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FROM HOME VERTICAL GARDEN TO FUNCTIONAL VERTICAL FARM WITH THE USE OF AUTOMATION

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INTRODUCTION

As the population grows, so does the need for resources used to produce food. The concept of **vertical plant cultivation** has the potential to respond to this demand, especially in urban and densely populated areas. The goal of this concept, on a global level, is to **increase agricultural production** per unit area. It is also closely related to **organic food production**, and aims to produce **good quality food**. The advantage of this concept is the possibility of continuous food **production throughout the year**, regardless of external factors. The concept of vertical plant cultivation inspires the question of how to transform an ordinary home garden into a "**vertical farm**". For the transition process, **automation and monitoring** are key.

AUTOMATION AND MONITORING

In the process of **transition from a home garden to a functional vertical farm**, it is necessary to ensure the supervision of the key technical parameters of the system. With that idea, **sensors are introduced into the system**.

An important step is monitoring process parameters, i.e. **monitoring of lighting, air flow and nutrients**.

Peristaltic pumps are useful for supplying nutrients.
The lighting problem can be solved by introducing **LED lighting**, and the air flow is regulated with the help of the **ventilation system**.

To manage the system's sensors and devices, a **control panel** is introduced into the process. All components related to management, in the initial stage of automation, it is useful to place them on the **motherboard**. In this way, by testing how the system reacts, the optimal level of functioning is reached. In the next phase of development, consider printed **circuit boards**, where the components are fixed and function as expected. The hardware component of the system management is a device like **Raspberry Pi**. As a software component of system management, the **MyCodo** program stands out.

An example of the functioning of such supervisory control system is shown in *Figure 1*.

Sensors measure the following parameters:

- *air temperature*
- *water temperature*
- *air humidity*
- *carbon – dioxide*
- *pH*
- *water flow*
- *electrical conductivity*
- *power consumption*

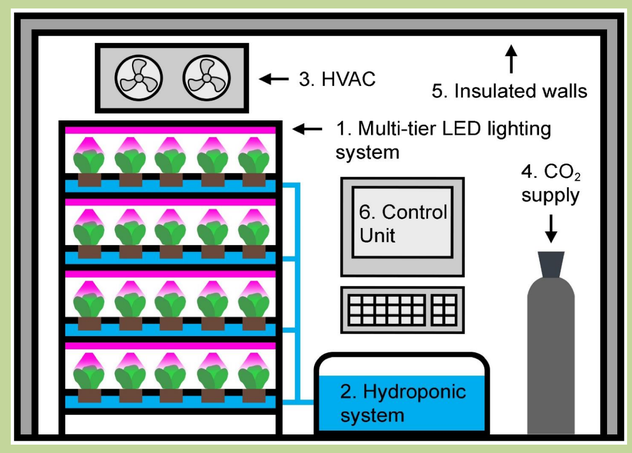

Fig 1. Supervisory control system

EXAMPLE FROM THE REAL WORLD

The concept of a vertical garden was carried out on the example of a **real plant** in an agricultural household. The idea was to carry out the process of **transition from an ordinary home garden to a vertical farm (hydroponics)**, where the main **resource** for growing plants is **water**. The conditions at the beginning of the process were domestic, but with the potential for further development. The key steps in the transition process were the **adaptation**, that is, the construction of the **physical system** and the previously described **system automation**.

To build the **physical system**, it is necessary to construct a base with water channels and the main tank, as shown in *Figure 2*. Also, make constructions for water supply and drainage, as shown in *Figures 3 and 4*, respectively.
The process of growing plants in this way was possible to continue using **existing plants** that were transferred to a **physically ready and automated system**. Furthermore, the existing plants of the system were taken for seedlings and in that way they were used to the maximum.

Fig 2. Base with water channels and main tank

Fig 3. Construction for water supply

Fig 4. Construction for water drainage

CONCLUSION

Finally, it is pointed out that the **concept of vertical cultivation of plants** has the **potential** to meet the requirements related to food production in the future. For this reason, it is becoming an increasingly interesting field of research. The great advantages of this way of growing plants are **control, improvement and maintenance of quality, all thanks to automation**. From the mentioned **example from the real world**, it can be concluded that the described **transition is feasible** even at this moment. Although the conditions at the beginning of the process are **domestic**, by **multiplying** the obtained systems it is possible to reach a professional level - that is, a **functional vertical farm**.

Key words: *vertical farms, automation, organic food production*

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