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Concept and Logic behind Logic Controllers and Diode

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ABSTRACT: ***Logic gate is one of the most important parts of an electronics device which perform an operation between the two or more inputs and produce only one logical output. In this paper we have developed a circuit using bipolar junction transistor in combination of 7 logic gate such as AND, OR, NOT, NAND, NOR, XOR and XNOR. By taking the two digital signal as the input terminal as "A" and "B" the circuit is developed is performed. This method will decrease individual use of circuit with each individual logic gates. The main this about this paper is it make the circuit design easy as the transistor used in this project is bipolar junction transistor.***

KEYWORDS: ***Bipolar Junction Transistors (BJT's), Integrated Circuits (ICs), Diode, Zener diode.***

INTRODUCTION

Logic gates is an electronics device implementing a Boolean function which is used to perform logical operation between two or more inputs and produces a single logical output. In this logic gate the digital signal get inside through the input signal and outside through output signal. Generally, the logic gate has two inputs and one output terminal but sometimes this input signal vary and may have inputs more than two signals but there is a with only one input and only one output which work in binary term called NOT gate. This not gate compliment the data such as if the input signal is active high then the output signal will be active low. To obtain circuits like flip flops, multiplexer, latches, counter etc… we can combine as much as logic gate we need to design the circuit. By combining this logic gate and designing the using bipolar junction transistor we can increase the efficiency of the circuit[1].

REVIEW OF LITERATURE

Mallampati Krishna Prasad et. al. had developed a circuit using bipolar junction transistor (BJT) which gives the output for four logic gates such as AND, NAND, OR and NOR by taking the two inputs as "A" and "B". Previously the circuit which was developed had only one circuit for each logic gate but now they have developed a new circuit which comprises four logic gates a single circuit. By this method they decreased the size of the special circuit. Instead of using four IC's for four logic gates they used a single IC for all the four logic gates

so that the space which was captured by the other three circuits can be used for other purposes. This project used six bipolar junction transistors to make the circuit easy to design.

TYPES OF LOGIC GATES IN THE CIRCUIT:

AND: An AND gate is a basic digital logic gate that perform its function according to the truth table wherein "0" represent the low signal and "1" represent the high signal. The function of the AND gate is to find the minimum between the two binary digits. According to the truth table if the input A has low signal i.e. "0" and input B is also low "0" then the output Y will be low "0" with the implementation of logical conjunction. If input A is low "0" and input B is high "1" then the output Y is low "0". However, if any one of the input is low and the other is high then the output will remain low, but if both the input is high i.e. input A is high "1" and input B is also high "1" then the output will be high "1". Thus we can say that if the input is high the output will be high with the logical function.

INPUT A	INPUT B	OUTPUT Y = A.B
0	0	0
0	1	0
1	0	0
1	1	1

Figure 1: The above figure represents an AND logic gate and truth table which represents the function of the gate.

OR: The OR gate is a digital logic gate that works in an accordance with the logical disjunction. The main function of the logical OR gate is to effectively find the maximum between two binary digits. According to the truth table when both the input A and B is low "0" then the output will also be low, but if any one of the input is high "1" then the output will also be high "1". Such as if input A is high "1" and the input B is low "0" then the operation according to the logical disjunction Y = A+B will the output Y as high signal.

Figure 2: An OR gate logic circuit with two input digital signal and one output digital signal.

INPUT A	INPUT B	OUTPUT Y = A+B
0	0	0
0	1	1
1	0	1
1	1	1

Figure 3: The above table is an OR gate truth table. It shows the functionality of the circuit.

NOTE: The logic gate NOT is basically a single input inverter which changes the input digital signal data "1" to an output digital data "0" and when the input data is "0" then the output is "1". It performs the inverted or complementary function as a logical operation so NOT gate is commonly known as inverter because of its inverting functionality. The inversion is indicated as the bubble symbol on the output terminal of the logic gate[2].

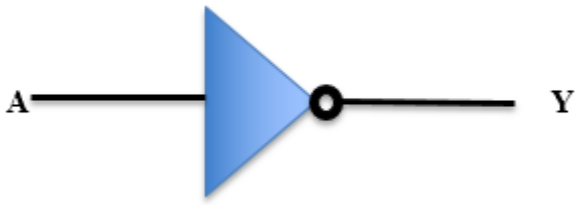

Figure 4: A NOT gate logic circuit which has only one input and output terminal. The output result is the compliment of the input signal.

INPUT A	OUTPUT Y = $\overline{A}$
1	0
0	1

Figure 5: The table shows the functionality of the NOT logic gate, which gives the compliment result of an input signal.

NAND: In digitalelectronics the NAND gate is the combination of NOT gate + AND gate. It produces a complementary value of the results such as if the input A and B is low "0" then firstly the AND gate will perform the logic conjunction and the result will be low "0". As we have explained in the first line that the NAND gate is the combination of NOT + AND so the NOT gate produce the complimentary of the results. Thus we can say that NAND gate compliment the result with the performance of and gate within it. The output result will low only if all the input is high and the output result is high only if any of the input is low. A NAND is made by De Morgan's theorem using a transistor and a junction diode where two input NAND gate logic may be expressed as Y = A+B and then it is made equivalent to an inverter by following the NOT gate operation.

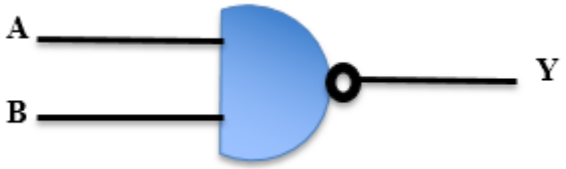

Figure 6: A NAND gate logic circuit which perform the result with combination of NOT gate + AND gate.

INPUT A	INPUT B	OUTPUT Y = $\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Figure 7: The above table represent the functionality of the NAND logic gate which fulfill the result with the combination of NOT + AND gate.

NOR:NOR gate is a logic gate which is a combination of NOT gate + OR gate. A bubble is connected at the output terminal of the NOR gate which act as an inverter. It gives a positive result i.e. high output when the both the input is low or negative. Like NAND gate NOR gate is also called as the universal gate by which we can form any of the logic gates. Firstly, with the performance of OR gate when any of the input digital signal is high then the output will be high but the NOR gate perform as an inverter which complement the output data produce with the performance of OR gate. But when both the input digital signal is low then the output will be high with the logical operation function of gate[3].

Figure 8: A NOR gate logic circuit which perform the result with combination of NOT gate + OR gate.

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INPUT A	INPUT B	OUTPUT Y = $\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

Figure 9: The above table represent the functionality of the NOR logic gate which fulfill the result with the combination of NOT + OR gate.

CONCLUSION

In this paper we can conclude that with the combination of all the logic a circuit is designed which perform all the task using single circuit where in all the gates can perform at the same time or can perform one after another as per the requirement. The main aim of this paper is to reduce the space which was needed for each circuit for each logic gates. And the most important thing is now the user don't have to remember the ICs number that which IC is required to perform which task. They can easily perform the task by using the single circuit.

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