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Automatic Safe Landing-Site Detection System

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ABSTRACT

An automatic safe landing-site détection system is propose for aircraft emergency landing based on visible information acquired by aircraft-mounted cameras. Emergency landing is an unplanned event in response to emergency situations. If, as is usually the case, there is no airstrip or airfield that can be reached by the unpowered aircraft, a crash landing or ditching has to be carried out. Identifying a safe landing-site is critical to the survival of passengers and crew. Conventionally, the pilot chooses the landing-site visually by looking at the terrain through the cockpit. Specifically, we first propose a hierarchical elastic horizon detection algorithm to identify the ground in the image. Then, the terrain image is divided into non overlapping blocks, which are clustered according to a "roughness" measure. The adjacent smooth blocks are merged to form potential landing-sites, whose dimensions are measured with principal component analysis and geometric transformations. If the dimensions of a candidate region exceed the minimum requirement for safe landing, the potential landing-site is considered a safe candidate and is highlighted on the human machine interface. At the end the pilot makes the final decision by confirming one of the candidates, and also by considering other factors such as wind speed and wind direction, etc. Preliminary experimental results show the feasibility of the proposed system.

Keywords : **Image acquisition, Color conversion, Pre-processing, Post-processing, Dimension assessment, Visualisation.**

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I. INTRODUCTION

An automatic safe landing-site detection system is proposed for aircraft emergency landing based on visible information acquired by aircraft-mounted cameras. Emergency landing is an unplanned event in response to emergency situations. The top-five leading factors of unplanned landing, which is also called emergency landing, are engine failure, running out of fuel, extremely bad weather, medical emergency, and aircraft hijack. Under the two most emergent situations, engine failure and running out of fuel, the aircraft may quickly lose ying power, and its manoeuvrability may be restricted to gliding. Once these happen a forced landing process has to be immediately carried out. If, as is usually the case, there is no airport, or even a runway that can be reached by the unpowered aircraft, a crash landing or ditching is inevitable .So, finding a safe landing site is critical to the survival of passengers and crew. Conventionally, the pilot chooses the landing-site visually by looking at the terrain through the cockpit. This is a required, fundamental skill acquired in the sight training program. However, many external environmental factors, i.e., fog, rain, illumination, etc., can significantly affect human vision so that the decision of choosing the optimal landing-site greatly depends on the pilots sight experience- the most significant internal factor which can vary a lot among different pilots. In addition the visual angle that the human eyes can simultaneously cover is limited: when the pilot looks to the left, what is on the right is missed and vice versa. Since time is of supreme importance in the scenario

we are considering, the inability to simultaneously scan on both sides of the cockpit is a distinct disadvantage. Imaging sensors can alleviate this problem by creating panorama images that encompass the entire field-of-view (FOV) in front of the aircraft. In order to compensate for the natural inadequacies of human vision and also to alleviate the negative effects of both external and internal factors, a robust, reliable, and efficient process for safe landing-site detection is greatly desirable. Therefore, we present a vision-based, automatic safe landing-site detection system.
The success of this vital decision greatly depends on external environmental factors that can impair human vision and on the pilot's flight experience, which can vary significantly among pilots. Therefore, we propose a robust, reliable, and efficient detection system that is expected to alleviate the negative impact of these factors. We focus on the detection mechanism of the proposed system and assume that image enhancement for increased visibility and image stitching for a larger field-of-view (FOV) have already been performed on the terrain images acquired by aircraft mounted cameras. Following are avantages and application of our system.
Advantages :

1. It assists the pilot to find the safe landing Ares in emergency condition.
2. It saves time for the pilot to devote to other necessary actions under emergency conditions.
3. It also provides the dimensions of those areas.

Appication:

1. Automatic safe landing for aircraft.
2. Geological survey.
3. Security purpose.

II. LITERATURE SURVEY

[1]In this system, the visualization module is designed and constructed to highlight largest safe landing-site candidates on the human-machine interface for the pilot's final decision, though the system may detect safe landing-sites in the system. If the system provides the pilot with all the possible choices in the system, he may get confused when seeing so many recommended areas on the screen, and the time cost of making a decision is very complicated under the emergency situation in the system. The landing-sites are sorted in a descending order based on their approximate areas .therefore the pilot can efficiently evaluate the recommended candidates in a rational order in the system. The pilot will make his final decision by choosing one landing-site from the recommended candidates and by taking into account other factors as well in the system.

[2]This paper has presented preliminary work in modelling three options for UAV SLZ detection. Additionally, we have discussed a novel, lightweight approach to discriminating between potential options for SLZ detection. This approach is based upon utilizing the models of required execution time in conjunction with the UAV's remaining flight time to determine a viable, optimal solution, thus assisting in UAV decision management within a time-constrained safety critical situation.

[3]The paper presents an automatic pilot assistive safe landing-site detection system for robust, reliable, and efficient emergency landing. The proposed system makes up for the limitations of human eyes, assists the pilot to find safe landing-sites, and more importantly, saves time for the pilot to devote to other necessary actions under emergency conditions. To meet the practical needs a criterion to set the threshold of the roughness value for evaluation has to be found and a LIDAR system can be used along with the proposed system to obtain higher accuracy on the
Hazard level information of the surface.

