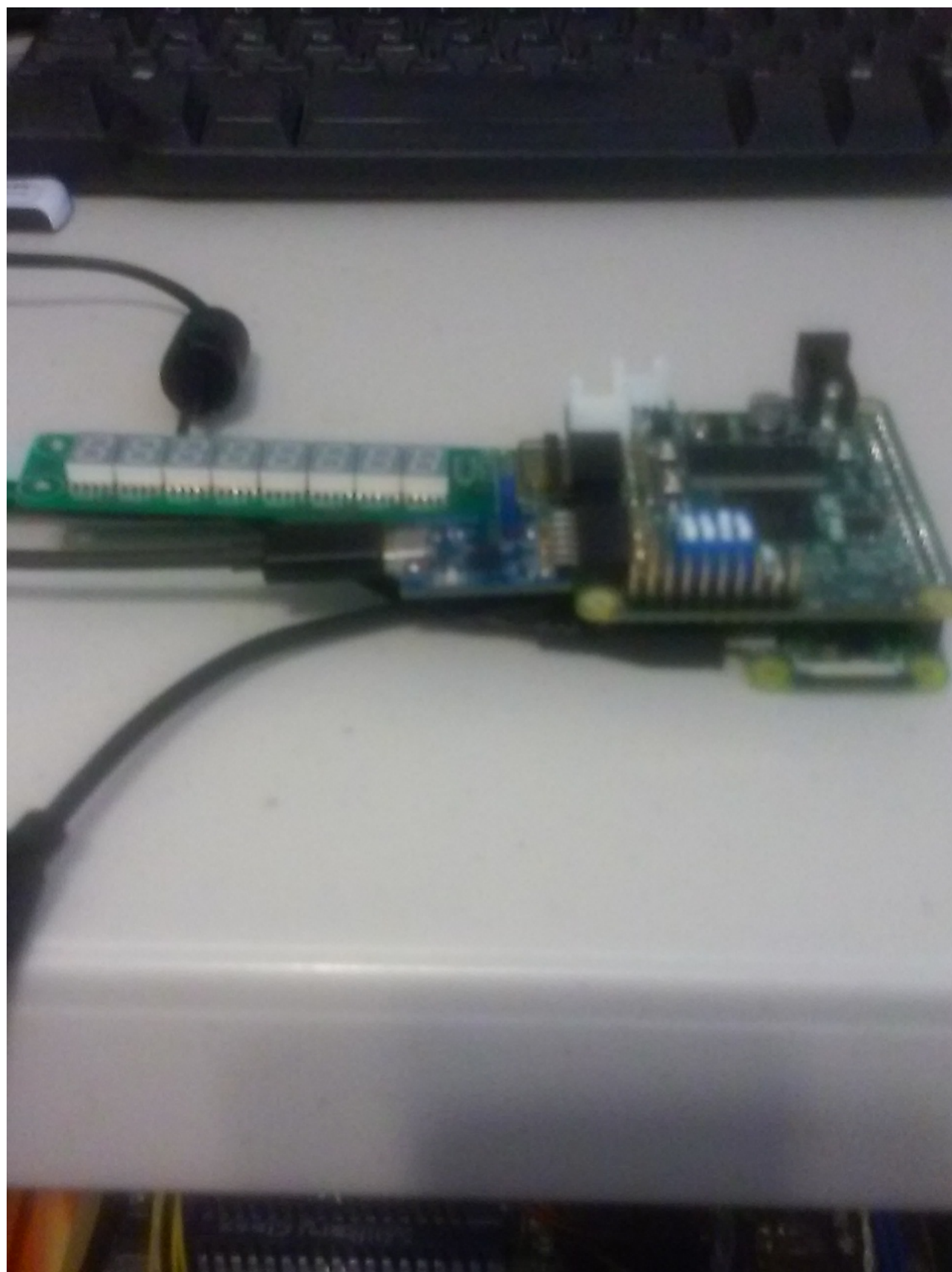# *Testing Verilog on the CATBOARD*
on RPi Zero with CATBOARD
05/18/18

A Pizero with CATBOARD FPGA. The CATBOARD provides 2 PMOD connector and a 20 pin with 3.3 v & Grd and 18 I/Os.

