7,4 Algorithm - Hamming Code

(Using socket programming)

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***Abstract*— In this paper a new method has been developed to detect and correct the errors during transmission of signal using Hamming Code. The theory of error-correcting codes is a relatively recent application of mathematics to information and communication systems . It gives facilities of reconfiguring the design construct an unlimited number of times. Hence, an attempt is made to implement the Hamming Code for detecting and correcting errors.**

***Keywords* — n bit parity , server side , client side, error detection and correction , hamming code.**

I. Introduction

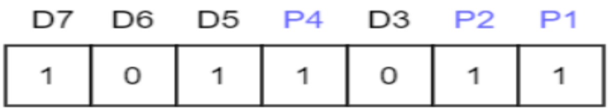
In the late 1940's Richard Hamming recognized that the further evolution of computers required greater reliability , in particular the ability to not only detect errors, but correct them. His search for error-correcting codes led to the hamming codes,perfect 1-error correcting codes ,and the extended hamming codes . [1] Hammings development [Ham] is a very direct construction of a code that permits correcting single bit errors. He assumes that the data to be transmitted consists of a certain number of information bits, and he adds to these a number of check bits „p‟such that if a block is received that has at most one bit in error, then „p‟ identifies the bit that is in error (which may be one of the check bits). Specifically, in Hamming code „p‟ is interpreted as an integer which is 0 if no error occurred, and otherwise is the 1-originated index of the bit that is in error. Let „k‟ be the number of information bits, and „m ‟the number of check bits used. Because these check bits must check themselves as well as the information bits, the value of „p‟ ,interpreted as an integer, must range from 0 to which are distinct values. Because „m‟ bits can distinguish cases, we must have

$$2m \geq m+k+1$$

This is known as the Hamming rule[2].

II. Hamming Code

Hamming code is a technique that is used for error detection and error correction.It only detects single bit errors. bits are added in data bits at the place at the 2^n . Where n = 0 ,1, ,2 , 3, 4 ……………..



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

B. Libraries used :

sys/socket.h: This library provides the socket API, which is used to create and manage network connections. The socket() function is used to create a socket, and the bind() function is used to bind the socket to a specific IP address and port number. The listen() function is used to listen for incoming connections, and the accept() function is used to accept incoming connections.

netinet/in.h: This library provides definitions for internet domain addresses. The struct sockaddr_in is used to store information about internet domain addresses.

arpa/inet.h: This library provides functions to convert internet addresses in their numerical form to the standard dot notation and vice versa. The inet_ntoa() function is used to convert a numerical IP address to the standard dot notation.

stdio.h: This library provides input and output functions, such as printf() and scanf(). This library is used to output messages to the console.

stdlib.h: This library provides general purpose functions such as malloc() and exit().

unistd.h: This library provides access to the POSIX operating system API, which includes functions for performing basic file and process management. The close() function is used to close a file descriptor.

errno.h: This library defines the errno variable, which is used to store information about the last error that occurred.

string.h: This library provides functions to manipulate strings, such as strlen() and strcpy().

sys/types.h: This library provides definitions for the basic types used in the system.

signal.h: This library provides the signal handling functions, such as signal() and raise(). The signal() function allows the program to specify the action to be associated with a particular signal.

These libraries provide the basic functionality needed to implement a multi-client server chat group in C, such as creating and managing network connections, threading, and string manipulation

III.Methodology

1. client side :

