GIS-SAPIO
Automated Aedes Aegypti Web-based Analysis and Prevention Monitor

Georges D. A. Nze[1], Lourdes M. Brasil[1], Josiane S. A. Souza[1] and Marco A. B. Rodrigues[2]
[1]*Engineering and Innovation Laboratory, University of Brasilia – UnB/FGA, Gama, Brazil*
[2]*Biomedical Engineering Course, Federal University of Pernanbuco - UFPE, Recife, Brazil*

Keywords: Dengue, Public health, GIS-SAPIO, Aedes aegypti, Web.

Abstract: This work proposes the creation of a fully automated and dynamic web platform to analyze and prevent the Aedes aegypti mosquito's proliferation in Brazil. The Web Based Geographic Information System for SAPIO (GIS-SAPIO) is part of a project denominated: System Acquisition and Image Processing Ovitraps (SAPIO) for obtaining and processing ovitraps – traps where the mosquito's eggs are deposited – and algorithms are used for the automation of eggs counting. The data obtained from image processing is processed thru an automated script and sent to SAPIO´s database, and finally displayed on a web platform. This technique should help for monitoring and prevent Dengue overall Brazil dynamically.

1 INTRODUCTION

Aedes aegypti mosquito's proliferation is increasing all over Brazil. A large amount of cases having the disease spread by the mosquito (known as dengue fever) has been reported by the Brazilian Health Ministry and to revert present scenario, efforts are been made to prevent and control in old fashion, the proliferation of dengue (Ministério da Saúde, 2010).

This old fashion prevention aims to report, door to door, the implication of having containers that could retain water for a long period of time, and being a vector for the mosquito to lay its eggs in it.

Nonetheless, this prevention technique is useless because not all citizens really understand the problems that could imply in having stagnant water containers at or near their houses, even being really small quantities of water in any kind of recipient.

The Brazilian Health Ministry is doing a great effort for the publication of online and printed document that shows how citizens should protect their surroundings from this mosquito on a daily basis but the proliferation scenario is still maintained since 2007 (Dengue, 2011).

In recent work, different Web-based application proposals using relational database and analysis (Sucaet, 2008) for monitoring the mosquito population has been presented but do not treat the current effect of dengue proliferation. Other Web-based application for climate information resources for Malaria control is proposed in (Emily, 2006) but their main purpose is to reveal current precipitation, temperature, relative humidity or general climate conditions suitable for Malaria transmission and nothing about the proliferation of the disease dynamically with substantial data.

In (Dengue, 2011) is presented a public health platform based on web application to follow the proliferation of Dengue. Their proposal isn't based on real time data base acquisition but on stored data from previous event collected in old fashion. Some data as shown in Table 2 lack of data from previous years and there is no explanation about it.

All these works demonstrate that it is a great deal of using geographical and database processing principles, and this work being part of the SAPIO project propose another but simple and efficient free Web-based application to monitor and analyze the proliferation of dengue dynamically. The use of Geographic Information System (GIS) is of great interest because of collecting, storing, analyzing and integrating it with different kind of database (Sucaet, 2008). This database is to be maintained by statistics data collected by human health expert, thru GPS, and automatic data processing. Doing so would be easier to deployed general information of the virus proliferation in a daily based technique for all kind of users: government to general society.

D. A. Nze G., M. Brasil L., S. A. Souza J. and A. B. Rodrigues M..
GIS-SAPIO - Automated Aedes Aegypti Web-based Analysis and Prevention Monitor.
DOI: 10.5220/0003765803660369
In *Proceedings of the International Conference on Health Informatics* (HEALTHINF-2012), pages 366-369
ISBN: 978-989-8425-88-1

2 METHODS

The methods herein explained are part of SAPIO´s Public health research group. This project is divided in two actions: (1) Putting ovitraps in region having a dense concentration of dengue, and counting the amount of eggs using System Acquisition and Image Processing techniques (Mello, 2008) and (Andrade, 2010); (2) Mapping the results on a website to show the mosquito's proliferation statistic as to prepare the government and society in taking proper actions in real time (Amvame, 2011).

2.1 Trapping Technique

Plastic buckets are filled of stained water with a wood slide on the edge, Figure 1. This bucket and slide (*ovitrap*) is currently used as a trap for the mosquito. A smell from the wood slide is used to attract the Aedes aegypti into the trap and lay the larva on it: this is the *ovitrap* technique.

