

Decision support system for environmental monitoring systems using data logs

Sistema de apoyo para la toma de decisiones en sistemas de monitoreo ambiental utilizando Data Log

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Abstract

This article describes the proposal of a support system for decision-making in agricultural automation using Data log, which is mainly focused on rice cultivation. This project has an Excel program (programming in Macros) configured to save temperature and humidity data in real time, as well as the date and time the data are recorded, in the same way they are presented graphically to facilitate the visualization of its advance or backward movement, it has functions that will allow to restart the data already saved (table and graph), this will help reduce times when eliminating data by data, in the same way it can be reusable as many times as necessary ; all of the above in order to provide a good production to farmers, reducing losses that are had with this grass, and avoiding unnecessary payment of catastrophic insurance.

Data log, Environmental monitoring, PLC, agricultural, crop, macros, reduce, automation

Resumen

En el presente trabajo se describe un sistema de apoyo para la toma de decisiones efectiva en el monitoreo ambiental utilizando Data log, enfocándose principalmente en el cultivo de arroz. El proyecto cuenta con un programa en Excel (programación en Macros) listo para guardar datos de temperatura y humedad en tiempo real, registrando la fecha y hora en que son guardados. Los datos se presentan de manera gráfica para facilitar la visualización de su avance o retroceso, cuenta con funciones que van a permitir reiniciar los datos ya guardados (tabla y gráfica), lo que ayudará a disminuir tiempos a la hora de eliminar dato por dato, para que de igual forma pueda ser reutilizable las veces que sean necesarias, con la finalidad de brindar una buena producción a los agricultores, disminuyendo pérdidas notorias que se tienen con esta gramínea, y evitando un pago innecesario de seguro catastrófico.

Data Log, Monitoreo ambiental, PLC, agrícola, cultivo, macros, reducir, automatización

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Introduction

In the processing industry, important decisions are made that lead to satisfactory financial remuneration, yet the agricultural industry has been underestimated, even though it is just as important as any other, because it provides the food basket that every human being needs to feed themselves, as well as generating income and jobs (Envira IOT, 2020).

The magazine Envira describes that one of the lines of development that is arousing most interest is precision agriculture, within the progressive digitalisation of the countryside. This can be defined as "an integrated agricultural information and production system that can collect precise data on each individual plot of land and thus personalise the cultivation of each site independently".

The newspaper "El dinero" mentions that rice production relies on technology to be competitive. The author of the newspaper mentions that the use of technology is taking over land preparation work (Severino Jairon 2013). The increase in labour costs has forced the search for more viable alternatives, as the planting, cultivation and harvesting of rice is one of the agricultural sectors with the highest technological absorption.

Over the years, the priority has been to reduce costs and maximise production in order to obtain better profits. Consequently, this has led to unemployment in the countryside, as it is a fairly high expense that, although it is a disadvantage for day labourers, for producers, the addition of technology to crops is a good alternative.

The article Technology for agriculture talks about Agriculture 4.0 as a result of the evolution of cyber-agriculture in which Big Data analysis, mobile communication and cloud services are introduced, thus seeking to merge the needs of the farmer with the most sophisticated advances in technology (HSBC Business Banking, 2019), in order to take advantage of the potential of the information that the field yields and change the way food systems are produced.

The aforementioned article reflects a strengthened relationship between the countryside and technology, which is why it is supported by bank financing, which seeks to help reduce losses in agriculture, as well as provide increased production for farmers.

Betzari Peláez mentions the impact of technology applied to agriculture, which, thanks to the arrival of technology and its positive use, has brought many favourable changes to agriculture (Peláez C. Betzari, 2017), for example: drones, telematic irrigation systems, seeders and tractors with GPS, etc. This has provided greater security by increasing farmers' production, and not only that, it has also improved the efficiency of business profitability.

With the above, we have another point in favour that corroborates once again that technology is extremely important in everyday life, especially in agriculture, because thanks to the good management of this tool, production, quality and profitability of the field can be improved.

In 2018, Seminis mentions the need for innovations to feed the world (Seminis, 2018), and that the agricultural industry increasingly presents new challenges as the population grows, so producers require all possible help in the innovations that technology can provide.

Methodology.

