Development of Diagnostic and Control System for SMART Home

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***Abstract*—The fire parameters studied, a fire signalization and extinguish control system proposed. Given system makes it easy to manage any event in house by distance control. If a gas leakage or fire occurs in apartment or at home, an alarm is triggered and a notification is sent to the mobile phone. At the same time, changes occurred in the apartment "under the control" of the system can be tracked in special monitor mode that it is possible to prevent of the fire and without increasing its scale.**

Keywords—control system, fire, extinguisher, temperature sensor, smoke sensor, automatic mode

I. INTRODUCTION

Fire alarm and warning systems are electronics based systems that detect fires that may occur in buildings, homes and facilities, help to prevent injuries to people working and living in these areas, and to take the necessary measures to minimize losses. For this reason, such systems are one of the most important automatic control systems in smart buildings.

Fire extinguishing systems are the common (group name) name of the systems used to stop or reduce the effects of a fire. This system group includes irrigation systems, dry dust and gas extinguishing systems. The purpose of fire extinguishing systems is to cool combustible materials and lower the temperature of these substances below the combustion temperature. In addition, some fire extinguishing systems reduce the level of oxygen in the air with heavy and non-combustible gases to reduce the fire. In the event of a fire, fire extinguishing systems are activated manually or automatically. Chemical gases such as water, foam, dry chemical dust, CO2 and Fm200, and Novec are used as extinguishing agents in automatic fire extinguishing systems. However, the most commonly used are water, foam and CO2. Water is widely used as a fire extinguisher in fires due to its low cost and high heat absorption, which lowers of the combustion temperature [2,6].

At the moment, the demand for motor fuels and lubricants is increasing due to the increase in oil production. However, it is already obvious that such a resource as crude oil is exhaustible (1-3). It is with the aim of solving this problem that the process of development of oil refining has been going on for several decades in the direction of:

- deepening and chemicalization of the process;
- increasing efficiency and achieving optimization of the quality of the resulting finished product, reducing its consumption;
- options for the creation and use of alternative fuels.

The first direction is the most high-tech and intensively developed at the moment branch of the oil refining industry, with the creation of flexible technological schemes and all kinds of catalytic and hydrogenation processes for deep processing of oil and oil residues (5). In this regard, when considering catalytic technological schemes, the most interesting is the catalytic cracking of petroleum feedstock, which is capable of producing high-quality fuel components for internal combustion engines with an octane rating of 85-95 from low-quality, low-value and cheap heavy feedstock. In addition, this technological process is associated with by-products such as mixed gases, which are propane-propylene and butane-butylene gases in composition, which, in turn, are feedstock for the production of various hydrocarbons, such as ethers, alkylates, etc (4, 6). With the help of catalytic cracking units, such valuable components in chemical products as soot feedstock and naphthalene, expensive types of coke are obtained.

As catalytic cracking process is one of the most important processes for deep oil refining, the control of this process is also very essential.

There are many parameters affecting catalytic cracking process. However, the main parameter is temperature. Certain temperatures should be maintained during conduction of this process in order to make system operate in its most efficient regime.

II. PROBLEM STATEMENT

Combustion is the rapid oxidation of combustible substances and gases, when produces heat and light. During the meeting of a substance is heated to ignition temperature with oxygen exothermic chain reaction is occurred. The following three components must be present in order for combustion to begin:

1. Flammable substance (Fuel), 2. Oxygen, 3. Heat (Igniter).

Products that arise after a fire are used to detect a fire. Smoke, heat, and flames are the most important combustion products used in fire detection. The fire detectors are response to physical size of combustion products (Figure 1).

Figure 1. Fire detector

- Smoke control systems are used in high-rise buildings, shopping malls, business centers, factories, airports and in other buildings. Installation of this system in high-rise buildings is more important than in other places. Because people suffer more from smoke in fires over there. Many skyscrapers have been built according to the smart building concept, which includes automatic systems for control and manage of regarding processes in such objects. For this reason, it is necessary to use this system in smart buildings to prevent or reduce human losses [4].

- Active fire safety measures are measures activated by a fire, while passive measures conducted before the fire, use for early detection of fire, reducing the possible effects of fire and extinguishing the fire. Active fire safety measures consist of 5 main groups dependency on according to the work done:

- Measures to ensure fire detection (fire detection and warning system, explosive rain system)

- Measures to ensure the announcement of the fire (emergency lighting system, emergency sound system, call the fire brigade, etc.)

