

Technical Document (Preliminary Design)

Achmadi ST s.MT

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Chapter 1

Joinwit

1.1 Introduction

This document explain essential part of development. In this development chapter, currently use Joinwit product (as is, no deep reverse engineer). All development files (including source of this document) available as open-sources at https://github.com/mekatronik-achmadi/fo_respiro

The main hardware part section of development consist:

- Optical Power Meter module. Taken from product JW-3208
- Laser Source module. Taken from product JW-3109
- Custom Central Processor Unit. Using development board Cz-mini STM32F103Vx. Essenstial module consist:
 - STM32F103Vx chip, an 32-bit armhf core chip
 - LCD-TFT based on ILI9320 protocol
- Bluetooth Serial module HC-05
- 5v Power Source. Currently using a common powerbank

The main Software part section of development consist:

- a real-time multithreaded firmware based on ChibiOS/RT using both kernel scheduling and hardware abstraction layer.
- a desktop interface that data with interchange Custom CPU based Qt5 SDK
- a mobile apps interface that data with interchange Custom CPU based on Android SDK

1.2 Hardware

1.2.1 Optical Power Meter

This module is used to aquire any raw photonic signal or power. This module has no any modification or engineering, except geting ADC input signal that has voltage level compatible with STM32 series chip (custom CPU chip). Type and brand used is JW (Joinwit) 3208 series.

1.2.2 Laser Source

This module is used to provide laser signal/power. This module has no any modification or engineering. Type and brand used is JW (Joinwit) 3109 series.

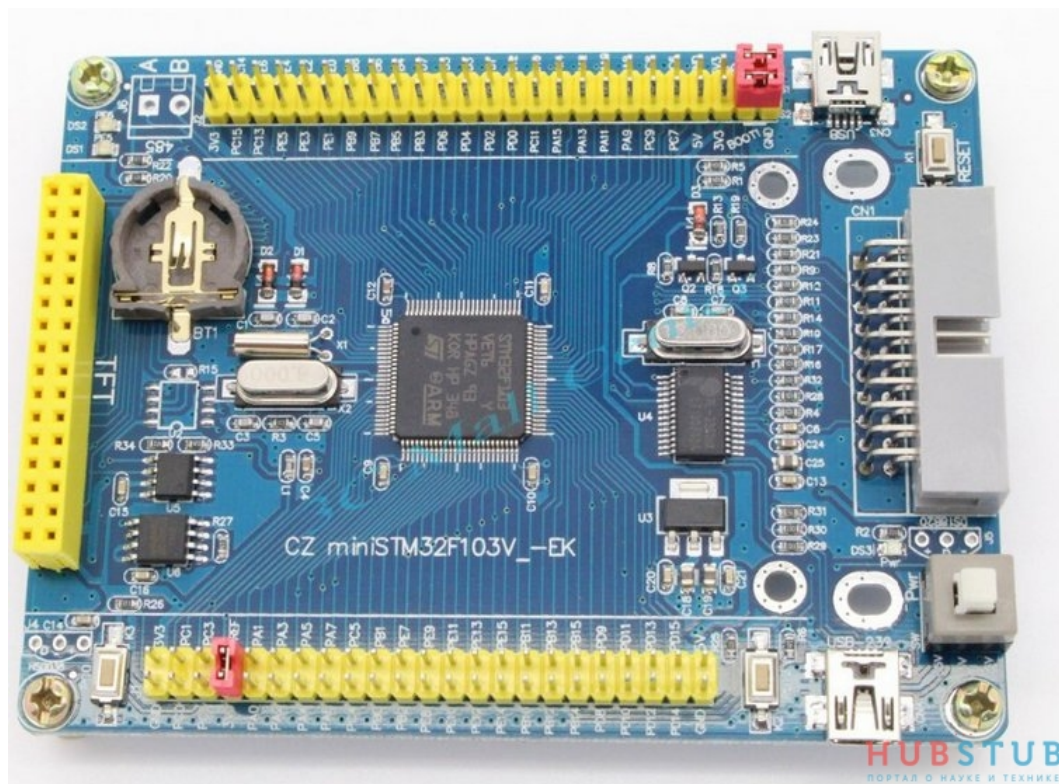


Gambar 1.1: Instrumen JW3208 dan JW3109

1.2.3 Custom Central Processing Unit

This module (development board) is used as central processing system. Type and brand used is CZ-miniSTM32F103Vx. Internal module used are consist:

