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# Effect of foliar application of silicon on some Characteristics Development of the grain product drying system by adapting a microcontroller

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**Annotatsion.** The duration of drying processes is considerable in time, from 8 to 36 hours, and it can be assumed that unforeseen circumstances are likely to occur in this interval. For this reason, and also during the setting of the temperature regulators in the system, the possibility of remote monitoring and changing its parameters was sought. In the proposed version of the process control system in the experimental convective dryer, a personal computer with a Windows operating system and MATLAB and LabVIEW software packages are used.

**Keywords:** convective dryer, grain, microcontroller, sensors for temperature, WEB application.

**Introduction.** When choosing an appropriate application for remote control of the work computer, there are several key characteristics that determine the behavior of the overall system:

stability - it is no coincidence that it is in the first place, since in certain embodiments the system may be in a difficult to reach place. The requirement for stability is difficult to measure, but as in most cases, the aim is to be 99.99% ready for an adequate response at any given moment.

security - although a potential security breach would not cause irreparable damage, it is desirable to avoid it at all costs.

accessibility - often corporate/company networks are secured by firewalls that are set to filter the sending and receiving of data on certain ports. This would lead to potential problems and complications in wide-ranging workstation setups.

potential problems - the system may experience various problems that negatively affect its operation. The complete isolation of problems is practically impossible, but when choosing, their influence must be reduced. Such problems are - lack of connectivity, limit on the number of users, changes in network settings and configurations, etc.

price - in case a product is chosen that does not offer a free license (even if it is specifically for educational purposes), the price would have a big impact. In most cases, developers offer free copies for educational (or non-commercial) purposes.

popularity - the fewer terms of use a given system has, the easier it is to use. It is desirable that the application that is selected has versions for different operating systems, including those for mobile devices such as tablets and smartphones.[1,2]

**Material and Methods.** The collected knowledge and the accumulated experience with the management of drying processes in a convective dryer and the development of technologies and means for their practical application, receive their improvement with the embedding of the management in a microcontroller. A local application on the microcontroller module is started and reads data from the dryer module. It collects the data from the sensors for temperature, speed and, in general, the state of the environment in the dryer and the environment in the room where the dryer is located, fig.1. It also receives the information about the weight of the product in the dryer from the scale and the speed, humidity and temperature of the drying agent. Energy consumption can also be added using a suitable electronic power meter (POWR2 by Shenzhen

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Sonoff Technologies) with an interface to transmit the recorded data (the current one only has a display to visualize the readings). It converts this data into a structured form and saves it to the database.[4,6]

**Results.** This module has no user interface and runs in background mode. User operator intervention is not required. It is designed so that when a drying process is started, it starts automatically and when the process is finished, it closes automatically.

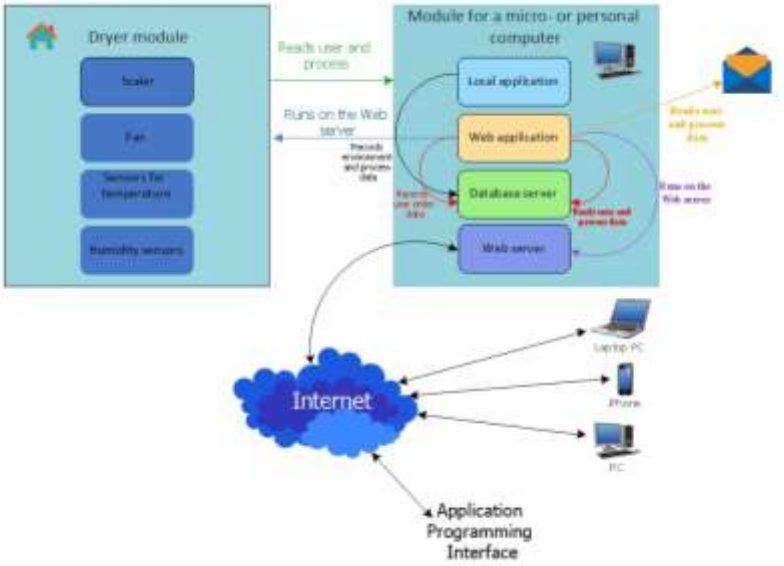


Fig. 1. Architecture of the intelligent drying control system.

With the aim of greater autonomy, after the proposed algorithms have been verified experimentally with Lab VIEW and MATLAB, a WEB application is proposed, which realizes all the functionality of the control of the convective dryer. The advantage of this approach is that in order to run this application it is enough to have a WEB server installed on the personal computer or in the cheaper version with a microcomputer. This is not a problem, due to the fact that such WEB servers are developed with different versions according to the hardware used. All work stable enough and can be run on computers with not particularly high parameters, as well as on microcomputers and microcontrollers.

