Big Data Predicting Natural Disasters

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Abstract: Analysing Big Data trends is not only a valuable business practice, but can also enhance the effectiveness and performance of emergency and disaster management organisations. Due to the availability and use of smartphones and social media, disasters can be assessed with real-time information and fast, reliable and reliable response can be achieved. Big Data has the potential to enhance the recovery of disasters by using collective knowledge and linking victims with emergency responders and the family. Emergency responders will minimize their search time and optimize their recovery time when they have access to information in real time that highlights the most affected areas. Working with expert expertise and satellite imagery, Big Data has started patterns that have already saved lives and proven successful in emergency situations. This paper aims to review the best algorithms, frameworks and models used for the prediction of Natural disasters precisely floods. Early prediction of such disasters can help the people and management to get prepared in advance.

Keywords: Big data; Disasters; Floods; Prediction; IoT.

1. Introduction

With the advent of new technology, one wonders if policymakers will think more about integrating Big Data developments into disaster prediction and relief assistance. Popular technologies such as the Internet of Things (IoT) have entered the mainstream in the past two decades. Although the severity of natural disasters is rising, technological advancements have decreased fatalities and injuries significantly as a result of this technology. For example, agencies like NASA and the National Oceanic and Atmospheric Administration (NOAA) have leveraged big data technologies to forecast the landfall of Hurricane Harvey and organize emergency response staff. The system helped authorities pick suitable sites and evacuation routes for emergency response as well as identify and plan possible flooding areas accordingly. Additionally, agencies have used machine learning algorithms in the storm impact region to determine the storm's trajectory and its possible harm.

Big Data technology has proved its value as a tool to support and plan for disasters. This helps emergency response agencies recognize and monitor groups such as elderly neighbourhoods or areas with large baby and child concentrations. Additionally, big data tools help rescue workers identify aid resources and prepare operations in emergency situations. Big data also enables real-time crisis coordination, and emergency managers use the technology to predict how people will respond to crises. Big data systems of today are growing at an exponential pace with some reports stating that in the last two years 90 percent of world data has been developed. Both such data can be used to support emergency management in making more informed decisions before, during and after natural disasters.

The main aim is to improve data collection, management, analysis and visualization of disaster management systems for timely and effective decision-making. Today, disaster management based on Big Data Analytics (BDA) and IoT is an under-investigated research field, which contains many exciting opportunities and challenges. With IoT's ability to provide a ubiquitous network system with interlinked sensors and intelligent devices. The combination of IoT big data technologies speeds up the scale of work in both fields. So IoT and big data both bring interdependence with the technologies and need further growth.