- Analog to Digital Converter (ADC) with 12-bit data size to acquire input signal from Optical Power Meter.
- Serial data UART (both USB and HC-05) with 8-bit data size to communicate with outside of the chip.
- General digital I/O to control Laser Source module.



Gambar 1.2: Development Board CZ miniSTM32F103Vx

1.2.4 Bluetooth Serial

This module is used to provide communication feature with any device (either computer or mobile) that support Bluetooth radio communication. Type and brand used is HC-05.



Gambar 1.3: Module Bluetooth HC-05

1.3 Hardware Bill of Material

Below are part list for purchasing purposes:

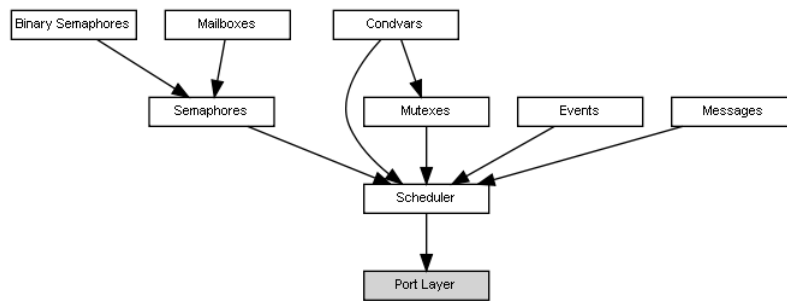
- Optical Power Meter JW-3208 from e-Bay: <https://www.ebay.com/p/Joinwit-Handheld-Optical-Pow-2191151148>
- Laser Source JW-3109 from e-Bay: <https://www.ebay.com/p/Jw3109-Handheld-Optical-Light-Sour-1683352799>
- Development Board CZ-MiniSTM32F103Vx from Aliexpress: <http://www.aliexpress.com/item/FREE-SHIPPING-ARM-Cortex-M3-mini-stm32-stm32F103VEt6-Cortex-development-board-72MHz-32216480157.html>
- LCD-TFT ILI9320 from Aliexpress: <https://www.aliexpress.com/item/3-2-inch-37PIN-TFT-LCD-S-32579843844.html>
- HC-05 Bluetooth RFComm module from Digiware: <http://digiwarestore.com/en/bluetooth/hc-05-bluetooth-module-432241.html>

1.4 Software

1.4.1 ChibiOS/RT

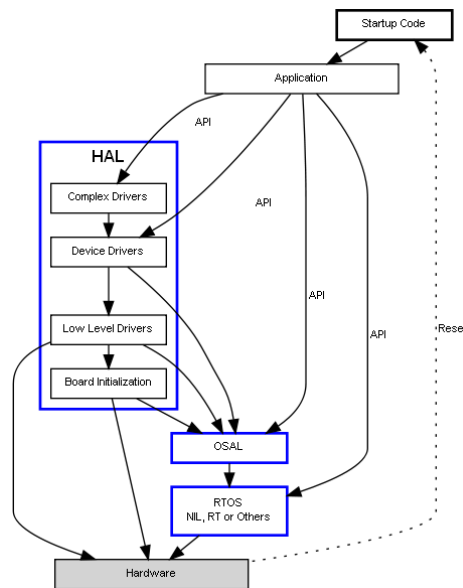
ChibiOS/RT is framework to build high quality firmware for many embedded system chips. In this work, both kernel and hardware abstraction are used.

