Proposed Design of New Drones for Specific Applications in Field Cultural Heritage

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ABSTRACT

1 Introduction

Recently, we have witnessed new challenges in many sectors, including industry, transportation, and other sectors. Therefore, drones have played an important role in confronting these problems and enabling humans to deal with the new challenges with complete comfort [1, 2]. The drones are mainly based on a number of high-performance motors for manoeuvring and moving in several degrees of freedom and task execution. We mention some applications that we found use the drone to deal with it, for example, agriculture [3], construction industry [4], civil protection [5], and underwater applications [6]. Control strategies and algorithms are very important in the internal system of the drone for achieving stabilisation and good performance. There are many different control strategies used in several searches. PID control [7] is very robust strategy. It has provided good performance in many experiments of recent research. Adaptive robust control is also a good strategy that is used in some searches [8]. It used for trajectory tracking, regulating and correcting the trajectories. It should also be noted sliding mode control [9], machine learning [10], and intelligent artificial [11]. These strategies are used in many recent investigations, especially machine learning and intelligent artificial, because they have proven their high efficiency and have received a lot of attention recently. This work aims to present the proposed design for develop new drone for specific application in field cultural heritage. The goal of this drone is conducting exploration and inspection of coastal built cultural heritage sites by termocamera. We define a systematic approach for building drone with good criteria that insure high performance in specific applications.

2 The intended operation scenario

The process of searching and exploring for historical antiquities in rugged areas covered with trees or complex sites that are difficult to reach constitutes a big challenge for archaeologists, which makes the search for historical sites full of risks. So that we suggest novel design of drone for use to exploration and inspection of coastal built cultural heritage sites by use termocamera. An infrared termocamera is a technology that uses opto-electronic devices to detect and measure radiant energy (electromagnetic waves) and creates a process that correlates radiation with surface temperatures without direct contact with the object. The characteristics of our proposed design: medium size, average flight level with a maximum altitude of 200 m. It also has transfemoral legs in order to base it on them, and at the same time it can carry some important things or tools using these transfemoral legs. After completing the construction of this drone, it will be tested in multiple environments several times in order to determine the efficiency of this drone through to sure form full protection from drops of water, sand, gravel, and other physical factors and reveal the possibility of further development or being satisfied with the results obtained. Some commercial drones are highly efficient, but they may not be suitable in our project because these drones are programmed with fixed algorithms and cannot be customised and modified in terms of the internal system. In our project we need to add some modifications and some new features, such as saving the discovered locations, determine its coordinates and other features that require modification to the drone's internal system in order to apply them. The Product Design Specification (PDS) for the drone are presented in Table 1. Required velocity, flight time in a workspace area of 8 km^2 is 30min are an important point in special applications, and these values were determined in order for the drone to be able to carry out the required tasks in record conditions. For example, according to the criteria mentioned in the table, this drone will be able to survey a range of 8 km^2 in only 8 times. If we change these values, the number of tasks will increase, and this process will be slow. Therefore, these requirements are important in our project in order to achieve good, highly efficient work in cultural heritage applications.

3 A proposed design concept

In this section, we present the PDS that were obtained by summarising the important information from previous searches. Table 1 presents the proposal design and the PDS for specific applications in field cultural heritage. The figure in the table presents the proposed design with 6 Dofs. The PDS are very important for good performance in specific applications. Minimum velocity 12m/s is introduced for arriving at the site in a short time, payload 2 kg introduced for a camera with 200 g and auxiliary components. Control range 8 km is required for good workspace covers big city area square. We plan to use a good battery for 30 min flight (suitable value for cultural heritage applications taking into account 12m/s velocity). Shields around the propellers and IP for water and solids are introduced for safety because the drone will be operated near sea and near the mountains.

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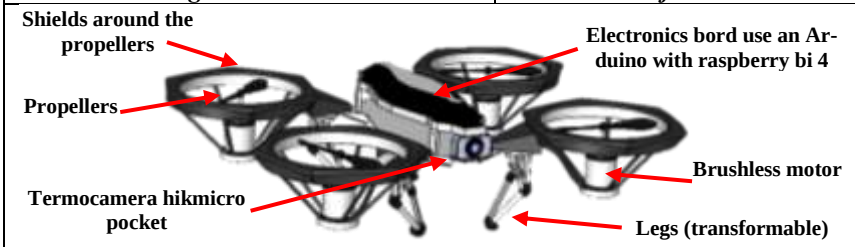
Table 1: The proposed design and Product Design Specification

▪ *Heritage Drone*	▪ *6 Dofs*	▪ *Requirement*	*Define*
		➢ Velocity	12 m/s
		➢ Payload	2 kg
		➢ Control range	8km
		➢ Height	200 m
		➢ Time flight	30 min
		➢ Shields around the propellers	4
		➢ IP for water	>=4
		➢ IP for solid	>= 5

These requirements are needed to achieve a drone with full protection from water drops and sand, gravel and other physical factors. The PDS is the result of a comprehensive search in literature sources in order to analyse characteristics of drones and extract the important requirements for specific applications in the field cultural heritage.

3 Conclusion

The proposed design with criteria required for cultural heritage applications has been presented in this paper. This stage is considered the conclusion of the previous works through analysis a lot of information about the drone from many different projects in different industry sectors. The analysis conducted allowed us to obtain a PDS and develop an innovative drone for application in exploration and inspection of coastal built cultural heritage sites by using a termocamera.

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