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A system for Tsunami detection and Relief initiation using Twitter hashtags

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TABLE OF CONTENTS

Abstract

Tsunami is hazards that threaten many countries. To protect people from this hazard, a warning system must rapidly and effectively provide critical information to those at risk to help them to take appropriate actions to save their lives. The proposed model have open source dataset collected from accelerometer ,float sensor and microcontroller these tools detects Tsunami waves as well as submarine earthquake and convert it into a dataset. Tsunami waves are very harsh under the hazard condition and the model will be a relief to people. These sensors have a practical implementation that detects Tsunami waves and earthquakes by the water pressure. We can also provide relief by generating hashtags on twitter so that we have a image data of the disaster made and can provide relief to them.

Introduction

A Tsunami warning system (TWS) is used to detect Tsunamis in advance and issue Warnings to prevent loss of lives and damage to property. It is made up of two Equally important components :a network of sensors to detect tsunamis and a Communication infrastructure to issue timely alarms to permit evacuation of the coastal Areas .There are two distinct types of tsunami warnings system :International and Regional.

Early detection is the primary way for reducing the damages of Tsunami hazard. Wireless sensor networks can detect and monitor waves among coastal areas in real time and immediately in comparison to satellite based techniques. Satellite based detection is a more popular method for detection of fire but their long duration of scanning and low resolution limits the efficacy of using satellite based systems. In wireless sensor networks, sensors in large amounts are deployed near the places. These sensor nodes collect the data in terms of temperature, humidity, water pressure and other parameters and send them to the respective cluster head, thereafter these cluster heads send the data to the manager node making a network.

Tsunamis are examined as one of the serious calamities which demolishes various resources and acts as a threat for a living environment. Water provides crucial resources and is most essential to maintain earth's balance. Recently due to human behavior and unusual natural aspects, we have seen Tsunami destroying mankind. Correspondingly a solution is essential that can provide prevention and detection of Tsunami. Conventionally the prevention of Tsunami measures through watching towers, submarine sensors and satellite imagery. These conventional methods have deficits so it is very essential to bring a system which is an effective solution to this hazard .A large number of sensor nodes are densely deployed in the oceans. These sensor nodes are organized into clusters so that each node has a corresponding cluster header. Sensor nodes can measure water pressure , earthquakes and tidal waves. They are also assumed to know their location information by equipment such as GPS. After we have these sensors deployed under

water they gives us live data of the activities underwater and the water waves that causes tsunami are generally caused submarine earthquakes. We collect the data from buoy that are directly connected to the sensor under water that gives the satellite live data of under water activities .

After the data is collected from the buoy , data accumulation, data from sensor is collected for further processing using machine learning techniques which can check for false positive, false negative, true negative, true positive and then output in form of percentage.

