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DEVELOPMENT OF A TRAINING DEVICE FOR STUDENT PILOTS

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ABSTRACT

In this study, it is implemented a non-motion Flight Training and Test Device, named as FTTD, with the aim of introduction the cockpit environment for student pilots. It is intended to reduce costs and save time with the use of commercial of-the-shell (COTS) software and hardware in FTTD platform. Additionally, an airport where student pilots at Anadolu University generally perform flight missions is modelled similarly to the real world. Meanwhile, FTTD platform is tested by the instructor pilots in order to get feedbacks which help to improve the system. It is shown that such a low cost flight training devices would be useful in terms of cost and safety as well as learning with classroom based training.

INTRODUCTION

Simulation, as an educational tool, is the imitation of situations, behaviors, tasks or events which are present reality. Simulation is used for the purpose of research, analysis, validation, visualization and learning in the field of aviation, engineering and manufacture etc. [Lammers, 2007]. Simulation systems, which are mostly used in aviation, are divided into two categories as real-time simulations and fast-time simulations. Flight simulators which are set of simulation systems are mostly used by flight training and air traffic control training for minimizing risks of training and improving quality of training.

Flight Simulation Training Device (FSTD) is a particular example of the use of real-time simulation tool in the field of flight training. FSTD is defined as means a training device which include a full flight simulator (FFS), a flight training device (FTD), a flight navigation procedures trainer (FNPT) or a basic instrument training device (BITD) in the case of airplanes. The relation and types of these devices are shown in Figure 1 [EASA, 2012]. These training devices have a great contributions to aviation safety as well as financial benefits. These devices are essential training tools for the student pilots before, during and after real flight phase of training.

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Flight training devices are, as a part of Flight Simulation Training Device (FSTD), used as an effective tool to improve quality of pilot training by Flight Training Organizations (FTO). Some of the significant advantages of the use of FSTD's are related to [Alerton, 2010; Ehest, 2013]:

- Safety,
- Cost-effectiveness,
- Environmentally-friendly,
- High availability etc.,

In sum, the use of training devices in flight training provides significant advantages in terms of cost and safety as well as progressive and pedagogical learning.

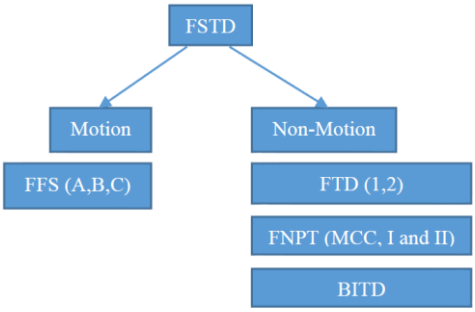

Figure 1: Types and Levels of FSTD

It is known that training devices in pilot training provide positive transfer of training [Koonence 1998; Dennis 1998; Cohen 2001; Macchiarella, 2005;]. Meanly, if a training device reflects how closer to real flight environment, the more skill, ability and knowledge can transfer for student pilots in real flight training. Therefore, flight training with low-fidelity devices can be more effective and provides high level of training transfer [Allerton, 2010; Noble,2002]. Training devices also aid student pilots in order to enhance their knowledge, skills and attitude in a safe environment. It is possible to create adverse or emergency events that cannot find the opportunity to experiment in a real flight. Hence, student pilots can be trained within training devices over and over with no time limitation and have a better chance to know the real aircraft used in flight.

Furthermore, commercial of-the-shell (COTS) hardware and software products are important factors to reduce initial costs and time while enhancing activities [Shutao, 2008]. Rapid development of technologies and COTS products on the market are enabled to implement specific and low cost training devices such as FTTD platform which is mainly used for Cessna 172. Cessna 172 is the most frequently used and main aircraft in initial phase of flight training for student pilots in order to fulfill the duties such as familiarization of flight missions, recognition of the cockpit elements etc.

In this study, it is implemented a non-motion Flight Training and Test Device, named as FTTD. The main aim of FTTD platform is formation an environment in order to introduce both cockpit and training area to student pilots. It is intended to reduce costs and save time with the use of COTS software and hardware in FTTD platform. FTTD platform is tested by the instructor pilots and get favorable feedbacks. The structure of the FTTD platform is described in the next part of this study.

FTTD SYSTEM STRUCTURE

FTTD formed for the purpose of getting advantages in terms of cost, time and safety is composed of hardware and software COTS components. FTTD is a platform that can be used for both flight training and research purposes. FTTD platform have two user positions: student pilot position and instructor pilot position. Instructor pilot position authorizes the instructor to a monitor and get feedback of student pilots. The scheme and implementation of FTTD platform are shown in Figure 2 and Figure 3 respectively.

