**Aim:**

**Implementation of simple electronic projects using Raspberry Pi and LEDs Objectives:**

1. Implementation of a timer to blink an LED in different frequencies.
2. Implementations of two LEDs blinking alternatively for every 250 milliseconds.
3. Implementation of a more efficient algorithm for rotating LEDs used for decoration at parties.
4. Implementation of a 4-bit binary counter to show numbers in binary using four LEDs.

**Summary of Experiment - 3 Goals and Outcomes**

The use of a timer in MicroPython is facilitated by its user-friendly interface, eliminating the need for intricate programming techniques. It is necessary to input the desired duration for the counter to elapse before initiating an interrupt. The current iteration of MicroPython for the Raspberry Pi Pico does not provide the capability to independently use the hardware timers. In contrast, it is feasible to generate a nearly infinite quantity of "software" timers, all of which are dependent on a single hardware timer.

By the end of this experiment, students will gain a comprehensive understanding of timers and their applications in electronic circuits. Through hands-on activities, they will be able to use the different timers at different frequencies, enhancing their practical knowledge of semiconductor devices.

**Pre-Lab Questionnaire:**

1. What is the time period of a wave with a frequency of 250 Hz?
2. What is the time period and frequency of a LED which blinks 120 times in 2 minutes?
3. What is the frequency of a wave that oscillates 25 times in 5 seconds?
4. What are counters used for?
5. What is a binary counter?
6. What are uses of binary counters?
7. What are the types of counters?
8. How 4-bit counter works?

**Answers to Pre-Lab Questions**

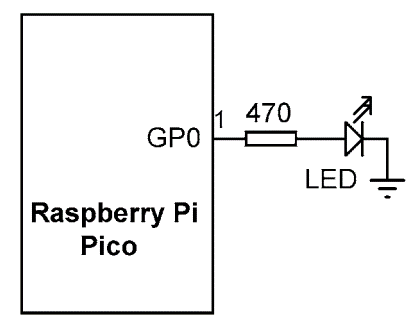
**Components/Equipment Required:**

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| **Sl. No.** | **Name of the**  **Component / Equipment** | **Specification** | **Quantity** |
| 1 | Raspberry Pi Pico | RP2040 microcontroller chip, 125MHz | 1 |
| 2 | Raspberry Pi Pico cable | USB Type A to Micro-B | 1 |
| 3 | Resistors (carbon type) | ¼ watt (470 Ω) | 8 |
| 4 | LED | 3mm, Red | 8 |
| 5 | Breadboard | 840 Tie points | 1 |
| 6 | Jumper Wire | --------------------------- | As per requirement |

**Objective 1**

**Implementation of a timer to blink an LED in different frequencies.**

**Circuit / Schematic Diagram**



(Figure 1 : Circuit diagram for implementation of a timer to blink an LED in different frequencies)

**Code**

**Write a program that turns an external LED to blink in different frequencies.**

**Observation**

**Figure 2: (Simulation-based electronic circuit in which a timer is used to blink an external LED in different frequencies.)**

**Figure 3: (Hardware implementation-based electronic circuit in which a timer is used to blink an external LED in different frequencies.)**

**Objective 2**

**Implementations of two LEDs blinking alternatively for every 250 milliseconds.**

**Circuit / Schematic Diagram**



(Figure 4 : Circuit diagram for two LEDs blink alternatively every 250 milliseconds.)

**Code**

**Write a program that turns two LEDs blinking alternatively for every 250 milliseconds.**

**Observation**

**Figure 5: (Simulation-based electronic circuit in which a timer is used to blink two LEDs blink alternatively every 250 milliseconds)**

**Figure 6: (Hardware based electronic circuit in which a timer is used to blink two LEDs blink alternatively every 250 milliseconds.)**

**Objective 3**

**Implementation of a more efficient algorithm for rotating LEDs used for decoration at parties.**

**Circuit / Schematic Diagram**



(Figure 7 : Circuit diagram to rotate LEDs used for decoration at parties.)

