

# **Programming Firebird V on linux**

## **E-Yantra Summer Internship Program**

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# Chapter 1

## Working on Avrdude (Linux Platform)

Hello world ! This is a quick tutorial for working on Avrdude on the linux platform. This chapter covers the installation of Avrdude and other necessary software followed by compiling a program, generating a .hex file and loading the .hex file to the Atmega2560 controller using stk500v2 programmer. Refer to [1][2][3][4][5]

### 1.1 Installation Procedure

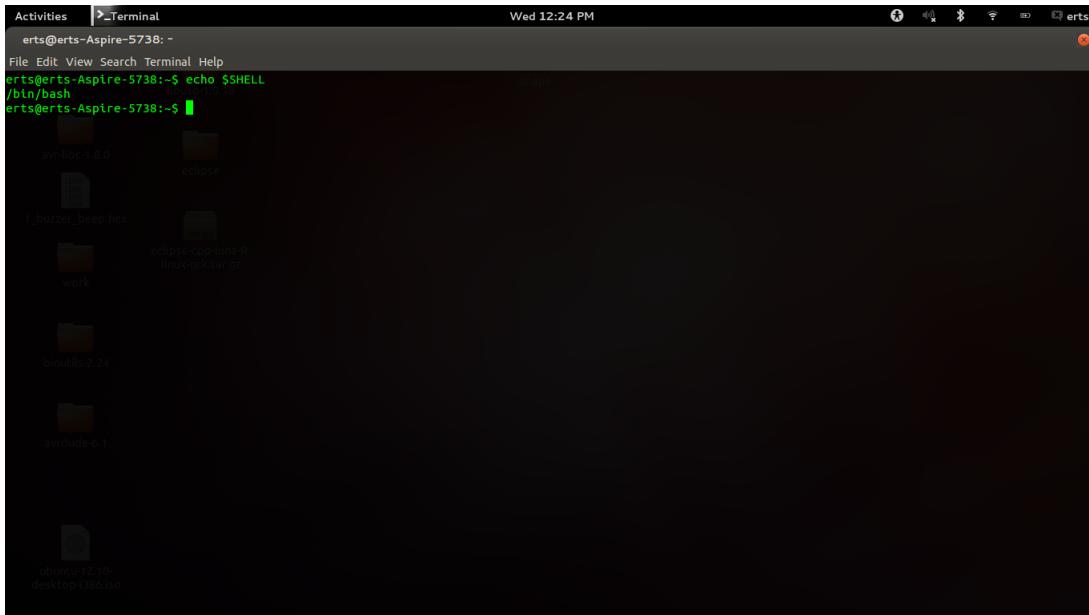
#### 1.1.1 Unix setup paths

**Step 1 :**

Open a new terminal and type -

```
echo $SHELL
```

Press return.

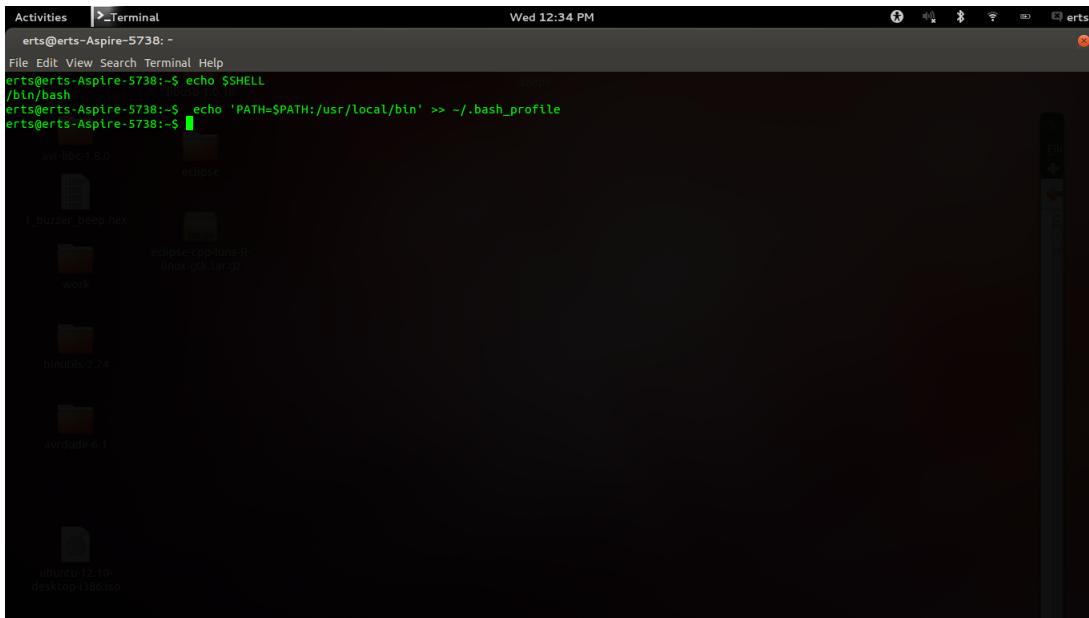


**Step 2 :**

If the output is **/bin/bash** then type the following command:

```
echo 'PATH=$PATH:/usr/local/bin' >> ~/.bash_profile
```

Press return.



