Lesson 7: Case Study ; CAN on RPi HAT (Assignment 7)

Command - sudo apt install wiringpi

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $ sudo apt install wiringpi
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Package wiringpi:armhf is not available, but is referred to by another package.
This may mean that the package is missing, has been obsoleted, or
is only available from another source

E: Package 'wiringpi:armhf' has no installation candidate
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $
```

Command - git clone git@github.com:WiringPi/WiriingPi

```
cxr1020@raspberrypi:~/Documents/WiringPiRepo $ git clone git@github.com:WiringPi/WiringPi.git
Cloning into 'WiringPi'...
Enter passphrase for key '/home/cxr1020/.ssh/id_ed25519':
remote: Enumerating objects: 1736, done.
remote: Counting objects: 100% (617/617), done.
remote: Compressing objects: 100% (119/119), done.
remote: Total 1736 (delta 556), reused 500 (delta 498), pack-reused 1119
Receiving objects: 100% (1736/1736), 804.06 KiB | 1.73 MiB/s, done.
Resolving deltas: 100% (1190/1190), done.
cxr1020@raspberrypi:~/Documents/WiringPiRepo $ cd WiringPi/
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ ls
build          debian          devLib    gpio     newVersion  pins       update   version.h  wiringPiD
COPYING.LESSER  debian-template  examples  INSTALL  People      README.md  VERSION  wiringPi
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $
```

SourceCode - build_sh (wiringpi)

```
  GNU nano 5.4                                                  build
#       However if you're clever enough to actually look at this script to
#       see why it's not building for you, then good luck.
#
#       To everyone else: Stop using cheap alternatives. Support the
#       Raspberry Pi Foundation as they're the only ones putting money
#       back into education!
###############################################################################

check_make_ok() {
  if [ $? != 0 ]; then
    echo ""
    echo "Make Failed..."
    echo "Please check the messages and fix any problems. If you're still stuck,"
    echo "then raise a GitHub issue with the output and as many details as you can"
    echo "  https://github.com/WiringPi/WiringPi/issues"
    echo ""
    exit 1
  fi
}

sudo=${WIRINGPI_SUDO-sudo}

if [ x$1 = "xclean" ]; then
  cd wiringPi
  echo -n "wiringPi:   "        ; make clean
  cd ../devLib
  echo -n "DevLib:     "        ; make clean
  cd ../gpio
  echo -n "gpio:       "        ; make clean
  cd ../examples
  echo -n "Examples:   "        ; make clean
  cd Gertboard
  echo -n "Gertboard:  "        ; make clean
  cd ../PiFace

^G Help         ^O Write Out    ^W Where Is     ^K Cut          ^T Execute      ^C Location     M-U Undo        M-A Set Mark
^X Exit         ^R Read File    ^\ Replace      ^U Paste        ^J Justify      ^_ Go To Line   M-E Redo        M-6 Copy
```

SourceCode - Makefile (wiringPi)

```
  GNU nano 5.4                                                  Makefile
#    along with wiringPi.  If not, see <http://www.gnu.org/licenses/>.
###############################################################################

DESTDIR?=/usr
PREFIX?=/local

ifneq ($V,1)
Q ?= @
endif

#DEBUG  = -g -O0
DEBUG   = -O2
CC      ?= gcc
INCLUDE = -I$(DESTDIR)$(PREFIX)/include
CFLAGS  = $(DEBUG) -Wall -Wextra $(INCLUDE) -Winline -pipe $(EXTRA_CFLAGS)

LDFLAGS = -L$(DESTDIR)$(PREFIX)/lib
LIBS    = -lwiringPi -lwiringPiDev -lpthread -lrt -lm -lcrypt

# May not need to  alter anything below this line
###############################################################################

SRC     =       gpio.c readall.c

OBJ     =       $(SRC:.c=.o)

all:            gpio

version.h:      ../VERSION
        $Q echo Need to run newVersion above.

gpio:   $(OBJ)
        $Q echo [Link]
        $Q $(CC) -o $@ $(OBJ) $(LDFLAGS) $(LIBS)

