

ILR - 08

Perception System Using Stereo Vision
and Radar

Team A - Amit Agarwal

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Table of Contents

- 1. Individual Progress 1
 - 1.1 Delphi ESR 2.5 1
- 2. Challenges 3
 - 2.1 WireShark Inconsistency 3
- 3. Teamwork 3
- 4. Future Plans 4
- 5. References 4

1. Individual Progress

Since the previous progress review, I was retasked with working on the Radar and getting the Radar set up through Ethernet. For this I worked with Harry and attempted to obtain data through the terminal and WireShark.

1.1 Delphi ESR 2.5

Over the past couple of weeks, Harry and I have been working on getting sensible data from the Delphi ESR 2.5 Radar. After multiple challenges to obtain data from the Radar and communication with Delphi, we were instructed by the team at Delphi to use the Ethernet port to get data instead. Previously, we were using the CAN connector to get data from the Delphi ESR 2.5 radar. The data obtained from the Radar through Ethernet is the raw detection level data in contrast to the processed tracking level data obtained through CAN.

The test car used was a 2004 Volvo S60 2.5T AWD acquired by Harry. The Delphi ESR 2.5 was mounted in front of the grill of the test car. This was done using multiple zip-ties and a 3D printed mount that is sturdy and keeps the Radar in place through uneven roads. The voltage generator was connected to an AC output in the Newell Simon Hall basement next to the car. DC power was taken from the voltage generator using alligator cables which provided 24 V as required for the Radar. The wire from the Radar had a female USB port, in which a USB to Ethernet converter was connected. A CAT5e Ethernet cable was attached to the converter. An Ethernet to USB convertor was connected to the other end, which was further connected to a MacBook Pro using a USB-A to USB-C converter. To complete the setup, the voltage generator was switched on. Once the Radar was drawing current from the Voltage Generator, the IP address of the Radar was confirmed. The IP address of the Radar was confirmed to be 192.168.2.21. This IP address was used to identify the Radar permanently.

To obtain the data through Ethernet, the first step was to confirm that the system used to obtain the data and the radar had to use the same IP indexing system. The IP address of the computer was changed using the `ifconfig` command in terminal from 10.1.1.34 to 192.168.2.55 to obtain data from the Radar. After this, the data was obtained using the `netcat` command in terminal using the IP address of the Radar and port number 5555. The data obtained using this command was completely unreadable. Although, it was later verified with Delphi that this is the expected form of the data, as shown in figure 1.

