



A cheaper, simpler synthesizer

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I.**Introduction**

For the budding musician that's just getting into keyboards, it quickly and painfully becomes obvious that instruments are very expensive. Synthesizers especially have a lot of complicated features, and quickly become overwhelming. In contrast, SynthBoy is a cheaper, simpler synthesizer targeting this entry-level market. It has simpler controls, and is easier to manufacture.



Figure 1: SynthBoy product concept. SynthBoy uses 12 user controllable knobs and 24 keys to attain a wide variety of different sounds.

II.**Technical Specifications****General description**

- Enclosure of 9x6x2 inches at ~1 lb
- Powered by 5 V_{DC} at 2.5 A
- Processed through Raspberry Pi board with 1.4 GHz 64-bit processor
- Realtime digital monophonic synthesis sampled at 48 kHz with 11-bit depth
- Output at line level voltage (~1 V_{p-p}) to 3.5 mm jack for universal output to headphones, speakers, or amplifiers

User input (12 knobs + 24 keys)

- CAR signal
 - Freq selection (notes C0 to C6)
 - 24 musical keys (C_n to C_{n+2})
 - Octave selector knob (-2 to +2)
 - Wave shape rotary switch (Pulse, Square, Sine, Triangle, Ramp)
 - Volume knob (-inf dB to +6 dB)
- LFO signal
 - Frequency knob (.2 Hz to 20 Hz)
 - Wave shape rotary switch (Pulse, Square, Sine, Triangle, Ramp)
 - Mix knob (0% to 100%)
- Envelope
 - Attack knob (1 ms to 10,000 ms)
 - Decay knob (1 ms to 10,000 ms)
 - Sustain knob (1 ms to +inf ms)
 - Release knob (1 ms to 10,000 ms)
- Hi-cut filter
 - Frequency selection knob (2 kHz to 20 kHz)
 - Mix knob (0% to 100%)
- Lo-cut filter
 - Frequency selection knob (5 Hz to 500 Hz)
 - Mix knob (0% to 100%)

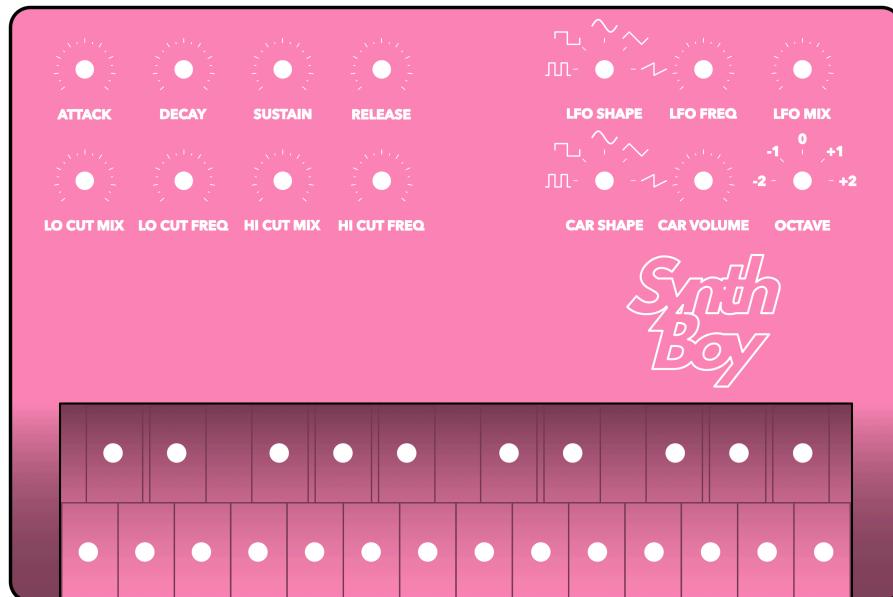


Figure 2: Design of SynthBoy enclosure for 3D model pre-fabrication. It reveals the holes where the knobs and buttons will be inserted for quick and cheap furnishing.

