Make Your Own 8051 Minimal System

by Nematic!

Even before Arduino was a thing, the world had microcontrollers only thing was they were pretty less known and best example will be an 8051 Microcontroller which was quite famous and guess what even today for enthusiasts like me it's still famous! So in this tutorial, I'll take you back to 1980s and show you how to build a Minimal system for 8051.

So let's get started

Littel History about 8051

The 8051 series of microcontrollers was developed by Intel in 1980 for embedded systems. They should have been extinct by now, but they are still around and are in fact quite popular. The 8051 has since then been upgraded. The newer variants of the 8051 currently available in the market are more powerful, consume less power and, most importantly, are cheaper.

As a student, you should study the 8051 to get acquainted with basic microcontroller architecture, embedded system designing, prototyping. In the meantime, you should make a few projects and test your code efficiency. Also, note that you don't exactly have to work on the original 8051 made by Intel, you can pick any new variant in the market 89C51, 89C52, 89S51, 89S52 or P89V52RD2.

Supplies:

1. 8051 IC
2. Soldering Iron
3. PCB
4. Helping Hand
5. LM7805
6. PCB Terminal
7. Capacitors
8. PCB Headers
9. Switches
10. Resistors

Step 1: Watch the Videos!

//www.youtube.com/embed/8255_CHE5gE

If you don't wish to read all the stuff you can watch my video tutorial.

Step 2: Understanding the Schematic
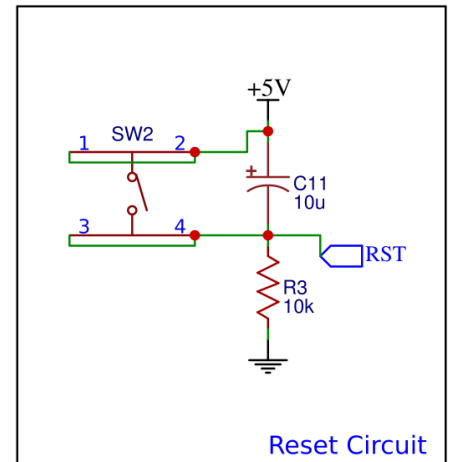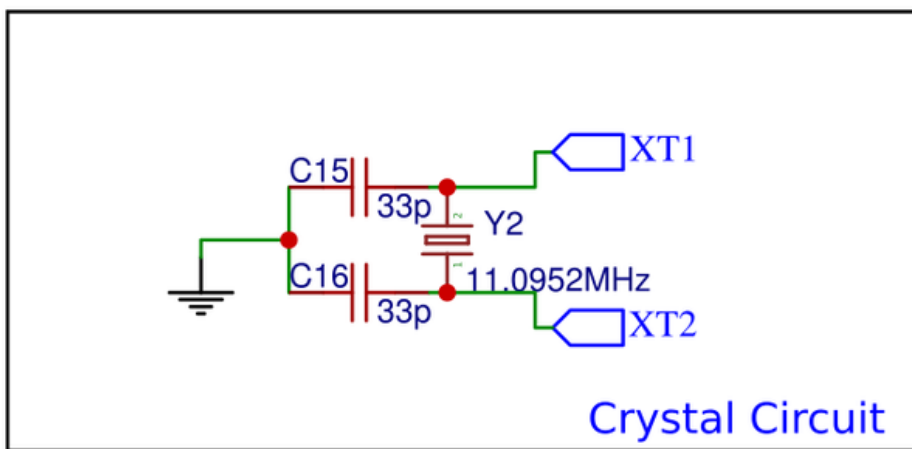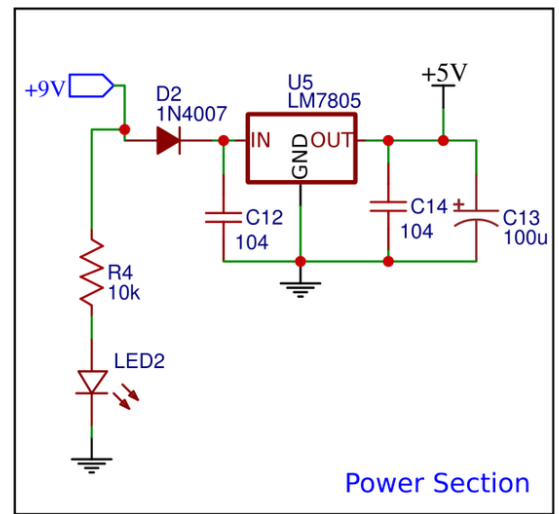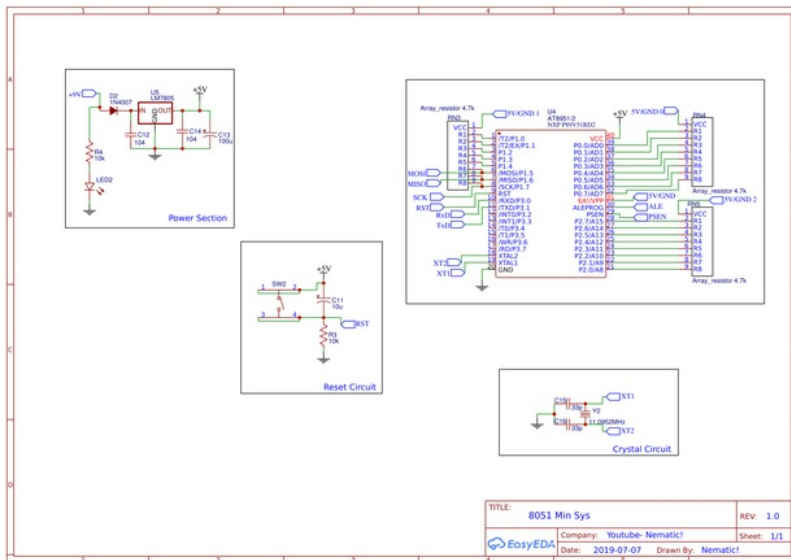
Here is the schematic for the minimal system,(Download PDF for better Quality)

