# KNOCKING PUZZLE

By [rusher](#)

The player hears a sequence of knocks. If they repeat the sequence of knocks correctly, a new sequence will play. If the player sequence is incorrect, the player will hear the current knocking sequence again.

The puzzle is solved when all sequences have been repeated correctly by the player.

- The knock-sequences can be configured by editing a text file on the SD card.
- The puzzle works with up to 10 sequences of up to 10 knocks each.
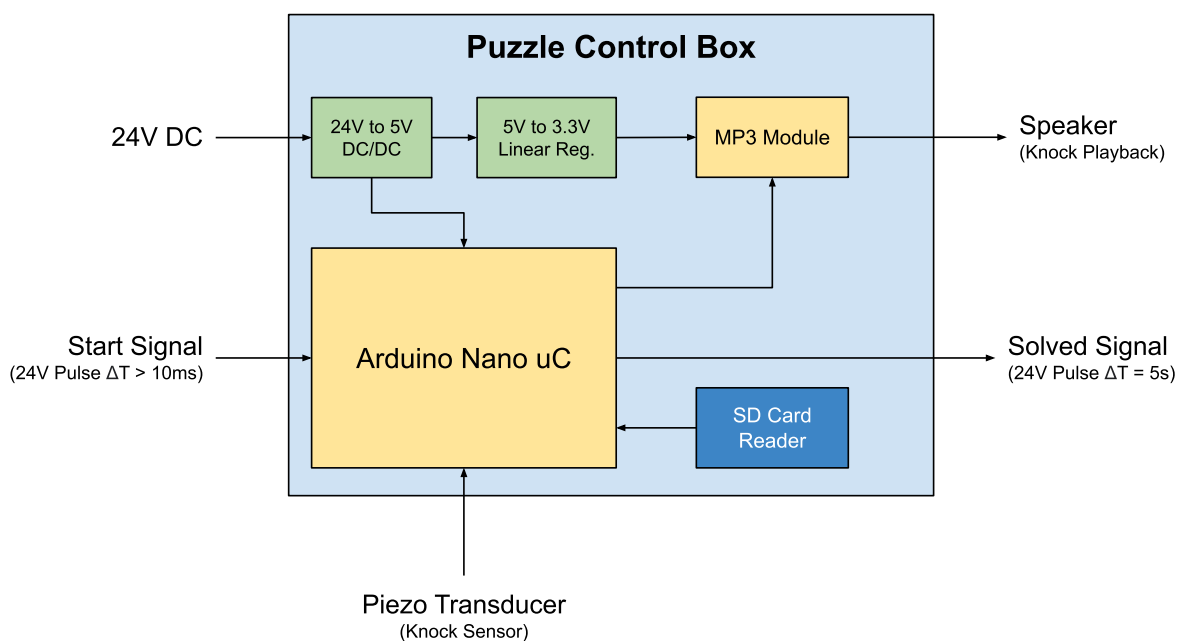
Electrical Specifications

External Voltage Supply:	24VDC (max. 36V)
Nominal Power Consumption:	2.5W
Max. Speaker Power:	3W @ 4Ohms
Signal I/O Voltage:	24VDC (24V SPS logic levels)

Control Box I/O Setup

24V/GND Connect supply voltage

SOLVED Outputs 24V Pulse $\Delta T = 5s$ indicating that the puzzle was solved, connect to SPS input

START Input 24V Pulse $\Delta T > 10ms$ to begin puzzle, connect to SPS output

PIEZO Connect to piezo transducer element

SPEAKER Connect a speaker (up to 3W) directly to the control box

SD CARD Contains preset knock-sequences, project documentation

Audio Line-Out Optional: connect to external amplifier

The START button and LEDs are for **troubleshooting** and **functional confirmation** (during normal operation the game is initiated by the 24V START signal):

- START button manually triggers knock-sequence playback
- RED LED lights up if the player sequence is incorrect
- YELLOW LED lights up if the player sequence is correct
- GREEN LED lights up if the puzzle has been solved

