

**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.

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. Since the compounds produced by these microorganisms are in most cases unwanted, a lot of research has been put into detecting and excluding them from the process as part of quality control. An important step in getting to know more of the brewer's house culture is logging the fermentation temperature, which in some cases can be as long as three years.

## 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 transmitting to the server.

The RPi based server is accessed on the internet by the end user and can be visualized using external libraries that works on both computers and mobile units.

## 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<sup>1</sup>

- 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.

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<sup>1</sup>Suggestions. To be discussed.

Preliminary time schedule

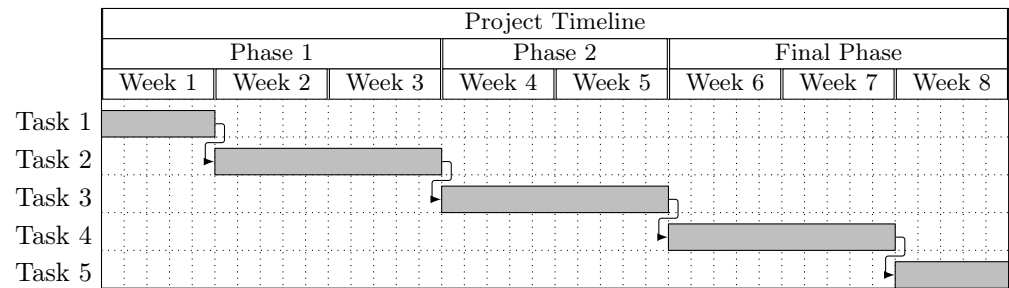


Figure 1: Gantt scheme representing the project timeline.