Figure 1 shows the methodology used in the development of this project, One of the most important activities in this project is the collection of data, because in order to start with the execution of the project it is of vital importance to know the temperature, humidity, type of soil, and everything necessary so that the project can be executed correctly and provide a good production (harvest); another important aspect is to register all the aforementioned data so that they can be executed correctly and the purpose is 100% satisfactory. Finally, there are the tests, which are essential to confirm that the project is working correctly, precisely at that moment is where it will be verified if something has failed (if so, the whole procedure must be reviewed again, to discover what was wrong), the tests must be carried out again and once it is ready, it can be executed.

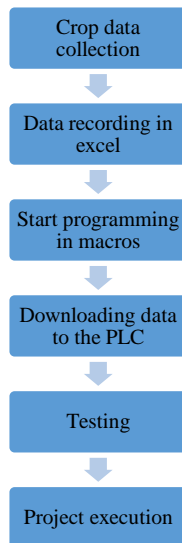


Figure 1 Project methodology
Source: Self Made

Development

After carrying out the research corresponding to the selected crop (necessary temperatures, humidity, type of soil, area in which the project will be implemented), the requested project begins, so a new spreadsheet must be opened to create the interface of user where the data registration will be carried out. The spreadsheet is one of the most used platforms for recording, storing and processing data, so using it for this purpose will facilitate the use of the information.

Spreadsheet settings

Headers were chosen, through the advice of an agricultural association, the table was stipulated with the following cells; Registration number, temperature, humidity, time and date. (Figure 2) The data will be recorded at the bottom of the headings, taking into account that, if the titles are very long, the cells must be reduced as desired and corresponding to each selected letter. This first table will be the one that connects the user and the process controlled by the PLC. While the second table will be responsible for showing the accumulation of data and the creation of the graph.

Data log			
Register number	CO ₂	Temperature	Time and date
Register number	% Temperature	% Humidity	Time and date

Figure 2 Interactive and accumulation table creation
Source: Own Elaboration

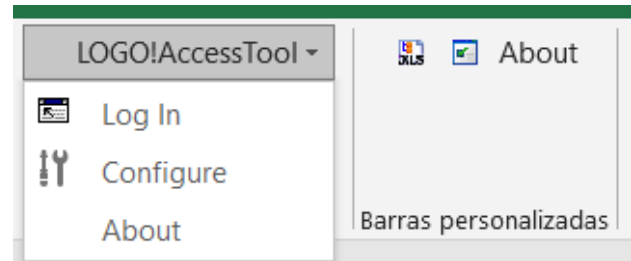


Figure 3 Coupling tool
Source: Own Elaboration

To establish communication between the spreadsheet platform and the local memory of the PLC, it is important to add an add-on to the system called "AccessTool" (Figure 3). This add-on will allow the use of reserved words (Table 1) as a formula for the transmission of data in text format.

Identifier	Reserved word
Digital Input	=LOGOVAR("I1")
Analogue Input	=LOGOVAR("AI1")
Digital Output	=LOGOVAR("Q1")
Analogue Output	=LOGOVAR("VW1")

Table 1 AccessTool reserved words
Source: Own Elaboration

You continue programming the date, for this you must select the cell in question, click on the tab that says "Formulas", select the option "Date and time", a window opens where at the end it says "Insert function", a new window opens and you must select the function "Now" (same function that contains a description "Returns the current date and time with date and time format") so the automatic time function will be programmed every time a data is added to the table.

Macro Configuration

For this section it is necessary to record macros, go to the "view" tab to select the macros option or use the command (Alt + F8), a window opens with three options (view macros, record macros, use relative references), select the option "record macros"; immediately a window opens, in which the name of the macro will be personalised, select "save in this book", a brief description can be added if desired.

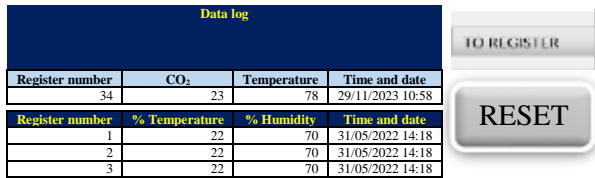


Figure 4 Insertion of functional buttons
Source: Own Elaboration

To add the function of the recorded macro to one of the buttons (Figure 4), you must position above the button that needs to perform the recorded function, to open the options window (cut, copy, modify text, modify points, hyperlink, assign macro, among others), right there, you must search and select the option "add macro", Afterwards, a dialogue box opens in which you must search for the name of the macro recording you made, select it, click on accept and you can start testing, recording data in the interactive table, and thus be sure that it is working correctly.

