Wireless Connectivity flight Performance Evaluation of Unmanned Helicopters

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ABSTRACT

Numerous simulation studies and researches have recently revealed the rapid development and evolution in the emerging area of intelligent unmanned aerial vehicle (UAV). This study aims to develop a flight performance evaluation about the wireless unmanned helicopter. The process includes the design and testing of flight hardware and software that interprets sensor data. For the unmanned helicopter used in this research, an inertial sensor that provides posture (roll, pitch and yaw angles) and a Bluetooth is used to provide wireless connection between the user's pc and the helicopter were installed in the helicopter. The helicopter's pitch, roll and yaw were the communication data. The accuracy of the system was confirmed by a computer simulation. The software also has been developed to support operators and displays helicopter position and posture by graphics.

Ⅰ.Introduction

Helicopters are useful versatile machines that can perform aggressive maneuvers [2]. As compare to the fixed-wing aircraft, Helicopters have better distinctadvantage in an urban environment, where hover capability is required. There is increased interest in the deployment of autonomous helicopters for military and civilian applications which include reconnaissance of an urban area and search and rescue missions [3]. This paper aim to develop a flight performance evaluation regarding the wireless unmanned helicopter as shown in Fig. 1.

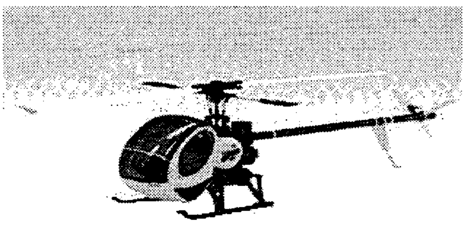

Fig. 1 Wireless Unmanned Helicopter

There are few connection set-ups which need to be done before the evaluation of the flight performance of the wireless unmanned helicopter is been carried out. The overall connection set-ups of the whole project are as follow:

i. A joystick is connected to a user pc.
ii. A user pc is connected to an electronic circuit board which consist a microprocessor and a Bluetooth. ATMEGA 128 and AT90S2313 areused as the microprocessor and ACODE 300 is used as a Bi-directional Bluetooth module for wireless communication.
iii. An unmanned helicopter is further connected through Bluetooth output.

Once all the connections between the devices have been carried out, as shown in Fig.2, a joystick can be used to stimulate the speed as well as the movement of the helicopter respectively.

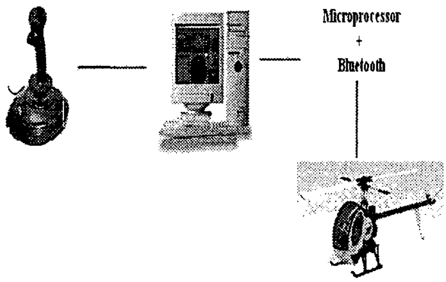

Fig. 2 System Architecture

The result will be further displayed on the software which written in Microsoft Visual C++. The software will keep track any of the joystick changes on time. If the connection states been interrupted, the software will keep on acquire the current state of the joystick until it get the current state of the joystick. The software will display the result of the helicopter's pitch, roll and yaw on the computer screen accordingly in 3 different graphs. The program will set the maximum and minimum values of the helicopter's pitch, roll and yaw, which are -90 and 90 respectively. The program allows the user to make any necessary changes on the maximum and minimum values of the pitch, roll and yaw.

II. The idea behind the wireless unmanned helicopter

The helicopter consisted of an AT90S2313 microprocessor, Fig. 3, a dc motor, Fig. 4, and speed controller, Fig. 5. A Bluetooth module, ACODE 300, is used the purpose to provide wireless communication between the user pc and the helicopter. The advantage of using ACODE 300, Fig. 6, is

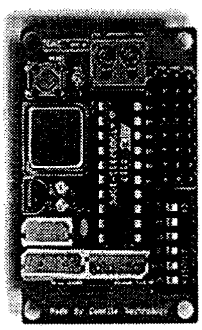

Fig. 3 AT90S2313

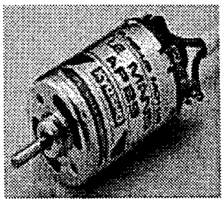

Fig. 4 Dc motor

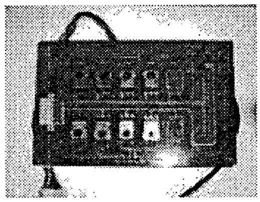

Fig. 5 Speed Controller

because it provided a bi-directional real-time 1:1 communication which can be accomplished within 100ft of open space with transmission error of less than 1%. With an external antenna, the range of communication can be extended further. After the initialization of a pair of ACODE-300 on the user pc, the RS232 serial communication between user pc and the helicopter can be accomplished. An electronic

