DISTRIBUTED CONTROL SYSTEM FOR HOUSE HEATING USING A WOOD FURNACE

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Abstract: A hundred years ago the basic home heating source was burning wood, but over the years many home heating fuels have emerged as the heat of choice, with wood heating taking a secondary or back-up roll in our busy homes. Even fireplaces were installed more as a focal accent with a warm and cozy ambiance, than as a main source of heating. Burning wood is quickly regaining popularity and regardless of what your main source of heating is, it may be a good choice of alternative heating for your home.[1] This paper present a distributed control system for a classic wood furnace used to heat a house.

Keywords: distributed control system, furnace, measurement, temperature

INTRODUCTION

Firewood is economical and readily available in most areas. That being said, equipping your home with a wood-burning stove or fireplace does require a small investment, but you can generally recoup these costs over a few heating seasons. The main choices when it comes to burning wood for home heating are: a traditional wood heat stove or fireplace, a pellet stove which can burn wood pellets or other fuels, or a wood furnace. Wood cook stoves are also increasing in popularity in modern homes due to their dual functionality.

In this paper we present a classic wood furnace for which was developed a control system for increasing it performance in order to heat the house.

The furnace used is a classic combustion with simple construction, equipped with minimal functioning systems: a heat pump and a mechanical air draft regulator (fig.1).

Fig.1. Wood furnace

Since the measuring points and the furnace position are at a considerable distance was adopted for the control system a distributed solution.

Therefore, in order to determine the operating temperature of the furnace, and hence the optimum ambient temperature, have considered four measuring points as reference: 3 points inside the house and the one for the outside temperature. Was adopted, in addition to the computing system that coordinates the whole system, a system for local display of the information for monitoring and control of elements of the furnace.

Also, the furnace has a number of parameters to be monitored and controlled, such as temperature of circuit flow and return, the position of the air draft controller, the position of air flap, the state of circulation pump etc., which involved development of a local measure and control system.

The block structure of the distribute control system adopted for house heating is presented in figure 2.

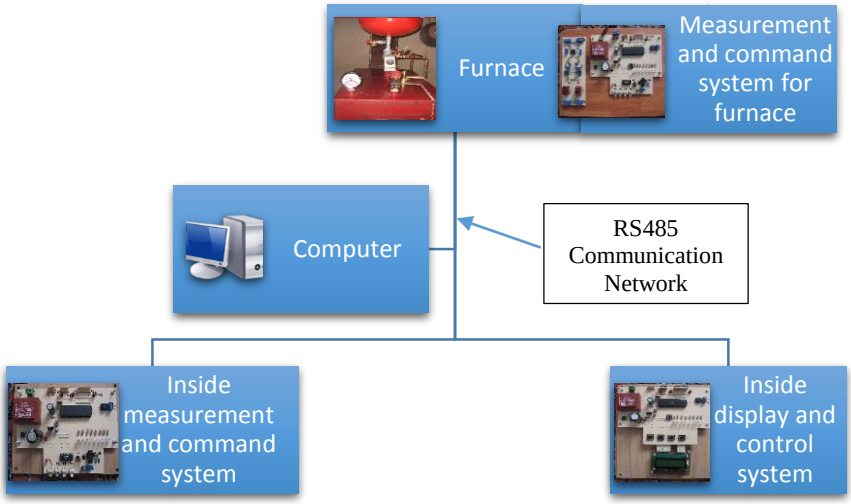

Fig.2.The distributed control system

Inside measurement and command system

The main parameter followed by the proposed system is temperature. Because inside of the house is required to monitoring and adjust the temperature in many areas, the measurement and command system inside of the house is developed around of a microcontroller. The system has 4 analog inputs, 8 digital outputs and 8 digital inputs.

The parameters followed and adjusted are: 3 inside temperatures from 3 different rooms, outside temperature, starting and stopping some supplementary conditioning elements (fans, electric radiator), local signaling about communication and the state of the system.

The circuit scheme and the implementation is presented in figure 3.