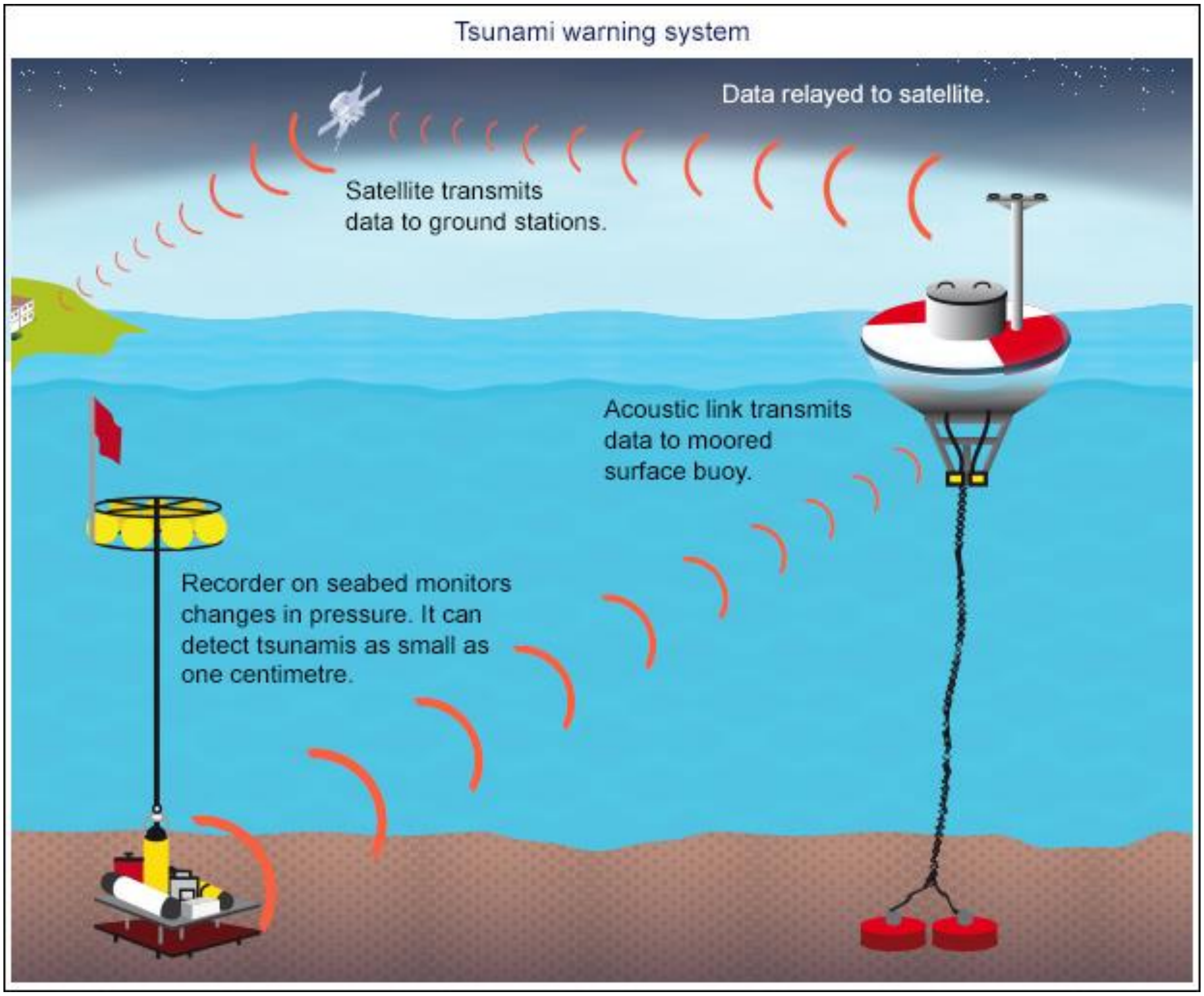
As we know, tsunami can have devastating consequences if not detected before it hits the ground. The general reason for the tsunami is submarine earthquakes but it can also be caused by negligence of human pyromania, which often results in the destruction of hundreds of kilometres. . Using wireless sensor network data and machine learning and deep learning techniques we can easily predict the probability of tsunami in the surrounding areas and initiate relief mitigation which we save a lot of human lives. The model's result 'true positive' will be evaluated on the basis of hashtags tracking from Instagram/Twitter due to the prevalence of Social Media usage and its hike in the face of natural calamities which can help the people that are affected by the tsunami.

Proposed Model

Data Accumulation: Data from wireless sensor network is collected for further processing. Data Preprocessing is done using normalization, scaling etc. Feature selection: Reducing the number of input variables when developing a predictive model. Cross Validation of the data is done. Training of the deep learning based model. Then we have the SAR images that are further processed and then we convert the images into matrix form and these matrix we have the mean mode and median these further at the end we have the processed data Testing of the deep learning based model. Checking for false positive, false negative, true negative, true positive. Classification output in form of percentage. and using social network hashtag for accurate relief mitigation.

The Buoy plays a important role in Tsunami detection as it receives the data from the sensor that are under deep sea level and records the movement of tectonic plates that are the main reason for Tsunami .As we know underwater earthquakes causes tsunami along with shift in tectonic movement. When we have the data accumulated from the Buoy the data then is transferred to the satellite and the data is processed.

Following figure illustrates the working of a Tsunami detection system.



As we can see in the above fig. the data from sensor been transferred to the Buoy and then to the satellite and then to the station or further processing.

Most of the current tsunami under water seismological algorithms has been developed since the 1960s when the giant Chilean earthquake generated in Pacific Ocean. Plate tectonic theory was also introduced in the same year, numerous mathematical models of earthquake source were developed to relate the seismic moment and size of the fault. For an observational sides, various tide gauge sensors, seismic networks was also deployed in 1960s.

The real-time observations and monitoring of a tsunami have been limited to deep-water pressure-sensor observations of variation in the sea level changes. The coastal based radar monitoring systems are implemented in various countries to detect the tsunami wave's arrival near to the coast and to analyze and present the report to the disaster management team for the quick and sudden action to save various lives. Belinda Lipa et al. have suggested an empirical model for the detection of the initial arrival of a tsunami, and demonstrate its use with results from data measured by fourteen high frequency radar sites in Japan and USA following the magnitude 9.0 earthquakes off Sendai, Japan, on 11 March 2011. The distance offshore at which the tsunami can be detected, and hence the warning time provided, depends on the bathymetry: the wider the shallow continental shelf, the greater this time.

Existing detection and warning systems

A comprehensive tsunami detection and warning system consists of

1:-Seismic data, marine data collection using in-situ method or satellite remote Sensing imageries

2:-A secured sea to ground surface and space based telecommunication network.

