



# Hamming code using multisim

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**Abstract:** Digital communication is the exchange of information between transmitter and receiver in the digital form. The messages generated by the source which are generally in analog form are converted to digital format and then transmitted. At the receiver side the digital format of data is converted into its analog form. For the effective transmission of the data various coding methods are used. Coding of the can be done experimentally by using simulation tools.

**Keywords:** Hamming code, virtual simulation, multisim, parity bit.

## I. INTRODUCTION

In today's Digital world digital communication has been becoming the one of the basic need of human life. It is necessary to create society, to educate the people, and to express emotions as well as needs. Digital communication is approachable technology used today in all electronics devices. The data can transmit up to long distance within a second due to digital communication. The main barriers of human communication are distance and language. The first barrier is solved in digital communication. The digital data which is the digital message signal cannot be sent as it is; it has to be converted into some other form this process is known as coding.

Various techniques are used for the coding Hamming code is one of that. In the teaching digital coding, teachers can use the basic teaching method for explaining the concept of coding techniques i.e. lecture method. If the teacher use experimental method for the clearing concept then course will be become interesting and student will take active part in it, but there are some problems in the experimental teaching, such as in-availability of the component, damaging the component while using it and once it get damaged take a long time replace it becomes costly also, sometimes student are not following safety precaution in the laboratory, it may lead to human injure; to avoid this all problem we can use the virtual simulation software to simulate the circuit it not only free but avoid the damage of component damage and human injury, By using virtual simulation student can observe the output waveforms of various electronic circuits in real time, it help to understand of the principles, and improves the classroom teaching.

## II. MULTISIM SIMULATION TOOL

Multisim is a virtual simulation tool developed by the National Instrument (NI). The NI Multisim Suite is available in various versions with price and free. Student can download free version for the performing experiment. It is one of the advanced virtual simulation tool for designing electrical and electronics circuit.

This software is perfect training tool for student for performing practical without getting harm. NI design suite is easy to use for beginners, we can model and amend difficult concept with ease. By using this simulation tool student can rectify the circuit problem easily. All the components are inbuilt in it, so we need not spend extra money for the purchasing component or any other device.

## III. HAMMING CODE HISTORY

Before hamming code there are several methods to find out the error in the data transmission, but they are not more effective, they can only check the one bit error not more than one or even not correct the error.

Richard Hamming worked for Bell Labs in the 1940s and 1950s. During that time, computers used relays and read information from punched paper tape. These systems were often prone to errors relating to the paper tape being misread or relay getting stuck. If an operator was on hand when the error occurred, the program could be restarted; if the error occurred outside of working hours, the computer would skip the entire program, losing time and work must be indented.

Hamming reasoned that, if a computer can detect an error, it could also correct the error. So, he began working on an error correcting algorithm, and in 1950, he published the Hamming code.



IV. HAMMING CODE GENERATION USING MULTISIM

Hamming code is basically a linear block code it is error correcting code. The parity bits are inserted in between the data bits shown in Fig. 1, the parity bits are inserted at each 2<sup>n</sup> bit where n= 0,1, thus P1 is at 2<sup>0</sup> = 1. P2 is at 2<sup>1</sup> = 2. P4 is at 2<sup>2</sup> = 4 shown in the following figure.

D7	D6	D5	P4	D3	P2	P1
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Fig. 1 Hamming Code word

Where D3, D5, D6, D7 are data bits and P1, P2, P4 are parity bits. Selection of parity bits for 7 bit hamming code P1- P1 is calculated using even / odd parity considering bits 1:- 1, 3, 5, 7. P2- P2 is calculated using even / odd parity considering bits 2:- 2, 3, 6, 7. P4- P4 is calculated using even / odd parity considering bits 4:- 4, 5, 6, 7.

A. Hamming code generation for the 4 bit data with even parity where data=1011 [D3=1, D5=1, D6=0, D7=1]

EX-OR Gate is used to test the input bits and check bit output. An Exclusive OR (XOR) gate is a 2-input gate whose output is 1 if exactly one of its inputs is 1.

