

Contents

Chapter 1 • Introduction11

1.1 The BeagleY-AI Single Board Computer (SBC).11

1.2 BeagleY-AI Features.11

1.3 BeagleY-AI Board Component Layout.12

1.4 Comparison with the Raspberry Pi 514

1.5 Pros and Cons.15

Chapter 2 • Installing the Operating System.17

2.1 Overview17

2.2 The Installation of the Operating System17

2.3 Connection to a Wi-Fi.20

2.4 Accessing Your BeagleY-AI Console from Your PC – The PuTTY Program22

2.4.1 Configuring PuTTY.24

2.5 BeagleY-AI CPU Temperature25

Chapter 3 • Using the Console Commands.27

3.1 Overview27

3.2 The Command Prompt27

3.3 Useful Console Commands27

3.3.1 System and user information27

3.3.2 Some useful commands.30

3.3.3 Resource monitoring on BeagleY-AI.39

3.3.4 Shutting Down41

3.3.5 Networking42

3.3.6 System information and other useful commands43

Chapter 4 • GUI Desktop Applications45

4.1 Overview45

4.2 The GUI Desktop45

4.2.1 Applications Menu.45

Chapter 5 • Using a Text Editor in Console Mode.57

5.1 Overview57

5.2 The nano Text Editor57

- 5.3 The vi Text Editor62
- 5.4 Using Thonny65
 - 5.4.1 The Thonny IDE65
- 5.5 The gedit Text Editor66
 - 5.5.1 Using gedit66
- Chapter 6 • Creating and Running a Python Program68**
 - 6.1 Overview68
 - 6.2 Method 1 – Interactively from Command Prompt in Console Mode.....68
 - 6.3 Method 2 – Create a Python File in Console Mode68
 - 6.4 Method 3 – Create a Python File in GUI Desktop Mode.....69
 - 6.5 Which Method?70
- Chapter 7 • Python Programming and Simple Programs.....71**
 - 7.1 Overview71
 - 7.2 Variable Names.....71
 - 7.3 Reserved Words71
 - 7.4 Comments72
 - 7.5 Line Continuation72
 - 7.6 Blank Lines.....72
 - 7.7 More Than One statement on a Line72
 - 7.8 Indentation.....73
 - 7.9 Python Data Types.....73
 - 7.10 Numbers.....73
 - 7.11 Strings.....77
 - 7.11.1 String functions78
 - 7.11.2 Escape sequences.....79
 - 7.12 Print Statement.....80
 - 7.13 List Variables.....80
 - 7.13.1 List functions81
 - 7.14 Tuple Variables82
 - 7.15 Dictionary Variables.....83
 - 7.15.1 Dictionary functions83
 - 7.16 Keyboard Input83

7.17 Comparison Operators	84
7.18 Logical Operators.	84
7.19 Assignment Operators	84
7.20 Control of Flow	85
7.20.1 The if, if..else, and elif	85
7.20.2 The for statement.	86
7.20.3 The while statement	87
7.20.4 The continue statement.	88
7.20.5 The break statement.	88
7.20.6 The pass statement.	89
7.21 Example 1 – 4 Band Resistor Color Code Identifier.	89
7.22 Example 2 – Series or Parallel Resistors	91
7.23 Example 3 - Resistive Potential Divider.	93
7.24 Trigonometric Functions	96
7.25 User Defined Functions.	96
7.26 Examples	100
7.27 Recursive Functions	111
7.28 Exceptions	111
7.29 try/final Exceptions	114
7.30 Date and Time.	115
7.31 Creating Your Own Modules.	116
Chapter 8 • BeagleY-AI LED Projects.	120
8.1 Overview	120
8.2 BeagleY-AI GPIO pin Definitions	120
8.3 Project 1 – Flashing an LED	121
8.4 Project 2 – Alternately Flashing LEDs.	125
8.5 Project 3 – Binary Counting with 8 LEDs.	127
8.6 Project 4 – Christmas Lights (Random Flashing 8 LEDs).	133
8.7 Project 5 – Chasing LEDs	135
8.8 Project 6 – Rotating LEDs with Pushbutton Switch	137
8.9 Project 7 – Morse Code Exerciser with LED or Buzzer.	140
8.10 Project 8 – Electronic Dice	145

