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GENTRIFICATION OF THE INNOVATIVE STARTUP ECOSYSTEM

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Abstract

The article examines conceptual and organizational approaches to the formation and development of an innovative startup ecosystem located within production facilities in industrial areas that have undergone gentrification, comprehensive reconstruction, and systemic revitalization. Particular attention is paid to the horizontal and vertical integration of technical, structural, and technological solutions, as well as to the organization of the startup company's research, consulting, and educational activities. *The article discusses Kseniia Kaplieva's concept of the functional structure of an innovative startup, including technological project support, selection of standards and components, preparation of technical documentation, development of patent and licensing strategies, and the application of artificial intelligence and artificial neural networks in monitoring and control systems.* Using an optics-focused startup as an example, the article analyzes potential applications of a light-emitting apparatus with an integrated emitter in machine vision, microscopy, endoscopy, surgical illumination, nuclear facility inspection, and underwater illumination systems. The importance of using standard components in the development of initial prototypes is emphasized as a means of reducing costs, identifying structural and circuit design errors at an early stage, and improving investment efficiency. The article demonstrates that the integrated application of scientific and technological developments, intelligent monitoring systems, prototyping, patent and licensing strategies, and modern production infrastructure is an important prerequisite for the successful development of an innovative startup and the achievement of the desired final result.

Keywords: *Gentrification of startup production facilities, revitalization of startup production facilities, industrial territory ecosystem, industrial territory infrastructure, optical specialization of the startup, fundamental issues of horizontal and vertical integration of technical, structural, and technological solutions, final integrated solution, production facilities as part of the industrial territory ecosystem, comprehensive reconstruction and systemic revitalization, development of a licensing strategy, supporting targeted training in the detailing of materials and processes*

What are the conceptual and organizational solutions for a startup company proposed by Kseniia Kaplieva, a well-known specialist in smart home and smart production facility technologies.

1. The company should have a scientific and research division with additional functions of interactive consulting and scientific and technological training.
2. The startup's clients may include startups, for example, those specializing in the chemical and pharmaceutical fields, that require professional support and accompanying targeted training in the detailed aspects of materials and processes that are the subject of development by each specific startup.
3. At the request of its clients, the startup company develops and models the technological route in the necessary detail, after which, on the basis of the development, it prepares a program and methodology for interactive training sessions, as well as technical requirements and conditions for finding the most suitable partner to manufacture the necessary semi-finished products and materials.
4. The startup company prepares all the necessary technological instructions for the client to implement the project.
5. The startup company selects the necessary applicable standards for the client to control and support the project development process.
6. Based on the developed technical requirements and conditions, as well as the requirements of the standards, the startup company prepares a draft agreement with the manufacturer, including a protocol and methodology for the handover and acceptance of completed orders.
7. If the client is interested, the startup company prepares basic materials for patent protection of the project and the development of a licensing strategy.
8. At the request of clients, the startup company prepares scientific and technical reports on conducted research and experiments, laboratory studies, and experimental technological work.

Fundamental issues of horizontal and vertical integration of technical, structural, and technological solutions under conditions

of the complex uncertainty of reality and the success of the final integrated solution are particularly relevant for startups located in production facilities as part of the ecosystem of industrial territories that have undergone all stages of gentrification, comprehensive reconstruction, and systemic revitalization. In this situation, conceptual and organizational solutions for building their functional structure, aligned with the classical principles of startup ecosystem theory, acquire exceptional importance.

What are the conceptual and organizational solutions for an innovative startup company proposed by Kseniia Kaplieva, taking into account systemic options for control and management with elements of artificial intelligence and artificial neural networks.

