Development of a Mobile Application for Calculation of Fire Risks in the Android Studio Environment

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Abstract

This work is devoted to the development of a mobile application in the Android Studio environment for calculating fire risks. The article reveals the concept of "fire risk". It is noted that fire risk is a combination of fire probability and quantitative measurement of its consequences. The paper notes that to ensure human safety, it is necessary to go through four stages to reduce the level of fire risk, namely: 1) to calculate fire risks; 2) to carry out the analysis of the received fire risks and to compare the obtained values with acceptable (limit) values; 3) if the risks are higher than the limit, it is necessary to identify and investigate the main factors that affect the value of each of them; 4) develop models and methods to reduce the level of appropriate fire risk levels.

The article reviews the existing programs for calculating fire risks and explains the development of its own application in the form of mobile communication.

The application allows for the calculation and evaluation of fire risks in emergency or dangerous situations. In the developed application "Territorial Risks", fire risks of level R3 were calculated and evaluated for Ukraine. While the risk has a tendency to decrease, its level is still more than five times the level of 1·10-5, which obliges us to take certain steps to decrease it. Further research will be directed towards the detection and research of the main factors that influence the decrease in fire risks. Further, there will be a focus on the development of models and methods for the decrease of those fire risks.

Keywords

Android Studio Model, Fire Risk, Mobile Application, Human Safety, Research Region.

1 Introduction

The urgency of implementing a risk-oriented approach to ensure the security of the population and territories of Ukraine is emphasized by the Strategy for Reforming the Civil Service for Emergencies. Thus, one of the tasks to be solved during the reform is the introduction of a man-made and fire safety management system

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based on a risk-oriented approach and European standards for assessing and analyzing the risks of fire and man-made safety of economic entities. At the same time, the implementation of a risk-oriented approach to ensure the safety of the population and the territory requires automation of the process of determining the levels of relevant risks and storing information about the objects of protection.

We face different risks every day, but not all of them are associated with danger. Everyday risks include the risk of falling asleep in the morning, the risk of not having time to get on the bus, which puts you at risk of being late for work or a scheduled meeting. These risks, however, are not so dangerous, so they rarely need analysis. There are risks that are dangerous to humans: such include fire risk. The National Standard of Ukraine states that fire risk is a a combination of fire probability and quantitative measurement of its consequences [1]. Brushlinskij M. [2] indicated that fire risk is a quantitative characteristic of the possible realization of fire danger (and its consequences), which is measured, as a rule, in the appropriate units. To ensure human safety, namely the reduction of fire risk levels, it is necessary to go through the following stages:

1) Carry out calculations of fire risks.
2) Carry out an analysis of the received fire risks. Compare the obtained values with acceptable (limit) values (for Ukraine this is the maximum allowable risk – $1 \cdot 10^{-5}$, which is approved by the Concept of risk management of emergencies of man-made and natural nature [3]).
3) If the risks are higher than the limit, it is necessary to identify and investigate the main factors that affect the value of each of them.
4) Develop models and methods to reduce the level of relevant fire risks.

Automation today is forcing us to move to modern methods of calculation and analysis, which is why it is necessary to develop an Android application in order to further accelerate the first two stages of human safety to reduce fire risk.

2 Related Works

Professor Brushlinskij identifies three main fire risks [2]:

R_1 – the risk for a person to be exposed to dangerous factors of fire per unit time;

R_2 – risk of death during fire (victim of fire);

R_3 – risk of death in fire per unit time.

In our previus work, a mathematical model of risk management for a person dying from fire per unit time (R_3) was developed and its features were investigated [4].

Fire risk assessment is also very important to determine the level of danger in the study area, which will allow to develop recommendations for the location of new fire stations [5, 6]. Fire risk analysis is widely used in the analysis of forest fires [7–11]. To assess the risks, Chinese scientists suggest using massive Geo-tagged social media data [12].

