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Digital Intercommunication System in Advanced Light Helicopter (ALH)

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Abstract

Analog Intercom System provides one-to-one communication, there was distortion and signal loss in analog system Also, there was no proper control over the volume and frequencies. Digital Intercommunication System is implemented. It provides secure and jam resistant voice/data communication from air to ground and air to air in Very High Frequency/Ultra High Frequency Bands (V/UHF). The main purpose of this system is to provide inter communication among the flight crew .It also has the facility to communication with ground crew through an external jack during maintenance operation whenever required. It is a central control for all communication equipment mounted on ALH .It interfaces with various radio channels, warning and other audio outputs. It facilitates to communicate among crew members of ALH as well as with air traffic control (ATC) and other helicopter.

Keywords: Analog Intercom System, ALH,Air Traffic Control(ATC), Digital Intercommunication System, flight crew

I. INTRODUCTION

The main purpose of the system is to provide inter-communication among the flight crew. Intercommunication is provided through three station boxes one each for pilot, co-pilot and two passengers. It is a central control for all communication equipment mounted on ALH. It interfaces with various radio channels, warnings and other audio

Outputs. The intercommunication is achieved through a microphone, station box, junction box and headphones

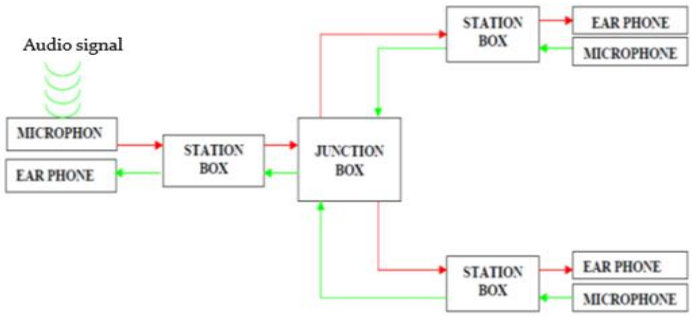


Fig.1.1: Analog intercommunication system

The speech from the microphone will be passed through a station box to the junction box. From the junction box this signal will be fed to other station boxes and headsets vice versa the block diagram as shown in the Fig 1.1.

The intercommunication system comprises of the following subcomponents:

a) Junction box. b) Station boxes.

a) Junction Box: It is a modular unit with a five station audio user junction box and individually replaceable card for each user. It provides interface between station boxes, radio channels, intercom channels and other audio warning and voice warning channels. Junction box is located in the nosecone region of the ALH shown in Fig1.2.

Fig.1.2: Junction box in ALH

Fig.1.3: Station box in ALH

b) Station Box: It is also a modular unit provides controls for the operation of the intercom and radio channels. It interfaces with junction box, microphones and earphones. Station boxes for pilot and co-pilot is located in the center console of the ALH and the third crew station box is fixed to the Centre of roof behind the co-pilot shown in Fig 1.3.

The leading of Intercom system are:

i. Intercommunication among crewmembers
ii. Provision for transmitting on more than one radio channel simultaneously
iii. A voice operated switch provided for better noise immunity
iv. Interfacing for five radio Trans receivers with volume control
v. Interfacing for six receivers with volume controls

II. EXPLAINATION OF PROPOSED PROJECT

Digital intercommunication with its electronic switching infrastructure provides internal communication between crew members the main purpose of this system is to provide inter communication among the flight crew .It also has the facility to communication with ground crew through an external jack during maintenance operation whenever required. It is a central control for all communication equipment mounted on ALH .It interfaces with various radio channels, warning and other audio outputs.

A. COMMUNICATION SYSTEM

It facilitates to communicate among crew members of ALH as well as with air traffic control (ATC) and other helicopters and external communication over the radios which are connected to the system.The below block diagram in Fig 2.1 shows the working principle of digital intercommunication system .The pilot/co-pilot is given input signals Ex: V/UHF, HF, Audio and RF signals. The pilot/co-pilot can select the required input signal. The dsp processor processes the input signal i.e. filtering and performs amplification, and displays the signal selected by the pilot/co-pilot. If the signal is an audio signal, the pilot/co-pilot can control the volume by increasing or decreasing the volume.