ChibiOS/RT Kernel is the high performance RTOS part of the ChibiOS embedded collection. Kernel RT has been designed with the idea of creating a very feature-complete RTOS that could excel in performance and code size.



Gambar 1.4: ChibiOS Multithreading Kernel

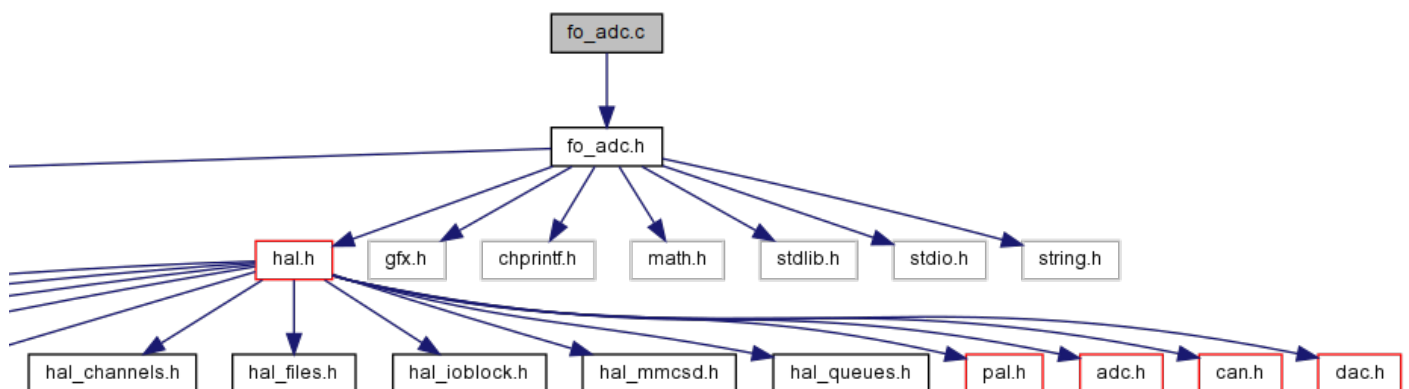
The HAL component is meant to be an abstraction layer between the application and the underlying micro-controller hardware. HAL offers an high level API for accessing common MCU peripheral like GPIO, ADC, SPI and so on and also take care of clocks-related and board-level initializations.



Gambar 1.5: ChibiOS Hardware Abstraction Layer

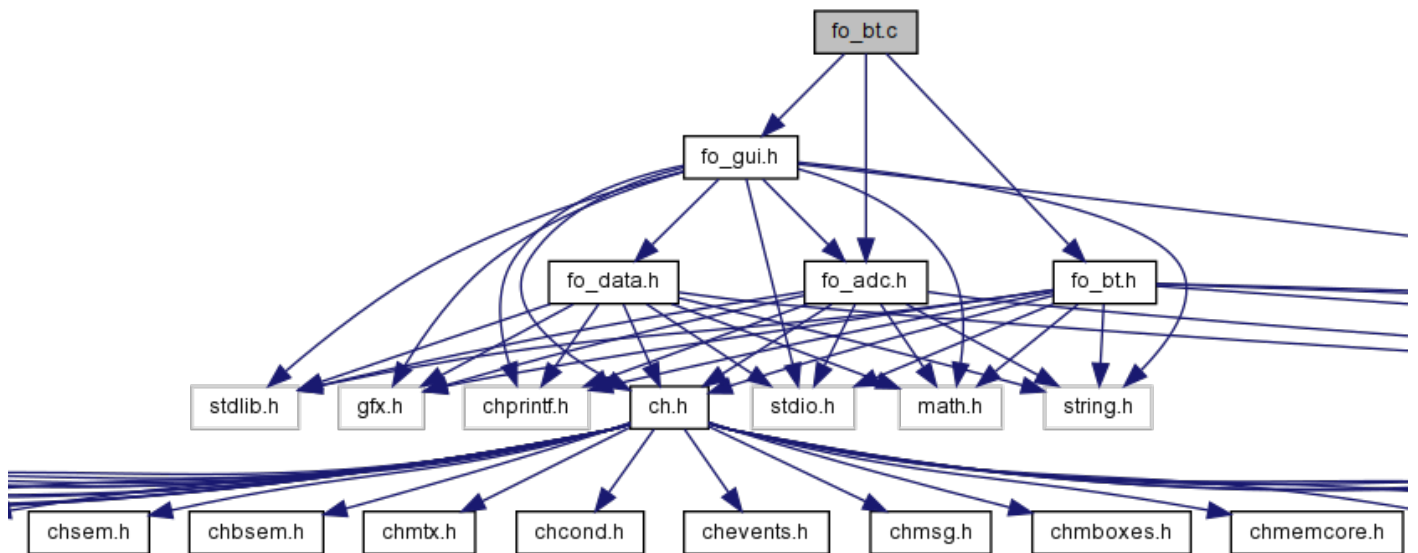
The main section of firmware consist:

- Analog to Digital Converter (ADC)



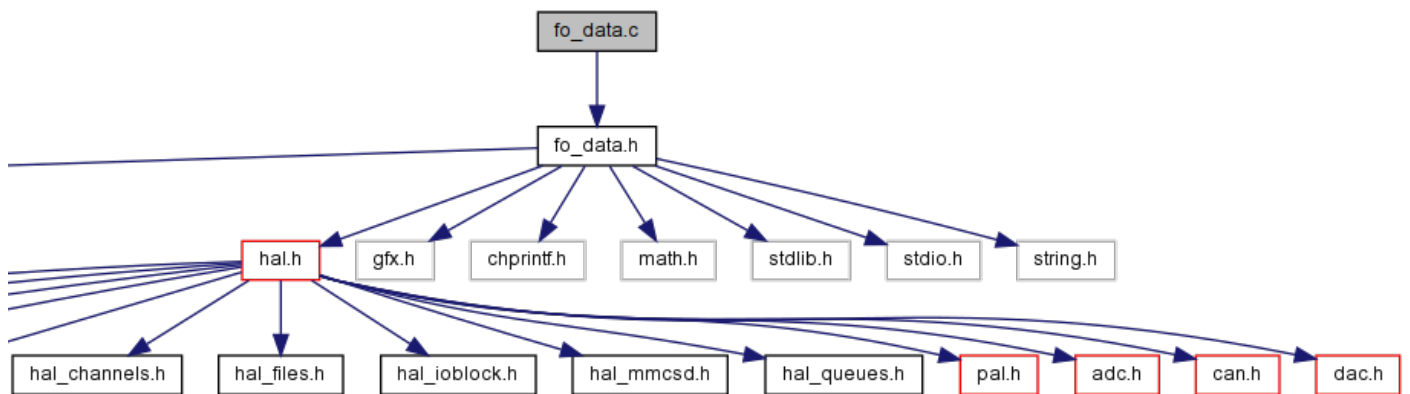
Gambar 1.6: ADC dependencies diagram

- Serial Shell Interface (both for Bluetooth and USB)



