Frequency Matching of Digital Signal for Diamond Cutting using Signal Processing Using Xilinx

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Abstract— We represent a new method of diamond cutting with the help of an analog signal. In today's world most of the signal is processed in digital form to increase in the accuracy here also we had borrowed the same concept and implement a diamond cutting tool on FPGA. Though diamond cutting is done through different methods but through this method we can save lots of time, more perfection and we can have more accuracy. The aim being that a given input signal should output exactly or nearly exactly the desired frequency required. The basic steps which are followed in this method are calculating FFT, frequency extraction, frequency matching and diamond cutting. In FFT we determine the frequency domain of our signal, by frequency extraction we realize the maximum and minimum frequency and in frequency matching we match the desired frequency with the current frequency.

Key words: Frequency Matching, Fast Fourier Transform, Frequency Extraction, Diamond Cutting

I. INTRODUCTION

Diamond cutting is the practice of changing a diamond from a rough stone into a geometrically shaped flat polished faces. Cutting diamond requires extreme knowledge, tools and techniques because of its high difficulty. The diamond cutting process includes these steps; cleaving, sawing, bruiting/cutting, polishing, and the inspection at the end. But this type of process requires an analog purpose, just by matching the frequency of that analog signal with the desired frequency. Today we are moving towards digital world. Everything right from computer to our cell phone is being digitized. But at the same time, it is to be seen that all physical world signals available to us are still very much analog in nature. But their processing obviously happens in the digital domain. In an FPGA board we have done a lot of operations on real world signals.

Hence, the analysis and the results which follow in the project is try to use an analog signal and use that analog signal for different purpose in this case we are using it for cutting the diamond. [1]

II. BLOCK DIAGRAM

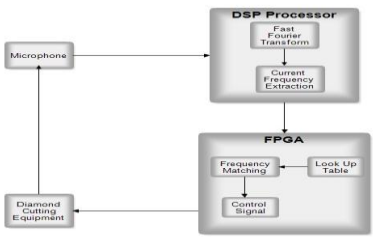

Fig.1: Block Diagram

III. WORKING OF PROJECT

1) Microphone

The large availability of analog signals is well known to us so we are using the same analog signals as our input, here the analog signal is the sound generated by the laser NdYag while cutting the available diamond. The first step of our project is to record the real time signal and store it. Any device such as mobile phone or laptops can be used to record the sound generated while cutting the diamond.

2) DSP Processor

There are two processes which comprises the Dsp processor.

[1] Fast Fourier transforms
[2] Frequency Extraction

The FFT is done to determine the frequency domain of any signal. In this case also we used FFT to determine the Frequency domain. Once the device has recorded the sound the second The FFT is done to determine the frequency domain of any signal. In this case also we used FFT to determine the Frequency domain. Once the device has recorded the sound the second step is to convert the sound into readable file. This can be done in mat lab with the help of wav read command .The command which is used is as follows

[Y, Fs, n bits, opts] = wav read ('Destination of file stored.wav');
Y= amplitude of frequency N bits=No of bits
Fs=Sampling Frequency .wav = extension

FFT computes the DFT and produces exactly the same result as evaluating the DFT definition directly; the only difference is that an FFT is much faster. Once the FFT of the signal is performed the next step is frequency extraction. By the name current frequency extraction we determine the maximum and minimum frequency of the signal. Thus with the help of frequency extraction we came to know about frequency containing the maximum information and frequency contains the minimum information. The maximum frequency is at and so it consists of maximum information. And the minimum frequency is at which can be seen from Figure 2.

