GPS module communication

BPC-DE2 Project

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Modules

- GPS module PA6H (Drotek Electronics)
- Display Nokia 5110
- Microcontroller Arduino UNO (ATmega328P)

Connecting Modules

<u>Connections between Display and Arduino</u>

RST to PB1

SCE to PB2

DC to PB3

DIN to PB4

CLK to PB5

Power delivery with 3.3 V

Led Backlight to GND

GND to GND

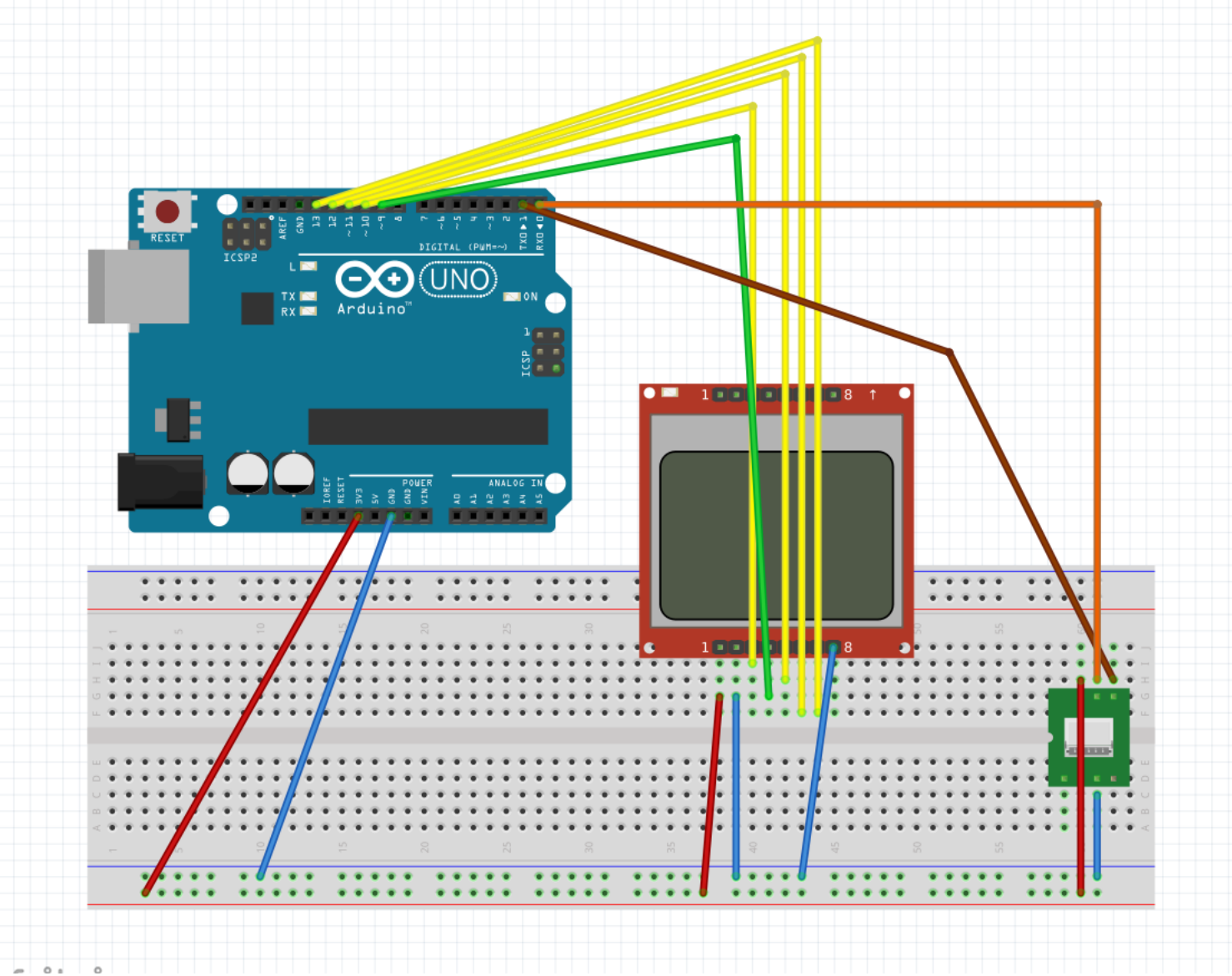
<u>Connections between GPS and Arduino</u>