9. The company should have a scientific and research division with additional functions of interactive consulting and scientific and technological training.
10. The startup's clients may include startups, for example, those specializing in the chemical and pharmaceutical fields, that require professional support and accompanying targeted training in the detailed aspects of materials and processes that are the subject of development by each specific startup.
11. At the request of its clients, the startup company develops and models the technological route in the necessary detail, after which, on the basis of the development, it prepares a program and methodology for interactive training sessions, as well as technical requirements and conditions for finding the most suitable partner to manufacture the necessary semi-finished products and materials.
12. The startup company prepares all the necessary technological instructions for the client to implement the project.
13. The startup company selects the necessary applicable standards for the client to control and support the project development process.
14. Based on the developed technical requirements and conditions, as well as the requirements of the standards, the startup company prepares a draft agreement with the manufacturer, including a protocol

and methodology for the handover and acceptance of completed orders.

15. If the client is interested, the startup company prepares basic materials for patent protection of the project and the development of a licensing strategy.
16. At the request of clients, the startup company prepares scientific and technical reports on conducted research and experiments, laboratory studies, and experimental technological work.

As an example, Kseniia Kaplieva proposed “Possible applications of the invention Light Emitting Apparatus with Integrated Emitter”.

1. Machine vision. Automated production requires the operating area to be illuminated with uniform monochromatic light. Lasers and laser diodes produce speckle patterns during operation and are unsuitable for use in devices for illuminating production facilities, especially those presented as part of the innovative startup ecosystem.

Speckle (from the English word *speckle* – spot, fleck) – a random interference pattern that is formed by the mutual interference of coherent waves having random phase shifts and/or a random set of intensities. In such a pattern, as a rule, light spots and speckles separated by dark areas of the image can be clearly observed.

It is necessary to note Kseniia Kaplieva’s original innovative concept for selecting standard components for the electronic parts of prototypes. This makes it possible to assemble circuit solutions at all stages of testing the operability of technological and structural solutions and to avoid additional expenditure of funds and time until the feasibility of achieving the ideal final result of the prototype has been verified.

Figures 5–11 show, as an example of component selection, housing and basic components for circuit variants of control and monitoring systems in electronic units and modules of the electrical and electronic parts of prototypes.

This possibility of developing circuit solutions for prototypes at the earliest stages of innovative projects makes it possible to eliminate schematic and structural errors and thereby ensure maximum investment efficiency in the project.

The development of prototypes from standard components also makes it possible to create experimental and control samples for comparative evaluation of the results of each stage, which makes it possible to select the optimal option for the next stage of testing, determining the best possible solution for achieving the ideal final result already at the initial stages of project development.

Figure 1. *The figure shows a spectrometer that is widely used by startups specializing in optics as a monitoring instrument when testing prototype variants of innovative technologies*



A speckle pattern – a pattern that is formed, for example, when randomly inhomogeneous objects, such as a rough surface, are coher-

ently illuminated, or when coherent radiation passes through a transparent medium with a spatially fluctuating refractive index.

Coherent radiation can be produced both by lasers and by conventional broad-spectrum light sources with an extended luminous body emitting partially coherent light with a short temporal coherence length and a small spatial coherence area.

Due to the inhomogeneity of the Earth's atmosphere, as well as its turbulence, speckle patterns are clearly visible, for example, in highly magnified photographs of stars taken with ground-based telescopes, which may reduce the quality of the resulting images.

Figure 2. *The figure also shows a spectrometer that is widely used by startups specializing in optics as a monitoring instrument when testing prototype variants of innovative technologies*



Thus, waves from observed cosmic objects entering a telescope have random phase delays, while the interference pattern in the focal plane (a mosaic of spots) continuously changes – the image of the object appears to “boil”.

Nevertheless, speckle patterns can also serve as a source of additional measurement information.

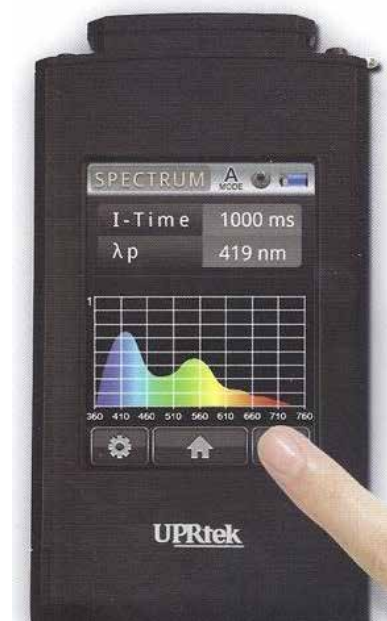
The analysis of speckle patterns is successfully used to study close binary stars.