Functional Description
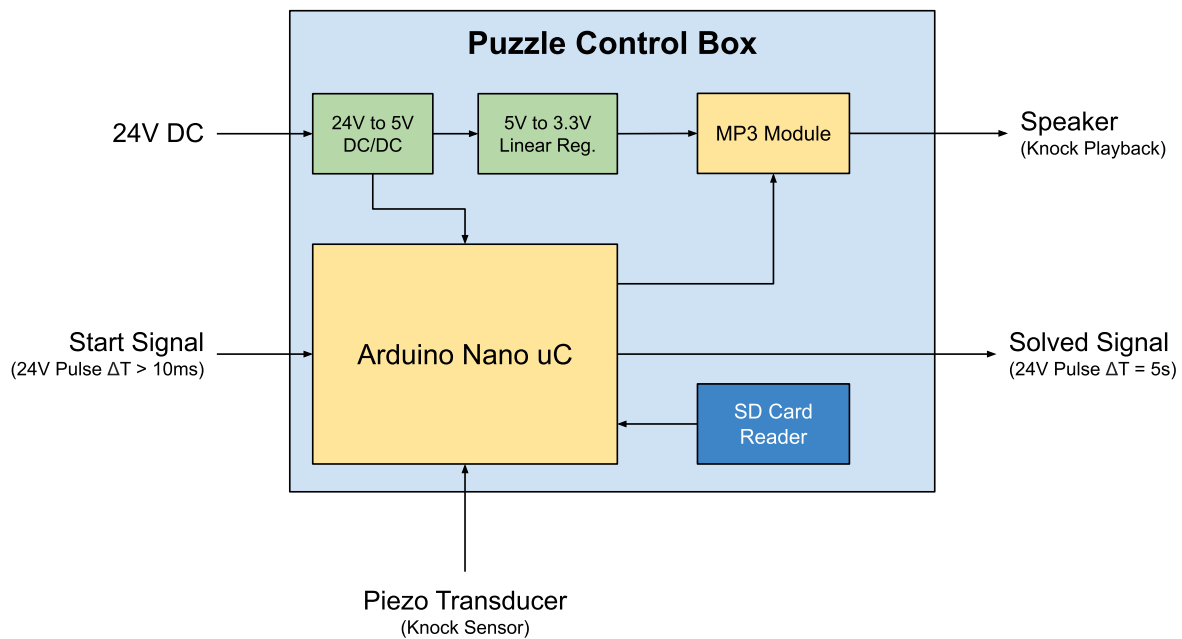
Start Puzzle

The Arduino Nano microcontroller runs the puzzle software. On boot, the uC loads the list of preset knock-sequences from the "patterns.txt" file on the SD card. After that, the system waits for the start signal pulse.

Audio Playback

The start signal pulse triggers audio playback of the first knock sequence: the MP3 module contains a single "knock" sound. The uC repeatedly triggers playback of the single knock, with longer and shorter intervals as directed by the preset knock-sequence data.

Knock Detection

After playback, the system pauses for several seconds before resuming playback of the same pattern. During the pause, players can repeat back the sequence by knocking on a designated surface.

A piezo disc transducer is mounted on the backside of the designated knock area. The mechanical shock from the knock is converted into an electrical signal and detected by the uC. The uC records the time inbetween knocks to differentiate long and short pauses, and stores the "player knock-sequence" in memory.

Pattern Matching

The player knock-sequence is compared with the preset knock-sequence. If the sequences match, the puzzle advances to the next pattern in the preset sequence list.

Puzzle Solved

After successfully repeating the last knock sequence, the uC outputs a 5s "solved" signal pulse. The uC automatically resets the puzzle and returns into a waiting state until the next start signal pulse is detected.

