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A domain model for monitoring emergency weather situations at airports

Paper proposes domain analysis of problem domain monitoring emergency weather situations at airports. Results of analysis allows to summaraze creteria for domain model designing. Using these criteria domain model is proposed. Models' inputs receive weather conditions information, the output provides recommendations on what to do in case the weather conditions are classified as extreme. At the same time, it is taken into account amount of information needed to be given to to the target user – the pilot, dispatcher or passenger.

Domain analysis of the application domain "monitoring emergency weather situations at airports"

Ground-based weather observations are a summary of weather information at individual ground stations. The network consists of public and private facilities that constantly provide up-to-date weather information. Ground observations provide information on local weather conditions and other relevant information for a specific airport.

Such information may be obtained from a meteorologist, an automated station updated or supplemented by a meteorologist, or a fully automated station. Either way, ground observation provides valuable information about individual airports. Although reports cover only a small area, a pilot can get a good idea of the weather over a large area by watching several stations transmitting reports at the same time [1].

Aviation meteorological reports are designed to accurately reflect actual weather conditions. Each report provides current information that is updated periodically. An example of such a report is a METAR.

METAR (**MET**eorological **A**erodrome **R**eport) is aviation meteorological code for the transferring actual weather information at the aerodrome. It is highly standardized through the International Civil Aviation Organization (ICAO), which allows to understand it in most countries of the world [2]. An example of such a row is: `UKBB 031130Z 01009MPS CAVOK 20/04 Q1019 R88/CLRD// TEMPO 03010G16MPS`, where, for example, `UKBB` is the code of Boryspil International Airport"), and `01009MPS` shows a wind direction of 10° and a speed of 9 m/s.

Domain model designing

Criteria for the successful functioning of the model

Weather is one of the main risk factors for aviation accidents. Many incidents in aviation happen precisely because of extreme weather conditions. To prevent weather-related emergencies, it is necessary to develop a support system that provides guidance on optimal behaviour for the various participants in the flight process.

Let us form the criteria for the successful functioning of the model:

C1. Ease of use;

C2. Convenience of the user interface;

C3. Independence from the type of user device;

C4. No need to install on the user's device;

C5. Providing only necessary information;

C6. Multiculture user interface.

Domain Model

Consider ground-based observations and METAR meteorological code as input data for the model. It is expected that this data will be received from an external system using an application programming interface (API). The next step is to convert the METAR code into an object-oriented model, that is, to extract the necessary information from the code and present it in the form of program objects.

Data presented in this form can be processed and analysed using software algorithms for reading METAR code. In this case, there are two processes:

• presentation of weather information in a format that can be processed by all model components. It is recommended to use the JSON format because it is modern and readable by both software components and humans

• providing instructions in case of emergency weather conditions in a format that can be processed by all components of the model. For the reasons described above, it is suggested to use the JSON format. This process involves evaluating the received weather information for compliance with the emergency situation and forming instructions depending on the role of the user. The model is presented in Figure 1.
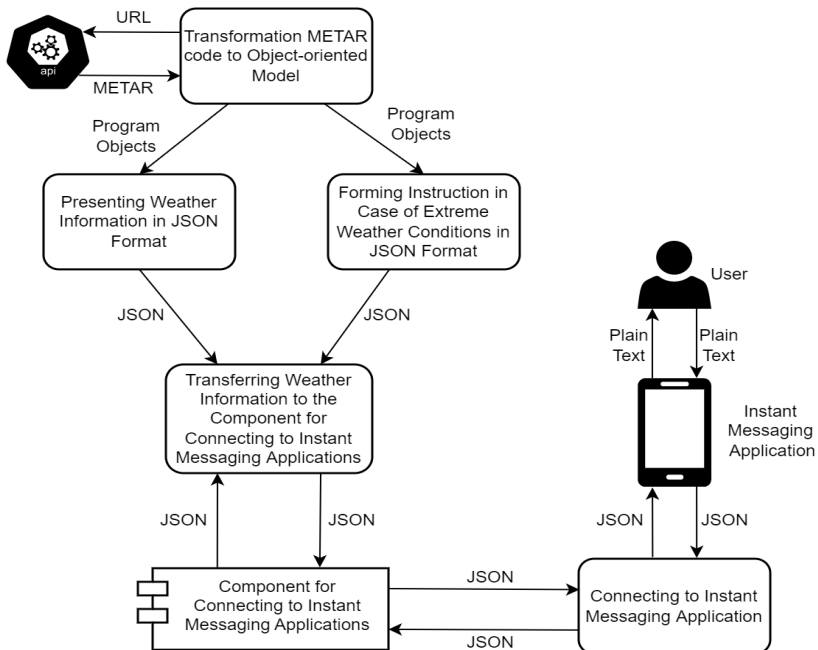

Fig. 1. Domain model for monitoring emergency weather situations at airports

The main feature of the model is a component for connecting to instant messaging applications. This component receives data in JSON format and sends it to the user's device.

Instant messaging apps are one of the most popular places for people to interact with each other. These are application which most people have so it is a good solution to orient on chatbots when serving data to users. Chatbots use conversational user interface (CUI)s). A CUI is an interface that uses text that a user enters into a messaging application [3].

In described model the instant messaging application processes data in JSON format and converts it into plain text, which is convenient and understandable for the user.

Conclusions

The designed domain model plays role of a framework for designing and development of different tools to all flight participants. Using designee model functional and non-functional requirements to the tools may be easily modified. From the point of view of architecture it satisfies to of scalable architecture. Flexibility of the model allows using analytical representation of its components and implementing the rules of its structure refinement [4].

After modification according to cognitive features of the model it may provide an information about extreme weather situations, in accordance with the specifics of the climatic conditions of a certain region as well as extended instructions for actions in the event of such situations.

At the same time, the designed model can be reused in other industries. For example, monitoring emergencies in a city or country, taking into account the characteristics and responsibilities of all users: doctors, military, public service workers and ordinary citizens.

References

1. I. Gultepe et al., "A Review of High Impact Weather for Aviation Meteorology" Pure & Appl. Geophys., vol. 176, no. 5, pp. 1869–1921, 2019.

2. J. Novotny, K. Dejmal, V. Repal, M. Gera, and D. Sladek, "Assessment of TAF, METAR, and SPECI Reports Based on ICAO ANNEX 3 Regulation" Atmosphere (Basel)., vol. 12, no. 2, p. 138, 2021.

3. J. Mayo, Programming the Microsoft Bot Framework: A Multiplatform Approach to Building Chatbots. Microsoft Press, 2017.

4. Monograph Innovative Smart Healthcare and Bio-Medical Systems Editor in Chief Abdel-Badeeh M. Salem, Chebanyuk O., Palahin O. Chapter Title: An Approach for Designing of Domain Models in Smart Health Informatics Systems Considering Their Cognitive Characteristics Monograph. –USA: CRC Press, Taylor & Francis Group, 2020. – 258 p. chapter pages P. 171-193