If the output is **/bin/csh** or **/bin/tcsh** then type the following command:

```
echo 'set path = ($path /usr/local/bin)' >> ~/.cshrc
```

Press return.

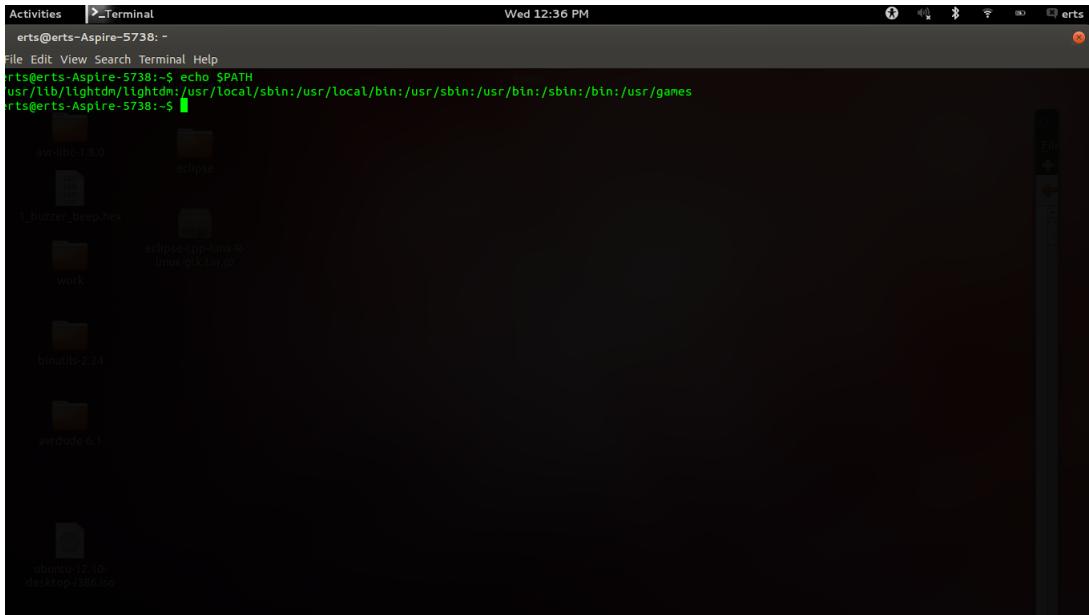
### Step 3 :

Close any open terminals and open a new one.

Now type :

```
echo $PATH
```

You should get an output similar to the one shown :



The important thing is that somewhere in the line of text you see **/usr/local/bin**.

## 1.1.2 Download and install the developer tools

### Step 1 :

You'll need the following packages: flex, byacc, bison, gcc, libusb and libusb-dev (for USB avr programmers)  
So type -

```
sudo apt-get install flex byacc bison gcc libusb-dev
```

A screenshot of a Linux desktop environment. In the top left corner, there's an 'Activities' button and a 'Firefox Web Browser' icon. The top right shows system status icons. The main area is a terminal window titled 'erts' with the command: 'erts@erts-Aspire-5738:~\$ sudo apt-get install flex byacc bison gcc libusb-dev'. Below the terminal, the desktop background shows various icons including 'avr-libc-1.8.0', 'eclipse', '1\_buzzer\_beep.hex', 'work', 'binutils-2.24', '1\_buzzer\_beep.c', 'avrduude-6.1', 'gcc-4.9.0', and 'ubuntu-12.10-desktop-i386.iso'.

### 1.1.3 Download & install binutils

**Step 1 :**

Download the latest release of binutils from -

<http://ftp.gnu.org/gnu/binutils/>

Navigate to the binutils directory by typing -

```
cd binutils-x.yz
```

Configure binutils for AVR. by typing -

```
./configure --target=avr --program-prefix="avr-"
```

A screenshot of a Linux desktop environment, similar to the previous one. The terminal window shows the command: 'erts@erts-Aspire-5738:~\$ cd Desktop/binutils-2.24' followed by 'erts@erts-Aspire-5738:~/Desktop/binutils-2.24\$ ./configure --target=avr --program-prefix="avr-' and a cursor. The desktop background is the same as the first screenshot.