While spectroscopic measurements provide the orbital dimensions of stars in a binary system in linear units (in AU), the analysis of speckle patterns provides them in angular units (in arcseconds).

Comparing these data makes it possible to determine the distance to the system. Moreover, since the main result of studying the orbits of stars in a binary system is the determination of the masses of their components, the analysis of speckle patterns makes it possible to significantly increase the number of stars for which the mass has been determined.

When studying a surface, the speckle pattern contains information about the microrelief and shape of the object, the near-surface layer, and the distribution and movement of scatterers within it.

Figure 3. *The figure also shows a spectrometer in operation, which is widely used by startups specializing in optics as a monitoring instrument when testing prototype variants of innovative technologies*



Thus, statistical processing of speckle patterns can provide information about

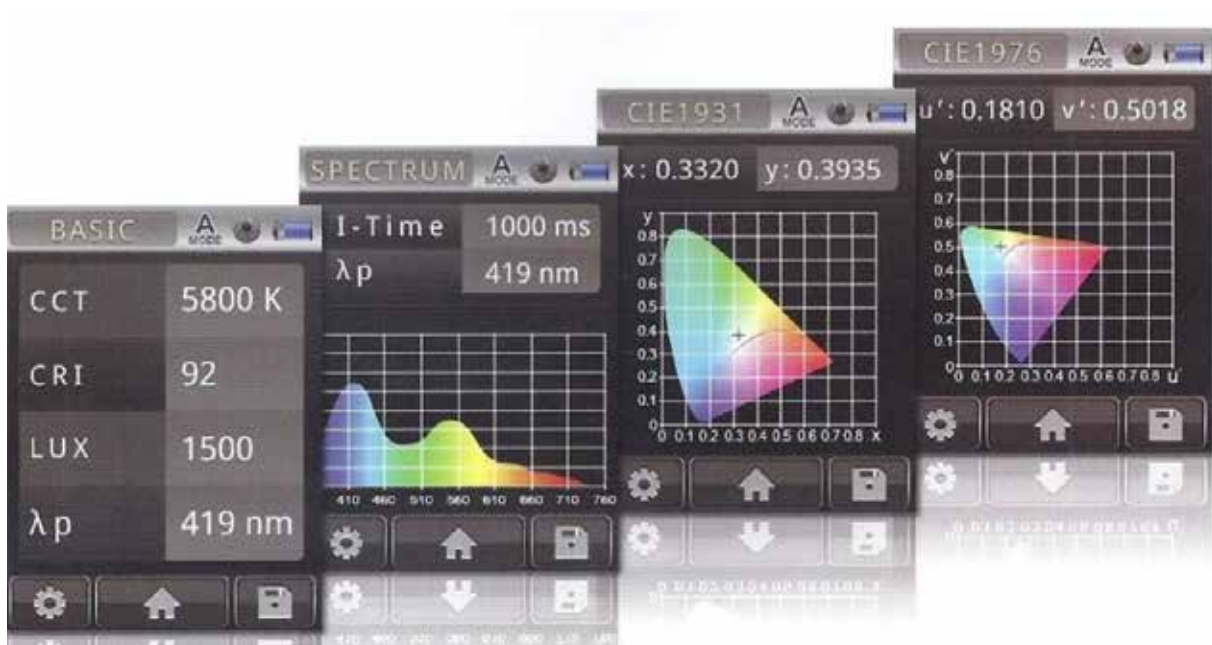
such parameters as displacement, velocity of movement, including that of scatterers in the near-surface layer, amplitude and frequency of vibrations, etc., changes in which may be caused both by controlled deformations, displacements, and internal mass transfer, as well as by random processes such as chemical transformations and phase transitions, abrasion resulting from friction, deposition, condensation or evaporation of particles on the surface, heating, etc.

