An alternative low-cost proposal for monitoring environmental radiation in Brazil

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Abstract. Nowadays, it is increasingly necessary to monitor environmental radiation to ensure the protection of the population from nuclear or radiological accidents. In this sense, some countries have already implemented environmental monitoring networks. Despite this, Brazil not only has a radiological survey of the subsoil of its territory, but also only a small fraction of the urban environment has been monitored, not yet having a network of monitoring stations. Thus, the objective of this work is to present a system already under development, which consists of an alternative way of permanently monitoring environmental radiation. The proposed system is based on a device developed to carry out this type of monitoring, as well as on works related to low-cost "citizen science" initiatives. In this case, the device itself is self-sufficient to take all the readings and send them via the mobile telephone network, depending only on energy provided by a battery. Each device is a mobile station composed of a Geiger counter, a temperature, humidity and atmospheric pressure sensor, in addition to a microcontroller associated with a telephony chip and Global Positioning System (GPS). Today the system is in the calibration and adjustments phase, already having results of a preliminary study, in which more than 25,000 readings were collected accumulated in a period of about 15 days. The results, although preliminary and in need of adjustments in the filters and visualization on the map, demonstrate the applicability and full potential of the proposed system.

1. Introduction

Despite advances in radiation protection, nowadays it is increasingly evident the need to monitor environmental radiation to ensure the protection of the population, whether from accidents in the nuclear industry (such as Chernobyl and Fukushima), or due to radiological accidents (such as that of Goiânia in Brazil or Ciudad Juarez in Mexico), either due to effluents from mining companies or even to prevent acts of terrorism [1].

In this sense, some countries have already implemented monitoring networks. Germany, for example, has a network of more than 1,800 fixed monitoring stations equipped with Geigers detectors. Europe as a whole has a network of over 5,000 monitoring stations [2].

Despite this, Brazil not only does not have a radiological survey of the subsoil of its entire territory, but also only a small fraction of the urban environment has been monitored, and above all, the country does not have a network of monitoring stations [2].

As a result, our population is exposed to risks such as late identification of an accident that could lead to exposure of a large number of people [2; 3].

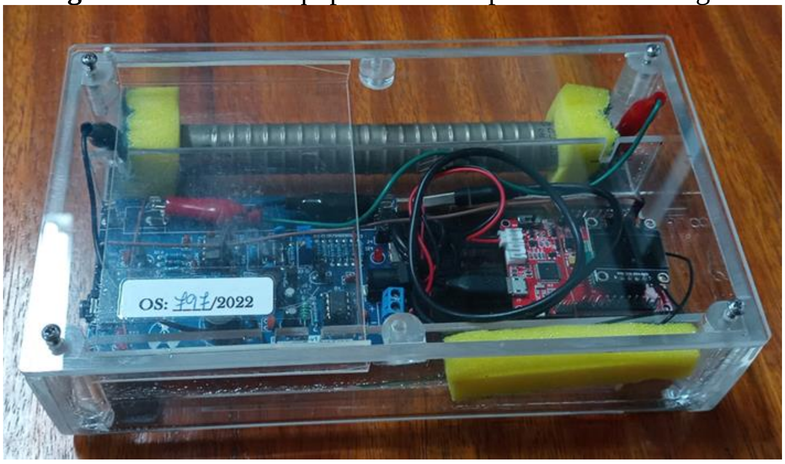
Thus, the objective of this paper is to present a system already under development, which consists of a proposal, not only for a radiological survey, but an alternative way to carry out permanent monitoring of environmental radiation.

This system would be fully applicable to Brazil, considering that due to the territorial extension and budget restrictions, the use of a system along the lines of the German or the European would be practically unfeasible, in view of the costs for installation and mainly for maintenance.

2. Materials and Methods

The first paragraph after a heading is not indented (Bodytext style). The proposed system is based on a device specially developed to carry out this type of moni-toring (figure 1), which, as in other studies, seeks low-cost alternatives, as for example found in “citizen science” initiatives [4-7].

Figure 1. Low-cost equipment developed for monitoring



Source: The author

In this case, the device is self-sufficient in itself to take all the readings and send them via the mobile telephone network, depending only on energy provided by a battery or the vehicle, dispensing with any user interference.