After completion you will see the following text -

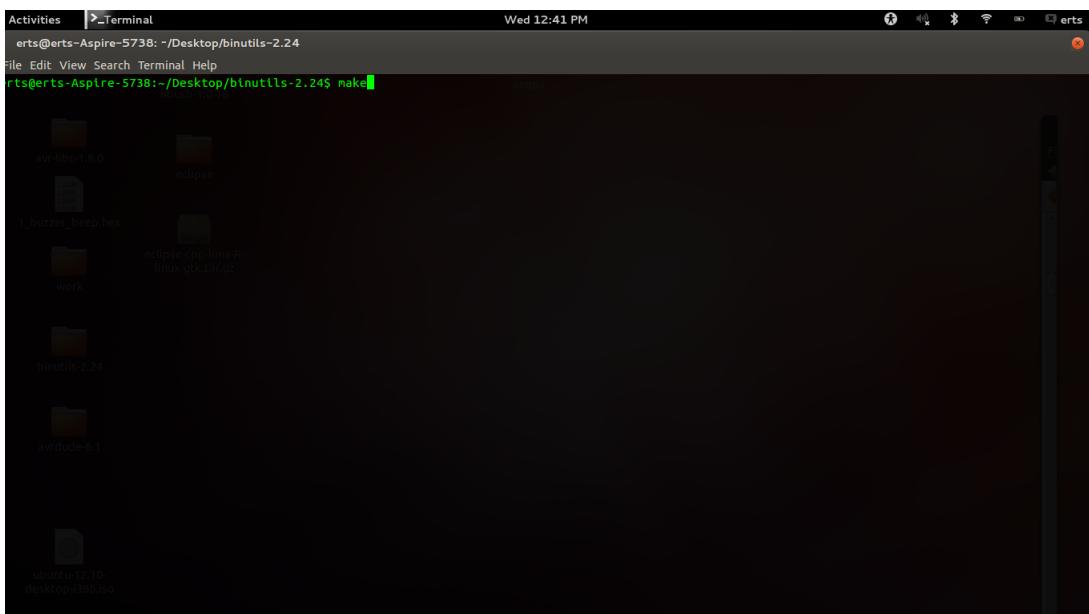
```
Activities Terminal Wed 12:40 PM
erts@erts-Aspire-5738: ~/Desktop/binutils-2.24
File Edit View Search Terminal Help
checking for avr-gcj... no
checking for avr-gfortran... no
checking for avr-gccgo... no
checking for avr-ar... avr-ar
checking for avr-as... avr-as
checking for avr-dltool... no
checking for avr-ld... avr-ld
checking for avr-lipo... no
checking for avr-nm... avr-nm
checking for avr-objdump... avr-objdump
checking for avr-ranlib... avr-ranlib
checking for avr-readelf... avr-readelf
checking for avr-strip... avr-strip
checking for avr-windres... no
checking for avr-windmc... no
checking where to find the target ar... just compiled
checking where to find the target as... just compiled
checking where to find the target c... pre-installed
checking where to find the target c++... pre-installed
checking where to find the target c++ for libstdc++... pre-installed
checking where to find the target dltool... just compiled
checking where to find the target gcc... pre-installed
checking where to find the target gcj... pre-installed
checking where to find the target gfortran... pre-installed
checking where to find the target gccgo... pre-installed
checking where to find the target ld... just compiled
checking where to find the target lipo... pre-installed
checking where to find the target nm... just compiled
checking where to find the target objdump... just compiled
checking where to find the target ranlib... just compiled
checking where to find the target readelf... just compiled
checking where to find the target strip... just compiled
checking where to find the target windres... just compiled
checking where to find the target windmc... just compiled
checking whether to enable maintainer-specific portions of Makefiles... no
configure: creating ./config.status
config.status: creating Makefile
erts@erts-Aspire-5738:~/Desktop/binutils-2.24$
```

## Step 2 :

Compile binutils by typing -

```
make
```

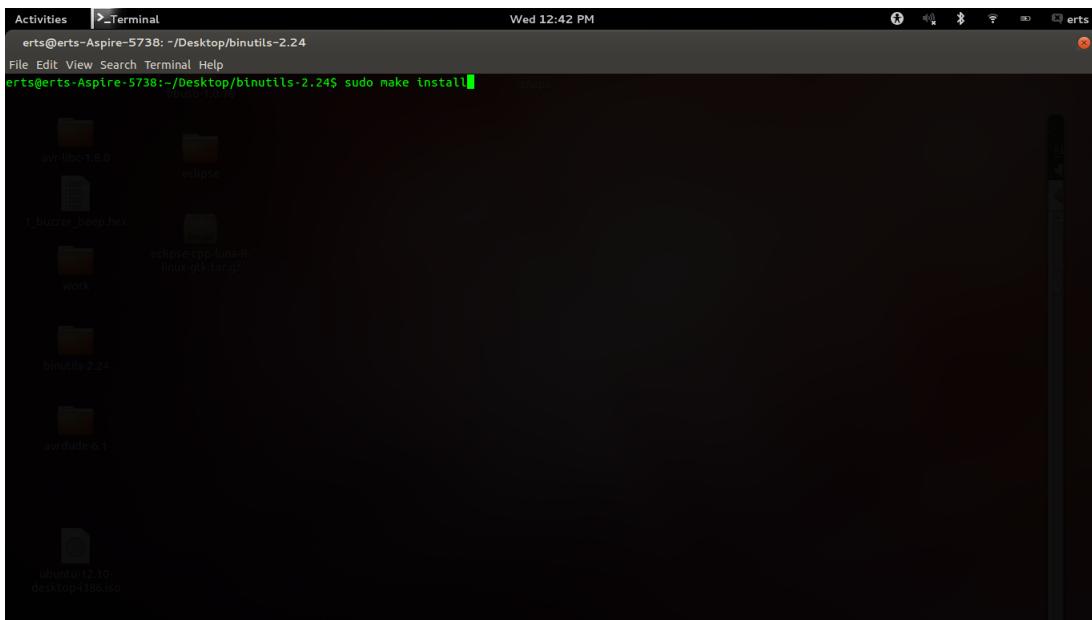
Press return.



