



User-Centered Design For The Development And Selection Of Technology To Control Atmospheric Preservation Variables Of Vital Electronic Systems Of Small Satellites In Micro Gravity And Outer Space

(Mirror application case: System of preservation of historical works)

ABSTRACT

Maps, plans, graphic art, feather art and, in general, all historical work, require special care. High rates of temperature and humidity, as well as the presence of oxidizing gases, dust, vibration, shock, UV radiation, in addition to the development of fungi and insects, among others, favor the degradation process by damaging its structure. The user-centered design, when applied to preservation and conservation issues, facilitates the structuring of systems adapted to the particular conditions required by the work to maintain it in the best possible conditions. These systems allow, mainly, to measure and maintain the preservation variables. The user-centered design allows the designer to integrate the elements involved in order to arrive at efficient solutions, which help the engineers to decide and be able to execute the necessary measures for the protection of the vital systems of the micro satellite, economically and with easy technology, to use.

RESEARCH OBJECTIVES

- Design and development of the system for continuous monitoring, based on user-centered design, that is capable of receiving data through a sender-receiver system controlled by software. The monitoring is recorded daily in the system and access to the database is done via the web.
- Establish continuous monitoring programs on the environmental conditions of the shelter system, in order to ensure that humidity, temperature and movement are adequate.
- Maintain the environmental parameters for the protection of the documents: 18-22 degrees Celsius of temperature, 35-55% of relative humidity and maintain the movements outside the natural frequency of vibration of the work of the system.

METHODOLOGY

When talking about the monitoring of atmospheric variables, we always welcome systems that measure the variables of the environment based on devices that use processors or microcontrollers, as well as the creation of new systems that allow the easy integration of sensors that record the phenomena that occur (such as changing atmospheric parameters, movement and pollution). These systems need to develop a condition that can have the facility to improve and expand their measurement system, that can be automated and, in some cases, add control. Therefore, the user-centered design will be used as an auxiliary to the selection of the necessary technology to control the preservation variables, in this case protection of historical documents (pre-Columbian codices) that will be encapsulated in a preservation system which is a case very similar to what can be found in outer space.

CRITICAL PRESERVATION VARIABLES

The microclimate within the system is a very important factor for different areas of the preservation of key systems in space. Therefore, it is necessary to have systems that can measure the different critical variables, process the information and store it for later analysis. There are many systems dedicated to this application, but they do not cover a series of relevant needs: to have a system that can be adapted in an agile and flexible way to the needs of the user, which can be modified, expanded and allowed to monitor the microclimate phenomena (either in real time or updating the information every time) as well as monitoring remotely. The different climatic variables to be measured can be the ambient temperature, the temperature inside the system, pressure, relative humidity in the microenvironment, radiation, amount of vibration and its direction, among others. The climate monitoring system is made up of different types of sensors that measure different parameters of the system.

ENVIRONMENTAL AGENTS THAT CAUSE DETERIORATION

HUMIDITY AND TEMPERATURE

Humidity is the amount of water vapor present in the environment, it is the agent most difficult to control and in turn the most relevant since it determines the water content in the microclimate, on which the chemical reactions of degradation depend, the attack biological and some undesirable physical changes.



The value of the relative humidity determines the behavior of the vital systems of the satellites in outer space. The humidity relation in the surrounding environment shows the capacity of the environment to promote the correct functioning of said systems when in contact with the materials. In a closed volume, if no water is added or removed, the relationship between relative humidity, temperature and moisture content in the materials can be simplified as follows:

As the temperature decreases, the relative humidity and moisture content of the works increases.

As the temperature increases, the relative humidity and the moisture content of the works decrease

LUMINOUS INTENSITY

The radiant energy visible to the human eye is a small part of the electromagnetic spectrum, whose lengths range from 400 to 760 nm. The amount of energy of the different radiations is inversely proportional to their wavelength, so that small wavelengths such as UV and blue light have more energy and cause more deterioration or chemical changes in vital systems especially in the outer space. The shorter wavelengths provide activation energy in the form of photons that trigger chemical reactions.

UV radiation must not exceed 75 µW / lm.

VIBRATIONS

Vibration is defined as the oscillating movement that a particle makes around a fixed point. This movement can be regular in direction, frequency and / or intensity; or random, which is the most normal.

The research carried out on the characteristics of movement and manipulation of the satellite shows that the main risk factor present for the integrity of vital systems is the presence of vibrations, since when the excitation frequency coincides with one of the natural frequencies of the system, the phenomenon of resonance takes place.

The most important characteristic of the resonance is that it gives rise to large displacements, by greatly amplifying the vibrations. In most mechanical systems, the presence of large displacements is an undesirable phenomenon, since it causes the appearance of tensions and deformations that can cause damage.

The fundamental criteria of prevention of their effects are based, mainly, on the measurement and reduction of the vibrations transmitted to the body of the satellite, which consist of the following:

1. Control of vibration at the source
2. Vibration control in the receiver
3. Vibration control during the transmission path

USER-CENTERED DESIGN (FOR TECHNOLOGY SELECTION)

The fundamental part of the methodology applied to the selection of technology, which helps us to preserve and integrity of the vital systems of the satellites, is the user-centered design, which helps to reduce the uncertainty in said process. We understand users as designers, engineers and launch experts. This methodology operates under the following principles:

-The user-centered design is based on observing and listening to users.

-A fundamental part of the user-centered design focuses on validating the concepts of solution through its test or interaction with users.

When applied to the protection of vital satellite systems, submerging potential users and using available technology, the following results are obtained:

-The user-centered design, when applied to protection issues, facilitates the structuring of systems adapted to the particular conditions required by the work to keep it in the best possible conditions. These systems allow, mainly, to measure and maintain the variables of microclimate preservation.

-To determine the appropriate technology, it is necessary to know the relevant factors that the engineers have studied to maintain the vital systems, the characteristics and conditions of the launch and of the outer space, and even the financial conditions.



Results of the system of preservation and display of pre-Columbian codices (Mirror case for satellite application)

- Construction and total implementation of the preservation and exhibition system with satisfactory physical preservation.
- To date the variations of temperature and relative humidity are minimal, with 2 degrees Celsius and three percentage points of relative humidity.

Conclusions of the use of user-centered design

- The user-centered design allows the designer to integrate the elements involved in order to arrive at efficient solutions, which help the engineers to decide and be able to execute the necessary measures for the protection of the vital systems of the microsatellites, economically and with technology Easy to use.
- A data monitoring system provides information on the variations that are presented in the protection system in a constant and precise manner, allowing an effective monitoring of the operating conditions.
- Data logging allows to monitor closed systems, where considerable variations of environmental conditions can be traced back to their causes to take corrective measures that prevent the deterioration of satellite systems.



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