A New Way to Convert Analog to Digital and Digital to Analog Data Using Successive Approximation

Saikat Sinha

***Abstract*- All the electronic and telecommunication channels use the Analog to Digital conversion and Digital to Analog conversion. There is no device existing or existing device may not be able to make the conversion properly or smoothly or correctly or fast. There is also no strategy exist to convert Analog to Digital or vice-versa directly. But, using the Successive Approximation Technique we can convert very efficiently from Analog to Digital or Digital to Analog. Moreover we can apply some security systems like encryption and data encapsulation during the data transition period every stage of conversion. By the following technique we can not only able to convert the data we can also send them from a sender to a receiver. In the transmission process we can use both the guided and unguided media and the sender can be any device connected to the network such as mobile phone, tablets, laptops, etc. with fast, secure and efficient way. In the following Article the discussion and presentation of this newly introduced strategy is discussed.**

***Index Terms*- Analog to Digital Conversion, Digital to Analog Conversion, Successive Approximation, Successive Approximation of ASCII code, 2-way ADC and DAC.**

I. Introduction

In conventional Analog to Digital conversion or Digital to Analog conversion we have only the one way process. Either we can convert Analog to Digital or Digital to Analog. But, the technique what I have introduced in this article we can convert the data both ways by using the Successive Approximation Technique. Some security measures can be provided in each stage of data transmission. As we know most data we use in the computer are in ASCII format. So that we will be able to send 8-bit or the multiple of 8-bit data through the transmission channel. We can take a data in ASCII from the sender as an input. Then convert the data in every stage while sending to the receiver's end. While sending we can encrypt the data and while receiving we can decrypt the data. Thus, we can convert Digital to Analog or vice-versa of data transformation we can have a conversation throughout the web using a single conversion technique with a security process.

II. Some Important Details

2.1 Successive Approximation: The words 'Successive Approximation' stands for the form of an existing response is gradually changed across successive trials towards a desired target behavior by rewarding exact segments of behavior. Here I project the conversion of Data from Analog to Digital and vice-versa.

2.1.1 Analog to Digital Conversion: Taking a known or unknown data Analog data we can convert that into a Digital data.

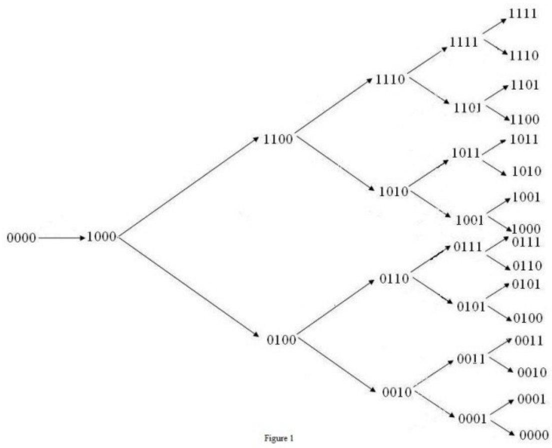

Figure 1

Here figure 1 displays how the Successive Approximation technique works. Here we have taken a 4-bit unknown analog data and convert that into digital data.

2.1.2 Digital to Analog Conversion: Taking a known or unknown data or bunch of digital data we can convert that into Analog data.

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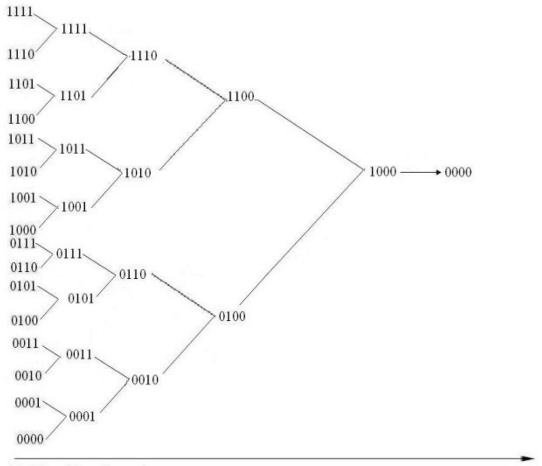

Figure 2

Here figure 2 displays how the Successive Approximation technique works. Here we have taken 4-bit unknown digital data and convert that into analog data.

