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Development of a Web Application for the management of Georeferential Information regarding Biological Traps against the Fall Armyworm of the Center for Innovation and Technological Development of the Mezquital Valley

Desarrollo de una Aplicación Web para la gestión de Información Georreferencial referente a Trampas Biológicas contra el Gusano Cogollero del Centro de Innovación y Desarrollo Tecnológico del Valle del Mezquital

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Abstract

Today information technologies in the agricultural sector are widely used and this paper presents the development of a Web application that aims to manage the information generated by the application of biological traps that are installed in plots contaminated by the worm plague. armyworm (Spodoptera Frugiperda), these are developed by the Center for Innovation and Technological Development (CiDT) and distributed to corn producers in the Mezquital Valley to combat the plague. The Web application was developed with the agile development methodology called incremental, PHP technology, the MySQL Database Management System and the Here® WeGO API for manipulating georeferenced maps. To guarantee the functionality of the Web application, unit tests were implemented, defining use cases with information provided by CiDT. This Web application represents the first stage of a Hybrid Information System whose goal is to serve CiDT as a tool for monitoring and analyzing the behavior of the fall armyworm plague.

Web Application, Precision Agriculture, Spodoptera Frugiperda

Resumen

Hoy en día las tecnologías de información en el sector agrícola son muy utilizadas y el presente trabajo presenta el desarrollo de una aplicación Web que tiene como objetivo gestionar la información generada por la aplicación de trampas biológicas que se instalan en parcelas contaminadas por la plaga del gusano cogollero (Spodoptera Frugiperda), éstas son desarrolladas por el Centro de Innovación y Desarrollo Tecnológico (CiDT) y distribuidas a los productores de maíz en la región del Valle del Mezquital para combatir la plaga. La aplicación Web fue desarrollada con la metodología de desarrollo ágil denominada incremental, tecnología PHP, el Sistema Gestor de Base de Datos MySQL y el API de Here® WeGO para la manipulación de mapas georreferenciales. Para garantizar la funcionalidad de la aplicación Web se implementaron pruebas unitarias definiendo casos de uso con información proporcionada por CiDT. Esta aplicación Web representa la primera etapa de un Sistema de Información Híbrido que tiene como meta servir en el CiDT como herramienta para el monitoreo y análisis del comportamiento de la plaga del gusano cogollero.

Aplicación Web, Agricultura de Precisión, Spodoptera Frugiperda

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Introduction

Currently, technology in the agricultural field has many applications, either to improve the production of fruits and vegetables, or to prevent and counteract pests that harm production. This paper presents the work carried out for a Web application whose purpose is to serve as a computer tool to manage and store the information generated by biological traps that are built and distributed by the Center for Innovation and Technological Development (CiDT) among producers. of corn to combat the plague of the fall armyworm (Spodoptera Frugiperda) in the plots of the Valle del Mezquital region.

This pest has the characteristic of destroying the corn plant by eating its bud, causing the loss of parts or the entire plot. Given this situation, the CiDT developed a biological trap in which it eliminates the female butterflies through pheromones, thus preventing their spread. The use of these traps is beneficial since it avoids the use of insecticides that harm the health of both the plants and the soil, as well as the people who apply them. However, the CiDT does not have a computational tool that allows it to collect, store and process information generated by the traps to carry out an analysis regarding their distribution in order to have better performance.

In the market you can find different Web and mobile applications that deal with pest control, however, some of them require the acquisition of components for their operation, such is the case of Intagri S.C. (Intagri S.C., 2022)and DEGESCH (PRESERVE, 2022), these solutions represent a good option but given the economic situation in the region's producers, it is difficult to acquire and maintain the necessary components for operation.

There are also other solutions that use Information Technology (IT) such as iGEO ERP (IGEO ERP Cloud Platform, 2022), Kizeo (Kizeo, 2022)and Evisane (Evisane, 2022); however, despite being good solutions, acquiring a license for the use of these applications implies taking advantage of all the services they offer to take advantage of and in this case, given the requirements established by the person in charge of the CiDT, many of the services offered would not be used.

