

EXTRAPOINTS APPLICATION NOTE

Sounds Specification

1) Abstract

The purpose of this application note is to explain the implementation adopted to play simple melodies with the LandTiger V2.0 LPC1768's loudspeaker. Note that external speaker circuit is connected to DAC output pin P0.26. The DAC output is enabled by JP2 jumper and the speaker is driven by an onboard audio amplifier U2 (LM386)*.

2) Playing sounds

2.1) Initialization

The Loudspeaker and DAC hardware modules are activated at the board boot. JP2 is used to enable the external speaker. Speaker connected to P0.26: Jumper short. No speaker output: Jumper removed. The input clock configuration for DAC is obtained from PCLK_DAC.

2.2) Timing and priorities

Timer1 is used to count the time elapsed for note duration and Timer3 is in charge to manage the sinusoid frequency as implemented in *IRQ_timer.c*. Since Timer1 counts the note time duration, it must have a higher priority than Timer3 – Priority 0 for Timer1, Priority 1 for Timer3. If a Timer1 interrupt is triggered, it does no longer matter the Timer3 sinusoid construction since the note will immediately change. Timer1 has been initialized to 0.5 seconds in *sample.c* – the loudspeaker will play notes at about 120 BPM.

2.3) Development strategy

The implementation strategy consists in the definition of three vectors in *IRQ_timer.c* (*eatingNotes[3]*, *cuddleNotes[12]*, *runNotes[5]*) containing counts for different sinusoid frequencies based on the relative animation. The current Tamagotchi state is stored in a “*typedef enum {ALIVE, END, EATING, CUDDLING} status*” variable.

2.4) Functionality

Based on the current Tamagotchi state, each time an interrupt is triggered by Timer1 – if the volume is not set in SILENT mode – it will initialize Timer3 with the proper note frequency that belongs to that specific animation – picking it from the dedicated array – and will enable Timer3.

Each time Timer3 generates an interrupt it will load into the DAC register a new sinusoid point value and the equivalent analog value will be sent to the loudspeaker.

2.5) Conclusions

By adopting this strategy, changing the note at each Timer1's interrupt, the output will be a melody played by the loudspeaker. The main drawback of this solution is the fixed value of Timer1 – which results in fixed 120 BPM. There could be more refined solutions that can change dynamically the note duration but let the loudspeaker play in the way discussed before is the best trade-off between code size and functionality.

* For further hardware information, please visit: https://os.mbed.com/media/uploads/wim/landtiger_v2.0 - manual_v1.1.pdf