

# RESEARCH AND DEVELOPMENT OF AN ASSISTED SYSTEM FOR PERSONALIZATION AND PROGRAMMING OF MEDICINES

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**ABSTRACT:** A support system for people who need medicines with respect to a preestablished schedule is the result of a research - development process. Based on the defining influencing elements and specific methodology, two main research directions have been followed. Several concepts and design detailed elements are developed as a medicine dispenser, but with a complex structure. Also, an assisted system for personalization and programming of medicines is developed; this includes a simple medicine storage and the distribution of medicine through a web-based application, and is considered a safe system for further development.

**KEYWORDS:** *medicine, product development, web application, nursing, safe system*

## 1. Introduction

The consumption of medicines [6] is an indicator that reflects both the state of health of the population and the efficiency of the health system and services in a country. Romania is a country with a low consumption of medicines, i.e., almost half of the European average. This conclusion is maintained for both prescription and over-the-counter (self-medication) [1].

A smart medicine dispenser helps the patients for taking their medications on time, easilly, without missing pills, and reducing the risk of over/ under dosing. A such of dispenser can inform and alert the patients to take the defined dose at the right time. It assures communication between patients and caregivers, notifying in case the patient missed the pill. Also, it includes an application on smartphone which will allow to remotely manage and control pill schedules and usage data [10].

An automatic dispenser of medicines is realised with the main function of remote and real-time monitoring of the activities of the elderly patients in home environment. It includes alarming whwn the omission of medicines and other critical events take place. The monitoring system consists of wireless sensor nodes distributed in the patient house. The tests demostrated the correct operating and the utility of the system [11].

The main objective of the present paper is to develop and analyse an innovative medicine dispenser, and an assisted system for personalization and programming of medicines, as support for people who need medicines according to a certain schedule.

The assisted system for personalization and programming of medicines is envisaged as accessible to the use of people in need or of the medical staff who care them.

## 2. Business strategy

### 2.1. Need analysis

For this analysis, the main needs have been identified. In the same time, a questionnaire was made [2, 4] in order to identify the needs of potential users. The questionnaire was distributed to a sample of 300 people, of whom 182 replied.

The characterization of the expressed needs/ requirements is presented in Table 1.

Table 1. Need analysis

Need	Parameter	Value
To provide treatment for the necessary period	Storage space	28 compartments (14 compartments for storage, 14 for collecting)
Have easy access to medicines in the compartment	The size of the compartments	50 mm x 40 mm x70 mm (bottom compartments are removable)
Have stability	Metal disc/ suction cups	2 units
Have autonomy	Batteries	3300 mAh
Be paired with a smartphone	Mobile app	-
Have a visual alert	LED	1/ compartment
Have audible warning	Buzer	80 dB
Indicate battery level	Lcd Screen	1
Confirm that the drug has been taken	Proximity sensor	Detection distance 4 mm
To announce when the storage space is empty	Proximity sensor	Detection distance 4 mm
Not accessible to children	Locking system	1 unit
Be affordable	Price	< 300 RON
Be easy	Table/ Material	max. 500 g

## 2.2. Functions and characteristics of potential solutions

A requirement analysis on function – potential solution characteristics has been unrolled, and main results are as presented in Table 2.

Table 2. Functions and characteristics of the potential solutions

	Function	Characteristics of the potential solutions
1	Storage of medicines	Transparent polymer boxes
2	Accessing medicines	Side-closure cover
3	Protection of medicines	Sterile environment, without disruptive factors
4	Managing medicines to the user and informing them	Developing a web application

Certain core system functions have been defined. The system must be simple and easy to physically reach. At the same time, the costs of producing an advanced automated personalization and medication programming assisted system were taken into account.

## 2.3. Market segmentation

An analysis of different national cultures showed no differences in the habits of taking medication with the help of certain product, and customers who purchased medication personalization and programming assistance systems, regardless of race or religion, used these products in the same way. Therefore, it was concluded that a geographical segmentation of the market for the proposed product is not necessary.




After meeting with professionals in the medical field, the following information was obtained regarding the storage of medications under optimal conditions for their intended use:

- the pills need to be kept in the original packaging for proper hygienic use, but they can be removed from the package and stored in a dry and disinfected place
- pills/ capsules need to be stored at a temperature below 25°C
- syrups/ medicines in glass containers cannot stand in direct light
- the injectable needs to be stored only in the refrigerator
- capsules/ pills may stay in contact with other drugs of the same type.