Today there are programs for calculating the object fire risk [13–15]. The Fogard software package was developed by the Institute for Technical Regulation and Independent Evaluation in Russia [16]. The complex consists of three modules, one of them being "Fogard-risk", to determine the calculated values of the object fire risk. Russia has also developed the Sitis complex [17], which contains 5 different modules for calculation and one of them, Sprint, for calculating the value of the object fire risk. In Ukraine, there is a software package "RizEx-2" [18] for assessing emergency risks. This software package consists of 4 blocks, which contain 19 modules. One of the modules "Risk" allows to obtain a generalized field of territorial risk of high-risk object for many data sources of danger at the studied object, taking into account the probability of occurrence, development, and implementation of different types of threats inherent in this source of danger, taking into account climatic, meteorological and topographic features of the region. We propose to develop software for the identification and analysis of fire risk.

3 Presentation of the main research material

According to the works of Professor Mykola Brushlinsky [2], the integral fire risk R_3 is determined according to the equation:

$$R_3 = R_1 \cdot R_2 = \frac{M_{victims}}{Q_{people} \cdot T}, \qquad (1)$$

where $M_{victims}$ – the number of deaths due to fires in the region during the period T; Q_{people} – the number of people living in the research region.

Using statistical data for 2010–2020 on the number of deaths from fires throughout Ukraine (these statistics are contained in the Analytical reports on fire and man-made safety of Ukraine) and on the average population of Ukraine, we calculate the fire risk according to formula 1. The results of the calculation are shown in Figure 1 below.

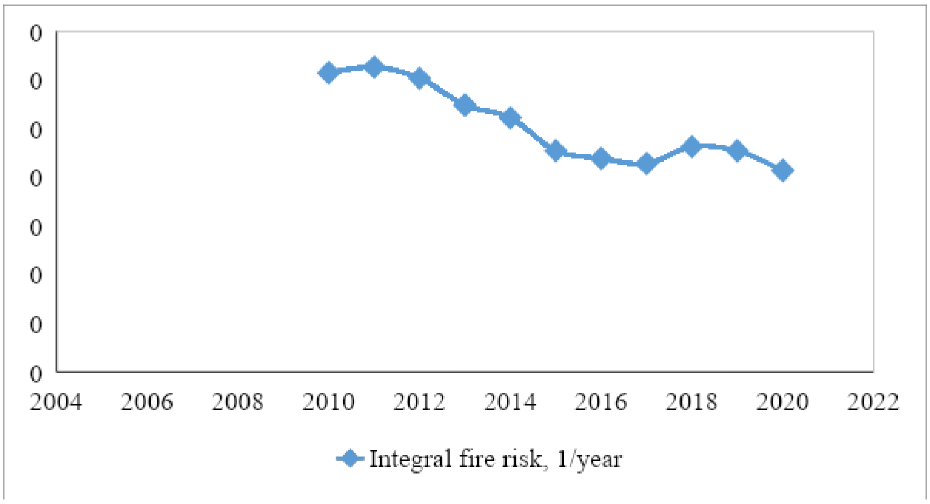

Figure 1: Dynamics of integral fire risk R_3 during 2010–2020 years, 1/year

From the figure 1, there is a tendency to reduce the risk, but nevertheless, the value of the identified fire risk is still high enough and more than 5 times exceed acceptable limits [3]. Microsoft Excel was used to plot the calculations. However, the use of spreadsheets to calculate the integral fire risk is not always convenient, as it is necessary to constantly adjust both the calculations and the construction of a diagram describing the dynamics of the risk. As a result, a “Territorial Risk” mobile application has been developed in Android Studio, which allows you to store statistical information about dangerous events and their consequences on your mobile device, as well as to analyze the relevant integral risks.

The main page of the program (Figure 2) contains information about administrative-territorial units (objects of protection).

Figure 2: Home page of the mobile application

When adding a new region (button "Add region") it is necessary to fill in information about the research region (Figure 3), namely to enter the name of the region and population.