## Step 3 :

Now install binutils by typing -

```
sudo make install
```



#### 1.1.4 Download and install avr-libc

**Step 1 :**

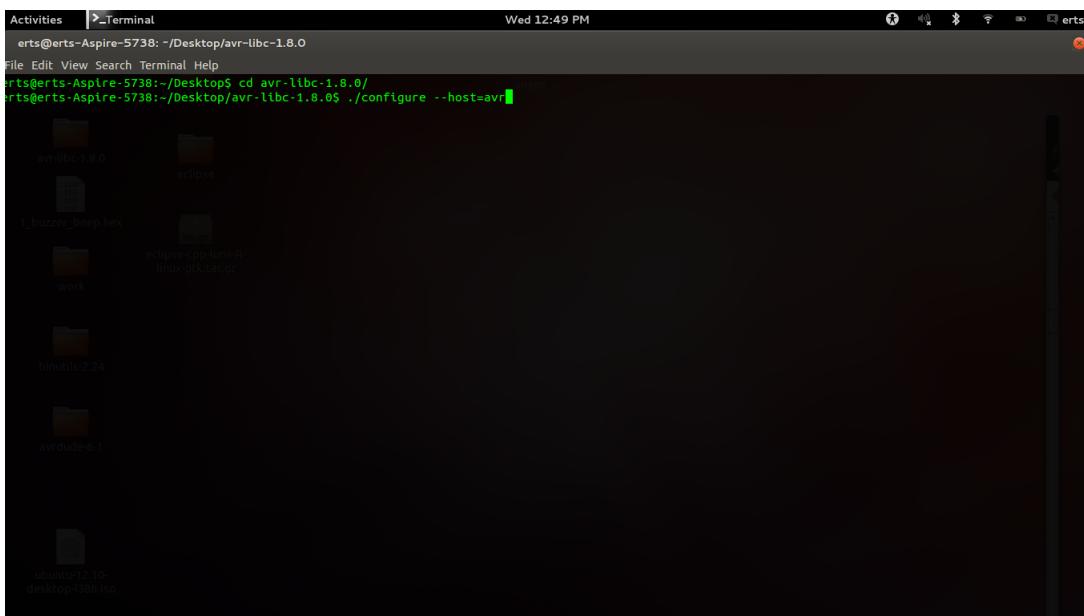
Download the current release of avr-libc from -  
<http://savannah.nongnu.org/projects/avr-libc/>

Navigate to the avr-libc directory by typing -

```
cd avr-libc-x.y.z
```

Configure avr-libc for AVR. by typing -

```
./configure --host=avr
```



After completion you will see the following text -

```
Activities Terminal Wed 12:51 PM
erts@erts-Aspire-5738: ~/Desktop/avr-libc-1.8.0
File Edit View Search Terminal Help
config.status: creating avr/lib/avr51/at90usb1286/Makefile
config.status: creating avr/lib/avr51/at90usb1287/Makefile
config.status: creating avr/lib/avr6/Makefile
config.status: creating avr/lib/avr6/atmega2560/Makefile
config.status: creating avr/lib/avr6/atmega2561/Makefile
config.status: creating avr/lib/avrxtmega2/Makefile
config.status: creating avr/lib/avrxtmega2/atmega16a4/Makefile
config.status: creating avr/lib/avrxtmega2/atmega16d4/Makefile
config.status: creating avr/lib/avrxtmega2/atmega32a4/Makefile
config.status: creating avr/lib/avrxtmega2/atmega32d4/Makefile
config.status: creating avr/lib/avrxtmega4/Makefile
config.status: creating avr/lib/avrxtmega4/atmega4a3/Makefile
config.status: creating avr/lib/avrxtmega4/atmega4d3/Makefile
config.status: creating avr/lib/avrxtmega5/Makefile
config.status: creating avr/lib/avrxtmega5/atmega4a1/Makefile
config.status: creating avr/lib/avrxtmega5/atmega4a1u/Makefile
config.status: creating avr/lib/avrxtmega6/Makefile
config.status: creating avr/lib/avrxtmega128a3/Makefile
config.status: creating avr/lib/avrxtmega128d3/Makefile
config.status: creating avr/lib/avrxtmega192a3/Makefile
config.status: creating avr/lib/avrxtmega192d3/Makefile
config.status: creating avr/lib/avrxtmega256a3/Makefile
config.status: creating avr/lib/avrxtmega256a3b/Makefile
config.status: creating avr/lib/avrxtmega256d3/Makefile
config.status: creating avr/lib/avrxtmega/Makefile
config.status: creating avr/lib/avrxtmega128a1/Makefile
config.status: creating avr/lib/avrxtmega7/atmega128aiu/Makefile
config.status: creating avr/lib/avrtiny10/Makefile
config.status: creating avr/lib/avrtiny10/attiny4/Makefile
config.status: creating avr/lib/avrtiny10/attiny5/Makefile
config.status: creating avr/lib/avrtiny10/attiny9/Makefile
config.status: creating avr/lib/avrtiny10/attiny10/Makefile
config.status: creating avr/lib/avrtiny10/attiny20/Makefile
config.status: creating avr/lib/avrtiny10/attiny40/Makefile
config.status: creating config.h
config.status: config.h is unchanged
config.status: executing depfiles commands
erts@erts-Aspire-5738: ~/Desktop/avr-libc-1.8.0
```

