INVENTOR GUIDE

BE INSPIRED
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Innovators have conquered the deepest seas, traversed the highest mountains, harnessed the energy from the Earth and sent humanity to space all in the pursuit of discovery. We are all capable of extraordinary feats, driven by curiosity and adventure into the unknown. At pi-top we believe every single person can become a great innovator if given the chance to ignite their own passion in the undiscovered.

There are no dreams too large, no innovation unimaginable and no frontiers beyond our reach, if only we try.
How to use this guide

Choose an Inventor Journey
Select one of the pathways to create your own amazing inventions. Use the inventor journey pathways to build up your knowledge to make your final project.

Code & Build
Follow the step-by-step guide in pi-topCODER to code and build your invention.

Expand
Use your imagination and creativity to build on your creation and invent something new! Add new components and code to expand on functionality in all different ways.

Share
Share your incredible invention with the rest of the pi-top community and show what you’ve invented.
Components

**LEDs**
LEDs (light-emitting diodes) are little devices that emit light when electric current flows through them.

**A Jumper Cables**
These cables are electrical wires to direct the flow of electricity. You can connect them on your pi-topPROTO+

**B Jumper Cables**
These cables are used to connect the Raspberry Pi GPIO pins to your pi-topPROTO+ ADC pins.

**Button**
Allow or block electricity flow around a circuit - connect or disconnect things!

**Buzzer**
Buzzers will make a loud noise when electricity passes through it!

**Resistor**
Control the amount of electricity that flows through a circuit.

**Temperature Sensor**
This will change its resistance depending on the temperature around it.

**Light Sensor**
Detect amount of light - useful for robots to interact with their environment!

**Metal Wire**
Electricity flows through a metal wire. So, this is a useful tool for lots of your projects!

**Variable Resistor**
A variable resistor is a special type of resistor which allows you to control the amount of electricity that flows through it.
pi-top PROTO+ is a prototyping board (the platform) for all your inventions. The breadboard, in the middle, allows you to plug in your LEDs, Buzzers, Buttons and more.

The GPIO pins (general purpose input/output) are used as the physical interface for your Raspberry Pi and the outside world. Follow the pi-top CODER app’s step-by-step building instructions and bring your inventions to life!

**Getting Stuck?**

To learn the basics on how the pi-top PROTO+ works, check out the breadboard lesson plan in the pi-top CODER app.
Inventor’s Journey

Power on your pi-top - you should be greeted with pi-top DASHBOARD. From here, it is easy to launch pi-top CODER, where you’ll find all the step-by-step guides you need.

First, follow the basic pathway (outlined below) to build your fundamental understanding. Then, follow one of the inventor’s journey pathways to design and build new inventions!

Basics of Coding:

1. Let There be Light!
2. Button Down
3. You’ve Got the Measure of it
4. Be like a Bat
5. Make Some Noise!
Music Maker

1. Don’t Push Me
2. Melody Madness
3. Make Some Wubs
4. What’s a Theremin?

Space Race

1. Rapid Reflexes
2. Tap Tap revolution
3. Double Click King
4. Keep it Steady

Smart Robot

1. Hello World
2. Clappy Hands
3. Feed Me
4. Chatter Box
Let There be Light!

Let's build your first electronic circuit. Add some code to turn on a light. The light is an LED which stands for 'light emitting diode'.

Inventor’s Journey

1

Challenges
Can you make it blink faster?
Can you use other components?

Real-life Applications

- Computer Monitor
- Traffic Lights
- Car lights

This is the first step to building your first invention which is powered by your pi-top laptop. The power (electricity) is an output.
Button Down

This is where you’re going to make your code respond by pressing a button, this is called an INPUT. This is one way we can make the digital world, a computer for instance, interact with the physical one, your finger in this case. It could be the switch that makes your doorbell ring.

Inventor’s Journey

Challenges
Create a click counter for the button

Real-life Applications

- Keyboard
- Gaming Controller
- Doorbell
You’ve Got the Measure of it

Sensors which aren’t just on or off are called analogue, for example, light. It’s not just dark or light, it can be dim. We’re going to learn how to measure these values.

Inventor’s Journey

Challenges
Can you measure the temperature? Can you measure how much a variable resistor turned?

Real-life Applications

Science Lab
Oven Temperature
Air Condition
Be like a Bat

Using an ultrasonic sound sensor we can send out a signal and time how long it takes to come back. Using this information we can measure how far away an object is. Here we’ll learn how to measure that distance.