III. New Approach for A/D D/A conversion

From the above diagrams we can see that for an unknown data taken as an input in an ADC can be the output of the DAC.

From the following detailed figures we can prove this.

Which we have taken as unknown input from an

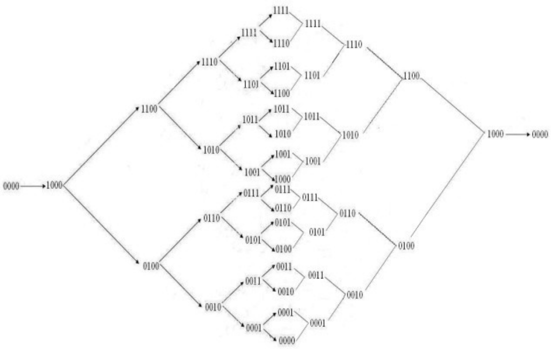

Figure 3

ADC is the same as the output we get in the DAC.

3.1.1 The New Rule:

I have seen that the differences which are coming between the stage transitions they are following a pattern if we can see through the decimal perspective.

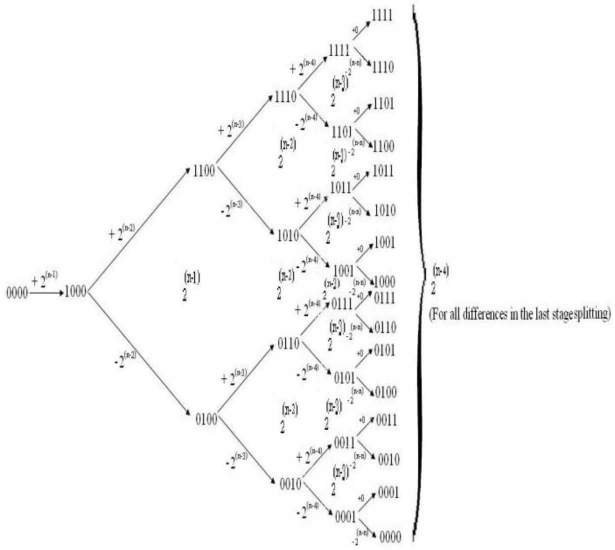

Figure 4

The above figure is for the ADC conversion.

We can also do the DAC by following the following figure.

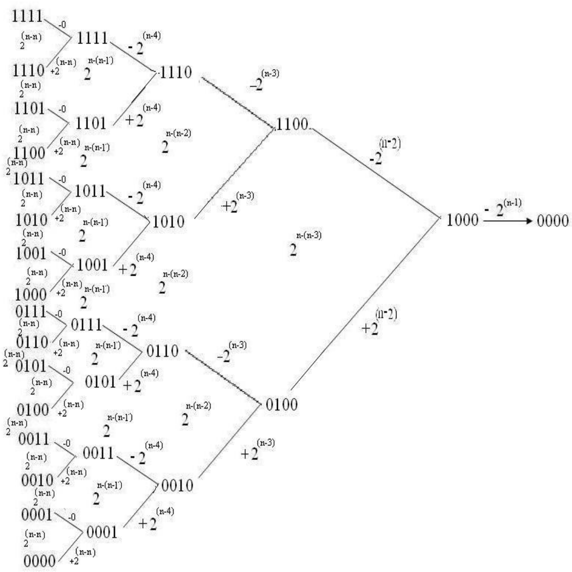

Figure 5

By merging the above two figures we get the following figure to describe the 2-way conversion technique by using successive approximation.