## 2.4. Competing products

As a result of the documentation, among the most relevant products comparable to the present idea resulted 3 competing products out of the 30 analyzed both on the Romanian market and in other states, as shown in Table 3 [7, 8, 9].

Table 3. Competing products

No. crt.	Product	Features	Advantages	Disadvantages
1		Material: plastic. Size: variable.	Large partitioning. Simple locking. Compartmentalization is single or divided. Low price: 1.7 euro/pc	Manual safety system.
2	 Ezy Dose (7-Day) Pill	Dimension: 14.5 x 14.5 x 4.2 cm. Material: plastic. Number of compartments 7. Bluetooth.	Setting up is simple, but requires some technical knowledge. The alarm is loud enough to wake up from sleep.	The lid is not easy to close safely. The rotation does not lock, it can rotate freely. Very small compartments.
3	 MedQ Daily Pill Box	Material: plastic. Number of compartments 14.	Provides treatment for 14 days. Visual warning to indicate container.	No locking system for compartments. You can schedule one to two alarms a day. High price/ \$ 80.

## 2.5. Target customer profile

Statistics indicate that both males and females have an equal interest in acquiring personalized drug programming and assistance systems, as they both desire to uphold an organized way of living.

Acquiring revenue is a crucial factor to consider. One valuable market for purchasing personalized and programmed medication systems to save time for nurses are hospitals and nursing homes. Although the centers are the purchasers, the ultimate beneficiaries of this product are the patients and residents receiving treatment.

## 3. Development of technical solutions

To deal with the intricate process of evaluating numerous product concepts, selection is commonly executed in two stages. The first stage involves sorting out the concepts to quickly obtain some feasible options. This is a rough, preliminary assessment. The second stage is the concept evaluation, a more precise and detailed evaluation of the chosen few concepts. The ultimate goal is to choose a single concept with the highest probability of leading to a successful process [3].

### 3.1. Development of an innovative medicine dispenser

Different concepts of an innovative medicine dispenser have been created, as presented in Fig. 1.