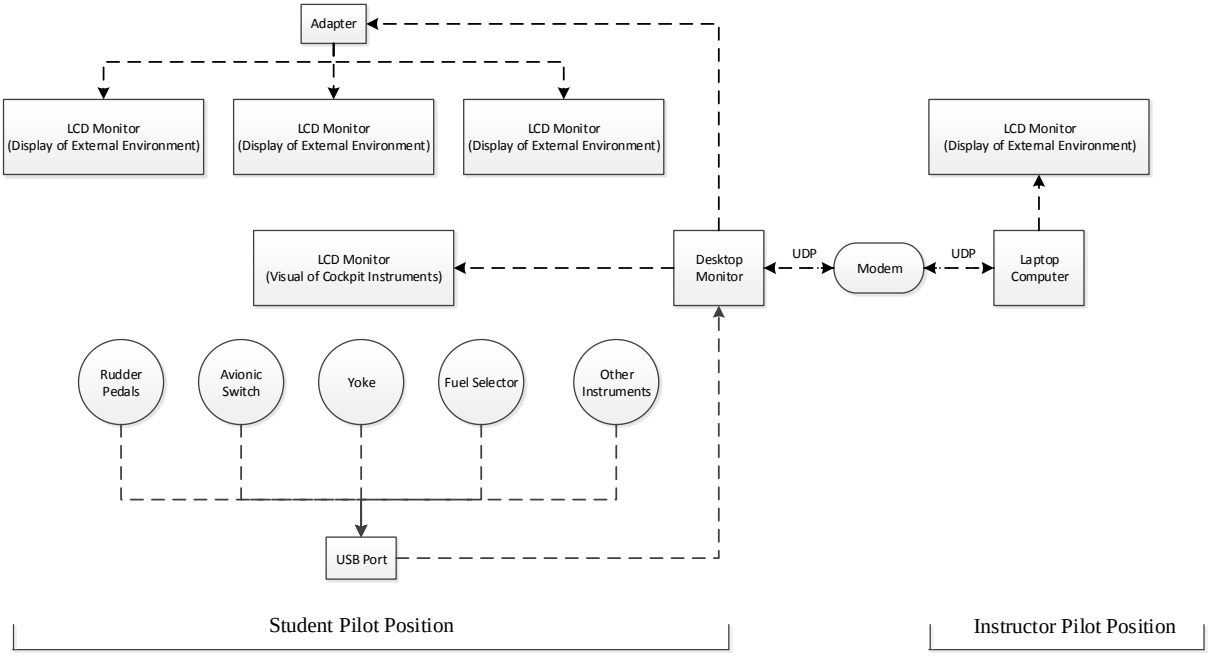

Figure 2: Scheme of FTTD Platform

The hardware components of FTTD are chosen same exactly of Cessna 172 including rudder pedal, yoke, flap control, switch panel, throttle quadrant, trim wheel, fuel selector panel and other equipment.

Figure 3: FTTD Platform

The software component of FTTD is chosen as X-Plane due to certified by Federal Aviation Administration (FAA). X-Plane commercial and open source simulation program used widely in academia and industry. The reason of the popularity use of X-plane is the flight model known as Blade Element Theory (BET) which providing accurate models for many types of manned and unmanned vehicles [Bittar, 2015]. BET breaks the aircraft down into many piece of elements and then finds the forces of each element in many times per second. After all, these forces converted into required parameters that you permit to fly as shown in Figure 4 [X-plane, 2017]. In sum, the main properties of operation of X-plane is based on describing the geometric shape of any aircraft and predicts how that aircraft will fly by means of BET [Bittar, 2014]

Figure 4: Representation of Cessna 172 Aerodynamic Forces

X-Plane is a COTS product that permits the researcher to send and receive information via User Datagram Protocol (UDP) protocol. UDP is a protocol that provide faster data traffic than other protocols whereas it is not guarantee data packet. X-Plane includes 133 data sets that each are 41 bytes shown in Figure 5 [X-plane, 2017].

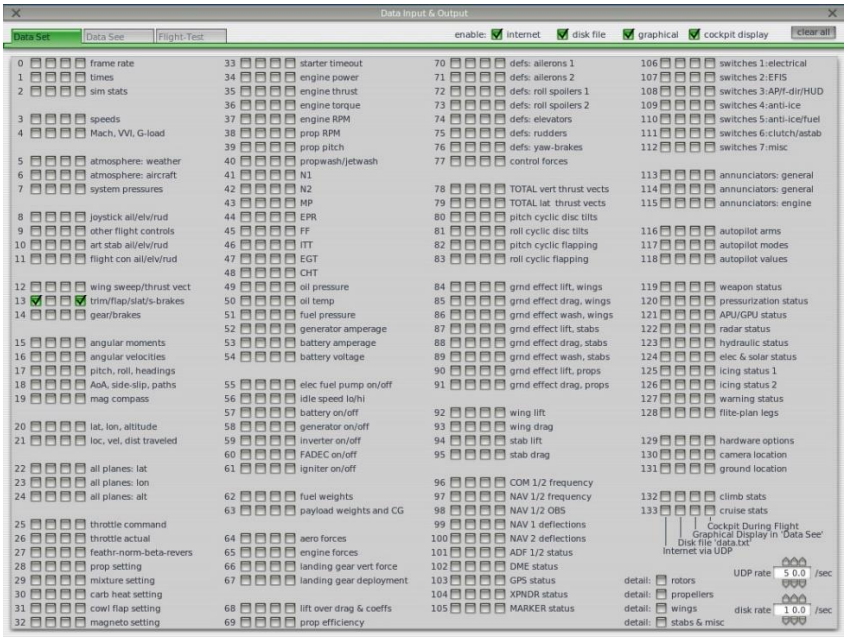

Figure 5: UDP Data Set of X-Plane

It is a significant factor for student pilots to feel real world environment in simulator training. For the purpose of enhancing the reality of training devices areas where student pilots generally perform flight missions at is modelled similarly to the real world shown is Figure 6 as an example.

Figure 6: LTBY - Eskisehir Hasan Polatkan Airport

CONCLUSION

In this study, it is implemented a non-motion Flight Training and Test Device, named as FTTD, with the aim of introduction the cockpit environment and training area to flight students. It is intended to reduce costs and save time with the use of commercial of-the-shell (COTS) software and hardware in FTTD platform. Development of the platform is done with the test and feedback are given by the instructor pilots at Anadolu University. As a conclusion it is noted by test and feedback of FTTD that a low cost flight training devices would be useful in terms of cost and safety as well as learning for classroom based training

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