For this reason, a Web application was developed as the first part of a Hybrid Information System whose global objective is to be the tool that solves the needs that CiDT has with traps and thus avoid the use of insecticides in the plots.

To detail the work carried out in the Web application, this document is included in the Methodology to be Developed section, where the methodologies, tools and technologies used are detailed. The Results section where the functional tests and the results obtained from them are described. The Conclusions section where, based on the results obtained, the functionality of the application is concluded. Acknowledgments section for those who supported or guided the development. The Financing section where the economic support that the project had to develop the presented Web application is mentioned. And finally the References section.

Methodology to develop

The Web application was developed with the implementation of the agile development methodology called incremental with PHP technology (php.net, 2022), the MySQL Database Management System (DBMS) (ORACLE, 2021) and the Here® WeGO API (Here Technologies, 2021)for manipulating georeferenced maps.

The busy incremental methodology is the one commented by (Pressman, 2010) where he mentions that software development is divided into functional increments where each one is made up of five stages: communication, planning, modeling, construction and deployment. In this case, the Web Application was developed in 7 increments in which each one has a specific function according to the established requirement. The development of each increment was carried out using the PHP, HTML, CSS, JavaScript and SQL languages for the persistence of the information through the use of the DBMS MySQL.

The first increment includes the user registration module, it includes the roles: Administrator, Producer, Technician and Guest. A sample of this increase can be seen in figure 1.

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Figure 1 User Registration
Own Elaboration

The second increment contemplates the functionality for access to the Web application where the RFC of the person to be registered is taken as the username. Figure 2 shows the login screen.

Figure 2 Login
Own Elaboration

The third increment is formed by the personal data module that has the function of updating the data of the user who has logged in, a screenshot of this module can be seen in figure 3.

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Figure 3 Personal data module
Own Elaboration

In the fourth increment, the parcel module was considered, where the information of the parcels that belong to the corn producers in the Valle del Mezquital region is managed, as part of the information it includes the georeferential data of the parcel in order to locate it with a georeferencing system. The data of the parcel that is managed are name, municipality, surface, RFC and name of the producer. This module implements the API offered by Here® WeGO for manipulating georeferenced maps in the Web application. Figure 4 shows the screen where parcels are added and the location of the parcel on the map.

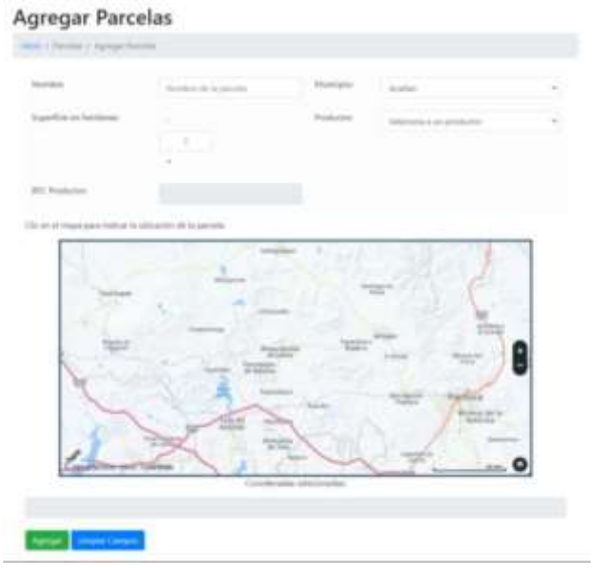

Figure 4 Add parcels
Own Elaboration

The traps module was developed in increment five and comprises the functionalities to add, install, uninstall and delete acquired biological traps. In each function, the general information of each trap is managed, but its georeferenced information is also considered in order to locate it on the Here® WeGO maps.

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Figure 5 shows the main screen of the module where the location and information of each trap installed in the plots can be consulted.

