Implementation of Boolean Logic in Arduino using IC 7474

Sai Harshith kalithkar
harshith.work@gmail.com
FWC22118
IIT Hyderabad-Future Wireless Communication Assignment

February 2023

Contents

1 Problem

(GATE EC-2022)
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,

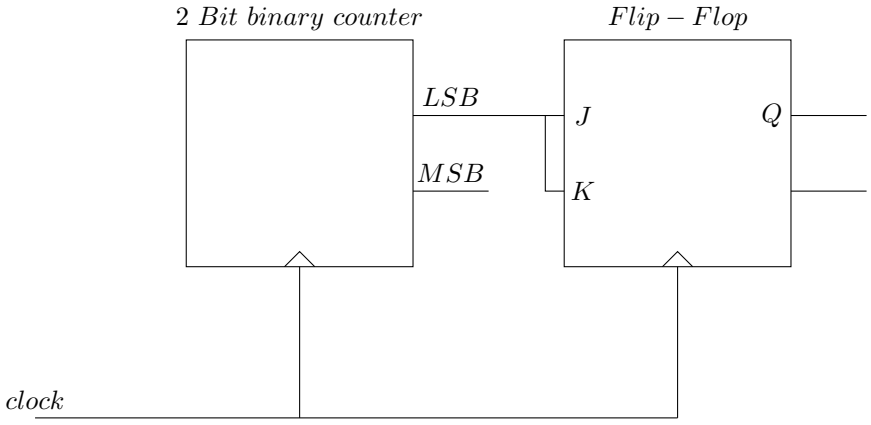

Figure 1: Diagram

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%

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

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 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.

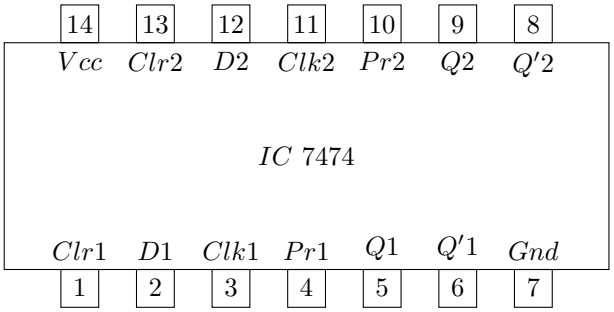

Figure 2: 7474 Pin Diagram

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	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

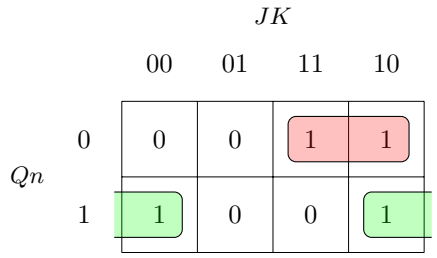

Figure 3: Kmap

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);
}
```