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FEATURES AND COST COMPARISON OF BIOLOGICALLY INSPIRED VISION SYSTEMS

Annotation. The economic analysis of the advantages of known analogues of biologically inspired systems for unmanned aerial vehicles (UAVs), quadrocopters, etc.

Key words: UAV, vision system, navigation.

INTRODUCTION

With the advancement of technical progress, in our time, it is possible to use natural models of vision for the development of new optoelectronic devices in the field of navigation and machine observation. Such models are able to reduce an amount of performing operations while improving the performance of the entire system. The simplicity of their implementation allows the use of inexpensive and small components that can perform basic or auxiliary functions of guidance, recognition, control, etc. These models include the structure of insect compound eyes, which has a number of advantages and disadvantages. Now there are known analogues that use in such models.

The principle of building facet eyes can be used to create integrated optical-electronic systems with a wide field of view, including circular systems. This gives a large spatial resolution. One of such system is the monocentric, large-scale camera AWARE-2 (Fig. 1) [1].

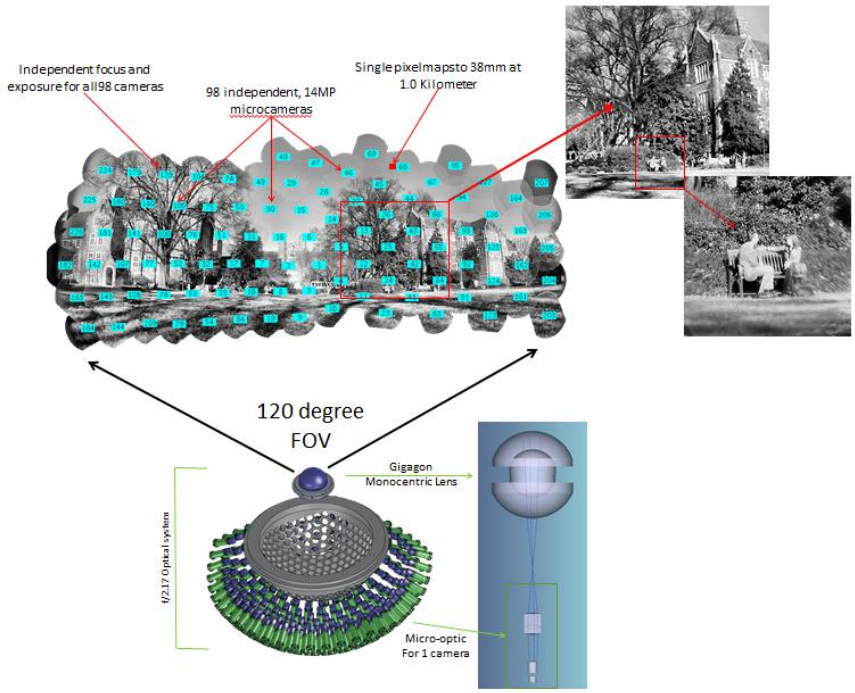

Figure 1 – The main structure and image formation of monocentric camera AWARE-2

This system allows us to create an image in size of one gigapixel at a viewing angle of 120° to 50°. However, the disadvantage is the transfer of large amount of information in real time via an electronic channel, further processing and recording. The use of multi-chamber optoelectronic systems with a specific form of optical components in one device also increases the cost of the entire device.

Another example of using the facet vision system is the development of an artificial compound eye, called CurvACE (Fig. 2) [2, 3]. The angle of view of such a prototype is 180° to 60°. As a model, the eyes of fruit fly of Drosophila species were taken. Such a curved sensor can be useful in air and terrestrial modes of transport, medical equipment, navigation and tracking systems.