Using a Pizero to program the FPGA.
Most of Verilog was written by Dan Gisselquist, Ph.D. from Gisselquist Technology, LLC. He is working with the ICOBARD which is a HX8K Lattice FPGA like the CATBOARD. The Verilog and C++ software is found at

URL: https://github.com/develone/catzip.git

```
File Edit Tabs Help
1
pi@pizero-1:~/catzip/rtl $ sudo config_cat pptest/speechpp.bin

OK: GPIO 25 exported
OK: GPIO 17 exported
OK: GPIO 22 exported

OK: SPI driver loaded

Setting GPIO directions
out
out
in
Setting output to low
0
Reseting FPGA
0
1
Checking DONE pin
0
Continuing with configuration procedure
263+1 records in
263+1 records out
135100 bytes (135 kB, 132 KiB) copied, 0.108344 s, 1.2 MB/s
Setting output to high
1
Checking DONE pin
1
pi@pizero-1:~/catzip/rtl $
```

The verison of speechpp.bin uses a PPL to reduce the 100MHz Oscilator down to 66MHz.

```
wire   clk_66mhz, pll_locked;
SB_PLL40_CORE #(
    .FEEDBACK_PATH("SIMPLE"),
    .DELAY_ADJUSTMENT_MODE_FEEDBACK("FIXED"),
    .DELAY_ADJUSTMENT_MODE_RELATIVE("FIXED"),
    .PLLOUT_SELECT("GENCLK"),
    .FDA_FEEDBACK(4'b1111),
    .FDA_RELATIVE(4'b1111),
    .DIVR(4'd8),        // Divide by (DIVR+1)
    .DIVQ(3'd4),        // Divide by 2^(DIVQ)
    .DIVF(7'd94),       // Multiply by (DIVF+1)
    .FILTER_RANGE(3'b001)
) plli (
    .REFERENCECLK   (i_clk      ),
    .PLLOUTCORE     (clk_66mhz   ),
    .LOCK        (pll_locked ),
    .BYPASS       (1'b0       ),
    .RESETB       (1'b1       )
);
assign  s_clk = clk_66mhz;
```

The ICOBOARD used **SB_PLL40_PAD since a different GBIN was used,**

Running **"arm-netpport"** on pizero-1 which receives the data from the FPGA in parallel using 11 gpio pins
Maps pins on FPGA to Pins on Rpi. These pins were different on the ICOBOARD.

```
set_io i_clk     C8

set_io o_ledg[0] A9
set_io o_ledg[1] B8
set_io o_ledr    B7

set_io  i_pp_dir    R3
set_io  i_pp_clk    T8

set_io io_pp_data[0] R4
set_io io_pp_data[1] T3
set_io io_pp_data[2] T13
set_io io_pp_data[3] T6
set_io io_pp_data[4] T5
set_io io_pp_data[5] P9
set_io io_pp_data[6] T9
set_io io_pp_data[7] T11

set_io o_pp_clkfb    T7

# define RASPI_DIR 28 //BCM20  PIN 38, GPIO.28 IOB_59  R3
# define RASPI_CLK 10 //BCM8   PIN 24, GPIO.10, IOB_75 T8

# define RASPI_D0 27 //BCM16   PIN 36, GPIO.27, IOB_63 R4
```

```
# define RASPI_D1 24 //BCM19   PIN 35, GPIO.24, IOB_61 T3
# define RASPI_D2 0 //BCM17    PIN 11, GPIO.0 ,IOB_94  T13

# define RASPI_D3 21 //BCM5   PIN  29,GPIO.21 ,IOB_73  T6

# define RASPI_D4 22 //BCM6    PIN 31,GPIO.22 ,IOB_69  T5
# define RASPI_D5 4 //BCM23    PIN 16,GPIO.4, IOB_83   P9

# define RASPI_D6 5 //BCM24    PIN 18, GPIO.5, IOB_79  T9
# define RASPI_D7 1  //BCM18   pin 12, GPIO.1, IOB_89  T11
# define RASPI_D8 11 //BCM7    PIN 26, GPIO.11, IOB_75 T7

#define READ_FROM_ICO   0
#define WRITE_TO_ICO    1
```

