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APPLICATION OF HEAD-UP DISPLAY TO REDUCE PILOT'S INFORMATION STRESS LEVEL AND IMPROVE FLIGHT EFFICIENCY

Consider head-up display. Investigated the prospects for its use in modern civilian aircraft to decrease stress and increase awareness of the pilots

Recently, Aviation is becoming more widespread and the number of annual freight and passenger traffic increases. Of course, the main and most important task lies with the pilot, in fact, he is responsible not only for the safety of passengers, but also for their lives. Under the influence of various factors (psychological, time of day, weather conditions, etc.), the level of attention, safety, performance can be significantly reduced. For example, in a plane crash in Colombia May 19, according to experts (airliner "Boeing 727" Colombian airline "SAM", which killed 132 people) was caused by the crew, for failing to navigate the difficult weather conditions. In favor of the version of the crew error according to a decryption of the "black box" discovered at the scene. In particular, the tape recording of conversations pilots shortly before the crash showed that they were too late to find that the plane was off course and flying too low. Hardly had the commander to order futures climb as the ship crashed into a mountain slope. Up to this point in the cockpit remained calm.

The main task nowadays is to provide the pilot with the advanced equipment, which will be extremely easy to use, but it will increase the efficiency of the pilot. During the flight, the pilot is constantly replaced by a point of attention up to 80 times per minute, which affects the psychological factors and reduces the pilot's attention. In order to reduce the load on the pilot can use the head-up displays.

The LED on the windshield, head-up display (HUD) - the system of the aircraft, designed to display a character - flight and navigation information on the background of the special circumstances behind the cab.

Use of HUD, would greatly reduce the likelihood of information overload (stress) pilot, who was forced to watch as both of the surrounding space, and for the readings of numerous devices.

Stress in this situation acts as a subjective response and reflects the inner mental state of tension and excitement, this state is interpreted as an emotion, defensive reactions and processes to overcome (coping processes), occurring in man[1, 2, 3]. These processes may contribute to the development and improvement of functional systems, but also cause mental stress [6, 7].

HUD is also used to display not only the symbolic information, but also more complex images - for example, to match the actual image area and the information received from the cameras, working in the infrared. This system allows you to fly at extremely low altitudes in low visibility conditions and at night [8].

How HUD constructed? It's designed as a display on the windshield. A typical HUD contains three primary components: a projector unit, a combiner, and a video generation computer.

The projection unit in a typical HUD is an optical collimator setup: a convex lens or concave mirror with a Cathode ray tube, light emitting diode, or liquid crystal display at its focus. This setup (a design that has been around since the invention of the reflector sight in 1900) produces an image where the light is parallel i.e. perceived to be at infinity.

The combiner is typically an angled flat piece of glass (a beam splitter) located directly in front of the viewer that redirects the projected image from projector in such a way as to see the field of view and the projected infinity image at the same time. Combiners may have special coatings that reflect the monochromatic light projected onto it from the projector unit while allowing all

other wavelengths of light to pass through. In some optical layouts combiners may also have a curved surface to refocus the image from the projector.

The computer provides the interface between the HUD (i.e. the projection unit) and the data to be displayed and generates the imagery and symbology to be displayed by the projection unit [8].

In the development of ILS systems require special attention the following factors:

- the surface on which the image should be completely transparent and does not interfere with the review;

- generated image must be collimated (projected at infinity) - otherwise the pilot will have to continually re-focus vision when switching focus from an object in space out of the cockpit on the readings of HUD. Being projected to infinity, the image of the HUD is seen always in focus, regardless of where the pilot is looking, and does not require time-consuming for accommodation.

Existing HUD divided into two types:

- Fixed - consisting of high-brightness electron-beam instrument (EBL), and combined with an optical system projecting an image on the screen in the EBL space out of the cockpit.

- Helmet-mounted - in which the screens are output to the image attached to the helmet pilot. A special system tracks the position of his head, and provides a display on the screens of the relevant information. Determination of the position of the head pilot, and hence the angular coordinates of the line of sight, it allows you to support that goal, which is currently facing his eye. This type of HUD are both monocular (more common), and binocular.

For the entire period of the pilot, from takeoff to landing and finishing exposed psychological various stress. A significant role is played by the attention and concentration, which can increase the pilot using this system (by reducing the number of sensors that will be displayed directly on the windshield) [5,6,7].

Typical aircraft HUDs display airspeed, altitude, a horizon line, heading, turn/bank and slip/skid indicators.

There are other symbols and data available in some HUDs:

▪ boresight or waterline symbol—is fixed on the display and shows where the nose of the aircraft is actually pointing.

▪ flight path vector (FPV) or velocity vector symbol—shows where the aircraft is actually going, the sum of all forces acting on the aircraft. For example, if the aircraft is pitched up but is losing energy, then the FPV symbol will be below the horizon even though the boresight symbol is above the horizon. During approach and landing, a pilot can fly the approach by keeping the FPV symbol at the desired descent angle and touchdown point on the runway.

▪ acceleration indicator or energy cue—typically to the left of the FPV symbol, it is above it if the aircraft is accelerating, and below the FPV symbol if decelerating.

▪ Angle of attack indicator—shows the wing's angle relative to the airflow, often displayed as *"α"*.

▪ navigation data and symbols—for approaches and landings, the flight guidance systems can provide visual cues based on navigation aids such as an Instrument Landing System or augmented Global Positioning System such as the Wide Area Augmentation System. Typically this is a circle which fits inside the flight path vector symbol. Pilots can fly along the correct flight path by "flying to" the guidance cue.