SD Cards, Knock-Sequence configuration

To extract the SD card from the control box enclosure, press it inward first, then pull it out

On the SD card, the "patterns.txt" file contains the knock-sequences the player has to repeat to complete the puzzle. The puzzle progresses through the list of sequences top to bottom. These sequences can be changed by the editing the patterns.txt file. The "original_patterns.txt" file is a backup of the default sequence list.
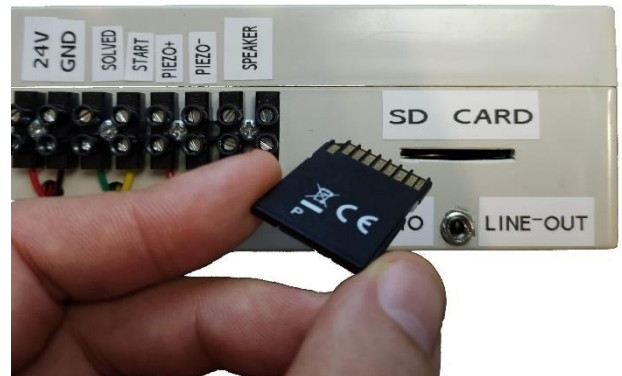
- The puzzle can work with up to 10 sequences, each containing up to 10 knocks.
- ALL sequences must contain a MINIMUM of 2 knocks.

If you are creating a new sequence list on a new, empty SD card: the puzzle will only work if your new file is named "patterns.txt" and placed in the top-level directory.
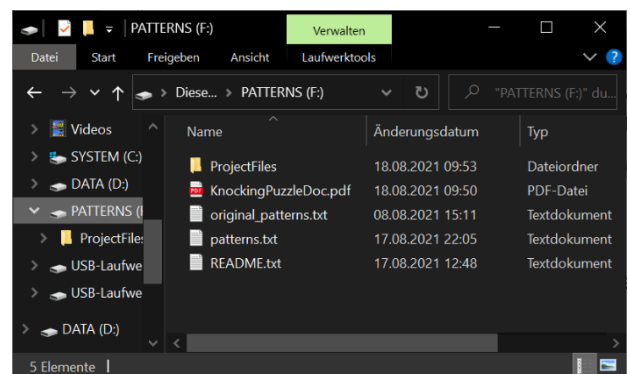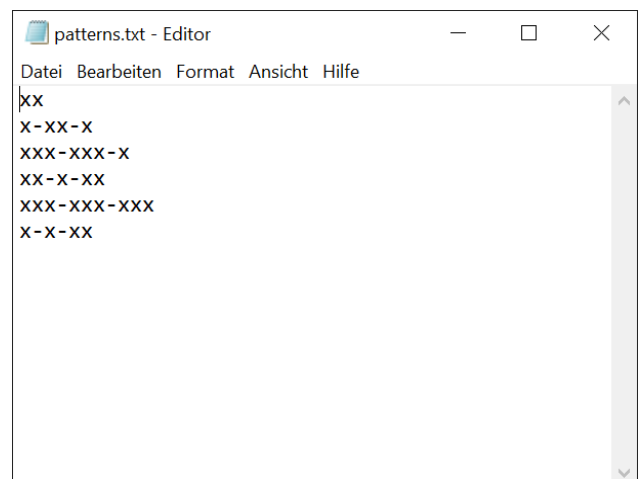
Creating or Editing Knock-Sequences

A knock-sequence contains "x" for knock, and "-" for long pause, examples:

x = one knock (invalid!)

