Design of Multi-Function Positioning Key-link

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Abstract

It is generally accepted that personal and property security serves as the priority of all citizens and cornerstone of national security and stability, and wasting time and energy looking for keys every time before going out has greatly affects our efficiency. In this regard, we designed a multi-functional keychain featuring on positioning to save people from such troubles and improve their efficiency. As one of the wireless signal digital equipments, the product is composed of control unit chip, infrared ray and USB interface. The product is designed in the form of intelligent charging, one-button start-up of mobile phone APP, low power consumption and easy operation. Combining with the S-shaped evolution curve, causality analysis, morphological analysis and IFR in TRIZ theory, the two improvement directions of the system are obtained. The system is obtained by using the completeness rule, function analysis, object field analysis, nine-screen diagram, physical contradiction, 76 standard solutions and other tools. A series of schemes have been put forward. Finally, we evaluate these schemes and analyze their functional value to get the final scheme. Finally, we evaluate these schemes and analyze their functional value to get the final scheme. It realizes the combination of smart chip and mobile phone APP operation, single-machine locating button line locating mode, keys vibrating and luminous and sound alarm, and banknote checking, lighting, storage and alarm functions as well as an integrated positioning system.

Keywords: outdoor rescue; positioning; TRIZ

1. Description of project

1.1

1.2 project source

With the rapid development of science and technology in the 21st century, people's living standards have been greatly improved and the pace of life has been greatly accelerated[1] . However,

they waste a lot of time searching for things in life which inevitably makes people feel impatient.In the past, people constantly updated their transportation tools to save time, but now they are always wasting time under their eyes, as shown in figure 1. For this reason, we designed a multi-functional positioning key chain with a micro structure, which integrates positioning, alarm, storage and other functions into a whole, so that you can avoid trouble and improve work efficiency.

Figure 1. Common situations in life

We design a multifunctional positioning key chain belongs to the field of wireless signal digital product equipment, using control unit chip, infrared and USB interface. The robot features smart charging, one-click startup of mobile APP, low power consumption and convenient operation[2] .

1.3 problem description

Table 1.1 problem description table

Question number	Question	detailed description
1	Small volume	The key ring is too small
2	quality	If the key chain is too heavy, it will affect the user experience. If it is too light, it will fall unconscious
3	Functional weak	The traditional key chain is just for decoration
4	Low availability, low recovery value	Traditional key chain are plastic products, difficult to recycle, difficult to degrade.

1.4 significance of the project research

Does not appear on the market at present too many items of science and technology and life fusion products, except for a few electronics is a blend of cutting-edge technology, the most common household items also stagnation in the general function, if can make all sorts of living things are as much as key functional, convenient it can enrich our life, save the time, release the Labour force.

Table 1.2 Table of main technical parameters

Parameter number	Parameter name	Parameter Requirements
1	volume	≤90cm³
2	quality	≤150g
3	Power Supply	High Density Core
4	control	Microcontrol Unit Chip
5	display	light-emitting diode

2. Initial situation analysis of invention problem

2.1 working principle of the system

The control interface appears after opening the APP， The key chain vibrates, emits light and gives sound alarm. In addition, the multi-function key chain itself has additional functions. On the key chain of the single machine, the banknote detection button is used for banknote detection[3]. Double click the check button for the lighting function; Push the button to store the usb flash disk, press the single alarm button, automatically connect to the mobile APP, and inform the family members (the first contact) in the first time.

2.2 main problems

The difficulty of multifunctional fusion lies in that each additional function means that it needs to occupy more space[4] . How to put so many accessories in the narrow space is the main problem to achieve multifunctional key chain.

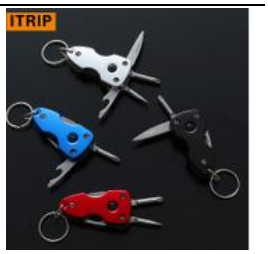
2.3 Restrictions

(1) the miniaturization technology of energy components is not mature;

(2) more functions need corresponding larger volume;

