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The NE555 and its amateur radio applications



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A small box, a big idea



Lucas returns to the club with his notebook: “For the open day, I would like visitors to hear Morse code!”



Henri places a tiny black package on the table: “This is the NE555. Eight pins, lots of ideas.”



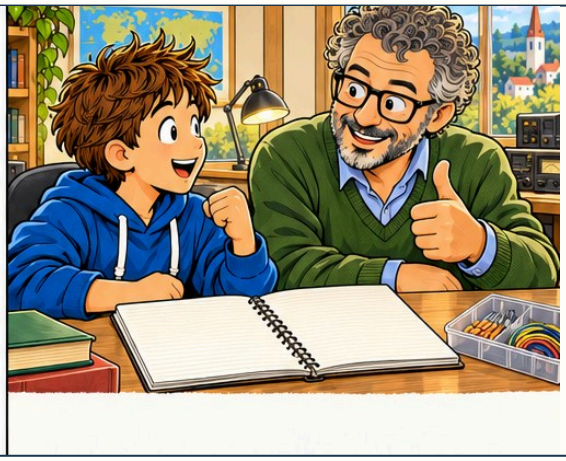
“Can it talk to another station?” Henri smiles: “Let us start with a sound, here in the clubroom.”



A Morse key waits near the speaker. Their challenge: to build a device that helps visitors learn.



Lucas draws a box with three controls: power, tone and volume. The project is taking shape.



“What if it does not work?” — “We will learn how to find out why. That is part of the adventure!”

The project wish list



Lucas would like a pleasant sound, an easy-to-use key and enough volume for a small workshop table.



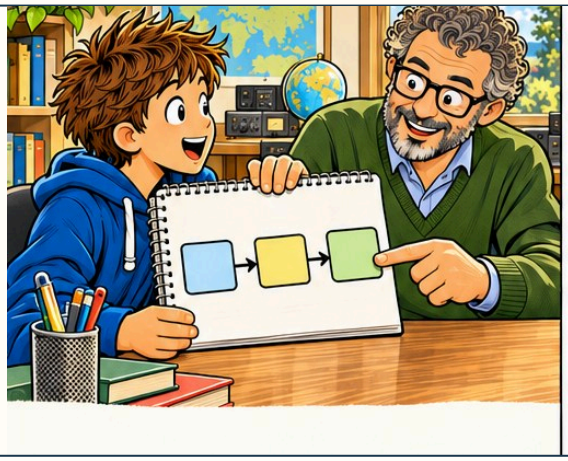
"And no need for an antenna," adds Henri. Their device will be a sound Morse trainer, without radio emissions.



They choose a 5 V regulated power supply and limit the current during the first tests.



Henri clears a work area. Electronic components and tools each have their place.



In the notebook, Lucas separates three functions: producing the tone, controlling it and amplifying it.



"We will test each function," he decides. To make the whole device work, they will proceed in small steps.

Getting to know the 555



Henri opens the manufacturer's datasheet: "A familiar name does not replace the documentation for the actual component."



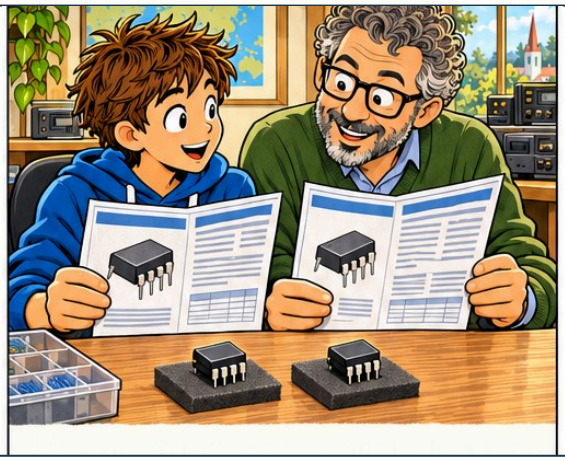
The NE555 is a bipolar timer. Resistors and a capacitor give it its rhythm.



It can produce a pulse, oscillate or hold a state, depending on its circuit. Lucas acts out these three functions.



"So it does everything?" — "It is very useful, but it also has voltage and current limits."



They verify that their reference works at 5 V. A neighboring CMOS version does not necessarily have the same limits.



Lucas stores the datasheet with the components: "This belongs in our toolbox."

Eight pins, one reading direction



Before plugging anything in, they look at the eight-pin DIP package, seen from above.



With the notch at the top, pin 1 is at the upper left; a small dot may also identify it.



On the left, count down from 1 to 4. On the right, count up from 5 to 8: the numbering runs around the package.



"If I turn it over, my drawing no longer matches!" Lucas compares the component with the top view again.



Henri asks him to draw four pins on each side, then the notch. They have not connected anything yet.

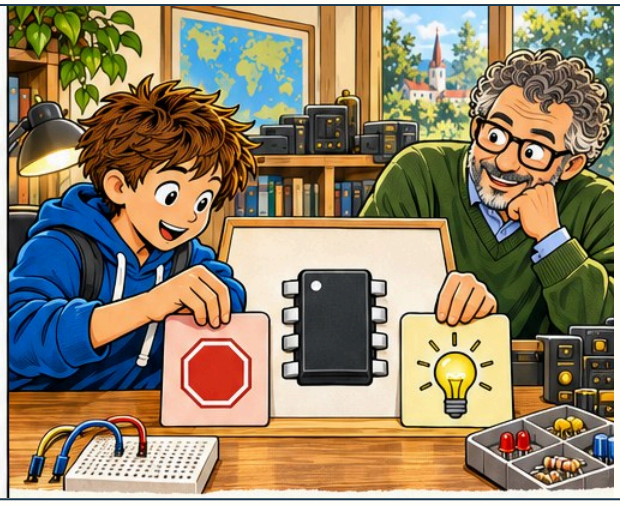


They keep this mark visible on the notebook and check the marking before placing the component.

A role for every pin



Lucas identifies the functions: 1, ground; 8, positive supply. These two pins power the circuit.



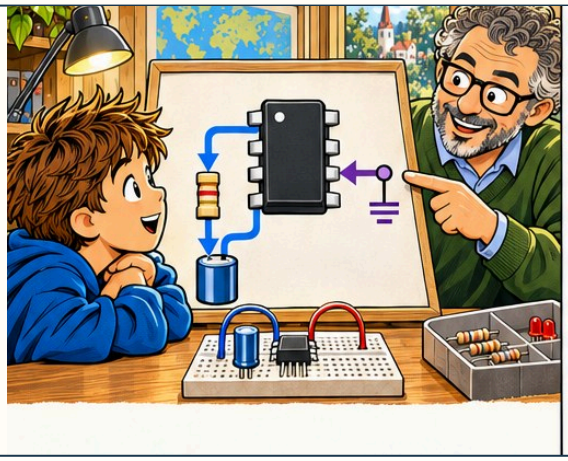
Pin 3 is the output. Pin 4, RESET, forces the circuit into reset when held low.



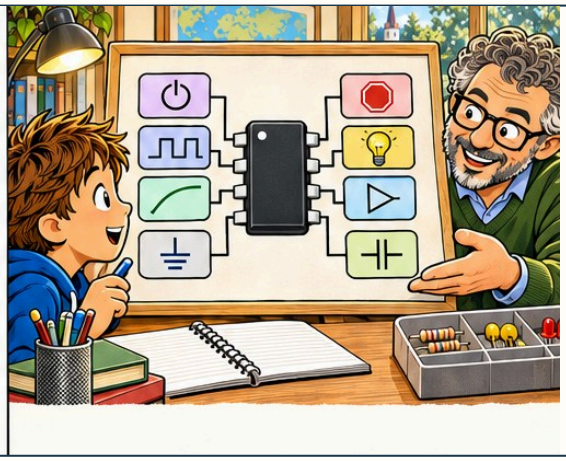
Pin 2, TRIG, detects a voltage falling below about one third of the supply voltage.



Pin 6, THRES, monitors the upper threshold, about two thirds of the supply voltage in the usual circuit.



Pin 7, DISCH, is used to discharge the capacitor. Pin 5, CONT, provides access to the internal reference.

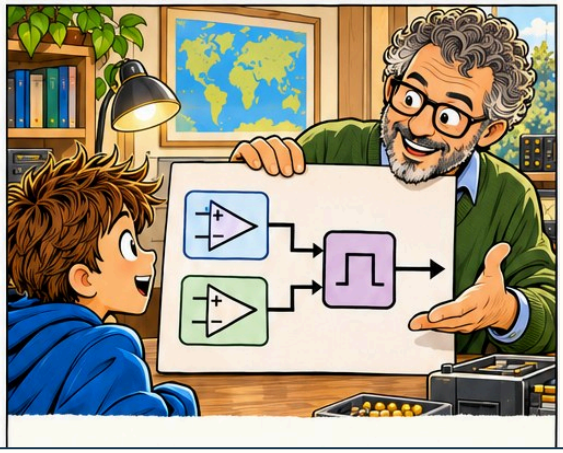


"Eight different roles, not eight interchangeable terminals!" Lucas matches each function to the drawing.

A small team inside



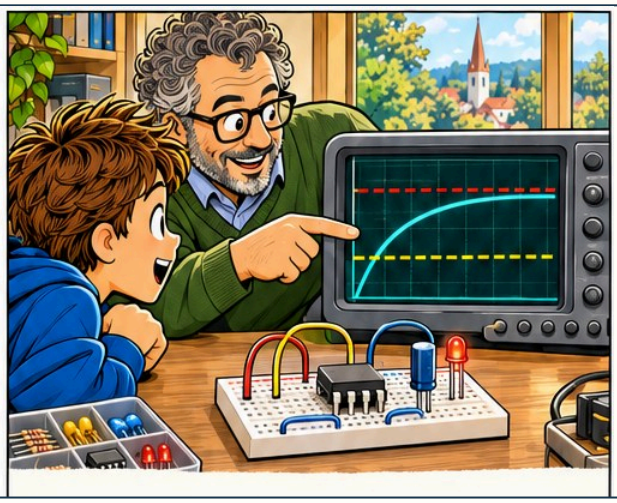
Henri draws two comparators: each compares a voltage to a reference.



An internal latch remembers the last command. The output and the discharge transistor follow this state.



“One starts it, the other stops it?” — “That is a useful picture, provided we respect their operating conditions.”



In the usual circuit, the internal references are close to VCC/3 and 2VCC/3.



RESET can force a reset. Lucas understands why this input must not be left floating.



He follows the arrows with his pencil: measure, decide, remember, act. The package becomes less mysterious.

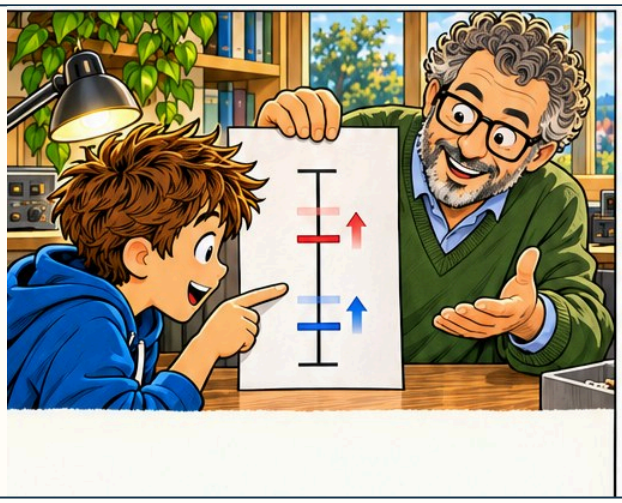
One third and two thirds



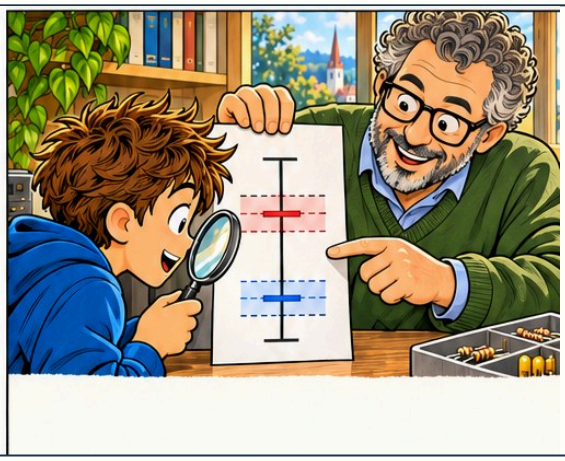
With VCC = 5 V, the theoretical benchmarks become approximately 1,67 V and 3,33 V.



“So these are not two fixed voltages for all power supplies,” notes Lucas.



Henri varies a paper gauge: the two marks follow the supply voltage.



Actual values have tolerances. The technical sheet specifies the conditions and possible deviations.



The capacitor voltage will rise and fall between these levels. This journey determines a timing interval.



Lucas draws a little electrical swing: “Perhaps a rhythm is a story about thresholds.”

A plan before the wires



"Shall we connect it?" Henri first puts down a sheet: "Let us decide what each wire must connect."



They choose an astable circuit: it oscillates on its own as long as RESET permits it.



Two resistors, RA and RB, and a capacitor C will approximately set the oscillation frequency.



An indicator light will first show activity. The sound will come after the controls.



Lucas draws the timing circuit and the future audio chain separately. He leaves room for measurements.



