

Familiarization with Internet of Things (IoT) concepts and the Raspberry Pi Pico microcontroller while gaining practical experience using Python for simple IoT projects.

Aim:

Familiarization with Internet of Things (IoT) concepts and the Raspberry Pi Pico microcontroller while gaining practical experience using Python for simple IoT projects.

Objectives:

1) Understanding IoT Fundamentals:

Gain foundational knowledge about IoT, which involves connecting physical devices to the internet to collect and exchange data. Explore IoT architecture, communication protocols, different IoT platforms, and real-world use cases.

2) Familiarization with Raspberry Pi Pico Microcontroller: The Brain of an Embedded System:

Learn about the Raspberry Pi Pico microcontroller, a versatile and affordable embedded system platform. Understand its capabilities, features, and its role as the central processing unit in IoT projects.

3) Introduction to Python:

Explore the Python programming language, an essential tool for IoT development. Cover key concepts such as interpreted languages, variables, keywords, operators, and data types in Python. Understand how to import libraries and the basics of flow control, including conditional statements and loops. Compare Python with other programming languages and identify its applications in IoT.

4) Familiarization with Online Simulator "WOKWI":

Get acquainted with the online simulator "WOKWI," a valuable tool for IoT development and simulation. Learn how to use it to create and test IoT projects.

5) Onboard LED Blinking with Raspberry Pi Pico:

Practice your newfound Python skills by programming the onboard LED of the Raspberry Pi Pico. Create a program that **turns the onboard LED on for 2 seconds and then off for 1 second.**

6) Building an External Circuit:

Constructing an external circuit and controlling it from the Raspberry Pi Pico. Develop a program that instructs the Raspberry Pi Pico to **turn an external LED on for 3 seconds and off for 2 seconds.**

7) Blinking both the Onboard and External LED:

Combine your knowledge and skills by implementing a hardware setup that simultaneously controls the onboard LED and an external LED using the Raspberry Pi Pico. Create a program to **blink both LEDs, with each LED being on for 5 seconds and then off for 5 seconds.**

Summary of Experiment - 1 Goals and Outcomes

By the end of this experiment, students will have gained a solid understanding of IoT fundamentals, Raspberry Pi Pico, Python programming, and practical experience in building and controlling IoT-related hardware. These skills will serve as a strong foundation for more complex IoT projects in the future.

Pre-Lab Questionnaire:

- 1) How does the Internet of Things (IoT) affect our everyday lives?
- 2) How does IoT work?
- 3) Describe the different components of IoT.
- 4) How does IoT influence the development of smart cities?
- 5) What is the difference between business IoT and Industrial IoT (IIOT)?
- 6) What are the major impacts of IoT in the Healthcare Industry?
- 7) What are the challenges to the widespread use of IoT?
- 8) What is the key difference between IoT platforms and IoT protocols?
- 9) How does understanding IoT fundamentals, such as architecture and protocols, benefit someone working on IoT projects?
- 10) Explain what is a microcontroller?

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- 11) Mention what is the difference between a microprocessor and a microcontroller.
- 12) What is the significance of real-time data in IoT applications?
- 13) What security measures are essential in IoT projects to protect against cyber threats?
- 14) What are some real-world examples of IoT applications that have a positive impact on the environment?
- 15) How can IoT benefit agriculture?
- 16) How can IoT help in reducing energy consumption in buildings?
- 17) In the Python section, can you list at least five keywords?
- 18) Consider the potential limitations of Python in IoT, such as memory constraints and performance issues. How can these limitations be mitigated in real-world projects?

Answers to Pre-Lab Questions

Components/Equipment Required:

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)	$\frac{1}{4}$ watt (330 Ω)	1
4)	LED	3mm, Red	1
5)	Breadboard	840 Tie points	1
6)	Jumper Wire	-----	As per requirement

Objective 5

Onboard LED Blinking with Raspberry Pi Pico:

Practice your newfound Python skills by programming the onboard LED of the Raspberry Pi Pico. Create a program that **turns the onboard LED on for 2 seconds and then off for 1 second.**

Code

5.1: write a program that turns the onboard LED on for 2 seconds and then off for 1 second.

Observation

Figure 1: (Simulation-based onboard LED blinking of Raspberry Pi Pico on for 2 seconds and then off for 1 second.)

