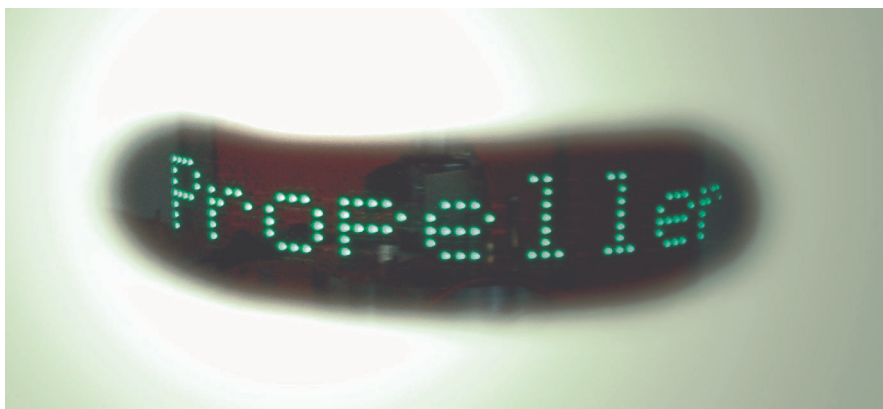# Propeller Display

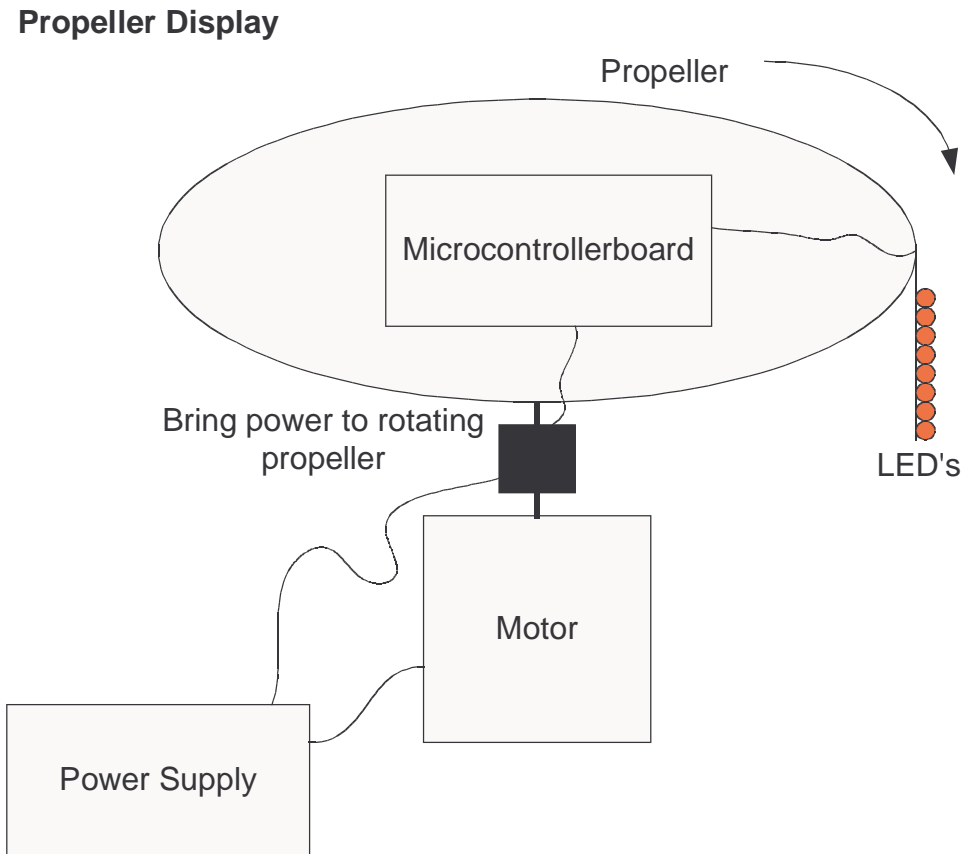Renesas H8 Design Contest 2003

Entry H3210

Abstract

1 Overview

The idea was to develop a very special display with rotating LED's. They are mounted on a propeller and driven by a high-end microcontroller from renesas.
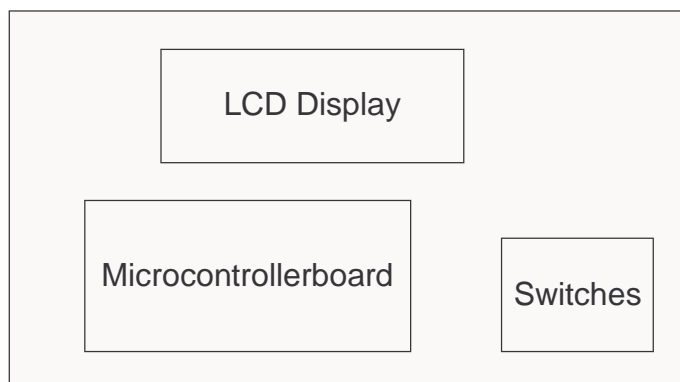
To change the displayed text, the user can enter it to a little battery operated terminal and transfer it wireless to the rotating propeller.

Because there are red, green and blue LED's avaylable, it's possible to display various colors inclusive white when all colors are mixed together.

The following drawing shows the basic components of the project.

Propeller Display

Terminal

2 Functions and Properties

2.1 Power Up

After the power up, a little demo is started and shows all graphical features of the propeller display. The demo is repeated until the user enters a text or the display is powered down.

2.2 Enter a text

It should be easy without reading a thick manual to enter a text on the terminal. If the text is entered it should be fast and safe transferred to the display. It would be nice if this happens wireless.

After the reception of the text, it is displayed immediately on the propeller display until a new text is received.

2.3 Display

Texts and pictures should be easy readable with as less flickering as possible.

