**A**

**Project Report**

on

“ IMPLEMENTATION OF NUMBER SYSTEM CONVERSION”

**Submitted by**

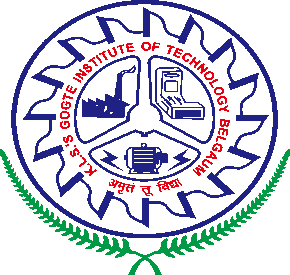
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**THEORY:**

**NUMBER SYSTEM :**

Number systems are the technique to represent numbers in the computer system architecture, every value that you are saving or getting into/from computer memory has a defined number system. Computer architecture supports following number systems. We are familiar with the decimal number system which is used in our day-to-day work. Ten digits are used to four decimal numbers. To represent these decimal digits, ten separate symbols 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are used. But a digital computer stores, understands and manipulates information composed of any zeros and ones. So, each decimal digit, letters, symbols etc. written by the programmer (an user) are converted to binary codes in the form of 0’s and 1’s within the computer. The no. system is divided into some categories according to the base (or radix) of the system as binary octal and hexadecimal. If a number system of base r is a system, then the system has r distinct symbols for r digits. The knowledge of the number system is essential to understand the operation of a computer.

• Binary number system

• Octal number system

• Decimal number system

• Hexadecimal (hex) number system

**BINARY NUMBER SYSTEM :**

A Binary number system has only two digits that are 0 and 1. Every number (value) represents with 0 and 1 in this number system. The base of binary number system is 2, because it has only two digits. Only two digits 0 and 1 are used to represent a binary number system. So the base or radix of binary system is two (2). The digits 0 and 1 are called bits (Binary Digits). In this number system the value of the digit will be two times greater than its predecessor. Thus the value of the places are

<-- 32 <-- 16 <--8 <--4 <--2 <--1

The weight of each binary bit depends on its relative position within the number. It is explained by the following example—

Example: The weight of bits of the binary number

10110 is = 1X24+0X23+1X22+1X21+0X20

= 16+0+4+2+0

= 22(decimal number)

The weight of each bit of a binary no. depends on its relative pointer within the no. and explained from right hand side

Weight of 1st bit = 1st bit X 20

Weight of 2nd bit = 2nd bit X 21

................................................

............................................... and so on.

The weight of the nth bit of the number from right hand side

=nth bit X 2n-1

=nth bit X (Base)n-1

It is seen that this rule for a binary number is same as that for a decimal number system. The above rule holds good for any other positioned number system. The weight of a digit in any positioned number system depends on its relative positon within the number and the base of the number system.

**OCTAL NUMBER SYSTEM :**

Octal number system has only eight (8) digits from 0 to 7. Every number (value) represents with 0,1,2,3,4,5,6 and 7 in this number system. The base of octal number system is 8, because it has only 8 digits. A commonly used positional number system is the Octal Number System. This system has eight (8) digit representations as 0,1,2,3,4,5,6 and 7. The base or radix of this system is 8. The values increase from left to right as 1, 8, 64, 512, 4096 etc. The decimal value 8 is represented in octal as 10, 9 as 11, 10 as 12 and so on. As 8=23, an octal number is represented by a group of three binary bits. For example 3 is represented as 011, 4 as 100 etc.

**DECIMAL NUMBER SYSTEM :**

Decimal number system has only ten (10) digits from 0 to 9. Every number (value) represents with 0,1,2,3,4,5,6, 7,8 and 9 in this number system. The base of decimal number system is 10, because it has only 10 digits. In this system the successive position to the left of the decimal point represent units, tens, hundreds, thousands etc. For example, if we consider a decimal number 257, then the digit representations are

2 5 7

Hundred Tens Units

Position Position Position

The weight of each digit of a number depends on its relative position within the number.

**Example :** The weight of each digit of the decimal no. 6472

6472 = 6000+400+70+2

= 6X103+4X102+7X101+2X100

The weight of digits from right hand side are-

Weight of 1st digit = 2 X 100

Weight of 2nd digit = 7 X 101

Weight of 3rd digit = 4 X 102

Weight of 4th digit = 6 X 103

The above expressions can be written in general forms as the weight of nth digit of the number from the right hand side

= nth digit X 10n-1

= nth digit X (base)n-1

The no. system in which the weight of each digit depends on its relative position within the number is called positional number system. The above form of general expression is true only for positional number system.