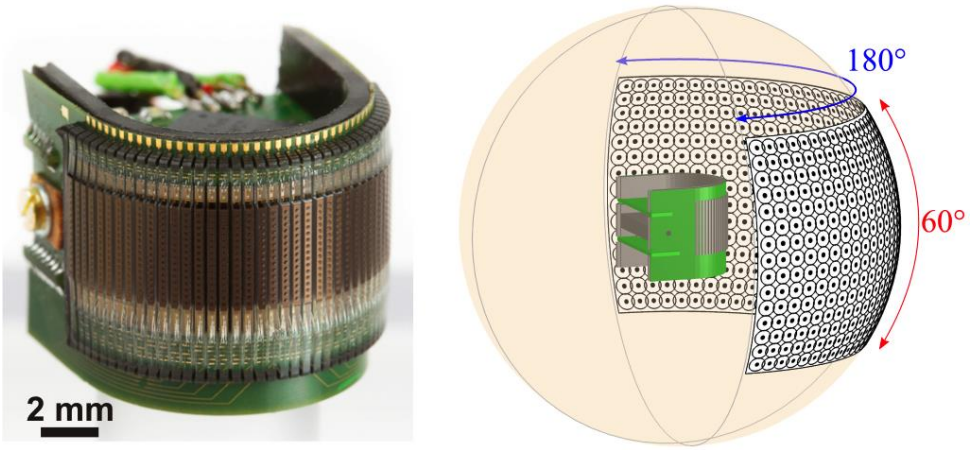

Figure 2 – Artificial compound eye CurvACE

As in the biological compound eye, CurvACE contains three material and functional layers (Fig. 3).

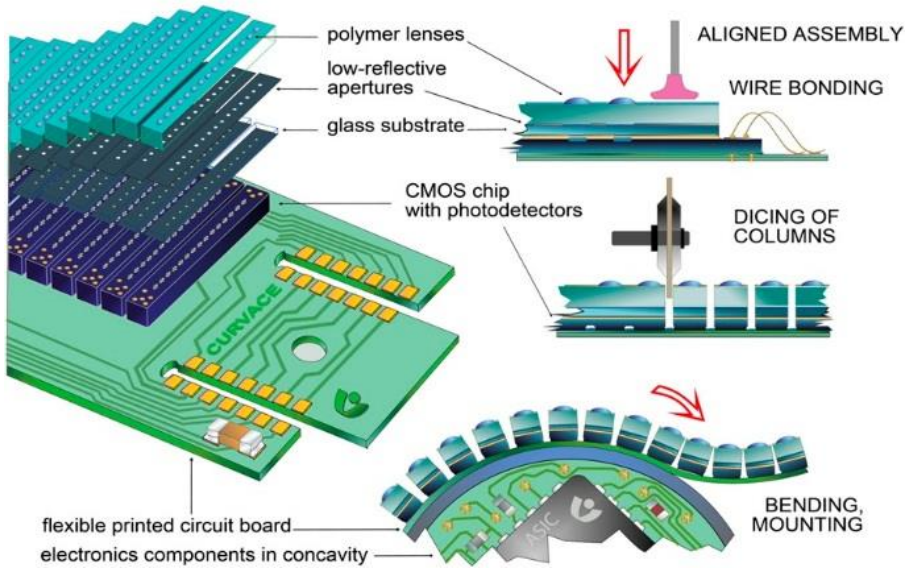

Figure 3 – Main structure of an artificial eye CurvACE

The first layer consists of an array of polymeric microlenses that have a high level of transparency. They focusing light on the second layer, where there is an array of radiation detectors. The third layer is a flexible electromechanical board that transmits output signals to processor units. A pre-designed algorithm then performs analysis of incoming data and give result about direction and velocity. The total thickness of all layers reaches less than 1 mm. Since in many facet eyes there is a pigment that prevents light from one ommatidium in the adjacent one, in this case the solution is used in two opaque metal layers. The main disadvantage of this solution is data computation by one processor in which requires high calculation speed and may affect the price increase of the microprocessor.

CONCLUSIONS

In conclusion we can say that biologically inspired systems is a great solution for creating simple and inexpensive devices that must perform such functions like navigation, guidance, obtaining obstacles and searching of fast moving objects, etc. A simple preprocessing of visual information can reduce the number of executed operations, which significantly affects the response rate of the rest of the system. At the same time, it should be noted that information about speed, direction of self-moving that can be taken from a wide field of view are in demand in automobiles with autopilot, miniature aircrafts, UAVs, video surveillance systems and more.

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