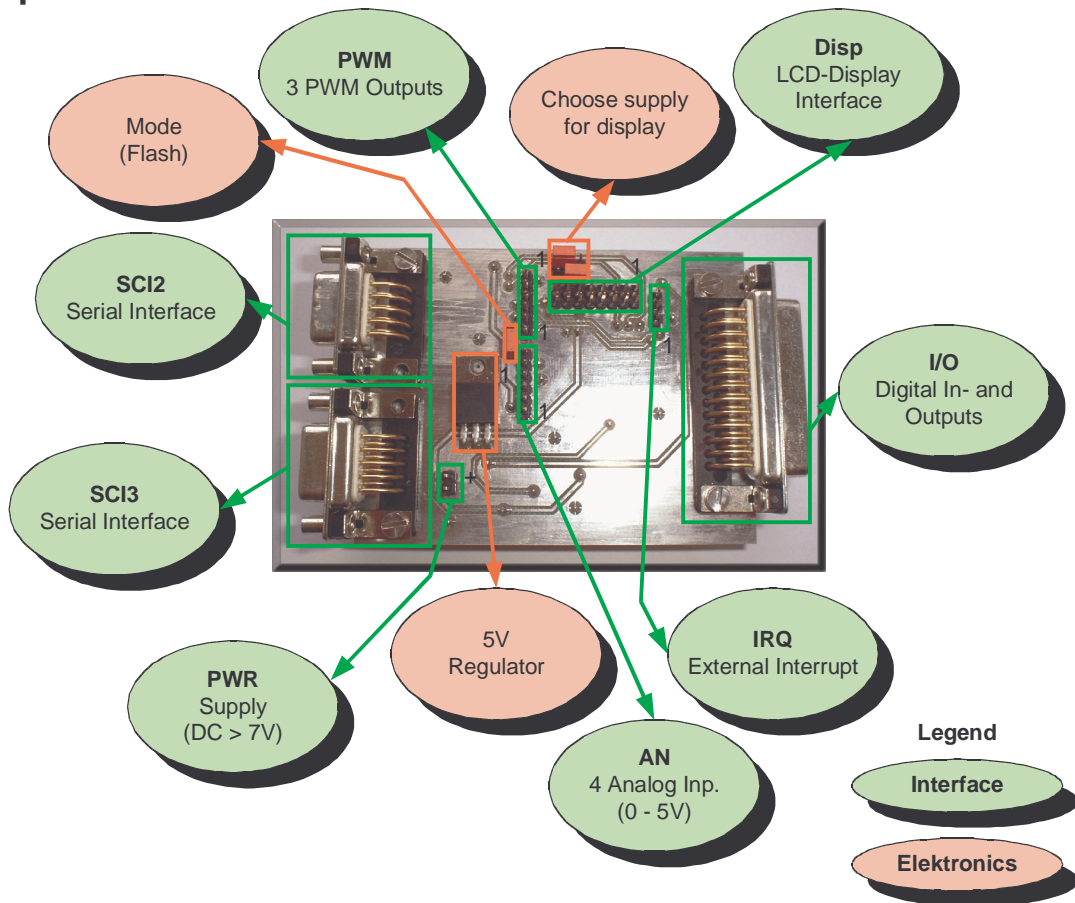# 3 Microcontroller Board

3.1 Description

Heart of the project is a self developed microcontroller board with the H8S/2633 microcontroller from renesas. It has enough processing