Project in Embedded Systems 15hp 1TE721

A FERMENTATION TEMPERATURE MONITORING SYSTEM
using Atmel AVR and ARM single-board computer

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Background

In recent years, the number of small scale breweries has skyrocketed in numbers. This has led to an increased demand of advanced brewing systems operating on much smaller volumes compared to the macro-scale brewing industry. These systems are often equipped with sensors logging temperature and pressure. For the most common commercial beers, such as lagers, there exists optimized means of production where the temperature controls plays a big part in order to maximize yield and minimize the length of the production cycle.

A traditional brewing style, often referred to as *farmhouse brewing*, focuses on letting a mixed flora of yeasts and bacteria (commonly Brettanomyces, Pediococcus, Lactobacillus) free-rise in temperature, hence not using any control systems. One historically popular option is letting it ferment in a cellar due to it's stable climate. Since the compounds produced by these microorganisms are in most cases unwanted, a lot of research has been put into detecting an excluding them from the process as part of quality control. Only a small share of the research have had the focus on producing beer using these microorganisms which makes it interesting to log the temperature dynamics of a mixed fermentation as a pre-study in order to learn how the fermentation can be controlled to get satisfactory results.

Objectives

The objective of this project is develop a small and portable system prototype that allows an AVR MCU to communicate with a Raspberry Pi (RPi) through serial communication. The signal should not contain any unnecessary noise and can therefor be filtered by the MCU before being transmitted to the server in a time series database.

The RPi based server is accessed on the internet by the end user and can be visualized using external libraries compatible with the choice of database.

Preliminary tasks

The time planning for the enumerated tasks is visualized as a Gantt scheme in Figure 1.

1. Setup project repository, as well as report and documentation workflow. Formulate preliminary time plan and goals. Look for suitable hardware.
2. Get started with the AVR toolchain, write Makefiles and configure a development environment. Configure ARM compatible Linux on the RPi. Write UART routines and verify that the communication is working. Extend the communication to contain temperature data from the sensor.
3. Apply a filter to the signal. Design the website, configure databases and visualization of data.
4. Extend the website with more features. Collect or generate dummy-data in order to present a proof of concept.
5. Present the project, i.e all project phases, and finalize the report

Grading criteria and grade to be achieved[1]

- Grade 3. The temperature is measured by the microcontroller and presented through a visualization on a website that is accessible from the internet. The website is hosted on a Raspberry Pi computer configured with an appropriate ARM compatible Linux distribution.
- Grade 4. The thermostat signal is processed through a Kalman filter or similar. After the initial fermentation, the ambient conditions governs the temperature of the beer. The code is portable and it is possible to extend the system with temperature control in a fermentation chamber.
- Grade 5. In addition to the stated grading criteria, the data is accessed in a manner similar to an interactive process view that a production company might order as a web application.

The goal for the project is to achieve the grade 5.

[1] Suggestions. To be discussed.

Preliminary time schedule

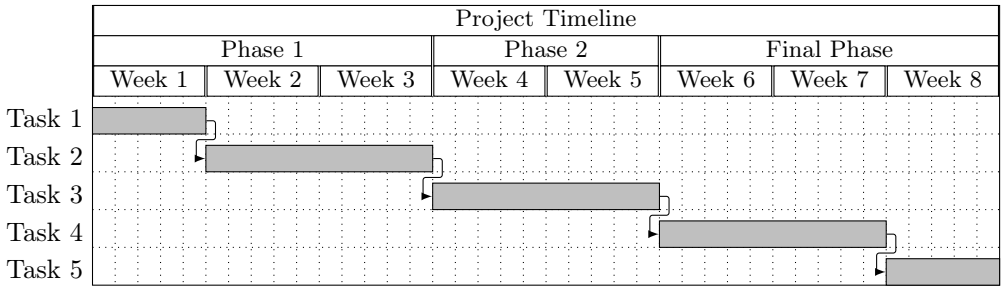

Figure 1: Gantt scheme representing the project timeline.