2.2 Counting Technique

A human health specialist collects the wood slides and manually counts the eggs deposited by the mosquito. The first part of this project, automates using a special algorithm the eggs counting by image processing techniques, and compares it with the manual technique, Figure 1. All counting are saved with respect to their localization.

2.3 Data Acquisition and Database

The resulting data collection obtained from the Counting Technique, Table 1, goes thru SAPIO´s XML script for correct translation of data into a free relational database, Figure 1. The database is dynamically maintained, using a 5 second refresh time rate, as data comes from image processing.

Table 1: Example of Pernanbuco´s reported infection cases from 2000 to 2004.

State	UF	Reported Infection Cases				
Pernanbuco		00	01	02	03	04
AFLITOS	PE	10	28	43	0	0
AFOGADOS	PE	8	8	39	0	0
AGUA FRIA	PE	51	63	591	14	22
ALTO DO MANDU	PE	132	81	468	7	19
ALTO JOSE BONIFIACIO	PE	5	2	181	1	3

2.4 Web-based Monitoring

After data acquisition, Table 2, a web-based is use to show mapping and statistic information collected from the first stage as shown in Figure 1. Google Maps (Google, 2010) API are used to support current implementation and *phpMyAdmin* (PhpMyAdmin, 2010) is used for database acquisition.

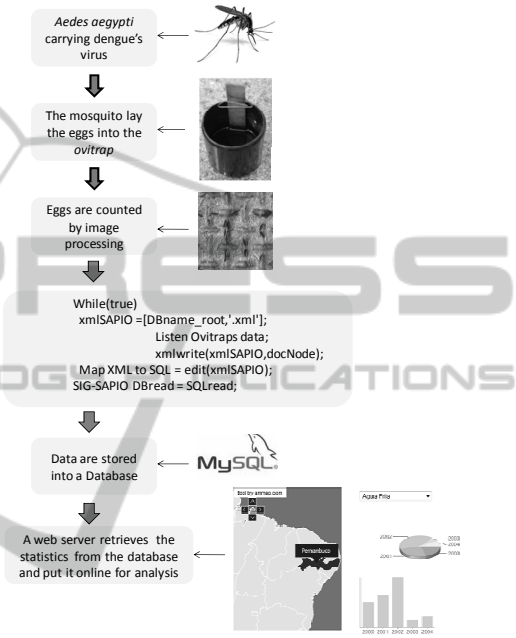

Figure 1: Diagram showing the methodology leading from egg counting to web-based monitoring.

Table 2: Infection incidence related to Pernanbuco and Brasília from 2009 to 2010.

State or Territory	UF	Infection Incidence	
Pernanbuco		2009	2010
IGARASSU	PE	-	no info.
GARANHUNS	PE	2.1	2.3
ITAPISSUMA	PE	-	0.8
FLORESTA	PE	-	5.7
OLINDA	PE	1.3	1.1
OURICURI	PE	-	7.2
PETROLINA	PE	0.8	0.9
RECIFE	PE	1.6	1.9
Distrito Federal		2009	2010
BRASÍLIA	DF	1.7	0.6

Satisfactory	< 1.0%
Alert	1.0% - 3.9%
Epidemy risk	> 3.9%

The prototype shown in Figure 2 demonstrates how dengue monitoring would be displayed for web users. A general map is presented for the user to have direct statistic information from any state, and in need of more detailed information from that state, a link calls Google Maps to provide accurate positioning of the dengue proliferation.

3 RESULTS

The results here by far obtained are very satisfactory because of the difficulty in integrating Google APIs with other open source applications. The present work shows a great integration between the two stages of the SAPIO project, and now can have a simple but still great techniques and data acquisition shown visually thru Web for monitoring the proliferation of dengue, Figure 2.

As it is really important to reach the entire population for a daily prevention and alert, it should be remembered that the access to the internet is still a challenge in poor region of Brazil, and if not the computers technologies and data speed rates used in those areas are of poor performance. The idea is to have the web-platform being accessible for those having equipment working at transmission data rate of at least 256 Kbps.

The Brazilian Ministry of Communication is actually implementing the PNBL (National Plan of High Speed Internet Connexion in Brazil) for Internet access purpose overall Brazil for people having small savings.