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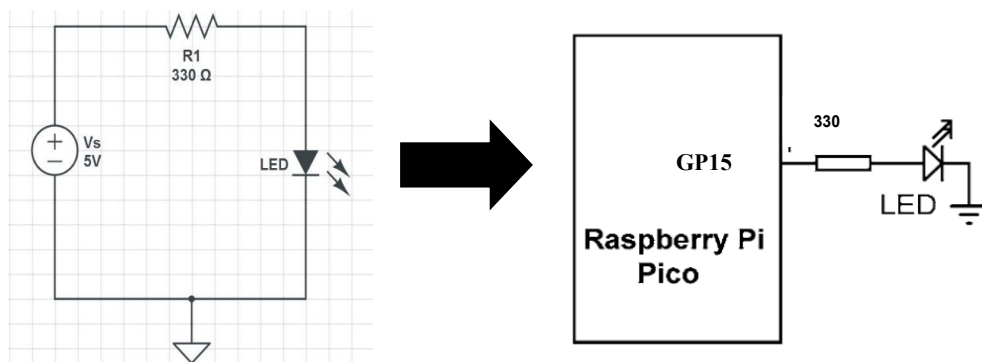
Figure 2: (Hardware Implementation based onboard LED blinking of Raspberry Pi Pico on for 2 seconds and then off for 1 second.)

Objective 6

Building an External Circuit:

Constructing an external circuit and controlling it from the Raspberry Pi Pico. Develop a program that instructs the Raspberry Pi Pico to **turn an external LED on for 3 seconds and off for 2 seconds.**

Circuit/ Schematic Diagram



(Figure 3 : Simple LED Circuit for blinking an LED) (Figure 4: Hardware Implementation to blink an LED)

Code

6.1: write a program that turns the external LED on for 3 seconds and then off for 2 seconds.

Observation

Figure 5: (Simulation-based Simple External LED Circuit for blinking an external LED on for 3 seconds and off for 2 seconds using Raspberry Pi Pico.)

Figure 6: (Hardware Implementation based Simple External LED Circuit for blinking the external LED on for 3 seconds and off for 2 seconds using Raspberry Pi Pico.)

Objective 7

Blinking both the Onboard and External LED:

Combine your knowledge and skills by implementing a hardware setup that simultaneously controls the onboard LED and an external LED using the Raspberry Pi Pico. Create a program to **blink both LEDs, with each LED being on for 5 seconds and then off for 5 seconds.**

Circuit/ Schematic Diagram

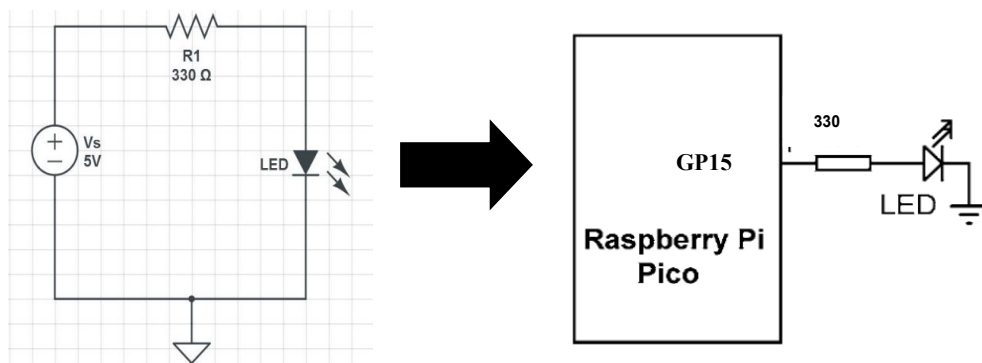


Figure 7: Simple circuit to blink both the onboard LED and External LED, with each LED being on for 5 seconds and then off for 5 seconds using Raspberry Pi Pico

Code

7.1: write a program to blink both the onboard LED and External LED, with each LED being on for 5 seconds and then off for 5 seconds using Raspberry Pi Pico.

Observation

Figure 8: (Simulation-based setup to blink both on-board and external LED using Raspberry Pi Pico)

Figure 9: (Hardware Implementation based setup to blink both on-board and external LED using Raspberry Pi Pico)

Conclusion:

Precautions:

Post Experiment Questionnaire:

- 1) Can a microcontroller work independently?
- 2) What is the Raspberry Pi Pico, and why is it significant in IoT projects?
- 3) What are the key components of the Raspberry Pi Pico microcontroller?
- 4) What are the advantages and disadvantages of using the Raspberry Pi Pico as the microcontroller for IoT projects compared to other microcontrollers?
- 5) What programming language is used in this experiment, and why is it chosen?
- 6) Explain the purpose of the "WOKWI" online simulator.
- 7) In what scenarios might an online simulator like "WOKWI" be preferable to using physical hardware for IoT experimentation?
- 8) Discuss potential challenges or issues that students might face when building an external circuit and how could they troubleshoot these problems effectively.
- 9) Why is it important to learn to synchronize the onboard and external LEDs in the final part of the experiment, even if it may seem like a simple exercise?
- 10) Reflect on the trade-offs between using a hardware-based Raspberry Pi Pico and a software-based simulator like "WOKWI" for IoT experiments in terms of realism, cost, and learning experience.

Answers to Post-Lab Questions

(Signature of the Faculty)

Date: _____

(Signature of the Student)

Name: _____

Registration No.: _____

Branch: _____

Section _____

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