Each device is a mobile station composed of a Geiger counter, a temperature, humidity and atmospheric pressure sensor, as well as a microcontroller associated with a telephony chip and Global Positioning System (GPS).

Having developed a program in the C++ language, so that this microcontroller counts the Geiger pulses, it also obtains the temperature, humidity, and atmospheric pressure of the environment, as well as georeferencing data, transmitting via the telephone network to a virtual computer in the cloud.

This computer is active, with internet access 24 hours a day, 7 days a week, receiving data. After a first treatment, this computer makes the data available for georeferenced access, being able to issue alerts directly to the cell phones of the people of interest, when necessary.

These stations would not be in vehicles for exclusive or specific use, but in vehicles that routinely travel long distances, such as buses, trucks, taxis, vehicles linked to public agencies or service providers.

3. Results and Discussion

In recent years, citizen science projects with the development of Apps and sensors began to use smartphones to collect data in various areas of knowledge, including the environmental area. These Apps also apply to the area of environmental radiation including the nuclear area [4-7].

Some of these devices only indicate the presence of radiation, while others are capable of transmitting the readings via a wireless connection to the user's smartphone, which associates them with georeferenced data and retransmits them to a central [4-7].

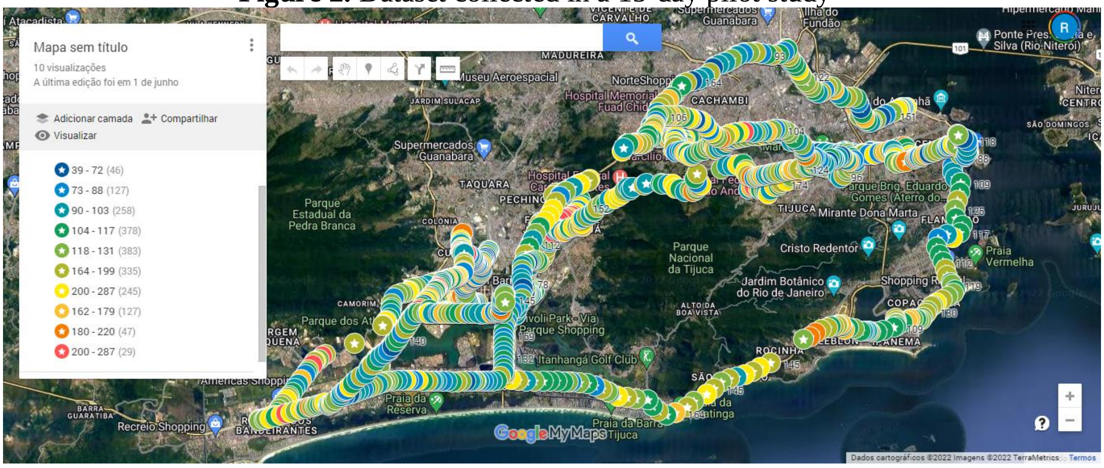
In citizen science, the vast majority of data is collected through mobile devices, such as smartphones [4-7].

The use of free software applied to different projects is also highlighted, contributing to lower their cost [4-7].

Currently, the system proposed in this article is in the calibration and adjustments phase, already having results from a preliminary study, in which more than 25,000 readings were collected accumulated over a period of about 15 days.

The results, although preliminary and in need of adjustments in terms of filters and visualization on the map, demonstrate the applicability and full potential of the proposed system, as shown in figure 2.

Figure 2. Dataset collected in a 15-day pilot study



Source: The author

As this is still a pilot and preliminary study, all the measurements presented here were obtained with the device in a car. Readings are presented in counts per minute (com.).

These results already show the gains that remote monitoring, at a distance, by devices connected to the internet.

By monitoring locations inaccessible to a technician, for example, it makes it possible for an office to have access to field information in real time, including issuing alerts, which would otherwise be more difficult.

4. Conclusion

The use of this device in vehicles would allow the same device to measure thousands of points per day along a route, as well as to take several readings from the same location over time, as the vehicle repeated the route.

And this dataset would allow a continuous radiological survey/monitoring that would otherwise be extremely costly and difficult to implement in a country like Brazil.

As noted, the system even in a preliminary character already shows all its potential. At the moment, details are being worked on regarding data filters to be presented in the visualization of results, as well as on treatments related to measurements of the same location at different times.

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