

An apartment building heating system Initial informal requirements

The problem is to design the software for the control system of the heating system, in a large apartment building. The software is to be run on a small computer, in the building manager's office.

The building is composed of multiple apartments. However, each apartment has its own temperature sensor, furnace system, abnormal status indicator and heating requirements. But, all apartments use oil from a single oil tank.

A master switch can be set On/Off to operate all furnaces.

The software system thus receives a heating system master switch setting (On/Off).

The sensor in each apartment inputs an error difference between the apartment actual temperature and the desired temperature for the apartment (assume that the setting of the desired temperature is done directly -that is, not through the computer- via a dial connected to the sensor).

Each oil furnace has a motor that drives a fan to supply combustion air, and also that drives a fuel pump. The furnace provides a motor RPM (rotations per minute) status indicating whether or not the motor is at normal operating speed, a combustion status indicating whether combustion is taking place or not, and a fuel flow status indicating whether adequate fuel flow exists or not.

When the apartment gets too cold, the motor is activated. When the motor reaches normal operating speed, the ignition is activated and the oil valve is opened. The fuel is ignited at this time and the furnace begins to heat the water, which circulates through the apartment. The fuel flow indicator and the (optical) combustion sensor status signal the software if abnormalities occur. The furnace is alternately activated and deactivated by the software to maintain the temperature within the required limits [For purposes of comfort and furnace efficiency, the total change of temperature allowed in each apartment is 4 degrees. For example, if an apartment temperature of 70 degrees is desired, the furnace must operate so that the temperature never falls below 68 degrees or rises above 72 degrees -unless the outside temperature is greater than 72 degrees].

When a furnace is deactivated, first the oil valve is closed, and 5 seconds later (to allow for the valve lag-time), the motor and ignition are deactivated. There is a 3-second lag-time before the motor stops.

The software must generate valve signals signaling the oil valve on a furnace to open or close, motor signals directing a furnace motor to start or stop, ignition signals directing ignition to start or stop, and signals to indicate abnormal status for combustion and fuel flow.

Note that furnace turn-off must be initiated within 5 seconds after either the master switch is turned off, the fuel flow rate falls below adequate level or the optical detector indicates the absence of combustion.

When a furnace gets into an abnormal condition, it must be manually (somehow) restarted.