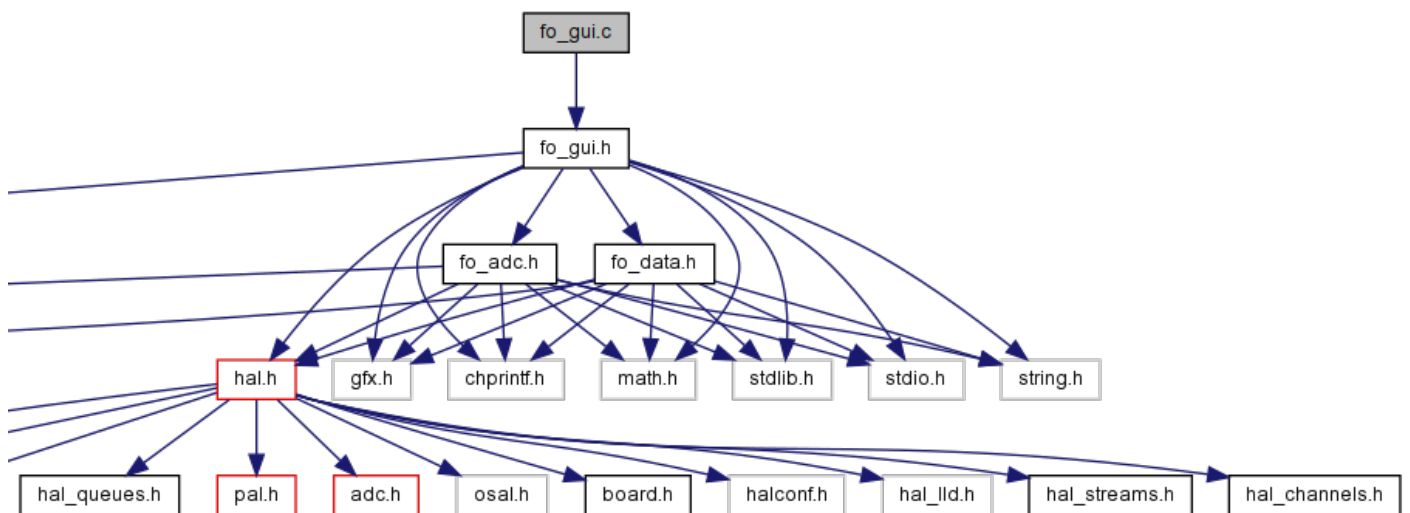
Gambar 1.7: Bluetooth Serial dependencies diagram

- Data Handling (include calibration)



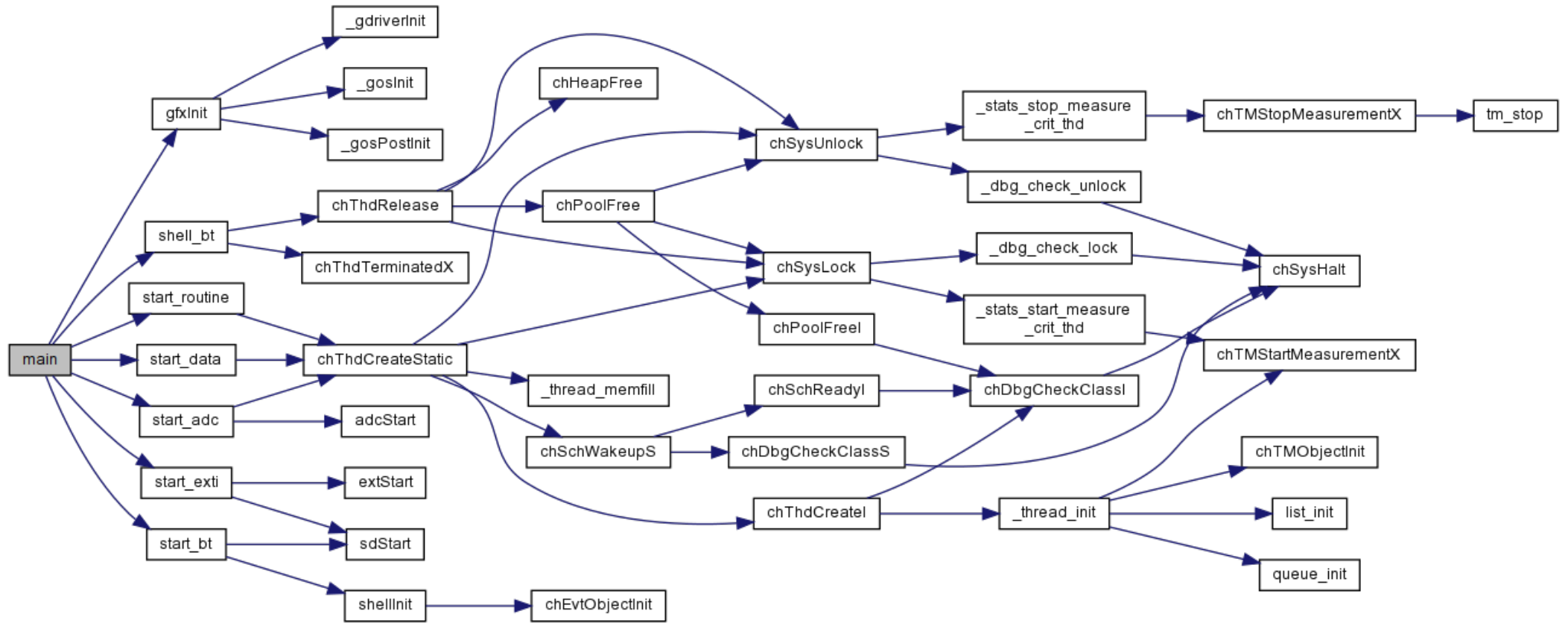
Gambar 1.8: Data handling dependencies diagram

