

CalcHack System Design

CalcHack is an opensource, open hardware hack for TI graphical calculators. It is essentially a calculator on steroids – or a cheat engine for reallife.

There are many ideas I have for what it should be able to do, this ranges from multiplayer games to inter-calculator communication and wikipedia/wolframalpha access.

I want to create a simple to use programming environment to write apps in C++ which should not be more difficult to learn than TI Basic. This will be done through a number of libraries and engines. With this anyone can write apps and distribute them preferably on an opensource basis.

CalcHack will be available for all the TI graphical calculators that have a link port and B/W LCD. More support might be added as time passes, but focus is on TI82 Stats, TI83, TI84, TI83+, TI84+ and Voyage 200.

The main features are:

- 9 Axis sensors (gyroscope, accelerometer, magnetometer)
- microphone (digital)
- speaker (about 1W, integrated DAC and AMP)
- networking (NRF24L01)
- RTC
- Extension port (many ADC's, one could write an oscilloscope app, for example)
- micro SD card for app and appdata storage
- undetectable without opening up calculator – an 8 character password is needed to run CalcHack, without knowing it you can't even tell if CalcHack is present in a calculator!

I am still working on the software part, and because of hardware problems (the main CPU on my prototype is dead, and replacement didn't arrive yet) software features finished are very limited:

2D-Graphics:

- pixels
- lines
- triangles
- rectangles
- filled triangles
- filled rectangles
- characters
- strings
- simple menu with scrollbar
- bitmaps (hacky, no real function because no SD card yet...)

3D-Graphics:

- rendering perspective, zoom and resolution choosable
- 3D objects: only boxes, but code is written as template so adding different objects is very easy and fast
- 18 FPS (more isn't better because of the way greyscale is realised) @ 150 polygons inside screen area, 2000 in buffer (for example one room in a game), 50% CPU (not overclocked), all calculations VERY pessimistic!

This is the basic part list (everything is available from Digikey):

USB Connector	ZX80-B-5P
MCU	STM32F405R
Coprocessor	STM32F103T6
SD Socket	475710001
MEMS Microphone	MP45DT02
Audio AMP	TPA6211A1DF
Accelerometer/Compass	LSM303C
Gyroscope	BMG160
Speaker 1	CLS0401MAE
Speaker 2	GC0351P-3
Osc 20MHz	ASDMB-20.00
Osc 32kHz	SG-3030JC
Step down inductor	TPS62142RG
	IHLP1212BZE
P-MOS (VCC-Calc)	AO3415
N-MOS (drive->Pmos, Vbatt)	2N7002P,215

Caps:

20p 50v	CL10C200JB8NCNC
3.3n 50v	CL10B332KB8SFNC
100n 50v	CC0603KRX7R9BB104
0.22u 16v	C1608X7R1C224K080AC
1u 6.3v	C0603C105K9PACTU
2.2u 6.3v	JMK107BJ225KAHT
10u 16v	CL21A106KOFNNNE
22u 6.3v	CC0805MKX5R5BB226

Ferrite bead HZ0603A252R-10

Resistor 40k MCT06030C3902FP500

There are two speakers because both fit and I haven't decided / tested which one to use yet.

Code and hardware design files can be found @
<https://github.com/calchack>

I regret not having wireless connectivity ready to present yet as it is probably the most important parts of all. But I am working hard to make it work as soon as possible.

I don't have much more to say, take a look at the basic demonstration video on youtube and I hope you like CalcHack ;)

https://www.youtube.com/watch?v=lbnoKJ1_KmI