"We will have a plan to build from, then check it with fresh eyes," he says as he prepares the notebook.

Five volts well prepared



They use a regulated, isolated 5 V supply, adjusted and checked before connecting the circuit.



The current limiter is set low for the first test, then adapted to the circuit according to the instructions.



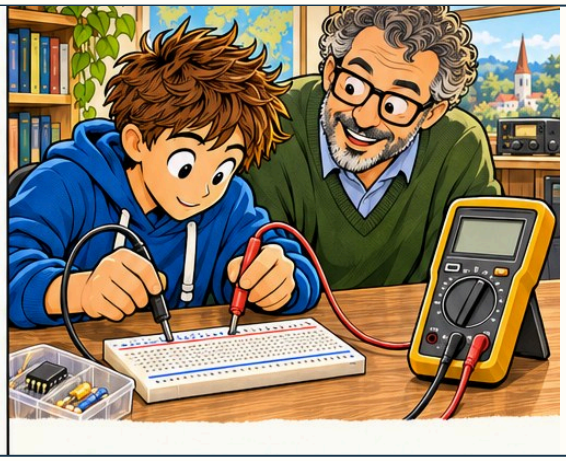
The positive wire connects to the +5 V supply rail; the return wire connects to circuit ground. Lucas checks polarity.



"A battery is not automatically a suitable supply for 5 V," Henri reminds him, pointing to their labels.



They disconnect the supply before any wiring work. Nothing in this workshop connects directly to the mains.



Lucas measures the unloaded supply rails with the multimeter, then switches the power off before continuing.

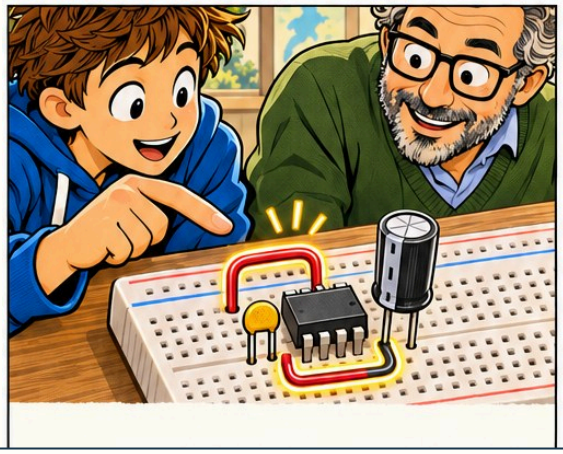
A local energy reserve



Henri places 100 nF between pins 8 and 1, with short connections, as close to the NE555 as possible.



A 10 µF capacitor completes the decoupling between +5 V and ground; its polarity is respected.



The 555 output can cause brief current spikes. These local energy reserves help stabilize the power supply.



Pin 5 receives 10 nF to ground in this circuit. This capacitor does not set the main tone.



"Two small capacitors, two different tasks," notes Lucas, who distinguishes them in his drawing.



They check the values again. Good intentions alone cannot compensate for a very long power cable.

Choosing the right components



Lucas selects the components RA = 10 kΩ, RB = 100 kΩ and C = 10 nF. These values will provide an initial tone.



For the timing capacitor, they choose a suitable, stable component using its datasheet.



An LED will have a series resistor of 2,2 kΩ. Henri will not connect it directly between output and ground.



The speaker remains in its bag: a suitable audio amplifier circuit will be needed to drive it.



They prepare a potentiometer, short wires and the Morse key. Every value goes on the component list.



"A box of components is not a circuit yet," laughs Lucas. The plan will show how to connect them.

Colors tell a value



Lucas reads the colour bands, then measures the resistors out of circuit with a multimeter.



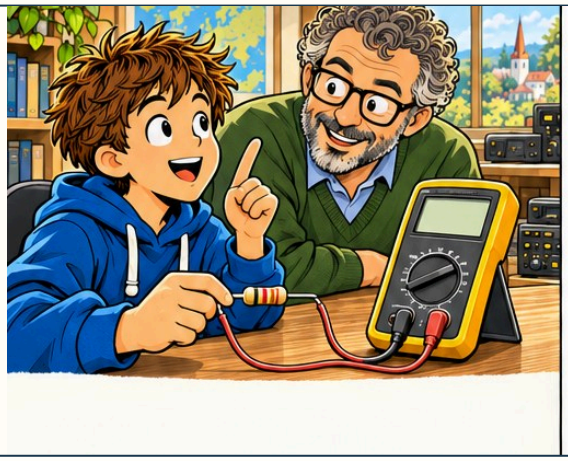
10 kΩ is 10 000 Ω; 100 kΩ is 100 000 Ω. A forgotten zero would change the tone a lot.



The final band may specify tolerance. A nominal value does not promise an exactly matching measurement.



"This one is not a 100 Ω resistor!" He returns the similar-looking component to its compartment.



Henri lets him state the value before looking at the multimeter. The instrument confirms his reasoning.



Lucas attaches a small value card to his solderless breadboard. He has just prevented his first fault.

Ten nanofarads, not ten microfarads



On the timing capacitor, Lucas finds the code 103: 10 000 pF, or 10 nF.



10 nF are equal to 0,01 µF. A 10 µF capacitor would be a thousand times larger.



"Then our whistle would become a very slow rhythm!" Henri appreciates this prediction.



The 10 nF capacitor chosen here is non-polarized. The 10 µF reservoir capacitor must be fitted with the correct polarity.



They compare the markings with the component datasheets. Appearance alone is not enough.



Lucas writes the unit beside every number: "Small letters can make a big difference."

The hidden connections of the breadboard



Before inserting the 555, they mark the internal connections of the solderless breadboard with the multimeter.



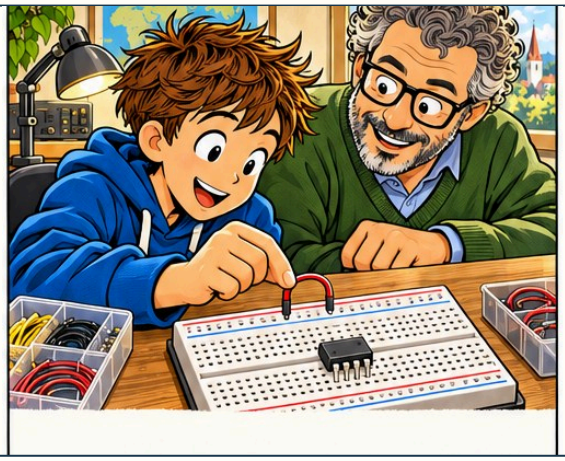
The package straddles the central gap: its two rows of pins remain electrically separate.



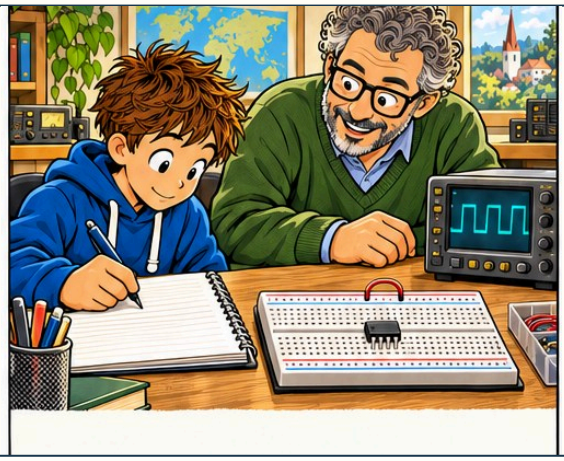
The small groups of holes connect in a specific direction. Lucas tests instead of guessing.



Some supply rails have a break in the middle; they check their own solderless breadboard.



A short jumper wire will connect the necessary segments. No wire should replace a component by accident.



Henri turns the drawing to match the solderless breadboard's orientation. Lucas checks one connection at a time.

The first wiring



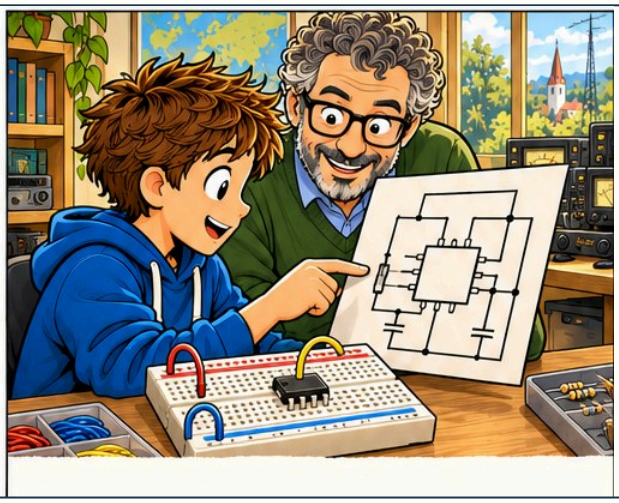
With the power off, they connect pin 1 to ground and pin 8 to +5 V.



For this first continuous test, pin 4, RESET, connects to +5 V. The input now has a defined state.



100 nF connects 8 to 1; 10 µF decouples the rails; the 10 nF capacitor on pin 5 connects to ground.



Lucas checks every connection on the plan, without connecting the timing resistors yet.



They check the notch, the rails and the absence of a short circuit between supply and ground.



"The heart of the timing circuit is still missing," announces Henri. Lucas prepares capacitor C.

A modest indicator



Output 3 will connect to a resistor of 2,2 kΩ, then the LED anode; its cathode will go to ground.



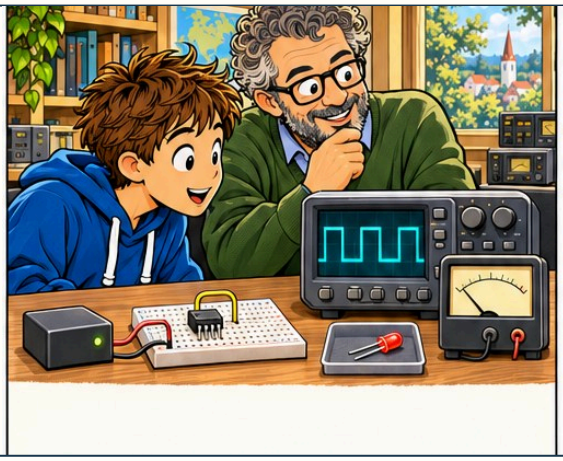
Henri helps identify the anode and cathode using the LED datasheet, then the multimeter's diode mode.



"With about 2 V in the LED, even 5 V at the output would limit the current to about 1,4 mA. "



The actual output of the bipolar NE555 does not necessarily go all the way to the positive rail. The current may be lower.



This LED is an indicator, not a heavy load. They leave precise measurements to the multimeter and oscilloscope.



Lucas leaves the LED visible at the solderless breadboard edge. It will help him understand what the output does.

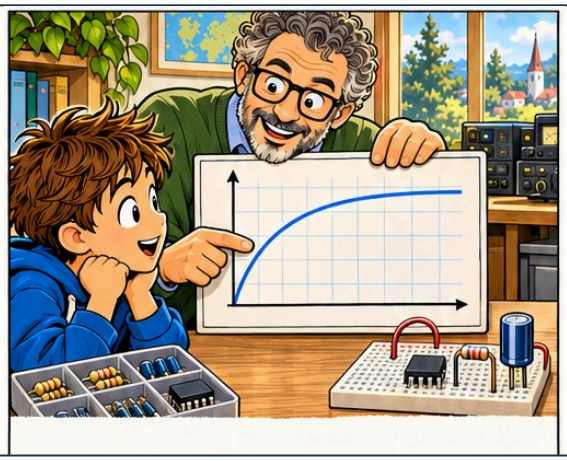
A sponge for time



Henri compares the capacitor to a small reservoir that fills through a resistor.



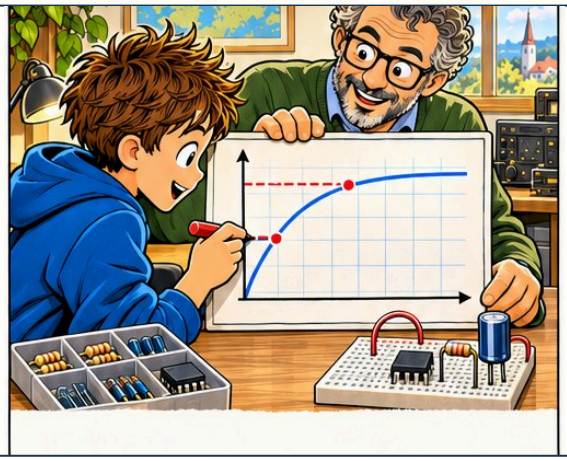
The greater the resistance, the slower the charging. The larger C is, the more charge is required.



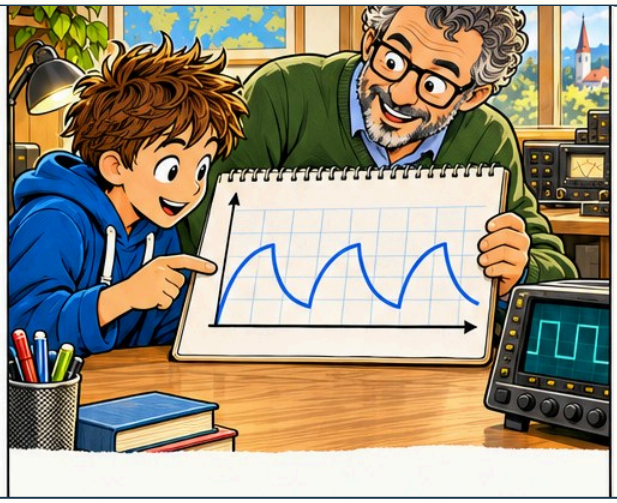
The voltage does not rise in a straight line: the charging curve bends towards the supply voltage.