**Code**

**Write a program to rotate LEDs used for decoration at parties.**

**Observation**

**Figure 8: (Simulation based electronic circuit for rotating LED Lights display pattern for decoration at parties.)**

**Figure 9: (Hardware based electronic circuit for rotating LED Lights display pattern for decoration at parties**

**Objective 4**

**Implementation of a 4-bit binary counter to show numbers in binary using four LEDs:**

**Circuit / Schematic Diagram**



(Figure 10 : Circuit diagram for a 4-bit binary counter to show numbers in binary using four LEDs.)

**Code**

**Write a program for a 4-bit binary counter to show numbers in binary using four LEDs**

**Observation**

**Figure 11: (Simulation based electronic circuit for a 4-bit binary counter to show numbers in binary using four LEDs.)**

**Figure 12: (Hardware based electronic circuit for a 4-bit binary counter to show numbers in binary using four LEDs.)**

**Conclusion:**

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**Precautions:**

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**Post Experiment Questionnaire:**

1. What are the possible reasons that half of my Christmas/Diwali lights out?
2. Is there a standard length of LED mini light strand? I know light sets come in strands of 50,100 and even higher, but is there one standard length?
3. Is the reason one bad bulb can take out an entire series of lights is that it breaks the circuit? Is that true of all light strands?
4. In digital logic, a counter is a device which \_\_\_\_\_\_\_\_\_\_\_\_

a) Counts the number of outputs

b) Stores the number of times a particular event or process has occurred

c) Stores the number of times a clock pulse rises and falls

d) Counts the number of inputs

1. A counter circuit is usually constructed of \_\_\_\_\_\_\_\_\_\_\_\_

a) A number of latches connected in cascade form

b) A number of NAND gates connected in cascade form

c) A number of flip-flops connected in cascade

d) A number of NOR gates connected in cascade form

1. What is the maximum possible range of bit-count specifically in n-bit binary counter consisting of ‘n’ number of flip-flops?

a) 0 to 2n

b) 0 to 2n + 1

c) 0 to 2n – 1

d) 0 to 2n+1/2

1. A decimal counter has \_\_\_\_\_\_ states.

a) 5

b) 10

c) 15

d) 20

1. The representation of octal number (532.2)8 in decimal is \_\_\_\_\_\_\_\_

a) (346.25)10

b) (532.864)10

c) (340.67)10

d) (531.668)10

1. The decimal equivalent of the binary number (1011.011)2 is \_\_\_\_\_\_\_\_

a) (11.375)10

b) (10.123)10

c) (11.175)10

d) (9.23)10

1. An important drawback of binary system is \_\_\_\_\_\_\_\_

a) It requires very large string of 1’s and 0’s to represent a decimal number

b) It requires sparingly small string of 1’s and 0’s to represent a decimal number

c) It requires large string of 1’s and small string of 0’s to represent a decimal number

d) It requires small string of 1’s and large string of 0’s to represent a decimal number

1. The largest two-digit hexadecimal number is \_\_\_\_\_\_\_\_

a) (FE)16

b) (FD)16

c) (FF)16

d) (EF)16

1. The given hexadecimal number (1E.53)16 is equivalent to \_\_\_\_\_\_\_\_\_\_\_\_

a) (35.684)8

b) (36.246)8

c) (34.340)8

d) (35.599)8

1. The octal number (651.124)8 is equivalent to \_\_\_\_\_\_

a) (1A9.2A)16

b) (1B0.10)16

c) (1A8.A3)16

d) (1B0.B0)16

1. The octal equivalent of the decimal number (417)10 is \_\_\_\_\_

a) (641)8

b) (619)8

c) (640)8

d) (598)8

1. Convert (0.345)10 into an octal number.

a) (0.16050)8

b) (0.26050)8

c) (0.19450)8

d) (0.24040)8

**Answers to Post-Lab Questions**

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| --- | --- | --- | --- |
| **(Signature of the Faculty)** | |  | **(Signature of the Student)** |
|  | | **Name:** |  |
| **Date:** |  | **Registration No.:** |  |
|  |  | **Branch:** |  |
|  | | **Section** |  |