According to Kseniia Kaplieva, the speckle pattern can be used for the subjective assessment of visual defects.

When radiation containing a speckle pattern enters the human eye, a granular image is formed on the retina.

Movement of the observer's head produces different effects depending on the condition of the visual system.

Figure 4. The figure shows, as an example, a system of monitoring modules that, during online real-time monitoring and control of a prototype of a startup's innovative product, assess its actual ability to achieve the ideal final result, which determines the level and nature of the project's success



Thus, an observer with normal vision sees a changing speckle pattern perceived as chaotic flickering of spots. An observer with hyperopia sees the spots of the speckle pattern moving in the same direction as the movement of the head, while an observer with myopia sees them moving in the opposite direction. The perceived speed of movement of the spots is directly proportional to the degree of refractive error.

Light-emitting diodes used to form speckle patterns do not provide uniform illumination, their brightness is lower, and, in addition, LED radiation is non-uniform in the far field. A suitable option here is the version of the specified invention with a droplet

of phosphor at the end of the fiber, in which case the size of the luminous body will be determined by the diameter of the droplet – 100–150 μm , or by the diameter of the fiber core – 30–50 μm .

This is three times smaller than that of an LED, and, in addition, the light will be more uniform.

The cost of a machine vision system ranges from 2–3 thousand dollars to 25–50 thousand dollars. According to preliminary estimates, the proposed light-emitting apparatus should be 35–50% less expensive in any design and any configuration version of the apparatus.

Figure 5. *The figure shows the concept of selecting basic components for the first prototypes developed by an optics-focused startup*