2.4 current solutions and existing problems and deficiencies

Table 2.1 current solution table

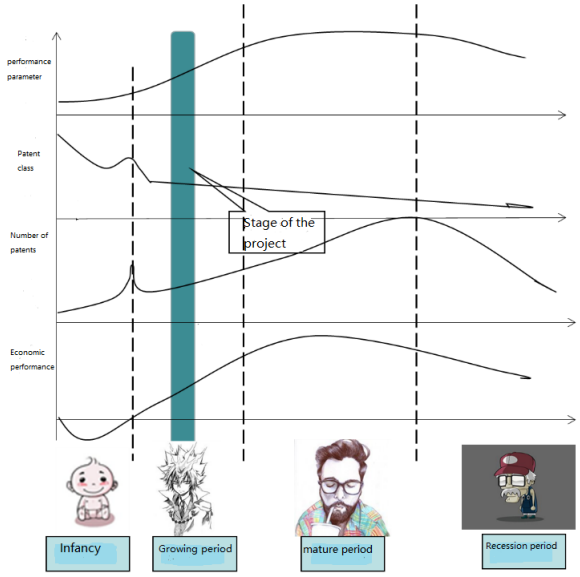
Existing programs	implementation	Problem solved	deficiencies	The pictures
Multi-function combination tool key chain	Using knives, wine and other functions combined together	Enhanced the use of key chain function	Once lost cannot be found	
Usb key chain	Usb flash drive and key chain combination	Realize electronic information storage function	Less functionality, lost cannot be found	
Anti-loss patch wallet buckle	Mobile APP starts with one click	Prevent lost to forget	Not waterproof, less function	

Part two: system analysis

3. System analysis

3.1 s-shaped curve

As shown on the left, the s-shaped evolution curve of the multi-function key chain. After consulting relevant data, it can be seen that the related patents of multi-function positioning key chain are concentrated on invention patents, with better performance parameters. However, for some devices, further optimization is needed. To sum up, we judge the multifunctional key chain in the growth period[5] .



The strategies for the growth period are as follows:

(1) optimization is the main method to develop engineering systems;

(2) constantly apply the system to new fields;

(3) try to find solutions that compromise and reduce disadvantages.

FIG. 3.1 s-shaped curve

By analyzing the function of the key chain with less causality, we can find out the causes leading to the key chain function can not be too much, and based on these reasons, we can get 18 solution directions, and the reason 1.5 is the natural reason, do not discuss, the solution direction is shown in table 3.1.

Table 3.1 solutions 1 -- 15

Source of problem	The solution
1.1.1 sufficient energy should be loaded	Solution 1. Increase the energy density of the battery
	Programme 2. Seek to improve the efficiency of energy utilization
	Programme 3. Use of efficient energy sources
	Scenario 4. Use external energy
1.1.2 key chain occupies a large volume	Programme 5. Use of efficient ballast
	Option 6. Do not use a larger signal board

1.1.3 various internal systems	Programme 7. Tailoring of internal structures
	Programme 8. Use of efficient equipment
1.2.1 it takes time to receive and process signals	Scheme 9. Efficient signal processing system
	Option 10. Replace a new signal transmission mode
1.2.2 low durability	Scheme 11. Use of wear-resistant materials
	Programme 12. Switch to waterproof materials
1.2.3 low battery efficiency	Programme 13. Conversion to efficient energy storage facilities
1.3.1 different types of workers wear them in different ways	Scheme 14. Adopt multiple colors and product appearance modeling
	Scheme 15. The improved functional modules can be connected in series

3.2 final ideal solution (IFR)

The establishment of the final ideal solution (IFR) is shown in table 3.2:

Table 3.2 analysis table of final ideal solution

The problem	The results of the analysis
Design goals?	Design a variety of functional types, province, wear-resistant waterproof suitable for a variety of work industry multi-functional key chain
Ideal end result?	Multi-function key chain can achieve a variety of functions
What is the barrier to the ideal solution?	Limited energy source storage, in a limited space to complete a variety of functions of the larger volume
What causes the disorder?	Multifunctional key chain battery endurance is limited, less selective materials
What are the conditions for the absence of such obstacles?	Simplify the internal structure, optimize the shape design, using a variety of propulsion methods combined.
What are the resources used to create these conditions?	Electrical energy, control board, intelligent circuit board system, mechanical mechanism.

Through the analysis of the final ideal solution, we get the final ideal solution is the multi-

function key chain can realize various functions[6] . By comparing the 40 solution directions with the final ideal solution, we select 9 solutions close to the final ideal solution, which are:

Table 3.4 solutions 26 -- 35 close to the final ideal solution

Package number	Content of project
Scheme of 16	Increase the efficiency of energy utilization, thus reducing the volume. After reducing the volume, on the one hand, it enhances the usage, on the other hand, it also provides conditions for the users to choose the original demand mode.
Scheme of 17	Using external energy, the charging mode saves the carrying battery space and reduces the volume.
Scheme of 18	Does not use the large volume circuit board, reduced the volume.
Scheme of 19	Improve the key chain material, so that it has a flexible function, bring more comfortable use.
Scheme of 20	Vector propulsion is adopted to enhance the flexibility and the contractibility of the U disk.
Scheme of 21	Improving an external structure that allows us to search for objects faster.

