International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 5 Volume No.6 Aug-Sept – 2022
DOI:10.46647/ijetms.2022.v06i05.063 ISSN: 2581-4621

Human Machine Interface In Aviation

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Abstract
A Human-Machine Interface (HMI) is a user interface that connects a person to a machine or a device or to say, a screen that allows a user to interact with a device. Interfaces such as leap motion controller, multi touch display, speech recognition etc. helps to ease functions or the command execution in various sectors of aviation industry such as cockpit, air traffic controller (ATC), Unmanned Aerial Vehicle (UAV) of the aircraft cockpit and other related elements in aviation industries. The aim is to ease the interaction between the machine and the human and also to improve the accuracy of the system. The minimisation of equipment in the aircraft industry has led to less generation of e-waste.
Keywords: ***HMI, Speech recognition, Gestures, ATC, UAV***

1. Introduction

A human-machine system is one that combines the functions of a human operator (or a group of operators) and a machine. This term can also be used to emphasize the concept of such a system as a single entity that interacts with its surroundings [6.1]. A user interface (UI) is the space where humans and machines interact in the industrial design field of human-computer interaction. The goal of this interaction is for the human to operate and control the machine effectively, while the machine simultaneously feeds back information that aids the operators' decision-making process [6.2].
Traditionally, knobs, switches, and throttles have been utilised to control the systems used in the aviation sector, such as navigation panels, display panels, and so on. The contemporary rise of digital technology has resulted in the change of old aircraft equipment to modern multi-interaction interfaces, reducing the complexity of aviation equipment such as ATC, Cockpits and UAVs. This research investigates how human-machine interfaces interact with the aviation sector.

Fig. Human Machine Interface (Cockpit)

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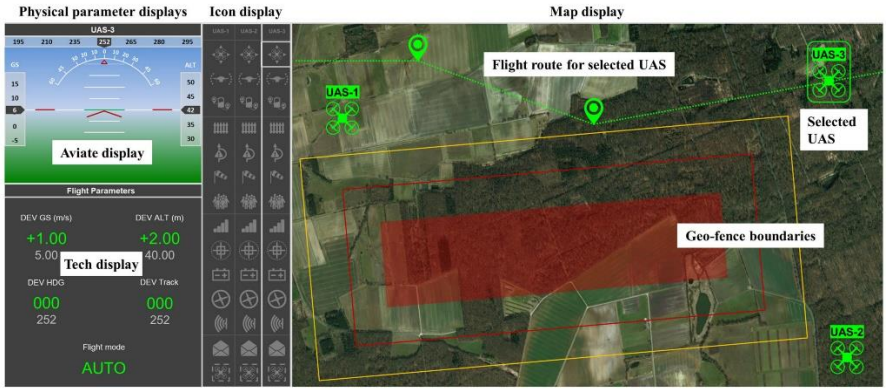

Fig. Depicting the Human–Machine Interface Design for Monitoring Safety Risks Associated with Operating Small Unmanned Aircraft Systems in Urban Areas

2. Why Human Machine Interface?

As humans and machines cannot communicate directly, an interface is required. As a result, many interfaces, particularly in the aviation industry, such as leap motion controllers, multi-touch displays, speech recognition, and so on, are used.

The Leap Motion Controller is a little USB attachment that should be positioned on a tabletop facing up. It can also be connected to a virtual reality headset. Using two monochromatic infrared cameras and three infrared LEDs, the system monitors a roughly hemispherical region from a distance of around one metre. This device's application is that it can be used to control drones using gesture input [6.3].

To elaborate on the multi touch display, it is a sort of user interface that permits input via pressure and gestures at multiple locations on the surface of a panel. The goal of deploying this device in the aviation industry is to simplify command execution in ATC.

