ZXAV

Release v1.0.1

Introduction

ZXAV is a tiny audio/visual DJing/VJing app for the ZX Spectrum. Intended for live performance, it uses the Spectrum's 3 channel AY sound chip for audio output and the bitmap display for visual output.

I while ago I wrote 1kdj (https://www.pouet.net/prod.php?which=53074) - a DJ program in 1 kilobyte of code. I've been wanting to make something like this again for a while now. I figured I could probably make the audio more flexible as well as adding visuals this time, but it would take a bit more memory - audio *and* visuals but in just 4 kilobytes of code. So, ZXAV was born.

It's worth remembering that ZXAV is, first and foremost, an exercise in size-coding - fitting as much as possible into a limited amount of code space. 4 kilobytes is a common size-coding target in the demoscene, and it seemed like a good limit to aim for with ZXAV. While I have tried to make ZXAV as usable as possible, there are some oddities and limitations that arise as a result of this self-imposed limitation. Sometimes usability was sacrificed to make way for features, other times features were cut to make the software more usable. If, while using ZXAV, you ever find yourself thinking "why the heck would anyone ever implement a feature like this?" or "why is this feature missing?", then the answer will most likely be "because it saved me a few bytes".

Features

4 channels:

- VFX - 1 visual channel with 26 different visual effects
- VOICE A - 1 melody/arp channel
- VOICE B - 1 TB303-inspired bass synth channel
- DRUM - 1 percussion channel with 8 fully editable sounds

Each channel has it's own independent sequencer:

- Up to 16 steps per sequence
- 2 independent sequences per channel
- Speed and length settings per sequence

Other features

- Built from the ground up for live performance - ZXAV is *always* in play mode
- Several "ready-to-play" examples to get you started
- Re-mappable notes to create your own scales

Running ZXAV

Any ZX Spectrum emulator should work or, if you feel daring, a real Spectrum. ZXAV requires the AY sound chip that came in the later models of the ZX Spectrum - the Spectrum 128 and upwards. You can run ZXAV in 128 mode (or greater) of any emulator - but a 48k with AY extension would work just as well. The same rules apply when running on real hardware.

If you just want to get started and play around, try using one of the snapshots from the examples folder and use the keys 1-4 to change sequences.

Using ZXAV

The interface is a bit quirky. On the left is the main visual effect display, on the right is the editor. The editor has a number of pages: sequencer, voice A parameters, voice B parameters, a note mapping page and two drum voice editing pages. Use the 9 and 0 keys to cycle left and right through the editor pages. The name of the current editor page is shown at the top of the editor.

The cursor keys move the cursor around the editor. To change values in the editor you use the SPACE key and keys A-Z. The letter values represent different things in different editors whereas SPACE generally represents no change, ie: a repeat of the last step.

SEQUENCER editor page

You will see four vertical “channel strips”, labelled VFX (the visual FX channel), VA and VB (the melody and bass channels), and DM (the percussion channel). At the bottom of each channel strip you will see a number of columns. Each channel has two sequences. To the left of each sequence set you’ll also see a small dash mark that shows you the current play position in the sequence. Each sequence extends downwards from step 1 to 16. Use the cursor keys and SPACE/A-Z to enter “notes” into the sequences.

Above each sequence are two letters (initially these are set to F, P) and a number, listed vertically. F is the speed - the length that each note last for. A lower value means a faster speed - A is fastest, Z is slowest. P is the length of the pattern. A lower value means a shorter patter - A is one note, P is 16. The number underneath (1, 2, 3, or 4) is the key that you press to swap to this channel’s other sequence. The dot indicators underneath those number show the current pattern (a filled circle) and the next pattern (an empty circle). The next pattern automatically follows on when the current one finishes. The new speed and length are also latched in when a pattern starts.

The columns for each of the steps of the four channels follow the pattern:

VXVX AIAI BB DD

Where:

V - VFX
X - Accent for VFX
A - Voice A note
I - Voice A instrument
B - Voice B note
D - Drum note

Remember that there are two sequences per channel, so the channel strips are two steps wide.

The VFX channel has 26 possible note values, each with a possible accent (the accent effects are listed below inside [square brackets). Think of the effects being grouped on the keyboard into vertical columns of similar types:

SPACE - No change from what was in the last step

Q - Noise [alternate noise pattern]
A - Character-based noise [more noise]
Z - Horizontal noise wipe [re-seed positions]

W - Horizontal block of noise - top [alternate noise pattern]
S - Horizontal block of noise - middle [alternate noise pattern]
X - Horizontal block of noise - bottom [alternate noise pattern]

E - Vertical block of noise - left [alternate noise pattern]
D - Vertical block of noise - middle [alternate noise pattern]
C - Vertical block of noise - right [alternate noise pattern]

R - Random shaded rectangles [alternate patterns]
F - Animated stripes [opposite direction]
V - Scroll selected columns upwards [re-seed choice of columns]

T - Threads [faster scroll]
G - Matrix writer [leave a trail]
B - Robot writer [re-seed positions]

Y - Random horizontal lines [thicker lines]
H - Random vertical lines [thicker lines]
N - Snakes [thicker tails]

U - Crawler [crawls faster]
J - Spirals [draw faster]
M - Heart chessboard [randomise direction]

I - Diamond expanding outwards [inverted pattern]
K - Diamond shrinking inwards [inverted pattern]

O - Clear the screen [fill the screen]
L - No-op

P - Hex dump of AY registers [randomise position]

Place an A in the second column to activate the accent for that step, SPACE to clear it.