xx = two knocks with a *short* pause

x-x = two knocks with a *long* pause
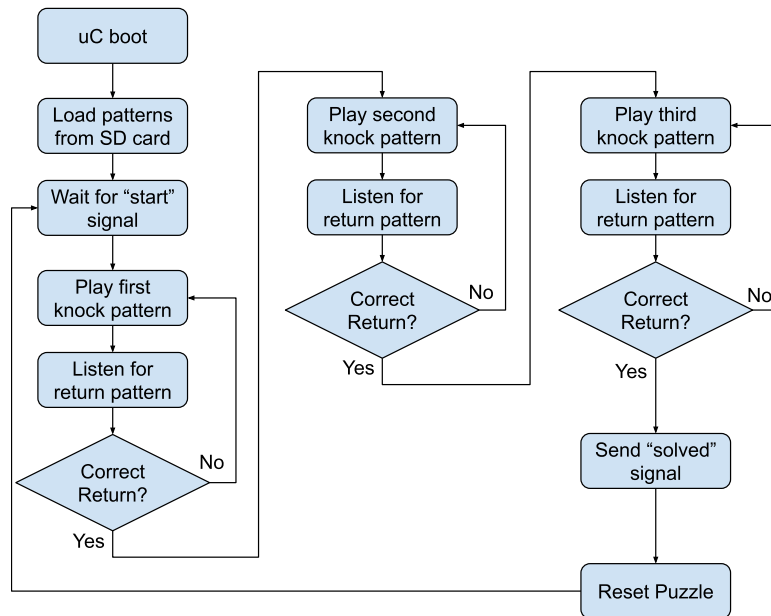
Changing Sound File

Inside the control box, there is a second microSD card, connected to the MP3 module. It contains the knocking sound file. Before replacing or altering the file, please refer to the Player Mini wiki for correct file and folder naming convention.
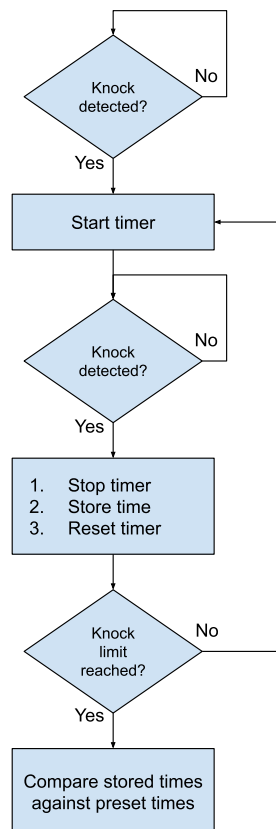
Software