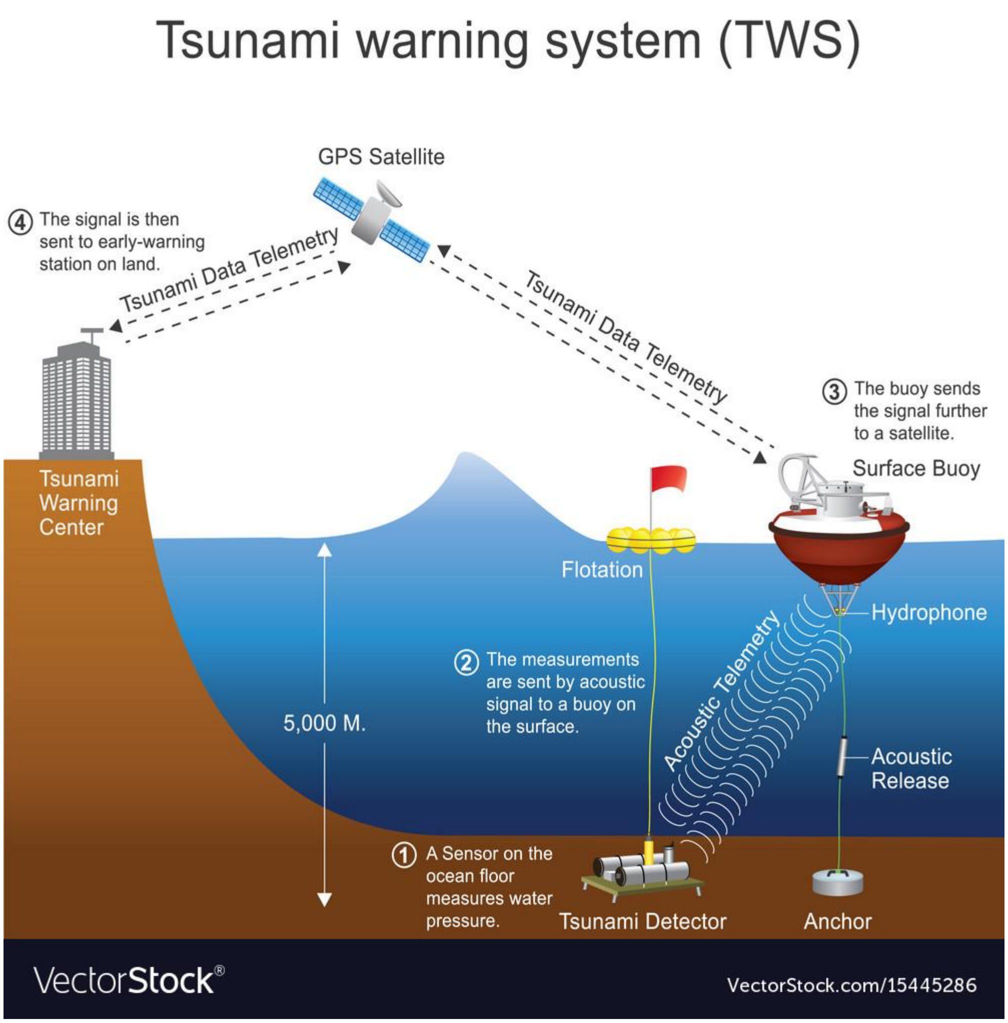
3:-An observing system which is effectively a virtual network known as Global Seismic

4:-Network (GSN), to measure and record all seismic vibrationsRegional satellite or other telecommunication based network to provide efficient budget link analysis