Note that if you have a SPACE in your VFX sequence then the last used effect will continue to play. If you do not want *any* effect to run then use the L ("No-op") effect.

The VA channel is a melody channel that supports pre-programmed arpeggio-like instruments. There are 26 possible note values represented by the characters A to Z. A space means no note on this step. The actual notes that are mapped to the A-Z keys can be seen and edited in the NOTES editor page. You can edit the instruments for this voice on the VOICE A page. The second column for each sequence of this instrument specifies the instrument (pitch envelope) for the voice. Use the values A to H to choose between the 8 different instruments. A SPACE means no change in instrument on this step. The pitch envelope is re-triggered when a new note is played, or when the instrument is changed on a note that is still playing. The volume envelope is re-triggered when a new note is played. This means that programming a continuous run of the same note will not re-trigger the voice or pitch envelopes, allowing for notes that last longer than one step.

The VB channel is a simple TB303 style bass instrument. There are 26 note values represented by the characters A to Z. A SPACE means no note on this step. The notes values are the same as those used by VA (and use the same mapping table) but sound two octaves lower. You can edit the instrument for this voice on the VOICE B page.

The DM channel has eight instruments: A-H:
SPACE - No new noise.
A - Kick.
B - Soft kick.
C - Snare 1.
D - Snare 2.
E - Closed hat.
F - Open hat.
G - FX 1.
H - FX 2.

These are just the default sounds - you can fully edit the sounds on the DRUMS editor page.

VOICE A editor page

This instrument has a global Attack/Release envelope for volume and multiple "instruments" (8 are available, named A to H) for pitch. There are the following options for the amplitude envelope:

ATTACK - A is a slow attack, Z is fast
VOLUME - Max volume of sound. A is silent, P max volume

RELEASE - A is a slow release, Z is fast

Each instrument is a vertical list of 8 steps. The steps loop, and each step specifies the pitch offset from the base pitch of the current note. A value of A means no change, B means +1 semitone, M means +1 octave, etc.. A value of SPACE means no change from the previous pitch. Amongst other uses, it is possible to use instruments to program arpeggios, to dynamically transpose whole sequences or to create sound effects.

The first three instruments are pre-set, but can of course be fully edited:

A - Major arp.
B - Minor arp.
C - Octave arp.

VOICE B editor page

Here is the editor for the bass instrument behind Voice B. There are the following options for the amplitude envelope:

ATTACK - A is a slow attack, Z is fast
VOLUME - Max volume of sound. A is silent, P max volume
RELEASE - A is a slow release, Z is fast
RETRIG - There are two re-trigger modes: A re-triggers the attack portion of the envelope only after a rest, B re-triggers on every new note.

For pitch there is one parameter:

SLIDE - Portamento speed between notes. A is slow, Z is fast.

NOTES editor page

On this page you can map which notes are played by which physical keys on the keyboard. By default, the note map is set up with a piano-style keyboard across the keys A (a2) to L (b3). The sharps/flats are above the naturals.

By editing the values on this page you can change the keys to represent any layout that you desire. There are two sets of two columns, the first set maps the keyboard keys A-M and the second maps N-Z. To the right of the arrow is the note that the key maps to. These range from A(c2) to Z(a#4).

See the appendix for some example mappings.

DRUMS editor page

There are two DRUMS editor pages: DRUMS ABCD and DRUMS EFGH. Each page can edit four drum voices. On each page you will see four vertical strips - one for each voice. The column headings P, V and N stand for Pitch, Volume and Noise.

Pitch values go from A (high pitch) to Z (low pitch), SPACE means no change in pitch from previous step. Volume values go from A (silent) to P (full volume), SPACE means no change from previous step. Note that the AY has non-linear volume curves so the steps between each value are not equal. Noise values go from B (high pitch) to Z (low pitch), A means no noise and SPACE means no change from previous step. When set to a value from B-Z, the noise is played alongside the pitch value of the drum for that step.

Note that if you start an instrument with SPACE in any of its channels then it will “inherit” the value form the last instrument played. This means that you can “pass on” pitch, volume or noise values from one instrument to another to make instruments sound differently depending on what last played.

Tips

A few tips to think about:

- Every one of the six sequences can be a different speed and a different length. Use this to set up polyrhythms or to make some sequences last half or twice as long as others (think slowing moving melody pads running at a slower speed or fast running rhythm tracks)
- Setting visual sequence speed to extremely fast values (such as A) will give the visuals a very different look. Check out the GrowingCity and InBetween examples to see this trick in action.
- ZXAV is built for live jamming! Remember that you can change the sequences and the instruments at any time. In fact, because of the limited amount of sequences available, live-editing is the best way to evolve a piece while it plays.
- You can use the 1-4 keys to change sequences from any editor page - you don't have to be on the SEQUENCER page.