"And how does it empty?" Henri shows the discharge path controlled by pin 7.



Lucas connects this curve to the two thresholds. The 555 will not wait until the capacitor is completely full.



He predicts a rise, a fall, then another rise. Their rhythm is beginning to take shape.

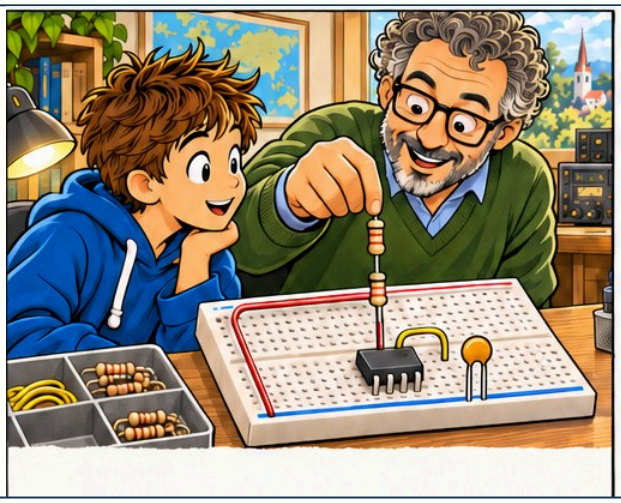
The repeating circuit



They connect pins 2 and 6 together. This common node connects to one terminal of C = 10 nF.



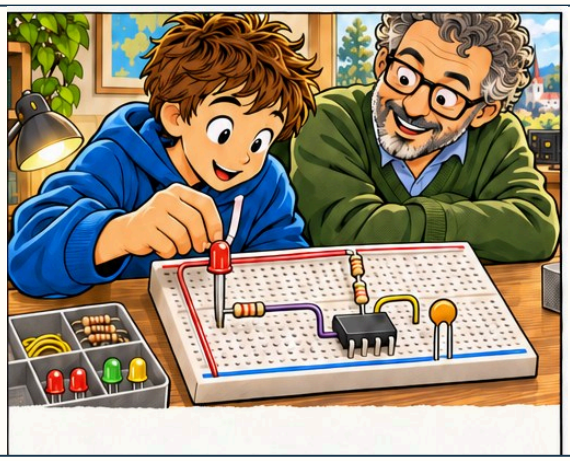
The other terminal of C connects to ground. The two comparators monitor the capacitor voltage.



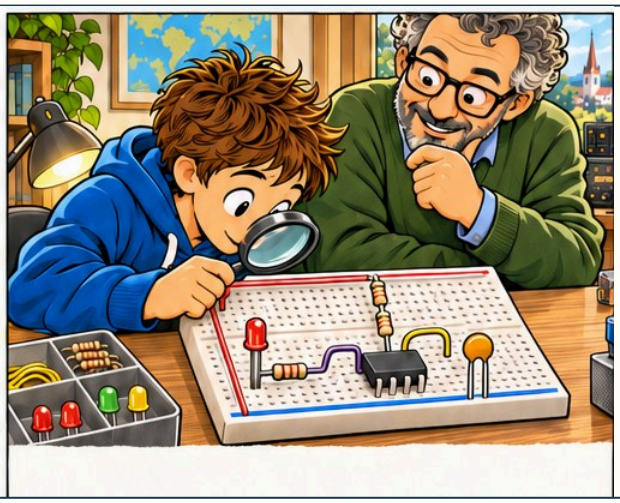
RA = 10 kΩ connects +5 V to pin 7. RB = 100 kΩ connects pin 7 to node 2–6.



"Through RA then RB to charge; through RB to discharge," Henri summarizes, tracing the wires on the plan.



Output 3 remains reserved for the indicator and measurements. It does not connect directly to capacitor C.

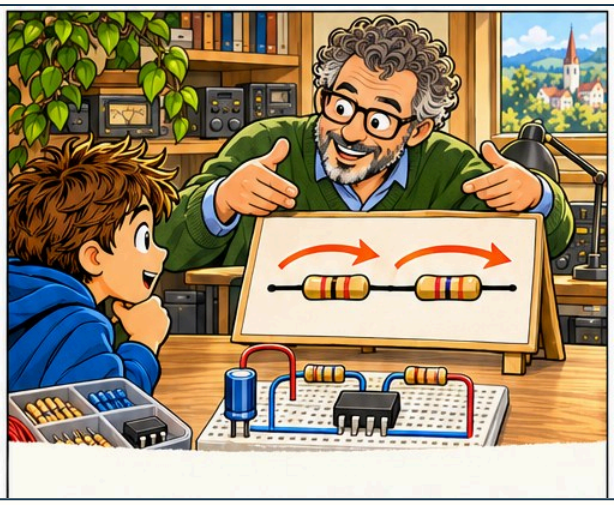


Lucas reviews the entire chain. Every wire finds its place before the first start-up.

Charging starts the cycle



At start-up, C has little charge. A voltage below the lower threshold normally commands a high output.



The internal discharge transistor is then off. C charges through RA and RB.



Its voltage crosses about a third of VCC and continues to rise. The internal memory retains its state.



"It does not change its mind at every moment!" Lucas follows the curve towards the upper threshold.



When the voltage reaches approximately two thirds of VCC, the threshold comparator causes switching.

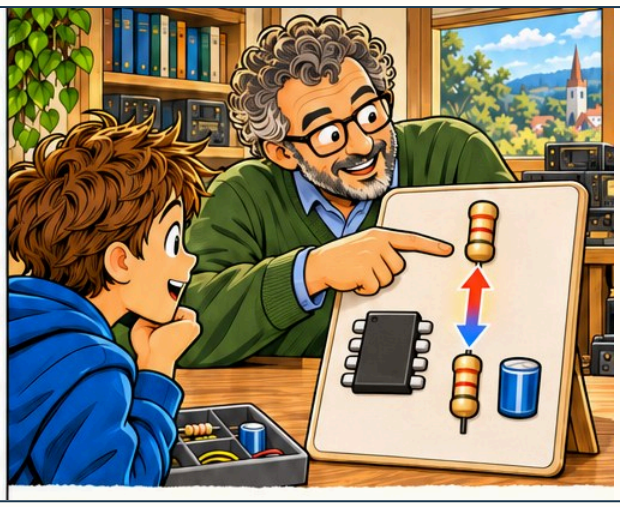


The output goes low and the discharge path starts conducting. The second half of the journey begins.

Discharging closes the loop



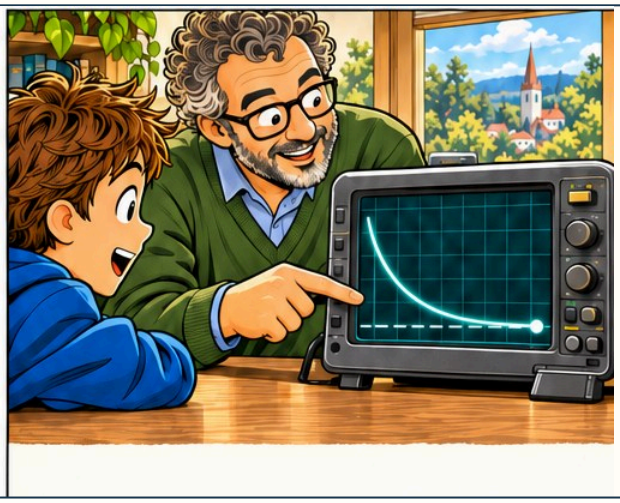
The capacitor now discharges through RB and the internal transistor connected to pin 7.



RA limits the current between +5 V and pin 7 when pulled close to ground.



"So definitely not a simple wire in place of RA! " Lucas underlines this constraint.



By returning below about a third of VCC, the voltage of C triggers a new start.



The output voltage goes high, discharge stops, and C charges again towards the upper threshold. The cycle repeats.

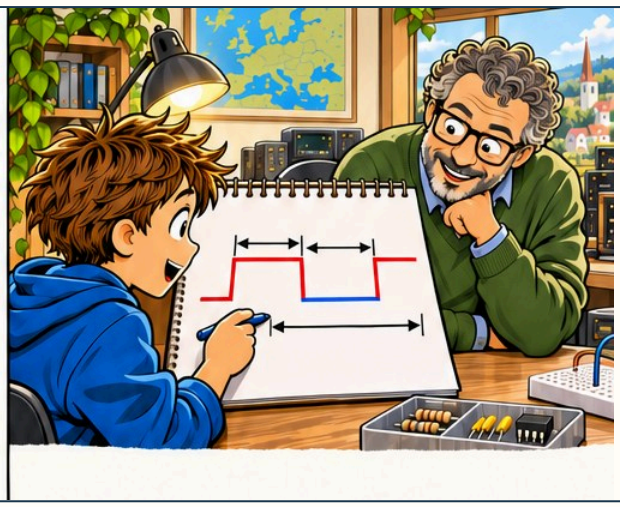


At the output, a rectangular waveform; across C, curved rises and falls. Two shapes for the same rhythm.

Three timing formulas



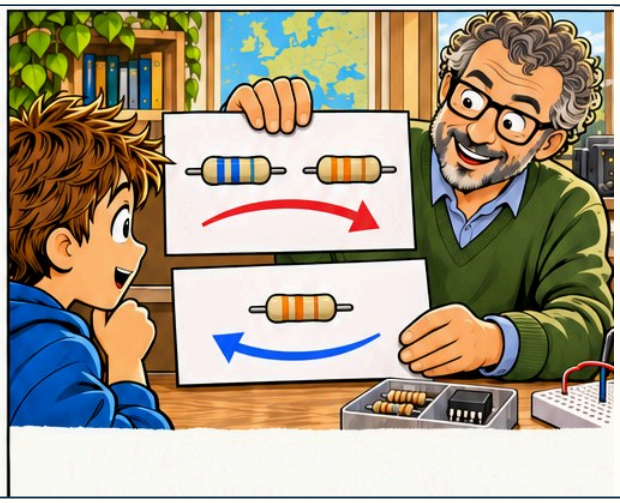
Henri writes the approximations: tH = 0,693 × (RA + RB) × C; tL = 0,693 × RB × C.



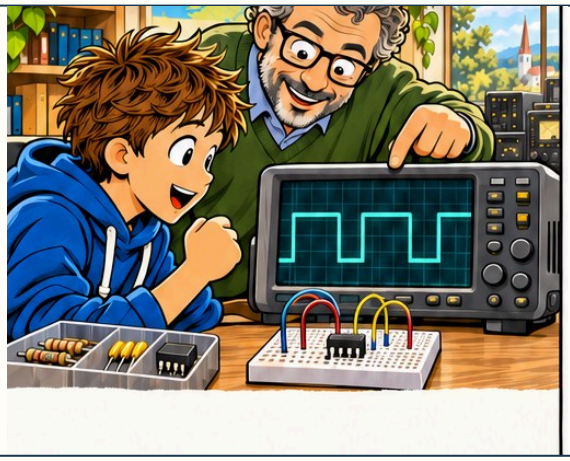
The duration of a cycle is T = tH + tL. The oscillation frequency is f = 1/T.



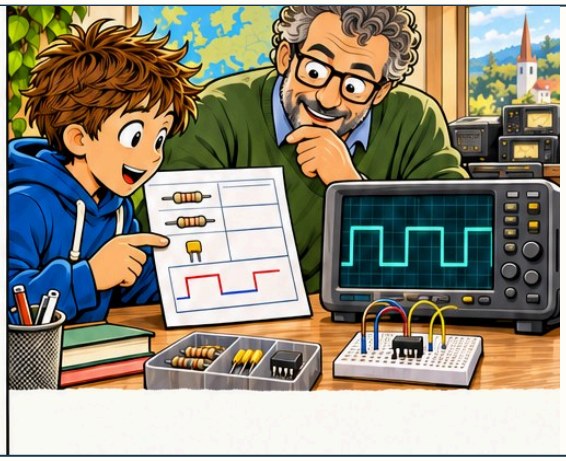
We also use f ≈ 1,44 / [(RA + 2RB) × C]. The resistances are in ohms, C in farads.



"Why double RB? " Lucas finds RB in charging and discharging.



In this classic astable circuit, the high interval exceeds the low interval: it is not exactly 50 %.



The calculation predicts the nominal operation. Tolerances and actual circuitry will decide the measurement.

A tone close to 700 hertz



For RA = 10 kΩ, RB = 100 kΩ and C = 10 nF, they find tH ≈ 0,762 ms.