Rx to Tx (PD1)

Tx to Rx (PD0)

Vin to 3.3 V

GND to GND



Requirements of the projects:

- Communication with GPS Data
- Storage with export to PC
- Displaying data on the Nokia 5110 display

NMEA sentences

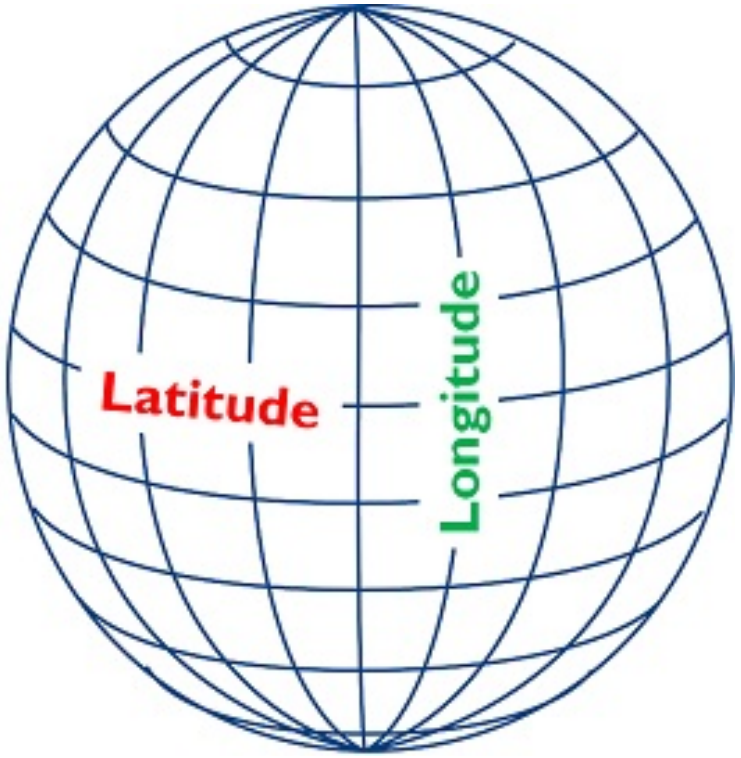
$GPGGA,*080714.000,4913.6237,N,01634.4839,E*,1,8,1.15,276.1,M,43.5,M,,*52