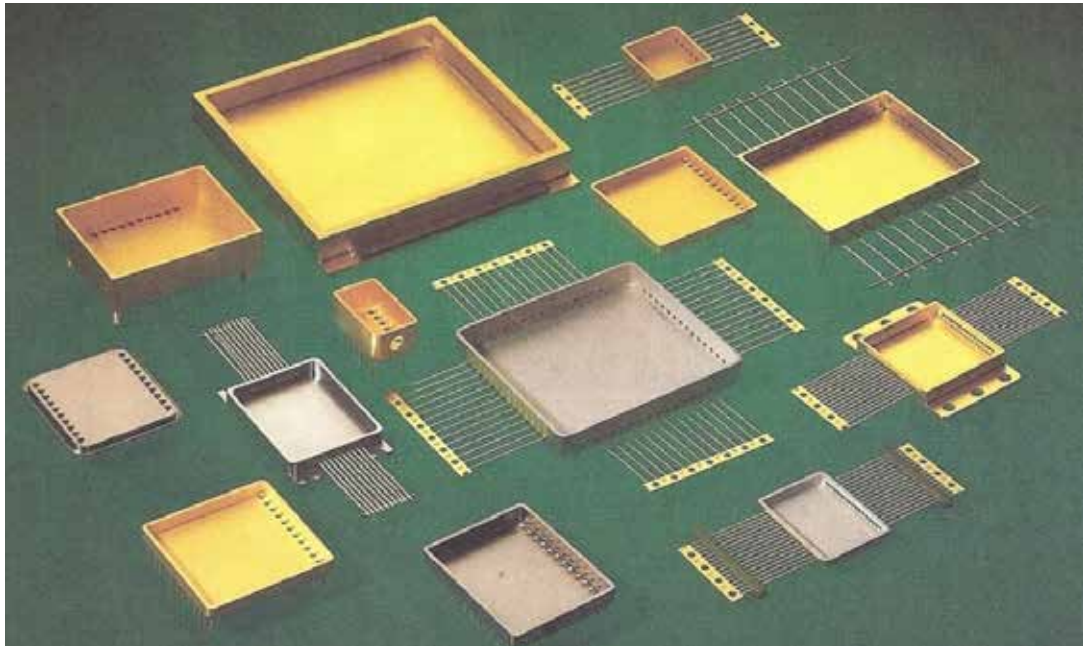
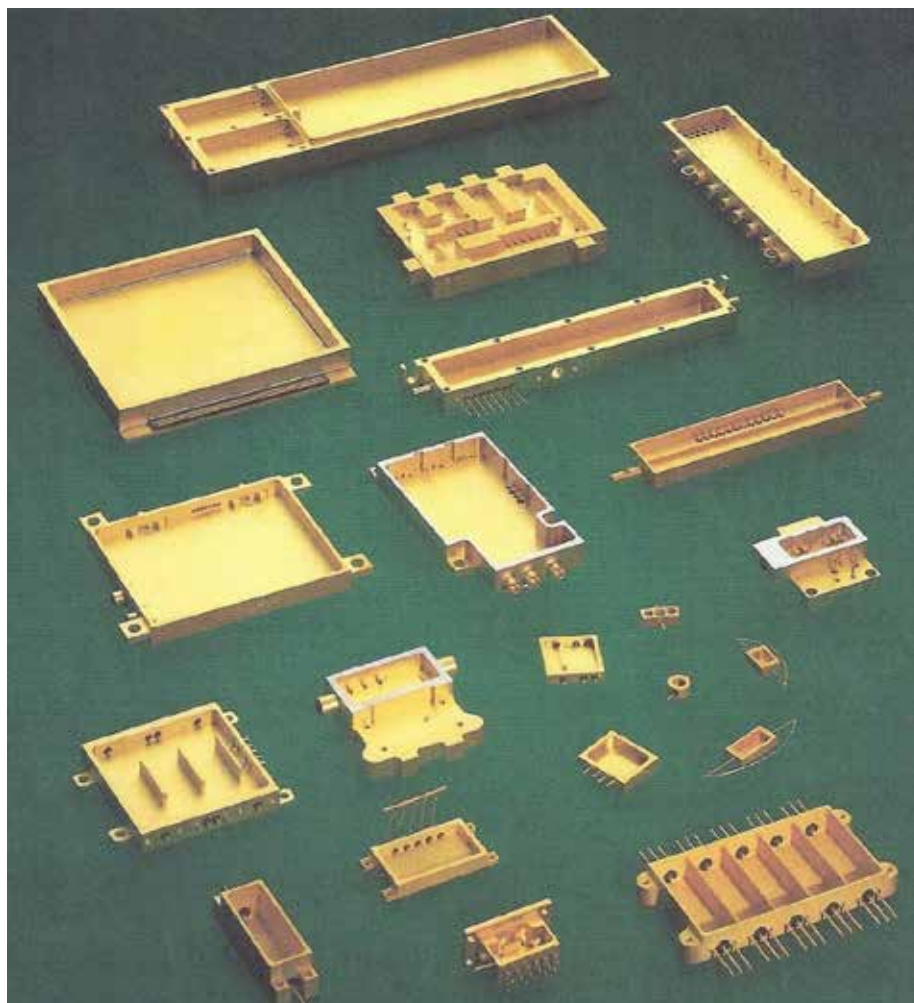


Figure 6. *The figure also shows the concept of selecting basic components for the first prototypes developed by an optics-focused startup*



The service life of the proposed apparatus is determined by the service life of the laser diode. Since all possible measures to extend the service life of the laser diode are provided for in the proposed apparatus – intensive cooling, a modified mounting module with control and regulation electronics operating in the radio-frequency range, selective material selection, and special coatings, including synthetic diamond films – the service life can be estimated at 10,000 hours or more.

2. Illumination systems in microscopes. The monostructure of light radiation when using the proposed invention makes it possible to eliminate chromatic vibration and increase resolution. The cost of an illumination system currently used in various types of microscopes may range from 2–3 thousand dollars.