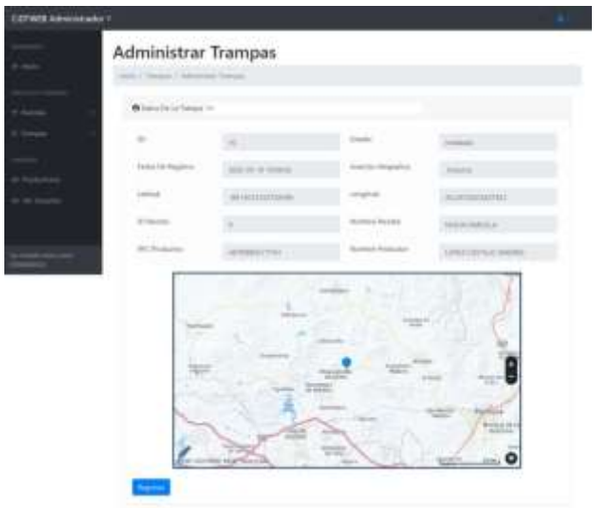


Figure 5 Trap management
Own Elaboration

The report module is contemplated in increment six and contains the function of recording the temperature and the number of butterflies that are captured in each one of the traps installed in the plots, these records are important to generate a database that allows an analysis of the behavior of the fall armyworm pest in the plots of the region.

In Figure 6 you can see the interface to record the information of a trap and in figure 7 you can see the report of each record made to a specific trap.

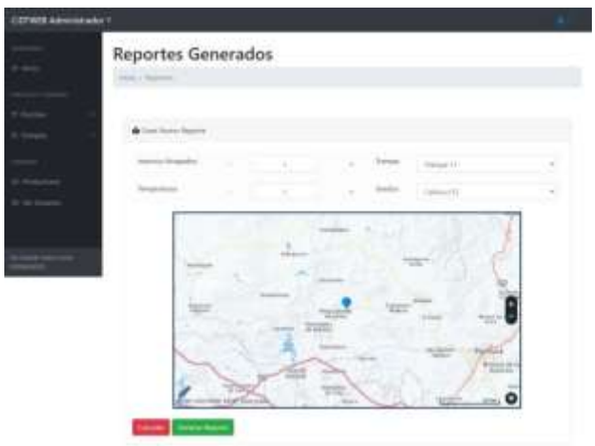


Figure 6 Reports generated by biological traps
Own Elaboration

Figure 7 Report of records generated by a biological trap
Own Elaboration

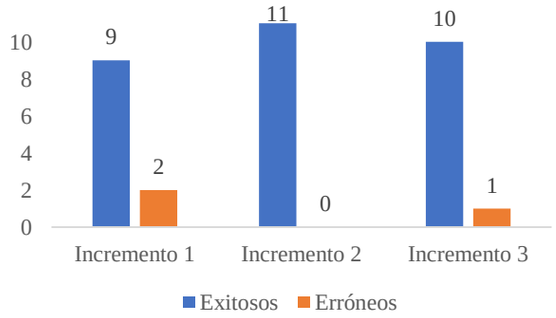
In the last increment, the module for managing the users of the Web application was developed. This module is used only by the administrator of the Web application and allows managing the information of each registered user through the functionalities to add, update, delete and assign role. Figure 8 shows the main interface of the module.

Figure 8 Report of registered users
Own Elaboration

Once the increments were developed, they were integrated into the Web application to apply a set of tests to guarantee their functionality, this activity is described below.

Results

During the development of each increment in the deployment stage, a set of so-called unit or component tests were carried out, where eleven test cases were defined for each increment with different input data provided by the CiDT. Graph 1 shows the results of the tests carried out for increments 1, 2 and 3.