power, RAM, flash and peripherals to operate in single chip mode without many external components.

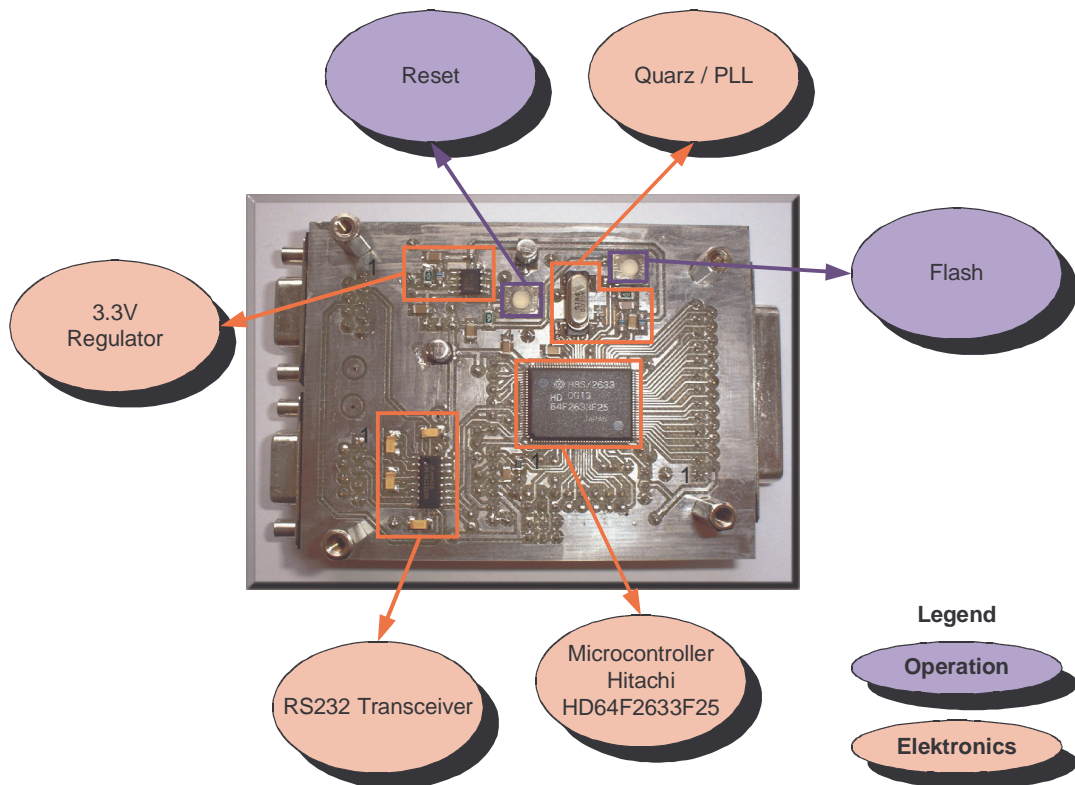The propeller display and the terminal are both based on this board.

