Introductionweek business case

Committee Volundr of e.t.s.v. Thor

Welcome!

Welcome to the business case of e.t.s.v. Thor organized by Volundr, the committee of Thor focussed on the practical side of Electrical Engineering and Automotive Technology.

Today you will take your first steps into the wonderful world of Electrical Engineering and Automotive Technology. Using the package you have received you will make a small device which will allow you to connect to your fellow students. Since you have found the guide you have probably found the packages and scanned the QR code on the table, you have taken the first steps already! Since you are probably excited to start building your own communication device, let's not wait any longer! If something is not working or you're stuck you can ask your parents for some help. If even they don't know what to do either, ask them to contact a Volundr member to come by for help.

Good luck and have fun!

- VOLUNDR

The Goal

Of course the goal of the introduction week is to make new connections, you get to know the university, the associations and your fellow students! That is why during this case you will built an EE/AT student detector, the one and only **DetecThor**! This will be done using only a few components and an esp, often used for various internet of things (iot) applications. If all goes well you'll have a working DetecThor at the end of the business case which you can use for instance at the train station to see (or hear) if there are fellow first year students close by! Enjoy the business case and we hope to see you at other practical skill workshops during your studies!

The components

Before starting the assembly of the case it is important to check if you have all the necessary components. If everything is correct, you should find the following components in your package:

- Breadboard
- NodeMCU
- Red Ligth Emmitting Diode (LED)
- Resistor
- DIP switch
- Buttons (2x)
- Buzzer
- Wires

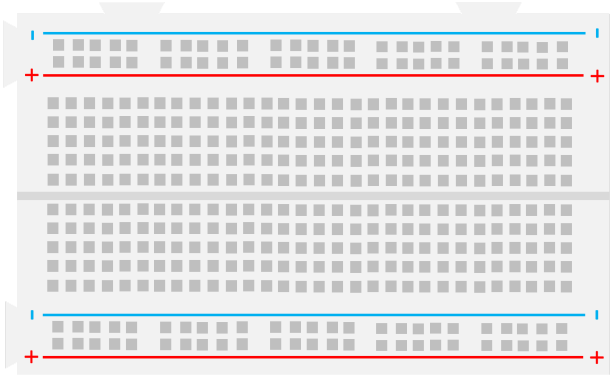
If you miss any of the components please inform your intro parents so they can contact a Volundr member to help you out. If you are not sure what each component is, don't worry! The next section is a small explanation of what is in your bag.

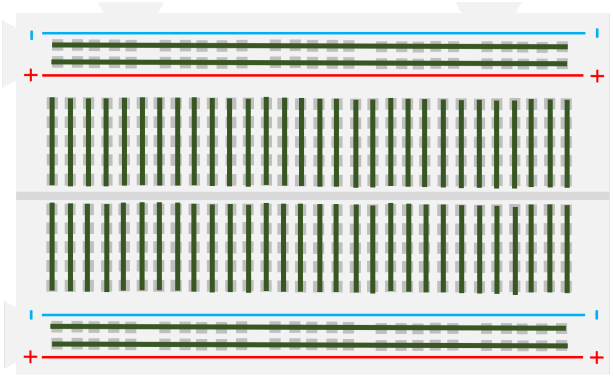
> ⚠ **Warning**
> Electrical components, like for instance LEDs, can break when they are not used correctly. Therefore we ask you to double check your circuits before testing. In case something accidentally breaks or one of the components produces *'magic smoke'* please ask your parents to contact Volundr or the TIC.

General knowledge

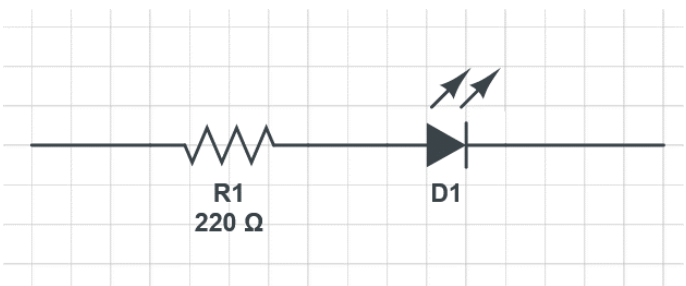
Breadboard and wires

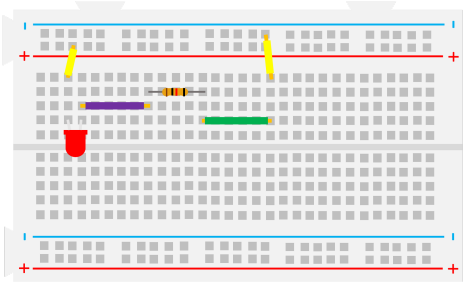
A breadboard is a quick and easy way to make prototypes. It doesn't require you to solder anything, so for this use-case it's ideal! The holes in the breadboard are internally connected as can be seen below. Just stick in the leads (the metal pointy bits) into the board to make a connection.





