Implementation of Boolean Logic in Arduino using IC 7474

M Patrick Manohar
patrickmanohar152001@gmail.com
FWC22119
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,

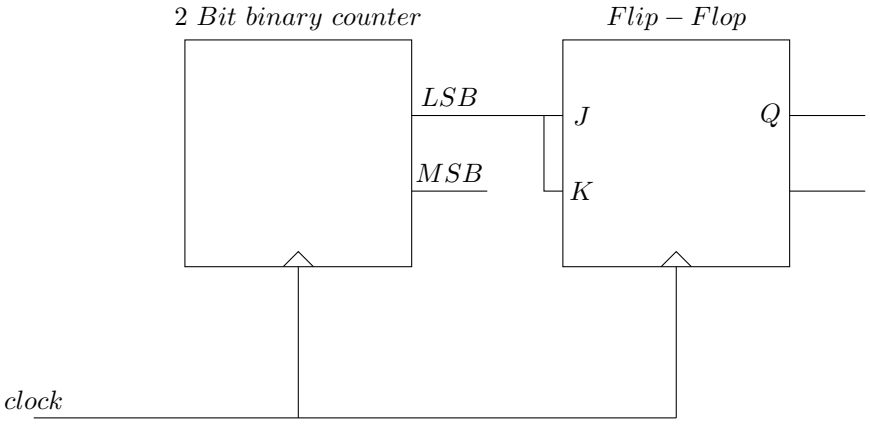

Figure 1: Circuit

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

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.

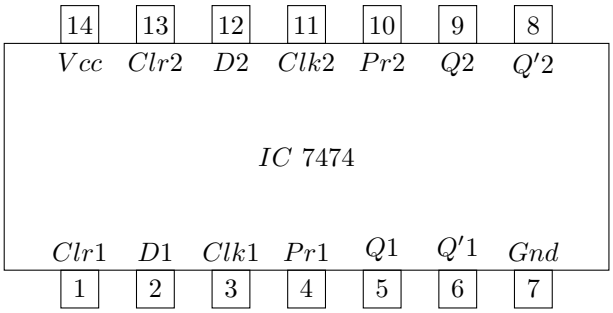

Figure 2: 7474

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

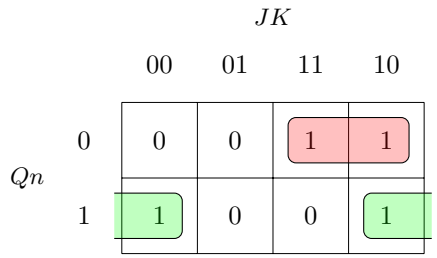

Figure 3: kmap

5 Software

The Arduino code for the given circuit using IC 7474 is

```
.include "/sdcard/arduino/report2/m328Pdef/m328Pdef.inc"

.def q=r18
.def q1=r19
.def q2=r20
.def d=r21

setup:

ldi r17,0b10111100
out DDRD,r16
ldi r16,0b11111111

loop:

ldi r22,0b00000000
and r22,r17
out PORTD,r22

call delay

ldi r22,0b00000100
and r22,r17
out PORTD,r22

in r17,PIND
ldi r23,0b00001000
and r23,r17
mov q1,r23

in r17,PIND
ldi r24,0b00010000
and r24,r17
mov q2,r24
```

```
ldi r25,0b00000000
mov r26,q1
com r26
cp r26,r25
brne equal

ldi r24,0b00001000
and r24,r17
mov r24,q1
out PORTD,r24

ldi r24,0b00010000
and r24,r17
mov r24,q2
out PORTD,r24

in r16,PIND
ldi r24,0b01000000
and r24,r16
mov q,r24

mov r24,q
mov r27,q1
lsr r24
lsl r27
lsl r27
eor r27,r24
mov d,r27

ldi r24,0b00100000
and r24,r16
mov r24,d
out PORTD,r24

ldi r24,0b10000000
and r24,r16
mov r24,q
lsl r24
out PORTD,r24

rjmp loop

start:
rjmp start

equal:
com q2

delay:
ldi r23,100
loop1:
ldi r24,100
loop2:
ldi r29,100
loop3:
dec r29
brne loop2
```

```
dec r24
brne loop1
dec r23
brne delay
ret
```