- Evacuation measures (control of elevators and security systems)

- Smoke control measures (Pressure equipment, control of HVAC - heating, ventilation and air condition systems)

- Fire control and extinguishing measures (use of fire extinguishers, fire extinguishing systems).

- Passive fire safety measures are measures taken before the fire to ensure the safety of evacuation routes in buildings, to control the spread of smoke, to prevent the collapse of the building, the spread of fire and to prevent the spread of fire. Unlike active security measures, these measures do not include automatic control systems. In addition, measures taken to ensure the safety of the occupants of a building during the design and planning phase of a building, to reduce the likelihood of fire occurrence and spread, and to reduce the amount of any material losses and damages are included in this group [4, 5, 6].

III. PROBLEM SOLUTION

Home automation is the application of evolving technologies to suit the needs and special desires of users. For fire module used in project demand software to work with the central control device Arduino Mega 2560.

A flame detector designed to detect and respond to the presence of a flame or fire shown in Figure 2. The response to any detected flame depends on the developed system, it is possible to use given sensor to close a fuel line and sound an alarm, to activate of the fire extinguishing system [1, 2]. A flame detector is faster and more accurate than a smoke or heat detector due to operation principal of it. The visual flame detectors also known, those analyze IR radiation by (CCD) device and use flame recognition technology to confirm fire. Infrared (IR) flame detectors track a special infrared spectral group emitted by burning gases. The typical response time of an IR detector is 3-5 seconds. Dual IR (IR/IR) flame detectors compare signals in the infrared range of the two media, and send an alarm when this difference exceeds a certain value.

These sensors can detect fire up to 3 meters. Flame sensors are one of the most widely used devices due to their reliability. There are two types of flame sensors. Both types of sensors (with three and four pin) can easily communicate with any microcontroller [1].

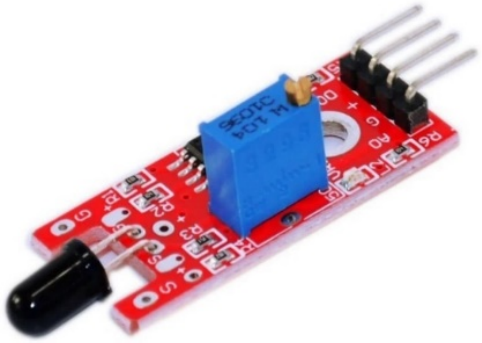

Figure 2. Fire sensor KY-026

KY-026 sensor used as a fire alarm. Connecting of fire sensor to the Arduino Mega2560 + Wool Shield module (Figure 3).

First of all, it is necessary to input of the libraries of the modules to the Arduino IDE program. To do this, the command "#include" is used. After this command, the name of the library must be entered inside the uppercase and lowercase (<>) characters.

In the next step, we enter the Auth Token given to us in the Blynk program. To do this, we will use the command "char auth [] =". If the fire value is > = 500, the Active beep module is activated, the red light on the Rgb LED on the front is lit, and the information about the fire is also sent to the Blynk program on the phone. If the fire value is less than 500, is selected "No Fire!" which displayed in "Serial Monitor" section (Figure 4).

The following figure shows the software block of the MG-2 smoke sensor. If the smoke value is > = 240, the Active beep module is activated, the red light on the Rgb LED on the front is lit, and the smoke information is also sent to the Blynk program on the phone. If the smoke value is below 240, "No smoke!" will be displayed in the "Serial Monitor" section (Figure 5).

A microcontroller is a microcircuit that is used to control electronic devices. A typical microcontroller contains the functions of both the processor and peripheral devices, and also contains random access memory and read only memory. In short, a microcontroller is a computer operating on a single chip that is capable of performing relatively simple operations. Microcontrollers are widely used in computing, consumer electronics, industry, etc.

A microcontroller is essentially a microcircuit, which consists of:

– Central processing unit. It includes a control unit, registers, ROM.

– Peripheral, which includes I/O ports, interrupt controllers, timers, various pulse generators, analog converters, and the like.

A microcontroller is often referred to as a microprocessor. But it is not so. The latter carries out only certain mathematical and logical operations. And the microcontroller also includes a microprocessor with other elements, being only part of the MC.

During operation, the microcontroller reads commands from memory or input port and executes them (7). What each command means is determined by the microcontroller's command set. The system of instructions is embedded in the architecture of the microcontroller and the execution of the command code is expressed in the implementation of certain micro-operations by the internal elements of the microcircuit. Microcontrollers, as a rule, do not work alone, but are soldered into a circuit, where, in addition to it, screens, keyboard inputs, various sensors are connected. There are several architectures on the basis of which microcontrollers are built. These are CISC (Complex Instruction Set Computers), RISC (Reduced Instruct Set Computers), Harvard, Princeton.