The following tables shoes the following magnitude for tsunami

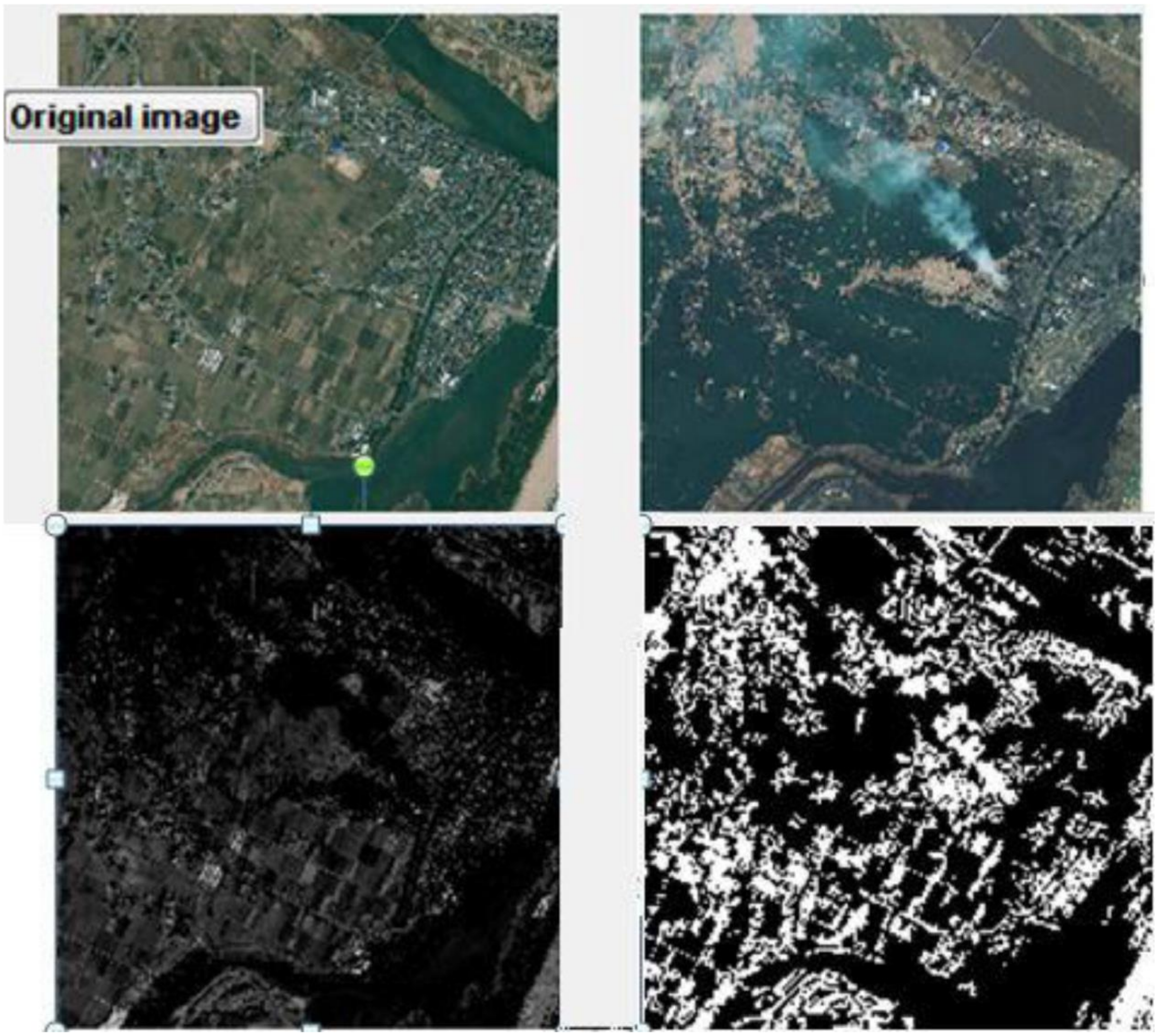
Earth-quake depth	Location	Magnitude	Tsunami potential
<100 Km	Very near sea	>7.9	Ocean wide destruction
		7.6 to 7.8	Regional destruction
		7.0 to 7.5	Local destruction
		6.5 to 7.0	Very small scale
	Inland	>6.5	No tsunami potential
>100 Km		>6.5	No tsunami potential

Architecture Diagrams



This is the diagram for the field work or the field output of the Tsunami Detection Sysytem

SAR Image processing



The remote sensing tools are now a day on demand to analyze the tsunami affected regions. One of the important and sophisticated well known sensor Synthetic Aperture Radar (SAR) sensors can be used to observe the datasets. SAR satellite sensor has been designed and, partially, put into operation, leading to an important breakthrough in Earth Science studies.

The simulation has been carried out in MATLAB interface. A Wiener filters can be used to enhance SAR image by removing the speckles and further post tsunami analysis can be carried out using image processing technique. Wiener filter that is especially suitable for speckle and noise reduction in multilook synthetic aperture radar (SAR) imagery. The proposed filter is nonparametric, not being based on parametrized analytical models of signal statistics.

The presence in orbit of several satellites (constellation), instead, allows to improve the frequency of observation and accordingly to have a better possibility in surveying the phenomenon as soon as it occurs. It is worthwhile to remember the accomplishment of COSMO-SkyMed (Constellation of Small Satellites for Mediterranean basin Observation) satellite constellation, the first global constellation for Earth Observation. COSMO-SkyMed data can be used to exploit the most advanced remote sensing technology with the four SAR satellites. The satellite constellations would provide more timely and comprehensive data and the ability to support disaster management and information on the evolution of disaster areas.

Conclusions

In this article, we carried out a case study of existing tsunami system for the detection and monitoring. A decision based matrix has been prepared to provide the early warning issues based upon the bottom pressure rate measurements. The model was then followed up by the enhancing SAR image processing techniques with the removal of speckle noise using wiener filters. The filters are more suitable for the post tsunami analysis. For the future work, we could propose the improving communication network using the fiber optics microwave cables in the ocean for the selected region. The real-time monitoring can be observed based on the data acquition techniques to provide BPR to the coastal .

References

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