)

[4]ACOLI. O uso de armadilhas de oviposição (ovitrampas) como ferramenta para monitoramento populacional do Aedes spp em bairros do Recife. Recife: FIOCRUZ, 2006. (http://www.arca.fiocruz.br/handle/icict/3956)

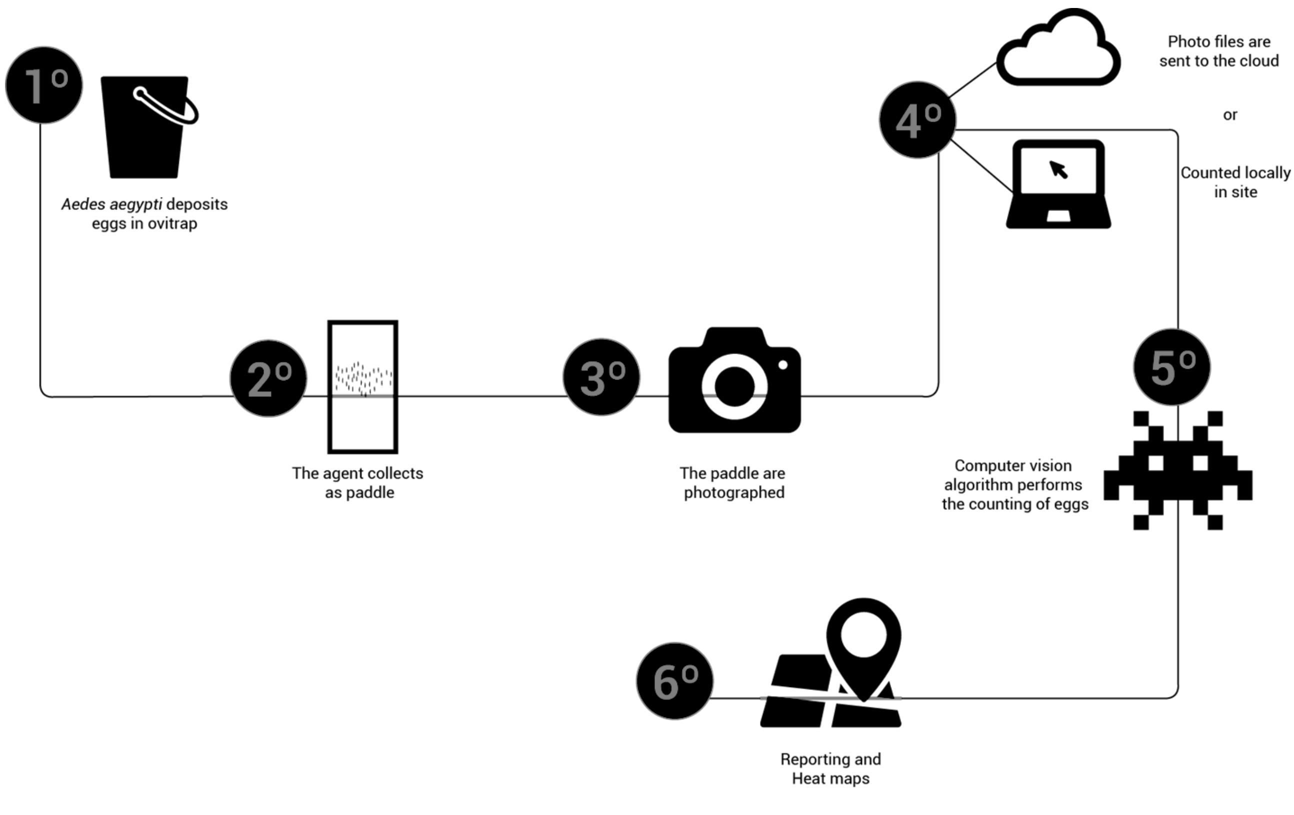
compared to traditional surveillance methods and more expensive traps[5].

The innovation we have developed to this process consists on the substitution of human work force on the cumbersome process of egg counting. Traditionally this process is done with optical equipment (entomological microscopes) and by human workers that perform the counting process manually. This procedure is slow, requires specialized workers, is expensive and prone to error, and has prevented the broad adoption of the method.

We have developed computer algorithms that using image analysis and computer vision techniques perform the counting processes of the eggs deposited on the wooden paddles automatically. This innovation is a solution for the inconveniences presented by the manual efforts, allowing a fast, cheap and precise process that does not require specialized lab workers and special equipment.

In our process, the wooden paddles collected are photographed using common digital cameras, and those photographies are analyzed by our algorithms. The data generated is then transferred to a database and used later to generate the maps. The process requires only one operator to take the pictures using a simple dark box, a digital camera and a computer. This simple infrastructure can process hundreds of paddles per day, which correspond to a very large area.

