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A DSP based Embedded System for Noise removal using Beagle Board-XM

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***Abstract*— In recent years, embedded systems supported microprocessors have progressed considerably. This truth permits exploitation powerful operating systems and programming languages with a high level of abstraction that facilitates the event of applications. A low-priced device supported the chip OMAP 3530 developed to manage audio and image signal exploitation wireless transmission. Filtering steps supported median filter and audacity code to boost the signal to noise magnitude relation. This work represents the filtering of image exploitation median filter and filtering the noise signal by exploitation audacity.**

I. INTRODUCTION

A great advances within the development of embedded systems supported microcontrollers [1]. AN example is that the Open transmission Application Platform (OMAP) series, from texas Instruments, that incorporates many transmission processors with low energy necessities for specific functions. The enhanced power of those processors permits exploitation them in an exceedingly high-abstraction surroundings the installation of powerful in operation systems, like GNU/Linux, is establishing a bridge between classical programming of embedded systems and a customary laptop.

First, compile the BB a borderline operating system (OS) supported by GNU/Linux that contains the libraries required for programming. That way, a high-abstraction programming environment protective the functionalities of the hardware. additionally, it permits saving plenty of operating time within the development of low-level libraries. It value noting that in embedded systems, in distinction to non-public computers, the hardware is sometimes terribly specific and restrictive; thus every code element ought to be rigorously adjusted so as to reduce the resource consumption.

Once the software package was discovered, an extra layer is extra by installing a JAVA virtual machine. It provides a awfully high-level programming language and an enormous quantity of libraries particularly attention-grabbing in our case to develop graphical user interfaces.

Finally, a digital communication system has been developed with the aim of function an example of the potential of the development framework. The system, supported Wiener methodology, permits managing audio signals, noisy-channel modelling, and signal filtering so as improve the signal to noise ratio (SNR). The system is intended to send and receive signals between 2 or a lot of devices exploitation Bluetooth. The system receives and displays the signal, and so filters it and analyzes the standard of the communication method. The filtering algorithms enforced is applied to many filtering schemes like, for instance, the noise reduction drawback that deletes a broadband interference that contaminates the required signal.

This work shows the implementing the filtering technique of received noise signal and image signal exploitation filtering algorithmic program.

II. A LOW-PRICED EMBEDDED SYSTEM: THE BEAGLEBOARD-XM

The beagle Board [2] may be a low-priced hardware platform specifically designed to be employed by the open source community. it's made by texas Instruments in association with Digi-Key as an educational board that might be employed in schools round the world to show open source hardware and open supply code capabilities.

A. Hardware Description

The central chip may be a member of the OMAP series made by Texas Instruments and designed for developing transmission applications for mobile devices. Nowadays, this chip is employed in several high-end mobile phones just like the Nokia N series. at intervals the OMAP series, the OMAP3 provides powerful enough to run desktop in operation systems like GNU/Linux. Specifically, the chip OMAP 3530 employed in the BeagleBoard-XM includes a ARM Cortex A8 kernel functioning at 720 mhz, therefore it's able to run not only a GNU/Linux OS however additionally resource-intensive applications like real-time video process.

B. Software Description

The Ubuntu was the OS chosen to drive the board. it's a unique GNU/Linux distribution created by atiny low cluster of the those that have collaborated with vital comes like Open-Embedded, OpenZaurus or OpenSimpad. The project aims to get a stable and easy distribution for embedded devices, like the BeagleBoard-XM. It includes some basic libraries, the Gnome graphical environment, libraries for Bluetooth and also the JAVA virtual machine. we've got used a 8GB SecureDigital card as disk storage, that was divided in 2 partitions by means that of the Gparted code. the primary partition, with a capability of one hundred MB and formatted as FAT32, contains only a file to load the operative system. this is often the boot partition. The second partition takes up the rest of the card capability. it's formatted as EXT3 and contains the OS and also the applications The OS was written within the card by means that of a further computer and packages and libraries was compiled for the BeagleBoard-XM design throughout the primary boot.