- LCD-GUI display (both graph and console)



Gambar 1.9: GUI dependencies diagram

By including ChibiOS API, all module dependencies can be described below:



Gambar 1.10: Main source dependencies diagram

1.4.2 Qt-based Desktop Interface

1.4.3 Android Mobile Interface

Chapter 2

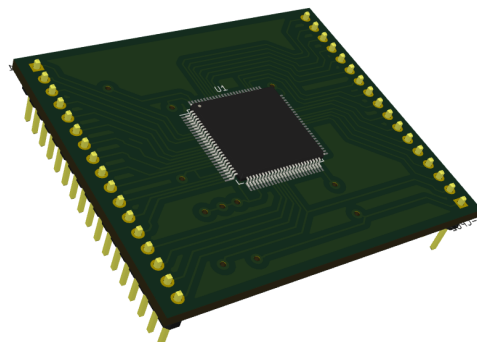
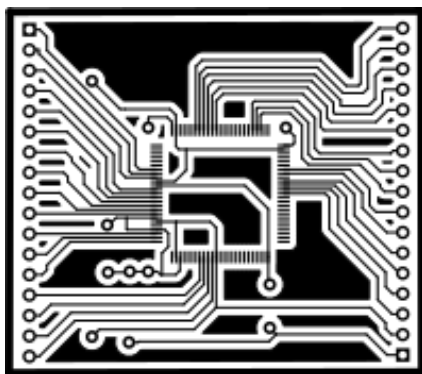
Prototype