8.11 Project 9 – Varying the LED Flashing Rate	149
Chapter 9 • Using an I²C LCD.	152
9.1 Overview	152
9.2 The I ² C Bus	152
9.3 I ² C Pins of BeagleY-AI	153
9.4 Project 1 – Using an I ² C LCD – Seconds Counter	154
9.5 Project 2 – Using an I ² C LCD – Display Time	158
9.6 Project 3 – Using an I ² C LCD – Display the IP address of BeagleY-AI	160
9.7 Project 4 – Reaction Timer – Output to Screen	161
9.8 Project 5 – Reaction Timer – Output to LCD	163
9.9 Project 6 – Automatic Dusk Lights	166
9.10 Project 7 – Ultrasonic Distance Measurement	168
9.11 Project 8 – Car Parking Sensors.	172
Chapter 10 • Plotting Graphs With Python and BeagleY-AI.	176
10.1 Overview	176
10.2 The Matplotlib Graph Plotting Library	176
10.3 Project 1 – RC Transient Circuit Analysis - Charging	190
10.4 Project 2 – RC Transient Circuit Analysis - Discharging	193
10.5 Transient RL Circuits	195
10.6 Project 3 – RCL Transient Circuit Analysis	196
10.7 Project 4 – Temperature, Pressure, and Humidity Measurement – Display on the Screen	200
10.8 Project 5 – Temperature, Pressure, and Humidity Measurement – Plotting the Data.	203
Chapter 11 • Using a 4 x 4 Keypad.	206
11.1 Overview	206
11.2 Project 1 – Using a 4x4 Keypad	206
11.3 Project 2 – Security Lock with Keypad and LCD	214
Chapter 12 • I²C, SPI Bus, and PWM Projects	217
12.1 Overview	217
12.2 Project 1 - I ² C Port Expander	217
12.3 Project 2 - SPI ADC - Voltmeter.	220
12.3.1 The SPI bus	221

12.4 Project 3 – Voltmeter – Output to LCD 227

12.5 Project 4 – Analog Temperature Sensor Thermometer – Output to the Screen . . 230

12.6 Project 5 – Analog Temperature Sensor Thermometer – Output on LCD 232

12.7 Using a Digital to Analog Converter (DAC) 235

12.7.1 The MCP4921 DAC 235

12.7.2 Project 6 - Generating square wave signal with any peak voltage up to +3.3 V. . 236

12.7.3 Project 7 - Generating sawtooth wave signal 240

12.7.4 Project 8 - Generating triangle wave signal 242

12.7.5 Project 9 - Generating arbitrary wave signal. 244

12.7.6 Project 10 - Generating sine wave signal 247

12.7.7 Project 11 – SPI Port Expander. 251

12.8 Pulse Width Modulation (PWM 256

12.8.1 PWM channels of BeagleY-AI 258

12.8.2 Project 12 – Generate 1000Hz PWM waveform with 50% duty cycle 258

12.8.3 Project 13 – Changing the brightness of an LED 261

12.8.4 Project 14 – Mosquito repeller 262

Chapter 13 • Communication Over the Wi-Fi. 265

13.1 Overview 265

13.2 UDP and TCP. 265

13.2.1 UDP communication 266

13.2.2 TCP communication. 266

13.3 Project 1 – Sending a Text Message to a Smartphone Using TCP 267

13.4 Project 2 – Two-way Communication with the Smartphone Using TCP 271

13.5 Project 3 – Communicating with a PC Using TCP. 273

13.6 Project 4 – Controlling an LED Connected to BeagleY-AI from a
Smartphone Using TCP 276

13.7 Project 5 – Sending a Text Message to a Smartphone Using UDP. 278

13.8 Project 6 – Controlling an LED Connected to BeagleY-AI from a
Smartphone Using UDP 281

13.9 Communicating with the Raspberry Pi Pico W over Wi-Fi. 283

13.9.1 Project 7 – BeagleY-AI and Raspberry Pi Pico W communication –
controlling a relay over Wi-Fi 286

- 13.10 Project 8 - Storing Ambient Temperature and Atmospheric Pressure
Data on the Cloud 289
- 13.11 Using Flask to Create a Web Server to Control BeagleY-AI GPIO Ports
from the Internet 297
- 13.12 Project 9 – Web Server - Controlling an LED Connected to BeagleY-AI
Using the Flask 300
- Chapter 14 • Using Serial Communication 303**
 - 14.1 Overview 303
 - 14.2 USB – TTL Serial Conversion Modules. 304
 - 14.3 BeagleY-AI and PC Communication Over Serial Port – Testing the Hardware and
Software Configurations. 306
 - 14.4 Project 1 – BeagleY-AI – PC Two-Way Communication Over Serial Port –
Using Python 308
 - 14.5 Reading Geographical Coordinates – Using a GPS 311
 - 14.5.1 Project 2 – Displaying geographical coordinates on the monitor 312
 - 14.5.2 Project 3 – Displaying geographical coordinates on LCD. 317
 - 14.5.3 Project 4 – BeagleY-AI – Raspberry Pi 4 communication over a serial link 321
- Chapter 15 • Real Time Clock (RTC). 325**
 - 15.1 Overview 325
 - 15.2 The Hardware 325
 - 15.3 Setting the RTC Time 326
- Chapter 16 • Artificial Intelligence (AI) with the BeagleY-AI 327**
 - 16.1 Overview 327
 - 16.2 BeagleY-AI Detailed Hardware Specifications. 327
 - 16.3 Project 1 - BeagleY-AI TensorFlow Lite Object Detection 328
 - 16.4 BeagleY-AI ChatGPT. 335
 - 16.5 BeagleY-AI Smart Assistant. 335
 - 16.6 BeagleY-AI Robotics 336
 - 16.7 BeagleY-AI Machine Learning 336
- Chapter 17 • Useful Websites 337**
- Index 338**