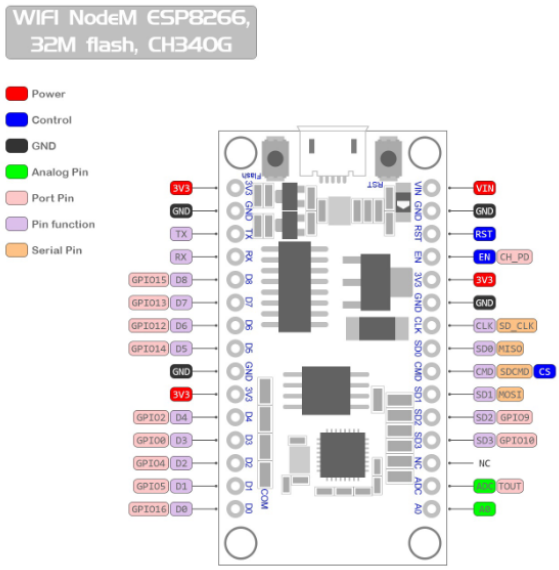
For small connections you can use the supplied wires. There are some longer wires, try to use the short ones as much as possible so the long ones can be used for the longer connections. By utilizing this system we can convert our schematic into a circuit as shown below.





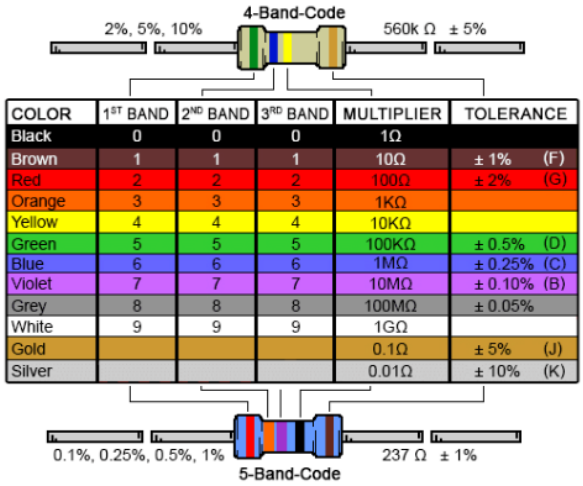
NodeMCU

The NodeMCU is a small open source Internet of Things-platform (IoT) which can be used for many applications. The microcontroller is often used for prototyping and small projects. One of the coolest features of the NodeMCU is the Wi-Fi capability. The exact pinout of this microcontroller is given below. Keep in mind that the NodeMCU has to be placed over the middle line of the breadboard, otherwise you will short the pins of the NodeMCU (see breadboard internal connection diagram under *breadboard*)!



Resistors

To check the value of a resistor you can use the chart in figure 3. In this case there is only one resistor, which value you can check using the chart. Resistors do not have a polarity so it doesn't matter which way you connect them in your circuits.

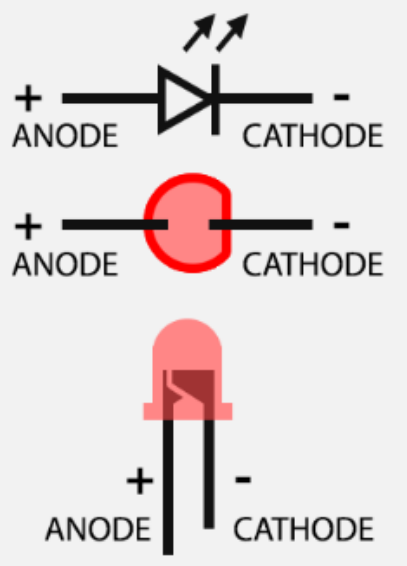


COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	± 0.5% (D)
Blue	6	6	6	1MΩ	± 0.25% (C)
Violet	7	7	7	10MΩ	± 0.10% (B)
Grey	8	8	8	100MΩ	± 0.05%
White	9	9	9	1GΩ	
Gold				0.1Ω	± 5% (J)
Silver				0.01Ω	± 10% (K)

LED's

The LED does have a polarity so you have to connect it in the right orientation, as can be seen in the figure below.

> ⚠ **Warning**
> Make sure your LEDs are connected with the proper polarity! Failing to do so will cause your circuit to malfunction!



Buzzer

In your package you can find the buzzer (probably still in plastic) which has three pins. The buzzer is used to make some sound in your communication device. Make sure that, during the assembly, you check which pin has to be connected to what. The three pins are Ground (GND), Input/Output (I/O) and VCC (), these can also be seen in the figure below.

Buttons

There are two small black buttons in the package you received. The buttons will be used to send a signal to the other boards.The buttons do not have to be placed over the middle line of the breadboard, this will save some space. However make sure to connect them in the right direction as some pins of the button are internally connected. If you turn the button to ensure you have the pins on the left and right side, the top and bottom sides are connected. The buttons can be seen in figure 5 in both states, pressed and released.

