Digital System Design using HDL Lab Report

Experiment 5
Structural vs behavioural description
Binary to gray code converter

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1 Binary to gray code converter

A Binary to Gray Code Converter is a digital circuit or algorithm that converts a binary number into its corresponding Gray code representation. In Gray code, two successive values differ in only one bit, unlike binary, where multiple bits can change between successive numbers. This property makes Gray code useful in applications where it is essential to minimize errors, such as in rotary encoders, digital-to-analogue conversion, and error correction in communication systems.

To convert a binary number to Gray code, the most significant bit (MSB) of the binary number remains the same in the Gray code. For each subsequent bit in the binary number, the corresponding Gray code bit is obtained by performing an XOR operation between the current binary bit and the previous binary bit. For example, if the binary number is 1101, the first Gray code bit is the same as the first binary bit (1). The second Gray code bit is obtained by XORing the first and second binary bits ($1 \oplus 1 = 0$), the third by XORing the second and third binary bits ($1 \oplus 0 = 1$), and the fourth by XORing the third and fourth binary bits ($0 \oplus 1 = 1$). Therefore, the Gray code equivalent of 1101 is 1011. This process ensures that only a single bit changes between consecutive numbers, reducing the likelihood of errors during transitions, which is especially important in high-precision systems.
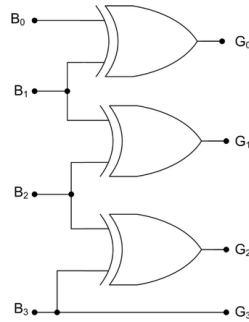

Figure 1: Binary to gray code converter

1.1 Structural modelling

Structural implementation was done using three XOR gates as shown in figure
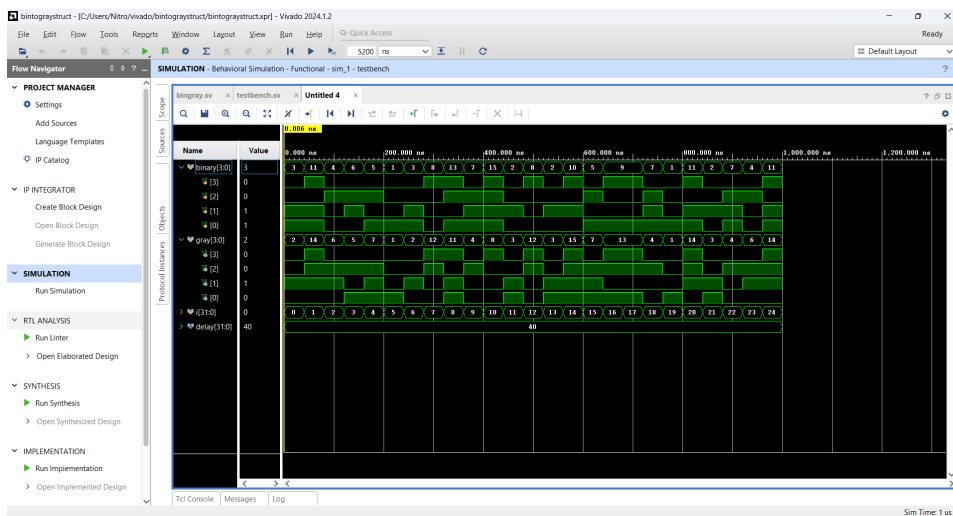

Figure 2: Binary to gray code converter Structural modelling output

1.2 Behavioural modelling

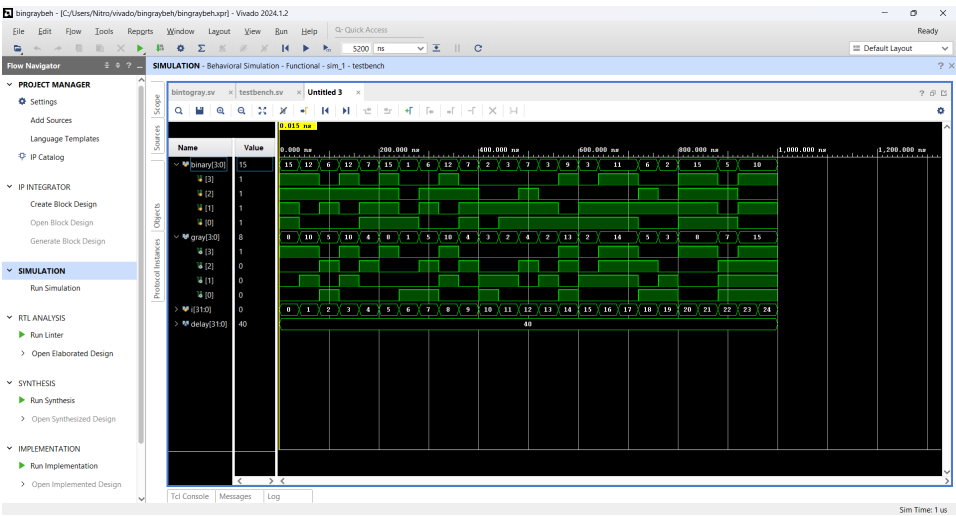Behavioural modelling was performed, and the following output was obtained.

Figure 3: Binary to gray code converter behavioural modelling output