Gesture Controlled Quadcopter

Gaur, Vivek; Mishra Abhishek; Aquil, Manal; Thapa, Himanshi and Verma, Rahul Kumar

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Abstract
In designing of a gesture controlled gimble during the flight of a quadcopter. This paper describes the sensing of hand gestures using sensors like accelerometer and gyroscope. Their integrated outputs are transmitted and received wirelessly through a X-Bee attached on both the ends. This helps in operating a gimble attached to a quadcopter. The proposed design of gesture controlled gimble gives movement in X,Y axis when the quadcopter is in aerial flight state. Most common of the movements were used and the system was designed in a way so that the best results can be seen.

Keywords: Gimble | Quadcopter | Accelerometer | Gyroscope

Introduction
A quadcopter is one of the most complex flying machines due to its versatility to perform any type of aerial tasks. Classical quadcopters or quadrotors are usually equipped with four rotors and now a days a gimble is attached to control the camera angles and its movement. A gimble is a simple structural design consisting of three motors usually brushless to control the camera movement in X,Y as well as circular direction. These sort of models are now a days used in surveillance, photography etc.
A primary goal of gesture recognition system is to create a system which can identify specific human gestures and use them to convey information or for device control (Butalia and Shah, 2010). The main idea of this paper is to build a gimble that can be controlled by hand gestures wirelessly. Through hand gestures a user is able to control the motion of this gimble in both X and Y axis. Thus, helping the camera to provide the desired view.

Review of Literature
Not much work has been done on designing a gimble that can be controlled by the human
hand gestures. But because in this research we are focusing epically on motion gestures (Bhattacharya et al. (2012)) there have been many questions especially about the motion gesture design that has been left unanswered in the past researches like what parameters do users manipulate to create different types of motions and gestures? Is there a design space or taxonomy of different dimension that design can manipulate in the creations of these gestures? Etc. In this paper, we describe the results of a guesibility study for motion gestures which elects natural gestures from end users as follows: given a task to perform with the device (e.g. Rotating the gimble motors to get different views from camera, Zoom IN, Zoom OUT for camera) (Mistry and Chang, 2009). The results of the study yields a specific research contribution to motion gesture design i.e. participants were asked to give motions to operate a gimble as per their convenience and then the most common movements were reviewed and selected. As a result an end user motion gesture which was very easy and convenient for the user was selected. These motions selected by the users were performed, wearing a glove equipped with an accelerometer and a gyroscope. The range of outputs were received and studied thoroughly and logics were designed to operate the servo motors using them. The two servo motors were synchronized together to obtain the best results.

**Block Diagram Or Transmitter And Receiver**

The block diagram of gesture controlled gimbleis shown in the Fig 1. The reason of choosing Arduino Uno was its versatility, cost effectiveness and numerous other advantages. Arduino Uno is quite easy to operate and at the same time it is easy to burn a program in it. It has an Atmega 328p and

![Fig 1: Block Diagram of transmitter and receiver](image)

uses its own software to burn the program. The software used was Arduino 1.6.4.

The system makes use of two sensors *i.e.* accelerometer and gyroscope. The accelerometer used in this paper was ADXL335. This sensor is used to measure the change or palm movement in X, Y and Z axis. Although outputs of only X and Y axis were used for more convenience. The sensor is very small, low profile package with excellent temperature stability and can survive about 1000 G shocks. The gyrosensor used in this paper is GY-521 MPU 6050. This sensor is also used to measure the movements in X, Y and Z axis. This sensor also is very small in size and gives accurate readings in all sorts of temperatures. For communication between both the ends X-Bee were used at both transmitting and receiving end. X-Bee is one of the most commonly used signals transmission device in today’s era. It has an outdoor range of about 300 feet.
Servo motors used were Futaba s303 (Kaura et al., 2013). They have an operating temperature range of -20 to 60 degree Celsius. They have a high torque of 3.2 kg per cm. Thus they were the best in market to be used.

Flow Chart

Fig 2: Design of flow of outputs.

Input parameters
As shown in figure 2, the outputs from the hand gestures were obtained through accelerometer and gyrosensor outputs (Shiravandi et al., 2013). The outputs of the gyrosensors are more accurate and stable in comparison to the accelerometer. The main aim of using a gyrosensor was to make the system redundant i.e. if the outputs of the accelerometer were not received due to any technical glitch then the system would automatically shift to the output of gyro sensor. The outputs are thus fed in to Arduino Uno which processes them so that they can be transmitted through X-Bee. The inputs received from Accelerometer and gyrosensors are both received in analog form whereas the signal transmitted by the X-Bee is in the digital signal form. Thus, the analog signal is converted to digital form and then transmitted.

Output Parameters
The signal is received by a X-Bee receiver and is decoded. This decoded signal is then fed into an Arduino Uno and the servo motors are operated. The inputs of the X axis are used for to regulate Servo1 in X-axis whereas the inputs of the Y-axis are used to rotate the servo2 in Y-axis.

Both the motors are synchronized to get the best glitch free output.

Experimental Results

<table>
<thead>
<tr>
<th>S.No</th>
<th>Reading from accelerometer</th>
<th>Converted Reading</th>
<th>Movement Motor 1</th>
<th>Movement Motor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>380</td>
<td>485</td>
<td>90°</td>
<td>82.8°</td>
</tr>
<tr>
<td>2.</td>
<td>235</td>
<td>482</td>
<td>0°</td>
<td>8°</td>
</tr>
<tr>
<td>3.</td>
<td>298</td>
<td>489</td>
<td>55°</td>
<td>81.2°</td>
</tr>
<tr>
<td>4.</td>
<td>453</td>
<td>492</td>
<td>121.18°</td>
<td>81.7°</td>
</tr>
<tr>
<td>5.</td>
<td>540</td>
<td>485</td>
<td>169.5°</td>
<td>80.5°</td>
</tr>
<tr>
<td>6.</td>
<td>384</td>
<td>499</td>
<td>82.8°</td>
<td>0°</td>
</tr>
<tr>
<td>7.</td>
<td>378</td>
<td>479</td>
<td>80°</td>
<td>22.8°</td>
</tr>
<tr>
<td>8.</td>
<td>379</td>
<td>482</td>
<td>656</td>
<td>80.2°</td>
</tr>
<tr>
<td>9.</td>
<td>380</td>
<td>485</td>
<td>1021</td>
<td>80.6°</td>
</tr>
</tbody>
</table>

Table1. Data Recorded during tests

The outputs of the accelerometer and gyroscope ranged from 235 to 540 in analog units. These outputs were converted into a range of 0-1023, where 235=0 and 540=1023 and then this range was used to define the angles of the motor where 0=0degree and 1023=170degree.

Both the servos are kept at an initial angle of 90° for a straight palm parallel to the earth.

Conclusion
This is a small effort made in the field of quadcopters and one of its most popular applications of aerial surveillance and aerial
photography. The gimble was earlier controlled through a channeled remote control. But now operating a gimble would be much more convenient and user friendly, as simple hand gestures would provide the desired view from the camera. This paper also shows our vision of introducing hand gestures controlled quadcopters and quadroters which would be much more user friendly and flying them would be much more easy and convenient.

References