The web platform would permit users to surf around the Brazilian map, top-left in Figure 2 showing the Pernanbuco State as an example, and look at current or past statistic about dengue in their region, top-right of Figure 2. This is important to have as quickly as possible without having to navigate thru many unnecessary links. Another accurate information than the one displayed in the top-right, would display their current localization.

The map shown at Figure 2 would bring the local position of the treat were the disease is suppose to occur or appeared, and the drop down box would make available access to other cities in current or other state.

Not seen in Figure 2 yet, would be multiple sort of data displayed for better understanding of what is going on in the area selected for analysis, and it all would depend on what type of information is been collected from the database. Figure 3 shows, as an example, a static spatial data displaying 2008

Figure 2: SAPIO´s prototype Web Platform for Real Time Dengue Proliferation Analysis.

Dengue Fever throughout Brazil, (Dengue, 2011). This visualization technique will be implemented for a real time analysis for SAPIO.

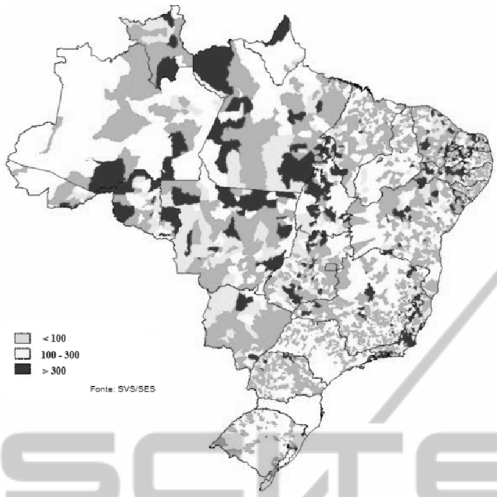

Figure 3: Dengue Fever incidence by State in Brazil, 2008.

All Data retrieve from the expert would be uploaded thru a special link, in SAPIO´s web platform, into the Database Server in real time with their GPS coordinates.

As future work, the idea is to work with the Brazilian National Climate Institute as to having a more robust, detailed and statistical analysis scenario were dengue is to be monitored before it causes more damages throughout Brazil.

4 CONCLUSIONS

This work has shown the development of a web-based application that can provide the monitoring and analysis of dengue proliferation in real time. Its database is filled with data coming from an automated Aedes aegypti image processing egg counting from ovitraps. This platform should be used for monitoring and prevention of the disease as an alert for all citizens. At this current stage, the work herein proposed shows how important is it to make all data collected from SAPIO been visualized by anyone, and to fight and prevent dengue into a web illustrated format.

ACKNOWLEDGEMENTS

This research is partially sponsored by FINEP-Brazil and CNPq-Brazil.

REFERENCES

Amvame, G., Brasil, L., Rodrigues, M., 2011. Sistema WEB para Monitoração e Análise de Proliferação do Aedes aegypti. In *Pan American Health Care Exchanges*. Rio de Janeiro, Brazil. PAHCE 2011.

Andrade, M., Brasil, L., 2010. Automatic Identification of Aedes Aegypti Eggs Deposited in Ovitraps Slides Using Image Processing Techniques. In *Congresso Brasileiro de Engenharia Biomédica.* São João Del Rei. CBEB 2010.

Mello, B., Santos, P., Rodrigues, M., 2008. Image Segmentation of Ovitraps for Automatic Counting of Aedes aegypti Eggs. In *30th Annual International Conference Of The IEEE Engineering In Medicine And Biology Society*. Vancouver, Canada.

Dengue., 2011: Programa nacional de controle da Dengue. In *http://www.dengue.org.br*/.

Ministério da Saúde. "Programa nacional de controle da Dengue. Brazil". http://portal.saude.gov.br/saude/area.cfm?id_area=920. Brazil 2010.

Sucaet, Y., Van Hemert, J., 2008. Web-based relational database for monitoring and analyzing mosquito population dynamics. In *J Med Entomol*.

Emily, K., Pietro, Ceccato., Stephen, J., 2006. Web-based climate information resources for malaria control in Africa. In Malaria Journal 2006, 5:38.

Google Maps., 2010. In *http://www.google.com.br/.*

PhpMyAdmin., 2010. In *http://www.phpmyadmin.net.*