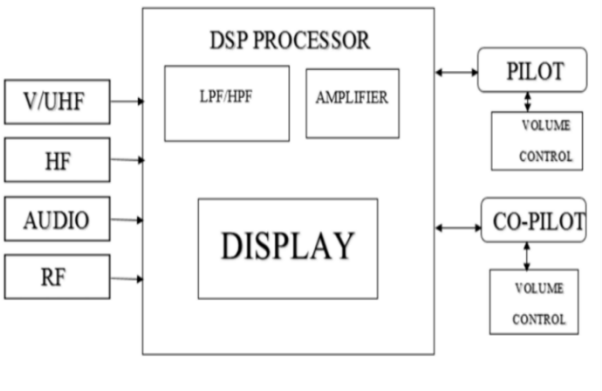


Fig 2.1: Digital Intercommunication System

B. V/UHF (Very /Ultra high frequency)

V/UHF system is the main & most important communication system on the ALH.The main purpose of the V/UHF communication system is to provide short distance communication (i.e., Line–Of– Sight communication) between air-to-air, air to ground and ground-to-ground two-way communication in the VHF and UHF bands in the airborne platforms. In ALH two independent sets of V/UHF sets are available. The overall frequency range for this system is 30-407 MHz The working principle and operation of both sets are similar. It also provides secure way of communication, radio relay broadcasting, ECCM (Electronic Counter Counter Measures) etc. This system facilitates 40 preset channels, 2 transmission power level-High &Low.

C. HFSSB (HIGH FREQUENCY SINGLE SIDE BAND)

HF SSB stands for High Frequency Single side band communication system. The main purpose of the system is to provide long-range air to ground, air-to-air and ground-to-ground long range for both voice and data. It can also use for short-range communication. This is a non-line of sight communication with operating frequency 2MHz to 30 MHz The system can operate in simplex communication and semi duplex communication. Types of modulation that can be selected in this system are USB & AM.

D. AUTOMATIC DIRECTION FINDING SYSTEM (ADF)

This is a microprocessor based automatic direction finder system used for navigation. The main purpose of the system is to indicate the direction of arrival of electromagnetic signal from the ADF ground station which is known as NDB (Non directional beacon) station. The Automatic Direction Finder (ADF) provide bearing & audio reception to the selected ground beacon. The ADF system operates in LF &MF band. The frequency range of 190 to 1860KHZ and also on 2182 kHz marine frequency. This system enables the crew to obtain radio bearings to any MF (medium frequency) beacon within the range of ADF system.

PRINCIPLE OF OPERATION:

The principle of operation of the system is line of sight propagation which is also known as space wave propagation.

Line Of Sight Communication: - A characteristic of some open-air transmission technologies where the area between a transmitter and receiver must be unobstructed.

The range is approximately given by

$$R=1.25(\sqrt{hr} + \sqrt{ht}) \text{ nautical miles.}$$

Where hr = Receiving antenna height from the sea level in feet.

ht = Transmitting antenna height from the sea level in feet.

R = Range in nautical miles.