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Fig 1.Beagle Board-XM(Top side)

III. DSP IN BEAGLE BOARD-XM

Digital Signal processing (DSP) is dispensed by means that of specific hardware, because of the massive range of required float operations. an optimized hardware is particularly necessary once the signal processing is performed in real time, as an example for the noise cancellation procedures performed by a mobile phone throughout a call. The chip OMAP 3530 integrated into a BB-xm provides the computing capability required for signal processing and it additionally has the benefits of embedded systems, like low cost and low energy necessities.

A.Filtering Methods

Linear smoothing filters are better filters for removing gaussian noise and, in most cases, the other kinds of noise as well. A linear filter is designed using the weighted sum of the pixels in successive windows. Typically, constant pattern of weights is employed in every window, which implies that the linear filter is spatially invariant and might be implemented employing a convolution mask. If different filter weights are used for various components of the image, however the filter remains implemented as a weighted sum, then the linear filter is spatially varying. Any filter that's not a weighted sum of pixels could be a nonlinear filter. nonlinear filters will be spatially invariant, that means that constant calculation is performed regardless of the position within the image, or spatially variable. The median filter could be a spatially invariant, nonlinear filter. By analyzing these algorithms, we discover some merits and demerits of them in preserving image details. Having inheritable these deserves, we tend to propose a new formula that is a lot of sturdy, a lot of adaptive and higher at smoothing pictures.

B.Median Filter

Median Filter could be a simple and powerful non-linear filter that relies order statistics. it's simple to implement methodology of smoothing pictures. The median filter is often used to reduce noise in an image, somewhat like the mean filter. However, it typically will an improved job than the mean filter of preserving helpful detail within the image. This category of filter belongs to the class of edge preserving smoothing filters that are non-linear filters. this implies that for two images A(x) and B(x)

Median [A(x) + B(x)] median [A(x)] + median [B(x)]

These filters smooth the information whereas keeping the tiny and sharp details. The median is simply the middle value of all the values of the pixels within the neighborhood. Note that this is often not constant because the average (or mean); instead, the median has half the values within the neighborhood larger and half smaller. The median could be a stronger "central indicator" than the average. particularly, the median is hardly affected by a small range of discrepant values among the pixels within the neighborhood. Consequently, median filtering is incredibly effective at removing various types of noise.

The noise reduction could be a typical pre-processing step to enhance the results of later processing. Median filtering is very widely utilized in digital image processing as a result of, under bound conditions, it preserves edges whereas removing noise.

The main idea of the median filter is to run through the signal entry by entry, replacement every entry with the median of neighboring entries. The pattern of neighbors is named the "window", that slides, entry by entry, over the complete signal. For 1D signal, the foremost obvious window is simply the primary few preceding and following entries, whereas for second (or higher-dimensional) signals like images, a lot of complex window patterns are possible. Note that if the window has an odd range of entries, then the median is easy to define: it's simply the center value after all the entries within the window are sorted numerically. For an even range of entries, there's over one possible median.

In simple terms, a Median Filter will be applied to images so as to attain image smoothing or image noise reduction. The Median Filter in contrast to most image smoothing methods, to a degree exhibits edge preservation properties.

Then the median is calculated by initial sorting all the pixel values into ascending order so replace the pixel being calculated with the middle pixel value. If the neighboring pixel of image that is to be thought-about contains an even numbers of pixels, than the average of the two middle pixel values is employed to replace. The median filter offers best result once the impulse noise percentage is a smaller amount than 0.1 %. once the amount of impulse noise is enhanced the median filter not offers best result.

C. Algorithm of median filter:

- The algorithm for the median filter is as follows:
- Select a 2 dimensional window W of size 3*3. Assume that the pixel being processed is cx, y
- Compute Wmed the median of the pixel values in window W.
- Replace cx, y by Wmed.
- Repeat steps one to three till all the pixels within the entire image are processed.

