

## Declaration of authorship

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I declare that this piece of work which is the basis for recognition of achieving learning outcomes in the (Microprocessor Systems) EMISY course was completed on my own

# EMISY Project 21 Portable Compass

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## 1 Analysis of the project

### 1.1 Discussion of project requirements

We need to create a simple portable compass circuit  
It should:

- Use energy-saving power modes of microcontroller
- Be battery powered
- Be portable (cellphone/wrist watch)
- Communicate using graphical OLED display and two buttons keyboard

### 1.2 Discussion of solution

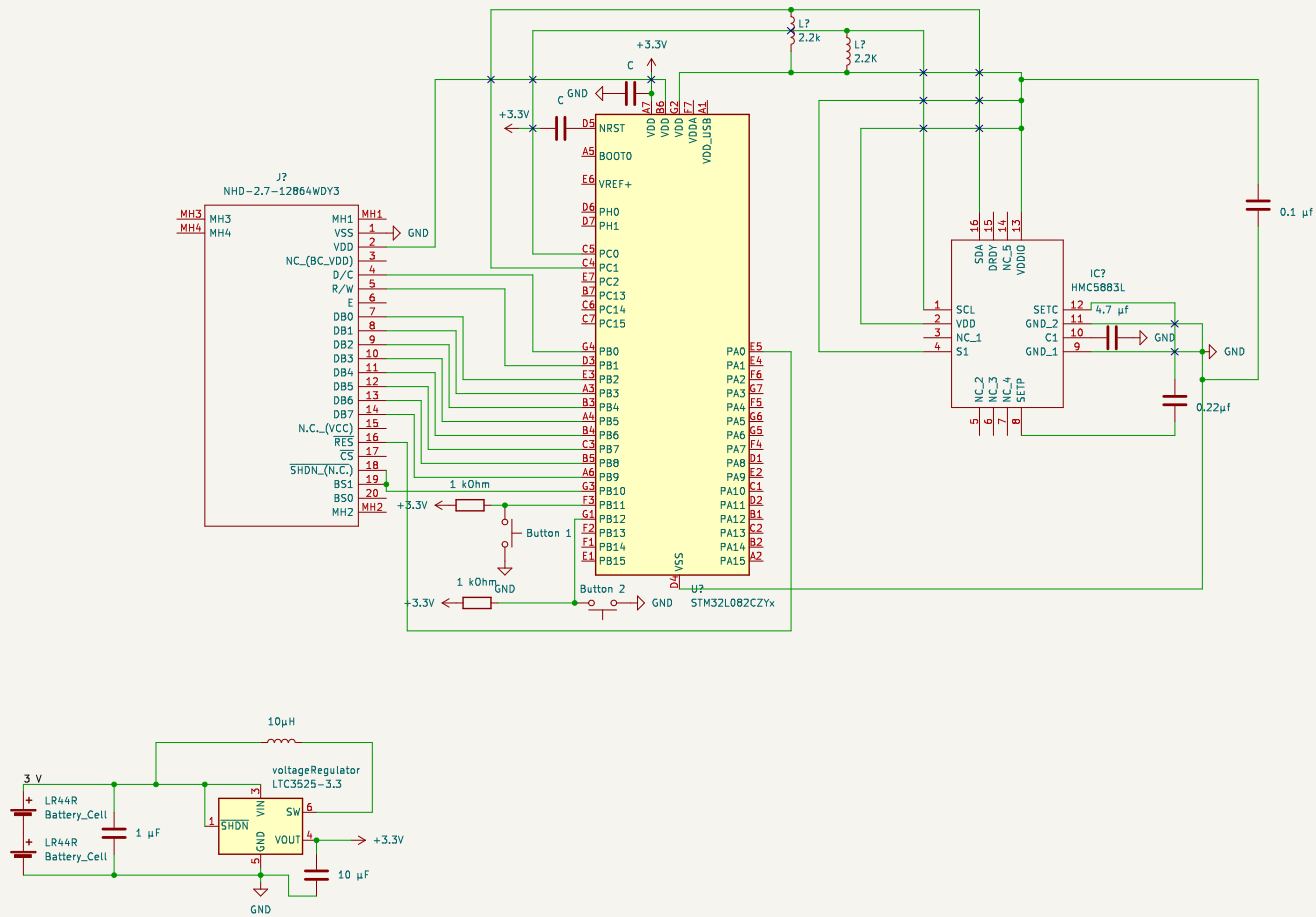
In my solution I focused on picking components based on firstly low power consumption, then size, then simplicity, whenever I could I tried to do everything as proposed in the component data sheet.