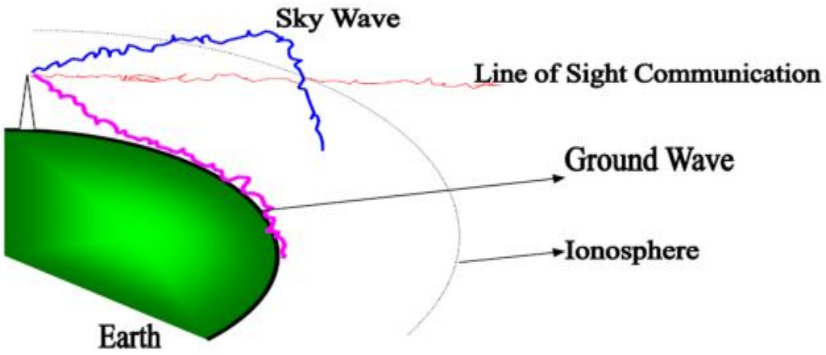


Fig.2.2: Illustration of line –of- sight communication

III. FLOW CHART

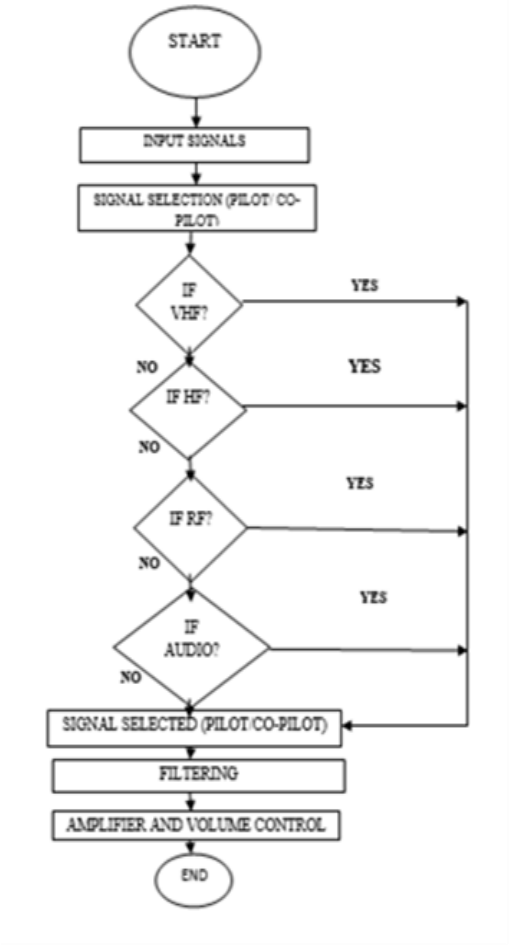


Fig.3.1: Flow chart

IV. RESULTS ANALYSIS

The Fig 4.1 shows the waveform the Audio signal is selected by the pilot, can control the volume by increasing/decreasing the volume control and displayed on the display screen.

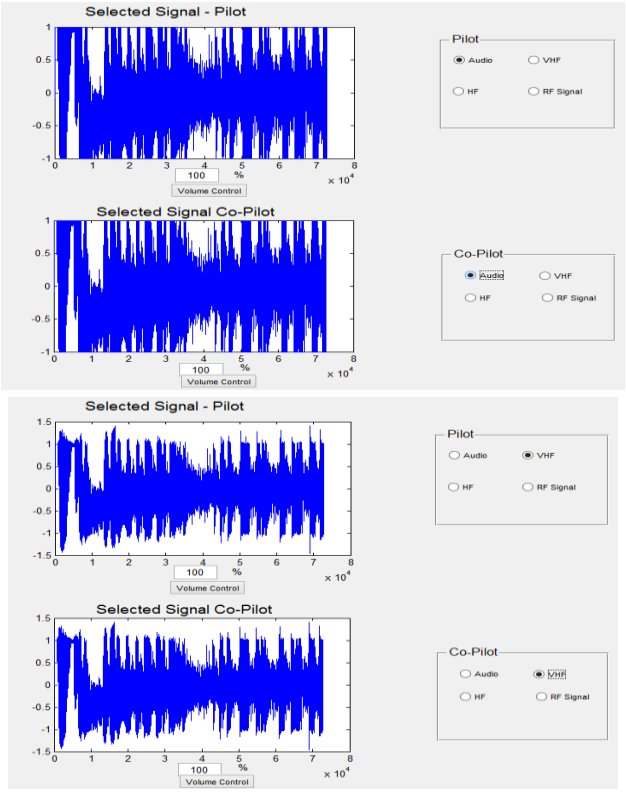


Fig.4.1. The selected Audio signal

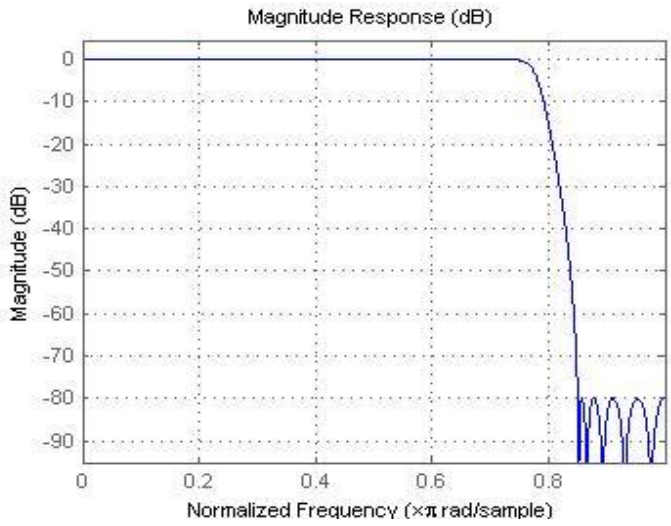


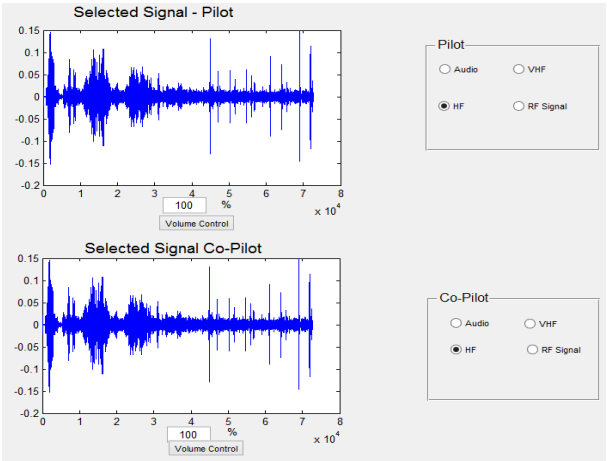
Fig 4.2. The selected VHF signal

When the VHF signal is selected by pilot/co-pilot the operation is performed by the DSP processor that is LPF, which allows low frequency signals and blocks high frequency signals. And also performs the amplification process and the corresponding signal is displayed on the display screen.