To insert now the "Reset" button, the same procedure is used, but with a different functionality; to delete the data in each cell of the accumulation table. To carry out the relevant tests and modifications that indicate whether the programme is working properly, the source code must be opened in Macros (Figure 5).

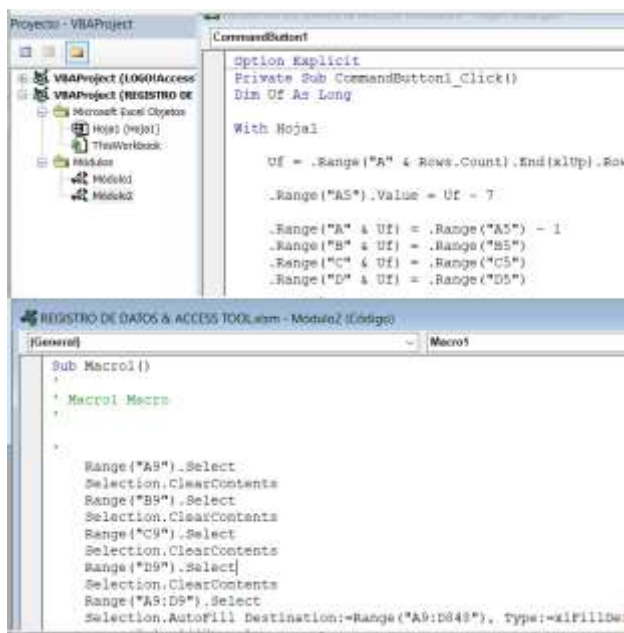


Figure 5 Code per functional module in Macros
Source: Own Elaboration

Graph Configuration

In order for the data that has been saved in the table to be reflected in a graph, you must select the information of the table that you want to graph, the option "Graphs" will appear, immediately the window changes and you must click on "insert", select "add graph", this will open a new window where you can choose the desired graph (column, line, circular, scatter, etc.), after this select the desired style of the graph (Figure 6). If the data provided in the chart automatically are not correct, they can be edited, this is by going to the chart, to customise and at the bottom will appear another one containing the options (delete, reset, change chart type, save as template, select data and plot line format) you must choose the "select data" option, then the legend entries (series) will appear, which you can delete or add more series to appear in column "Y" and column "X" in the chart.

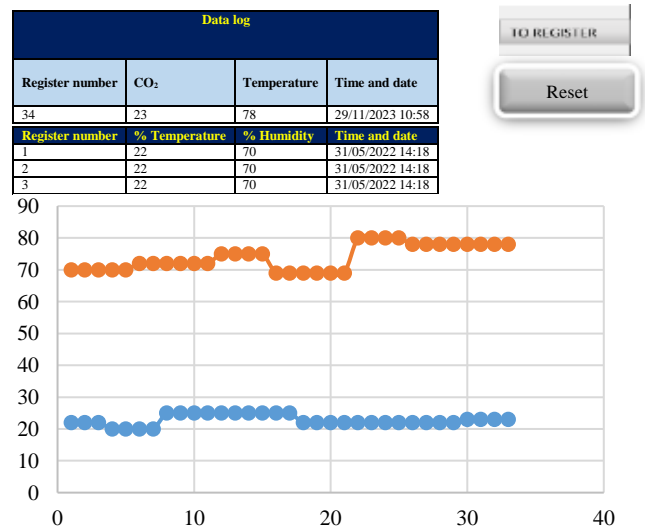


Figure 6 Scatter Graph
Source: Own Elaboration

PLC control programming

After having successfully completed the procedure in the spreadsheet, we will proceed to perform the relevant tests to support the decision to have successfully completed the required, for this as mentioned above, the data will be saved in the table and graph automatically, likewise will be removed from both the table and the graph by pressing the "Reset" button, will be tested, recording the data and observing that these have no problem when saved and deleted to continue recording data in this way. The aim of this is to reduce the time required to delete the saved data cell by cell, and if everything works favourably, the "support system" will have been successfully completed.