For the schematic itself I needed power saving microcontroller, oled display, battery, voltage regulator that works well with batteries and digital compass.

## 2 Detailed circuit diagram

### 2.1 Diagram itself

(Diagram is in pdf format so feel free to zoom in if something is not clearly visible)



## 2.2 Diagram description

Voltage regulator schematic is done one to one on how it was done in voltage regulator schematic in case of two battery cells

Digital compass also was connected exactly as specified in datasheet

For OLED I based on the pin descriptions from datasheet and on common patterns of connecting peripherals

Microcontroller itself was pretty straightforward with classic VDD, VSS and Reset pin connections

For buttons I used pull up resistors

## 2.3 Components

### 2.3.1 Microcontroller

I decided to use STM32L082CZ from STM32L0 line

**Relatively small** Up to  $10\text{ mm} \times 10\text{ mm}$  dimensions, compared to apple watch display of  $34\text{ mm} \times 40\text{ mm}$  for smaller version. [1] 111th page

**Square** It is shaped in a square which also simplifies portability [1] 111th page

**Power saving** STM32L0 line was designed specifically for low power consumption with power consumption as low as  $0.29\text{ }\mu\text{ A}$  in Standby mode [1] 1st page

**Consumer devices** This microcontroller comes from STM32L0x2 line prepared to be used in consumer devices [2]

**Ease of use** USB compatible microcontroller and dedicated debug port allows for swift code creation. [1] 1st page

### 2.3.2 All other components

**Oled display** For OLED display I decided to go with NHD-2.7-12864WDY3. It was an OLED display found on mouser webpage with lowest operating supply current of  $180\text{ }\mu\text{A}$ , supply voltage compatible with microcontroller ( $3.3\text{ V}$ ) and datasheet not in japanese. [3]

**Digital compass** For the compass I used HMC5883L with compatible voltage, low power consumption of  $100\text{ }\mu\text{ A}$ , compatibility with battery powered applications according to datasheet and small size

**Battery** For the battery I choose 2x LR44R series battery, with output voltage of  $1.5\text{ V}$  compatible with voltage regulator ( $3\text{ V}$  in series), compatible battery chemistry of Alkaline,  $150\text{ mAh}$  capacity for single battery and compact coin cell shape. [5]

**Voltage Regulator** For voltage regulator I choose LTC3525-3.3 with high 95% efficiency, desirable output voltage of  $3.3\text{ V}$ , low profile and tiny package, it is also available in kicad by default [6]

