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MONITORING SYSTEM MANAGEMENT FOR ORGANIC WHEAT RECEPTION BASE

Diana MESAROS, Marcel DUDA, Cristina MOLDOVAN, Sorin MUNTEAN, Nicu MERCA, Marius POP
Control Systems Engineering Department, University of Oradea, Str. Universităţii nr. 1, Oradea, Romania, E-mail: dsas@uoradea.ro , mariusvpop@gmail.com
Crop Science Department, University of Agricultural Sciences and Veterinary Medicine, Calea Manastur nr. 3-5, Cluj-Napoca, Romania, E-mail: marcel.duda@usamvcluj.ro, cristina.moldovan@usamcluj.ro, sorin.muntean@usamvcluj.ro
Technical and Soil Sciences Department, University of Agricultural Sciences and Veterinary Medicine, Calea Manastur nr. 3-5 Cluj-Napoca, Romania, Email: nicu.merca@yahoo.com

***Abstract*—The aim of this article is to present monitoring system management using the AGILE SCRUM Methodology and microprocessors based systems for temperature monitorization of a grain reception base for organic wheat. In this article is presented the well-detailed proof of concept for a web-based temperature monitoring system, using Arduino and temperature sensors for temperature monitorization and AGILE SCRUM Methodology for software development management. In this way, the operators from grain reception base will be able to monitor the temperature from different halls, build from different materials, remotely.**

Keywords*— *conditioning and storage of agricultural products, grain reception base, Internet of Things AGILE SCRUM methodology, project management, monitorization, web-based application, Arduino, microprocessor-based systems

1. ORGANIC WHEAT CONDITIONING AND STORAGE

In these days, the new trend in digitalization presents various colaborations between interdisciplinary fields such as automation, internet of things, computer science and agricultural industry.

This article aims to provide an early case study of multidisciplinary topics like automation including temperature monitorization for conditioning and storage of organic wheat.

The purpose of this case study is the implementation of a temperature monitoring system using Arduino microprocessors based systems to observe the temperature differences and features for organic wheat stored in different storage halls built from different materials. Using temperature sensors and microprocessor-based systems, the information collected from the grain storage hall is sent to a web-based application alowwing the remote monitorization of the temperature

Grain reception bases have the main purpose the storage of agricultural goods, and they are arranged in accordance with certain defined standards mentioned in the specialized literature [1-5].

In the following figure is the suggestive representation of the criteria for organizing the gram reception bases:

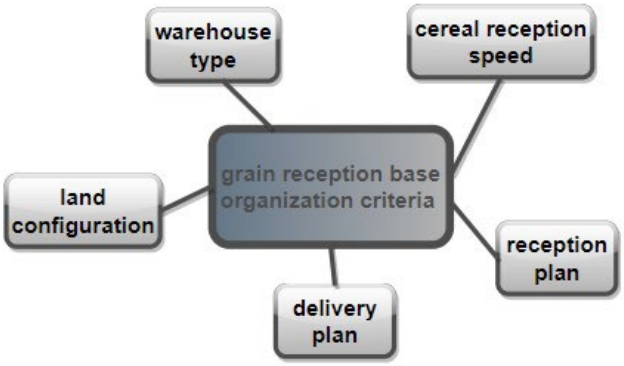


Figure 1. Grain reception base organization criteria [1-5]

Grain warehouses need to be equipped with cutting-edge technology, remodeled to meet European standards, and updated to ensure that grain storage conditions are always improved.

In the following are presented some of the prerequisites that must be fulfilled by the grain storage halls in order for them to meet the requirements for receipt and conservation [1-5]:

- convenient access to ensure that the delivery of grains and the receipt of agricultural goods may be completed with the least amount of time, money, and effort
- enable all processes to be completed within the scheduled time frame
- present sufficient number of doors in warehouses.
- present active aeration, drying, and chilling processes using both mobile systems and fixed installations

Important aspects represents the grain handling and grain delivery which must be mechanized. The automated loading of grains is also done with front loaders with telescopic arms and high-capacity installations. The following figure presents the schematic representation of a grain reception base:

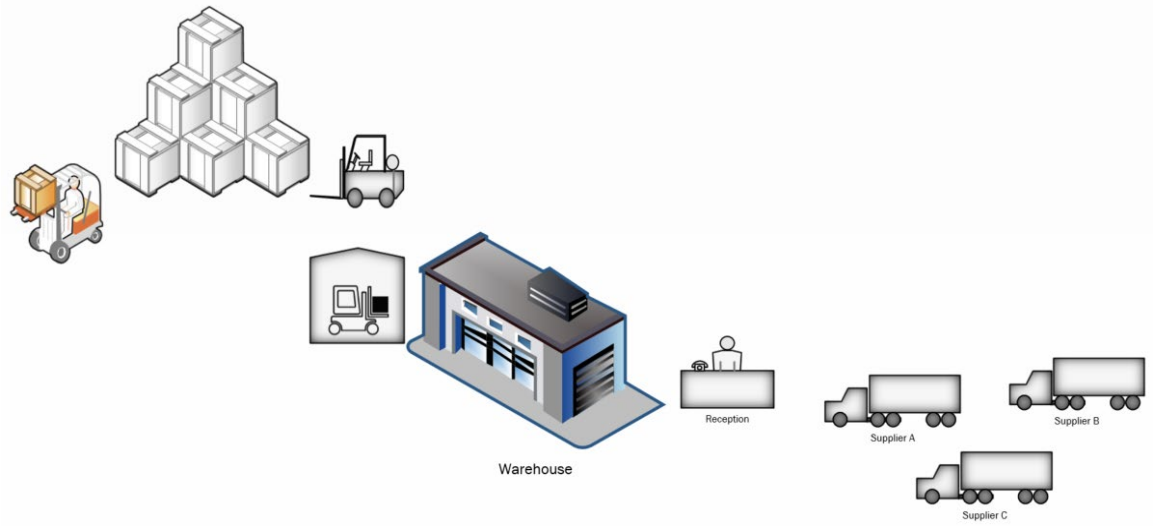


Figure 2. Schematic representation of a grain reception base

The presented storage halls store organic wheat harvested in the same period from the same plots or neighboring plots. Organic wheat is one of the most important types of grain grown in our country. The wheat stored in the two barns built from different materials was harvested in the middle of July, same year.

The temperature monitoring system is presented for two grain storage halls built from different materials, more precisely:

- Wheat storage hall A – reinforced concrete foundation and prefabricated modules from reinforced concrete diaphragm in proportion of 30% and wood in proportion of 70%.



Figure 3. The organic wheat storag A

- Wheat storage hall B – reinforced concrete foundation and autoclaved aerated concrete



Figure 4. The organic wheat storag B

Depending on the type of materials from which the storage hall is built, the temperature of the grains inside the hall can differ considerably [6,7].

As it is mention in literature, considering the presence of prefabricated modules from reinforced concrete diaphragm in proportion of 30% component, this material has a large thermal storage capacity, which allows for heat accumulation and therefore a lower thermal demand difference is identified

compared to the grain storage hall built from autoclaved aerated concrete [6,7].

Therefore, wheat storage hall A will have a lower temperature than wheat storage hall B.

2. AGILE SCRUM APPLIED IN TEMPERATURE MONITORIZATION

AGILE SCRUM represents a well-known software development project management methodology used not only in software development, but also in various other fields of engineering.

All AGILE SCRUM artefacts are widely described in literature, including in AGILE Manifestos [8].

Each project uses AGILE Manifestos to create interconnected components that cooperate to achieve a single objective. According to literature description, individuals and interactions are overprocesses and tools, working toward a final product is over thorough documentation [8-11].

The following figure displays the Agile Team [8-11]:

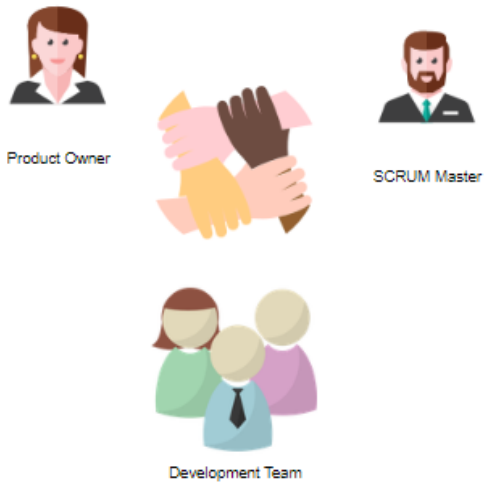


Figure 5. AGILE Team

The development team is made up of experts who, using their expertise, will produce the product in accordance with the specifications the product manager has listed in the backlog [8-11].

The Scrum Master is responsible for ensuring that the project runs well in terms of procedures and will assist the Product Owner in making necessary changes to the Backlog.

The Product Owner represents the individual who creates, explains, and prioritizes the backlog of tickets in order to add value to the project.

At every stage of the project, a minimum of one person of the project team is allocated to a specific task within a predetermined timeframe and budget.