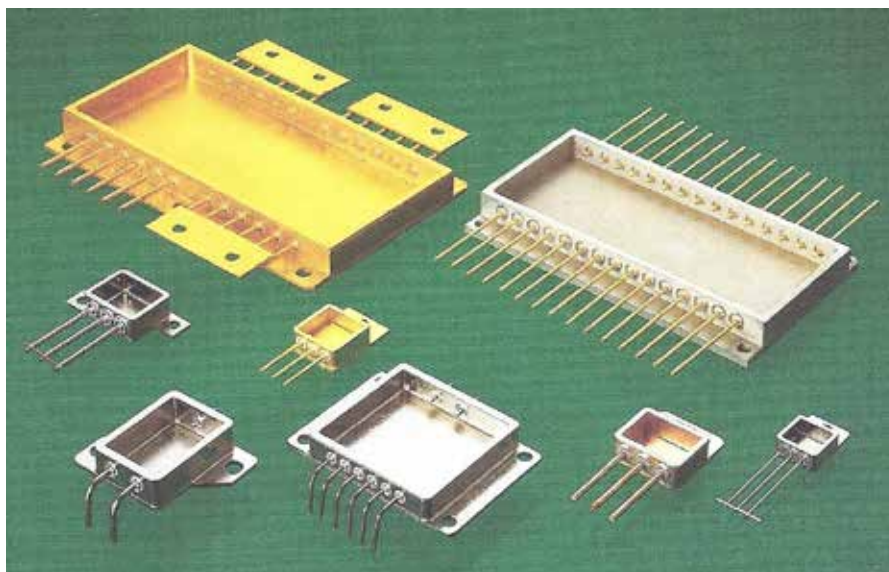
When using the proposed invention, energy consumption for illumination should

be reduced by 85–95%, while the cost of the proposed version of the invention is at least 50–60% lower than that of existing solutions.

The application of the proposed invention fundamentally changes and improves the overall technical characteristics of microscopes, which expands their range of use across all fields of engineering and technology.

The service life of the proposed version of the apparatus is also determined by the service life of the laser diode. Since all possible measures to extend the service life of the laser diode are provided for in the proposed apparatus – intensive cooling, a modified mounting module with control and regulation electronics operating in the radio-frequency range, selective material selection, and special coatings, including synthetic diamond films – the service life can be estimated at 10,000 hours or more.

Figure 7. *The figure also shows the concept of selecting basic components for the first prototypes developed by an optics-focused startup*



3. Use of the proposed apparatus in medicine. This is, first and foremost, endoscopy.

An optical fiber with a droplet of phosphor makes it possible to illuminate the entire surrounding space, as the rays will propagate in all directions. Currently, there is a problem because only a narrow area determined by the divergence of radiation from the fiber is illuminated.

In our case, when using a version of the invented apparatus, illumination can be provided in all colors, including white, that is,

for example, photodynamic therapy and ultraviolet irradiation can be performed – these are additional possibilities for diagnosis and treatment.

According to preliminary estimates, the cost of an endoscope illumination system designed using the proposed invention will be 35–45% lower, while the efficiency of the endoscope and the entire endoscopic procedure will increase significantly.

The service life of the proposed version of the apparatus is also determined by the

service life of the laser diode. Since all possible measures to extend the service life of the laser diode are provided for in the proposed apparatus – intensive cooling, a modified mounting module with control and

regulation electronics operating in the radio-frequency range, selective material selection, and special coatings, including synthetic diamond films – the service life can be estimated at 10,000 hours or more.