Here mainly we have 3 sections,

- System Clock or Crystal Section: In 8051 clock circuit, a quartz crystal is used to make the clock circuit. The connection is shown in figure and note the connections to XTAL 1 and XTAL 2. If serial communications are involved then its best to use 11.0592 MHz frequency, Hence we use 11.0592MHz crystal

- Reset Circuit: 8051 can be reset in two ways,power-on reset – which resets the 8051 when power is turned ON and Manual reset – in which a reset happens only when a push button is pressed manually. Above circuit is used to Reset the 8051 using Pushbutton

- Power Circuit: Every device requires power so does our 8051 which needs 5V so we use an LM7805 Voltage regulator along with complementary capacitors to avoid noise in the system

Power Section

+9V
D2 1N4007
U5 LM7805
IN GND OUT
+5V
C12 104
C14 104
C13 100u
R4 10k
LED2

Crystal Circuit

C15 33p
Y2
C16 33p
11.0952MHz
XT1
XT2

Reset Circuit

+5V
SW2
1 2
3 4
C11 10u
R3 10k
RST

Array_resistor 4.7k
RN3
VCC
R1 R2 R3 R4 R5 R6 R7 R8

5V/GND 1
U4
AT8951/2
NXP P89V51RD2
VCC

MOSI
MISO
SCK
RST
RxD
TxD
XT2
XT1

1 /T2/P1.0
2 /T2/EX/P1.1
3 P1.2
4 P1.3
5 P1.4
6 /MOSI/P1.5
7 /MISO/P1.6
8 /SCK/P1.7
9 RST
10 /RXD/P3.0
11 /TXD/P3.1
12 /INT0/P3.2
13 /INT1/P3.3
14 /T0/P3.4
15 /T1/P3.5
16 /WR/P3.6
17 /RD/P3.7
18 XTAL2
19 XTAL1
20 GND

VCC 40
P0.0/AD0 39
P0.1/AD1 38
P0.2/AD2 37
P0.3/AD3 36
P0.4/AD4 35
P0.5/AD5 34
P0.6/AD6 33
P0.7/AD7 32
EA!/VPP 31
ALEPROG 30
PSEN 29
P2.7/A15 28
P2.6/A14 27
P2.5/A13 26
P2.4/A12 25
P2.3/A11 24
P2.2/A10 23
P2.1/A9 22
P2.0/A8 21

+5V 5V/GND 0
RN4
VCC
R1 R2 R3 R4 R5 R6 R7 R8
Array_resistor 4.7k

5V/GND 5V/GND 2
ALE
PSEN
RN5
VCC
R1 R2 R3 R4 R5 R6 R7 R8
Array_resistor 4.7k

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Step 3: RS232 Interface or SPI?

To establish a communication link between the PC and the 8051 for programming,

Serial communication is often used either to control or to receive data from an embedded microprocessor. Serial communication is a form of I/O in which the bits of a byte begin transferred appear one after the other in a timed sequence on a single wire. Serial

No start and stop bits, so the data can be streamed continuously without interruption complicated slave addressing system like I2C

Higher data transfer rate than I2C (almost twice as fast)

Separate MISO and MOSI lines, so data can be sent

communication has become the standard for intercomputer communication. in 1980s, 8051 and PC used RS232 link but is not used now.