The file *"speech.hex"* is read by the FPGA and sent to the pizero.

```
File  Edit  Tabs  Help
pi@pizero-1:~/catzip/sw/host $ ./arm-netpport
Listening on port 8363
Listening on port 8364
.  |=================================================================|
.  |                                                                 |
.  | Four score and seven years ago our fathers brought forth on this |
.  | continent, a new nation, conceived in Liberty, and dedicated to  |
.  | the proposition that all men are created equal.                  |
.  |                                                                 |
.  | Now we are engaged in a great civil war, testing whether that    |
.  | nation, or any nation so conceived and so dedicated, can long    |
.  | endure. We are met on a great battle-field of that war. We have  |
.  | come to dedicate a portion of that field, as a final resting     |
.  | place for those who here gave their lives that that nation might |
.  | live. It is altogether fitting and proper that we should do this. |
.  |                                                                 |
.  | But, in a larger sense, we can not dedicate-we can not consecrate-|
.  | we can not hallow-this ground. The brave men, living and dead,   |
.  | who struggled here, have consecrated it, far above our poor power |
.  | to add or detract. The world will little note, nor long remember |
.  | what we say here, but it can never forget what they did here. It |
.  | is for us the living, rather, to be dedicated here to the        |
.  | unfinished work which they who fought here have thus far so nobly |
.  | advanced. It is rather for us to be here dedicated to the great   |
.  | task remaining before us-that from these honored dead we take     |
.  | increased devotion to that cause for which they gave the last     |
.  | full measure of devotion-that we here highly resolve that these   |
.  | dead shall not have died in vain-that this nation, under God,     |
.  | shall have a new birth of freedom-and that government of the      |
.  | people, by the people, for the people, shall not perish from the |
.  | earth.                                                           |
.  |                                                                 |
.  |                                                                 |
.  |=================================================================|
.
```

In addition, a remote host, using telnet can receive the data being sent from the FPGA. The command **"telnet pizero-1 8364**

```
pi@pi3-2:~/uart_rxtx/wbuart32/pptest $ telnet pizero-1 8364
Trying 2600:1700:bc40:b480::38...
Trying 2600:1700:bc40:b480:d428:7a81:e997:5433...
Trying 192.168.1.100...
Connected to pizero-1.
Escape character is '^]'.
|=====================================================================|
|                                                                     |
| Four score and seven years ago our fathers brought forth on this    |
| continent, a new nation, conceived in Liberty, and dedicated to     |
| the proposition that all men are created equal.                     |
|                                                                     |
| Now we are engaged in a great civil war, testing whether that       |
| nation, or any nation so conceived and so dedicated, can long       |
| endure. We are met on a great battle-field of that war. We have     |
| come to dedicate a portion of that field, as a final resting        |
| place for those who here gave their lives that that nation might    |
| live. It is altogether fitting and proper that we should do this.   |
|                                                                     |
| But, in a larger sense, we can not dedicate-we can not consecrate-  |
| we can not hallow-this ground. The brave men, living and dead,      |
| who struggled here, have consecrated it, far above our poor power   |
| to add or detract. The world will little note, nor long remember    |
| what we say here, but it can never forget what they did here. It    |
| is for us the living, rather, to be dedicated here to the           |
| unfinished work which they who fought here have thus far so nobly    |
| advanced. It is rather for us to be here dedicated to the great      |
| task remaining before us-that from these honored dead we take       |
| increased devotion to that cause for which they gave the last       |
| full measure of devotion-that we here highly resolve that these     |
| dead shall not have died in vain-that this nation, under God,       |
| shall have a new birth of freedom-and that government of the        |
| people, by the people, for the people, shall not perish from the    |
| earth.                                                              |
|                                                                     |
|                                                                     |
|=====================================================================|
```