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Simple exchange of data enables low-cost datadriven services

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Introduction

Residential heating units (from district heating supply) are often optimized when installed but then not serviced thereafter. A service technician is only called in if there is an observable decrease in comfort level. Even if the unit is maintained regularly the technician only observes the actual values on analog meters – and make decisions based on these observations. It is rarely considered how the units operate seen from a supply side. It is possible to verify the operation of the unit by introducing online measurements at a service job and potential optimizations can be identified and documented. Valuable information about the transport time and cooling in the transmission system can be shared with the supplier at the same time.

Vejle case

In this case, we show that it is simple to collect temperature data from the local district heating company, the district heating unit and the residential installation – and simple to make these data available for the service technician for optimization purpose. Since the system is intended for campaign use – no long-term stability or documented precision is needed, which radically reduces the cost. Two temperature and one flow sensor are furthermore available free of cost by using data from the energy meter in the house. The details on the tool are described in Fig .

Monitoring

District heating supply point:

Two temperature sensors placed on the outlet pipe connected to Node MCU and sim-based WiFi.

Private house:

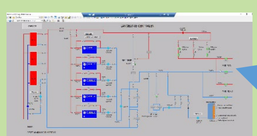
Five temperature sensors on a Node MCU running Tasmota, one optical eye on a Raspberry Pi collecting online flow and in/out temperatures from the energy meter, a Kamstrup 602. The values are transmitted every 10 seconds using local WiFi to a MQTT cloud service.

Prices (in EUR):

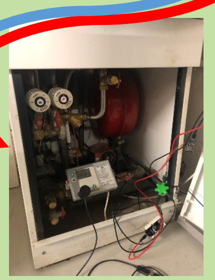
Node MCU (5), RPI(50), Temp sensor (4), IR eye (150)

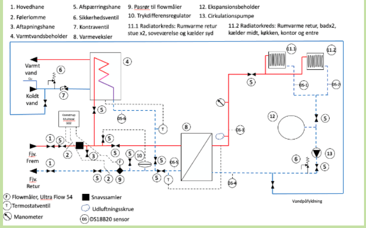
Fig 1

Langelinje 60, Vejle DH.



Transmission, 2.5 km pipeline, Logstor pipes, insulated, 30-50cmØ, 20-30 years old. Branch pipe 17m long.



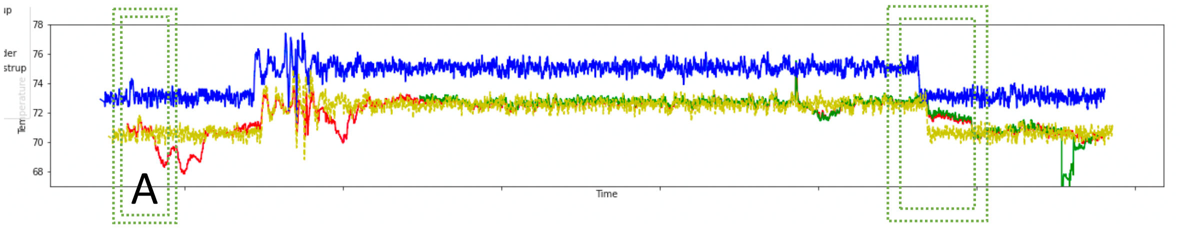


Svendsgade 79, private house

Data were guided to am MQTT service – from where it can be collected continuously. We use Node-Red for the SCADA system, storing the data in a MySql database, for data retrieval and simple presentation. The system was built from scratch as part of a 2-day mini-course in data-driven cloud services. The server cost is 10 EUR/month.

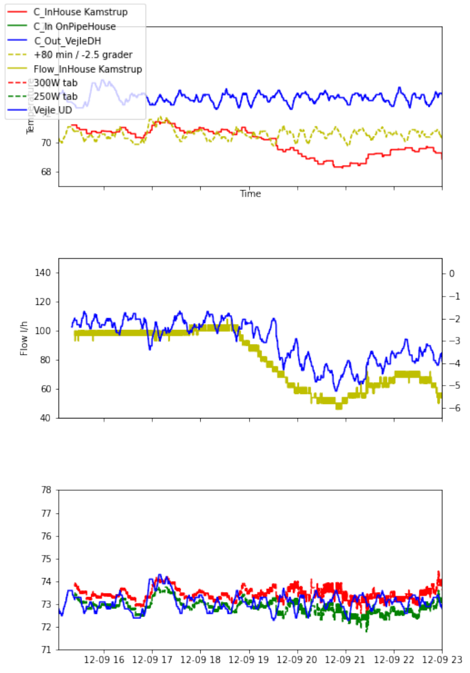
Data interpretation and possible use

B The supply temperature can change rapidly as seen in the end of the period of 5 days (Fig 2).

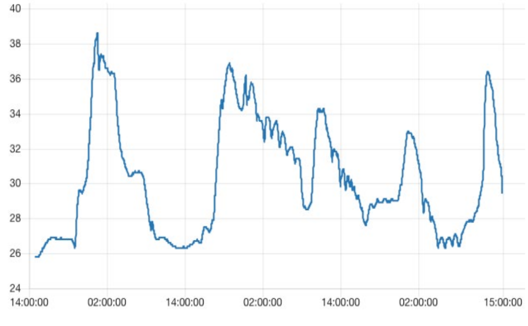


A A number of interesting observations are illustrated in Fig 3a-c. In Fig 3a the blue line illustrates the heat temp out of the DH plant in Vejle over 8 hours, 15th of Dec 2019. The yellow line is the temp measurement 80 minutes later at the inlet to the house. The pattern created by a temperature difference of only 1/8 degree is highly recognizable. When subtracting (a heat loss of) 2.5 degree Celcius a match is clear. The red line shows that there is no match at low flow situations.

It was also observed (Fig 3b) that the temperature drop from the DH company to the house, the blue line (right y-scale), and the branch line, yellow line (left y-scale) is clearly correlated. It is now possible to estimate the loss in the branch line alone (17 meters) to 250-300 watt. Now it is possible to match in the very low demand situations (40 l/h) illustrated in Fig3c. The transport time in the branch line to the house (17 meters) is at 40 l/h = 8 minutes, and at 100 l/h = 3 minutes. A shift in transport time is observed at the low flow periods in that range. A more sophisticated delay calculation could fit the observations more accurately.



C Several sensors monitor the return temperature from the different parts in the house. See example in Fig 4. The temperature is highly dependent on the actual situation and will change during the day, in accordance with the demand and supply situation.



Discussion

The tool presented and tested in this paper seems to be able to provide a stable dataflow. The only error was solved by a simple re-powering of a device. A toolbox with the sensors, controllers and optical eye can be built for less than 500 EUR. By making it a campaign tool, it can serve as a highly movable reusable tuning tool for the housing unit, while at the same time supply the district heating company with accurate measurements of heat transport time and heat loss in the transmission system. The data on these parameters are highly valuable for optimal operation and when considering changes in the supply system. The system also shows the ease of sharing data through cloud services and low-cost easy applicable IoT-technologies.

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