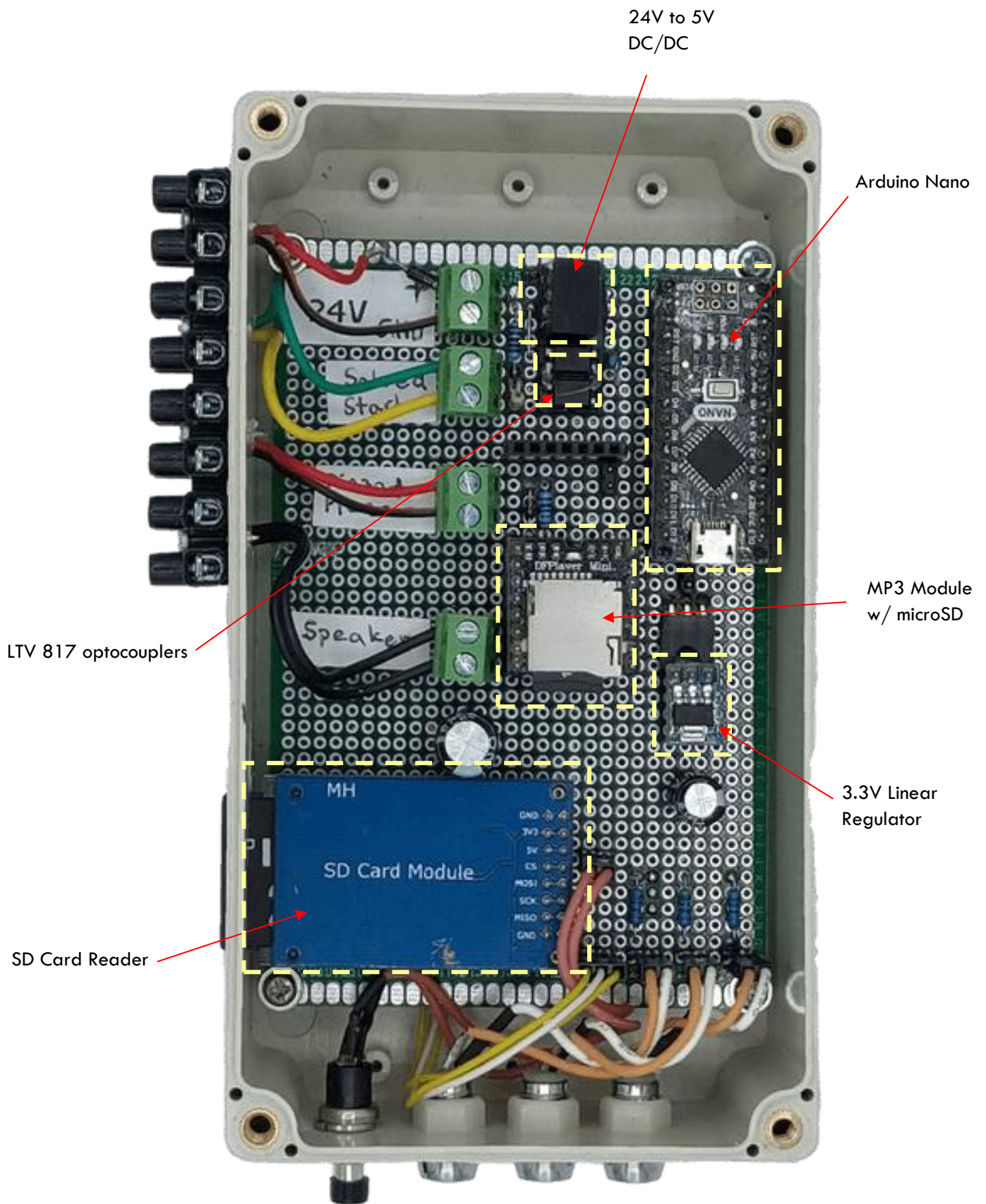**A copy of the Arduino sketch is located on the SD card, inside the ProjectFiles/PuzzleSourceCode directory. DFPlayerMini Library required:** https://github.com/DFRobot/DFRobotDFPlayerMini/archive/1.0.3.zip
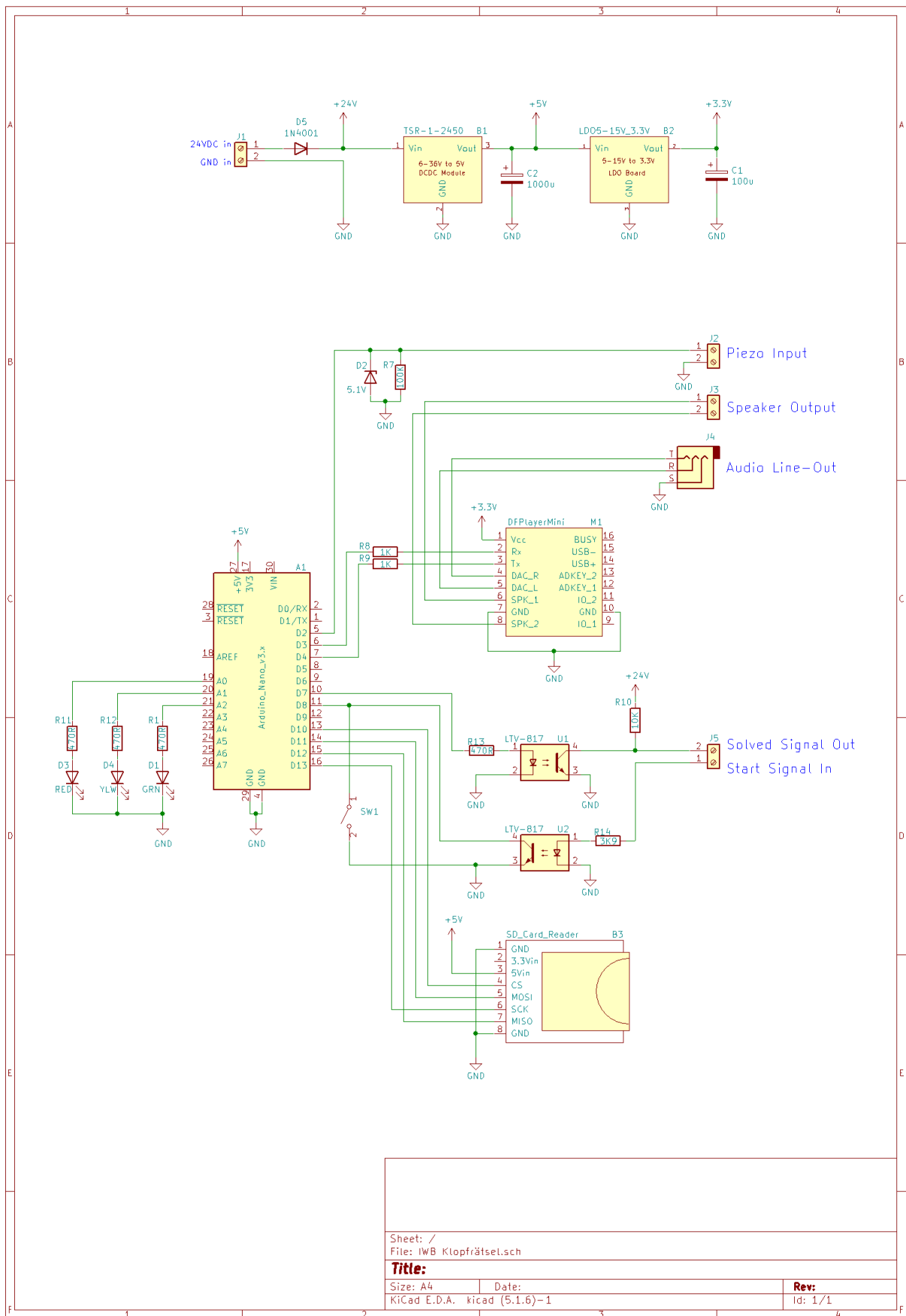
Basic Game Cycle

```
uC boot
   |
Load patterns
from SD card
   |
Wait for "start"
signal
   |
Play first
knock pattern
   |
Listen for
return pattern
   |
Correct Return? --No--> (back to Play first knock pattern)
   |
  Yes
   |
(to Play second knock pattern)

Play second
knock pattern
   |
Listen for
return pattern
   |
Correct Return? --No--> (back to Play second knock pattern)
   |
  Yes
   |
(to Play third knock pattern)

Play third
knock pattern
   |
Listen for
return pattern
   |
Correct Return? --No--> (back to Play third knock pattern)
   |
  Yes
   |
Send "solved"
signal
   |
Reset Puzzle --> (back to Wait for "start" signal)
```