2.1 Introduction

2.2 Hardware

2.2.1 Core

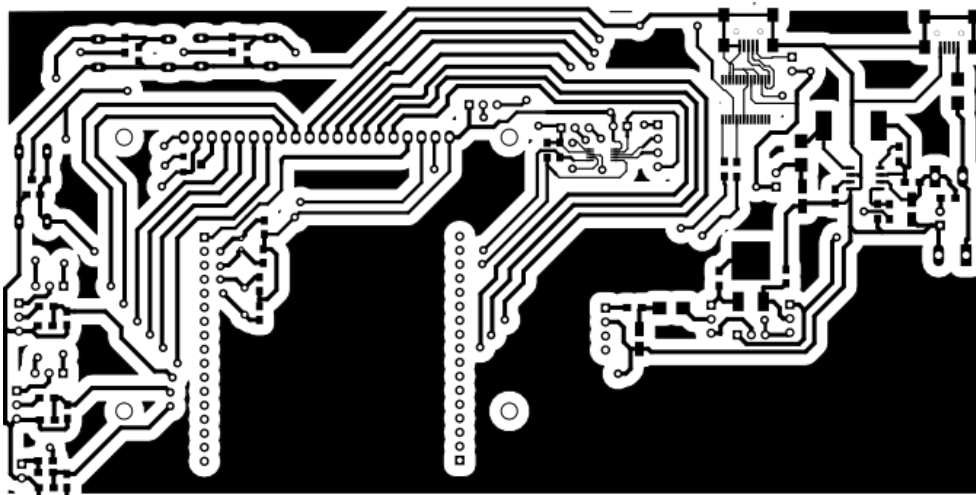
Core STM32F103Vx



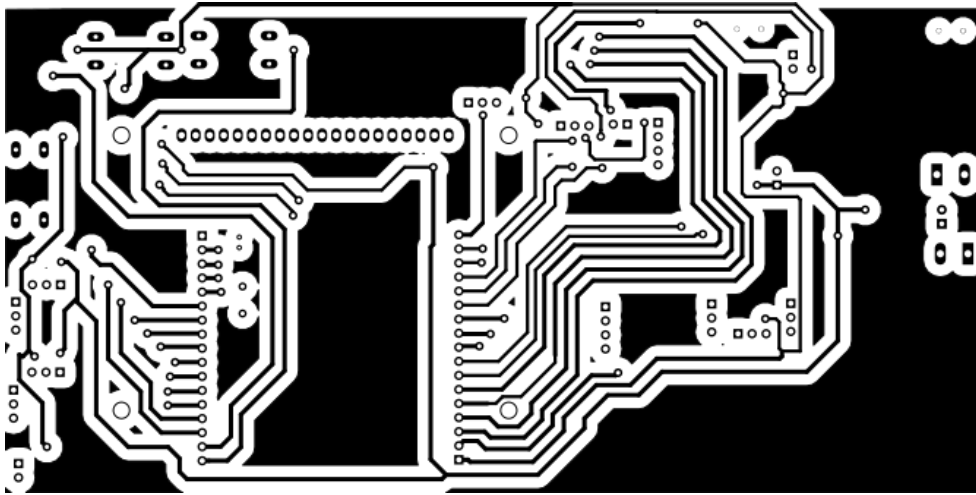
Gambar 2.1: Core Board Layout and Model

2.2.2 Mainboard

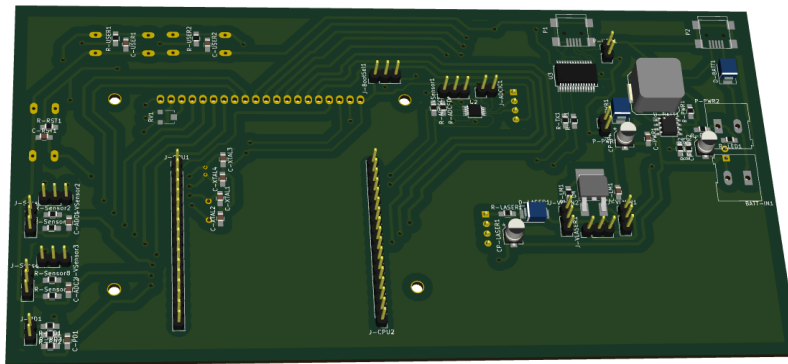
Core STM32F407Vx



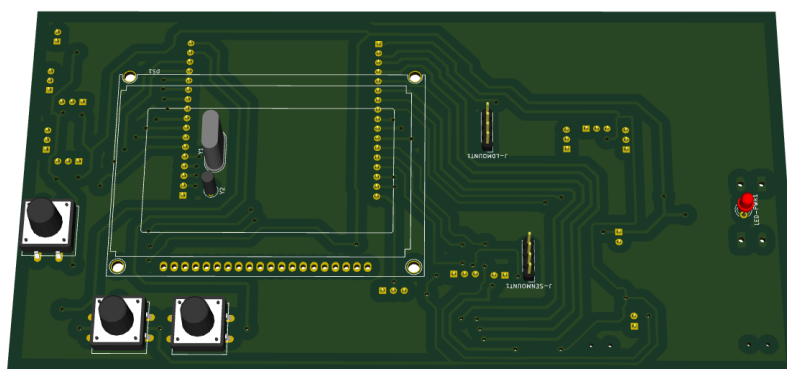
Gambar 2.2: Core Board Layout Up



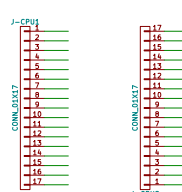
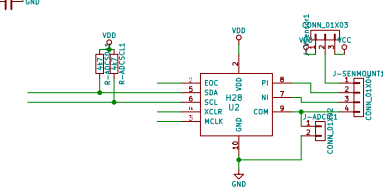
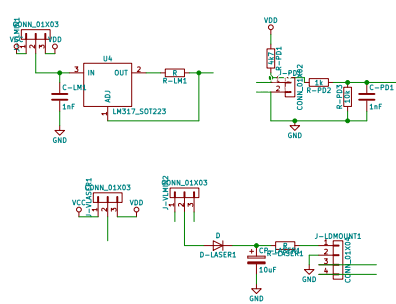
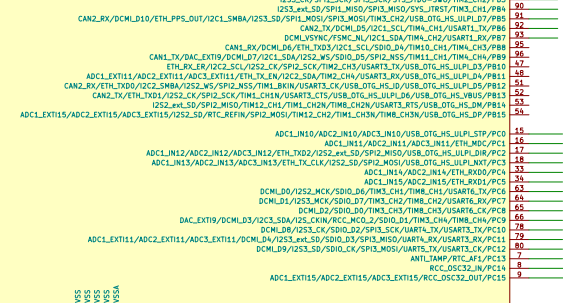
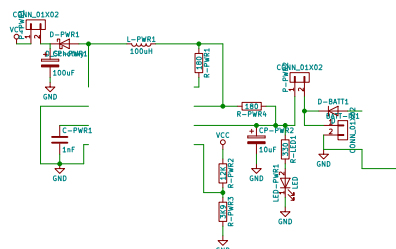
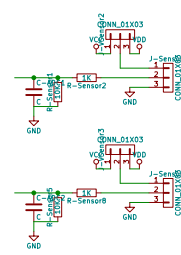
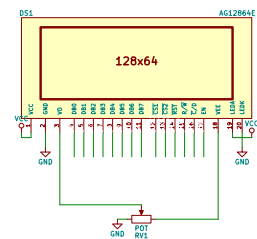
Gambar 2.3: Core Board Layout Bottom



Gambar 2.4: Core Board Model Up



Gambar 2.5: Core Board Model Bottom



2.3 Hardware Bill of Material

Below are part list for purchasing purposes:

- STM32F407VGT6 from Digiware: <http://digiwarestore.com/en/arm-core/stm32f407vgt6-131222.html>
- Graphic LCD 128x64 from Digiware: <http://digiwarestore.com/en/lcd-graphic/graphic-lcd-128x64.html>
- R_0805 330 from Digiware
- R_0805 180 from Digiware
- R_0805 12K from Digiware
- R_0805 3K9 from Digiware
- R_0805 R from Digiware
- R_0805 10K from Digiware
- R_0805 1K from Digiware
- MC33063/MC34063D from Digiware
- FT232RL from Digiware
- H28 from Digiware
- Elco 100uF
- Elco 10uF
- USB Mini B
- LED_0805 from Digiware
- C_0805 1nF from Digiware
- Schottky Diode from Digiware
- PIN Photodiode module T-11-155-R-SFC-AGC from Digikey
- Laser module TRDFB-1550-P-X-Y from Digikey

2.4 Software