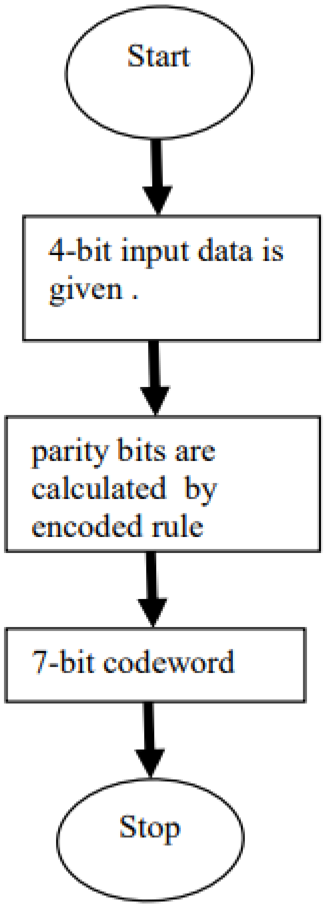
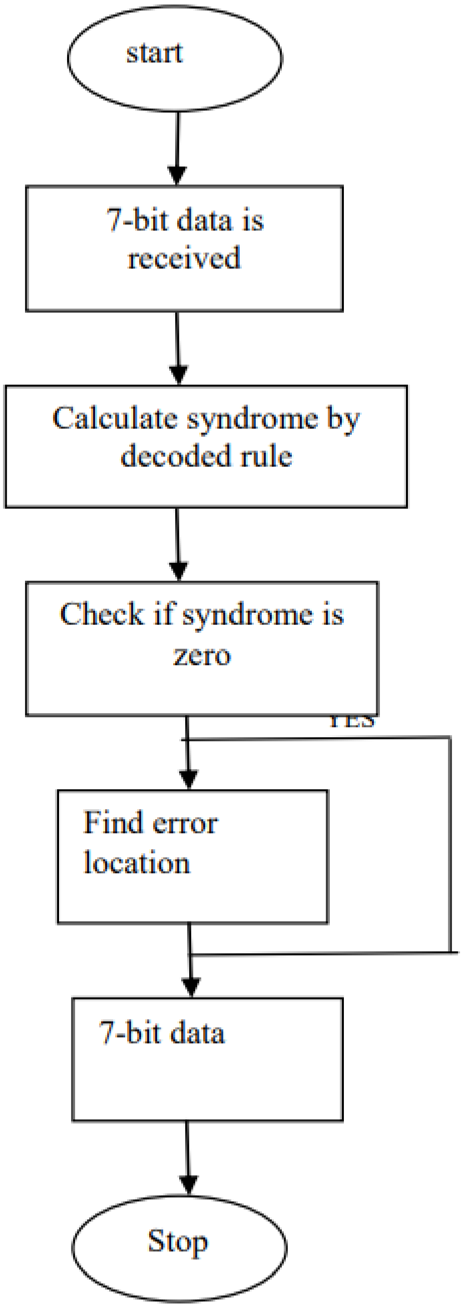

Start
4-bit input data is given .
parity bits are calculated by encoded rule
7-bit codeword
Stop

fig1.client sided work

2. Server side



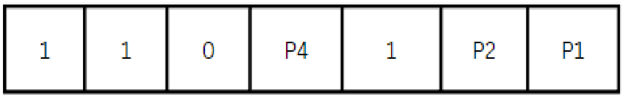
IV. Implementation And Results

A. client side

step -1 . First we initialize an array to store the data inputted by the client and store the values. (i.e. for (7,4) hamming code we store data at 0,1,2,4 position/index as the 3,5,6 positions are to be occupied by the parity bits (P1,P2 and P4).

example:

if data = 1101



1	1	0	P4	1	P2	P1

D7 D6 D5 D4 D3 D2
D1

step -2 .After that we calculate the even parity bits in the server side by using xor operation on the respective data bits .

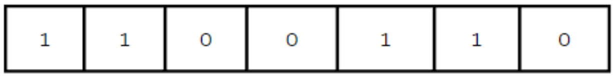
data[6] = data[4]^data[2]^data[0];

data[5] = data[4]^data[1]^data[0];

data[3] = data[2]^data[1]^data[0];

step -3 . Then we insert the following values at the respective position (i.e. for (7,4) at the position in the array at 3,5,6).

step -4. After calculating the values of parity bits and storing their value at their respective indices, the array is sent to the server .

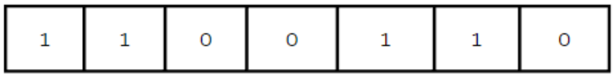


1	1	0	0	1	1	0

B. server side

Now at the server side

step-1.After the data sent by the client is received without any error. The Server reads the data and displays the received data.