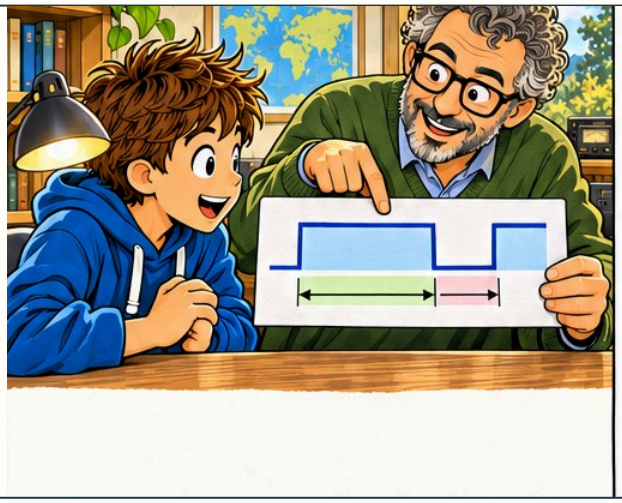
The low interval is about 0,693 ms. The period is therefore close to 1,46 ms.



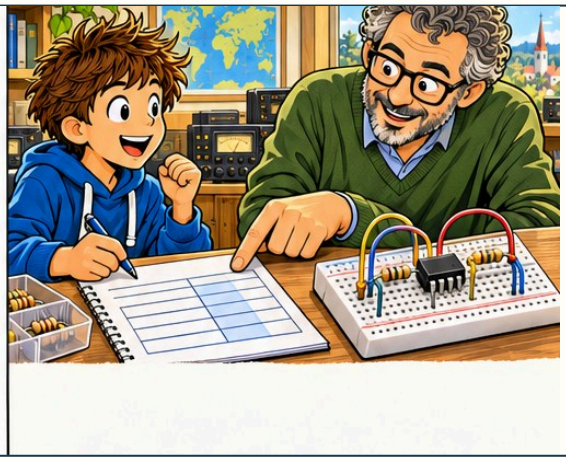
The formula using 1,44 gives about 686 Hz; using the rounded timing coefficients, about 687 Hz: similar results.



"We had aimed for around 700 Hz, not a guaranteed audio tone to the nearest hertz," recalls Henri.



The nominal duty cycle is (RA + RB)/(RA + 2RB), or approximately 52,4 %.



Lucas keeps the units and rounding visible. He will compare this prediction with the actual circuit.

The first power-up



They install the tools, check the plan again and turn on the power with the planned current limitation.



The indicator light appears to be on continuously: near 700 Hz, the eye cannot distinguish each pulse.



"It does not blink!" — "Your eye is slower than this circuit. Let us look for different evidence."



Henri connects the probe ground to the assembly ground, on this verified isolated power supply.

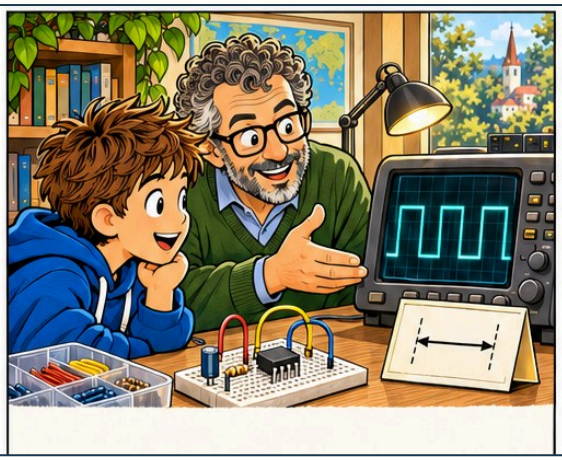


The probe tip goes to output 3. The oscilloscope displays rectangular pulses: the oscillator is working.



Lucas smiles: "The light gave me a clue, but not the whole answer."

Observing two different voltages



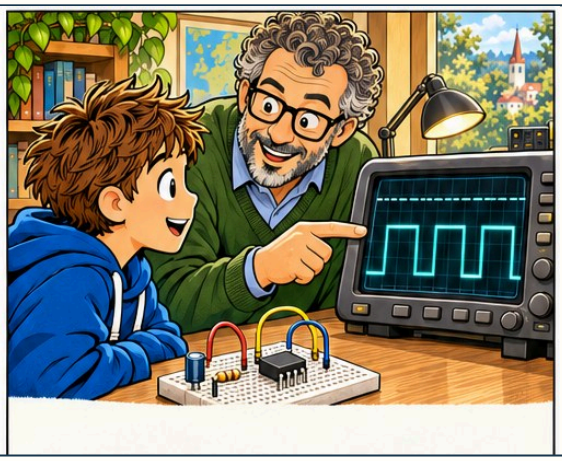
At output 3, they observe the high and low intervals. The measured oscillation frequency remains close to the calculation.



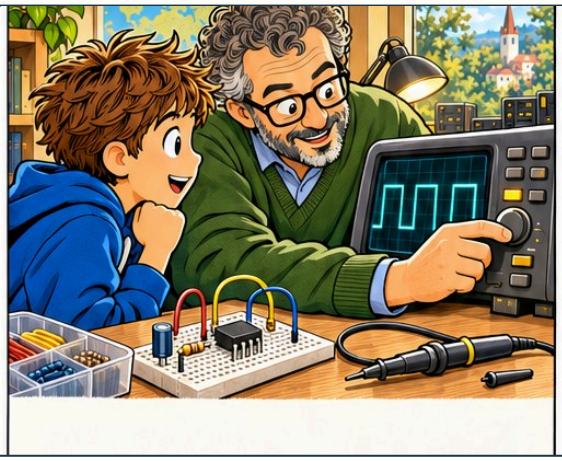
On capacitor C, the voltage rises and falls between the two expected thresholds.



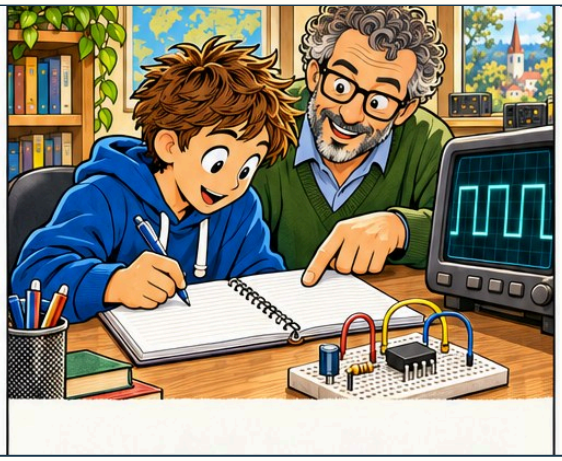
The two traces are different. Lucas always checks which point his probe is measuring.



The bipolar output does not necessarily reach 5 V under load. They avoid confusing logic level and perfect voltage.



The probe and instrument can affect the voltage being measured; Henri selects suitable measurement settings.



The notebook accommodates a separate forecast and observation. No observed value is invented in advance.

Why measurement differs from calculation



"I expected exactly the calculated oscillation frequency!" Henri points out the resistor and capacitor tolerances.



A slightly larger C slows down the oscillation. Component errors can be combined.



Thresholds, leakage and temperature add their effects. The formulas remain useful approximations.



With power off, they change one parameter at a time, then switch on again to measure.



Lucas compares two identified capacitors. He describes the observed trend without claiming fictitious precision.



"Understanding the gap is better than correcting a random number," he concludes, closing the notebook.

A knob to choose the tone



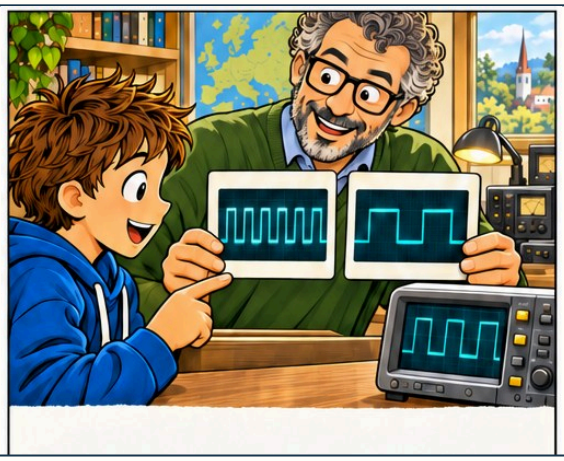
To adjust the tone, they replace RB with 47 kΩ in series with a potentiometer of 100 kΩ.



The potentiometer slider connects to the end terminal in use: the potentiometer is wired as a variable resistor.



The fixed resistor of 47 kΩ maintains a minimum resistance. RA remains at 10 kΩ.



With C = 10 nF, the nominal oscillation frequency ranges approximately from 474 Hz to 1 385 Hz.



"A useful setting, not a magic button." They cut the power to change the wiring.



After switching on again, Lucas chooses a comfortable tone. He marks a starting setting on the front panel.

Then suddenly, no more rhythm



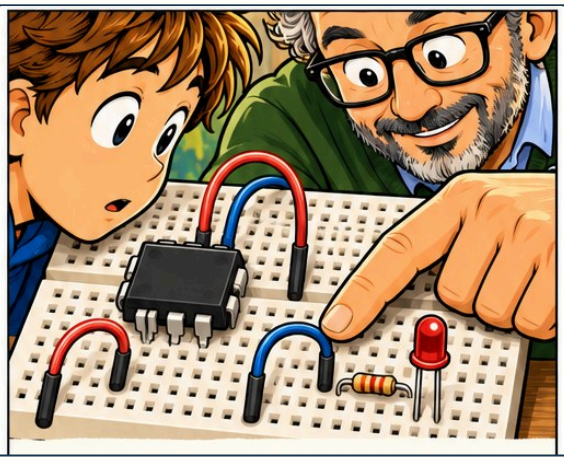
When Lucas moves the solderless breadboard, the waveform disappears from the oscilloscope. The indicator stays off.



“Is the 555 dead?” Henri suggests starting with what they can observe.



They turn off the power and compare the actual wiring to their plan, without randomly replacing parts.



A jumper wire has slipped one row too far. Pin 4 is no longer connected to the intended high level.



Lucas sees the link between RESET and the output: an undefined input can stop the circuit working.



They fix the connection, then prepare for another test. The breakdown finally has a verifiable explanation.

Troubleshooting in the right order



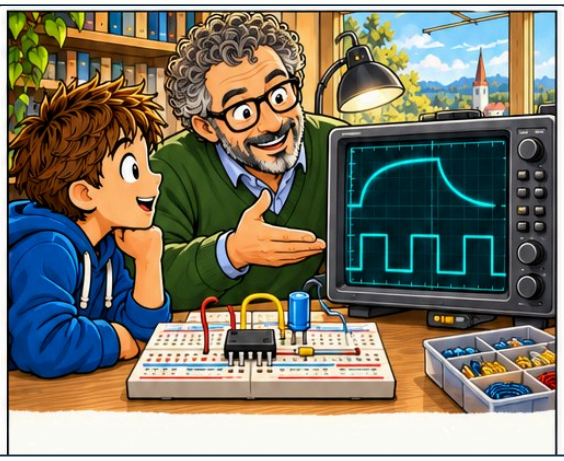
Henri suggests a routine: supply, ground, package orientation, RESET, timing components and output.



Lucas first checks the voltage between 8 and 1. A measurement elsewhere could mask a poor connection.



They inspect split rails, loose wires and the position of every pin.



Once they observe the voltage across C, they can better tell whether the fault is in the oscillator or a later stage.



Connections are corrected when powered off. Measurements are prepared before restoring power.



Lucas draws a diagnostic path: each question must reduce the number of possible causes.

A fault becomes a lesson



After the correction, pin 4 has its defined level. The circuit produces rectangular pulses again.



"We had a hypothesis, a check and a repair," summarizes Lucas. Henri lets him explain.



They gently pull on the jumper wires, with the power off, to identify loose connections.



Lucas stores excessively long wires and frees access to measuring points.



The notebook records the breakdown and its cause. A visitor will be able to learn from this incident without repeating it.



The rhythm is back. Now they must make it audible without asking the NE555 to drive the speaker directly.

A speaker is not a LED



Lucas moves the speaker towards output 3. Henri gently stops him: "Let us check the load it presents."



A small low-impedance speaker needs current that this circuit should not supply directly.



The NE555 sets the rhythm here; an audio amplifier module compatible with 5 V supplies the sound energy.



They choose a module whose input accepts this signal after coupling and adjustment of the level, according to its instructions.



The speaker will connect to the terminals provided by the module. Some outputs must not be grounded.

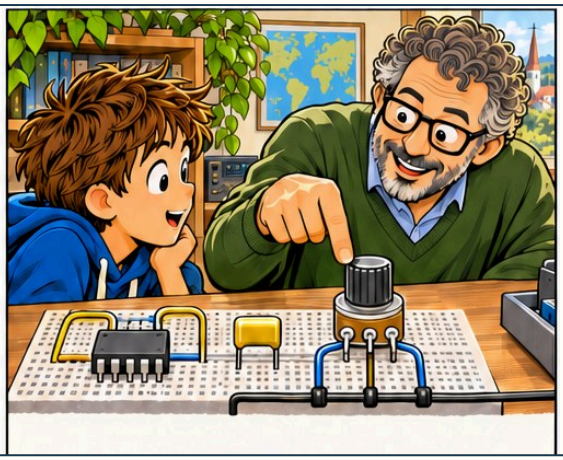


Lucas redesigns three blocks: oscillator, level adjustment, amplifier. Each element has its job.

The path of sound



With the power off, output 3 connects to a non-polarized 100 nF coupling capacitor.