^G Help         ^O Write Out    ^W Where Is     ^K Cut          ^T Execute      ^C Location     M-U Undo        M-A Set Mark
^X Exit         ^R Read File    ^\ Replace      ^U Paste        ^J Justify      ^_ Go To Line   M-E Redo        M-6 Copy
```

Output - build_sh (wiringpi)

```
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ ls
build          debian          devLib    gpio     newVersion  pins       update   version.h  wiringPiD
COPYING.LESSER  debian-template  examples  INSTALL  People      README.md  VERSION  wiringPi
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ ./build
wiringPi Build script
=====================


WiringPi Library
[UnInstall]
[Compile] wiringPi.c
[Compile] wiringSerial.c
[Compile] wiringShift.c
[Compile] piHiPri.c
[Compile] piThread.c
[Compile] wiringPiSPI.c
[Compile] wiringPiI2C.c
[Compile] softPwm.c
[Compile] softTone.c
[Compile] mcp23008.c
[Compile] mcp23016.c
[Compile] mcp23017.c
[Compile] mcp23s08.c
[Compile] mcp23s17.c
[Compile] sr595.c
[Compile] pcf8574.c
[Compile] pcf8591.c
[Compile] mcp3002.c
[Compile] mcp3004.c
[Compile] mcp4802.c
[Compile] mcp3422.c
[Compile] max31855.c
[Compile] max5322.c
[Compile] ads1115.c
[Compile] sn3218.c
[Compile] bmp180.c
[Compile] htu21d.c
[Compile] ds18b20.c
```

Command - gpio -v

```
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ gpio -v
gpio version: 2.70
Copyright (c) 2012-2018 Gordon Henderson
This is free software with ABSOLUTELY NO WARRANTY.
For details type: gpio -warranty

Raspberry Pi Details:
  Type: Pi 4B, Revision: 05, Memory: 8192MB, Maker: Sony
  * Device tree is enabled.
  *--> Raspberry Pi 4 Model B Rev 1.5
  * This Raspberry Pi supports user-level GPIO access.
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $
```

Command - gpio write 21 1

```
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ gpio -v
gpio version: 2.70
Copyright (c) 2012-2018 Gordon Henderson
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Raspberry Pi Details:
  Type: Pi 4B, Revision: 05, Memory: 8192MB, Maker: Sony
  * Device tree is enabled.
  *--> Raspberry Pi 4 Model B Rev 1.5
  * This Raspberry Pi supports user-level GPIO access.
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ gpio write 21 1
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ sudo strace -o /tmp/gpio.trace gpio write 21 1
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ vi /tmp/gpio.trace
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $
```

Command - sudo strace -o /tmp/gpio.trace gpio write 21 1

```
  GNU nano 5.4                                          /tmp/gpio.trace
mprotect(0x7f824d3000, 4096, PROT_READ) = 0
mprotect(0x7f8268f000, 4096, PROT_READ) = 0
mprotect(0x7f826b3000, 4096, PROT_READ) = 0
mprotect(0x5580ef7000, 4096, PROT_READ) = 0
mprotect(0x7f826f9000, 4096, PROT_READ) = 0
munmap(0x7f826b6000, 70924)             = 0
set_tid_address(0x7f826f0110)           = 601808
set_robust_list(0x7f826f0120, 24)       = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7f8264eb94, sa_mask=[], sa_flags=SA_SIGINFO}, NULL, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7f8264ec50, sa_mask=[], sa_flags=SA_RESTART|SA_SIGINFO}, NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) = 0
geteuid()                               = 0
brk(NULL)                               = 0x55904b4000
brk(0x55904d5000)                       = 0x55904d5000
openat(AT_FDCWD, "/proc/cpuinfo", O_RDONLY) = 3
fstat(3, {st_mode=S_IFREG|0444, st_size=0, ...}) = 0
read(3, "processor\t: 0\nBogoMIPS\t: 108.00\n"..., 1024) = 776
lseek(3, 0, SEEK_SET)                   = 0
read(3, "processor\t: 0\nBogoMIPS\t: 108.00\n"..., 1024) = 776
close(3)                                = 0
openat(AT_FDCWD, "/proc/cpuinfo", O_RDONLY) = 3
fstat(3, {st_mode=S_IFREG|0444, st_size=0, ...}) = 0
read(3, "processor\t: 0\nBogoMIPS\t: 108.00\n"..., 1024) = 776
close(3)                                = 0
openat(AT_FDCWD, "/dev/mem", O_RDWR|O_SYNC|O_CLOEXEC) = 3
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0xfe200000) = 0x7f826ef000
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0xfe20c000) = 0x7f826ee000
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0xfe101000) = 0x7f826ed000
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0xfe100000) = 0x7f826ec000
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0xfe00b000) = 0x7f826eb000
exit_group(0)                           = ?
+++ exited with 0 +++