We also propose a software application for mobile devices that allows the public authorities and the general public to inform the occurrence of disease cases.



[5]CODEÇO et al. Surveillance of Aedes aegypti: Comparison of House Index with Four Alternative Traps. PLOS Neglected Tropical Diseases | DOI:10.1371/journal.pntd.000347. (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4323346/)

Theory of Social Change

Objectives

1. Reduce the incidence of arboviruses transmitted by Aedes.

2. Reduce the breeding and population of the Aedes.

3. Reduce disinformation of population and companies on the location and size of vector populations, allowing for more intelligent and planned actions and interventions.

4. To increase the visibility on the actions of control of the vectors carried out by the public power.

5. Increase the efficiency of public resources expenditures in epidemiological surveillance and health.

6. Reduce losses due to absences at work, in companies and in teaching activities.

7. Save on the human and logistic resources employed in the combat and control of Aedes.

8. To educate the population about the ways of acting to combat Aedes.

9. Generate assertiveness in the use of human and logistic resources to combat and control Aedes outbreaks.

Impacts

1. Increases in life expectancy in the general population.

2. Increase the quality of life of the population in general.

3. Reduction of infant mortality.

4. Increased productivity of companies, educational institutions and government agencies.

5. Improving the competitiveness of enterprises.

6. Improvement of public health services and rationalization of private health resources by reducing the burden of care due to epidemics.

7. Improving education and awareness of the civic role of citizens in improving environmental and health conditions.

8. Improvement of socio-environmental conditions.

What we need

We have developed so far the ovitrap positioning method, the image analysis and computer vision algorithms, the map generation process and the computer system that manages the data collected and provides reports.

However we still use regular digital cameras to photograph the wooden paddles. We need to develop a cheaper and more robust photograph acquisition device. This can be accomplished replacing the general purpose digital camera by a simpler and purpose specific digital camera. This camera should also be able to work without a power grid supply, in order to allow remote areas to take the pictures that could be uploaded whenever connection is available or transported in a digital medium to a remote server.

We have been maintaining pilot projects in Brazil, in the state of Minas Gerais, namely on the cities of Mariana and Belo Horizonte. We have also the necessity to maintain those projects or even others for longer periods of time and larger monitoring areas in order to generate more significative data sets to allow the elaboration of predictive mathematical models of vector populational behavior.

We also need to develop a cheap software system to alert the resident population of the monitored area in order to produce community engagement in the process. This software system should use existing communications infrastructure, such as SMS messaging or smartphone apps.

Development phase

The company is configured as a startup and is in the process of contractual formalization. It had participated in the pre-acceleration program Lemonade – Techmall and was one of the finalists, receiving the award for best team. It had participated in the Social Good Brasil Lab 2016, and was the winner of the program (http://socialgoodbrasil.org.br/lab).

The company also has been approved to develop this project through Sesi Senai Innovation, a government program. Through this program will be invested U$ 96,065.00 for the technological development of hardware and software equipment required for the project. The beginning of the is in November this year, and will last 24 months.

Currently, it has a staff of seven, three are employees (one environmental engineer, one programming trainee and one journalist), all hired with our own resources. Four are partners, and will be presented at next paragrapher. Market pain validation research has already been carried out with public and private entities and four pilot projects have been executed to validate the MVP. At present, five pilot projects are underway, the longest one being in execution for nine months, and aims to test and learn with regard to the buoyancy of vector infestation data due to climatic seasonality. Another monitoring, carried out in a region of the Aglomerado da Serra, aims to analyze the engagement and involvement of the community in relation to the coping of the vector and to the protocol of control actions to the vector created by the company and made available to the population. In the private sector, an industrial pilot project is maintained in Santa Luzia. Two municipalities in the metropolitan area of Belo Horizonte are testing the monitoring services offered by Communitor for the purpose of future contracting.

Who we are

We are a startup company based in Belo Horizonte – Minas Gerais – Brazil (http://communitor.com.br). We have been working on this solution for one year and our work so far has been self funded. Our team is composed of:

Helena Gomes (Bachelor on Physical Education – UFMG) – Chief Executive Officer

Roberto Novaes (PhD – Law - UFMG) – Chief Product Officer

Guilherme Nascimento (MS Computer Science – UFMG) - R&D

Thiago Villete (Bachelor on Production Engineering – Newton) – Chief Operating Officer

Estimate of operating expenses (OPEX)

Team dimensioning

The team designed for the first year has seven people, accounting for the annual expense of U$ 196,780.21. Of these people, three make up the software development team and four the administrative team.