## Step 2 :

Compile binutils by typing -

make

Press return.

A screenshot of a dark-themed desktop environment. At the top, there's a header bar with the title "Activities > Terminal" and the date "Wed 12:52 PM". The main area shows a terminal window with the command "erts@erts-Aspire-5738:~/Desktop/avr-libc-1.8.0\$ make" and a file manager window displaying various files and folders on the desktop.

After completion you will see the following text -

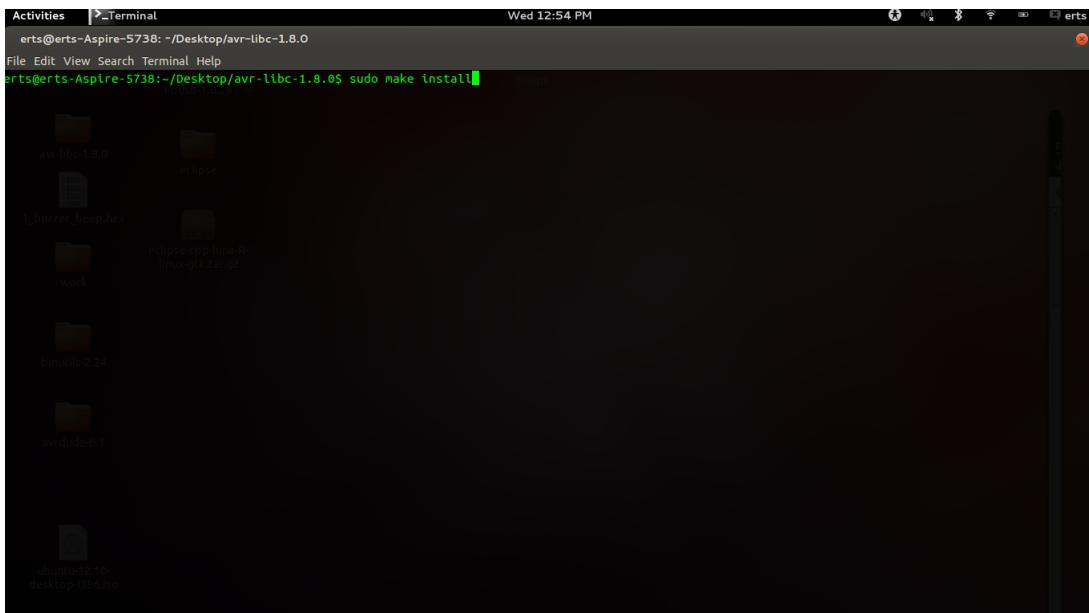
```

Activities | Terminal
erts@erts-Aspire-5738: ~/Desktop/avr-libc-1.8.0
File Edit View Search Terminal Help
make[5]: Nothing to be done for 'all'.
make[5]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib/avrltiny10/attiny20'
Making all in attiny40
make[5]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib/avrltiny10/attiny40'
make[5]: Nothing to be done for 'all'.
make[5]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib/avrltiny10/attiny40'
make[5]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib/avrltiny10'
make[5]: Nothing to be done for 'all-am'.
make[5]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib/avrltiny10'
make[4]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib/avrltiny10'
make[4]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib'
make[4]: Nothing to be done for 'all-am'.
make[4]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib'
make[4]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib'
make[4]: Nothing to be done for 'all'.
make[4]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr/lib'
make[3]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/avr'
make[3]: Nothing to be done for 'all'.
make[3]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/avr'
make[3]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[3]: Nothing to be done for 'examples'.
make[3]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/doc/examples'
make[3]: Nothing to be done for 'all'.
make[3]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc/examples'
make[3]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[3]: Nothing to be done for 'all'.
make[3]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[2]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
Making all in scripts
make[2]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/scripts'
sed -e 's,[@]prefix[],/usr/local,g' -e 's,[@]datadir[],/usr/local/share,g' -e 's,[@]DOC_INST_DIR[],/usr/local/share/doc/avr-libc-1.8.0,g' < ./avr-man.n.in > avr-man
chmod +x avr-man
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/scripts'
make[2]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0'
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0'
make[1]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0'
erts@erts-Aspire-5738:~/Desktop/avr-libc-1.8.0$
```