^G Help        ^O Write Out   ^W Where Is    ^K Cut         ^T Execute     ^C Location    M-U Undo       M-A Set Mark
^X Exit        ^R Read File   ^\ Replace     ^U Paste       ^J Justify     ^_ Go To Line  M-E Redo       M-6 Copy
```

Command - ls /usr/local/include

```
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ ls /usr/local/include
ads1115.h    ds18b20.h    max31855.h   mcp23016reg.h  mcp23x08.h  pcf8574.h  pseudoPins.h  softServo.h    wiringPiSPI.h
bmp180.h     gertboard.h  max5322.h    mcp23017.h     mcp3002.h   pcf8591.h  rht03.h       softTone.h     wiringSerial.h
drcNet.h     htu21d.h     maxdetect.h  mcp23s08.h     mcp3004.h   piFace.h   scrollPhat.h  sr595.h        wiringShift.h
drcSerial.h  lcd128x64.h  mcp23008.h   mcp23s17.h     mcp3422.h   piGlow.h   sn3218.h      wiringPi.h     wpiExtensions.h
ds1302.h     lcd.h        mcp23016.h   mcp23x0817.h   mcp4802.h   piNes.h    softPwm.h     wiringPiI2C.h
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $
```

SourceCode - wiringpi_h

```
cxr1020@raspberrypi:~/Documents/WiringPiRepo/WiringPi $ cat /usr/local/include/wiringPi.h
/*
 * wiringPi.h:
 *      Arduino like Wiring library for the Raspberry Pi.
 *      Copyright (c) 2012-2017 Gordon Henderson
 ***********************************************************************
 * This file is part of wiringPi:
 *      https://github.com/WiringPi/WiringPi/
 *
 *    wiringPi is free software: you can redistribute it and/or modify
 *    it under the terms of the GNU Lesser General Public License as published by
 *    the Free Software Foundation, either version 3 of the License, or
 *    (at your option) any later version.
 *
 *    wiringPi is distributed in the hope that it will be useful,
 *    but WITHOUT ANY WARRANTY; without even the implied warranty of
 *    MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 *    GNU Lesser General Public License for more details.
 *
 *    You should have received a copy of the GNU Lesser General Public License
 *    along with wiringPi.  If not, see <http://www.gnu.org/licenses/>.
 ***********************************************************************
 */

#ifndef __WIRING_PI_H__
#define __WIRING_PI_H__

// C doesn't have true/false by default and I can never remember which
//      way round they are, so ...
//      (and yes, I know about stdbool.h but I like capitals for these and I'm old)

#ifndef TRUE
#  define       TRUE    (1==1)
#  define       FALSE   (!TRUE)
#endif

// GCC warning suppressor
```

SourceCode - gpio-test_c

```
  GNU nano 5.4                                          gpio-test.c *
#include <stdio.h>
#include <wiringpi.h>
#include <unistd.h>

int main()
{
        puts("test of wiringpi\n");

        wiringPiSetup();

        int major = 42;
        int minor = 42;
        wiringPiVersion(&major, &minor);
        pringf("major:minor: %d:%d\n", major, minor);

        int gpio21  = 21;
        pinMode(gpio21, OUTPUT);

        while(1)
        {
                puts("LED ON");
                digitalWrite(gpio21, 1);
                sleep(10);
                puts("LED OFF");
                digitalWrite(gpio21, 0);
                sleep(10);
        }

        return 0;
}



File Name to Write: gpio-test.c
^G Help          M-D DOS Format    M-A Append      M-B Backup File
^C Cancel        M-M Mac Format    M-P Prepend     ^T Browse
```

Output - gpio-test

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ nano gpio-test.c
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ gcc -Wall -o gpio-test gpio-test.c -lwirin
gPi
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ ls
gpio-test  gpio-test.c
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ ./gpio-test
test of wiringpi

major:minor: 2:70
LED ON
LED OFF
LED ON
LED OFF
LED ON
```

