Summary

Current master's thesis describes the development of intelligent photoelectric smoke detector with RS485 interface. The main purpose of the development is to provide the customer with operable device which corresponds to required technical characteristics.

At the beginning of this thesis principle of operation of photoelectric smoke detectors was examined. Device construction was described. Also, the research of products on the market was conducted to find out, what kind of solutions already exist and to compare the difference and advantages of the developing device.

The first phase in development of the thesis is to design the program for microcontroller ATtiny85 to provide workability for the hardware of the smoke detector. Microcontroller was configured in accordance with the circuit diagram, the necessary functions have been written for the functioning of the device and carry out experiments over it. Using this program the measurements of the current smoke level can be taken, collected data can be analyzed, conclusions about the presence of fire and bad condition of the readings can be made. It was also implemented data transfer compatible with the RS485 interface and opportunity to access the device by its address.

The next part involves the process of designing test setup called "smoke tunnel" for testing working capability of the smoke detectors. 3D models and drafts were made. Built chamber showed good result. It is able to provide varying level of smoke for the full range visible for tested smoke detector. In this part total cost of materials and components used for test chamber was also calculated.

Then, the device test for external electromagnetic noise immunity was performed. It was discovered that the device is very vulnerable for electromagnetic interference. To protect the detector shielding, adding filters to the circuit board and program methods were tested. The best result was achieved with shielding, which almost completely eliminates disturbances. Other methods failed.

The final part of this thesis describes program made on PC in LabVIEW for the presentation of the device performance. Its algorithm and code is shown there. As a result we have program with understandable user interface. It sends requests to the device, reads and shows acquired data.

To sum up, the operable version of the smoke detector has been designed. However, the development of this device is not yet finished. Better methods for protection against electromagnetic interference can be found. Also, program for microcontroller will be updated to have the possibility to change parameters of the device like threshold values.

Kokkuvõte

Käesolev töö kirjeldab aruka fotoelektrilise suitsuanduri koos RS485 liidesega arendamist. Arendamise põhi eesmärk on tagada klientidele töötava seadme, mis vastatab kõikidele tehnilistele nõuetele.

Käesoleva töö alguses uuriti fotoelektriliste suitsuandurite tööpõhimõteid, kirjeldati seadme konstruktsiooni. Sellele järgnes turuanalüüs, mis oli läbi viidud selleks, et teada saada, millised lahendused on juba olemas ja et võrrelda seadmete erinevusi ja eeliseid.

Projekteerimistöö esietapil on kirjeldatud ATtiny85 mikrokontrolleri programmi projekteerimise protsess, et tagada suitsuanduri riistvarale funktsioneerimise. Mikrokontroller on konfigureeritud vastavalt skeemile, vajalikud funktsioonid on kirjutatud seadme funktsioneerimiseks ja katsete teostamiseks. Selle programmiga seadme abil saab teha jooksva suitsu taseme mõõtmisi, analüüsida kogutud andmeid, teha järeldusi tulekahju puhkemisest ja ebasobivatest näitudest. Samuti rakendatakse RS485 liidesega kokkusobivate andmete edastamist ja võimalust aadressiga seadmle ligi pääseda.

Järgmises osas on kirjeldatud katsejaama projekteerimise protsess. Olid tehtud 3D mudelid ja joonised. Ehitatud katsejaam saab anda erinevat suitsu taset katse suitsuandurile. Selles osas arvutati ka kogumaksumus katsejaamas kasutatud materjalide ja komponentide jaoks.

Seejärel, teostati katse seadme väliste elektromagnetiliste mürakindlusele. Avastati, et seade on ülitundlik elektromagnetiliste häirete mõjule. Anduri kaitsmiseks uuriti ekraneerimist, filtrite lisamist elektroskeemile ja programmi meetodeid. Parima tulemuse saavutati ekraneerimisega. Teised meetodid polnud efektiivsed.

Töö viimaseks etapiks oli programmi rakendus, seadme jõudluse esitamiseks, tehtud arvutis LabVIEW tarkvaraga. Selle algoritmi ja koodi näidatakse seal. Selle tulemusena sai valmis programm arusaadava kasutajaliidesega. See saadab taotlused seadmesse, loeb ja näitab saadud andmeid.

Kokkuvõtteks, funktsioneeritav suitsuanduri versioon on projekteeritud. Kuid selle seadme arendamine ei ole veel lõppenud. Võib leida paremaid meetodeid elektromagnetiliste häirete kaitseks. Uuendatakse ka mikrokontrolleri programmit, et oleks võimalus muuta seadme parametreid, nagu piirväärtuseid.