The primary objectives of the AGILE Methodology are [8-11]:

- on the one hand, adaptation, transparency, and communication
- on the other hand, providing clients with value quickly

The steps required for project development are presented in the following figure [8-11]:

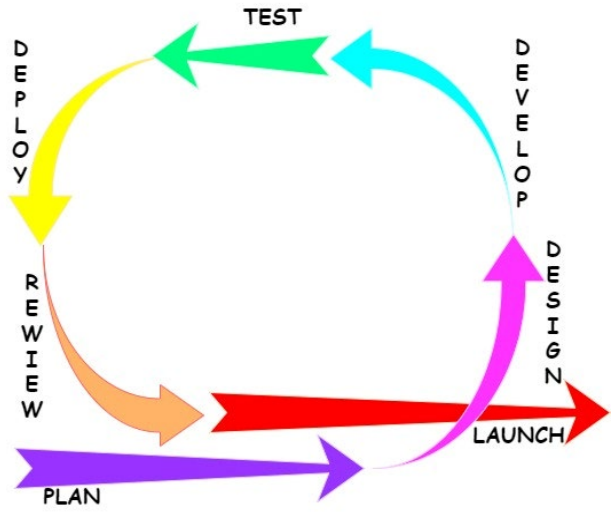


Figure 6. Steps of project development

In order to develop a monitorization system, the following steps are required:

- Plan – the monitorisation system
- Design the proof of concept of the project
- Develop both hardware and software components of the monitorization system
- Test the monitorization system
- Deploy the software
- Review the product
- Launch the product

3. MONITORING SYSTEM USING MICROPROCESSOR-BASED SYSTEMS

Nowadays, the benenefits of digitalization in all fields of industry are vey emphasized.

The definition of the Internet of Things is the ability to access various items or basic devices over the Internet. The possibility of linking some gadgets, such temperature sensors, to the Internet network will be discussed in this article [12,14].

In this paper, the suggested workflow is predicated on the idea that temperature sensors and microprocessor-based technologies are used to gather data from the two different grain storage halls.

In the following figure is represented a temperature monitorization system using Arduino microprocessors based systems and the simulation platform Tinkercad [15,16].

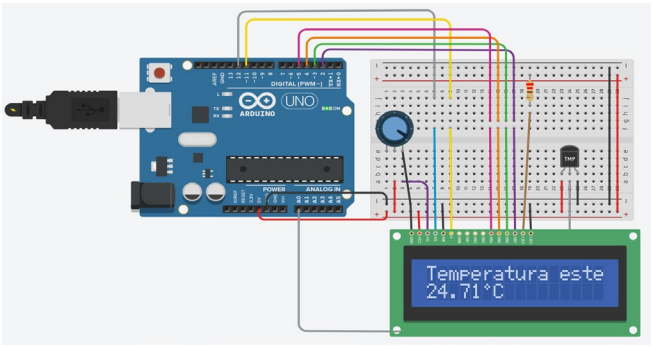


Figure 7. Arduino monitorization system [15,16]

The microprocessor-based system requires the implementation of a virtual serial channel on the USB connection between the PC and the board in order to view the data received or communicated by it.

Grain reception base operators may monitor these parameters by using a web-based application that displays the information gathered from the grain storage hall through the use of Arduino microprocessor-based devices with Ethernet connectivity and various types of sensors [12-14].

A web-based application displays the information gathered from both grain storage halls, emphasizing the temperature difference between those two halls buit from different materials.

The proof of concept for the suggested web-based temperature monitorization application for two different storage halls is shown in the following figure:

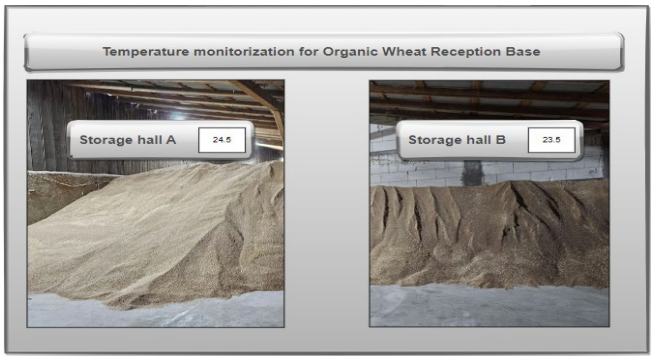


Figure 8. The proof of concept of the proposed web based monitorization application

Using this application, the grain reception base personnel may quickly monitor these parameters. This makes it simple to keep an eye on each grain storage hall from a distance using a laptop or smartphone.

4. CONCLUSIONS

The scope of this article is to present monitoring system management using the AGILE SCRUM Methodology and micropocessors based systems for temperature monitorization of a grain reception base for organic wheat.

This article presents a proof of concept for a web-based temperature monitoring system that uses the AGILE SCRUM Methodology for software development management and Arduino with temperature sensors for temperature monitorization.

In this way, the operators from grain reception base will be able to monitor the temperature from different halls, build from different materials, remotely.

In this article, for the purpose of presenting suggestive and understandable representations, the pictures presented in Figure 3 and Figure 4 were shot in author's farm. Also, all the diagrams presented in Figure 1, figure 2, figure 5, figure 6 and figure 8 were designed using the well-known design tool Microsoft Visio.

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