Examples

There are several examples available in the examples folder. These examples use the .szx snapshot format which is not supported by all emulators, but at least Fuse (which is cross-platform) does support it.

The examples have been designed to showcase examples of what can be created with ZXAV as well as to introduce you to some of the techniques that are available. Each of the examples is a fully-formed project. You can start playing with an example by using the 1-4 keys to change sequences, but you are actively encouraged to start poking around in the sequence and voice data too.

The following examples were kindly supplied by @infu_av:

- Growing City. In this example, the VFX simulates a growing city. Sequence 1 of the VFX channel grows the city. Temporarily switching to sequence 2 clears the city. Sequence 1 uses a scroll effect (effect V) to grow the city. If you move that V command higher up the sequence (it is placed on the last step of the sequence on loading the example) then the city will grow faster.
- InBetween
- Pillar Of Memories. Experiment with turning accents on and off for all steps of the VFX sequences.
- Snake Life
- Snow Figures
- Techno

The Future..

This is the final version of ZXAV. The goal was to see what kind of live-performance AV instrument I could fit into 4096 bytes as a pure size-coding challenge. With that goal met, the challenge sis now over. However, there has been some interest in expanding ZXAV, adding new features and improving existing ones. You could consider this release of ZXAV to be a prototype or a proof-of-concept. If there is enough interest in making a fully-featured “pro” version then it can be made to happen.

A Pro version would not be limited by the 4096 byte size restriction. Imagine what could be done without that restriction? More instrument types, more VFX, more sequencer patterns, sync with external instruments, better editing controls and UI, a bigger range of notes, bigger and better… what?

So the next part is up to you: if you would like to see a ZXAV Pro release then please let me know. Tell me what you like about ZXAV, what you would like to change/add/remove and how you would like to use the software.

Drop me a line at: evilpaul@evilpaul.org

Credits

All code, gfx, etc. by Paul “evilpaul” Grenfell.

Huge thanks to @infu_av for feedback, suggestions, example tracks, encouragement and generally being a sounding board on how to make ZXAV something that other people might want to use. Thanks!

ZXAV is totally inspired by the CBM 8032 AV project by Robert Henke and Anna Tskhovrebov. Huge thanks to Robert for sharing this work and for such a great write-up on his website. Find out more about this wonderful project at https://roberthenke.com/concerts/cbm8032av.html

License

ZXAV is released under a “do what you want but be respectful” license.

Things you can do:
- Perform live with this software.
- Record and release audio and video made with this software.
- Make money from what you create with this software.
- Share this software with anyone and everyone (at no charge.)

Things you cannot do:
- Don’t try to pass this software off as your own.
- Don’t charge money for this software.

If you *do* use this software (especially if you record or perform with it) then I would love to hear from you. Drop me a line at evilpaul@evilpaul.org

ZXAV is free software, but if you enjoy using it then you can show your appreciation by buying me a coffee at https://ko-fi.com/evilpaul

Release Notes

24/07/2020 - v1.0.0 - Initial public release
25/07/2020 - v1.0.1 - Documentation fixes and improvements (thanks @infu_av!)

Appendix

Note Table

Value	Voice A note	Voice B note	Voice A pitch table offset
A	a2	a0	No offset
B	a#2	a#0	
C	b2	b0	
D	c2	c0	
E	c#2	c#0	
F	d2	d0	
G	d#2	d#0	
H	e2	e0	
I	f2	f0	
J	f#2	f#0	
K	g2	g0	
L	g#2	g#0	
M	a3	a1	+1 octave
N	a#3	a#1	
O	b3	b1	
P	c3	c1	
Q	c#3	c#1	
R	d3	d1	
S	d#3	d#1	
T	e3	e1	
U	f3	f1	
V	f#3	f#1	
W	g3	g1	
X	g#3	g#1	
Y	a4	a2	+2 octaves
Z	a#4	a#2	

Speed Relationships

Base Tempo	Full Speed	Half Speed	Quarter Speed
750bpm	A	B	D
375bpm	B	D	H
250bpm	C	F	L
187bpm	D	H	P
150bpm	E	J	T
125bpm	F	L	X

Example: If one pattern is set to speed E, then to have another pattern that runs at half speed (ie: each note step last twice as long) you should set its speed to J.

Pattern Length Values

Value	Pattern Length
A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9
J	10
K	11
L	12
M	13
N	14
O	15
P	16

Example Note Tables

Key	Piano style keyboard across A-L, with sharps/flats above. Range from c2 to d3 (default)	Two A Major scales on rows A-K and Q-I	Two A Minor Pentatonic scales across the keys A-G and Q-T
A	C	A	D
B			
C			
D	G	E	I
E	F	O	U
F	H	F	K
G	J	H	N
H	L	J	
I		Y	
J	N	L	
K	O	M	
L	Q		
M			
N			
O	P		P
P	R		W
Q		M	G
R		R	Z
S	E	C	
T	I	T	
U	M	X	S
V			
W	D	O	
X			
Y	K	V	
Z			