SourceCode - /boot/config_txt

```
  GNU nano 5.4                                    /boot/config.txt
#hdmi_mode=1

# uncomment to force a HDMI mode rather than DVI. This can make audio work in
# DMT (computer monitor) modes
#hdmi_drive=2

# uncomment to increase signal to HDMI, if you have interference, blanking, or
# no display
#config_hdmi_boost=4

# uncomment for composite PAL
#sdtv_mode=2

#uncomment to overclock the arm. 700 MHz is the default.
#arm_freq=800

# Uncomment some or all of these to enable the optional hardware interfaces
dtparam=i2c_arm=on
#dtparam=i2s=on
dtparam=spi=on
dtoverlay=mcp2515-can0,oscillator=8000000,interrupt=25,spimaxfrequency=1000000

# Uncomment this to enable infrared communication.
#dtoverlay=gpio-ir,gpio_pin=17
#dtoverlay=gpio-ir-tx,gpio_pin=18

# Additional overlays and parameters are documented /boot/overlays/README

# Enable audio (loads snd_bcm2835)
dtparam=audio=on

# Automatically load overlays for detected cameras
camera_auto_detect=1

^G Help          ^O Write Out     ^W Where Is      ^K Cut           ^T Execute       ^C Location      M-U Undo         M-A Set Mark
^X Exit          ^R Read File     ^\ Replace       ^U Paste         ^J Justify       ^_ Go To Line    M-E Redo         M-6 Copy
```

Output - dmesg | grep spi (before making hardware connections)

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ ls /boot/
bcm2710-rpi-2-b.dtb       bcm2711-rpi-400.dtb     cmdline.txt    fixup4x.dat   kernel8.img       start4.elf
bcm2710-rpi-3-b.dtb       bcm2711-rpi-4-b.dtb     config.txt     fixup_cd.dat  LICENCE.broadcom  start4x.elf
bcm2710-rpi-3-b-plus.dtb  bcm2711-rpi-cm4.dtb     COPYING.linux  fixup.dat     os_config.json    start_cd.elf
bcm2710-rpi-cm3.dtb       bcm2711-rpi-cm4-io.dtb  fixup4cd.dat   fixup_db.dat  overlays          start_db.elf
bcm2710-rpi-zero-2.dtb    bcm2711-rpi-cm4s.dtb    fixup4.dat     fixup_x.dat   start4cd.elf      start.elf
bcm2710-rpi-zero-2-w.dtb  bootcode.bin            fixup4db.dat   issue.txt     start4db.elf      start_x.elf
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ sudo nano /boot/config.txt
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ sudo nano /boot/config.txt
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ sudo reboot
Connection to 192.168.1.235 closed by remote host.
Connection to 192.168.1.235 closed.
shekharrangnekar@Shekhars-MBP ~ % ssh cxr1020@192.168.1.235
ssh: connect to host 192.168.1.235 port 22: Operation timed out
shekharrangnekar@Shekhars-MBP ~ % ssh cxr1020@192.168.1.235
cxr1020@192.168.1.235's password:
Linux raspberrypi 6.1.21-v8+ #1642 SMP PREEMPT Mon Apr  3 17:24:16 BST 2023 aarch64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Nov 25 06:02:22 2023
cxr1020@raspberrypi:~ $ dmesg | grep CAN
[    7.238481] CAN device driver interface
cxr1020@raspberrypi:~ $ dmesg | grep spi0
[    8.291542] mcp251x spi0.0: MCP251x didn't enter in conf mode after reset
[    8.292178] mcp251x spi0.0: Probe failed, err=110
[    8.292211] mcp251x: probe of spi0.0 failed with error -110
cxr1020@raspberrypi:~ $ client_loop: send disconnect: Broken pipe
shekharrangnekar@Shekhars-MBP ~ %
```

Output - dmesg | grep spi (after making connection)