Inventor’s Journey

Challenges
Can you make an LED light turn on if the distance is too close?

Real-life Applications

- Drone to keep height
- Parking Sensor
- Robot
Make Some Noise

All music starts with a single sound. Use a pi-top SPEAKER or plug in your speaker to create your own orchestra of funny sounds.

Inventor’s Journey Completed!

Challenges
How many different sounds can you make as you create your own music?

Real-life Applications

- Boombox
- Headphones
- DJ concert
Don’t Push Me

At its most basic form, a musical instrument makes a single sound when you hit a key, or pluck a string. Let’s use a button to get your new instrument to make a sound.

Inventor’s Journey

1

Challenges
Can you get it to play different sounds every time you press the button?

Real-life Applications

Boombox
Alarm
Doorbell
Melody Madness

Music is made out of melodies, and melodies are made out of notes. Using the variable resistor we can change the tone to create different notes, to make a whole tune! The change in tone is called a change in frequency.

Inventor’s Journey

Challenges
Can you make your pi-top play twinkle twinkle little star?

Real-life Applications

DJ concert  Electric Synth  Alarm System
Make Some Wubs

In earlier lessons we made a light dimmer, let’s use that same knowledge to change the frequency of a tone ourselves! This allows us to build the basics of a musical instrument.

Inventor’s Journey

Challenges
Can you make it so that the speaker only plays 4 different notes? Can you limit your programme so that certain frequencies play a single note rather than a range of notes e.g. 0-100 = c?

Real-life Applications

- Theremin
- Electric Synth
- Doorbell
A Theremin is a musical instrument which makes sounds without even touching it, pretty cool eh! You control it by moving your hand closer to, further away from or along a sensor. Use your hands to make your own hands-free instrument! You can turn our distance sensor into a Theremin to make your own beats.

**Inventor’s Journey**

**Challenges**
Can you make it only play defined musical notes.

**Real-life Applications**
- Motion Sensing
- Microsoft Kinect™
- Radar
Sonic Synth

Combine all the previous inventions into one, and make an instrument which is truly unique.

Inventor’s Journey Completed!

Challenges

Can you put a beat to your song? Get your friend over and make an orchestra!
Rapid Reflexes

Test your reactions against your friends. With just a few components you can code a game to determine who is the fastest!

Inventor’s Journey

1

Challenges
Make a game for 3 people?
Make a game best of 3.

Real-life Applications

Arcade Games

Sport Competitions

Board Games
Fingers of Fury

How accurately can you time 10 seconds without using a watch? Now that you can detect a button press and the time that is taken to press it, let’s write a program which can identify which of two players pushes their button closest to 10 seconds after the game starts.

Inventor’s Journey

Challenges
Can you print a timed scorecard for this game?

Real-life Applications

Stopwatch
Video Games
Finger Drumming
Tap Tap Revolution

Challenge yourself to press the button as many times as possible in 5 seconds.

Inventor’s Journey

Challenges

Can you make the game end if you can’t complete it in under 10s? Can you make it so your player incurs time penalties every time they touch the wire?

Real-life Applications

Finger Drumming

Electric Synth

Typing Speed
Keep it Steady

Add a feature to give players a helping hand. When you press the invisibility button you can touch the wire as many times as you like for two seconds.

Inventor’s Journey

Challenges

Can you write your code, so that it randomly chooses the time that invisibility mode will last for? Can you add a sound effect to the invisibility effect?

Real-life Applications

Soldering Circuits

Video Games

Tablet Calligraphy
Space Race

Upgrade the steady hand game to count how many times you have touched the wire, and add a shield to your spaceship.

Inventor’s Journey Completed

Challenges
Each touch adds 5s to the total time.
Hello World

Bring your smart robot to life with a voice and glowing ears. It will be able to talk to you and show emotions!

Inventor’s Journey

1

Challenges

Can you make the eyes flash when there is a particularly loud noise?

Real-life Applications

Voice Assistant
Automated Support
Virtual Pet
Clappy Hands

Make your robot react to noise in its environment. Clap to make it react with a funny noise or phrase!

Inventor’s Journey

Challenges

Can you make the LEDs light up when you clap? Can you make the greeting appear only to people who clap three times?

Real-life Applications

- Noise Detector
- Smart Lamp
- Home Security
Feed Me

Use the light sensor to detect when you put food over the robot’s mouth feeding it with more power!