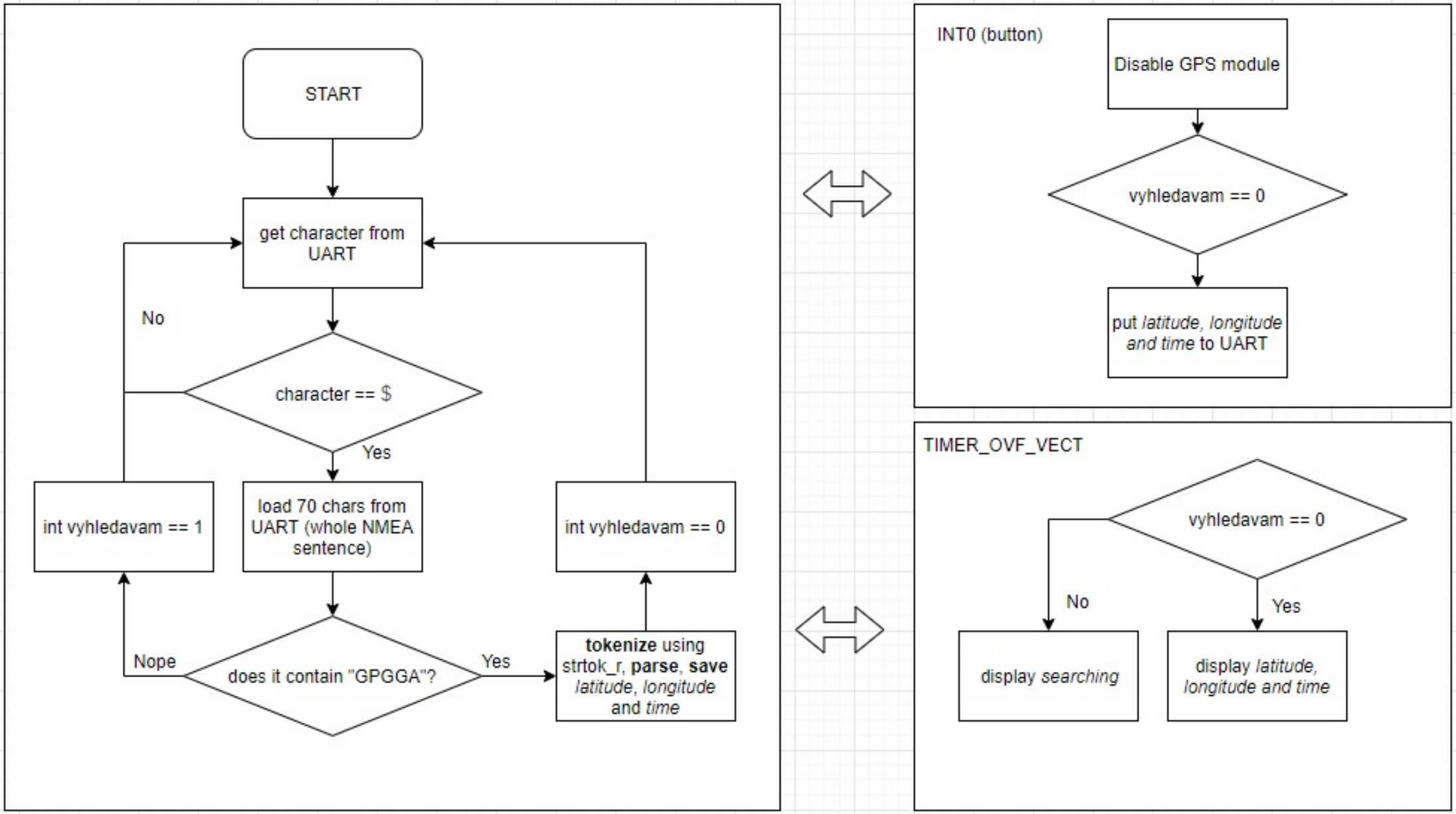
$GPGSA,A,3,01,22,14,03,23,11,19,17,,,,,1.45,1.15,0.88*0F
$GPGSV,3,1,12,22,85,003,12,01,73,146,12,03,65,278,13,11,53,184,13*76
$GPGSV,3,2,12,14,41,057,10,17,34,301,12,23,29,205,11,31,25,091,11*78
$GPGSV,3,3,12,19,21,319,13,32,16,046,14,09,02,214,,08,02,181,*77
$GPRMC,080714.000,A,4913.6237,N,01634.4839,E,0.61,186.44,271119,,,A*68
$GPVTG,186.44,T,,M,0.61,N,1.14,K,A*31

$GPGGA,064951.000,2307.1256,N,12016.4438,E,1,8,0.95,39.9,M,17.8,M,,*65

Table-2: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	064951.000		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See **Table-3**
Satellites Used	8		Range 0 to 14
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meters	Antenna Altitude above/below mean-sea-level
Units	M	meters	Units of antenna altitude
Geoidal Separation	17.8	meters	
Units	M	meters	Units of geoids separation
Age of Diff. Corr.		second	Null fields when DGPS is not used
Checksum	*65		
<CR> <LF>			End of message termination




START
get character from UART
No
character == $
Yes
int vyhledavam == 1
load 70 chars from UART (whole NMEA sentence)
int vyhledavam == 0
Nope
does it contain "GPGGA"?
Yes
tokenize using strtok_r, parse, save latitude, longitude and time
INT0 (button)
Disable GPS module
vyhledavam == 0
put latitude, longitude and time to UART
TIMER_OVF_VECT
vyhledavam == 0
No
Yes
display searching
display latitude, longitude and time

Video presentation

https://www.youtube.com/watch?v=jfIPIAEUn_A&feature=youtu.be

Extensions

<u>Application "Where is Česká</u>":