The difference between RISC and CISC is that CISC processors execute a large set of instructions with advanced addressing capabilities (direct, index, etc.), giving the developer the opportunity to choose the most appropriate instruction to perform the required operation, and in RISC processors, a set of executable instructions are reduced to a minimum (8, 11). In this case, the developer must combine commands to implement more complex operations.

Princeton architecture was developed by John von Neumann and independently by Academician S.A. Lebedev. It uses shared memory to store programs and data (fig. 1). The main advantage lies in the simplification of the CPU circuitry and in the flexibility in allocating resources between memory areas.

A feature of the Harvard architecture is the presence of separate address spaces for storing commands and data (fig. 2). This architecture was almost never used until the late 1970s, when MC developers finally realized that it was precisely this architecture that gave them certain advantages. In particular, the analysis of real programs shows that the amount of MC data used to store intermediate results is about an order of magnitude less than the required amount of program memory. This means that you can reduce the bit width of the data bus, reduce the number of transistors in a microcircuit, and at the same time speed up access to information in both "hemispheres" of memory. As a result, most modern MCs now use the Harvard-style RISC architecture.

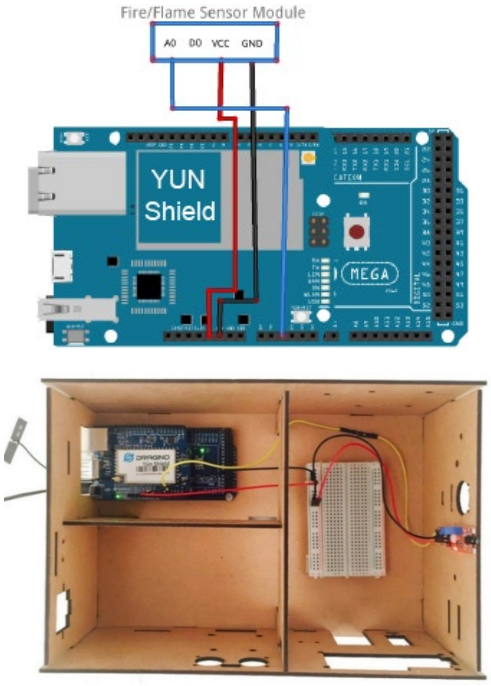

Figure 3. Connecting of fire sensor

Figure 4. "Serial Monitor" section

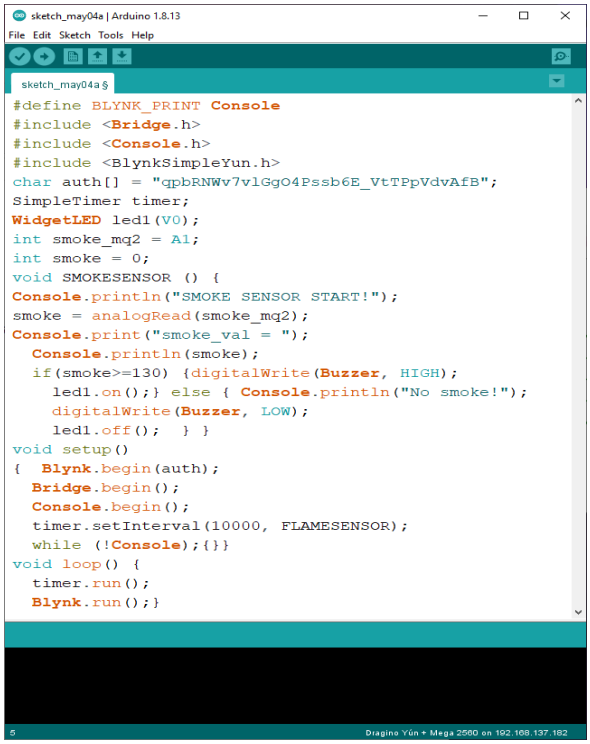

Figure 5. "Serial Monitor" section

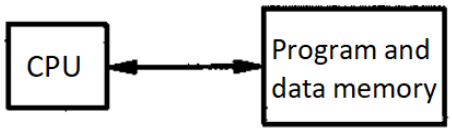

Figure 6. Princeton architecture

CONCLUSION

The following conclusions have been drawn from the research: The proposed system allows to easily manage of the process occurred in home via to remote control. If there is a gas leak or fire in the house, the alarm system is activated and a notification is sent to the phone. Changes in the apartment are under the controlled of the system can be seen in the "Serial Monitor" section.

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