Implementation of Boolean Logic in Arduino using IC 7474

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Contents

1 Problem

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Q.43. For the circuit shown, the clock frequency is $f0$ and the duty cycle is 25%. For the signal at the Q output of the Flip-Flop,

1. frequency of $\frac{f0}{4}$ and duty cycle is 50%
2. frequency of $\frac{f0}{4}$ and duty cycle is 25%
3. frequency of $\frac{f0}{2}$ and duty cycle is 50%
4. frequency of $f0$ and duty cycle is 25%

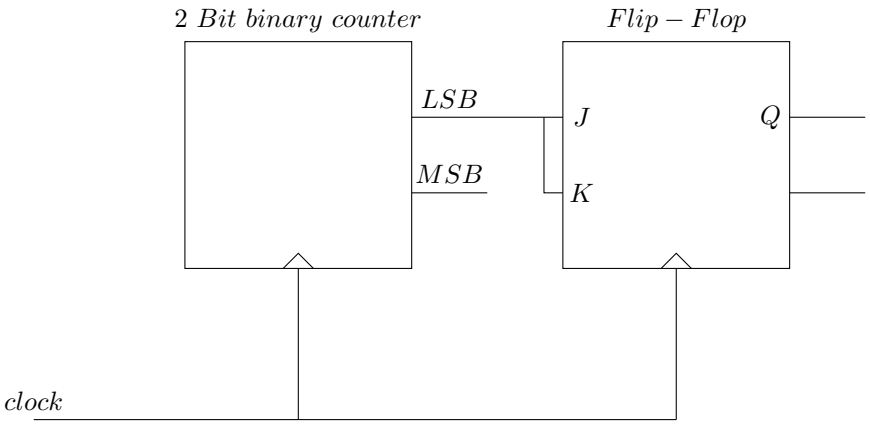

Figure 1: Circuit

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 seperate 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

COMPONENTS		
Component	Value	Quantity
Resistor	=220 Ohm	1
Arduino	UNO	1
Seven Segent Display	Common Anode	1
Decoder	7447	1
Flip Flop	7474	2
Jumper Wires		20
Breadboard		1

Table 1: Components

4 Hardware

The IC 7474 is a type of flip-flop integrated circuit that is commonly used indigital 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.

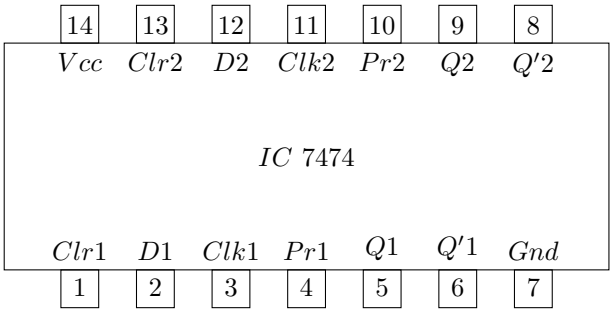

Figure 2: 7474

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

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

Table 2: Arduino - 7474

The truth table for the circuit is given in below table

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 3: Truth Table

The kmap for the circuit is

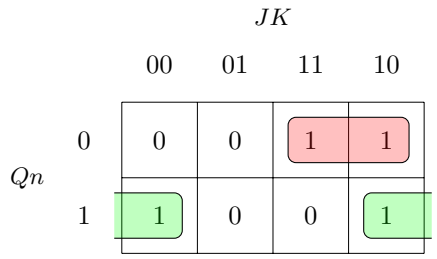

Figure 3: kmap

5 Software

The Arduino code for the given circuit using IC 7474 is

```
#include<Arduino.h>

int clockPin = 2; //clock input pin
int q1Pin = 3; //Q output of flip-flop 1 of first IC 7474
int q2Pin = 4; //Q output of flip-flop 2 of first IC 7474
int dPin = 5; //D input of flip-flop of second IC 7474
int qPin = 6; //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(13,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(13,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);
```