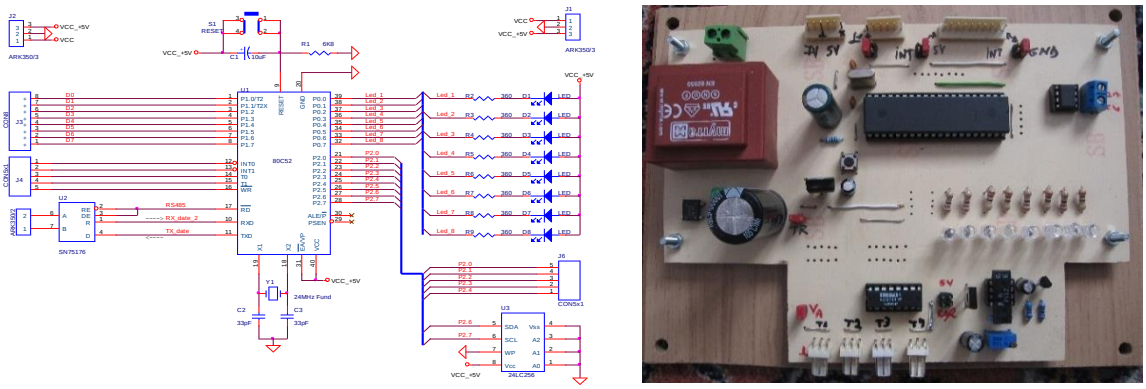

Fig.3. The inside measurement and commnad system

Inside display and control system

The inside display and control system is presented in figure 4 and include an alphanumeric display with 2 lines and 16 characters, and 4 control buttons. The system is developed with an 80C52 microcontroller from Atmel and communicate with the others systems through a RS485 communication network. Through this system are displayed the temperatures and the state from system and allow manual control of some elements from furnace (the position of air flap, the state of the circulation pump).

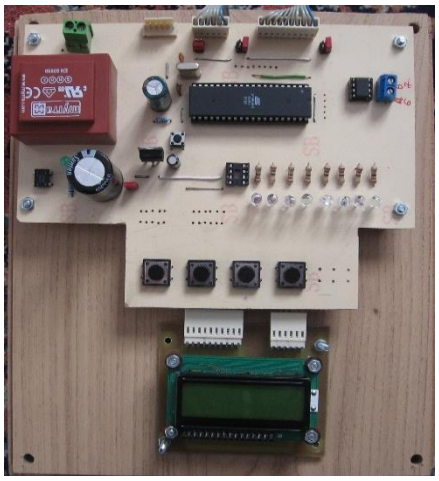

Fig.4. Inside display and control system

The measurement and command system of the furnace

For the furnace can be "automated" were taken into account several parameters to be followed in its operation and its influence to the ambient temperature inside the house. Thus, taking into account the security operation, monitoring and control parameters were:

- flow circuit temperature;
- return flow circuit temperature;
- position of air draft regulator;
- position of the air flap;
- start / stop of circulation water pump;
- the presence of voltage for circulation pump;
- the circulation pump operation;
- operation of the UPS.

The system is designed around one microcontroller with 4 analog inputs, 4 digital inputs and 12 digital outputs. The system allows local information through a system of LEDs. System diagram is shown in figure 5. Besides the system itself there is a current measuring system indicating circulation pump operation and inform for the presence of voltage.

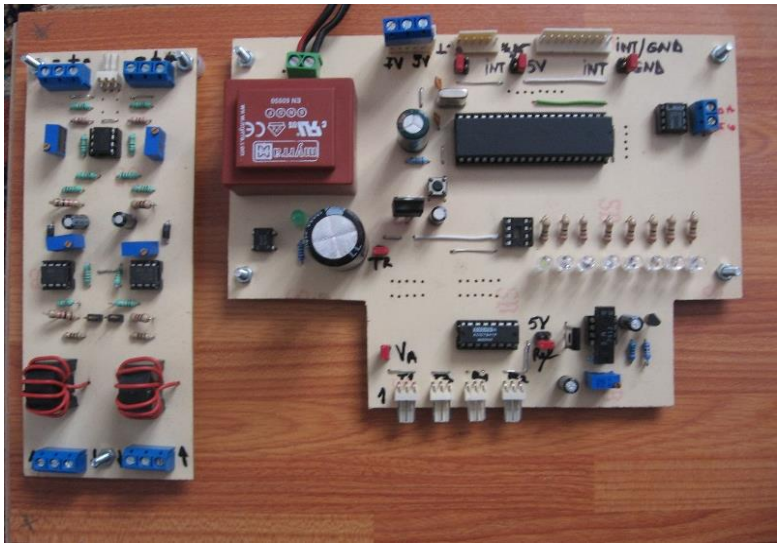

Fig.5. The measurement and command system of the furnace

The main computer

The main computer is designed to manage the overall operation of the entire system, it is connected to it via a RS485 communication network. The implemented software record and store all values and states of the whole system, and through the algorithm implemented it send commands to the system. Also on the main computer are graphical plotted the evolution of temperatures and can diagnose problems found on each system. The graphical user interface (GUI) of the application running at this level is shown in figure 6.

Fig.6. GUI of the software application

CONCLUSIONS

Implementing such a control system significantly improves the heating system by increasing furnace efficiency and safety in operation. Adopting the structure of distributed system made the system to be flexible and easily reconfigured, and gives temporary autonomy for individual modules.

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