

Surveying and Calculation of a Given Area using a Quad-copter

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Abstract—The field of geometry has various applications and calculating the area is one of them and doing it manually is challenging and equally a daunting task. In this paper we propose a method to make use of a flying object with a camera to calculate the area. This can be achieved by augmenting the flying object with a camera that takes pictures and these pictures can be used and we can perform some operations to calculate the area of a given plane in an image. This not only saves time that an entity invests but also saves the amount of money he/she invests in the calculation of the area. We can enhance the calculation by incorporating much faster techniques and methods.

Keywords-Geometry; flying; camera;MATLAB;

I. INTRODUCTION

The calculation of area has been an integral part of various avenues of our lives. From building a house to harvesting of crops in a field, we need to exactly calculate the area in order to perform the task in an efficient way. Building in an area that does not belong to you might lead you into trouble with the authorities and making use of pesticide in a land that does not belong to you might make you end up wasting a lot of money and time.

The conventional methods that exist today require more than one person to calculate the area with one holding the measurement device and the other making entries. This has a lot of flaws in it as the entity should invest a lot of money and has to wait a long time before they can get the results and the biggest issue of them all is the accuracy and the effect of the error increases with the increase in calculations and the area.

In order to overcome such flaws, we have devised a method in which we fly a quad copter at a certain height and capture images and we apply some image processing operations and calculate the area of the object or a given location. Here we overcome and increase the accuracy of the calculation drastically and we also speed up the process in which the results are obtained much faster than other age-old methods. We make use of altitude sensors to measure the height and we make sure we fly the quad copter at a constant height to maintain uniformity in the calculation. The calculations so obtained can be verified by making use of the conventional methods and thereby check the increase in accuracy of the measurement.

II SYSTEM OVERVIEW

The main aim of this project is to eliminate the third party to obtain information about the calculated data and to give the consumers hands on access to their data by making use of a quad copter and a camera. We split the working of the project to two parts with the first part dealing with maintaining the height and levitating the quad copter at a particular height and

the second part dealing with the image acquisition and image processing.

A. Determination of optimum height

The quality and the area covered by the quad copter depend on the height at which it flies and this part is very vital in the proposed method. We make use of an ultrasonic sensor which is attached to the quad copter to measure the height at which it is flying.

The ultrasonic sensor that we make use of has a maximum range of 450cm and there are some discrepancies to this value as it can vary when tested using a processor. In order to have to obtain proper accurate images we set the optimum height to 400cm and another 50cm as the buffer height. This buffer height is very useful as the quad copter is very hard to control. We can use a LED Display to show the height at which it is flying to the user or it can be directly seen in the processor. The ultrasonic sensor has a separate transmitter and a receiver and the receiver is used to send out sound waves which hit the obstacle at a particular distance and this sound wave is of a specific frequency and the receiver is used to listen the sound wave back by receiver.

B. Determination of the area

Once the quadcopter has normalcy and it is suspended at an optimum height we either make video of the area or we take one single image if it covers the entire area or we take multiple images in order to calculate the area by making use of image processing.

The image acquisition here can be viewed in three ways with the first one being taking the entire image of the location and this is a very easy way to calculate the image area and the second one is taking multiple images of a single location as it is very large to cover it in one single shot. This method arises because of the height at which the quad copter can fly is limited by the sensor's capability of measuring the height as mentioned earlier the ultrasonic sensor can only measure an obstacle at a distance of 450cm and sometimes at this height we might not be able to capture the entire image of the area.

The third one deals with the calculation of area of the image that is present in the boundary that is defined by us. This is the

most important part of all three as it holds high relevance to the real-world calculation. Most of the time the area of the location or object that is to be calculated is not uniform and when we apply the other two methods we might end up with ambiguous values and hence in order to avoid that we make use of another method to calculate the area of such locations with irregular boundaries that is present in the real world that is challenging, equally intriguing and takes a lot of time.

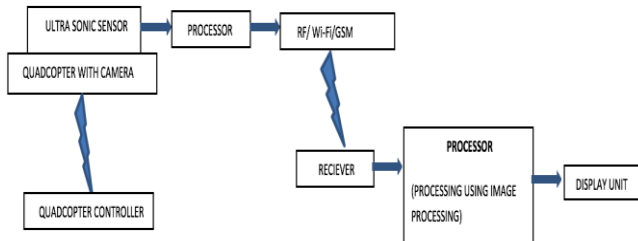


Fig 1: Block diagram to calculate the area

The block diagram shown Fig 1 is a basic block diagram of the components that can be used to perform this particular method.