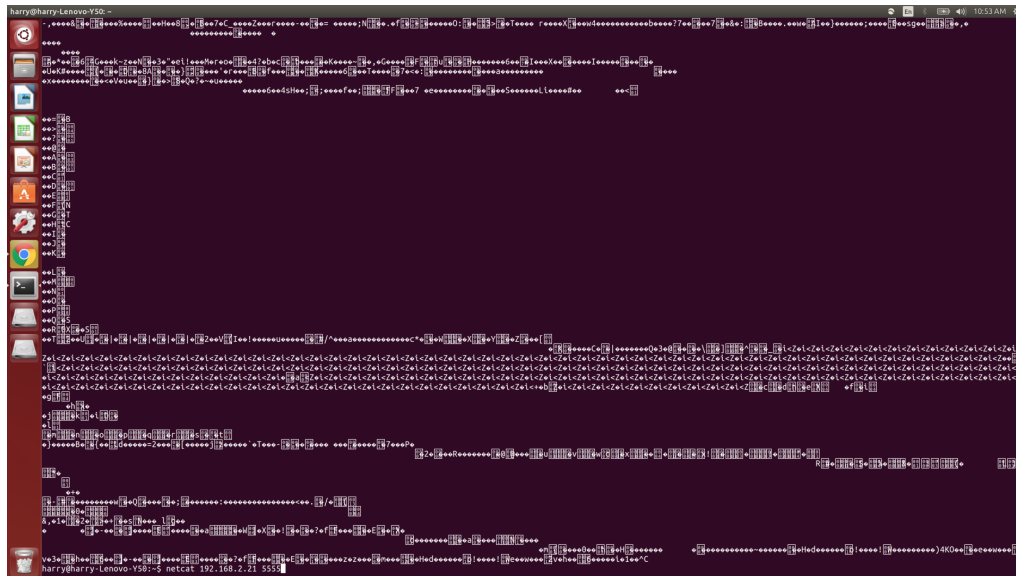


Figure 1: Unreadable data from the Radar

According to Delphi, the correct form of interpreting the data is to parse it as hex values. These hex values are stored similarly to a CSV file. The data values of the information given from the Radar are stored one after the other without any labels in the form of a 64-byte packet. These hex values need to be parsed according a table supplied to us which helps in decoding each packet of data. Delphi obtains the data in hex format using a software tool called WireShark. WireShark was installed on the system used was run using the command `sudo wireshark` right after verifying that packets are being received from the Radar using the netcat command used earlier. In WireShark, the eth0 line of connection was chosen to receive the data. The data that is received from the Radar is supposed to be shown in hex format. Obtaining data from WireShark worked inconsistently. On several occasions, WireShark would not detect the Radar as the eth0 connection. This is further discussed in the Challenges section.

```

00000000 83 e0 ff eb 1f 25 50 44 46 2d 31 2e 35 0a 39 39 |....%PDF-1.5.99
00000010 39 20 30 20 6f 62 6a 0a 3c 3c 3e 3e 0a 73 74 72 |9 0 obj.<<>.str
00000020 65 61 6d 0a 68 e0 08 17 bc 00 10 68 c0 07 1f eb |eam.h.....h....
00000030 21 59 81 f9 4d 5a 74 0c b4 0e 86 c1 cd 10 86 c5 |!Y..MZt.....
00000040 cd 10 eb ed be 55 00 ac 75 02 eb fe b4 0e cd 10 |....U..u.....
00000050 eb f5 eb 72 e9 2d 2d 57 41 52 4e 49 4e 47 2d 2d |...r.--WARNING--
00000060 0a 20 20 20 55 6e 61 75 74 68 6f 72 69 7a 65 64 |. Unauthorized
00000070 20 66 69 6c 65 20 61 63 63 65 73 73 20 77 69 6c | file access wil
00000080 6c 20 62 65 20 72 65 70 6f 72 74 65 64 2e 0a 20 |l be reported..
00000090 20 20 20 20 58 45 52 58 45 53 20 77 69 73 68 65 | XERXES wishe
000000a0 73 20 79 6f 75 0a 20 20 20 20 20 20 20 20 20 20 |s you.
000000b0 61 20 6d 6f 73 74 20 70 72 6f 64 75 63 74 69 76 |a most productiv
000000c0 65 20 64 61 79 00 68 6f 77 68 59 58 68 0d 0a 68 |e day.howhYXh.h
000000d0 37 69 68 68 7a 68 4f 77 68 34 35 68 0a 40 68 67 |7ihhzhOwh45h.@hg
000000e0 49 68 20 2c 68 23 6f 68 4d 5a 68 0a 0a 68 4e 6c |Th ,h#ohMZh.hNl
000000f0 68 61 57 68 46 75 68 61 6d 68 0a 20 68 3a 20 68 |haWhFuhamh. h: h
00000100 69 73 68 64 20 68 6f 72 68 73 77 68 61 73 68 20 |ishd horhswahsh
00000110 70 68 68 65 68 0a 54 e9 17 ff 00 00 00 00 00 00 |phheh.T.....
00000120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....
*
000001f0 00 00 00 00 00 00 00 00 00 00 00 55 aa |.....U.
00000200 25 50 44 46 2d 31 2e 35 0a 25 d0 d4 c5 d8 0a 34 |%PDF-1.5%. ....4
00000210 20 30 20 6f 62 6a 20 3c 3c 0a 2f 4c 65 6e 67 74 |h 0 obj <<./Lengt
00000220 68 20 32 39 32 20 20 20 20 20 20 20 0a 2f 46 69 |h 292 ./Fi
00000230 6c 74 65 72 20 2f 46 6c 61 74 65 44 65 63 6f 64 |lter /FlateDecod
00000240 65 0a 3e 3e 0a 73 74 72 65 61 6d 0a 78 da 6d 51 |e.>.>.stream.x.mQ
00000250 c1 6e 83 30 0c bd e7 2b 7c 2b 48 23 25 49 09 e1 |.n.0...+|H#I..
00000260 34 a9 da aa 75 b7 4d 5c a6 69 07 0a a1 a0 15 c2 |4...u.M..i.....
00000270 20 19 e2 ef 07 0b 91 b6 aa 8a 14 3f db cf ef 59 |.....?..Y
00000280 c9 3e 45 db 03 89 20 c1 09 a7 1c d2 12 08 8d 70 |..>E.....p
00000290 2c 28 f0 98 63 4a 19 a4 05 bc 7b 07 65 da c2 0f |(.cJ...{e...
000002a0 22 1a 79 ba aa 07 8b f0 b6 30 4d 67 71 59 5f e4 |".y.....OMgqY..
000002b0 9d 23 28 73 ae b4 4d 26 65 36 85 a3 38 89 7a 6d |.#(s..M&e6...8.Zm
000002c0 9a 41 96 e6 82 fd 8f f4 19 42 08 88 c0 09 4d ac |.A.....B...M.
000002d0 e1 71 f3 2d 2d 49 b6 79 3f 75 5a 5e cd 5a 97 d5 |.q.--I.y?uZ^Z..
000002e0 f2 24 f3 6c 16 b3 89 2a 1d 63 2d 74 6a 94 fd e0 |.$.l...*.c-tj...
000002f0 8a 99 76 33 18 df b4 7e 53 c6 32 3e 5b 35 5a 54 |..v3...~S.2>[SZT
00000300 39 a0 95 8d 67 a9 af 4d b2 61 18 55 5f ac 1b f5 |9...g..M.a.U...
00000310 f5 fc 04 f7 b7 e4 9f b2 ae 9b 56 59 d3 ea ba 3d |.....VY...=
00000320 ff 6e 81 1e 53 f4 85 68 18 c2 72 96 48 92 18 73 |.n..S..h..r.H..s
00000330 26 60 17 46 98 72 01 79 83 b6 c7 86 c0 83 42 2f |&.F.r.y....B/
00000340 68 bf fc 0b f8 f3 6d 74 97 60 1a 11 60 92 63 c6 |h ..nt...c

