Finolex Academy of Management and Technology, Ratnagiri

Department of Information Technology

Subject:	**Intelligent Systems (BEITL703)**		
Class:	**BE IT / Semester – VII (CBCGS) / Academic year: 2019-20**		
Name of Student:	**Kazi Jawwad A Rahim**		
Roll No:	**29**	**Date of performance (DOP) :**	
Assignment/Experiment No:	**9**	**Date of checking (DOC) :**	
Title: Case study on Expert System			
Marks:		**Teacher's Signature:**	

Aim: To study an Auto pilot Expert System in artificial intelligence.

2. Prerequisites:
1. Learn basics of artificial intelligence.
2. Knowledge and reasoning in artificial intelligence.

3. Hardware Requirements:
1. PC with minimum 2GB RAM

4. Software Requirements:
1. Windows installed
2. Swi ProDT

5. Learning Objectives:
1. To study an expert system.
2. To Analyze the current expert system.

6. Course Objectives Applicable: CO 4, CO 5, CO 6

7. Program Outcomes Applicable: PO 2, PO 3, PO 4, PO 5, PO 6, PO 7, PO 8, PO 9, PO 11

8. Program Education Objectives Applicable: PEO 2, PEO 3, PEO 4, PEO 5, PEO 6

9. Theory:

An autopilot is a system used to control the trajectory of a vehicle without constant 'hands-on' control by a human operator being required. Autopilots do not replace a human operator, but assist them in controlling the vehicle, allowing them to focus on broader aspects of operation, such as monitoring the trajectory, weather and systems. Autopilots are used in aircraft, boats (known as self-steering gear), spacecraft, missiles, and others.

History:

The first aircraft autopilot was developed by Sperry Corporation in 1912. The autopilot connected a gyroscopic heading indicator and attitude indicator to hydraulically operated elevators and rudder. (Ailerons were not connected as wing dihedral was counted upon to produce the necessary roll stability.) It permitted the aircraft to fly straight and level on a compass course without a pilot's attention, greatly reducing the pilot's workload.

Further development of the autopilot was performed, such as improved control algorithms and hydraulic servomechanisms. Also, inclusion of additional instrumentation such as the radio-navigation aids made it possible to fly during night and in bad weather. In 1947 a US Air Force C-54 made a transatlantic flight, including takeoff and landing, completely under the control of an autopilot.

Modern autopilots:

Not all of the passenger aircraft flying today have an autopilot system. Older and smaller general aviation aircraft especially are still hand-flown, and even small airliners with fewer than twenty seats may also be without an autopilot as they are used on short-duration flights with two pilots. The installation of autopilots in aircraft with more than twenty seats is generally made mandatory by international aviation regulations. There are three levels of control in autopilots for smaller aircraft.

The modern flight control unit of an Airbus A340

A single-axis autopilot controls an aircraft in the roll axis only; such autopilots are also known colloquially as "wing levelers," reflecting their limitations. A two-axis autopilot controls an aircraft in the pitch axis as well as roll, and may be little more than a "wing leveler" with limited pitch oscillation-correcting ability; or it may receive inputs from on-board radio navigation systems to provide true automatic flight guidance once the aircraft has taken off until shortly before landing; or its capabilities may lie somewhere between these two extremes. A three-axis autopilot adds control in the yaw axis and is not required in many small aircraft.

Autopilots in modern complex aircraft are three-axis and generally divide a flight into taxi, takeoff, climb, cruise (level flight), descent, approach, and landing phases. Autopilots exist that automate all of these flight phases except taxi and takeoff. An autopilot-controlled landing on a runway and controlling the aircraft on rollout (i.e. keeping it on the centre of the runway) is known as a CAT IIIb landing or Auto land, available on many major airports' runways today, especially at airports subject to adverse weather phenomena such as fog. Landing, rollout, and taxi control to the aircraft parking position is known as CAT IIIc. This is not used to date, but may be used in the future. An autopilot is often an integral component of a Flight Management System.