The control of the variables must be very simple, so that the user does not have any complications when making decisions. Therefore, an On-Off control using analogue threshold value switches and block logic was chosen, in addition to which a direct user interface was designed, using the features of the PLC. The control is designed exclusively for rice cultivation, and is also easily configurable for other types of products.

The aforementioned system implements an agricultural control system, making the most of one of the most evolved tools nowadays, such as programmable logic controllers (PLC) and spreadsheets, by manipulating and excluding factors that eradicate production, using them in a positive way to provide greater production, better quality and reduce wastage.

Conclusions

Veracruz is in the second place of rice production at national level, so it is mainly cultivated in the southern area, such as the Papaloapan basin, where there are numerous groups of farmers dedicated to produce it, in this study it was established that the most suitable type of sowing is: "Milagro filipino" and "Sica-4". Although analysing the quality and its improved variety, it is more common to use the former.

Temperature, solar radiation and wind have an influence on rice yield as they affect plant growth and physiological processes. This system indicated that the months of June and August are the most suitable for cultivating this grass, when there is more rainfall, as they require low temperatures and moist soil when sowing.

Other negative factors detected are pests, which reproduce and cause damage to the crop, causing irreversible problems in production due to the necessary temperatures required for sowing, and finally, diseases caused by fungi which attack various organs of the plant such as leaves, stem internodes, stalks and grains. These factors will be taken care of at a later stage thanks to the scalability of the system.

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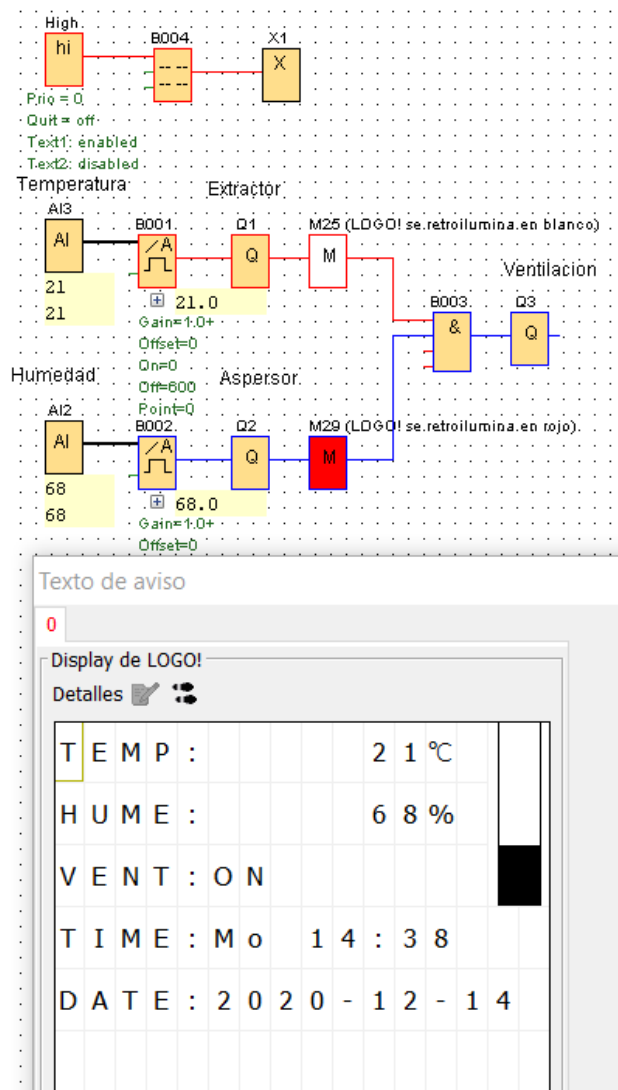


Figure 7 PLC programming
Source: Own Elaboration

Results

The system was elaborated with the purpose of registering agronomy variables, as well as to diminish losses that considerably affect the sowed product, it is an extremely important factor for the decision making since it favours the interpretation of the information, by means of a simple and friendly interface for the interested parties.

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