Example:

Sampling rate fs=8 kHz	Fs/2=4kHz
Cut-off frequency: 4000*0.85=3.4kHz	0.85 is the filtering response

When the HF signal is selected by pilot/co-pilot the operation is performed by the DSP processor that is HPF, which allows high frequency signals and blocks low frequency signals. And also performs the amplification process and the corresponding signal is displayed on the display screen. Here frequency starts from 3.4 kHz.



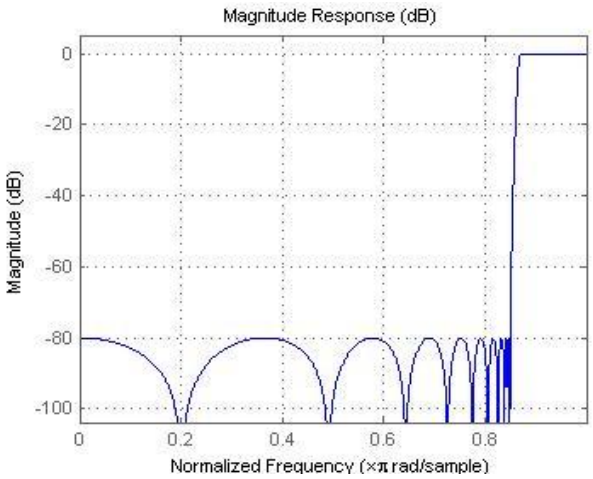


Fig.4.3. The selected HF signal

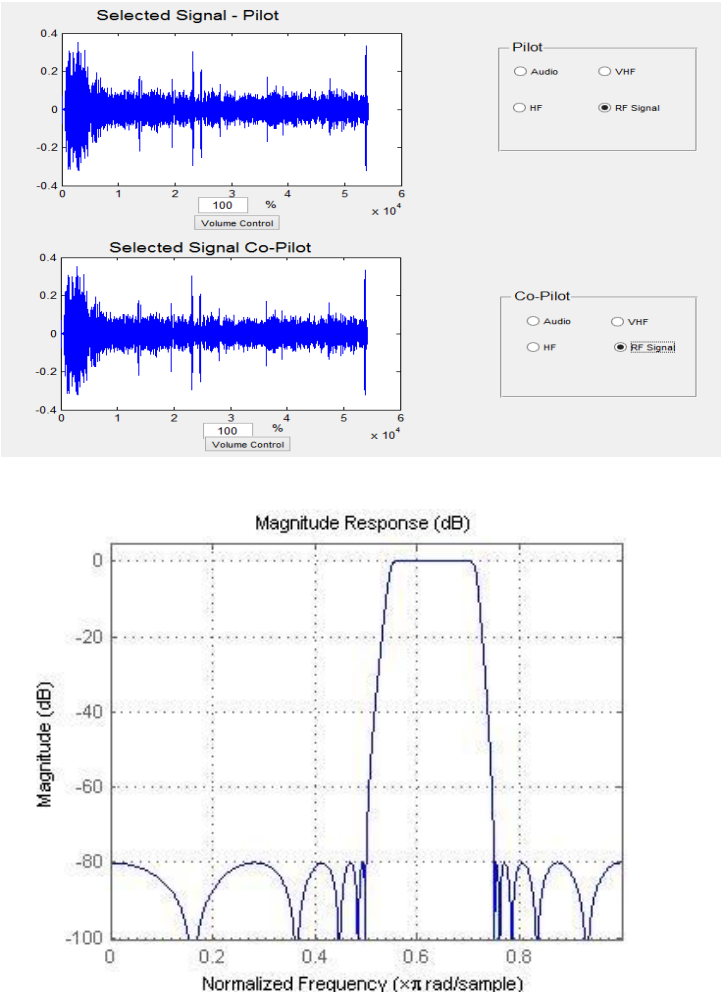


Fig.4.4: The selected RF signal

When the RF signal is selected by pilot/co-pilot the respective waveform is displayed on the display screen, and synchronously HPF filtering operation is performed as shown in Fig 4.4.

V. CONCLUSION

The "Digital intercommunication system" to overcome the problems occurring in the Analog system by considering the audio signals, amplification and filtering functions by using LPF and HPF in DSP processor.The drawbacks like selection of signals, no control over the audio signals and frequency ranges in the Analog system. We can design band pass filter by combining LPF and HPF to get thedesired frequency band. Digital intercommunication system is an intelligent communication system for selecting required signals by the flight crew members.

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