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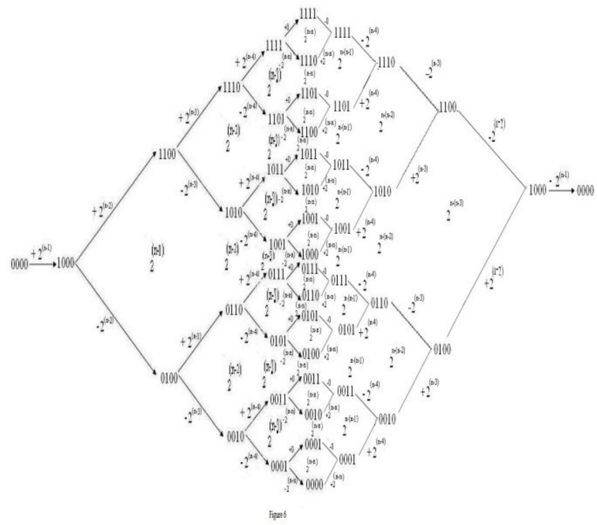

Figure 6

3.1.2 The Generalization

3.1.2.1 For ADC whatever the outputs we are getting according to the inputs. From the previous examples, we can have the answers applying the simple calculation of $\pm 2^{(n-s)}$.

Where, n= number of input bits and

s= number of stages in the Successive Approximation. This addition and subtraction method is both applicable from the 2^{nd} stage. We need to apply this up to n^{th} stage. On the 1^{st} stage we need to apply only $+2^{(n-s)}$. On the n+1^{th} stage the calculation will be $-^{2(n-n)}$ and +0.

3.1.2.2 On every stage where the splitting is taking place the difference between the every spited pair we get the difference of $2^{(n-s-1)}$.

3.1.2.3 For DAC whatever the outputs we are getting according to the inputs. From the previous examples, we can have the answers applying the simple calculation of $\pm 2^{(n-s)}$.

Where, n= number of input bits and

s= number of stages in the Successive Approximation. This addition and subtraction method is both applicable from the 2^{nd} stage. We need to apply this up to nth stage. On the n+1^{th} stage we need to apply only $-2^{(n-s)}$. On the 1^{st} stage the calculation will be $+2^{(n-n)}$ and -0.

3.1.2.4 On every stage where the splitting is taking place the difference between the every spited pair we get the difference of $2^{(n-s-1)}$.

3.1.2.5 For a 4-bit binary number we need 5 stages and for 8-bit number we need 9 stages for conversion.

3.1.2.6 For the known 8-bit ASCII data we need to apply this $\pm 2^{n-(n-2)}$ for the 1^{st} stage.

For the 2^{nd} stage $\pm 2^{n-(n-1)}$ will be applicable and for the 3^{rd} stage $\pm 2^{(n-n)}$ and for the last stage +0 and $-2^{(n-n)}$. This will do the ADC to do the DAC we simply need to use a mirrored calculation. The differences will be same just the sign will be changed the '+' will be '-'and vice-versa. The stage differences are $2^{n-(n-3)}$ for the 1^{st} splitting, $2^{n-(n-2)}$ for the 2^{nd} and $2^{n-(n-1)}$ for the 3^{rd} and $2^{(n-n)}$ for last. The stage differences will be mirrored too.

3.1.2.7 There will be no use of sign in the stage difference. It's just the difference value.

Therefore, for n number of bits we will need n+1 numbers of stages.

IV. ASCII in A/D – D/A conversion

As we know all the data we handle in the computer and cyber world are mostly comes in the form of ASCII code which stands for American Standard Code for Information Interchange. It's a 8-bit binary code which represents all the alphabets, numbers and special characters. From the process as I have shown we can convert any unknown Analog or Digital data input into our desired output. Since, the example I am showing for a known data so we need to apply the generalized formulae from the backend.

Example:
Here for example we have taken a character 'H' which ASCII value is '01001000'.