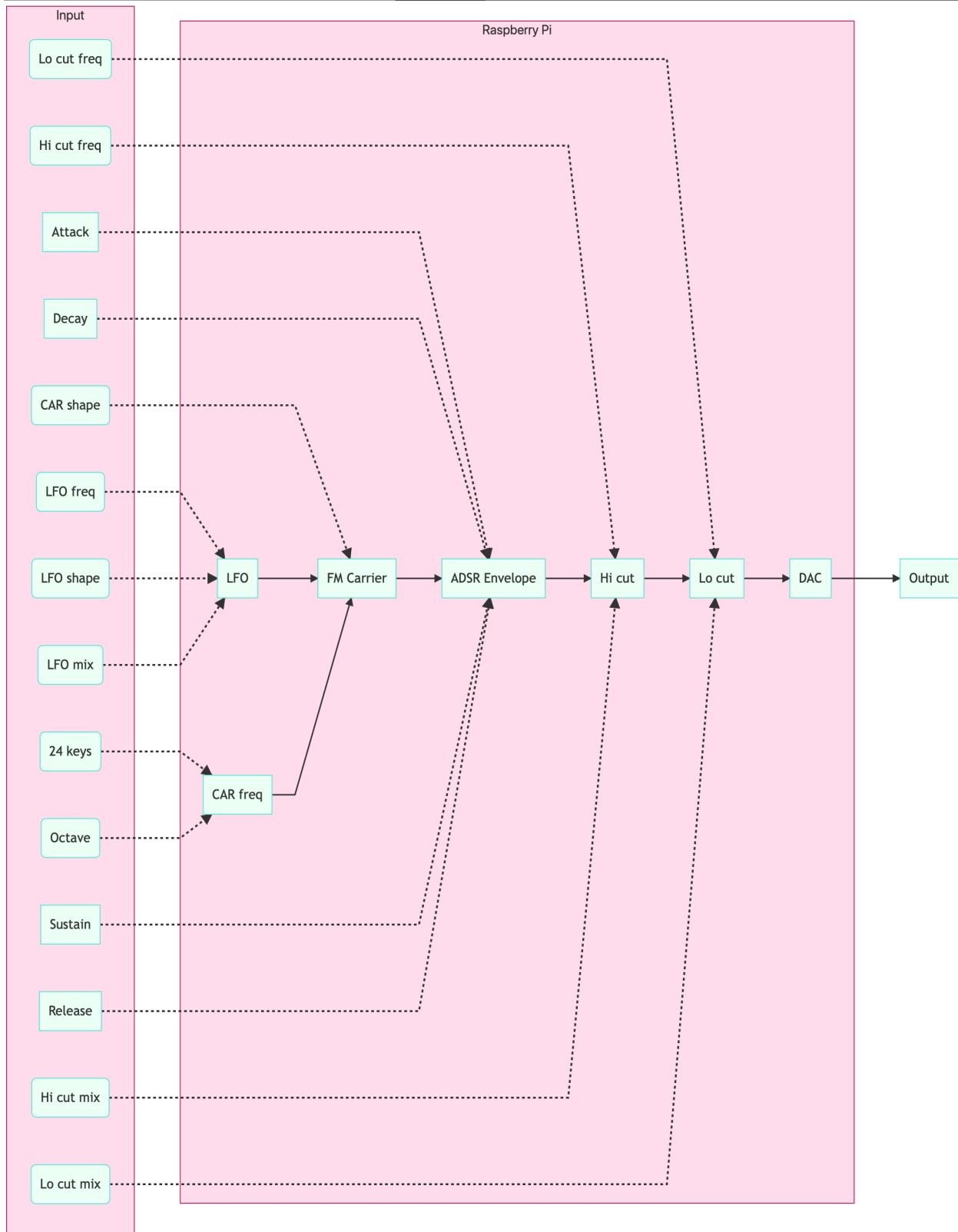


Figure 3: Block diagram of high-level system design of SynthBoy inputs, processing, and output. Dashed lines represent user controllable input.

III.