### 3 Draft of the microcontroller firmware

#### 3.1 Block diagram

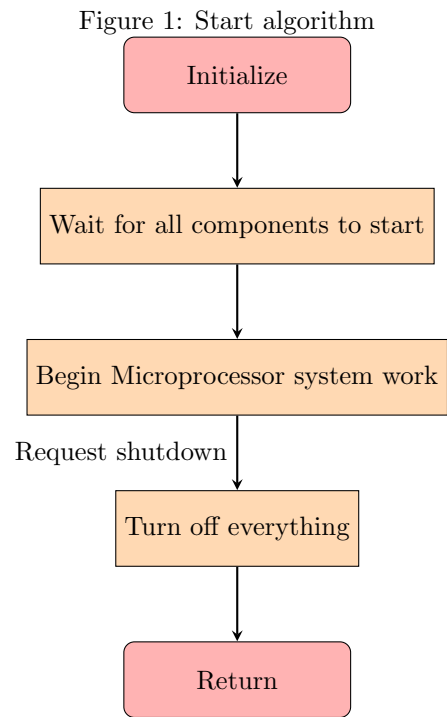


Figure 2: Main loop

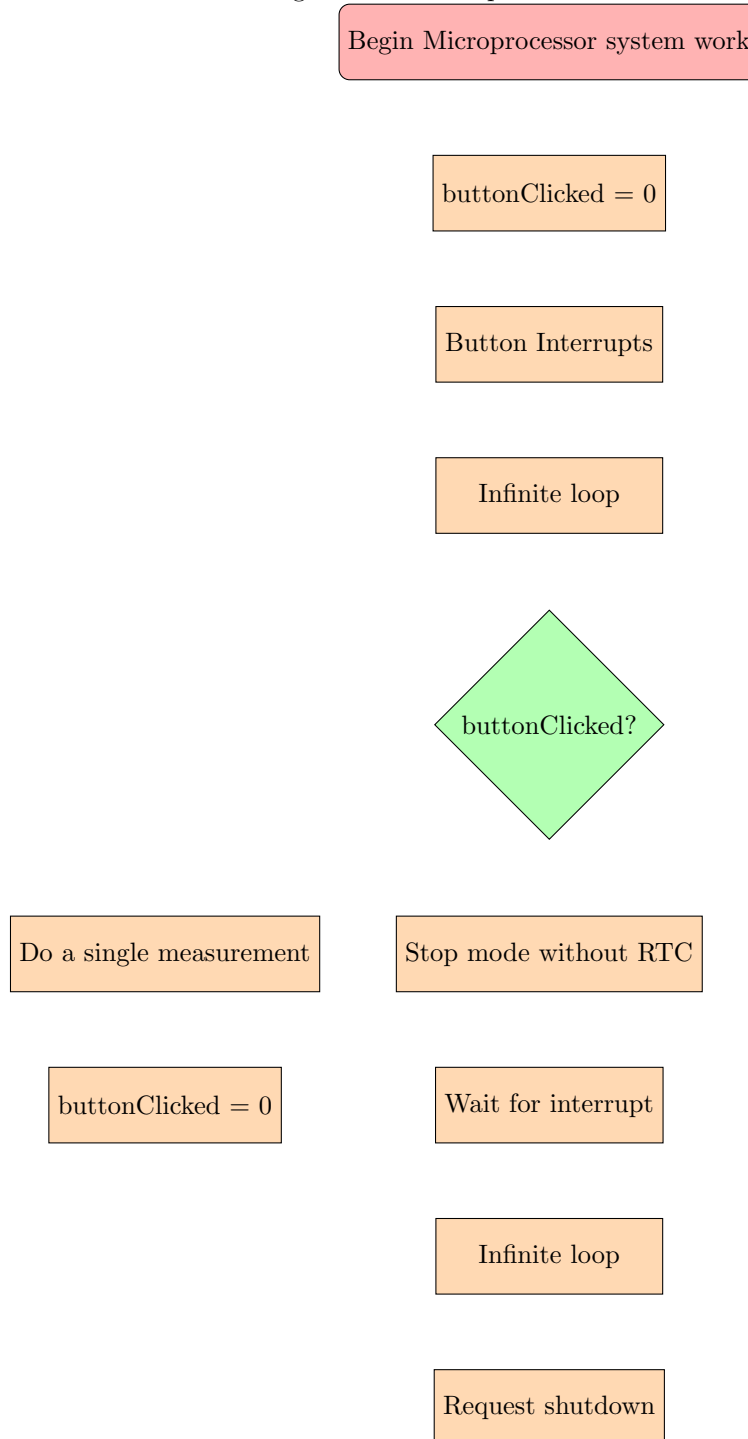
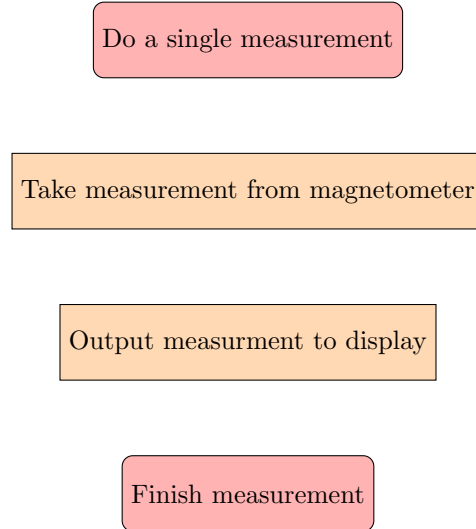


Figure 3: Single measurement algorithm



### 3.2 Description of the algorithm

#### References

- [1] STM32LO82CZ datasheet
- [2] Consumer Device STM32LOx2 Line
- [3] OLED datasheet
- [4] Magnetometer datasheet
- [5] Battery
- [6] Voltage regulator