III. SYSTEM ARCHITECTURE

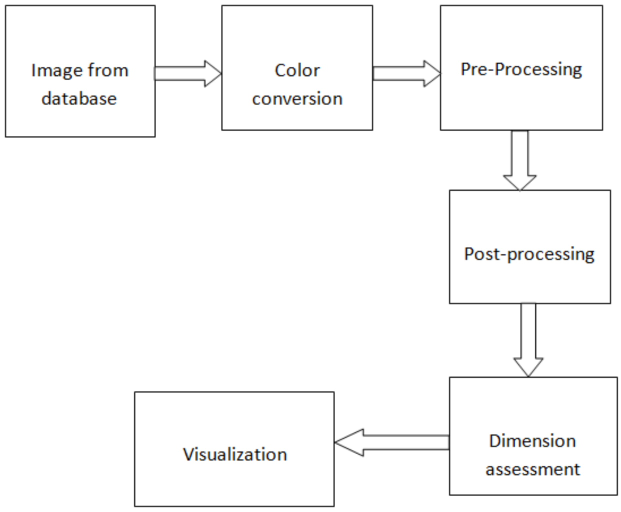

Fig 1. System Block Diagram

Description:

Image from database:-

For automatic safe landing-site detection system, some images are already captured using cameras and now we are processed image using various methods.

Color conversion:-

Generally, our database images are colored means RGB image. Then we need to convert it into grayscale image. A grayscale image is also called a gray-scale, or gray-level image. The rgb2gray syntax converts true color image RGB to the gray scale intensity image rgb2gray converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance.

Pre-processing:-

Preprocessing includes image enhancement and horizon detection.

Enhancement method :-

We make use of histogram equalization image enhancement method to ameliorate the effect of environment factors and to improve the contrast and sharpness of the images.

Histogram Equalization (HE)

Histogram equalization is widely used for contrast enhancement in a variety of applications due to its simple function and effectiveness. It works by flattening the histogram and stretching the dynamic range of the gray levels by using the cumulative density function of the image. One problem of the histogram equalization is that the brightness of an image is changed after the histogram equalization, hence not suitable for consumer electronic products, where preserving the original brightness and enhancing contrast are essential to avoid annoying artifacts.

X0 – XL-1 -> 0 to 255 Gray levels

P(x) -> Number of pixels

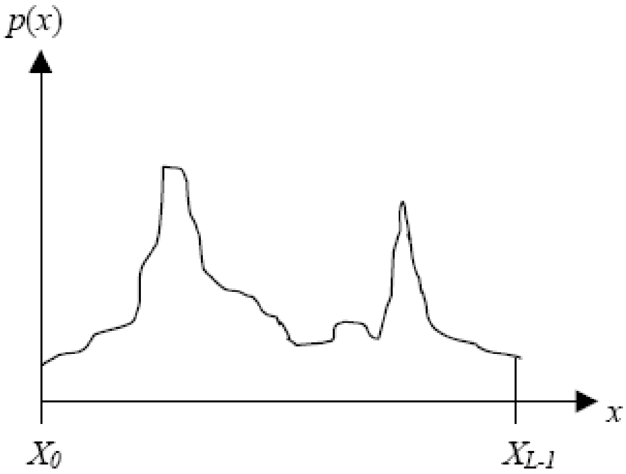

Fig. 2. Simple Histogram

Above Fig. 2 shows the histogram equalization is used to maps the input image into the entire dynamic range, (Xo, XL-1) by using the cumulative density function as a transform function.

Horizon detection:-

We make use of canny operator for edge detection. It is an optimal edge detection technique as provide good detection, clear response and good localization. It is widely used in current image processing techniques with further improvements.

Algorithm:

1. Image acquisition:
   This step deals with the capturing of image with the use of sensor.

2. Image stitching:
   Captured images are joined together and form a larger pan aroma image.

3. Image enhancement:
   Improve the contrast and sharpness of the images.

4. Horizon detection:
   Identify the ground & Sky in the aerial image.

5. Roughness assessment:
   Find roughness of the ground.

6. Segmentation:

- The result of connected areas, where each area is labelled with a unique color.
- To improve efficiency, isolated tiny spots and narrow branches of merged areas can be removed.
- By applying the morphological operation of image erosion without assessing their dimensions.

7. Dimension assessment:
   When potential -sites are obtained, we measure their dimensions.

8. Visualization:
   Landing Site –sorted in descending order.

IV. CONCLUSION

In this Paper we have presents an automatic safe landing-site detection system for robust, reliable, and efficient emergency landing. The proposed system makes up for the limitations of human eyes, assists the pilot to find safe landing-sites, and more importantly, saves time for the pilot to devote to other necessary actions under emergency conditions. The 100% results show the feasibility of the vision-based system. In the next step the proposed system will be fully developed to better meet practical demands and applications.

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