Gesture-glove controlled RC helicopter

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Abstract:

My project will be to design a RC helicopter that can be controlled with gestures via a control glove. The helicopter, including all mechanical parts, battery, and IR receiver, will come as-is out of box so the only thing that needs to be designed is the controller. The controller will be in the form of a control glove and will contain different sensors (for example, multi-axis gyroscope sensor(s) and flex sensors) which will determine the position and or movement of the gloved hand as well as certain gestures. These sensors will send the gathered movement data to a controller with a microcontroller/processor which will analyze the data and send the correct corresponding command to the helicopter via IR signal.

The initial plan is as follows: An accelerometer/gyroscope will be used to read movement in 2 or more axes to determine x and y horizontal movements. Flex sensors will be used in conjunction to determine vertical movement and other functions. A 3-channel RC helicopter will be used, therefore the included movements are: forwards/backwards, left/right turning, and up/down on the z-axis. All of the movement sensors will be connected to a control box containing a microcontroller/processor along with an IR transmitter which will transmit the data to the helicopter. The corresponding IR control code sequences will be determined by analyzing the signals from the control box included in the package.
Introduction:

Although RC helicopters are a fun hobby to pick up, the controls can be less than intuitive at times. There is usually a large learning curve for the typical RC helicopter in able to pilot it well. The goal of this project is to hopefully introduce a more intuitive control interface for RC helicopters. This will be done by using a gesture-based control glove with different motion sensors, such as accelerometers and force sensors, attached rather than a typical remote control box.

Objectives:

The objective of this project is to design a RC helicopter than can be controlled via a gesture-based control glove. The glove will contain an accelerometer/gyroscope sensor in order to determine tilt motion as well as force/flex sensors in order to determine flexing motion/applied force. These controls as of initial planning will respectively be translated into x/y planar movements and z axis movements of the RC helicopter. If time permits, additional control schemes will be added as well as accessories.

Features:

- Tilt/motion-based sensors – includes accelerometer/gyroscope
- Force-based sensors – include force/flex sensors

Hopefully by introducing these sensors into the RC helicopter control scheme, learning to fly an RC helicopter will be more intuitive/hands-on.

Technology:

- Accelerometer/Gyroscope (3 axes) sensor –

  Accelerometers have the ability to sense both static as well as dynamic acceleration. In this case the accelerometer will be used to measure tilt movement in 3 axes. A smaller scale accelerometer of around 1 or 2 g’s is needed to be able to accurately measure the tilt movement. The accelerometer will have an analog interface which produces a voltage proportional to the acceleration experienced. The bandwidth will be around 50-100 Hz and the power consumption will be around 100µA.

  Gyroscopes on the other hand measure angular velocity and are not affected by gravity. They are able to monitor the orientation of an object in motion.
Gyroscope sensors usually have roughly the same specifications as those of accelerometers.

For this project, an accelerometer/gyroscope combination known as an inertial measurement unit (IMU) was chosen. The reasoning for this choice was simple. The combination sensors provide extra information in a more easily accessible way than if the two sensors were used individually.

The specific IMU to be used will either be the IDG500/ADXL335 for its price point, or the 6DOF Razor, for its effectiveness. Both can be found on sparkfun.com

- Force/Flex Sensor –
  
  Flex sensors measure the amount an object is flexed by changing the resistance via metal pads across the sensor as it is flexed.

  Force sensors measure pressure applied to the sensor.

  The specific flex sensor to be used will be the SEN-08606 found on sparkfun.com

- Microcontroller -
  
  The microcontroller will be used to gather, interpret, and then send the data to the RF transmitter unit. An AVR microcontroller is most likely going to be used.

For the tentative design of the glove, the IMU unit will be placed on the right hand. This will control forwards/backwards movement as well as left/right turning in the x/y plane. Flex sensors will be used on the ring and index fingers to signal left and descent along the z axis. Force sensors will possibly be used over flex sensors; this will be determined as testing progresses. These sensors will be wired to a control box which will be placed on the hip of the user. The control box will contain the microcontroller board as well as the IR transmitter unit.

Overall, these technologies were chosen over other technologies because they seemed the most suited to create an intuitive set up for the user.
Above is a simple illustration/flowchart of the planned design for the control glove. The sensors will feed into the microcontroller/processor which will do the data analysis and then output to the transmitter unit.
Here is a simple flowchart illustrating the microcontroller’s process, where the decision block represents all of the input sensors.
Cost objective:

The cost for all of the sensors, microprocessor, and helicopter hardware is estimated to be less than 300 dollars.