

Get Started with the Raspberry Pi AI Kit

A Beginner's Guide to AI and Edge Computing



Dogan Ibrahim

Get Started with the Raspberry Pi AI Kit

A Beginner's Guide to AI and Edge Computing



Dogan Ibrahim

-
- This is an Elektor Publication. Elektor is the media brand of

Elektor International Media B.V.

PO Box 11, NL-6114-ZG Susteren, The Netherlands

Phone: +31 46 4389444

- All rights reserved. No part of this book may be reproduced in any material form, including photocopying, or storing in any medium by electronic means and whether or not transiently or incidentally to some other use of this publication, without the written permission of the copyright holder except in accordance with the provisions of the Copyright Designs and Patents Act 1988 or under the terms of a licence issued by the Copyright Licensing Agency Ltd., 90 Tottenham Court Road, London, England W1P 9HE. Applications for the copyright holder's permission to reproduce any part of the publication should be addressed to the publishers.

● Declaration

The authors and publisher have used their best efforts in ensuring the correctness of the information contained in this book. They do not assume, and hereby disclaim, any liability to any party for any loss or damage caused by errors or omissions in this book, whether such errors or omissions result from negligence, accident or any other cause.

- **ISBN 978-3-89576-638-1** Print

ISBN 978-3-89576-639-8 eBook

- © Copyright 2024 Elektor International Media

www.elektor.com

Prepress Production: D-Vision, Julian van den Berg

Printers: Ipskamp, Enschede, The Netherlands

Elektor is the world's leading source of essential technical information and electronics products for pro engineers, electronics designers, and the companies seeking to engage them. Each day, our international team develops and delivers high-quality content - via a variety of media channels (including magazines, video, digital media, and social media) in several languages - relating to electronics design and DIY electronics. www.elektormagazine.com

Contents

Preface	9
Chapter 1 • The Raspberry Pi 5	11
1.1 Overview	11
1.2 The Raspberry Pi 5 hardware	11
1.3 Active cooler	13
1.4 Raspberry Pi 5 Operating System	14
1.5 Benchmarks	15
Chapter 2 • Installing the Raspberry Pi 5 Operating System and Console Commands	17
2.1 Overview	17
2.2 Using a pre-installed SD card	17
2.3 Larger font in Console mode	18
2.4 Accessing your Raspberry Pi 5 Console from your PC – the Putty program	19
2.4.1 Configuring the Putty	21
2.5 Accessing the Desktop GUI from your PC	22
2.6 Assigning static IP address to your Raspberry Pi 5	24
2.7 Enabling Bluetooth	25
2.8 Connecting the Raspberry Pi 5 to a wired network	26
2.8.1 Unable to connect to a wired network	26
2.9 Installing the Raspberry Pi 5 Bookworm operating system on a blank microSD card	28
2.10 Some commonly used Console commands	29
2.10.1 The Console command prompt	30
2.10.2 System and user information	30
2.10.3 The directory structure	32
2.10.4 File Permissions	34
2.10.5 Help	38
2.10.6 Date and Time	38
2.10.7 File processing	38
2.10.8 Head and tail commands	40
2.10.9 Super User commands	41

2.10.10 Resource monitoring on Raspberry Pi 5	42
2.10.11 Shutting down	44
2.10.12 Networking.	45
2.10.13 System information and some other useful commands	46
Chapter 3 • The Raspberry Pi AI Kit.	48
3.1 Overview	48
3.2 Raspberry Pi 5 M.2 HAT+ adapter board.	49
3.2.1 Installing the HAT+ and the AI Kit	50
3.2.2 Installing the AI Kit software	53
3.2.3 Verifying the software installation.	54
Chapter 4 • Raspberry Pi Cameras.	57
4.1 Overview	57
4.2 Raspberry Pi cameras	57
4.3 Installing the camera.	58
4.3.1 Verify the camera installation.	59
4.4 rpical camera commands	59
Chapter 5 • Using a Text Editor in Console Mode.	63
5.1 nano text editor	63
5.2 vi text editor.	67
5.3 Using the Thonny	70
5.3.1 The Thonny IDE	71
Chapter 6 • Creating and Running a Simple Python Program	72
6.1 Overview	72
6.2 Method 1 – Interactively from command prompt in Console mode.	72
6.3 Method 2 – Create a Python file in Console mode	72
6.4 Method 3 – Create a Python file in Desktop GUI mode	73
6.5 Which method?	74
Chapter 7 • Python Programming	75
7.1 Overview	75
7.2 Variable names	75
7.3 Reserved words.	76

7.4 Comments	76
7.5 Line continuation	76
7.6 Blank lines	76
7.7 More than one statement on a line	77
7.8 Indentation	77
7.9 Python data types	77
7.10 Numbers	78
7.11 Strings	81
7.11.1 String functions	82
7.11.2 Escape sequences	83
7.12 Print statement	84
7.13 List variables	85
7.13.1 List functions	86
7.14 Tuple variables	86
7.15 Dictionary variables	87
7.15.1 Dictionary functions	87
7.16 Keyboard input	88
7.17 Comparison operators	88
7.18 Logical operators	88
7.19 Assignment operators	88
7.20 Control of flow	89
7.20.1 if, if..else, and elif	89
7.20.2 for statement	90
7.20.3 while statement	91
7.20.4 continue statement	92
7.20.5 break statement	92
7.20.6 pass statement	93
7.21 User defined functions	93
7.22 Examples	96
7.23 Exceptions	102
7.23.1 try/final exceptions	103

7.24 Date and time	103
Chapter 8 • The AI Kit Demo Programs	106
8.1 Overview	106
8.2 Demo software installation	106
8.2.1 The application structure	108
8.2.2 Detection demo example	108
8.2.3 Pose Estimation demo example	113
8.2.4 Instance segmentation demo example	114
8.3 Post-processing with rpicam-apps	115
8.4 Project 1 – Detect person presence using the AI Kit – LED output	118
8.5 Project 2 – Detect person presence using the AI Kit – WiFi based	120
8.6 Hailo software components	125
Chapter 9 • Pre-trained models	127
9.1 Overview	127
9.2 Hailo Model Zoo pre-trained models	127
9.3 Installing the DataFlow compiler	127
Chapter 10 • The Hailo AI SW Suite	131
10.1 Overview	131
10.2 The Hailo AI SW Suite	131
10.3 Re-training models	135
Chapter 11 • Raspberry Pi 5 Object Detection Training	136
11.1 Overview	136
11.2 YOLO	136
11.3 The training	137
11.4 Modified procedure	145
11.5 Hailortcli	145
APPENDIX – Useful Web Sites	148
Index	149