```
Connection to 192.168.1.235 closed by remote host.
Connection to 192.168.1.235 closed.
shekharrangnekar@Shekhars-MBP ~ % ssh cxr1020@192.168.1.235
ssh: connect to host 192.168.1.235 port 22: Operation timed out
shekharrangnekar@Shekhars-MBP ~ % ssh cxr1020@192.168.1.235
cxr1020@192.168.1.235's password:
Linux raspberrypi 6.1.21-v8+ #1642 SMP PREEMPT Mon Apr  3 17:24:16 BST 2023 aarch64

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cxr1020@raspberrypi:~ $ dmesg | grep CAN
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[    8.291542] mcp251x spi0.0: MCP251x didn't enter in conf mode after reset
[    8.292178] mcp251x spi0.0: Probe failed, err=110
[    8.292211] mcp251x: probe of spi0.0 failed with error -110
cxr1020@raspberrypi:~ $ client_loop: send disconnect: Broken pipe
shekharrangnekar@Shekhars-MBP ~ % ssh cxr1020@192.168.1.235
cxr1020@192.168.1.235's password:
Linux raspberrypi 6.1.21-v8+ #1642 SMP PREEMPT Mon Apr  3 17:24:16 BST 2023 aarch64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Nov 25 06:07:17 2023
cxr1020@raspberrypi:~ $ dmesg | grep CAN
[    7.308675] CAN device driver interface
cxr1020@raspberrypi:~ $ dmesg | grep spi0
[    7.395144] mcp251x spi0.0 can0: MCP2515 successfully initialized.
cxr1020@raspberrypi:~ $
```

Command - ifconfig -a

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ ifconfig -a
can0: flags=128<NOARP>  mtu 16
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 10  (UNSPEC)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

eth0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether d8:3a:dd:18:e3:fa  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 20  bytes 2330 (2.2 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 20  bytes 2330 (2.2 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.235  netmask 255.255.255.0  broadcast 192.168.1.255
        inet6 2603:8001:7e00:c814::1f2d  prefixlen 128  scopeid 0x0<global>
        inet6 fe80::9dd4:fc69:b388:2ecf  prefixlen 64  scopeid 0x20<link>
        inet6 2603:8001:7e00:c814:c144:493f:25e8:4d48  prefixlen 64  scopeid 0x0<global>
        ether d8:3a:dd:18:e3:fc  txqueuelen 1000  (Ethernet)
        RX packets 1510  bytes 924925 (903.2 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 739  bytes 80559 (78.6 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $
```

Command - ip link set can0 up type can bitrate 500000

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ sudo ip link set can0 up type can bitrate
500000
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $
```

Command - sudo apt install can-utils

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ sudo apt-cache search can | grep can-u
can-utils - SocketCAN userspace utilities and tools
libsigscan-utils - binary signature scanning library -- Utilities
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ sudo apt install can-utils
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfuse2 raspinfo
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  can-utils
0 upgraded, 1 newly installed, 0 to remove and 2 not upgraded.
Need to get 128 kB of archives.
After this operation, 605 kB of additional disk space will be used.
Get:1 http://deb.debian.org/debian bullseye/main arm64 can-utils arm64 2020.11.0-1 [128 kB]
Fetched 128 kB in 0s (733 kB/s)
Selecting previously unselected package can-utils.
(Reading database ... 111303 files and directories currently installed.)
Preparing to unpack .../can-utils_2020.11.0-1_arm64.deb ...
Unpacking can-utils (2020.11.0-1) ...
Setting up can-utils (2020.11.0-1) ...
Processing triggers for man-db (2.9.4-2) ...
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $
```