### Step 3 :

Now install avr-libc by typing -

```
sudo make install
```



After completion you will see the following text -

```

Activities Terminal Wed 12:55 PM
erts@erts-Aspire-5738: ~/Desktop/avr-libc-1.8.0
File Edit View Search Terminal Help
installing demo/iocompat.h into /usr/local/share/doc/avr-libc-1.8.0/examples/demo/iocompat.h
installing largedemo/Makefile into /usr/local/share/doc/avr-libc-1.8.0/examples/largedemo/Makefile
installing largedemo/Largedemo.c into /usr/local/share/doc/avr-libc-1.8.0/examples/largedemo/Largedemo.c
installing stdiodemo/Makefile into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/Makefile
installing stdiodemo/defines.h into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/defines.h
installing stdiodemo/hd44780.c into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/hd44780.c
installing stdiodemo/hd44780.h into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/hd44780.h
installing stdiodemo/Lcd.c into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/Lcd.c
installing stdiodemo/Lcd.h into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/Lcd.h
installing stdiodemo/stdiodemo.c into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/stdiodemo.c
installing stdiodemo/uart.c into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/uart.c
installing stdiodemo/uart.h into /usr/local/share/doc/avr-libc-1.8.0/examples/stdiodemo/uart.h
installing twttest/Makefile into /usr/local/share/doc/avr-libc-1.8.0/examples/twttest/Makefile
installing twttest/twttest.c into /usr/local/share/doc/avr-libc-1.8.0/examples/twttest/twttest.c
make[3]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc/examples'
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[3]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[3]: Nothing to be done for 'install-exec-am'.
make[3]: Nothing to be done for 'install-data-am'.
make[3]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[1]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/doc'
make[1]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0/scripts'
make[1]: Nothing to be done for 'install-exec-am'.
make[1]: Nothing to be done for 'install-data-am'.
test -z "/usr/local/bin" || /bin/mkdir -p "/usr/local/bin"
/usr/bin/install -c avr-man '/usr/local/bin'
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/scripts'
make[1]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0/scripts'
make[1]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0'
make[2]: Entering directory '/home/erts/Desktop/avr-libc-1.8.0'
make[2]: Nothing to be done for 'install-exec-am'.
make[2]: Nothing to be done for 'install-data-am'.
make[2]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0'
make[1]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0'
make[1]: Leaving directory '/home/erts/Desktop/avr-libc-1.8.0'
erts@erts-Aspire-5738:~/Desktop/avr-libc-1.8.0$ 

```

### 1.1.5 Download and install avrdude

**Step 1 :**

Download the current release of avrdude from -

<http://download.savannah.gnu.org/releases/avrdude/>

Navigate to the avrdude directory by typing -

```
cd avrdude-x.yz
```

Configure avrdude by typing -

```
./configure
```

```

Activities Terminal Wed 12:56 PM
erts@erts-Aspire-5738: ~/Desktop/avrduude-6.1
File Edit View Search Terminal Help
erts@erts-Aspire-5738:~/Desktop$ cd avrdude-6.1/
erts@erts-Aspire-5738:~/Desktop/avrdude-6.1$ ./configure

```

After completion you will see the following text -

```
Activities Terminal Wed 12:57 PM
erts@erts-Aspire-5738: ~/Desktop/avrdude-6.1
File Edit View Search Terminal Help
checking for strdup... yes
checking for strerror... yes
checking for strncasecmp... yes
checking for strtol... yes
checking for strtoul... yes
checking for gettimeofday... yes
checking for usleep... yes
checking for a Win32 HID library... no
checking for uint_t... no
checking for ulong_t... no
checking for parallel_device... /dev/parport0
checking for serial device... /dev/ttyS0
checking if gcc accepts -Wno-pointer-sign ... yes
checking that generated files are newer than configure... done
configure: creating ./config.status
config.status: creating doc/Makefile
config.status: creating Windows/Makefile
config.status: creating avrdude.spec
config.status: creating Makefile
config.status: creating avrdude.conf.tmp
config.status: creating ac_cfg.h
config.status: ac_cfg.h is unchanged
config.status: executing depfiles commands

configuration summary:
-----
DON'T HAVE libelf
DO HAVE libusb
DON'T HAVE libusb-1.0
DON'T HAVE libftd1
DON'T HAVE libftd1
DON'T HAVE libhid
DO HAVE pthread
DISABLED doc
ENABLED parport
DISABLED linuxgpio
erts@erts-Aspire-5738:~/Desktop/avrdude-6.1$
```