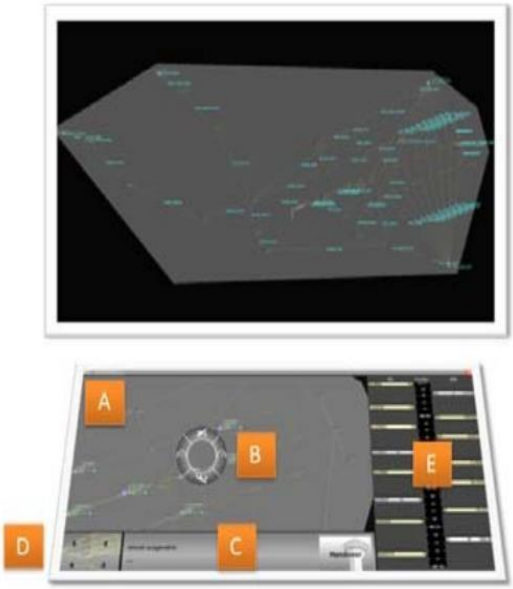

Fig. depicting the Multi Touch Interface

When it comes to speech recognition, it refers to a machine's or program's ability to detect words spoken aloud and convert them into intelligible text. To return to the aviation industry, it enables

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users or controllers to provide commands to the system through speech. The system then recognises the commands and performs the necessary action.
Interfaces are crucial for keeping up with the pace of technology and for increasing aviation industry productivity.

3. HUMAN MACHINE INTERFACE IN AVIATION

The inclusion of current technologies into the aviation sector has resulted in decreased complexity and ease of command execution. The aviation sector has several separate fields, such as Air Traffic Controller (ATC), Unmanned Aerial Vehicle (UAV), Cockpit, and so on. Over here, all of the executions were performed manually.
However, in March 2018, the French Defense Procurement Agency DGA contracted Dassault Aviation and Thales to establish an AI-based innovation ecosystem relevant to military aviation: this preliminary study programme is known as Man Machine Teaming (MMT). The purpose is to uncover innovations, analyse them, mature them, and eventually include them into the development of new fighter jets, specifically the future Rafale standards and the New Generation Fighter [6.4]. As a result of this concept, the entire aircraft industry, rather than just military aviation, gradually began to embrace new technologies.

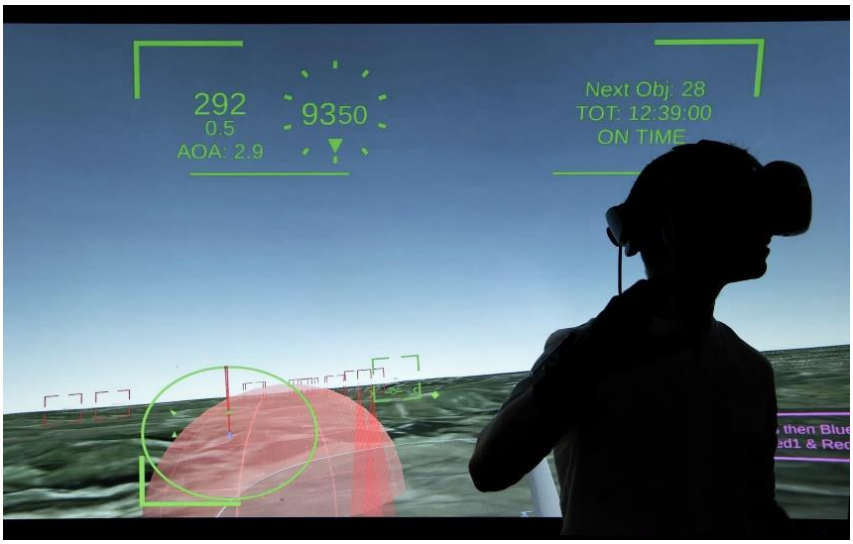

Fig. Man Machine Teaming (MMT) Project

When it comes to new technology, most systems' complexity decreases, lowering human workload. In today's environment, touch-based technology is preferred over mouse or keyboard technology, making it easier for young people to execute command execution in the sector.
Touches and speech recognition make it easier to communicate with people because most modern gadgets rely on speech and gestures to perform their functions. Users may simply memorise the motions, avoiding the need for additional training for people to communicate with the system [6.5]. Previously, mouse and keyboards were utilised to communicate commands with ATC and the pilot. The current implementation of the multi touch interaction display enables the user to execute commands more quickly and smoothly. Such as pressing the aircraft's call sign and changing the speed or altitude using the sliders on the multi touch interaction screen in ATC. The present traffic could also be displayed on a wider screen, and the distance between two aircrafts could be estimated by making a two-finger motion and clicking the aircrafts' call signs. Speech recognition could potentially be used to issue commands to ATC.