Features of the H8S/2633 Microcontroller

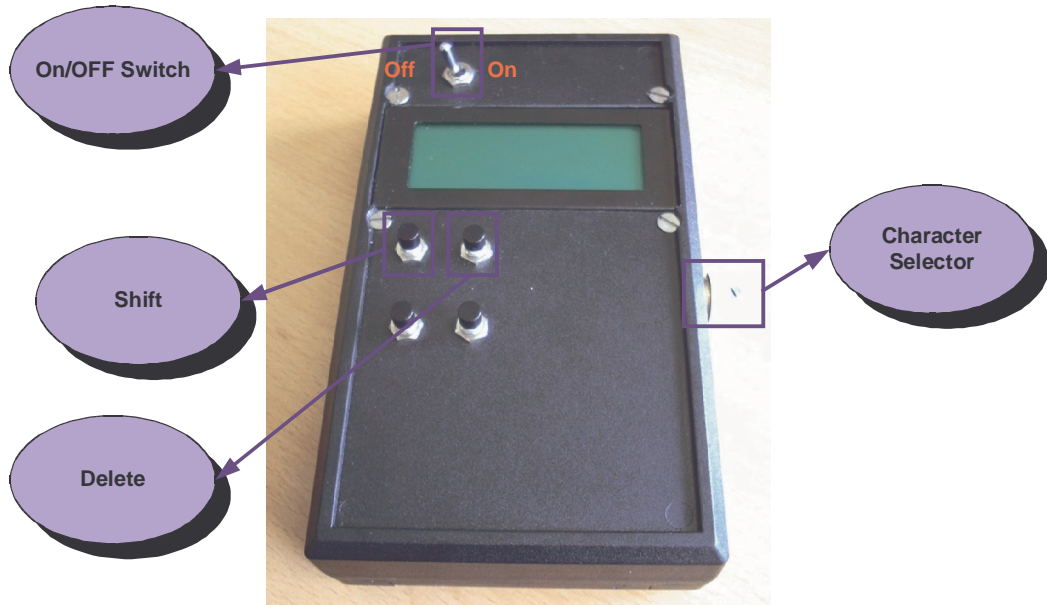| What	How many
Flashsmemory	256kB
RAM	16kB
Clock	25MHz
Timer	6ch 16-Bit Timer with 16 IC/OC plus 8-Bit Timer
DMAC (Direct Memory Access Con.)	Yes
DTC (Data Transfer Controller)	Yes
SCI (serial Interface)	5 (One of them with IrDA)
ADC (AD-Converter)	16ch 10-Bit
DAC (DA-Converter)	4ch 8-Bit
Various	PPG (16ch Pulse Pattern Generator), 32kHz Subclock