"Listen for return pattern" Process

```
Knock detected? --No--> (loop back)
   |
  Yes
   |
Start timer <------+
   |               |
Knock detected? --No (loop back)
   |
  Yes
   |
1. Stop timer
2. Store time
3. Reset timer
   |
Knock limit reached? --No--> (back to Start timer)
   |
  Yes
   |
Compare stored times
against preset times
```

Control Box Circuitboard

24V to 5V DC/DC

Arduino Nano

MP3 Module w/ microSD

3.3V Linear Regulator

LTV 817 optocouplers

SD Card Reader

Schematic

24VDC in — GND in — J1

D5 1N4001

+24V

TSR-1-2450 B1
Vin Vout
6-36V to 5V
DCDC Module
GND

+5V

C2 1000u

LDO5-15V_3.3V B2
Vin Vout
6-15V to 3.3V
LDO Board
GND

+3.3V

C1 100u

GND

J2
Piezo Input
GND

D2 5.1V R7 100K
GND

J3
Speaker Output

J4
T
R
S
Audio Line-Out
GND

+3.3V

DFPlayerMini M1
1 Vcc   BUSY 16
2 Rx   USB- 15
3 Tx   USB+ 14
4 DAC_R   ADKEY_2 13
5 DAC_L   ADKEY_1 12
6 SPK_1   IO_2 11
7 GND   GND 10
8 SPK_2   IO_1 9
GND

+5V

R8 1K
R9 1K

Arduino_Nano_v3.x A1
+5V
3V3
VIN
27 17 30
28 RESET   D0/RX 2
3 RESET   D1/TX 1
              D2 5
              D3 6
18 AREF   D4 7
              D5 8
19 A0   D6 9
20 A1   D7 10
21 A2   D8 11
22 A3   D9 12
23 A4   D10 13
24 A5   D11 14
25 A6   D12 15
26 A7   D13 16
GND GND
29 4

R11 470R R12 470R R1 470R
D3 RED   D4 YLW   D1 GRN
GND   GND

+24V

R10 10K

R13 470R LTV-817 U1
GND   GND

R14 3K9 LTV-817 U2
GND   GND

J5
Solved Signal Out
Start Signal In

SW1

+5V

SD_Card_Reader B3
1 GND
2 3.3Vin
3 5Vin
4 CS
5 MOSI
6 SCK
7 MISO
8 GND
GND

Circuit Components

	120x80mm Proto Board	https://www.bastelgarage.ch/120x80mm-prototyp-pcb-platine
J1-J3, J5	2 pin Screw Terminal	https://www.taydaelectronics.com/dg128-screw-terminal-block-2-positions-5mm.html
J4	3.5mm Stereo Jack	https://www.taydaelectronics.com/3-5mm-low-profile-stereo-audio-jack.html
B1	24V to 5V DC/DC	https://www.conrad.ch/de/p/tracopower-tsr-1-2450-dc-dc-wandler-print-24-v-dc-5-v-dc-1-a-6-w-anzahl-ausgaenge-1-x-156673.html
B2	3.3V Regulator Board	https://www.bastelgarage.ch/micro-spannungsregler-linear-ams1117-800ma-3-3v
B3	SD Card Reader Board	https://www.conrad.ch/de/p/tru-components-sd-karten-shield-2144972.html
M1	MP3 Player Board	https://www.bastelgarage.ch/dfplayer-mini-mp3-player-modul-fur-arduino
D1	Green 5mm LED	
D2	5.1V Zener Diode	
D3	Red 5mm LED	
D4	Yellow 5mm LED	
D5	1N4001	
U1, U2	LTV-817 Optocoupler	https://www.mouser.ch/ProductDetail/Lite-On/LTV-817?qs=N6LLV8I65%252BeGRLHZiOxD6A%3D%3D
R1, R11-13	470R	
R7	100K	
R8, R9	1k	
R10	10K	
R14	3.9K	
C1	100uF	
C2	1000uF	
SW1	Push Button Switch	https://www.taydaelectronics.com/electromechanical/switches-key-pad/push-button/pb-11d02-push-button-panel-mount-spst-no-pb-11d02-th1-00.html

External Components

Plastic Enclosure	https://www.conrad.ch/de/p/tru-components-f2-tc-6649504-universal-gehaeuse-158-x-90-x-60-abs-hellgrau-1-st-1662376.html
Lister-Terminal (mounted on enclosure)	
3W Speaker	https://de.aliexpress.com/item/32922607146.html
50mm Piezo Transducer	https://www.conrad.ch/de/p/tru-components-717770-piezokeramisches-element-spannung-30-v-1-st-1566917.html
5mm LED Bezels	https://www.taydaelectronics.com/leds/led-holders-bezels/5mm-bezel-led-holder-plastic.html