DIP switch

The red 8 pinned component in your package is the DIP switch, using this switch you will make sure to reach your group mates. By changing the position of the white pieces a certain number can be encoded. If the white

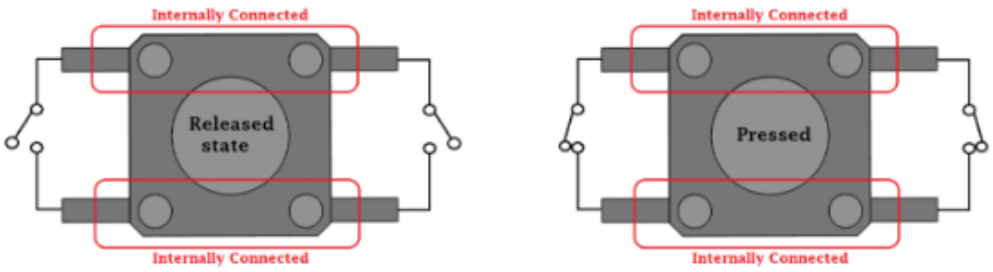
slider is positioned at the ”on” side, it encodes a 1 and otherwise it encodes a 0. This is based on binary counting, which is elaborated further in table 1. This means you can pick any number between 0 and 15 with your group to stay on the same channel or try to make multiple small channels within your group. The inner workings of the DIP switch are visible in figure 6.

MSB LSB 23 = 8 22 = 4 21 = 2 20 = 1

Table for Binary encoding

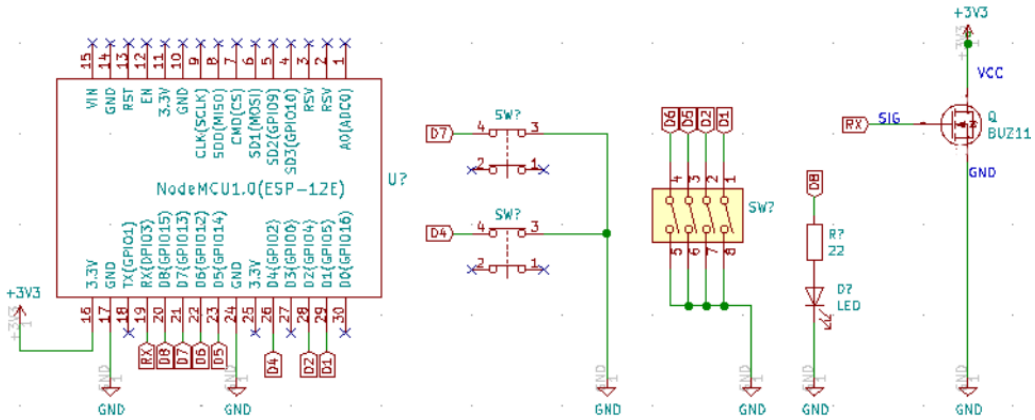
MSB			**LSB**	
Pin 1	**Pin 2**	**Pin 3**	**Pin 4**	**Channel**
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

Button states in both released (left) and pressed (right) condition



Assembly

Now that you are familiar with all the components needed for the DetecThor it is time to put it all together! To do this you have to make the schematic of figure 7 on your bread-board. When doing this try to put all components together as close together as possible, because otherwise you may encounter problems with placing everything on your board. The lines in the schematics are the wires in your real life device and the components match the components described above.



Testing

If everything is connected and you have double checked all your connections it is time to connect the NodeMCU to your power bank using the provided usb cable. The blue LED on the nodeMCU (so not the red LED you placed on the breadboard) should blink as soon as it is connected to at least one other NodeMCU. If you pay attention you should see that the more people in your group are connected the more the LED is going to blink. The NodeMCUs are connected via Wi-Fi in the form of a mesh network, all DetecThors in this mesh have a synchronously blinking LED. If you notice that your onboard LED (the blue one on the NodeMCU) is not blinking synchronously with the other NodeMCU's or it is not blinking at all it is a good idea to press the onboard reset button or to disconnect and connect the powerbank again. Wait for the onboard LED to blink in sync with the others before you start pressing buttons! Otherwise the NodeMCU may not be able to connect to the mesh network with the others properly. As soon as you are connected to other students you can send a message to other people holding a completed device. Try to play around with both buttons and try some different channels. Please try to keep your device on during the rest of the duration of the business case. Now your device is complete and can be used to find your fellow EE/AT students of this year! Please use at your own discretion and if you're seated in the ”stiltecoupe” (silence zones) in the train maybe it's a good idea to unplug your buzzer...

Want more projects like this?

Did you enjoy the business case and want to know what more you can do with the NodeMCU you just received? You can keep this set for your own so you can tinker with it at home as much as you want!

During the academic year Volundr organizes multiple practical skills workshops for you to enjoy such as a soldering workshop, 3D design workshop, PCB workshop, and many more! Keep an eye out for workshops like

these on thor.edu. Are you interested in the code behind this project? You can find it on the Thor Github by following this link.