Work Plan

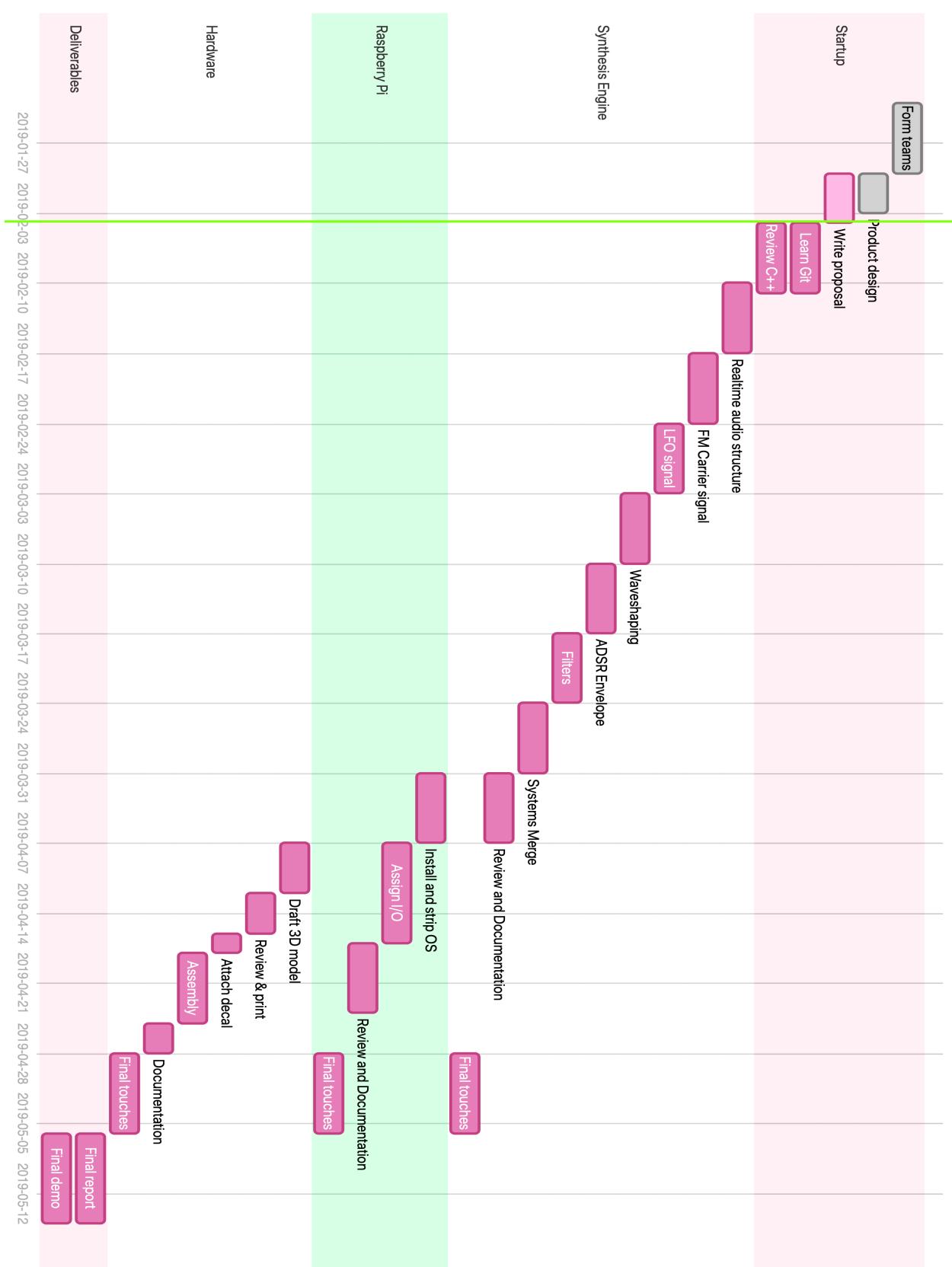


Figure 4: Gantt chart of development modules

The Gantt chart depicts the anticipated development times for each module of the product. The deliverables section currently only shows the final report and demo as those are the only deliverables with a known deadline. No point in time shows more than three overlapping modules as there are only three member on the project team. However, the first half of the project has many single module sprints because it will be more difficult to parallelize programming the engine as it will take significant communication and usage of Git.

IV.

Related Works

Similar offerings in this product segment include smaller Moog Music, Korg, and Teenage Engineering synthesizers. The Teenage Engineering OP-1 is the most similar in design with its extremely portable size. However, the OP-1 costs \$1,000, and the other manufacturers are roughly within the same range, which is well above what the SynthBoy costs. The main reason for this is because they have all crammed many features and effects into tiny packages. The OP-1 alone has 10 different synthesis engines within it.

The concept of providing more affordable offerings of wildly expensive products is not new to the musical instrument industry. The greatest examples of this are the two largest guitar companies, Fender and Les Paul. They both make expensive guitars that are used by famous artists and amateurs alike, but they also own subsidiaries Squire and Epiphone, respectively, that offer similar products with stripped features for cheaper. These entry-level guitars sell very well with even many famous professionals using them.

These fundamental concepts are what lead to the inception of the SynthBoy: to develop the essence of musical synthesis in a cheaper, simpler synthesizer.



Figure 5: The ultra portable Teenage Engineering OP-1 at dimensions of 11x4x0.5 inches.

V.

Team Members



Arya Daroui
Systems Engineer and Product Design

Electrical engineering student with focus in digital signal processing. Former Budget Director for student government. Years of experience with digital synthesis as hobby musician and producer.



Brian Fox
Software Engineer and Requirements Analysis

Electrical engineering student with focus in digital signal processing. Member of Tau Beta Pi, Eagle Scout, and former Nuclear Electricians Mate in the United States Navy.

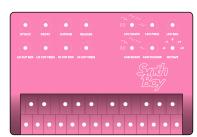


Jethro Iresare
Software Engineer and Hardware Implementation

Electrical Engineering student with focus in digital signal processing. Hobbies include poetry and music. Member of Tau Beta Pi and former intern at Navitas Semiconductor.

VI.**Parts and Costs**

Table 1: Itemized parts list and costs with images

Part	Unit Price [\$]	Quantity	Cost [\$]	Image
Momentary pushbutton, black	0.95	10	9.50	
Momentary pushbutton, white	0.95	14	13.30	
Selector switch, 5 way	6.33	3	18.99	
Potentiometer, 10 kΩ - pack of 25	12.90	1	12.90	
Knob, pink	0.70	12	8.40	
Raspberry Pi 3 B+	54.95	1	54.95	
3D Printed Enclosure*	30.00	1	30.00	
Total			\$148.04	

*Estimate: exact price not known until time of order with complete 3D model.