## Step 2 :

Compile avrdude by typing -

```
make
```

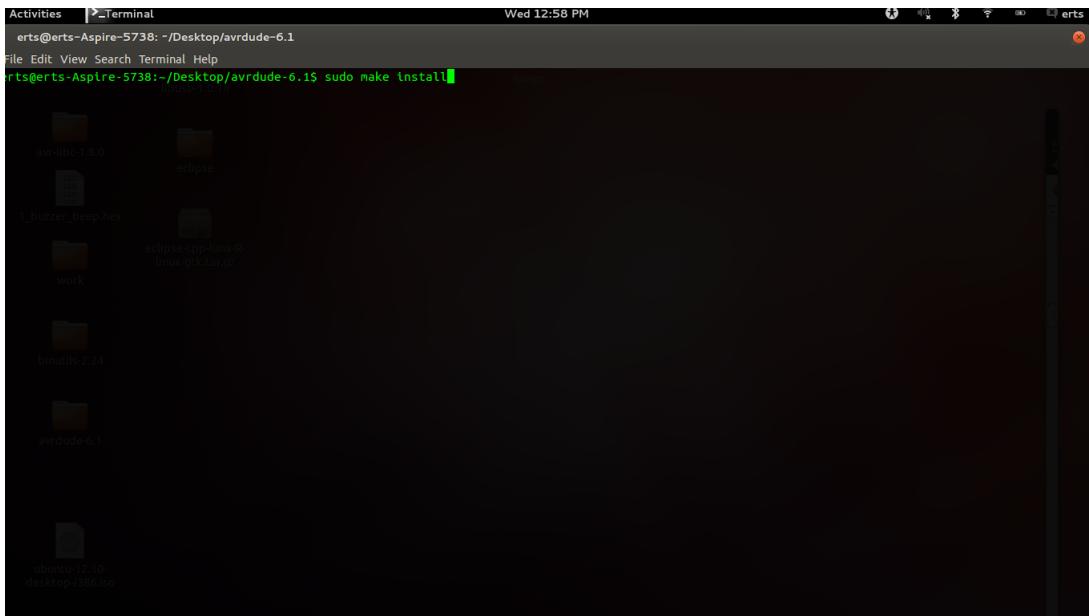
Press return.

```
Activities Terminal Wed 12:57 PM
erts@erts-Aspire-5738: ~/Desktop/avrdude-6.1
File Edit View Search Terminal Help
erts@erts-Aspire-5738:~/Desktop/avrdude-6.1$ make
make[1]: Entering directory `/home/erts/Desktop/avrdude-6.1'
  CC      avr-libc-1.8.0.o
  CC      eclipse.o
  CC      1-buzzer_deep.hex.o
  CC      work.o
  CC      binutils-2.24.o
  CC      avrdude-6.1.o
make[1]: Leaving directory `/home/erts/Desktop/avrdude-6.1'
erts@erts-Aspire-5738:~/Desktop/avrdude-6.1$
```

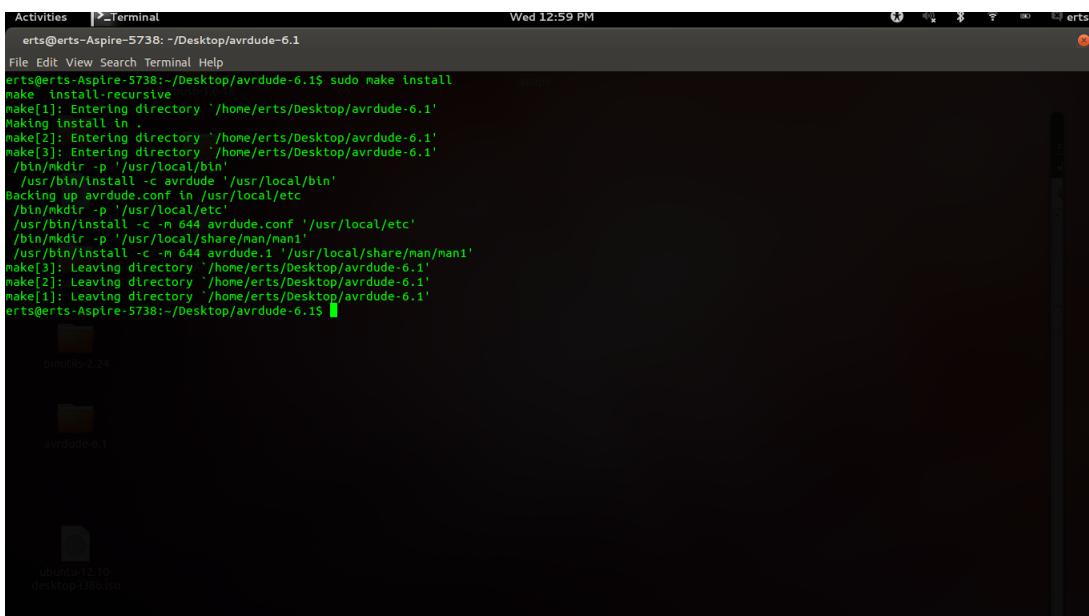
## Step 3 :

Now install avrdude by typing -

```
sudo make install
```



After completion you will see the following text -



## 1.2 Compilation, Generation and loading of .hex file

Type a program for the AVR platform on gedit text editor and save the file with .c extension.