So as a alternative we have SPI protocol which uses MOSI MISO and SCK pins for communication,

ADVANTAGES

and received at the same time

So hence I chose to ditch RS232 Port which you will find on many 8051 boards and simply used SPI pins
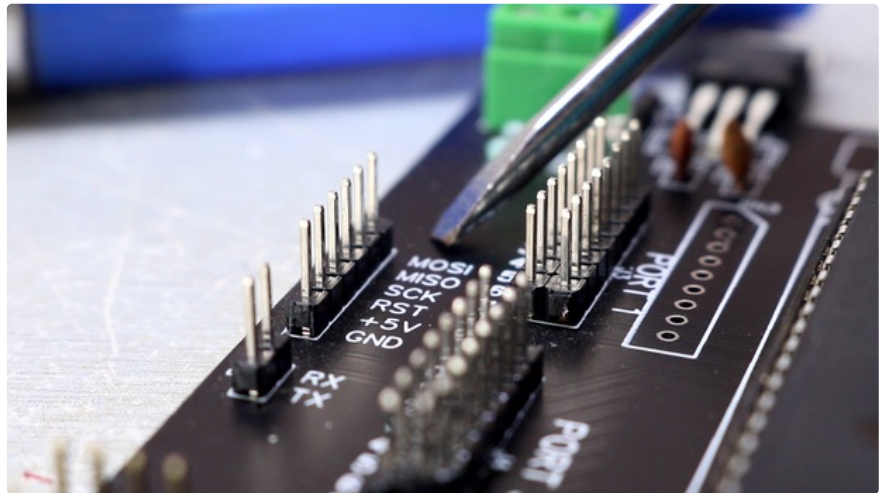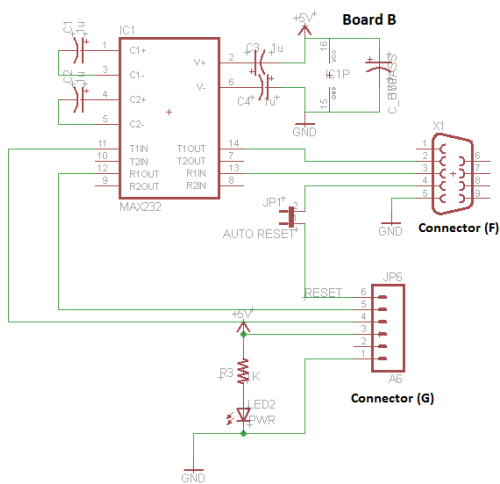
Step 4: Making PCB and Soldering

Since I plan to use this system for many projects and for prototyping I decided to design a PCB for it. So I fired up EASYEDA and designed this PCB and got them manufactured from China for cheap, By the way, feel free to download my Gerber file of PCB if you plan to make one by yourself.

Once I had the PCBs I soldered all the components

starting with the IC base you can even use a ZIF Socket, followed by the voltage regulator circuit and then Crystal circuit.

By the way, feel free to built your system on a Zero PCB or a breadboard just use short wire to avoid Parasectic Capacitances