Since being introduced on HUDs, both the FPV and acceleration symbols are becoming standard on head-down displays (HDD). The actual form of the FPV symbol on an HDD is not standardized but is usually a simple aircraft drawing, such as a circle with two short angled lines, (180 ± 30 degrees) and "wings" on the ends of the descending line. Keeping the FPV on the horizon allows the pilot to fly level turns in various angles of bank [8].

In the given situation pilot serves like an operator. It is known that the most characteristic feature of operator activity is mediated by the perception of the outside world and a managed object using the information model. Encoding information on the means of its representation, the use of automation systems deprives a person of a number of significant natural features of control objects, makes it difficult to form an adequate mental image of the object and situation. The transfer of some

functions of information training solutions and management of the facility increases the importance of automatic devices for monitoring their performance, resulting in the need to maintain high vigilance and preparedness interventions in the management. Using of control systems of coded information, its representation in a limited space in discrete units, or simultaneous mode are reflected in the processes of forming and maintaining the operational mental images of their interference, mutual induction, or coordination, which ultimately determines the level of sustainability of professionally significant qualities and mental health operator [2].

Any kind of psychological stress (personal, interpersonal, familial, professional, etc.) is basically the information that is the source of its development are external messages, information about the current (actual) or expected, the likely impact of adverse events, or threat of "internal" information in the form of past performances, retrieved from memory information about the psyche of traumatic events, situations and their consequences. These reactions are usually related to the production of negative emotions, the development of anxiety throughout the existence of a conflict situation (real or imagined) until it resolves or subjective overcome this condition. So, in these kinds of psychological stress of unfavorable and dangerous event is the starting point in determining risk of its occurrence, and forming a sense of anxiety, tension on the basis of the functional actualization mental image of the situation of professional activity. In control systems, information processes are the main content of professional work, and arising in the solution of labor problems of problem situations, failures of equipment, the critical modes, erroneous actions, and other disorders that entail adverse effects up to the accidents and disasters, develop on the background of the impact of objective and subjectively very important signal information or misrepresentation, breach of information security management process. In these circumstances, the information is not only a source of information about threatening, difficult, dangerous event, but also a means of regulating the process of countering violations of the emergency exit, and thereby overcome the feeling of anxiety for the poor of its outcome [2].

Steps to resolve the problematic situation in the event of erroneous (delays, inaccuracies) may themselves cause worsening of the problematic, increasing the negative effects of stressful situations. Thus, the operator of the process of information security management system that is associated with signaling the emergence of abnormal modes of operation, the solution of problem tasks, parry, or prevention of violations in the facility, etc., is the main source of information about the threat of adverse effects or consequences . The role of emotions, negative emotions, mental images of actualization of problem situations and their outcomes in these circumstances, certainly large enough, but the dynamism and efficiency of the flow of critical events, the need for intensive (in tempo, volume, variety acts, etc.) activities, availability of information overload, requiring considerable (sometimes excessive) intellectual effort, exhibit the most peculiar features of this type of stress.

The next aspect of the content of the concept of "information stress" is to determine whether the mental state that forms under the influence of extreme values of informational factors, classified as stress. Traditionally, the term "stress" is used to denote non-specific biochemical, physiological and psychological manifestations of activity in the adaptive response to the extreme impact of any significant factors for the organism. Through the deployment of non-specific adaptation processes the body maintains a certain period of time, the integrity and vitality when exposed to stressors. Obviously, non-specific adaptation processes perform stabilizing functions in response to the extreme effects due to consumption of "resources" compensatory functions, resulting in the organism may be possible to meet the challenges before him life problems [2].

Specific areas of study of mental stability of the human operator and psychological stress are largely due to the nature of accidents in transportation, manufacturing, energy, and the urgent tasks of ensuring the effectiveness and safety. Significant influence on the content of these studies have a number of provisions and concepts developed in psychology, namely the systematic organization of operator activity, regulation of mental states, the regulatory role of the mental image of "personal" and "human" factor, the psychological system activity and several others.

The basic psychological features of the operator's activity were the subject of a comprehensive study over the past few decades. In most of these studies the problem of functional stability of the human operator and the stress in a direct statement has not been studied specifically, although a number of issues addressed in it had a connection with this problem. In the category of stress studies often used as a characteristic of the mental state of the human operator or the price of its activities. However, there is no doubt that the study of the causes, mechanisms and consequences of stress and its impact on the quality of a particular management system is necessary to study the factors that characterize the procedural features of operator activity and functional manifestations of human labor activity under these conditions. It is obvious that the value of the functional characteristics of the labor process, laws of manifestation and working to ensure the activity of the human operator, the mechanisms of regulation of his conduct and condition of the extreme conditions make it possible not only to assess the mental state and especially its impact on the reliability of the activity, but also to justify specific recommendations for the maintenance of its at the required level.

The introduction of this system can significantly reduce crashes and accidents by reducing pilot workload information. After the pilot should to have a wide range of information, it checks that must be constantly, switching attention from one sensor to another, thereby reducing the overall level of attention and increases the likelihood of human errors. If the ship "Boeing 727" was fitted with the equipment, the catastrophe could have been prevented, saving the lives of passengers. On most modern aircraft (which are not only available but also have committed traffic) you can install this system. Comfort, and most importantly the life and safety of passengers depend on the pilot, so to ensure its maximum efficiency is a major concern of designers and engineers.

In addition, the use of HUL will greatly reduce the pilot's information stress. They will receive more detailed information on the status of the aircraft in the air.

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