

Implementation of Boolean Logic in Vaman Arm using IC 7474

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1 Problem

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Q.43. For the circuit shown, the clock frequency is f_0 and the duty cycle is 25%. For the signal at the Q output of the Flip-Flop,

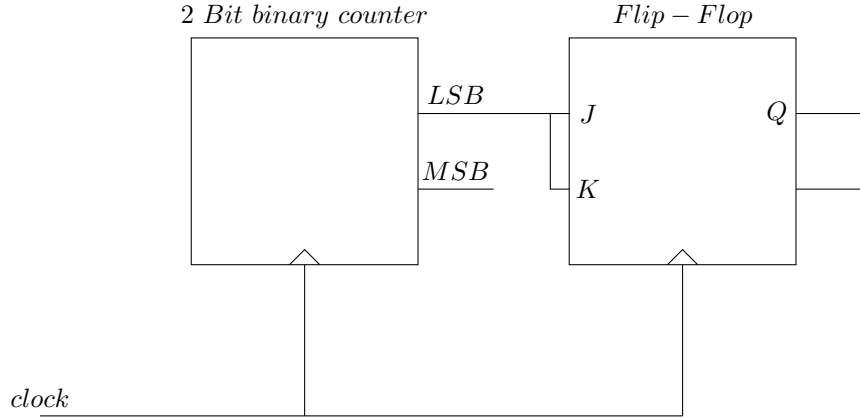


Figure 1: Diagram

1. frequency of $\frac{f_0}{4}$ and duty cycle is 50%
2. frequency of $\frac{f_0}{4}$ and duty cycle is 25%
3. frequency of $\frac{f_0}{2}$ and duty cycle is 50%
4. frequency of f_0 and duty cycle is 25%

2 Introduction

The Aim is to implement the above circuit in Arduino using IC 7474. IC 7474 is a dual positive-edge-triggered D-type flip-flop, which means it has two separate flip-flop that are triggered by the rising edge of a clock signal. A 2-bit binary counter can be implemented using 2 D Flip-flops similarly a JK Flip-flop can be implemented using one D Flip-flop. Thus we will use two IC 7474 to implement the whole circuit.

The LSB output of the 2-bit binary counter is given to J and K inputs of the JK Flip-flop which then gives the final Q output of the circuit. Since the inputs given to J and K are same it acts as T Flip-flop.

3 Components

1. Arduino UNO
2. IC 7474 - 2 units
3. Breadboard
4. Jumper Wires (M-M)

4 Hardware

The IC 7474 is a type of flip-flop integrated circuit that is commonly used in digital electronics applications. It is a dual positive-edge-triggered by the rising edge of a clock signal. Below is the pin diagram of IC 7474.

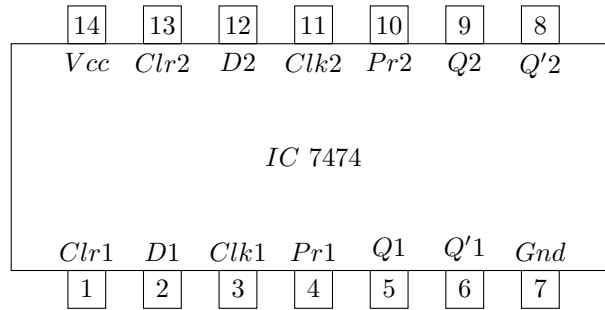


Figure 2: 7474 Pin Diagram

The connections between Arduino UNO and two IC 7474 is given in below Table

	INPUT	OUTPUT			CLOCK		V_{cc}	GND
ARDUINO	D6	D3	D4	D5	D2		5V	GND
7447		5	9		3	11	14	7
7474	5			2	3		14	7

Table 1: Connections

The truth table for the circuit is given in below table

The Kmap for the circuit is

counter	MSB	LSB	J	K	Q(t)	Q(t+1)
0	0	0	0	0	0	0
1	0	1	1	1	0	1
2	1	0	0	0	1	1
3	1	1	1	1	1	0

Table 2: Truth Table

		<i>JK</i>			
		00	01	11	10
<i>Q_n</i>	0	0	0	1	1
	1	1	0	0	1

Figure 3: Kmap

5 Software

The Arduino code for the given circuit using IC 7474 is

```

#include<Arduino.h>

int clockPin = 12; //clock input pin
int q1Pin = 13; //Q output of flip-flop 1 of first IC 7474
int q2Pin = 14; //Q output of flip-flop 2 of first IC 7474
int dPin = 15; //D input of flip-flop of second IC 7474
int qPin = 16; //Q output of flip-flop of second IC 7474

void setup(){
    pinMode(qPin,INPUT);
    pinMode(clockPin,OUTPUT);
    pinMode(q1Pin,OUTPUT);
    pinMode(q2Pin,OUTPUT);
    pinMode(dPin,OUTPUT);
    pinMode(17,OUTPUT);

    //Initialize outputs
    digitalWrite(clockPin,LOW);
    digitalWrite(q1Pin,LOW);
    digitalWrite(q2Pin,LOW);
    digitalWrite(qPin,LOW);
}

```

```

void jk_flipflop(int q1){ //code for JK flip-flop with LSB of 2 bit
    counter as input to both J and K
    int q = digitalRead(qPin);
    int d = q1^q;
    digitalWrite(dPin,d);
    digitalWrite(17,q);
}

void loop(){
    digitalWrite(clockPin,LOW);
    delay(10);
    digitalWrite(clockPin,HIGH);

    int q1=digitalRead(q1Pin);
    int q2=digitalRead(q2Pin);

    q1=!q1;
    if(q1==HIGH) q2=!q2;

    digitalWrite(q1Pin,q1);
    digitalWrite(q2Pin,q2);
    jk_flipflop(q1);
    delay(1000);
}

```