Command - dpkg -L can-utils

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ dpkg -L can-utils
/.
/usr
/usr/bin
/usr/bin/asc2log
/usr/bin/bcmserver
/usr/bin/can-calc-bit-timing
/usr/bin/canbusload
/usr/bin/candump
/usr/bin/canfdtest
/usr/bin/cangen
/usr/bin/cangw
/usr/bin/canlogserver
/usr/bin/canplayer
/usr/bin/cansend
/usr/bin/cansequence
/usr/bin/cansniffer
/usr/bin/isotpdump
/usr/bin/isotpperf
/usr/bin/isotprecv
/usr/bin/isotpsend
/usr/bin/isotpserver
/usr/bin/isotpsniffer
/usr/bin/isotptun
/usr/bin/j1939acd
/usr/bin/j1939cat
/usr/bin/j1939spy
/usr/bin/j1939sr
/usr/bin/log2asc
/usr/bin/log2long
/usr/bin/slcan_attach
/usr/bin/slcand
/usr/bin/slcanpty
/usr/bin/testj1939
/usr/share
/usr/share/doc
/usr/share/doc/can-utils
/usr/share/doc/can-utils/NEWS.Debian.gz
```

SourceCode - can_receive_c

```
  GNU nano 5.4                                  can_receive.c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <net/if.h>
#include <sys/ioctl.h>
#include <sys/socket.h>
#include <linux/can.h>
#include <linux/can/raw.h>

int main()
{
        int ret;
        int s, nbytes;
        struct sockaddr_can addr;
        struct ifreq ifr;
        struct can_frame frame;

        memset(&frame, 0, sizeof(struct can_frame));

        system("sudo ip link set can0 type can bitrate 100000");
        system("sudo ifconfig can0 up");

        printf("this is a can receive demo\r\n");

        //1.Create socket
        s = socket(PF_CAN, SOCK_RAW, CAN_RAW);
        if (s < 0)
        {
                perror("socket PF_CAN failed");
                return 1;
        }

        //2.Specify can0 device
                                [ Read 77 lines ]
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute   ^C Location  M-U Undo    M-A Set Mark
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify   ^_ Go To Line M-E Redo    M-6 Copy
```

Output - can_receive

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ cd ..
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ cd CAN_Receiver/
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Receiver $ ./can_receive
this is a can receive demo
```

SourceCode - can_send_c

```
  GNU nano 5.4                                    can_send.c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <net/if.h>
#include <sys/ioctl.h>
#include <sys/socket.h>
#include <linux/can.h>
#include <linux/can/raw.h>

int main()
{
        int ret;
        int s, nbytes;
        struct sockaddr_can addr;
        struct ifreq ifr;
        struct can_frame frame;

        memset(&frame, 0, sizeof(struct can_frame));

        system("sudo ip link set can0 type can bitrate 100000");
        system("sudo ifconfig can0 up");
        printf("this is a can send demo\r\n");

        //1.Create socket
        s = socket(PF_CAN, SOCK_RAW, CAN_RAW);
        if (s < 0)
        {
                perror("socket PF_CAN failed");
                return 1;
        }

        //2.Specify can0 device
        strcpy(ifr.ifr_name, "can0");
                                [ Read 83 lines ]
^G Help         ^O Write Out    ^W Where Is     ^K Cut          ^T Execute      ^C Location     M-U Undo        M-A Set Mark
^X Exit         ^R Read File    ^\ Replace      ^U Paste        ^J Justify      ^_ Go To Line   M-E Redo        M-6 Copy
```

Output - can_send

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Receiver $ cd ..
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ mkdir CAN_Sender
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code $ cd CAN_Sender/
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ nano can_send.c
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ cp ../CAN_Receiver/Makefile ./M
akefile
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ ls
can_send.c  Makefile
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ nano Makefile
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ make
gcc -Wall -g -o0 -o can_send can_send.c
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $ ./can_send
RTNETLINK answers: Device or resource busy
this is a can send demo
can_id = 0x123
can_dlc = 8
data[0] = 1
data[1] = 2
data[2] = 3
data[3] = 4
data[4] = 5
data[5] = 6
data[6] = 7
data[7] = 8
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment07-Code/CAN_Sender $
```