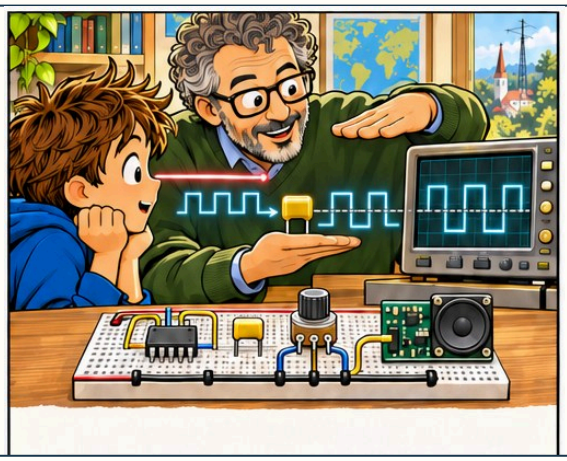
The other terminal connects to the top of a 47 kΩ potentiometer; its bottom connects to common ground.



The potentiometer slider connects to the high-impedance input of the chosen audio module. Its instructions confirm this connection.



The module and the NE555 share ground; the module receives its power according to its documentation.



The coupling capacitor blocks the output's DC component while allowing audio variations to pass.



They turn the volume to minimum before the first try. Lucas has not yet connected any headphones.

Finally, the first sound



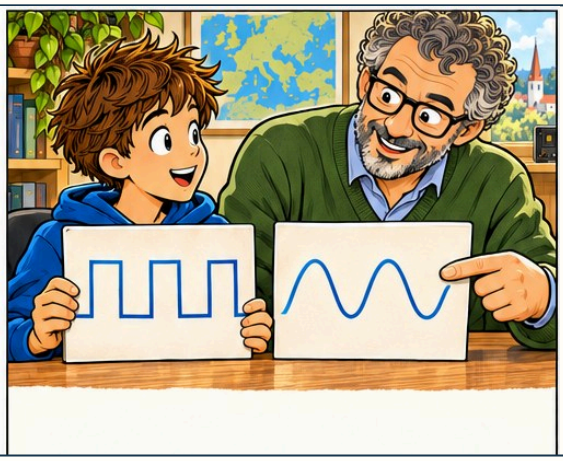
When power is turned on again, Lucas slowly increases the volume. A clear audio tone fills the small corner of the workshop.



"It sings!" Henri asks him to compare the sound he hears with the waveform on the oscilloscope.



They first adjust the oscillation frequency, then the audio level. Two buttons, two different effects.



The rectangular waveform contains harmonics: it does not have the timbre of a pure sine wave.



The volume remains comfortable for the table. They do not plug headphones directly into the output of the 555.



Lucas closes his eyes for a moment: the little curve of his notebook has become an experience that he hears.

The key must control the sound



The sound is continuous. “The key must enable it while pressed,” suggests Lucas as he switches off the supply.



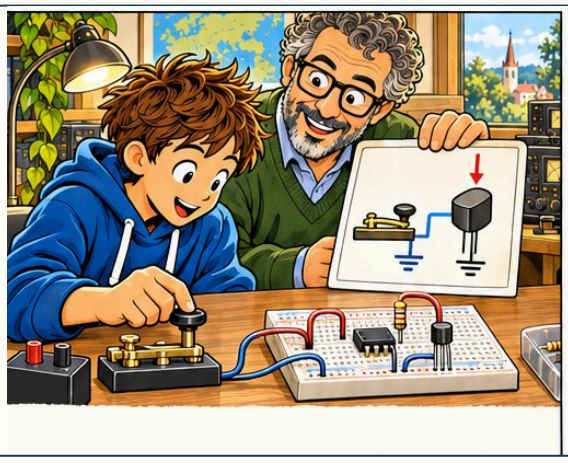
They remove the direct connection from RESET to +5 V. A resistor of 4,7 kΩ now connects RESET, pin 4, to +5 V.



An NPN 2N3904 has its collector connected to RESET and its emitter to ground; they check its actual pinout.



A 10 kΩ resistor connects the base to +5 V. At rest, current flows through the NPN, which holds RESET low: silence.



The key connects the base to ground: pressing it turns the NPN off; RESET goes high and the tone starts.

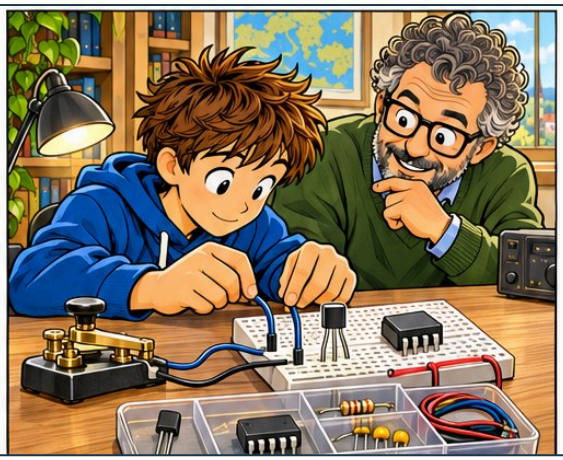


“The transistor inverts the key command!” They trace both states on the diagram before testing.

One press, one audio tone



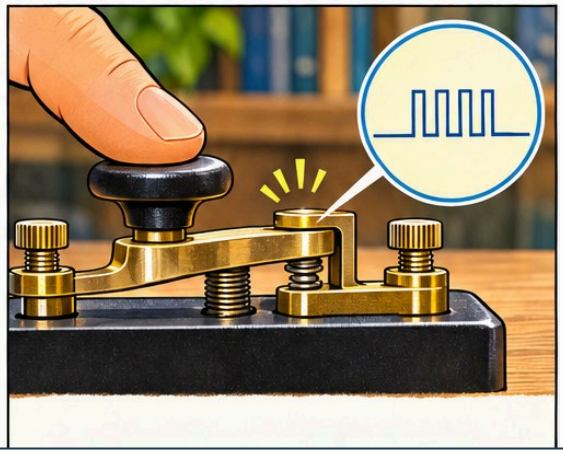
The key remains isolated from any radio station. Its two terminals are used only for our low voltage control.



One wire goes to the NPN base, the other to ground. Lucas checks the terminals and the pull-up resistor.



They switch on: silence at rest. Lucas presses the Morse key: the tone starts. He releases the key: it stops.



"It follows my movement!" Mechanical contacts can nevertheless bounce and produce small clicks.



Henri keeps wires short. The key cable should not become a large loop that picks up disturbances.

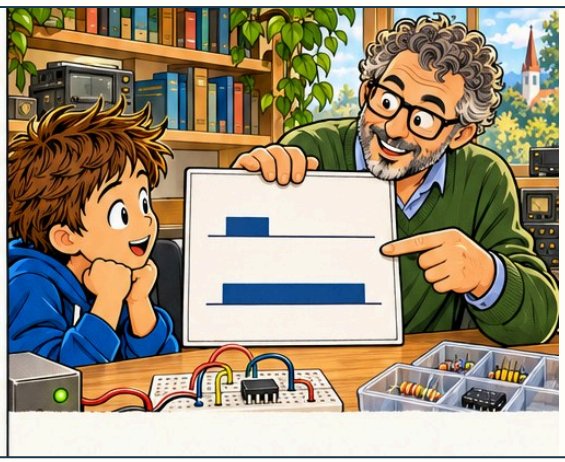


Lucas slowly repeats three presses. For the first time, the circuit responds to his finger.

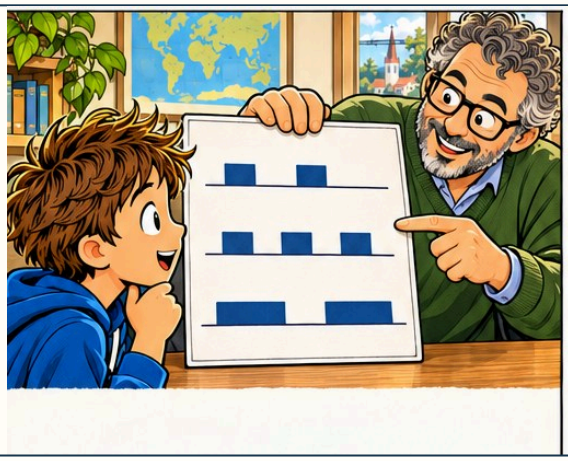
Morse code is also silence



Lucas taps too quickly and mixes everything up. Henri suggests slowing down and listening to the spaces.



A dot lasts one unit; a dash lasts three. Leave one unit between elements of the same character.



Between two characters, the space is worth three units; between two words, seven units in the reference rhythm.



“So silence is part of the message!” Lucas draws a strip with sounds and pauses.



Henri chooses a steady pace instead of a speed contest. The trainer cannot correct the operator’s movements by itself.



They use a short pattern. This time, Lucas hears where one character ends before the next one begins.

Learning together



Henri plays a small pattern; Lucas tries to reproduce it. They then exchange roles.



A hesitant response provokes a smile, not a judgment. They are looking for the passage that has been misunderstood.



Lucas discovers that changing the tone can make listening more pleasant without changing the Morse timings.



Volume does not replace attention or readable rhythm. They keep it low enough to speak calmly.



The notebook includes a short session and breaks. The open day should encourage visitors to try.

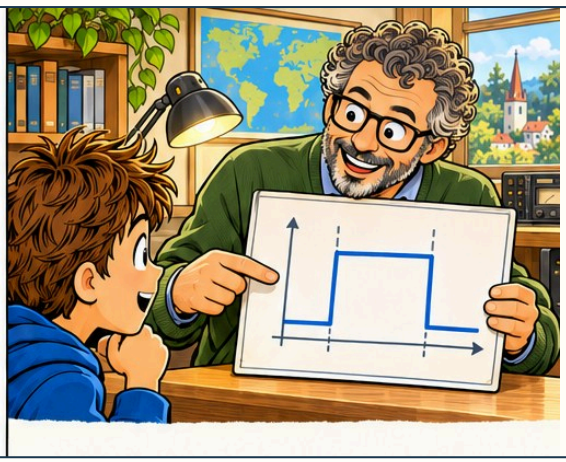


"I'll show you how to listen first," Lucas decides. Henri recognizes a lesson from their first adventure.

A little click between notes



When the sound begins, they hear a small click. “The switching is abrupt,” explains Henri.



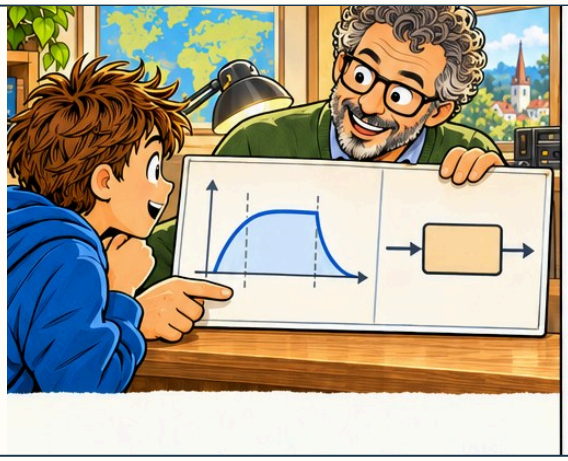
The signal starts and stops without a softened envelope. Audio coupling does not remove all of these transients.



Lucas also checks that the module does not saturate: too high a level can make the sound unpleasant.



They lower the level and observe the signal. Changing several things at once would confuse the diagnosis.



A progressive envelope control would require an additional stage, studied and tested separately.

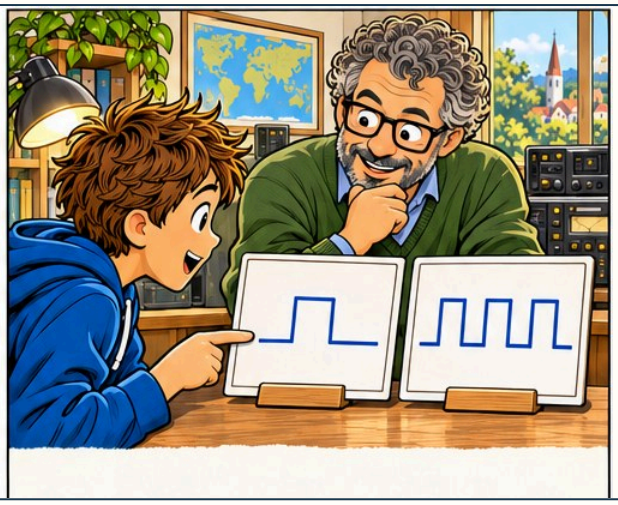


For this trainer, they use a comfortable setting and honestly report this limit in the instructions.

A second experiment: a single pulse



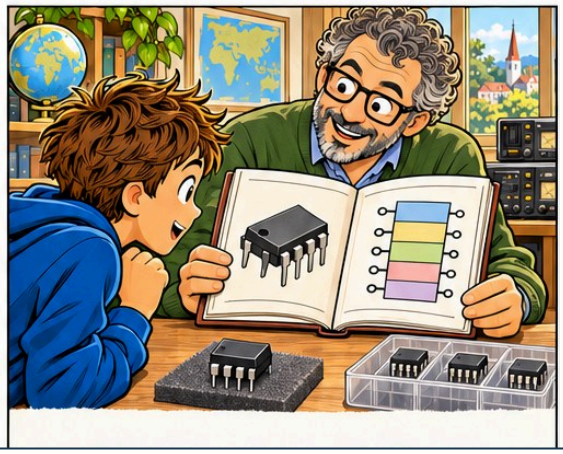
Lucas imagines a light that stays on briefly after a press. Henri suggests a monostable circuit.