**Inventor’s Journey**

3

**Challenges**

Can you make your thermometer play a sound after the temperature has been at a certain level for a period of time?

**Real-life Applications**

- Autonomous Vehicle
- Astrophysics
- Smart Clocks
Chatter Box

Using the ultrasonic range sensor, your smart robot can sense when people approach your smart robot. Make your robot greet them with a funny greeting!

Inventor’s Journey

Challenges
Can you make the greeting appear only to people who clap three times?

Real-life Applications

Parking Sensor  Roller Coasters  Aviation Safety
It’s ALIVE!

Bring the whole smart robot together by combining all the functionality and adding additional input for interaction!

Inventor’s Journey Completed!
Troubleshooting

**GPIO pins are not working.**
Is there power running through the pi-top PROTO+?

Is your **pi-top** PROTO+ aligned with the correct pins? Check that the 34 pin connector is properly aligned with the 34 pin connected in the **pi-top**.

**There is no power running through my components.**

- Ensure jumper cable connects from the 3v3 GPIO to the breadboard on the row with the first component.
- Ensure the final component on the inventor’s kit has a jumper cable that connects to the Ground GPIO on the breadboard.

**My keyboard and trackpad are not working.**

Make sure the USB dongle in the **pi-top** is properly inserted into the Raspberry Pi as this is what communicates with the Keyboard and Trackpad.

**My LED is not lighting up.**

- The 3v3 power connects to the positive side (longer leg) and the Ground should be connected to the negative side (shorter leg).
- Other components with directional problems:
  - Diodes, Buttons

**Button not working?**

Try using a jumper cable to bypass the button (connect it to the start of the next component). If the circuit works, then there is a problem with the Button which can be solved by disconnecting it and rotating it 90 degrees.

**Need more help?**

Still stuck? Please don’t hesitate to email us at **support@pi-top.com** or send us a tweet to **@GetPitop**.

[www.pi-top.com](http://www.pi-top.com)
Community +
Share your Invention

Tag us and use the hashtag #daretoinvent to share your inventions with our community.

www.pi-top.com
Continue Your Inventor’s Journey

Now that you have finished all of the inventor journeys there are a wealth of resources online which you can use to continue building, inventing and discovering new projects.

pi-topCODER

pi-topCODER has a wealth of resources in addition to the inventors pathways.

Raspberry Pi website

The Raspberry Pi website has a wealth of resources which you can explore.

https://www.raspberrypi.org

MagPi

This is the official Raspberry Pi Magazine and is full of great projects! You can find it online or in a store.
## Glossary

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<th>Term</th>
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<td>Raspberry Pi</td>
<td>A small credit card sized computer, it is the brain of the pi-top and runs the entire computer.</td>
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<td>GPIO Pins</td>
<td>The General Purpose Input Output Pins directly interact with the Raspberry Pi. You can code them to do almost anything!</td>
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<td>ADC</td>
<td>The Analogue to Digital Converter enables the Raspberry Pi to receive signals from the analogue world. It is part of pi-topPROTO+.</td>
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<td>pi-topPROTO+</td>
<td>pi-topPROTO+ is a prototyping board (the platform) for all your inventions which connect to the magnetic modular rail. It’s made with a breadboard and has a lot of useful pins such as the GPIO pins or ADC pins.</td>
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<td>LED</td>
<td>Light Emitting Diode, this is a little light commonly used in electronics. You have to be careful to plug it in the correctly!</td>
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<td>pi-topCODER</td>
<td>A platform on pi-topOS which you can use to learn how to build and program awesome projects.</td>
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<td>CEEDuniverse</td>
<td>pi-top’s very own space exploration game, while discovering new planets and strange creatures you will learn about science, technology and learn how to code.</td>
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Visit www.pi-top.com to see our full range of amazing accessories!

**pi-topPULSE**

*pi-topPULSE brings the arts into STEAM. Code your own games, create music and lightshows and build your own pi-top powered Amazon Alexa!*

**pi-topPROTO**

*Use *pi-top*PROTO to make circuits for *pi-top*CODER and CEEDuniverse & even solder your own projects.*

**pi-topSPEAKER**

*Use *pi-top*SPEAKER to give your *pi-top* a voice. Enjoy immersive gameplay in CEEDuniverse or making your own music in Sonic Pi.*
BE INSPIRED

pi-top
Model: 2.0
Brand: pi-top
Manufacturer Name: CEED LTD
Manufacturer Address: 19 - 23 Featherstone Street London, EC1Y 8SL

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.