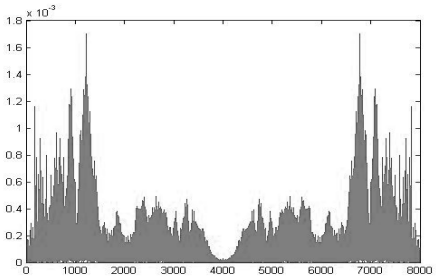

Fig. 2: Fast Fourier Transform

3) FPGA

The third part basically is of frequency matching. Here we have developed a Look up table according to our desired frequency which is known to us and they are divided in different time slots. The desired frequencies which are known have different particular frequencies which lies from 0 to 4000Hz.Initial frequency is 20 Hz which is also audible range of any human being. Here the source file or the sound recorded is of approx 1 min. The desired frequencies which are already known to us depends on the size of the diamond, if the size of diamond is larger than the frequencies changes and similarly for smaller size of diamonds, here the size of diamond is 3.2mm so from that we get different frequencies which are already known and stored in look up table. Suppose we have our current frequency as $(19c)_{16}$ or 412 Hz and the desired frequency is also 412 kHz, it lies in second time slots from 3s-6s so the *ST* output is 1(*figure 4*).In second case if the frequency is other than 412 kHz then at the output *ST* goes 0(*figure 5*) that means the frequency are not matched so the output indicates 0 between 3s and 6s. Also some part of tolerance is accepted here suppose in above case if the current frequencies are 402 Hz then also the output is 1 between time interval 3s-6s (*Figure 6*). The frequency of 10 Hz in both ways is accepted and the output in both the case is 1 i: e 422 Hz and 402 Hz, if the frequency is 424 Hz then the output is 0. If there is difference in frequency it will be displayed which can be seen from *Figure 7*. Suppose the desired frequency is 412 Hz and the current frequency which we have obtained is 420 Hz then there is difference of 8 Hz is displayed in below *Figure 7* here st denotes status signal which is our output if it is 1 or 0.If both the frequency matches then output is 1 and in second case it is 0. Curr denotes our desired frequency that is our input signals which; diff denotes the differences between two frequencies.

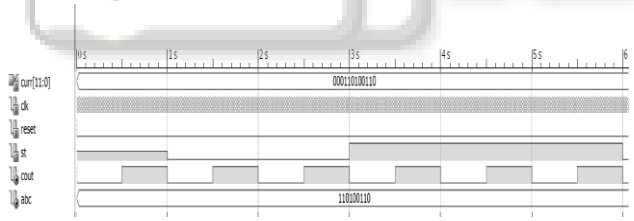

Fig. 4: Output 1 when both frequencies are matched

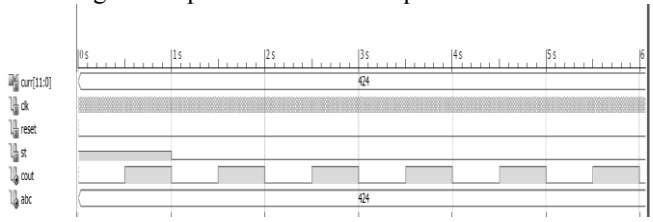

Fig. 5: Output is 0 when both frequencies doesn't match

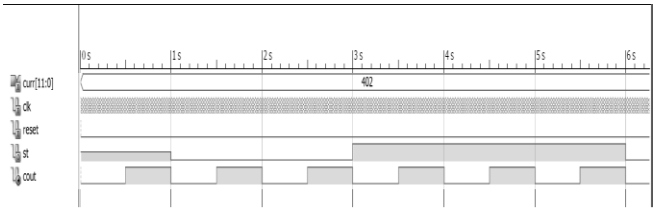

Fig. 6: Output is 1 when there is tolerance

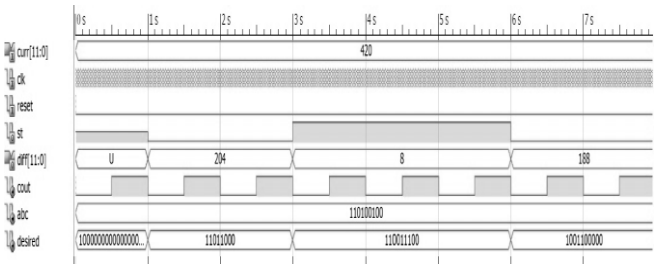

Fig. 7: Difference in frequency

IV. CONCLUSION

The underlying objective of the present work is to match the desired frequency with the current frequency which is successfully done and the differences between them are shown accordingly.

V. FUTURE WORK

The process does not end here and we have to generate a control signal which indicates that a control signal is generated when the frequency is not matched with the desired frequency so that the necessary actions are taken to overcome it.

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