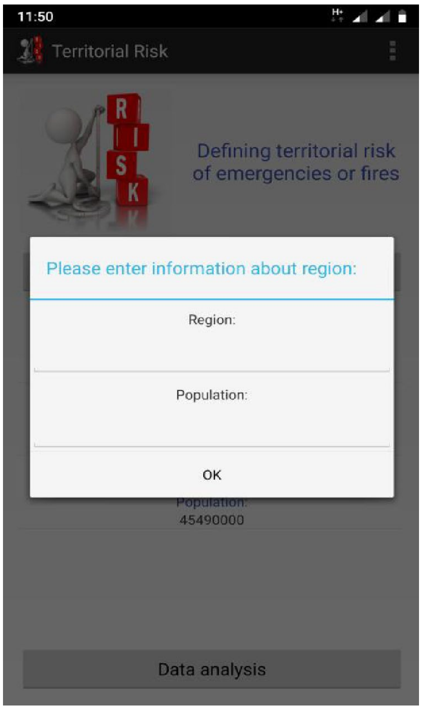

Figure 3: Adding information about the region being analyzed

After filling in the information about the object, you need to enter all the statistics that we will analyze. The program can analyze all three major fire risks, but in our case to calculate and analyze R3 it is necessary to fill in information about the average annual population of the region and the number of fire deaths during the year in the research region. We fill in such information across Ukraine from 2010 to 2020. To do this, go to the page "Region data" in the program and select the field "Add data" (Figure 4) to enter the required statistical information. Thus, we obtain a database for Ukraine on the number of deaths from fires over the past 11 years and the average annual population in Ukraine for each year from 2010 to 2020.

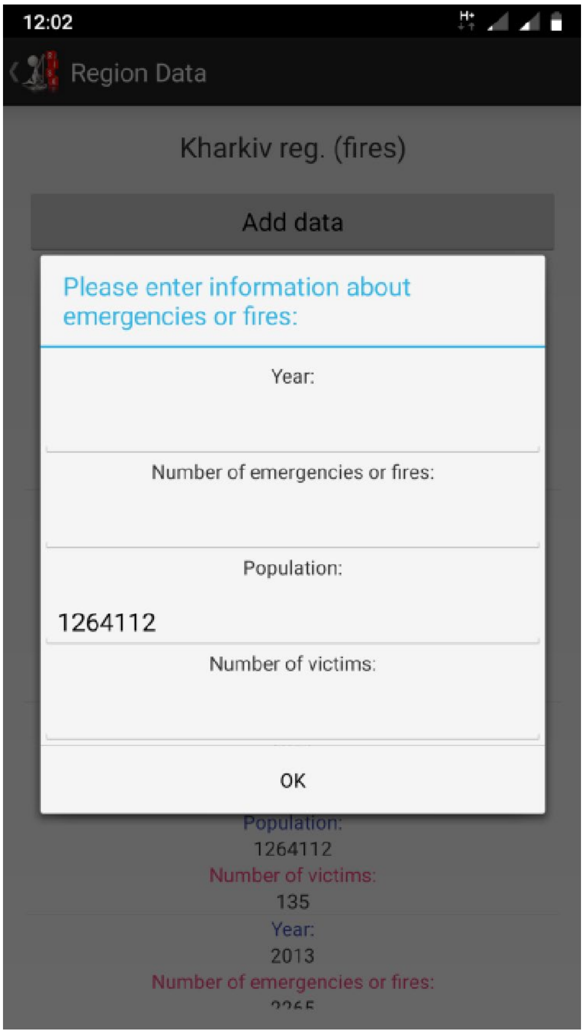

Figure 4: Form for filling in information about the reseach region

To obtain the result, select the region from the completed database for analysis, in our case – Ukraine, and then click on the type of analysis "Dynamic of risk" (Figure 5).