3.2 Top View

Legend
Interface
Elektronics

3.3 Bottom View

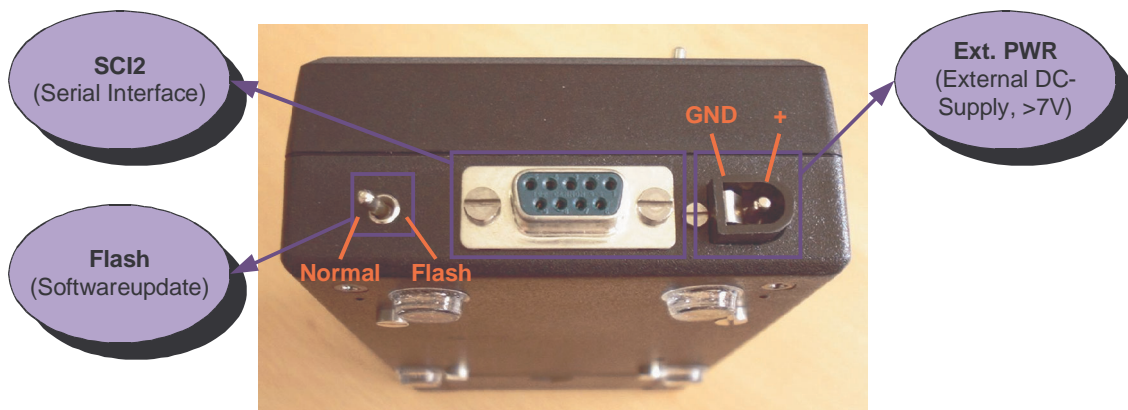

Legend
Operation