Modern autopilots use computer software to control the aircraft. The software reads the aircraft's current position, and then controls a Flight Control System to guide the aircraft. In such a system, besides classic flight controls, many autopilots incorporate thrust control capabilities that can control throttles to optimize the airspeed, and move fuel to different tanks to balance the aircraft in an optimal attitude in the air. Although autopilots handle new or dangerous situations inflexibly, they generally fly an aircraft with lower fuel consumption than a human pilot.

The autopilot in a modern large aircraft typically reads its position and the aircraft's attitude from an inertial guidance system. Inertial guidance systems accumulate errors over time. They will incorporate error reduction systems such as the carousel system that rotates once a minute so that any errors are dissipated in different directions and have an overall nulling effect. Error in gyroscopes is known as drift. This is due to physical properties within the system, be it mechanical or laser guided, that corrupt positional data. The disagreements between the two are resolved with digital signal processing, most often a six-dimensional Kalman filter. The six dimensions are usually roll, pitch, yaw, altitude, latitude, and longitude. Aircraft may fly routes that have a required performance factor; therefore the amount of error or actual performance factor must be monitored in order to fly those particular routes. The longer the flight, the more error accumulates within the system. Radio aids such as DME, DME updates, and GPS may be used to correct the aircraft position.

A midway between fully automated flight and manual flying is Control Wheel Steering (CWS). Although going out of fashion in modern airliners as a stand-alone option, CWS is still a function on many aircraft today. Generally, an autopilot that is CWS equipped has three positions being off, CWS and CMD. In CMD (Command) mode the autopilot has full control of the aircraft, and receives its input from the heading /altitude setting, radio and navaids or the FMS (Flight Management System). In CWS mode, the pilot controls the autopilot through inputs on the yoke or the stick. These inputs are translated to a specific heading and attitude, which the autopilot will then hold until instructed to do otherwise. This provides stability in pitch and roll. Some aircraft employ a form of CWS even in manual mode, such as the MD-11 which uses a constant CWS in roll. In many ways, a modern Airbus fly-by-wire aircraft in Normal Law is always in CWS mode. The major difference is that in this system the limitations of the aircraft are guarded by the Flight Computer, and the pilot cannot steer the aircraft past these limits.

Computer system details:

The hardware of an autopilot varies from implementation to implementation, but is generally designed with redundancy and reliability as foremost considerations. For example, the Rockwell Collins AFDS-770 Autopilot Flight Director System used on the Boeing 777 uses triplicate FCP-2002 microprocessors which have been formally verified and are fabricated in a radiation resistant process.

Software and hardware in an autopilot is tightly controlled, and extensive test procedures are put in place.

Some autopilots also use design diversity. In this safety feature, critical software processes will not only run on separate computers and possibly even using different architectures, but each computer will run software created by different engineering teams, often being programmed in different programming languages.

Result:

It is generally considered unlikely that different engineering teams will make the same mistakes. As the software becomes more expensive and complex, design diversity is becoming less common because fewer engineering companies can afford it. The flight control computers on the Space Shuttle used this design: there were five computers, four of which redundantly ran identical software, and a fifth backup running software that was developed independently.

10. Learning Outcomes Achieved

1. Understanding the expert system which controls the plane automatically using artificial intelligence.
2. Studying how expert system works.

11. Conclusion:

Autopilots have evolved significantly over time, from early autopilots that merely held an attitude to modern autopilots capable of performing automated landings under the supervision of a pilot.

References:

[1] Artificial Intelligence: A modern approach, Stuart Russel and Peter Norvig, Pearson.

[2] Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw.

[3] Principles of Artificial Intelligence, Nils J. Nilson, Narosa Publications.

Viva Questions

1. What is an expert system?
2. What is the use of artificial intelligence in expert system?
3. Which are other examples of expert system?
4. What is the goal of expert system?
5. Which are the advantages of expert systems?