After the analysis of the system, we have summarized the following five problems to be solved:

Problem to be solved 1:

The system has the problems of insufficient energy, low power storage and low efficiency.

Problem to be solved2;

How to use external energy to achieve the required function, reduce the volume of multi-functional positioning key chain.

Problem to be solved3;

Volume. Large size for carrying more functional modules; Small in size so that it can be carried easily.

4. TRIZ tools

4.1 problems to be solved

Through the previous analysis, we found that the system has problems of insufficient energy, low power storage, low efficiency and volume size.

4.1.1 functional analysis

In order to improve the power storage device, optimize the driving device, to solve the problem of low efficiency and large volume, we analyze the function of the multi-function positioning key chain in the positioning system.

The main function of the positioning system is to provide the location of the key chain, including alarm prompt and vibration prompt.

Positioning system components are: opening device, control device, transmission device, light device, vibration equipment.

Supersystem components are: housing, external environment.

Our analysis of powertrain and supersystem components is shown in table 4.1.

Table 4.1 component analysis table

	Open the device	Control device	Transmission device	The light source device	Vibration equipment	shell	The external environment
Open the device							
Control device	+						
Transmission device	+	+					
The light source device	+	+	-				
Vibration equipment	+	+	-	-			
shell	-	-	-	+	+		
The external environment	-	-	-	-	+	+	

In the above table, "+" means there is an effect between the two, and "-" means there is no effect between the two, or the effect has no effect on the optimization system, or the improvement in this aspect is unrealistic.

The interaction of each component is shown in table 4.2.

Table 4.2 component interaction analysis table

Feature vector	role	Feature objects	Change the parameters	Function type	Performanc e level
Open the device	open	Control device	Working state	good	The appropriate
Control device	control	Transmissi on device	Working state	good	The appropriate
Open the device	open	The light source device	Working state	good	The lack of
Open the device	open	Vibration equipment	Working state	good	The lack of
Control device	control	The light source device	Open state	good	The appropriate
Control device	control	Vibration equipment	Working state	good	The appropriate
The light source device	reflection	Shell device	Open state	harmful	
Vibration device	vibration	Shell device	Working state	good	The appropriate
The external environme nt	control	Shell device	Working state	harmful	

We sorted out the functions of the above multiple pairs of components and built the functional model as shown in figure 4.2:

Figure 4.2 functional model diagram

From the functional model diagram, we found the beneficial effect of multiple deficiencies and one harmful effect. How to eliminate the harmful effect, enhance the insufficient effect and simplify the functional model are our next goals.

4.1.2 simplified model

Open device such as switch, automatically control the circuit board to make the positioning key chain work; To increase the usability of the function, we want to have more energy devices, that is, to improve the energy storage devices and replace the battery output with charging devices.

We use function transformation to convert the opening device into an intelligent charging device using USB excuse to store electric energy with the original battery opening mode. The traditional way of power storage is transformed. The function redistribution process is shown in figure 4.3 (b).

1. The light source device is driven by the transmission device to realize the additional function of positioning key chain. We clipped the equipment out of the system, and realized the additional function of positioning key chain. The light source system was clipped out and replaced with another functional module, which turned into LED energy saving and luminous function.

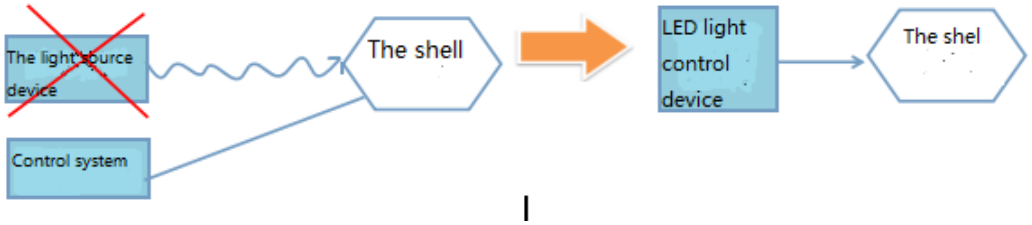


Figure 4.4 function clipping diagram

However, a single positioning key chain cannot meet our needs for daily life. We use the combination principle of 40 principles of invention to set a usb flash disk socket in a mutually symmetrical position, which can increase the function of the key chain.

But usb drives require additional electronic components, which increase the size of the multi-function latch and require a more complex control system.

To solve this problem, we can take two solutions.

