GNSS Logger Unit with RTKLIB

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Objective

• To record the GNSS data directly from module for post processing
• Small footprint and easy to use
• Use RTKLIB as base software
Why we choose Raspberry Pi?

• Mainstream product
• Easy to use and maintenance
• RTKLIB, Just compile and GO!!
• A lot of integrate module available in Market
Why we choose Ublox M8T?

- RAW output available (RAWX and SFRBX)
- Reasonable price
- Multiple GNSS support
Complement of Logger

• Raspberry Pi (B+, 2 and 3)
• Ublox M8T
• LCD Monitor
• USB cable
• Antenna
• USB Drive (Fat32)
Complement of Logger (2)

Antenna
Tallysman 2410
Tallysman 2710

USB Drive

Raspberry PI with LCD monitor

Ublox NEO M8T
Logger Data Flow

Antenna → Ublox M8T → RASPBERRY PI

GNSS Satellites

Logger unit Hardware

USB Drive
**Logger function with STR2STR**

- This logger unit uses STR2STR, one of the applications on RTKLIB. It's available on Windows as STRSVR.
- By the function of STR2STR, we record data directly from receiver to file (store over USB drive).
How to build?
How to build

Narrow down to 3 step
1. Raspberry Pi preparation
2. Receiver preparation
3. Software preparation
Raspberry Pi preparation

- Any version of Raspberry Pi can be used in this project. (B+, 2 and 3)
- In order to gain OS performance, a newer version of the board is better. (Model B+ uses a single core at 700MHz compared to model 2 and 3 with quad cores at a higher speed)
- But you need to be careful about the environment temperature of your experiment, as a newer CPU generates more temperature. This can cause system overheating and auto-shutdown
- Comparison of Raspberry Pi available on next slide
**Raspberry Pi preparation**

<table>
<thead>
<tr>
<th>Generation</th>
<th>B+</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong></td>
<td>25 USD</td>
<td>35 USD</td>
<td>35 USD</td>
</tr>
<tr>
<td><strong>Architecture</strong></td>
<td>ARMv6 (32-bit)</td>
<td>ARMv7 (32-bit)</td>
<td>ARMv8 (64/32-bit)</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td>Single core 700MHz</td>
<td>Quad core 900MHz</td>
<td>Quad core 1200MHz</td>
</tr>
<tr>
<td><strong>Memory</strong></td>
<td>512MB</td>
<td></td>
<td>1GB</td>
</tr>
<tr>
<td><strong>USB</strong></td>
<td>4 Ports</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Network</strong></td>
<td>10/100 Lan Port</td>
<td></td>
<td>10/100 Lan Port, Wifi</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>600mA (3W)</td>
<td>800mA (4W)</td>
<td>1400mA (7W)</td>
</tr>
</tbody>
</table>


- We recommend you to use Raspberry Pi 2 by balance of performance and consumption power
- This model capable to modify to Navigation unit as well
Raspberry Pi preparation

• Tested Operating system that can run RTKLIB are Raspbian and Ubuntu Mate
• Install the OS on SD card (8GB or over)
• Follow the default step of installation
Raspberry Pi preparation

• You can install the board on any case. On this project we used clear case

Case for Raspberry Pi 3 Model B/ Raspberry Pi 2 Model B/ Pi Model B+
https://www.amazon.co.jp.dp/B01CDUM3D6/ref=pe_492632_227730602_TE_item
Price at 790Yen/case
Raspberry Pi preparation

• LCD Screen for display information, we used Adafruit 2.4” 320x240 TFT

• Please soldering 40 female pin to LCD board for connect to Raspberry Pi

https://www.amazon.co.jp/dp/B019IBEMK0
Price at 5527yen/unit

http://www.marutsu.co.jp/pc/i/574345/
Price at 4350yen + tax
Raspberry Pi preparation

• Connect LCD board to Raspberry Pi board via 40 GPIO Pin
Receiver preparation

• Check the firmware of M8T, update to the new version (Current 3.01). For make receiver support Galileo satellite

• In this project we use 4 GNSS satellites. GPS, QZSS, Beidou and Galileo

UBLOX NEO-M8T TIME & RAW receiver board with SMA (RTK ready)
Receiver preparation

• The setting in receiver depend on what data you want to output and record

• In our project we use those setting below
  • NMEA and RAW output via USB
  • GPS, Galileo, QZSS and Beidou
  • 5Hz data output
Software preparation

• Pre OS configuration
• RTKLIB software installation
• CLI mode configuration
• LCD monitor setup
• USB drive configuration
• Auto-start script configuration
• Trigger OS shutdown by USB
Software preparation

Pre Operating System configuration

• Expand the disk file system
  • Open Menu ➔ Preferences ➔ Raspberry Pi Configuration
  • Select “Expand Filesystem” then restart the system
Software preparation

RTKLIB software installation

• Download RTKLIB software from GITHUB (2.4.3 or greater)
• Unzip and go to “RTKLIB-Master¥app” directory
• Execute “sudo chmod 755 makeall.sh” command
• Execute “sudo ./makeall.sh” and wait until it complete
Software preparation

CLI mode configuration

• Open Menu ➔ Preferences ➔ Raspberry Pi Configuration

• From the “System” tab, you can simply click the radio button next to “To CLI” to change the boot preference.