Unlike the astable, it waits for a trigger, produces a pulse, then returns to rest.



They prepare another solderless breadboard to keep the Morse trainer intact. The two experiments will remain separate.



The same NE555 can perform this function with different wiring. Lucas takes out its pinout diagram.



The nominal duration depends mainly on a resistor R and a capacitor C: T ≈ 1,1 × R × C.



“Continuous sound or a single interval: the same package, a different story!” He prepares a new test.

The monostable circuit diagram



On this second solderless breadboard: 1 to ground, 8 and 4 to +5 V; the same decoupling precautions apply.



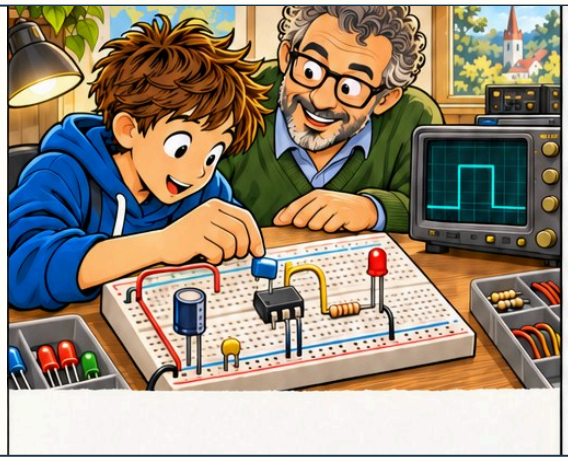
Pins 6 and 7 are connected to the same node. R = 100 kΩ connects this node to +5 V.



C = 10 µF connects this node to ground, with its positive terminal on the 6–7 side for the chosen component.



Pin 2 has a pull-up resistor of 10 kΩ to +5 V and a test push-button to ground.



Pin 5 receives 10 nF to ground; output 3 drives an LED through its resistor of 2,2 kΩ.



Lucas distinguishes this diagram from the astable circuit. “Here, 2 is not connected to 6!” Their check prevents confusion.

A short press to trigger the pulse



At rest, pin 2 is high and the output is low. The timing capacitor is discharged.



A brief press pulls TRIG below one third of VCC; the output goes high and C begins to charge.



Lucas releases the button immediately. The trigger must end before the intended timing interval.



If TRIG remains low, the end of pulse behavior is no longer that of a correctly prepared short trigger.



“Holding the button is therefore not a good way to measure T! ” They start again with a short press.



An automatic input would need a clean trigger signal compatible with the datasheet limits.

About a second, not a clock



With R = 100 000 Ω and C = 0,000 010 F, T ≈ 1,1 × 100 000 × 0,000 010 = 1,1 s.



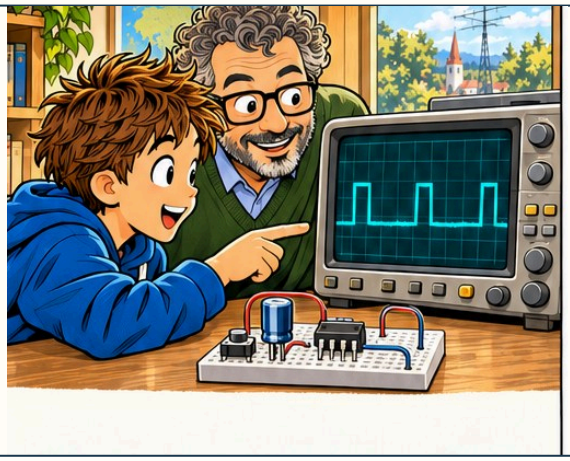
Lucas triggers the timer once, then observes the indicator light coming on and going off.



The 10 µF capacitor has tolerance and leakage. The actual interval can differ from the nominal calculation.



For long and precise durations, this simple RC is not necessarily the best choice.



They measure several pulses with a suitable instrument, without transforming their tests into a guarantee of precision.



Lucas writes: "Timing an action, yes; replacing a reference clock, no."

Controlling a demonstration relay



Henri suggests a small relay with a 5 V coil that consumes about 20 mA, to demonstrate indirect control.



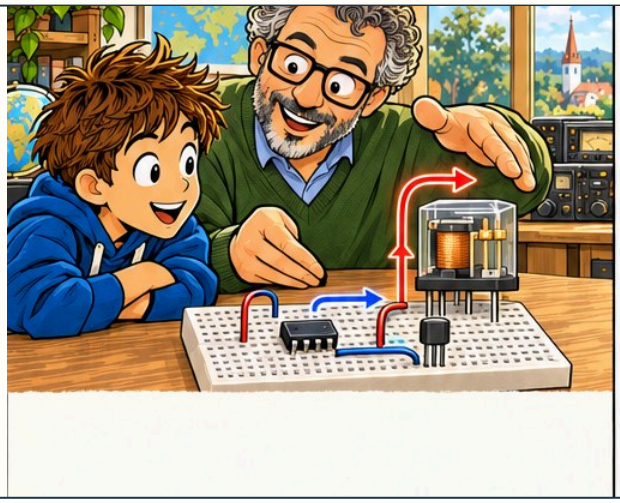
Output 3 connects to the base of a suitable NPN transistor through 1 kΩ; a resistor of 10 kΩ connects base to emitter.



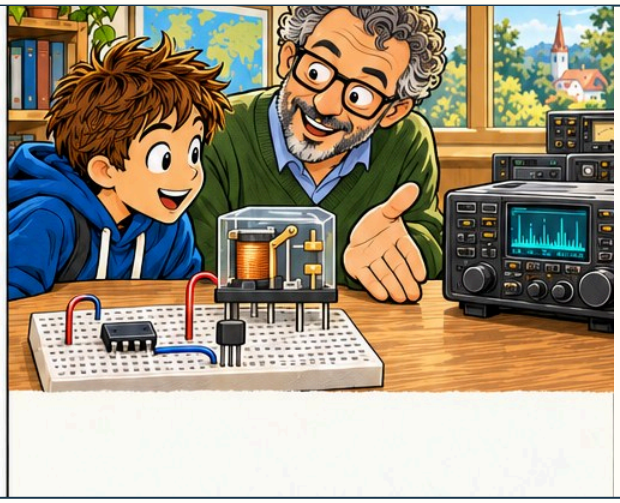
The transistor emitter goes to ground; the collector to one coil terminal; the other coil terminal to +5 V.



They check the transistor's actual pinout and permissible current in its datasheet: NPN devices are not all identical.



The output of the 555 drives the base, while the transistor switches the coil current.



The relay contacts remain unloaded during this test. No radio PTT input is connected.

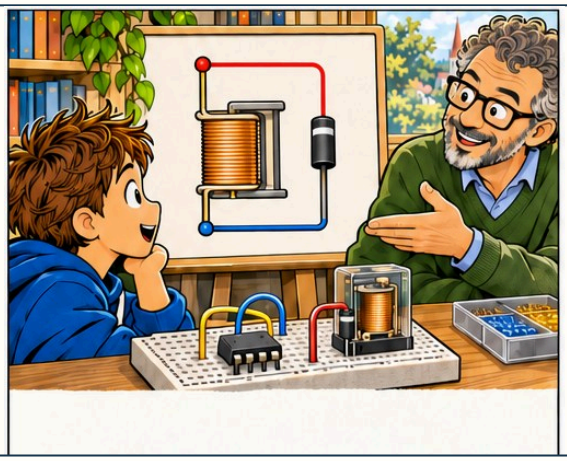
The diode that protects the coil



"A component is missing beside the coil," says Henri. Interrupting an inductive current can cause a voltage spike.



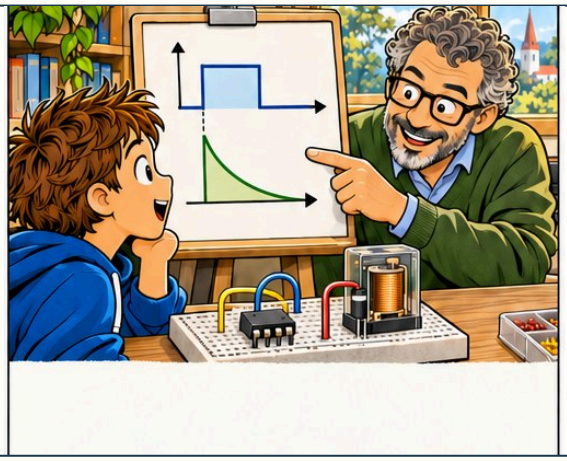
A 1N4007 diode is placed in parallel on the coil: cathode to +5 V, anode to the collector.



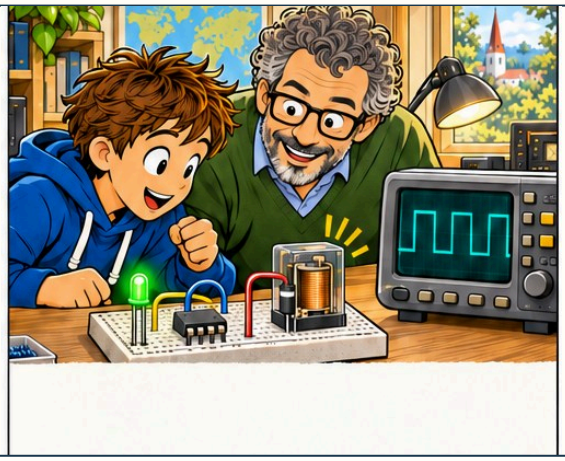
During normal operation, the diode is reverse-biased. At switch-off, it provides a path for the coil current.



Lucas marks the cathode ring before plugging in. A reversed diode would be a fault, not protection.



This freewheeling path also slows the relay's release. The choice of protection depends on the application.



They check the wiring with the power off, then trigger the monostable. The small mechanical click follows the indicator.

A radio idea, with its interface



Lucas thinks of timing a station accessory. Henri first asks him to read its instructions.



A PTT control or accessory may require very specific isolation, polarity and levels.



The demonstration relay does not become a universal interface. Contacts also have limits.



They only draw a timing function, separated from the station by an interface block to study.



"We won't try it on a station to see what happens," Lucas decides, putting away the cable.



Their test demonstrates a control principle. A real application will need its own design and validation.

Contacts that bounce



Lucas observes irregular details when the key is pressed. A mechanical contact can bounce several times.



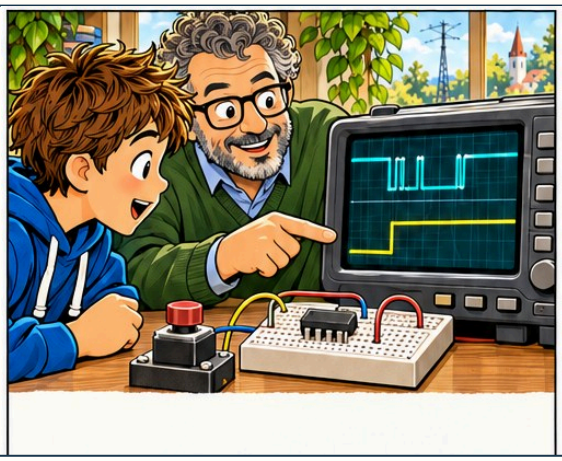
"One movement does not always produce one electrical edge," Henri explains with a waveform.



A 555 can help with debouncing, but an arbitrary monostable does not eliminate every troublesome case.



The selected interval, trigger waveform and start-up state must suit the application.

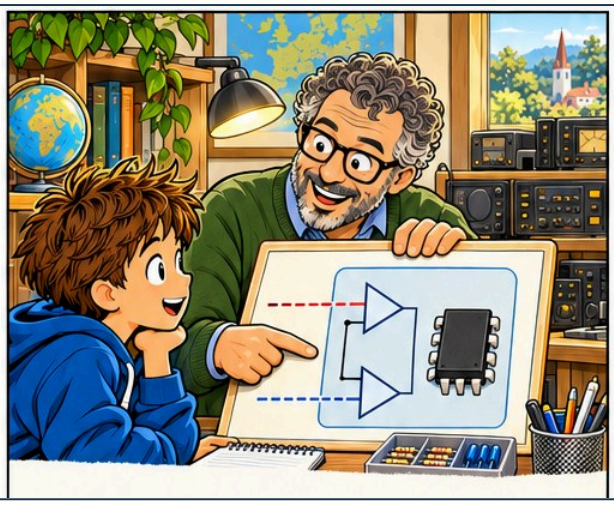


They observe input and output together before judging the result. The indicator alone can hide details.



Lucas adds a question to his file: "What signal really enters my circuit? "

Two thresholds to prevent hesitation



Henri connects pins 2 and 6 to introduce a Schmitt trigger using the 555.