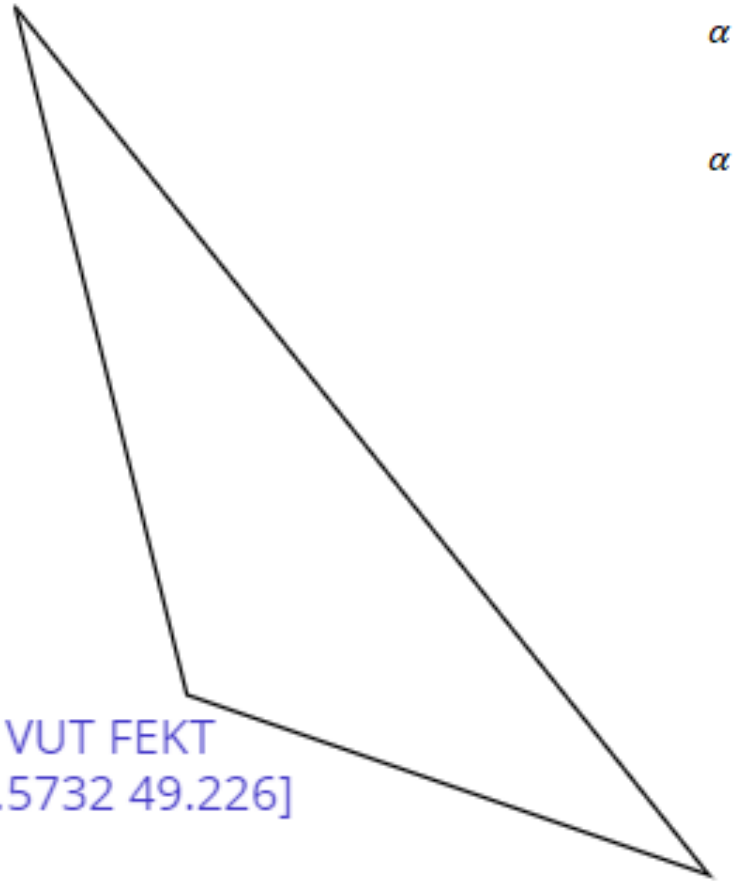
- **Module:** Arduino compass HMC5883L
- **Direction towards Česká tram stop should be displayed instead of north on the compass**
- **Calculation of angle to Česká from your position and orientation towards magnetic north**

<u>Generator of XML coordinate string</u>:

- **Export and use in Google Earth**

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
  <Placemark>
    <name>Simple placemark</name>
    <description>Attached to the ground. Intelligently places itself
       at the height of the underlying terrain.</description>
    <Point>
      <coordinates>-122.0822035425683,37.42228990140251,0</coordinates>
    </Point>
  </Placemark>
</kml>
```

C = Magnetic North
[-114.04 82.7]



A = VUT FEKT
[16.5732 49.226]

B = Česká
[16.6051 49.1974]

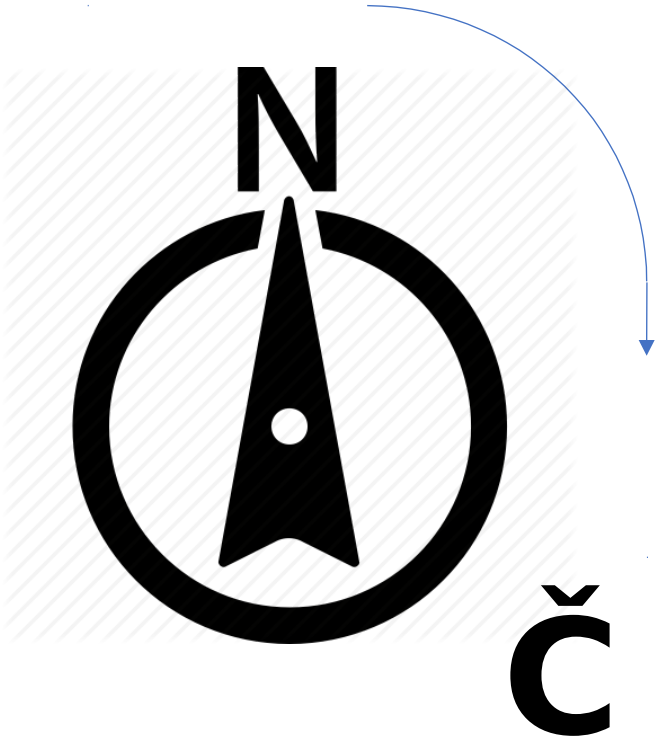
$$v1 = \overrightarrow{AC} = (-114.04 - 16.5732;\ 82.7 - 49.226) = (-130.6132;\ 33.474)$$

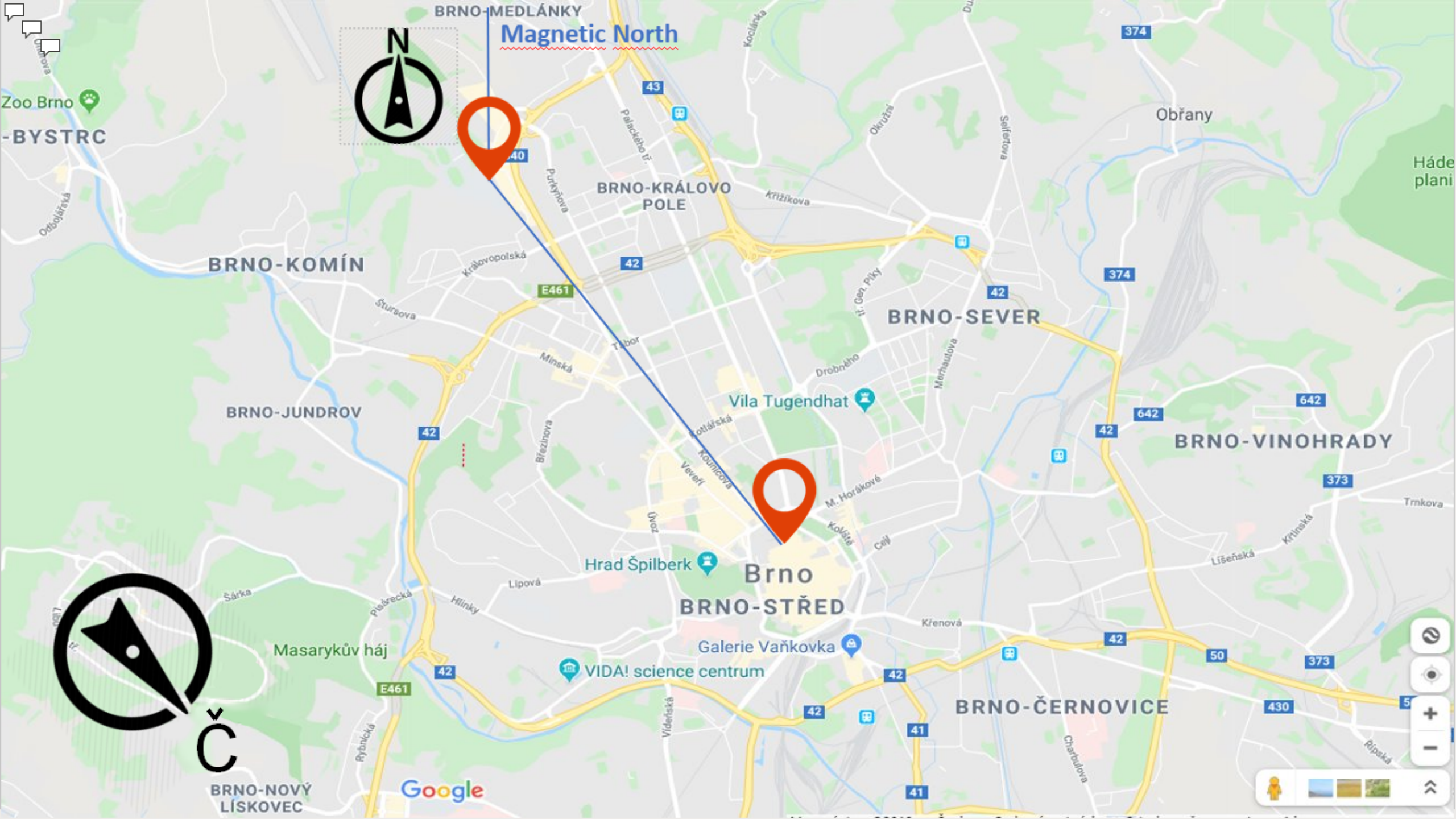
$$v2 = \overrightarrow{AB} = (16.6051 - 16.5732;\ 49.1974 - 49.226) = (0.0319;\ -0.0286)$$

$$\alpha = arccos\frac{v1v2}{|v1||v2|} = arccos\frac{-4.1666 - 0.9574}{134.8344 * 0.0428} = \arccos(-0.8879) = 2.6636\ rad$$

$$\alpha = arccos\frac{v1v2}{|v1||v2|} = arccos\frac{-4.1666 - 0.9574}{134.8344 * 0.0428} = \arccos(-0.8879) = 2.6636\ rad$$