III COMPONENTS AND TOOLS

We propose to make use of the following components and this can change based on the requirement of the user.

A. Components

- Ultrasonic Sensor

The ultrasonic sensor has a separate transmitter and a receiver, and the receiver is used to send out sound waves which hit the obstacle at a particular distance and this sound wave is of a specific frequency and the receiver is used to listen to the sound wave back by the receiver. The output voltage is 5V and the detection ranges between 2-450cm.

- Processor

We make use of two processors in this method with the first one being an Arduino Uno which is put on the top of the quad copter and this board is battery powered. This board stores all the data that is used for processing and in the calculation of the area.

The other processor is used to run the image processing algorithm and this processor can be a raspberry pi board or a computer. The image processing algorithm is stored in this Processor which takes images and height as input and outputs the area of the respective image that is provided as input.

- Camera

We embed the camera to the quad copter and as it flies to an optimum height it captures the area of the location and depending on the application we can embed better cameras and the quality is not only a function of better camera but is also influenced by the height at which the quad copter flies.

B. Tools

- MATLAB or Octave

We can make use of MATLAB or Octave for the image processing part. Both these tools require a pre-requisite of converting the normal image format into bit mapped image format. We aim to calculate the number of pixels in an image and then sum the whole value to obtain the final area.

- ImageJ

This is another tool that can be used to calculate the area of the object in an image. This is a public domain java-based image processing developed at the national institute of health located at Maryland, USA. In this tool we mark a line in the image and we calculate the area of the image relative to this line.

- Python

Python is an object oriented language. We will be using python for all the mathematical operations such as vectorization, Matrix multiplication etc. Python is an efficient tool and it can also be used to provide intelligence to the drone if used in the future. We use python because we perform some mathematical operations in order to calculate the area of the image. Python can be used as an alternative to MATLAB and it is much more flexible than MATLAB or octave.

One of the above mentioned software can be used in the determination of the area of an image. It depends on the particular person and his or her convenience.

The flow of the method is given as follows:

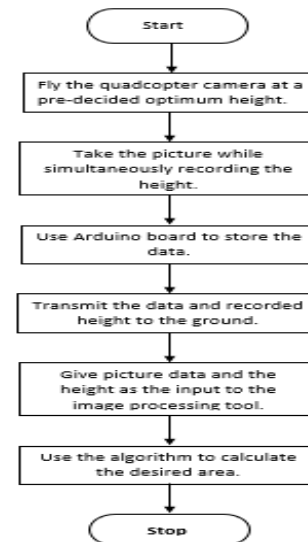


Fig 2: Flowchart for the proposed method

IV APPLICATIONS

The usage of the quad copter opens up many avenues and can be used for various applications in numerous fields. This can vary from agriculture to surveillance and to surveying a normal plot to build a house.

The first application that can be considered is spraying of pesticide over an unknown area of a given land. This increases the efficiency of the pesticide spraying and increase the agricultural produce by the farmer.

The second one is a very important one and the one which would save a lot of money and time to the consumer. It can be used to calculate the area of a plot and thereby the process can be automated.

We can also calculate the volume of the water bodies and it can be used for many such areas where it is close to impossible for human intervention. There are some shortcomings to this proposed method which is discussed in the next section.

VI DRAWBACKS

The altitude sensors which we use have a limited sensing capability and thereby limiting the flight capability of the quad copter.

The camera's quality will be decreased by the unusual movement of the quad copter and this may lead to delay in calculation of the area and also may increase the number of pictures we take and thereby increasing the amount of storage required.

VII FUTURE SCOPE

We can incorporate machine learning and provide the quad copter with intelligence and we can also make use facial recognition and pattern recognition to detect people's faces and patterns in real world. This can extensively be used in military applications.

We can also make use of SONAR sensors which has a long range for detecting obstacles and by doing so we can make the calculation of area easy by flying the quad copter in such a height where we can take one single shot of the entire location.

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