Elektronics

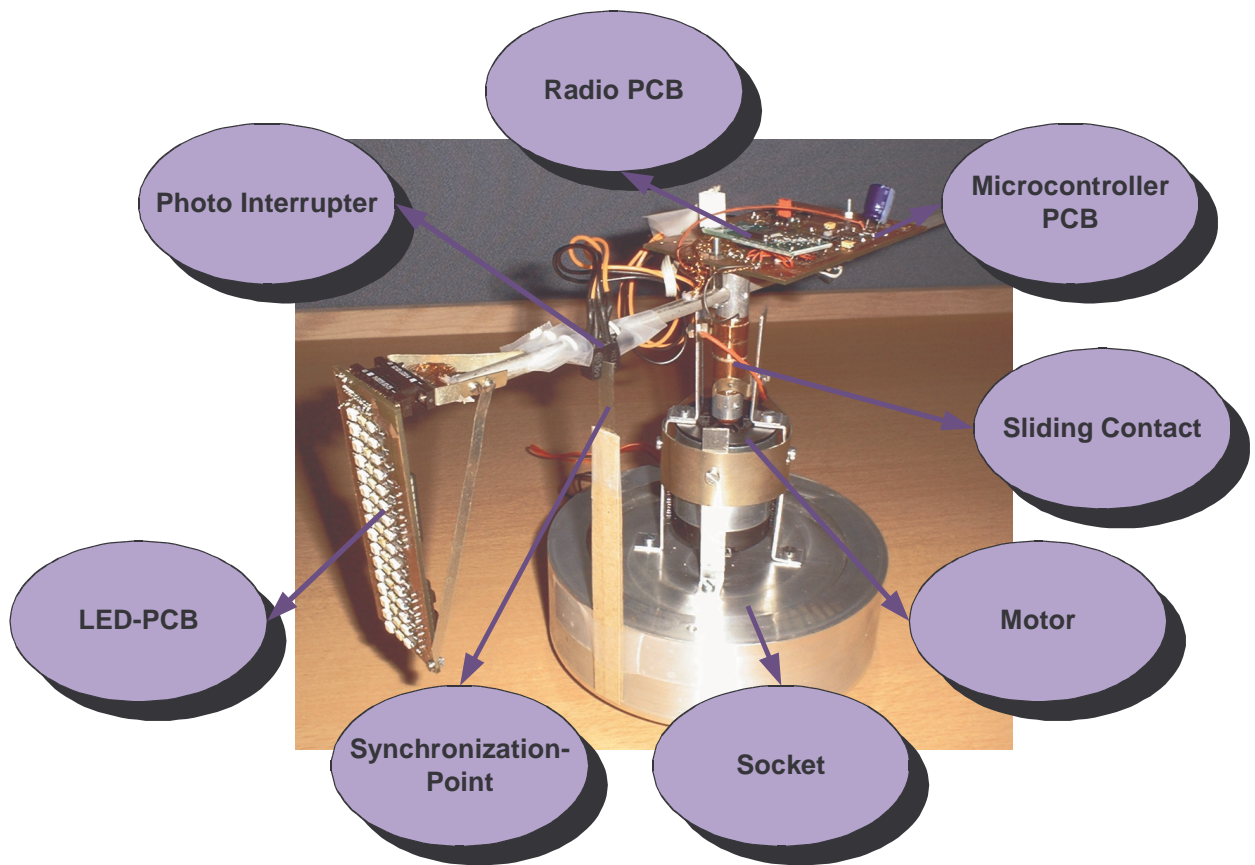# 4 Terminal
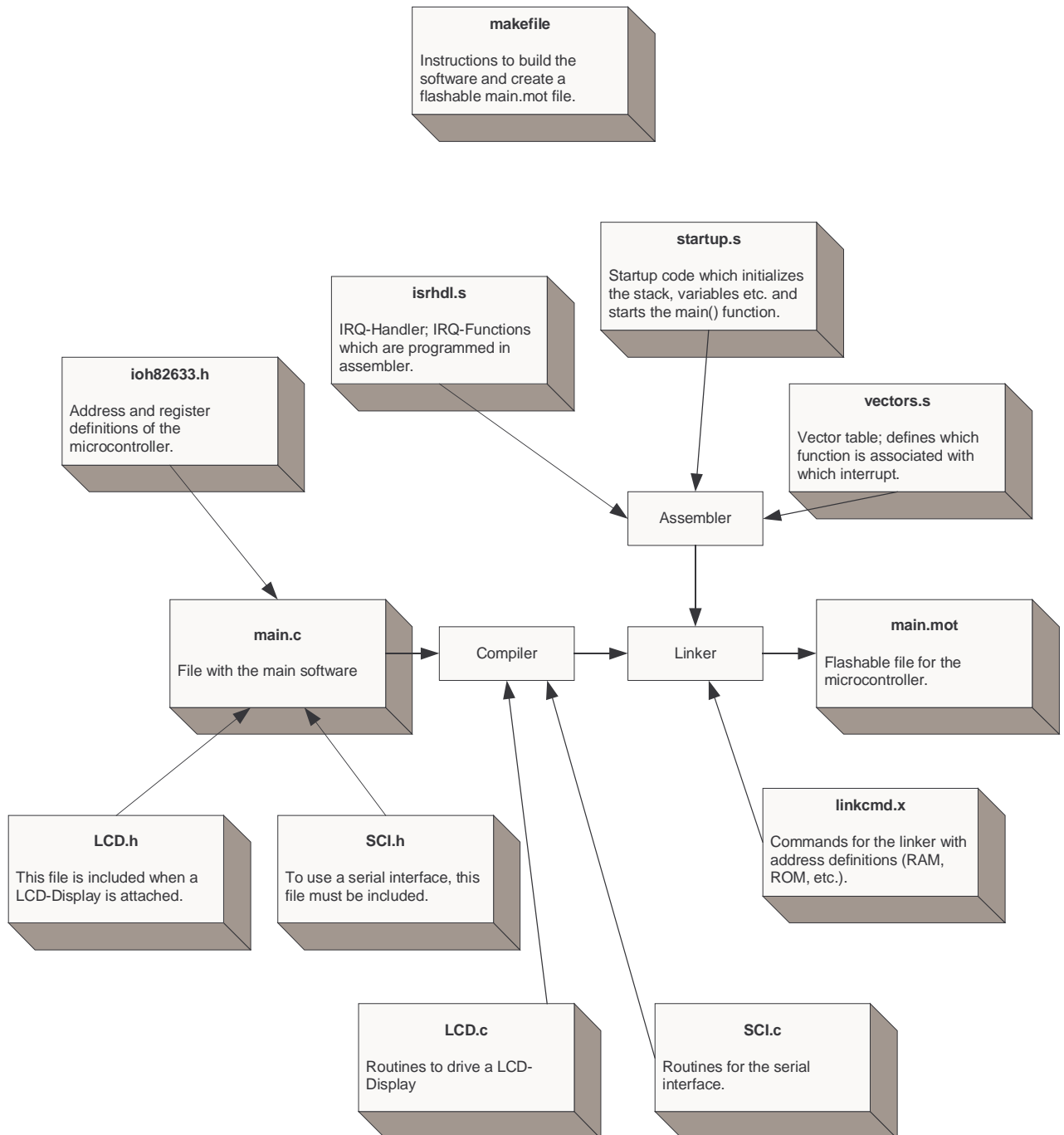
4.1 Front