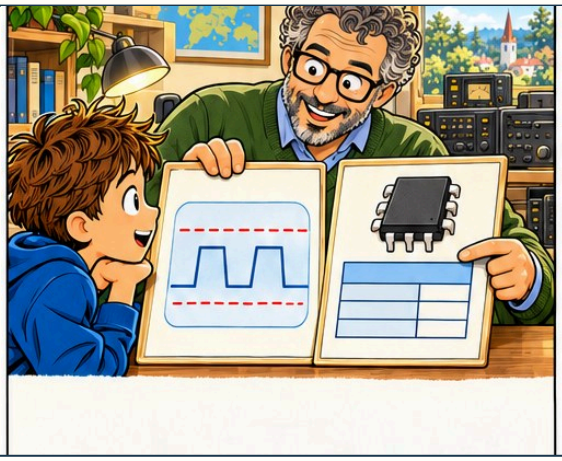
This time, a suitable test voltage controls this node; pin 7 is not used in the demonstration.



Going below approximately VCC/3, the input controls a high output. By rising above 2VCC/3, it makes it low.



Between the two thresholds, the previous state is preserved. This hysteresis avoids certain hesitant switching.



The applied voltage must stay within the permitted limits. An arbitrary signal cannot be connected directly.



Lucas follows a slow rise then a descent in the drawing. He understands why both thresholds matter.

Remembering a state: the bistable



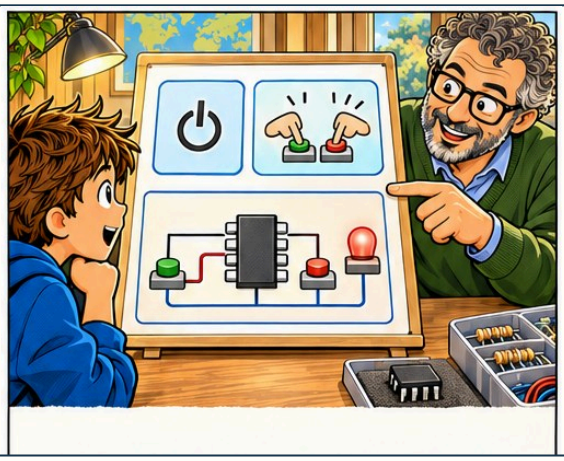
Lucas suggests a warning light that stays on until a stop command. Henri introduces bistable operation.



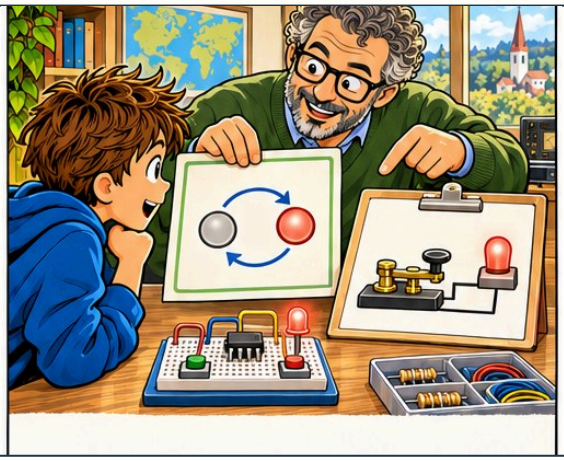
In a suitable circuit, TRIG commands the high state; RESET can force the low state.



Inputs must maintain defined levels. THRES must not cause unintentional switching.



Start-up behaviour and simultaneous commands must be considered: a memory circuit cannot guess the intention.



They keep this application at the block diagram stage, without adding it to their Morse trainer.

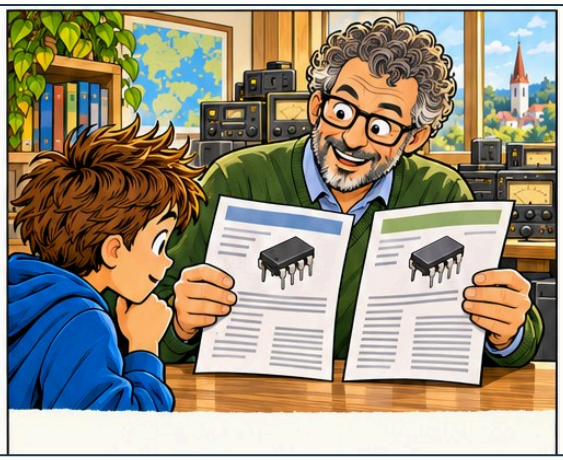


"Oscillating, timing, remembering: I finally see the difference," says Lucas beside his three cards.

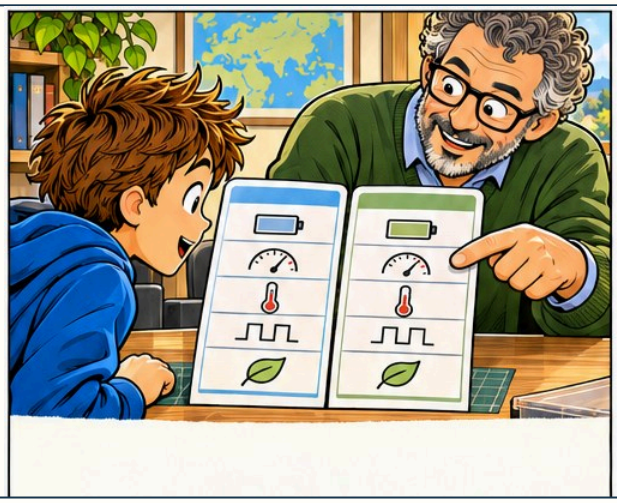
The CMOS cousins



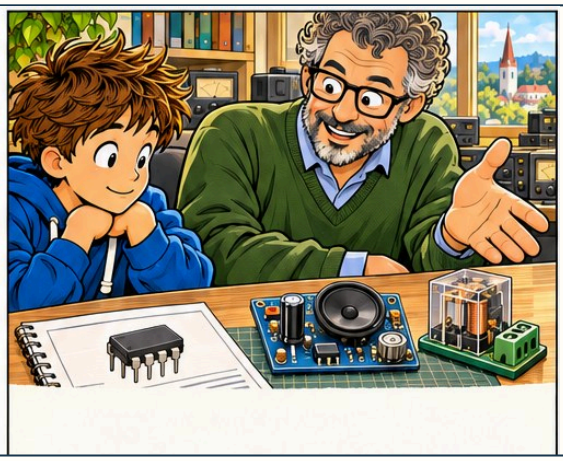
On another package, Lucas reads TLC555. “The same number: exactly the same component?”



Henri compares the datasheets: some CMOS versions draw less quiescent current and accept different supply ranges.



Output currents, guaranteed thresholds and absolute limits may be different.



A pin in the same location does not guarantee the same behavior with our audio module or relay.



The decoupling recommendations and input characteristics remain to be verified for the chosen reference.



They keep the specified NE555 in the device. Lucas now knows how to assess a sensible replacement.

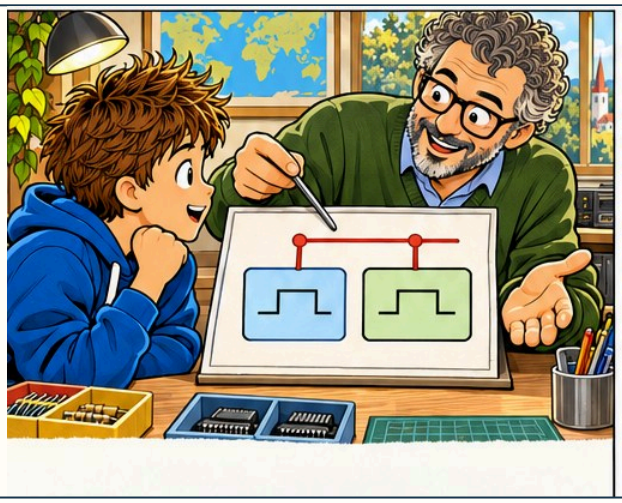
Two timers in one NE556



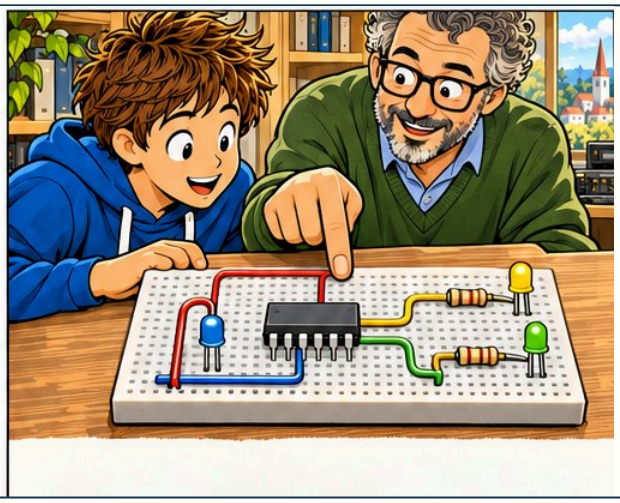
The NE556 combines two timers in one package. Lucas imagines separate tone and timing functions.



Henri shows the pinout: this fourteen-pin package must not be wired as two NE555s from memory.



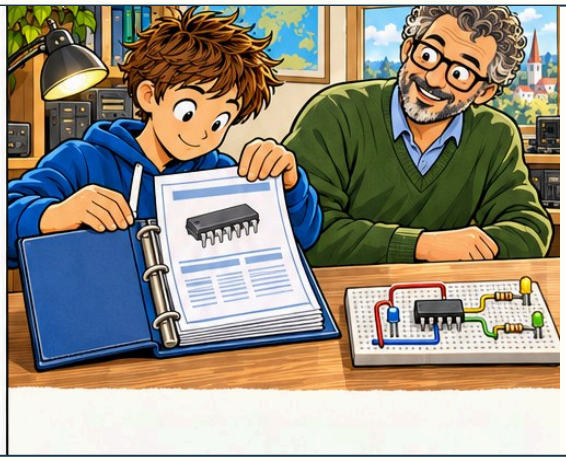
Each section has its own inputs and output. The two sections share the power supply.



Careful decoupling and routing helps prevent one section from disrupting the other.



They sketch an educational two-block siren, while keeping this album's build focused on their current project.



"More functions also require more checks," notes Lucas while putting away the NE556 sheet.

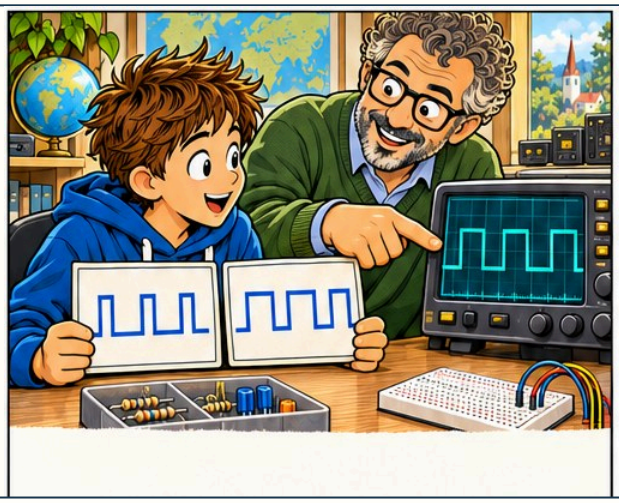
Pin 5 and the idea of modulation



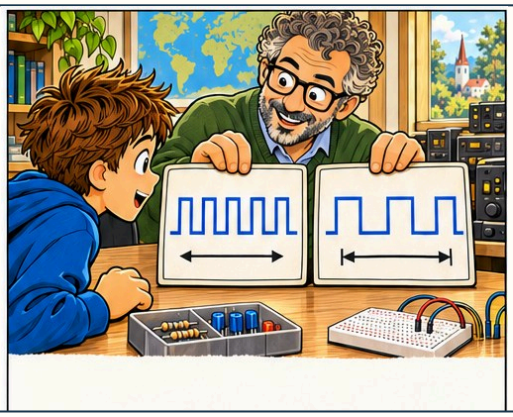
Lucas returns to CONT, pin 5. "Can we vary the behavior of the circuit? "



Henri explains that a suitable control voltage moves the internal references.



Depending on the circuit, this can modulate pulse width or vary the oscillation rate.



In this simple astable, changing the references can also change the oscillation frequency: PWM is not automatically independent.



A proper PWM controller is selected and designed for its load, with an appropriate power stage.



They keep this principle for further study. No motor or heavy load is added to output 3.

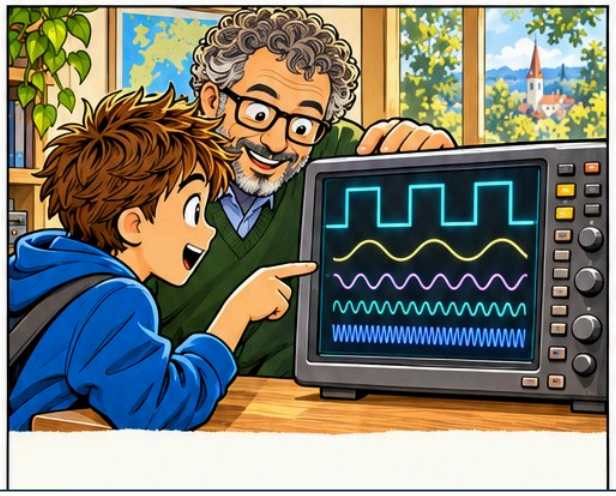
The trap of the universal radio generator



"What if our 555 became a transmitter? " Henri distinguishes audio oscillation frequency and stable radio carrier.



The NE555 is suitable here for a tone and time delays. Its RC is not a precise RF reference.