```

Figure 2: Hex data from the Radar

To get rid of this uncertainty in this project, an attempt was made to get the data in the correct format using the terminal itself. After a nominal amount of research, Harry and I could obtain the data from the terminal in a Hex format. This was done using the hexdump command in combination with the netcat command in terminal. The data obtained is shown in figure 2. Some more research was done to save the data obtained into a text file.

2. Challenges

The major challenges faced were due to WireShark, the software tool recommended by Delphi for data acquisition from the Radar.

2.1 WireShark Inconsistency

The issue behind the inconsistency of WireShark has not been narrowed down at this point. The problem faced is that WireShark only detects the Radar sometimes. A lot of troubleshooting steps have been taken like reinstalling WireShark and confirming the settings but no permanent solution has been found. The team will discuss this with Delphi to resolve the issue.

3. Teamwork

The work this week was performed well by all 5 team members. Harry and I worked on the Radar and getting data from the Radar in a hex format through WireShark and the Terminal. Yihao worked on implementing the ELAS stereo vision code in C++. Menghan created an independent visualization tool in C++ which can be used later. Zihao worked on the GPS module and obtaining egomotion measurements from it. All members worked well and in a timely manner.

4. Future Plans

In the future, we plan to successfully obtain and parse data from the Radar. On the Computer Vision side, the team will make progress in Object Tracking algorithm and potentially start implmenting the alogrithms. I will be working on a literature review for the Radar documentation to parse the messages obtained.

5. References

[1] "Delphi ESR 2.5". PolySync Support Center. N.p., 2016. Web. 12 Nov. 2016.