Figure 8. *The figure also shows the concept of selecting basic components for the first prototypes developed by an optics-focused startup*

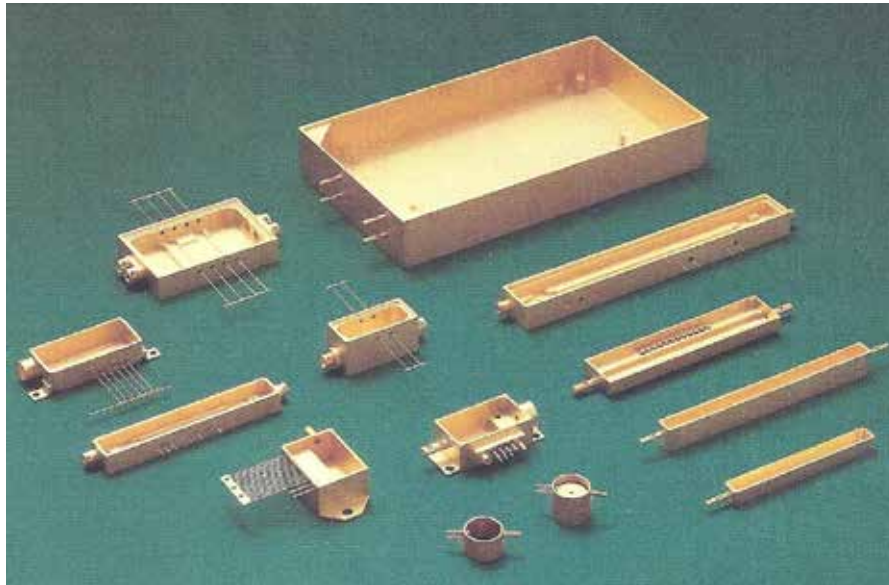
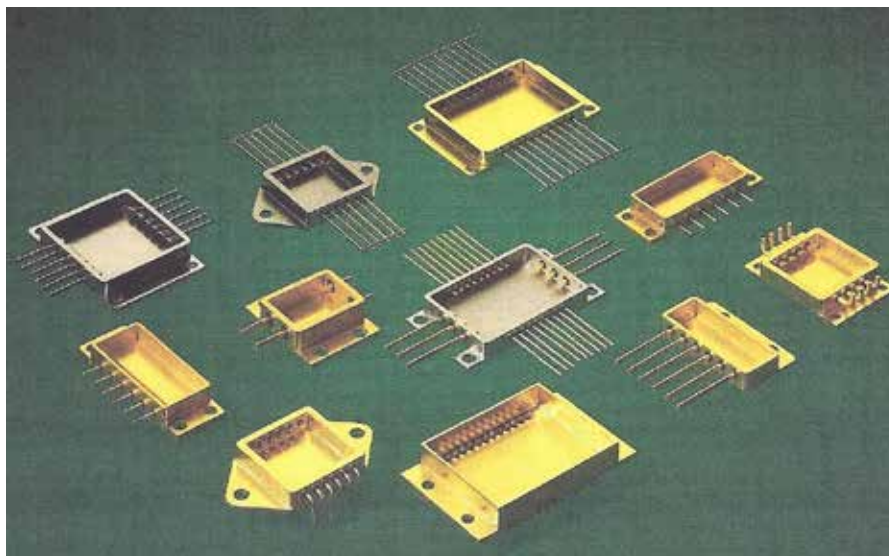


Figure 9. *The figure also shows the concept of selecting basic components for the first prototypes developed by an optics-focused startup*



Another application of the invented apparatus in medicine – illumination of the surgical field.

The optical fiber can easily be attached to a finger or an instrument (scalpel, clamp). This is particularly important in ophthalmology, where it is necessary to illuminate the