4.2 Connectors

5 Propeller (second prototype)

The propeller consists of the following items:

6 Software

The Software is splitted to several parts/files.

6.1 Different Files

makefile

Instructions to build the software and create a flashable main.mot file.

startup.s

Startup code which initializes the stack, variables etc. and starts the main() function.

isrhdl.s

IRQ-Handler; IRQ-Functions which are programmed in assembler.

vectors.s

Vector table; defines which function is associated with which interrupt.

ioh82633.h

Address and register definitions of the microcontroller.

Assembler

main.c

File with the main software

Compiler

Linker

main.mot

Flashable file for the microcontroller.

LCD.h

This file is included when a LCD-Display is attached.

SCI.h

To use a serial interface, this file must be included.

linkcmd.x

Commands for the linker with address definitions (RAM, ROM, etc.).

LCD.c

Routines to drive a LCD-Display

SCI.c

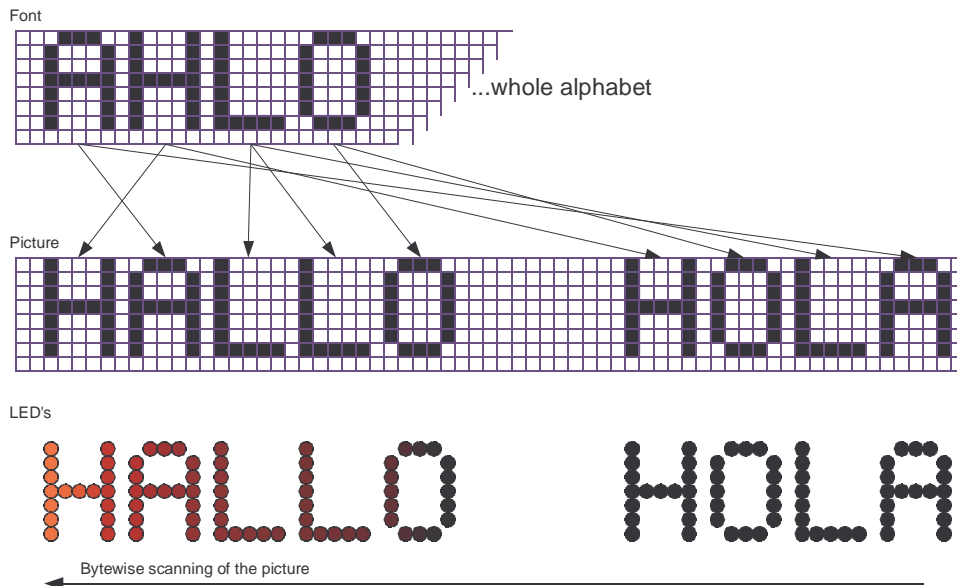Routines for the serial interface.

6.2 Principle of creating the picture

Before the text can be displayed, it has to be converted to a bitmap and stored in an array. Because the H8S/2633 has a lot of RAM, i store the whole text as a bitmap in it.

After the conversion, the bitmap can simply transferred periodically to the LED's which displays the picture column by column.

The eye of the visitor puts these colums together to the complete picture.