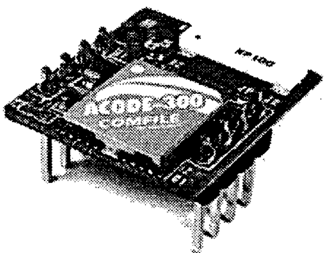

Fig. 6 ACODE-300

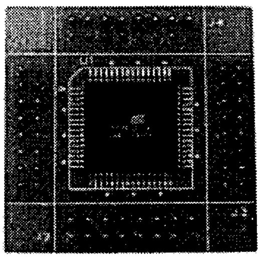

Fig. 7 ATMEGA 128

board which consists of an ATMEGA 128 microprocessor, Fig. 7,and an ACODE-300 is directly connected to the user pc. The ATMEGA 128 is used to process the command sent by the user pc and direct the command out through the TX port on the ACODE-300. The RX port on another ACODE-300 inside the helicopter will receive the command and the AT90S2313 microprocessor will further process the command being sent and generate an appropriate output with respect to the command. In other words, the movement of the joystick in the left direction will generate the movement of the helicopter in the left direction respectively.

III. Simulation Result

The simulator program, as shown in Fig. 8,will first set up the com port connection between the helicopter and the pc. Initially, the values for the transmission baud rate, transmission byte, transmission parity bits, as well as transmission stop bits are being set. As mentioned earlier, the simulator program will display the necessary movements of the joystick. Inside the program, there is a setting for the joystick.

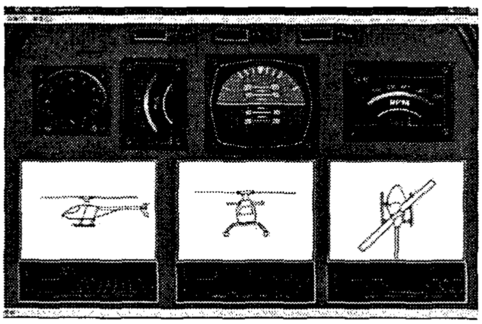

Fig. 8 Simulator Program

control stick sensitivity curve setting, we emphasize the Helicopter model drawing alteration functions which include RGM and Freya. In Fig. 9, there are some necessary settings for the pitch, roll and yaw of the helicopter. The user can set the maximum and minimum dead zone of the pitch, roll and yaw of the helicopter. The dead zone

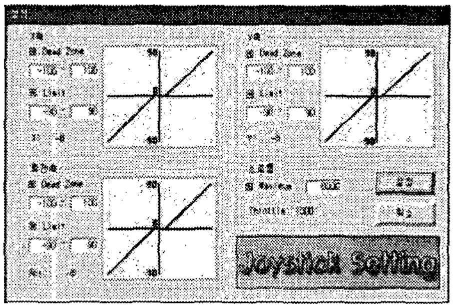

Fig. 9 Joystick control stick sensitivity curve setting (interface)

approximately zero value. In this case, we set the maximum equal to 100 and minimum equal to -100 for the dead zone for every pitch, roll and yaw of the helicopter. Apart from that, the user can also set the minimum and maximum limit values for each of the pitch, roll and yaw of the helicopter between the ranges of 0-90. The system will further display the result of the setting in different graphs. The curve of each graph is called sensitivity curve. As the way to make the sensitivity curve smooth, we migrate the sensitivity curve from original linear function to sigmoid function and from sigmoid function to polynomial function. The explanations above are further display in Fig. 10, Fig. 11, and Fig.12. Moreover, we do include the position graph display On/Off function and position change history save function inside our program. The throttle of the helicopter is been set at the value of 8000.

$$\{-1, Y=ax+b, Y=a'x+b', 1\} \quad (1)$$

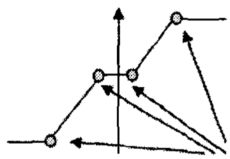

Fig. 10 Linear Function Graph

$$\{ Y = 1/(1+\exp(-ax)) \} \quad (2)$$

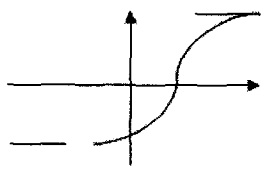

Fig. 11 Sigmoid Function Graph

$$\{ Y=ax\text{^}2+bx+c \} \quad (3)$$

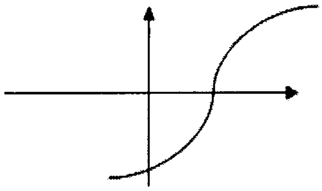

Fig. 12 Polynomial Function Graph

Ⅳ. Conclusions

In this project, the user can control the movement and the speed of the helicopter by using a joystick connected to the computer. The simulator software acted as a third party who provides the communication channel between the joystick and the helicopter. A Bluetooth module, ACODE 300, is used the purpose to provide wireless communication between the user pc and the helicopter. All the particular results will be further displayed on the simulator software GUI. A simulator software GUI is generated by using the Microsoft DirectX 9.0 sdk properties.

V. Acknowledgement

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