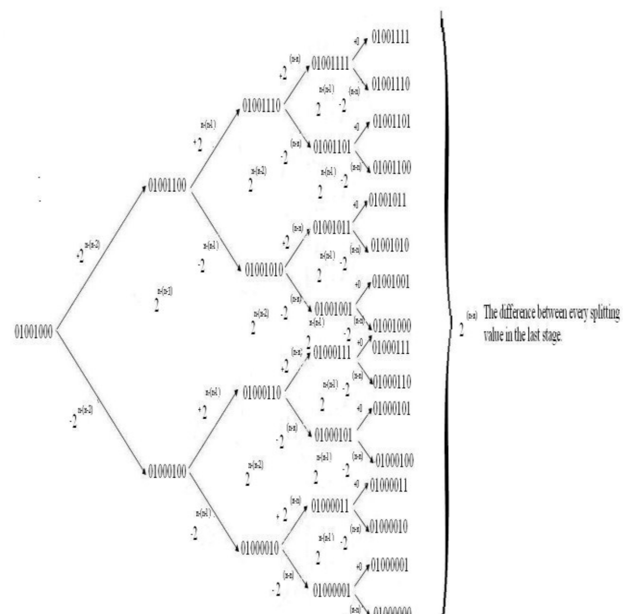

Figure 7

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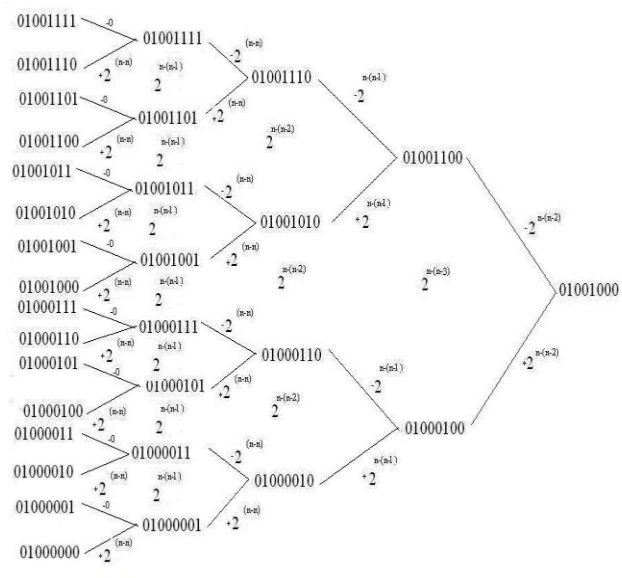

Figure 8

Now if we merge the figures 7 and 8 we see that the conversion is the equivalant process which I have mentioned earlier in this article.

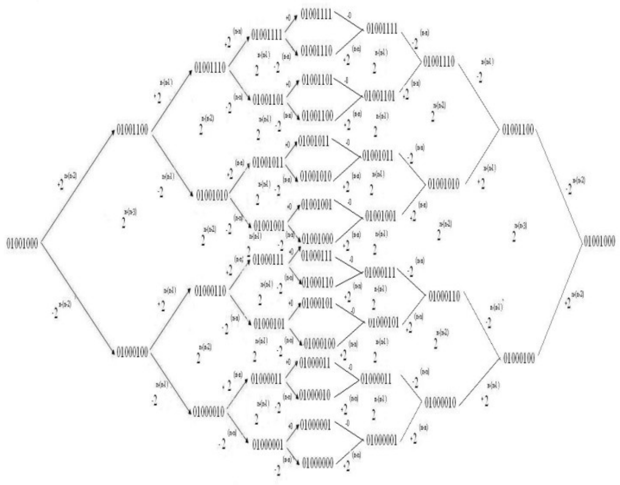

Figure 9

V. Conclusion and Future Work:

Thus, this way we can convert Analog to Digital and Digital to Analog very easily. We can also use ASCII code to send direct known data through out every possible communication channel and web. We can reduce the cost of the Telecommunication costs. Since, every conversation we make that is nothing but an Analog input to the phone and Digital output for us. We can also reduce the cost of the Internet packs, SMS or MMS packs. We can also apply the encryption process in every stage of data conversion that will make the data transmission with high security.

VI. Acknowledgement:

While preparing this article I got unlimited support and spirit from my family and friends.

My Parents Shri Kamal Kumar Sinha and Smt. Suparna Sinha and my elder brother Mr. Souvik Sinha never left my side. My three best friends Arpan Mondal, Pallab Modak and Sayantan Khamaru helped me to prepare the diagrams and gave me the directions while preparing the manuscript.

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Saikat Sinha lives at Khasthika, Bakhrahat, Police Station- Bishnupur, South 24 Parganas, PIN- 743377, West Bengal, India, is a student of Vivekananda College affiliated to University of Calcutta, Thakurpukur, Kolkata -700063, West Bengal, India since 2011, studying 3 year B.Sc Computer Science Honors, currently is in 3rd year. He had received his Higher

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