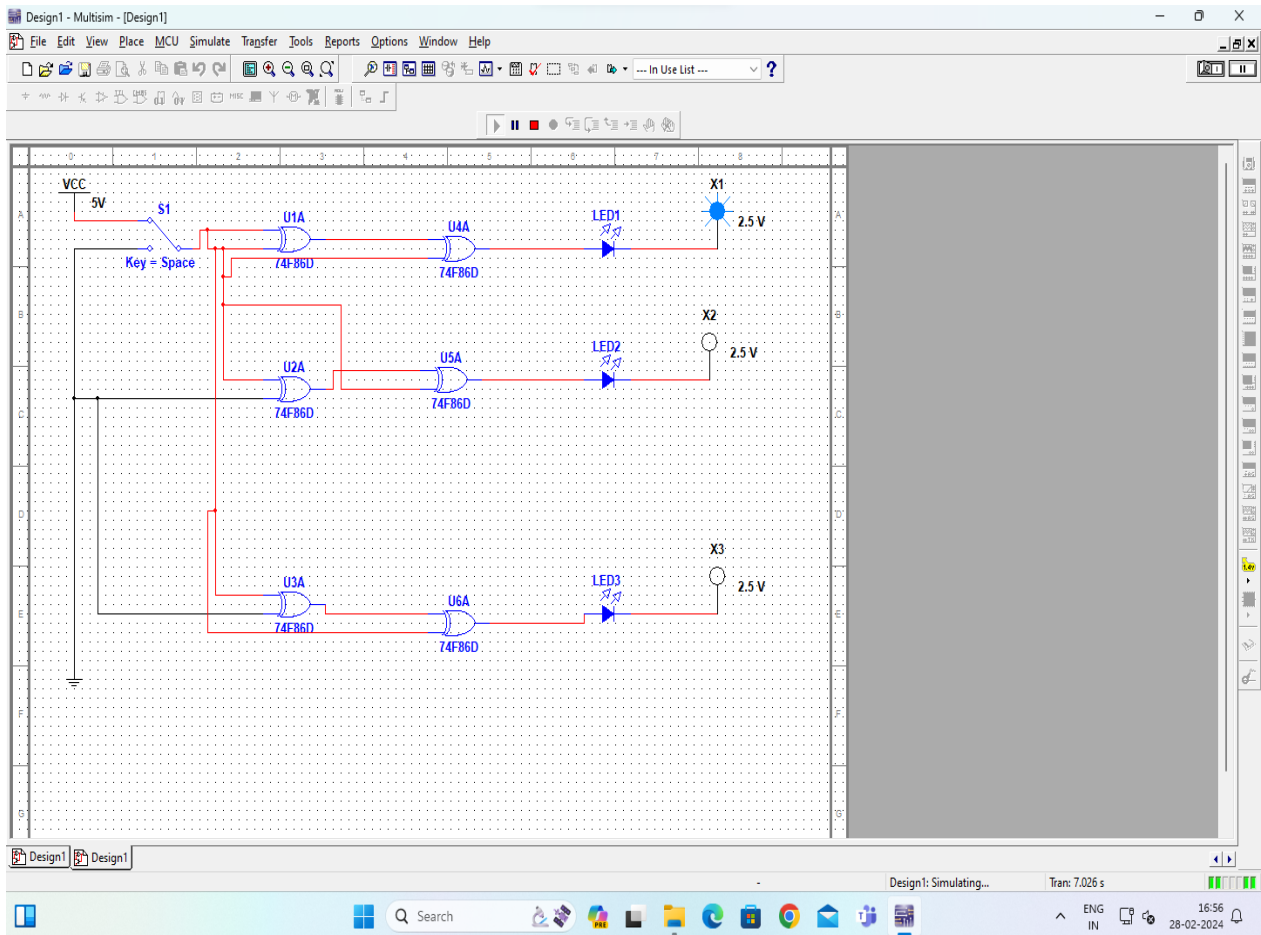


Fig. 2 Simulation circuit for hamming code parity bit generation

In the above simulation circuit EX-OR gate is used to find the parity bit, VCC taken as a digital input 1 and Ground is taken as the binary input 0. For the parity bit P1 two EX-OR gates are taken, for the first gate input is decided by using the data bits D3, D5 and the output is given to a second EX-OR gate with another input being the D7 bit and the output (parity bit) is decided to be 1 if the LED glows, otherwise it is binary 0 (LED OFF). Similarly for parity bits P2, P4, the data bits are D3, D6, D7 and D5, D6, D7 respectively.



Parity bits or check bits are added in the data bit for error detection, there are two types of the parity bits even parity bit and odd parity bit. Even parity bit means number of ones in the transmitted data should be even, similarly odd parity bit means number of ones in the transmitted data is odd.

#### B. Simulation output observation

Parity bit	Data bit to be consider	LED Status	Calculated parity bit
P1	D3,D5,D7	ON	1
P2	D3,D6,D7	OFF	0
P4	D5,D6,D7	OFF	0

Fig. 3 observation table

#### C. Result : By using virtual simulation tool multisim calculated Hamming code for the Assumed data is :

D7	D6	D5	P4	D3	P2	P1
1	0	1	0	1	0	1

Fig. 4 Generated hamming code with even parity

## V. CONCLUSION

NI Multisim is virtual simulation software .student can easily use it and combine there theoretical knowledge with simulation result. Teacher can be use multisim as a teaching aid for the effective teaching instead of only lecture method. It makes learning interesting. Student can used it in spare time for simulating different circuit and checking the output of simulation without worry.

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