**Discussion.** The advantage of such an approach is that the application itself runs on the server. All users use it through their browser. It is not necessary for every user to install it on his computer and then set it up. It is enough to start the browser, and in reality there is no mobile device or computer whose operating systems do not offer or support a browser. The WEB address must be entered in the address bar and the user can now access the application and its functions. In case of possible updates and expansion of functions, it is not necessary to inform all users one by one and to make new installations - each of them sees the new things when starting the application without problems. Naturally, different groups of users have access to different functionality. Some can only monitor the drying process, while others can also provide corresponding control effects by changing the drying temperature or speed of the drying agent. The process monitoring itself can be through a tabular representation of the parameter values for a certain/selected time interval of the process or in graphical form. In the WEB application, the functionalities for the access control of the groups of users, access to the database, where on the one hand the process data stored by the local module are read, and on the other hand the information about the actions of each user is recorded. The collected metadata necessarily records which user, exactly when he changed and which process settings. In addition, what elements of the user interface he used, where he clicked with the mouse or cursor on his mobile device, what IP address he connected from and much more can be recorded.

The WEB application also performs some predictive functions. It addresses the API (Application Programming Interface) for local weather forecast, from where it takes data for the next few days by hours and, when starting a drying process, provides the user with information about the expected duration of the process and about possible deviations from the typical course of drying, due to very high temperatures or, for example, higher air humidity, which will affect the conditions in the room with the dryer. Connecting to

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these APIs on the Internet is done using so-called API keys. This is a unique identifier that is used to identify the user or program calling the API. These keys are used to identify the application itself that uses the API, not individual users of the application. Different platforms providing such interfaces as a service use the key in different ways. In this case, it is important that for these predictions it is not necessary to identify all users, and this key is embedded in the application. The proposed solution has already been implemented in the built platform for collecting atmospheric air data with the architecture proposed in fig.2,[3].

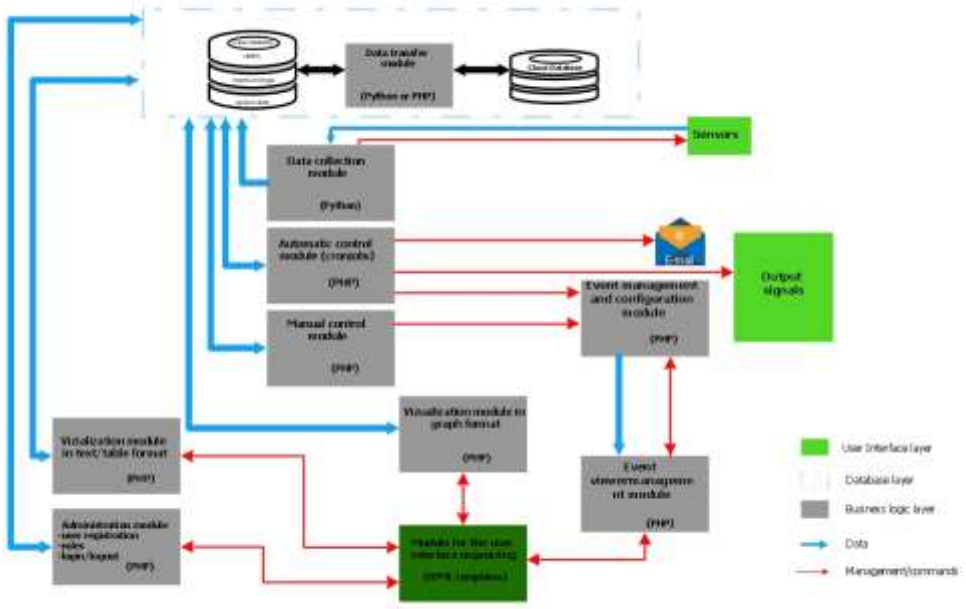


Fig. 2. System architecture for data collection and information processing

Another additional and important function is performed by the WEB application - it is possible to set an e-mail address to which a message can be sent in the event of atypical deviations in the course of the process.

**Conclusion.** An additional module for managing the local database is used in microcomputers and microcontrollers, since they have limited memory. It may be that the database has reached a critical volume and because of this all the applications on the device start working too slowly. This would complicate and confuse the drying process, therefore after each drying cycle, the collected data is sent to a cloud database and deleted from the local one.

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