Graph 1 Executions of test cases in increments 1, 2 and 3
Own Elaboration

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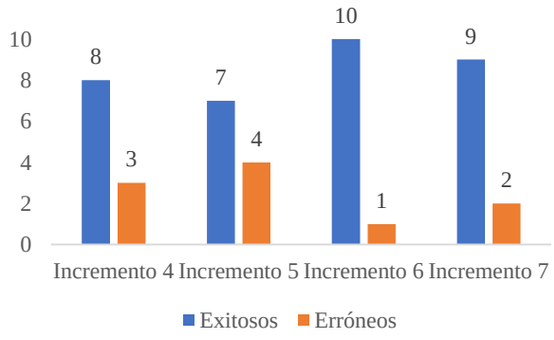
As can be seen, the increase presented two errors since the format of the RFC data was not validated, which is important since it is taken as a username. For increment 2 there were no errors since it consists of access to the system. For increment 3 there was an error related to the RFC syntax since it was not validated. Graph 2 shows the results when implementing the use cases at increments 4, 5, 6 and 7.



Graph 2 Executions of test cases in increments 4, 5, 6 and 7
Own Elaboration

Observing the results, it can be mentioned that increments 4 and 5 presented several errors because they are the most relevant of the Web application since they implement the Here® WeGO API for the management of georeferenced maps, the errors found in the executions were related to accessing maps, taking the position of a point, placing a point on the map and creating areas on the map; about the latter was due to the fact that since the free version is used, Here® WeGO does not allow the use of areas in its maps.

Conclusions

Despite obtaining errors in the test cases, these were corrected in the Web application in order to ensure its operation before being applied in a real environment.

The errors found caused deepening the knowledge for the implementation of the Here® WeGO georeferenced maps and thus enriching the domain of these for future projects. The implementation of the agile methodology called incremental allowed a development of the Web application through increments that were delimited according to the modules identified by the work team and the CiDT, each increment was planned, developed and tested according to the functional requirements requested.

The implementation of unit or component tests in each increment, allowed to ensure a correct operation guaranteeing an acceptable quality in the developed Web application.

Finally, it is important to mention that the developed Web application is the first part of a hybrid information system that aims to serve as a tool in the CiDT for monitoring and analyzing the behavior of the fall armyworm plague within the Mezquital Valley. Therefore, the use of georeferenced maps for the management of information generated by biological traps, allows the collection of relevant information for the CiDT.

Gratitude

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References

[I] Evisane. (2022). *Evisane Software de Sanidad Ambiental en la Nube*. Retrieved on May 27, 2022, from Evisane: https://www.evisane.com

[II] Here Technologies. (2021). *Here WeGo*. Retrieved on April 5, 2021, from Here Technologies: https://www.here.com

[III] IGEO ERP Cloud Platform. (2022). *Software para empresas de control de plagas*. Retrieved on May 27, 2022, from iGEO ERP CLOUD Platform: https://www.igeoerp.com

[IV] Intagri S.C. (2022). *El Monitoreo Herramienta Basica en los Programas de MIP y MIE en Hortalizas*. Retrieved on May 27, 2022, from Intagri S.C.: https://www.intagri.com/articulos/fitosanidad/el-monitoreo-herramienta-basica-en-los-programas-mip-mie

ISSN: 2410-4000

[V] Kizeo. (2022). *App y software de control de plagas*. Retrieved on May 27, 2022, from Kizeo Forms App y software de control de plagas: https://www.kizeo-forms.com/es-lat/app-y-software-de-control-de-plagas/

[VI] ORACLE. (2021). *The world's most popular open source database*. Retrieved on April 5, 2021, from MySQL: https://www.mysql.com

[VII] php.net. (2022). *Lenguaje PHP*. Retrieved on April 4, 2022, from A popular general-purpose scripting language: https://www.php.net

[VIII] PRESERVE. (2022). *DEGESCH Sistema para Monitoreo de Plagas*. Retrieved on Mat 27, 2022, from DEGESCH: http://degeschmexico.com/soluciones-integrales/soluciones-degesch/sistemas-para-monitoreo-de-plagas/

[IX] Pressman, R. S. (2010). *Ingeniería de Software: Un enfoque práctico* (7ª ed. ed.). Ciudad de México, Distrito Federal, México: Mc Graw Hill.