The rectangular signal contains harmonics; a wire that is too long can carry disturbances.



A laboratory oscillator does not become a suitable transmitter merely by adding an antenna.



A radio experiment would need a design covering stability, impedance matching, filtering and permitted use.



Lucas therefore leaves the antenna aside: their device already provides a real service by remaining a local trainer.

When the oscillator interferes with reception



While listening at the club, they notice a noise that changes when the trainer is switched on.



"A coincidence? " They compare on and off several times, without changing the receiver settings.



Repeated comparisons give a clue, but do not yet identify every interference path.



They move the assembly further away, shorten the connections and check the decoupling before doing the comparison again.



Henri distinguishes the useful sound in the speaker from unwanted interference escaping from the circuit.



Lucas finds a rule from volume 1: sharing the spectrum also means taking care of what we build.

Compare to understand



They only change one thing: the position of the audio cable. Then they compare on and off again.



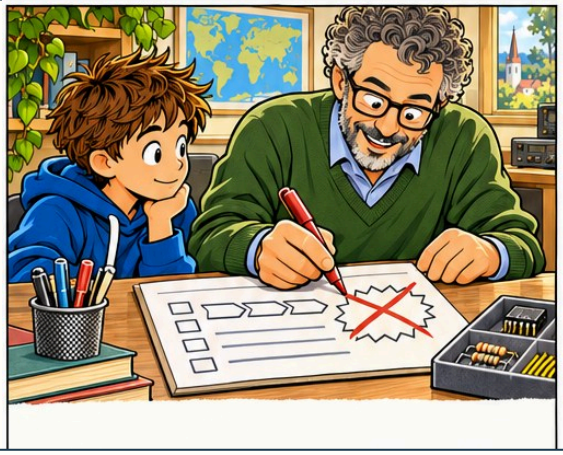
Lucas records the distance, wiring and power supply used. Without these details, the next test would be hard to compare.



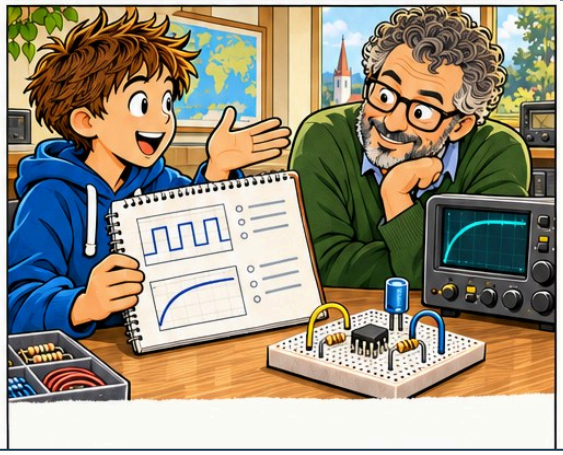
A local improvement does not prove that the entire spectrum is clean. Their receiver is not a complete laboratory.



A compact and correctly decoupled final assembly will be preferable to the prototype spread over long wires.



They do not claim compliance or measurements that they have not established.



“I can explain what I tried and what remains to be verified,” says Lucas. Henri approves of his method.

What about battery operation?



Lucas dreams of taking the trainer to the garden. They start by estimating the overall consumption.



The audio module, volume setting and speaker matter as much as the timer when estimating battery life.



The battery must feed a suitable regulator to maintain the specified 5 V; they follow its documentation.



A source capable of supplying a lot of current requires suitable protection against short circuits.



Henri suggests finishing the isolated power supply version first. The portable requirement will be documented separately.

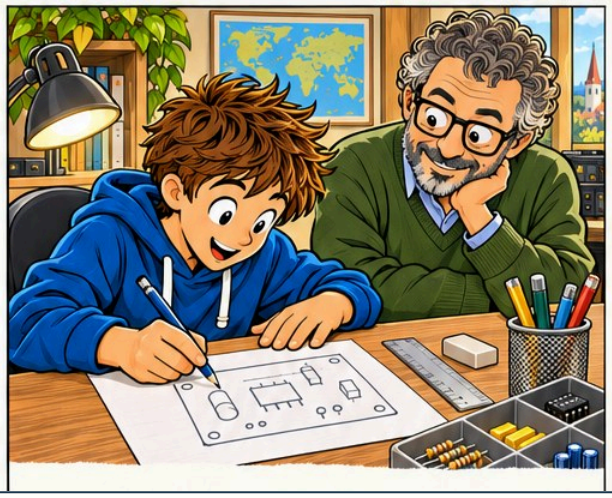


"Battery life cannot be promised from the capacity printed on a battery alone," concludes Lucas.

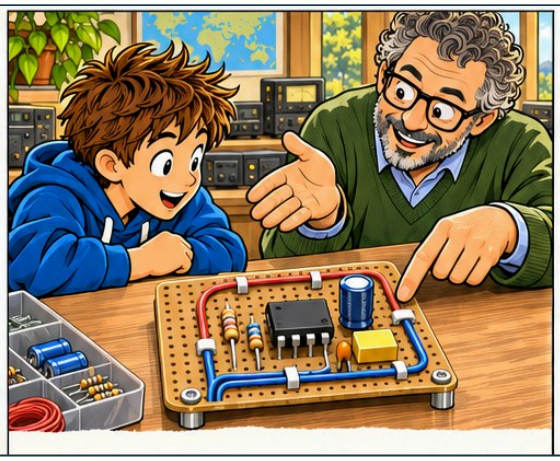
Preparing a durable assembly



The solderless breadboard was useful. For the open day, they must avoid jumper wires coming loose.



They prepare a compact layout plan, with access to controls and test points.



Decoupling stays close to the 555; audio return currents must not take a detour through the timing circuit.



The key and speaker cables have strain relief. Connections must not carry the pull of a cable.



Henri supervises fabrication using suitable tools and protection, outside this reading workshop.

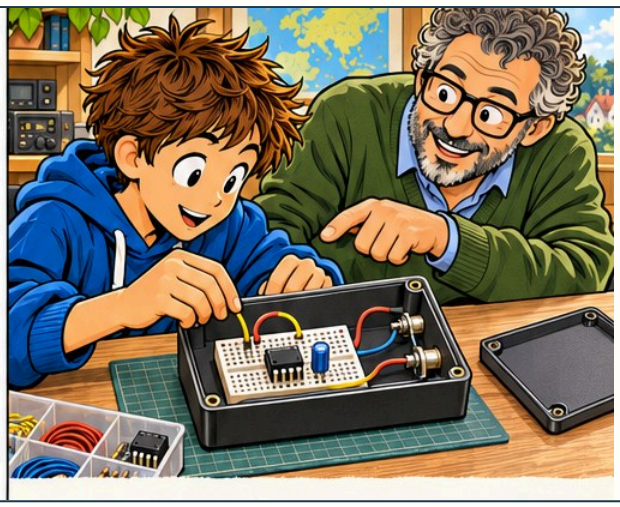


Lucas then checks continuity, polarities and the diagram before restoring power.

An electronics enclosure that explains its use



Lucas chooses a simple front panel: power, tone, volume and key socket clearly identified.



The circuit is fixed in a suitable box; no bare wire touches a conductive part.



Cable routing is protected. They check that turning a knob does not pull on the connections.



The intended power supply and its polarity will be indicated on the instructions and near the appropriate connector.



The key controls only this trainer; a similar-looking socket does not authorize a connection to a radio station.



Lucas tries the device without an explanation. The controls should be obvious to the next visitor.

Instructions for the next beginner



In the instructions, they explain the goal: to learn the Morse rhythm with a local sound, without transmitting.



The schematic shows the pins, component values, power-supply connections and the two states of the key.



The component list distinguishes timing, coupling and decoupling capacitors.



They add nominal calculations, limitations, component references and measurement points.



A short page describes the misplaced jumper wire and their troubleshooting method. Mistakes belong in the story too.



Lucas rereads the instructions as if he were visiting the club for the first time. He simplifies another sentence.

The dress rehearsal



The day before the open house, Henri sits in a visitor's seat. Lucas presents his workshop.



"First listen. Then try. And finally explain what changes when you turn this knob. "



He distinguishes tone, volume and rhythm. Henri asks a deliberately simple question.



Lucas shows the three blocks in the notebook, then lets his rehearsal visitor operate the key.



A audio tone is missing in the middle of the pattern. They exchange a look: the little device still has a surprise in store.



Lucas keeps calm and lowers the volume. He has just returned to his role as investigator.

The last mystery



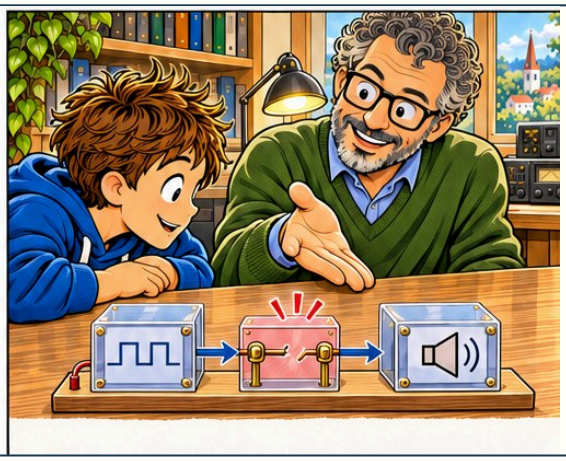
This time the rhythm circuit still works: output 3 shows pulses when the key is pressed.



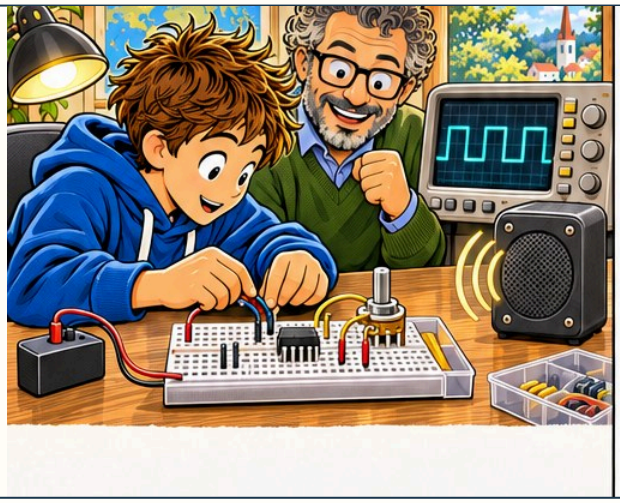
Lucas checks the power supply, then the audio chain. He does not replace the NE555 as a reflex.



With the power off, he finds a loose wire in the connection to the volume potentiometer slider.



"The rhythm was there; the sound no longer reached the amplifier! " The separation into blocks guided him.



They repair the connection and check that it holds. Another test produces a steady tone.



Henri resumes his visitor's seat. Lucas adds a connector check to his preparations.

Open Day



In the morning, the small electronics enclosure waits on a clear table. Lucas sets a gentle volume and a comfortable tone.



He begins by playing a pattern. Henri watches him give everyone time to understand.



The visitor tries the key. A hesitant sequence becomes steadier after a pause and another listen.



Lucas opens his notebook: “NE555 makes the audio tone; it’s your gesture that gives it a rhythm. ”



He shows the capacitor voltage rising and falling, then returns to the sound they hear. Theory meets experience.



A smile is enough to say that the workshop is working. Henri now lets Lucas guide the discovery.

What eight pins have taught us



After the workshop, Lucas finds the three cards again: oscillating, timing and remembering.



He adds the transistor that helps drive a load and the diode that protects the coil at switch-off.



Henri asks him what he will remember most. Lucas looks at his notebook of calculations and breakdowns.



"Check the pins. Keep the units. Measure the correct point. And understand before changing. "



He also shows the instructions: an idea becomes useful when another person can pick it up without guessing.



They put away the unused components. The little black package has given rhythm to a whole day of encounters.

The next rhythm will be yours



The place regains its calm. Lucas presses the key one last time: a short audio tone, then silence.



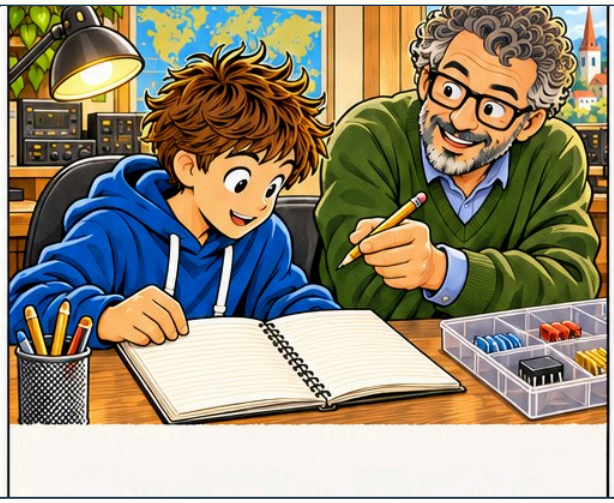
He remembers his arrival at the club and Henri's advice: listen, seek and share.



"Have we learned everything about the 555?" — "Enough to know how to ask better questions."



The trainer, its diagram and its instructions remain ready for the next beginner. Their adventure fits in a real box.



Lucas closes the notebook, then reopens it to draw a new idea. Henri hands him a pencil.



Outside, antennas stand against the sky. Inside, eight little pins have inspired a desire to experiment.