To convert a string to a bitmap it's necessary to have a font. Every possible character is stored in the flash. A little routine copies the single characters together to obtain a whole string.
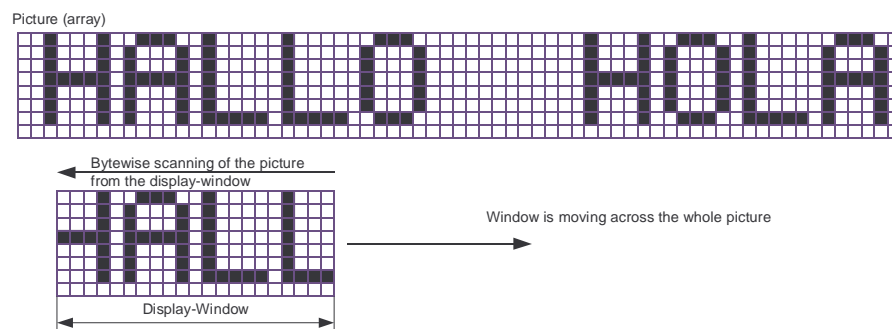

Have a look to this principle:

Because the motor of the propeller turns clockwise, the microcontroller has to output the picture from the right side to the left. If the direction would be wrong, the text appears mirrored.
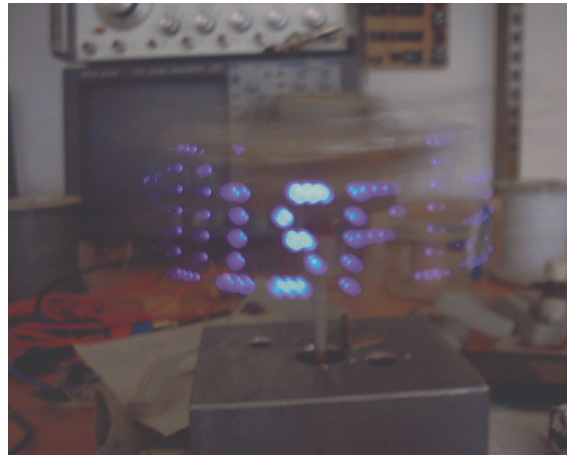
6.3 Scrolling

Scrolling is relatively easy to implement too. A window which complies to the pixelcount of one round of the propeller is moved over the picture.

Only the pixels in this window are putted out bye the LED's.

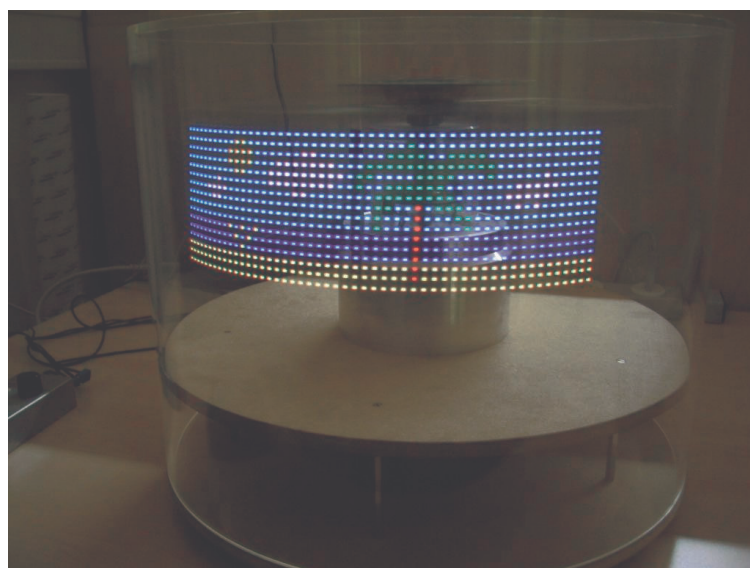When this window moves, also the displayed text moves and it looks like scrolling.

7 Photos

Very first prototype shows: „Propeller Display"

Photo of the second prototype

Picture shown by the third prototype