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Machine Learning and Internet of Thing for Smart-Hydrology of the Mantaro River Basin

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Abstract : the fundamental objective of hydrological studies applied to the engineering field is to determine the statistically consistent volumes or water flows that, in each case, allow us to size or design a series of elements or structures to effectively manage and develop a river basin. To determine these values, there are several ways of working within the framework of traditional hydrology: (1) Study each of the factors that influence the hydrological cycle, (2) Study the historical behavior of the hydrology of the area, (3) Study the historical behavior of hydrologically similar zones, and (4) Other studies (rain simulators or experimental basins). Of course, this range of studies in a certain basin is very varied and complex and presents the difficulty of collecting the data in real time. In this complex space, the study of variables can only be overcome by collecting and transmitting data to decision centers through the Internet of things and artificial intelligence. Thus, this research work implemented the learning project of the sub-basin of the Shullcas river in the Andean basin of the Mantaro river in Peru. The sensor firmware to collect and communicate hydrological parameter data was programmed and tested in similar basins of the European Union. The Machine Learning applications was programmed to choose the algorithms that direct the best solution to the determination of the rainfall-runoff relationship captured in the different polygons of the sub-basin. Tests were carried out in the mountains of Europe, and in the sub-basins of the Shullcas river (Huancayo) and the Yauli river (Jauja) with heights close to 5000 m.a.s.l., giving the following conclusions: to guarantee a correct communication, the distance between devices should not pass the 15 km. It is advisable to minimize the energy consumption of the devices and avoid collisions between packages, the distances oscillate between 5 and 10 km, in this way the transmission power can be reduced and a higher bitrate can be used. In case the communication elements of the devices of the network (internet of things) installed in the basin do not have good visibility between them, the distance should be reduced to the range of 1-3 km. The energy efficiency of the Atmel microcontrollers present in Arduino is not adequate to meet the requirements of system autonomy. To increase the autonomy of the system, it is recommended to use low consumption systems, such as the Ashton Raggatt McDougall or ARM Cortex L (Ultra Low Power) microcontrollers or even the Cortex M; and high-performance direct current (DC) to direct current (DC) converters. The Machine Learning System has initiated the learning of the Shullcas system to generate the best hydrology of the sub-basin. This will improve as machine learning and the data entered in the big data coincide every second. This will provide services to each of the applications of the complex system to return the best data of determined flows.

Keywords : hydrology, internet of things, machine learning, river basin
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