Solution one: change the structure

Within the charging device located in the side of the key chain multi-function electric energy storage, has simple structure, convenient operation, and the internal circuit board of compactness can reduce the volume of a positioning key chain, we can across the USB excuse to increase the capacity of a storage of electronic information, which add a USB device, a circuit board for the design of parallel structure. See figure 4.5.

(a) charging function circuit board

(b) usb circuit version

Figure 4.5 picture of multi-function positioning key chain circuit board

However, due to the lack of spatial degrees of freedom, the two structures were placed in parallel, and the volume we used was increased. We used object field analysis and converted it into a two-object field model by using 2.1.2 of 76 standard solutions.

4.2 nine-screen method

Table 4.3 solutions 22 -- 23 after resource analysis

Serial number	Package content	Program evaluation
plan22	Install the USB interface and U disk interface on the buckle of the positioning key chain at the same time	Only the two circuit boards need to be connected in parallel inside the fuselage, which can not only charge, but also store and read information.
plan23	Replace ordinary infrared light with LED light	The use of LED lights a little bit, to save energy consumption, in addition to the use of circuit board control principle, the button is pressed, that is, a check function, long press the button, lighting function.

4.3technical contradiction and physical contradiction

4.3.1 physical contradiction

For multi-function positioning key chain, we both need it to be large, in order to carry more equipment; It also needs to be small so that it can be stored and placed. This puts forward the technical requirements of "both large and small" for the volume of multi-function positioning key chain, which constitutes a pair of physical contradictions.

The following table is the corresponding principle table of the invention for each separation principle:

Table 4.8 separation principle and invention principle

Separation principle	The invention principle
Spatial separation	2, 4, 8, 12, 13, 24, 27
Time to separate	12, 15, 18, 25
Conditions for separation	2, 8, 12, 13, 14, 18, 36

For this physical contradiction, we decided to adopt the principle of conditional separation and try the corresponding 12 innovative principles one by one. A better scheme is listed in the following table:

Table 4.9 improvement plan 24 -- 28

Serial number	The invention principle	Package content
Plan24	1. Separation method	We can try to separate some part of the multi-function location key chain, so as to facilitate people's life.
Plan25	5. Grouping method	The robot is designed to be modular and can be combined in different ways in different situations.
Plan26	7. Nesting method	Put the small one inside the big one.
Plan27	14. Curved surface method	Make the shell irregular and close to the internal parts, reducing internal voids and reducing the volume.
Plan28		Use flexible materials to reduce space

For not being able to enter the narrow space, we adopt the separation principle of 40 principles of invention to separate the detection equipment from the main body and get two solutions.

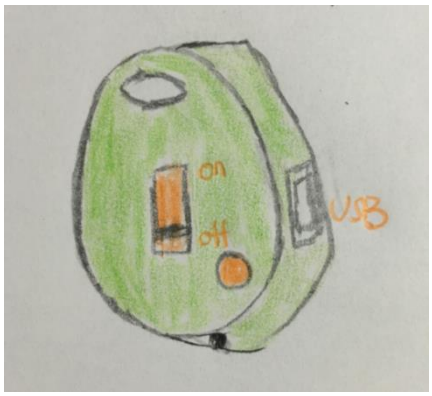
Solution one: complete separation

We are trying to separate a part of the multi-function location key chain so that it can facilitate people's life.

According to the principle of multifunctional positioning key chain system completeness, we know that a single detection device cannot complete the operation, and the detection device itself needs to add a complete power system, that is, the detection device itself is a smaller device.

We adopt the feedback principle of the invention principle and introduce the feedback system to realize the function.

As shown in the figure below, when the multi-function positioning key chain is working, the key chain will make an alarm sound and vibrate. You can use the mobile APP for real-time control.



Control key

(1) power ON: push up the control key to ON, and the device will be turned ON when "beep" is heard.

(2) shutdown: push down the control key to the OFF position. When a long sound of "di" is heard, the device will be closed.

(3) connect the device to the mobile APP.

(4) interface functions

（5）Device options Settings

(a) automatically connect to the anti-loss device after starting the machine. If it is shown as "disconnect", click the "connect" button.

(b) click the refresh button to add multiple anti-loss devices, such as keys, bags and so on.

The multi-function key chain can be operated by the combination of smart chip and mobile phone APP. After opening the APP, the control interface will appear. The single device search button will locate and search mode. Double click the check button for the lighting function; Push the button to store the usb flash disk, press the single alarm button, automatically connect to the mobile APP, and inform the family members (the first contact) in the first time.

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Category: 5. **Blockchain** – applications with TRIZ innovations