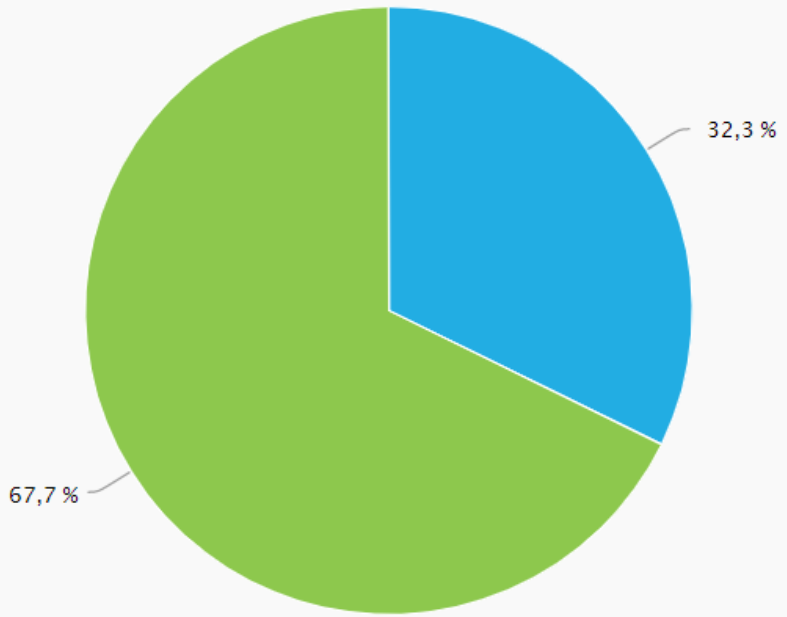
$$\alpha = 152.4967°$$




Magnetic North
N
Č
BRNO-MEDLÁNKY
Zoo Brno
-BYSTRC
BRNO-KRÁLOVO POLE
BRNO-KOMÍN
BRNO-JUNDROV
BRNO-SEVER
Obřany
Vila Tugendhat
BRNO-VINOHRADY
Hrad Špilberk
Brno
BRNO-STŘED
Masarykův háj
Galerie Vaňkovka
VIDA! science centrum
BRNO-ČERNOVICE
BRNO-NOVÝ LÍSKOVEC
Google

Results of our survey:

1 Víte, kde se v Brně nachází "Čára" (Česká)?



#	Možnosti odpovědí	Responzí	Podíl
1	Ano	10	32,3 %
2	Ne	21	67,7 %

Sources

- **Sergey Denisov's library: avr-nokia 5110:**
- https://github.com/LittleBuster/avr-nokia5110
- **Connecting Nokia 5110 to Arduino:**
- https://navody.arduino-shop.cz/navody-k-produktum/lcd-displej-nokia-5110.html
- **GPS:**
- http://yopero-tech.blogspot.com/
- http://www.tajned.cz/
- **Video:**
- https://www.youtube.com/watch?v=jfIPIAEUn_A&feature=youtu.be
- **KML exaple:**
- https://developers.google.com/kml/documentation/kml_tut

Thank you for your attention