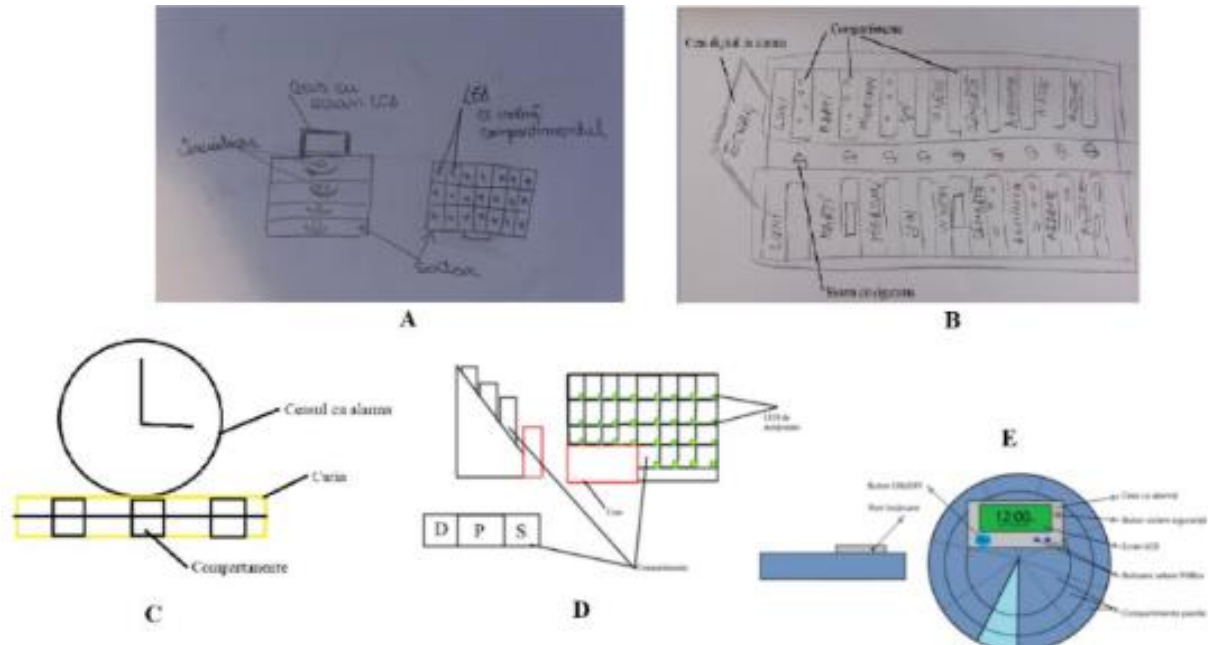


Fig. 1. Concepts on an innovative medicine dispenser

After analyzing and comparing the concepts, the second concept was selected for further development, which best takes into account the needs expressed by consumers. It offers generous compartment divisions and is also designed for primary needs, with mechatronic drive and LCD display. In addition, an automatic security system is included so that the compartments can be opened via an integrated system. Subsequently, the variant was analyzed and further developed, until at a certain point it was realized that its development is more difficult from manufacturing cost point of view [5].

The innovative medicine dispenser has been designed as a box with compartments dedicated to the medication and a LED in each of these, to indicate the medication to be administered, a clock-like screen equipped with a software system and a system for securing the compartments to be not easily opened by children (Fig, 2).

The considered innovative medicine dispenser product is a complex one, i.e. is expensive to be in detail designed, manufactured and sold.

So, the second research direction has been developed for achievement an assisted system for personalization and programming of medicines.



Fig. 2. A 3D model of the innovative medicine dispenser

### 3.2. Development of an innovative assisted system for personalization and programming of medicines

This system has been created with the aim to storage the medicine in a simple manner, and to distribute medicines to patients through a web application.

So, the medicine storage is in boxes of different sizes with a simple security system and an electronic label showing the patient's name and the dose to be taken (Fig. 3).



Fig. 3. Medicine storage boxes [7]

The interface of a medicine management application includes information that the user - medical professional or the patient - will enter into the system: patient's name or/and designation of the medicinal product and the frequency of hourly administration (Fig. 4).

**MedAdmin**

21:15:40

Numele pacientului:  Denumirea medicamentului:  Numele asistentei:  Număr de administrări/zi:

[Adaugă pacient](#)

Numele pacientului	Denumirea medicamentului	Numele asistentei	Număr de administrări/zi	Ultima administrare	Următoarea administrare
<a href="#">Șterge ultima înregistrare</a> <a href="#">Șterge toate înregistrările</a>					

Fig. 4. Entering data into the system

The user updates each administration, and this will keep a record of the administrations (Fig. 5).

**MedAdmin**

21:15:18

Numele pacientului:  Denumirea medicamentului:  Numele asistentei:  Număr de administrări/zi:

[Adaugă pacient](#)

Numele pacientului	Denumirea medicamentului	Numele asistentei	Număr de administrări/zi	Ultima administrare	Următoarea administrare
Dinea Laurentiu	Paracetamol	Anastasia Ionita	2	04/05/2023, 21:15:15	05/05/2023, 09:15:15
<a href="#">Administrare medicament</a> <a href="#">Șterge înregistrarea</a>					
Brabu Radu	Ibuprofen	Popescu Ioana	4	04/05/2023, 21:15:16	05/05/2023, 03:15:16
<a href="#">Administrare medicament</a> <a href="#">Șterge înregistrarea</a>					
Andritoiu Alexandru	Panadol	Anastasia Ionita	3	04/05/2023, 21:15:16	05/05/2023, 05:15:16
<a href="#">Administrare medicament</a> <a href="#">Șterge înregistrarea</a>					
<a href="#">Șterge ultima înregistrare</a> <a href="#">Șterge toate înregistrările</a>					

Fig. 5. Last administration

The development of the application permits as each user to have an unique account, and alerts when it is the time to take the medication.

#### 4. Conclusions

A medicine dispenser and an assisted system for personalization and programming of medicines have been developed, as innovative supports for people who need medicines according to a preestablished schedule.

The innovative medicine dispenser has been overall characterized as being of a complex structure, with impact on manufacturing cost.

The innovative assisted system for personalization and programming of medicines has been developed so that to includes a simple medicine storage and the distribution of medicine through a web-based application, and is considered a safe system for further development.

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