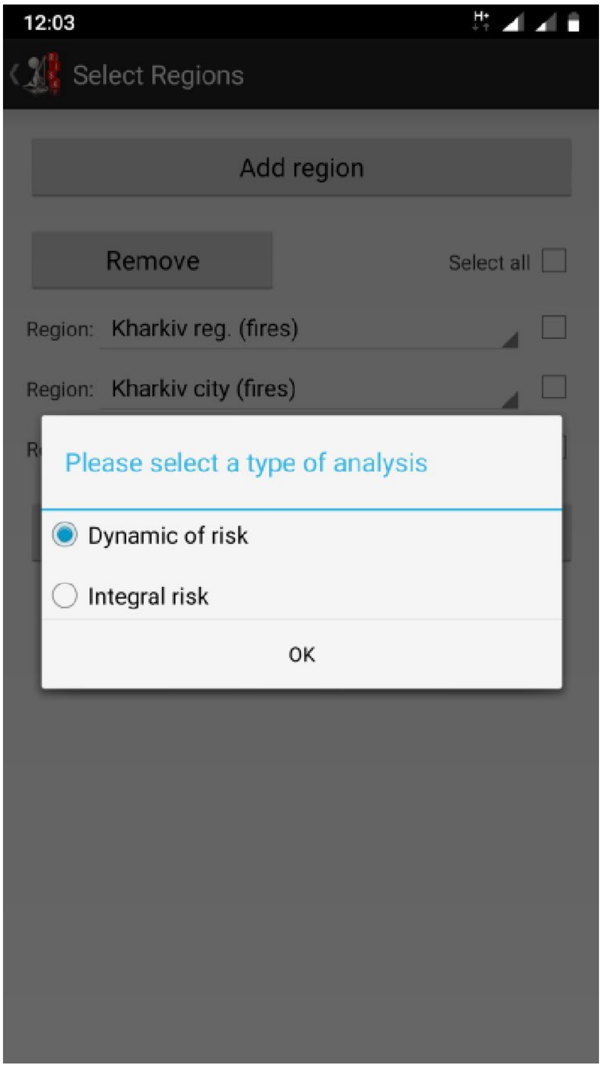

Figure 5. Analysis type selection window

The results of the calculation in the form of a graph are shown in Figure 6. On the graph, you can place a trend line and determine the regression equation. The program allows you to calculate the average value over the years. To do this, select the type of analysis "Integral risk". One graph can present the results of several regions for comparison (this applies to both dynamic analysis and integral values). The program also allows you to calculate and analyze various risks of emergencies or dangerous events.

Figure 6: Dynamics of integral fire risk R_3 during 2010–2020 years with using Android application "Territorial risk", 1/year

4 Conclusions

The paper reviews the existing programs for calculating fire risks and presents the characteristics of the developed own program in the Android Studio environment. The developed application allows to reduce the time of calculations of fire risks and their analysis for the safety of the population, namely:

1) Carry out calculations of fire risks.
2) Carry out an analysis of the received fire risks. Compare the obtained values with acceptable (limit) values.

The developed application also makes it possible to store a database of research regions. If necessary, you can also continue to work with the saved of the research object. Add statistics over time and make new calculations of all major fire risks, namely R_1, R_2, R_3.

The program allows you to calculate and analyze various risks of emergencies or dangerous events. In the developed mobile application "Territorial Risk" the territorial fire risk R_3 for Ukraine was calculated and analyzed. The tendency of this risk is decreasing, but its level is still more than 5 times higher than the limit value $1 \cdot 10^{-5}$, which forces us to take certain actions in order to decrease it. That is why further research will focus on identifying and investigating the main factors influencing the importance of fire risks, as well as developing models and methods to reduce the level of appropriate levels of fire risk.

It should also be noted that today the inspection of fire and man-made safety of facilities is carried out in accordance with the level of risk of the facility being inspected. That is why in the future it is advisable to develop a similar application to calculate the level of risk of the object being inspected.

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