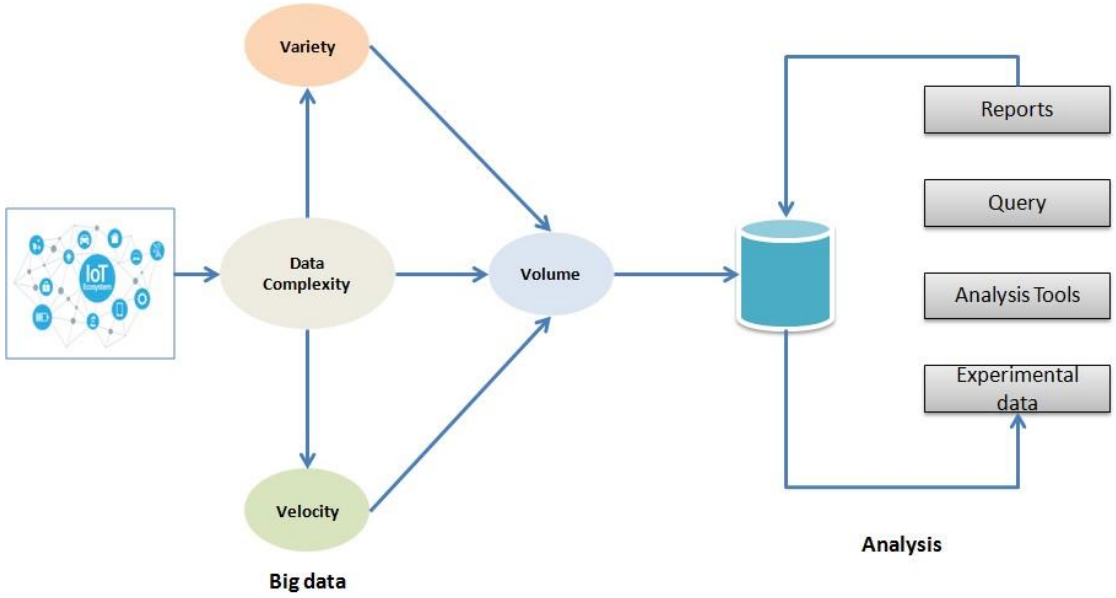

Figure 1 [6]: IoT and Big Data Processing

2. Literature Review

By incorporating new ideas from various research conferences, such as information technology, cartography, health sciences, and environmental sciences, disaster management related policy agencies, scholars, and practitioners have sought to improve disaster management processes. Many researchers have proposed their theories based on the use of IoT, Big Data and other supporting technologies for the prediction of disaster. M Anbarasan et al. [1] proposed the ideas and methods for flood disaster detection based on IoT, Big Data (BD) and coevolutionary deep neural network (CDNN) to address these difficulties. First, the BD flood data was taken from the input data. First, it reduces repeated data by using HDFS map-reduce (). Once repetitive data has been deleted, the data was pre-processed using the imputation of missing value and the normalization feature. Then, based on the pre-processed data, the rule was generated using the method of combining attributes. At the final point, the rules created were given as the input to the CDNN classifier which classifies them as a) flood chances and b) no flood chances. Parameters including Sensitivity, Specificity, Accuracy, Precision, Recall and F-score were compared to the results obtained from the proposed CDNN process. In addition, when the results were compared with other known algorithms such as the Artificial Neural Network (ANN) & Deep Learning Neural Network (DNN), the proposed program differs very reliably from other approaches. Shifeng Fang et al. [2] presented an integrated approach for early warning of snowmelt floods based on geoinformatics (i.e. remote sensing (RS), geographic information systems (GIS) and global positioning systems (GPS)), the Internet of Things (IoT) and cloud services. It consisted of key components such as IoT infrastructure and software, cloud information warehouse, management tools, applications and services, the findings of a case study show that it was possible to enhance the efficacy of flood prediction and decision-making by using the IIS. The conceptual program implemented in this paper was useful for collecting, handling and exchanging multi-source information in early-warning snowmelt flood, and in other water resource management tasks. This work included the creation of an early-warning prototype IIS for snowmelt flood in water resource management with the combination of IoT, Geoinformatics and Cloud Service, with the IIS, everyone could be an IoT sensor and an information warehouse provider, technical users and the public are both servers and clients for information management and services. In addition, the IIS offers a conceptual e-Science platform in resource management and environmental sciences. This study illustrates the critical importance of a systemic approach to IISs for successful management of resources and the environment.

In addition to it, Sandeep K. Sood et al. [3] proposed a smart flood monitoring and forecasting architecture based on the social collaborative Internet of Things (IoT) with the integration of big data and HPC. It classified geographical areas into a hexagonal network for energy-efficient deployment of IoT devices. Using these IoT tools, all related flood- and flood- attributes were sensed and computed via Big Data and HPC processing.

Singular Value Decomposition (SVD) was used for reduction of the attributes. The K-mean clustering algorithm was used to predict the current flood and flood condition at any location, while Holt-Winter's flood prediction approach was used to predict flood. This architecture was further tested on data collected by government of India, and results were effective. Azzedine Boukerche and Rodolfo W. L. Coutinho [4] presented a novel software for intelligent disaster management and smart city response systems. They addressed the core building blocks of their envisaged smart system, it planned the imagined system's main five building blocks, and highlighted the key technologies to be included in each building block. Furthermore, the reason for the interaction between the components of their program and how these interactions would occur was highlighted as well as the important obstacles that their smart system must face ahead was discussed. In context with these research works Gustavo Furquim et al. [5] added about fault tolerance in disaster predictions, they checked a fault-tolerant system for the identification and prediction of IoT-based and ML-based natural disasters called SENDI (Natural Disaster Identification and Prediction System). The system was developed using the ns-3 simulator and complied with the IoT specifications available in the simulator. Weka developed the MLP models and the data collected through a WSN deployed in real surroundings. A clustering scheme was implemented to fix device failures, such as node loss or connectivity, giving SENDI a capability for fault tolerance. In this method, nodes were rearranged to retain the ability to continue making forecasts based on their remaining resources. This clustering method was tested through experiments and obtained good results, both increasing the use of the system's total energy and giving SENDI a process that was sensitive to failures. SENDI proved to be more accurate in making higher degree predictions. But to minimize the need for a large number of nodes, SENDI needs to research the number of nodes needed to construct a stable and not easily degraded device version.

3. Conclusion and Future Work

The research work presented by authors was centred on the amalgamation of Big Data, IoT, wireless sensors. Data collected for the purposes of creating a predictive mode/framework for natural disasters like Floods was collected with the help of various IoT devices having built in wireless sensors. IoT systems produce a significant quantity of unstructured data, which are stored in the big data network. This IoT produced big data largely depends on the quantity, velocity, and variety of their 3V factors. The massive quantity of data is contained in big data files in the big data network which is essentially a centralized distributed database. Review of the collected IoT big data using analytical software such as Hadoop MapReduce or Spark Generating the analysed data reports. Researchers concluded that IoT and big data integration will offer new opportunities and applications across all sectors. It has the ability, in fact, to revolutionize other facets of our society. In the future, the work presented can be improved with IoT-based devices with an even longer range of sensors with reduced costs using innovative algorithms used in each stage of flood detection [1].

Moreover, according to researchers the standardization and application of IoT, data formats and data specifications, big data management and accessibility with information systems, which are subjects of further research in the near future [2]. Some authors even concluded that future development will include system enhancement with more sensor numbers, improved fog layer computing and actual cloud virtual instance data deployment. Due to the random existence of real data the inference methods can be moved to stochastic processes in the prototype [3].

Alternatively, a distributed approach could be implemented to boost forecast accuracy, where multiple nodes exchange forecasts among themselves. It will help to more reliably allocate the workload and render cumulative forecasts [5].

4. References

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[5] Figure 1 < https://www.whizlabs.com/blog/wp-content/uploads/2018/07/iot-big-data.jpg>.