• Then reboot to CLI
Software preparation

LCD Monitor Setup

• At console prompt, install new kernel by type commands below

$curl -SLs https://apt.adafruit.com/add-pin | sudo bash
$sudo apt-get install raspberrypi-bootloader
$sudo apt-get install adafruit-pitft-helper
Software preparation

LCD Monitor Setup (2)

• Enable & Configure the PiTFT
  
  $sudo adafruit-pitft-helper -t 28r

• At the end you will be prompted on whether you want the text console to appear on the LCD Screen. Answer Y to continue.
Software preparation

USB Drive Configuration

• Prepare USB drive using FAT32 file format
• Create mount point on Raspberry Pi by those commands below

$ sudo mkdir /media/usb

$ sudo chown -R pi:pi /media/usb
Software preparation

Auto-start script configuration
This allow STR2STR to auto-start when system boot completed

Edit “rc.local” by type this command below
$ sudo nano /etc/rc.local
Auto-start script configuration (2)

- After the initial comments (lines beginning with '#') add those commands below.

  ```bash
  sudo mount /dev/sda1 /media/usb -o uid=pi,gid=pi
  cd /home/pi/RTKLIB-master/app/str2str/gcc/
  sudo ./str2str -in serial://ttyACM0:57600#ubx –out
  file:///media/usb/$(date +%Y%m%d-%H%M%S)
  ```

- First command will auto mount USB drive, Second will go to STR2STR directory and the last one will start STR2STR with writing the output to USB drive
Software preparation

Trigger OS shutdown by USB

• As the logger unit has no keyboard when operating on field.

• We add more script to be trigger for shutdown process. By disconnect receiver from Raspberry Pi.

• To protect the output file from EOF problem.
Software preparation

Trigger OS shutdown by USB (2)

1. At console, Get information about the device via "lsusb"

   (The third field labelled ID is the vendor and model id separated by a colon)

2. Create a file in /etc/udev/rules.d

   (This is the same regardless of distribution. The file must end in .rules and all files in this directory are processed lexicographically. Such as 00-XXX.rules)
Software preparation

Trigger OS shutdown by USB (3)

3. Edit the created file as below

   ACTION="remove", ENV{ID_VENDOR_ID}="XXXX", ENV{ID_MODEL_ID}="XXXX", RUN="/sbin/shutdown -h now"

   Create a file in /etc/udev/rules.d

4. Run command "udevadm control --reload-rules" to take effect.

5. System is now ready to use as Logger unit.
How to use?
How to use?

We divide into 3 steps
1. Prepare and Start system
2. Shutdown system
3. Access the record file
Prepare and Start system

• Plug Ublox Neo-M8T unit (via USB) and USB drive to logger unit
Prepare and Start system

- Plug power cable to logger unit (USB2.0 cable from power adapter or power bank)
Prepare and Start system

• Logger system will start automatically as picture below.

(In case that system cannot start or boot to terminal prompt, please check M8T and USB drive are plug to the system correctly or not, then reboot the system again)
**Shutdown system**

- When you done the experiment, please unplug the Ublox Neo-M8T from logger unit and system will start to shutdown automatically.
**Shutdown system**

- The last state of shutdown system is “Reached target Shutdown” then you can remove power cable
Access the record file

• When you shutdown unit, record file will available in the USB drive. Filename will be written by the time of Raspberry PI system, please check the actual time inside the file again (GPST)

• As the script configuration, file will not has the extension
Access the record file

- Recorded file UBX can be review from ucenter application provided by Ublox.
- From here, you can briefly review data and position in map view
Experiment
Experiment with Logger unit

• We conducted an experiment using logger unit in Laboratory work, Hamamatsu and Summer camp in Thailand recently.

• At Summer camp, we collect data and did the post processing by using TUMSAT base station data.
**Summer Camp Experiment**

**Rover (Logger Unit)**

**Base station setup by TUMSAT**
Experiment result (RTK Plot)
Experiment result (Google Earth)
Experiment result (Crop some area)
Future work

• Study and develop the prototype for more efficiency.
• Gathering the record data for improve my research
Contact point

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