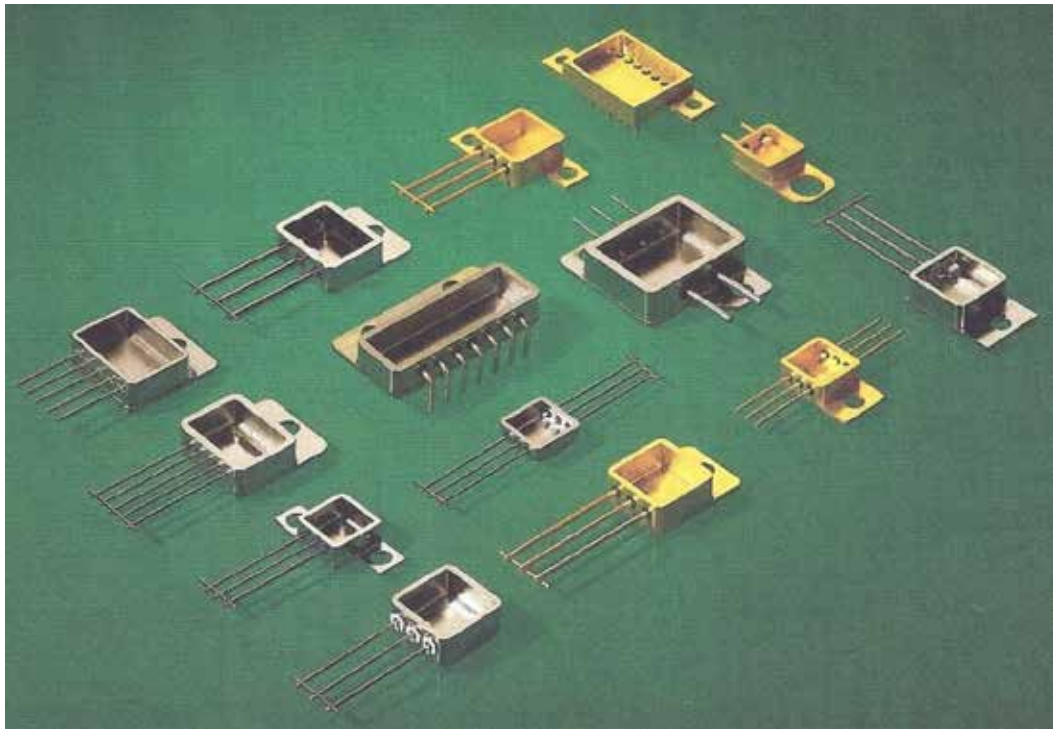
sclera of the eye uniformly. The fiber used for this purpose is thin, with a diameter of 100 μm . It can easily be inserted into the eye without causing injury and can illuminate the sclera in all directions. This is considered a very important factor in ensuring the success of the operation.

The cost of the proposed local surgical field illumination system may be approximately 3,000 dollars.

The service life of the proposed version of the apparatus is also determined by the service life of the laser diode. Since all possible measures to extend the service life of the laser diode are provided for in the

proposed apparatus – intensive cooling, a modified mounting module with control and regulation electronics operating in the radio-frequency range, selective material selection, and special coatings, including synthetic diamond films – the service life can be estimated at 10,000 hours or more.

Figure 10. *The figure also shows the concept of selecting basic components for the first prototypes developed by an optics-focused startup*



4. Online inspection system for monitoring the condition of nuclear reactor containment structures and systems located near nuclear reactors.
5. Presumably, the proposed version of the invention may cost several hundred thousand dollars.
6. Several hundred such devices are required worldwide; several hundred such devices are also needed for the inspection of nuclear reactors on submarines and other facilities with nuclear power systems.

The service life of the proposed version of the apparatus is also determined by the service life of the laser diode. Since all possible measures to extend the service life of the laser diode are provided for in the proposed apparatus – intensive cooling, a modified mounting module with control and regulation electronics operating in the radio-

frequency range, selective material selection, and special coatings, including synthetic diamond films – the service life can be estimated at 10,000 hours or more.

7. Underwater illumination systems, particularly for bathyscaphes and divers.

The estimated cost may reach 100,000 dollars.

The service life of the proposed version of the apparatus depends on numerous components, but the service life of the illumination system itself is also determined by the service life of the laser diode. Since all possible measures to extend the service life of the laser diode are provided for in the proposed apparatus – intensive cooling, a modified mounting module with control and regulation electronics operating in the radio-frequency range, selective material selection, and special coatings, including synthetic diamond films – the

service life can be estimated at 10,000 hours or more.

In the event of specific interest, this system, based on Kseniia Kaplieva's concept, can be developed in greater detail.

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