### 1.2.1 Compilation

To compile the program type -

```
avr-gcc -mmcu=atmega2560 filename.c -o some_name
```

```

Activities Terminal
erts@erts-Aspire-5738: ~/Desktop
File Edit View Search Terminal Help
erts@erts-Aspire-5738:~/Desktop$ avr-gcc -mmcu=atmega2560 i_buzzer_beep.c -o output
In file included from i_buzzer_beep.c:66:0:
/usr/lib/gccavr4.5.3/../../../../avr/include/util/delay.h:95:3: warning: #warning "Compiler optimizations disabled; functions from <util/delay.h> won't work as designed"
erts@erts-Aspire-5738:~/Desktop$ 

```

### 1.2.2 Generation of the .hex file

To generate the .hex file type -

```
avr-objcopy -O ihex some_name source.hex
```

```

Activities Terminal
erts@erts-Aspire-5738: ~/Desktop
File Edit View Search Terminal Help
erts@erts-Aspire-5738:~/Desktop$ avr-gcc -mmcu=atmega2560 i_buzzer_beep.c -o output
In file included from i_buzzer_beep.c:66:0:
/usr/lib/gccavr4.5.3/../../../../avr/include/util/delay.h:95:3: warning: #warning "Compiler optimizations disabled; functions from <util/delay.h> won't work as designed"
erts@erts-Aspire-5738:~/Desktop$ avr-objcopy -O ihex output source.hex
erts@erts-Aspire-5738:~/Desktop$ 

```

### 1.2.3 Loading the .hex file

To load the .hex file on the Atmega2560 microcontroller using stk500v2 programmer type -

```
sudo avrdude -c stk500v2 -p m2560 -P /dev/ttyACM0 -U flash:w:'filepath/filename.hex':i
```

```
Activities Terminal Wed 3:45 PM
erts@erts-Aspire-5738: ~/Desktop/avrdude-6.1
File Edit View Search Terminal Help
erts@erts-Aspire-5738:~/Desktop$ avr-acc -mmcu=atmega2560 i_buzzer_beep.c -o output
In file included from i_buzzer_beep.c:6:0:
/usr/lib/gcc/avr/4.5.3/../../../../avr/include/util/delay.h:95:3: warning: #warning "Compiler optimizations disabled; functions from <util/delay.h> won't work as designed"
erts@erts-Aspire-5738:~/Desktop$ avr-objcopy -O ihex output source.hex
erts@erts-Aspire-5738:~/Desktop$ cd avrdude-6.1/
erts@erts-Aspire-5738:~/Desktop/avrdude-6.1$ sudo avrdude -c stk500v2 -p m2560 -P /dev/ttyACM0 -U flash:w:'/home/erts/Desktop/source.hex':i
[sudo] password for erts:
avrdude: AVR device initialized and ready to accept instructions
Reading | ##### | 100% 0.01s
avrdude: Device signature = 0x1e9801
avrdude: NOTE: "flash" memory has been specified, an erase cycle will be performed
To disable this feature, specify the -D option.
avrdude: erasing chip
avrdude: reading input file "/home/erts/Desktop/source.hex"
avrdude: writing flash (3824 bytes):
Writing | ##### | 100% 2.95s
avrdude: 3824 bytes of flash written
avrdude: verifying flash memory against /home/erts/Desktop/source.hex:
avrdude: load data flash data from input file /home/erts/Desktop/source.hex:
avrdude: input file /home/erts/Desktop/source.hex contains 3824 bytes
avrdude: reading on-chip flash data:
Reading | ##### | 100% 2.87s
avrdude: verifying ...
avrdude: 3824 bytes of flash verified
avrdude: safemode: Fuses OK (E:FD, H:DA, L:FF)
avrdude done. Thank you.
erts@erts-Aspire-5738:~/Desktop/avrdude-6.1$
```

Congratulations ! You have just completed the installation of Avrdude and loaded a .hex file on the Atmega2560 controller using the same.

# Bibliography

- [1] <http://www.ladyada.net/learn/avr/setup-unix.html>
- [2] <http://kamilskowron.pl/en/avr/ubuntu-avr-and-c-programming-microcontrollers-on-linuxatmega8/>
- [3] <http://ftp.gnu.org/gnu/binutils/>
- [4] <http://savannah.nongnu.org/projects/avr-libc/>
- [5] <http://download.savannah.gnu.org/releases/avrdude/>