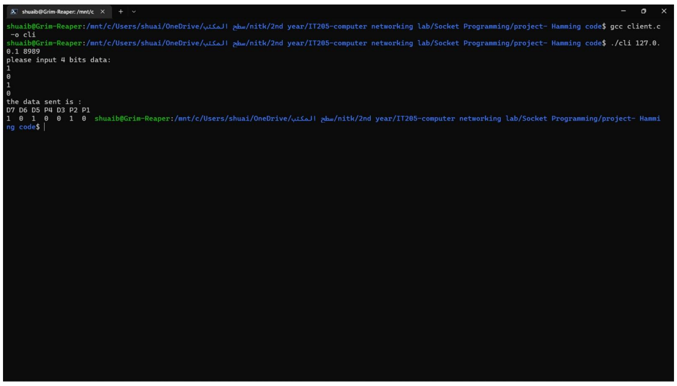
1	1	0	0	1	1	0

step-2.To stimulate error correction-We take a input -test array with a single bit error for error correction of the test data-

We use-   p = 4*p4+ 2*p2 +p1;

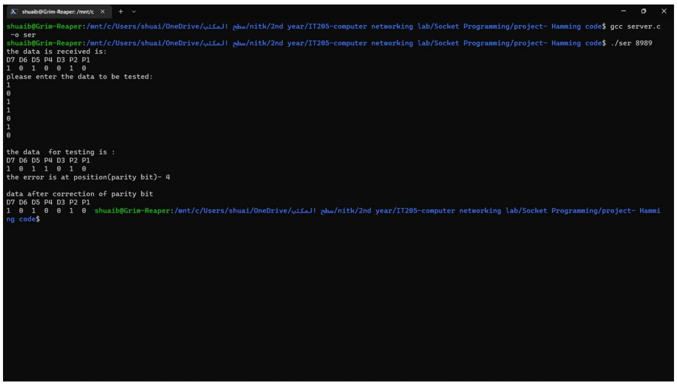
Where p4, p2 and p1 are the evaluated values of parity bits P4 , P2 and P1 respectively.

A.CLIENT SIDE :



```
shuaib@Grim-Reaper:/mnt/c/Users/shuai/OneDrive/سطح المكتب/nitk/2nd year/IT205-computer networking lab/Socket Programming/project- Hamming code$ gcc client.c
 -o cli
shuaib@Grim-Reaper:/mnt/c/Users/shuai/OneDrive/سطح المكتب/nitk/2nd year/IT205-computer networking lab/Socket Programming/project- Hamming code$ ./cli 127.0.
0.1 8989
please input 4 bits data:
1
0
1
0
the data sent is :
D7 D6 D5 P4 D3 P2 P1
1  0  1  0  0  1  0  shuaib@Grim-Reaper:/mnt/c/Users/shuai/OneDrive/سطح المكتب/nitk/2nd year/IT205-computer networking lab/Socket Programming/project- Hammi
ng code$ |
```

B. SERVER SIDE:



```
shuaib@Grim-Reaper:/mnt/c/Users/shuai/OneDrive/سطح المكتب/nitk/2nd year/IT205-computer networking lab/Socket Programming/project- Hamming code$ gcc server.c
 -o ser
shuaib@Grim-Reaper:/mnt/c/Users/shuai/OneDrive/سطح المكتب/nitk/2nd year/IT205-computer networking lab/Socket Programming/project- Hamming code$ ./ser 8989
the data is received is:
D7 D6 D5 P4 D3 P2 P1
1  0  1  0  0  1  0
please enter the data to be tested:
1
0
1
1
0
1
0

the data  for testing is :
D7 D6 D5 P4 D3 P2 P1
1  0  1  1  0  1  0
the error is at position(parity bit)- 4

data after correction of parity bit
D7 D6 D5 P4 D3 P2 P1
1  0  1  0  0  1  0  shuaib@Grim-Reaper:/mnt/c/Users/shuai/OneDrive/سطح المكتب/nitk/2nd year/IT205-computer networking lab/Socket Programming/project- Hammi
ng code$
```

IV. Advantages of the Hamming code

1. Hamming codes are a family of linear error-correcting codes.

2. Hamming codes can detect one-bit, or correct one-bit errors without detection of uncorrected errors. By contrast, the simple parity code cannot correct errors, and can detect only an odd number of bits in error.

V. Conclusions And Future work

7,4 Hamming Code Algorithm Is used to detect and correct one error in the program. In this project we used socket programming that will help to detect and correct one error in the sending data or in the data that will be sent by the client .

Throughput is less modified in the hamming code so we can design this for more no of bits in that it can detect the error and correct it .

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References

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[2]Hamming codes

[3]GeeksForGeeks

[4]YouTube Videos (1)

[5]YouTube Videos (2)

[6]Socket tutorial