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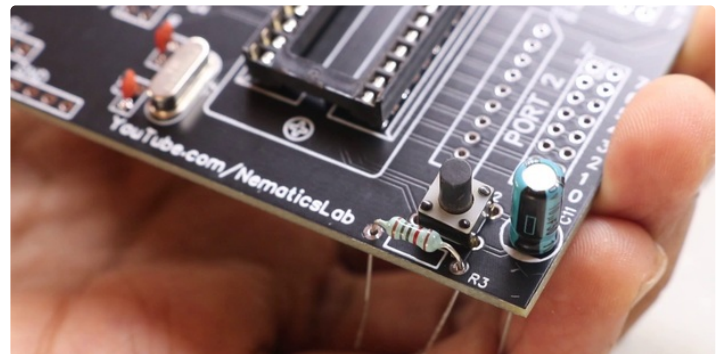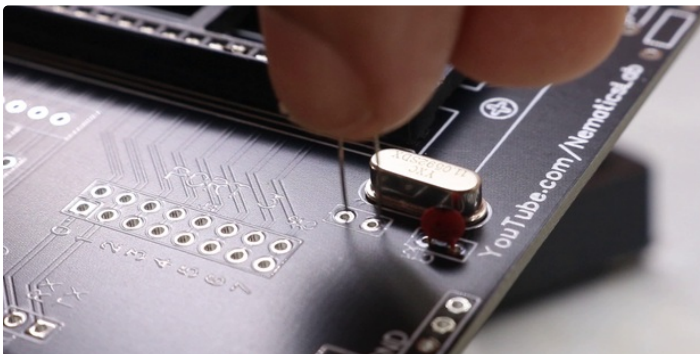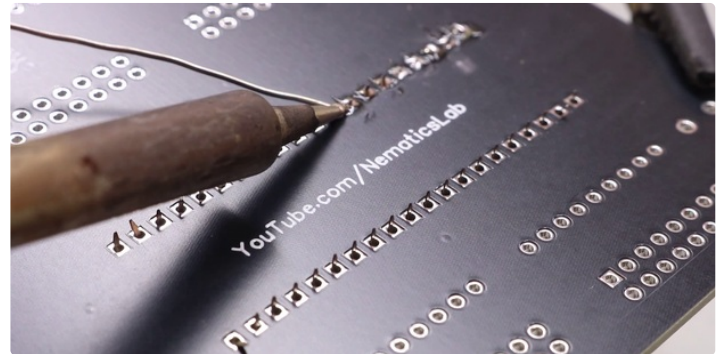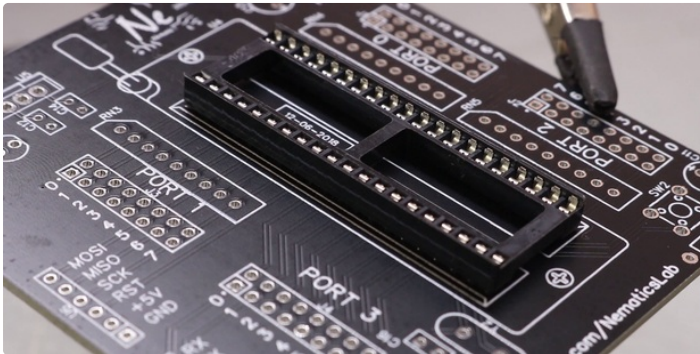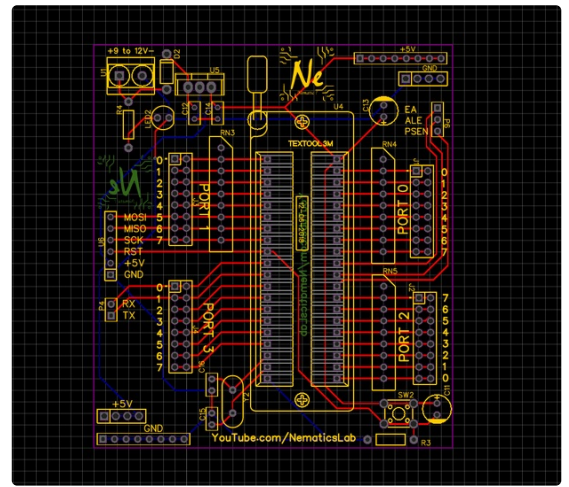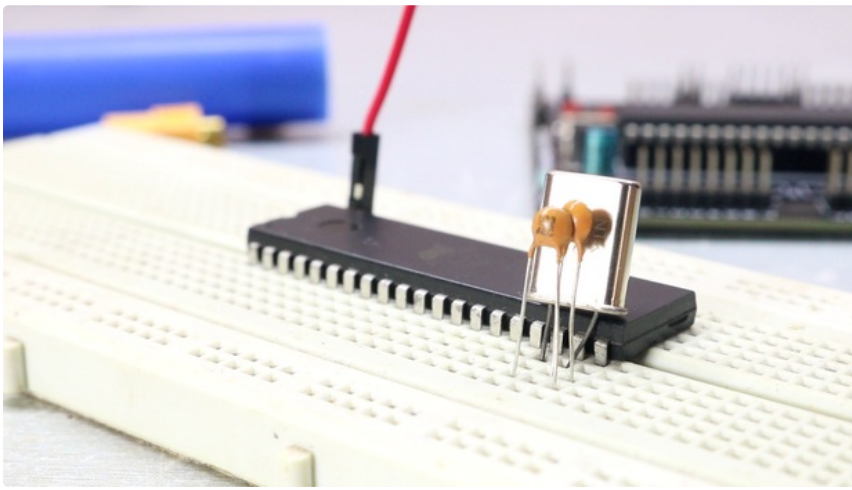
Step 5: Done!

Once you have successfully soldered everything, Congratz you have made an 8051 Development Board!

So that's pretty much it for this tutorial guys, If you like my work consider checking out my YouTube channel for more awesome stuff:
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upcoming projects

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