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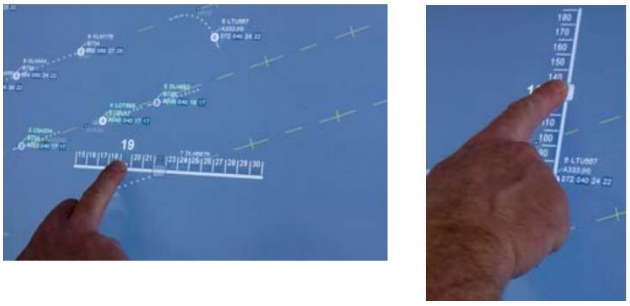

Fig. depicting the Speed and Altitude commands in ATC.

The speech recognition interface accepts user input and converts it to the relevant command to be executed. For example, "SWISS AIR 759 BRAVO CLEAR FOR TAKE OFF" is a take-off clearance command issued by ATC via speech recognition.

To measure the efficiency of the systems, various machine learning and neural network algorithms were used. Data sets were gathered in order to put several machine learning and neural network models to the test. The acquired data set is divided into two parts: training and testing. The training data sets are utilised to train the model to recognise the necessary motions and perform the right action. The test data is used to evaluate the functionalities of the trained model [6.6]. Almost all of the models were found to be accurate to within a factor of two. The introduction of technologies has resulted in substantially higher efficiency and precision in the aviation sector.

4. Pros & Cons

"Nothing is perfect; it is what you make of it," Emily Fisk Giffin once said. Even after years of growth and technological developments, we can never state that Human Machine Interface is totally correct, even though it has its own advantages. HMI, like the two sides of a coin, has both advantages and disadvantages.

4.1. The benefits of HMI may include:

- Less complexity

The modern aviation system assists in the execution of directives with simple gestures. Too much aviation equipment could be merged into single interfaces for command execution. This also reduces workload [6.7].

- Easy to implement

In place of multiple equipment in the aviation industry, it could be replaced with multi touch screens or devices, that utilizes touch speech recognition and eye gaze to function implementation.

- Understanding of aircraft systems

Traditional equipment is prone to failure, and solutions must be discovered by the users themselves. As a result, the HMI aids in the analysis of the situation and the provision of alternatives [6.7].

- Easy to memorize

  Gestures are designed in a way that they are easily recognisable and memorisable.

- Less equipment needed.

As previously said, less equipment is required, resulting in less e-waste.

4.2. The limitations of HMI may include:

- Decrease in cognitive skills

The entire automation of the aircraft may result in a loss in the pilot's knowledge and cognitive skills. It is due to the pilots' lack of oversight over the aircraft controls [6.7].

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- Improper equipment usage

The use of equipment by negligent or inexperienced people may be futile. It has the potential to jeopardise the entire system.

- Less accuracy

Because of the lack of precision in touch, touch panels are not required to offer correct results. Incorrect acts caused by inaccuracy in touch could be harmful.

- Unacceptance of new technologies

Traditional equipment is preferred by older generations over new technology. It is difficult for them to adjust and use.

- Highly dependable

The reliance on current systems may diminish their ability to solve mistakes manually.

5. CONCLUSION:

At the end of the day, we can come to a conclusion that the Human-Machine Interface is useful and practical in modern world businesses, particularly in the aviation industry. We can also observe different sorts of interfaces and how they have been used in the realm of aviation. We can confidently predict that HMI will continue to develop as a result of the growing interest in it. Humans will continue to create new discoveries and develop more enhanced and greater things in the realm of HMI.

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