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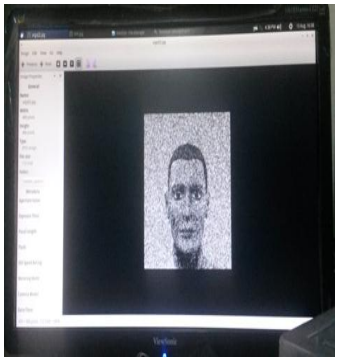

Fig. 2NoiseImage.

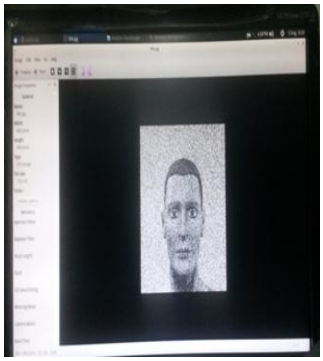

Fig. 3 Filtered image

IV. AUDACITY IN BEAGLEBOARD

Audacity could be a free open source digital audio editor and recording computer software system application, available for Windows, Mac OS X, linux system} and alternative operating systems. additionally to recording audio from multiple sources, Audacity are often used for post-processing of every kind of audio, as well as podcasts by adding effects like normalization, trimming, and fading in and out. Audacity has also been used to record and mix entire albums, like by Tune-Yards. it's conjointly used for filtering techniques by using Nyquist programming language to put in writing the own plug-in effects for Audacity.

A. Audacity Nyquist programming

Audacity permits to use the Nyquist programming language to write down own plug-in effects for Audacity. not like VST and LADSPA plug-ins, Nyquist plug-ins will be written using a normal text editor and do not need to be compiled. type the following into the Nyquist Prompt (using LISP syntax):

(sum s 1)

Or sort the following equivalent SAL command:

return s + one

mod-script-pipe: this can be a gui plug-in that enables Audacity to be driven from an external Perl script. Commands are sent to audacity over a named pipe. A sample Perl script is enclosed within the latest Audacity SVN Development Code. Any scripting language that supports named pipes will be utilized in place of Perl.

Fig a.

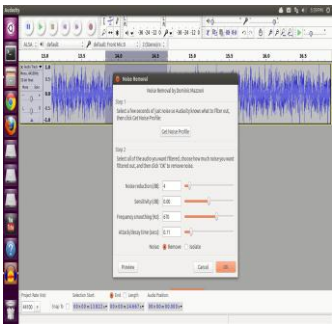

Fig b.

Fig a. Received signal from outside.
Fib b. Removing Noise for some portion.

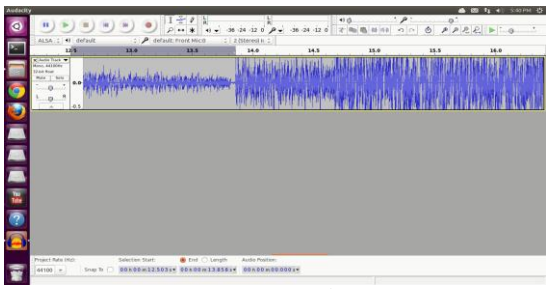

Fig c. Removed noise signal for some portion.

CONCLUSION

It has been shown a system for digital communications that runs on an embedded device. The device employed was a Beagle board based on the chip OMAP 3530 from Texas Instruments. The system has been developed in three stages.

First, a minimal operating system based on GNU / Linux has been compiled to be loaded on the desired platform. Then, a Java virtual machine has been installed in order to provide a high-level programming environment and the libraries needed to manage the device.

Finally, a DSP application provided with a graphical interface has been developed in Java. It allows to handle several audio signal, add different types of noise to them and filter the noise using Audacity software.

Power consumption is less. No license issues are required. Open source is advantage. It required 5V,320mA and 1.6W.

In future installing the Bluetooth drivers in to the Beagle board wireless communication can be done and I2C protocol communication can be implemented.

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