**HEXADECIMAL NUMBER SYSTEM :**

A Hexadecimal number system has sixteen (16) alphanumeric values from 0 to 9 and A to F. Every number (value) represents with 0,1,2,3,4,5,6, 7,8,9,A,B,C,D,E and F in this number system. The base of hexadecimal number system is 16, because it has 16 alphanumeric values. Here A is 10, B is 11, C is 12, D is 14, E is 15 and F is 16. The hexadecimal number system is now extensively used in computer industry. Its base (or radix) is 16, ie. 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F. The hexadecimal numbers are used to represent binary numbers because of case of conversion and compactness. As 16=24 , hexadecimal number is represented by a group of four binary bits. For example, 5 is represented by 0101.

**Number System Conversion :**

As the computer uses different number systems, there is a process of converting generally used decimal number systems to other number systems and vice-versa.

**Binary to Decimal Conversion :**

To convert a binary number to its decimal equivalent we use the following expression.The weight of the nth bit of the number from right hand side

=nth bit X 2n-1

First we mark the bit position and then we give the weight of each bit of the number depending on its position. The sum of the weight of all bits gives the equivalent number.

**Example:** Convert binary (110100)2 to its decimal equivalent

**Solution:** (110100)2=1X25+1X24+0X23+1X22+0X21+0X20

=32+16+0+4+0+0

=(52)10

(110100)2 =(52)10

**Decimal to Binary Conversion :**

There are different methods used to convert decimal number to binary number. The most common method is, repeated-division method. In this method, the number is successively divided by 2 and its remainders 0’s abd 1’s are recorded. The final binary result is obtained by assembling the remainders in reverse order to obtain the binary equivalent of the decimal number. In this case, the last remainder will be the most significant bit (MSB).

**Example :** Convert (75)10 to its binary equivalent

2 |75 Remainder

2|37 1

2|18 1

2|9 0

2|4 1

2|2 0

1. 0

So, (75)10=(1001011)2

The method to convert the fraction decimal number to its binary equivalent, is repeatedly multiply the fraction part by 2 and count the most significant bits in the order they appear.

**Octal to Decimal Conversion :**

The method of converting octal numbers to decimal numbers is simple. The decimal equivalent of an octal number is the sum of the numbers multiplied by their corresponding weights.

**Example:** Find decimal equivalent of octal number (153)8

**Solution:** 1X82 + 1X81 + 1X80 = 64 + 40 + 3 = 107

So, (153)8 = (107)10

**Decimal to Octal Conversion :**

The procedure for conversion of decimal numbers to octal numbers is exactly similar to the conversion of decimal number to binary numbers except replacing 2 by 8.

**Example:** Find the octal equivalent of decimal (3229)10

**Solution:** 8 | 3229 Remainders

8 | 403 5

8 | 50 3

8 | 6 2

0 6

So, (3229)10=(6235)8

**Hexadecimal to Decimal Conversion :**

The method of converting hexadecimal numbers to decimal number is simple. The decimal equivalent of an hexadecimal number is the sum of the numbers multiplied by their corresponding weights.

**Example:** Find the decimal equivalent of (4A83)16

**Solution:** (4A83)16=(4 X 163) + (10 X 162) + (8 X 191) + (3 X 160)

=16384+2560+128+3

=(19075)10

(4A83)16=(19075)10

**Decimal to Hexadecimal Conversion :**

To convert a decimal integer number to hexadecimal, successively divide the given decimal number by 16 till the quotient is zero. The last remainder is the MSB (Most Significant Bit). The remainders read from bottom to top give the equivalent hexadecimal integer. To convert a decimal fraction to hexadecimal, successively multiply the given decimal fraction by 16, till the product is zero or till the required accuracy is obtained, and collect all the integers to the left of decimal point. The first integer is the MSB and the integers read from top to bottom give the hexadecimal fraction.

**Example:** Convert decimal (1234.675)10 to hexadecimal.

**Solution:**

1st consider (1234)10

Remainder

Decimal Hexadecimal

16|1234 2 2

16|77 13 D

16|4 4 4

(1234)10 = (4D2)16

**Conclusion :**

The significance of number system in the computational machine is vital. Basically one cannot understand the basic phenomena of computer without a thorough comprehension of number system. Understanding different number systems is extremely useful in many computer-related fields. Binary and hexadecimal are very common.