# FLOOD MONITORING AND EARLY WARNING

PHASE 3:*DEVELOPMENT PART 1*


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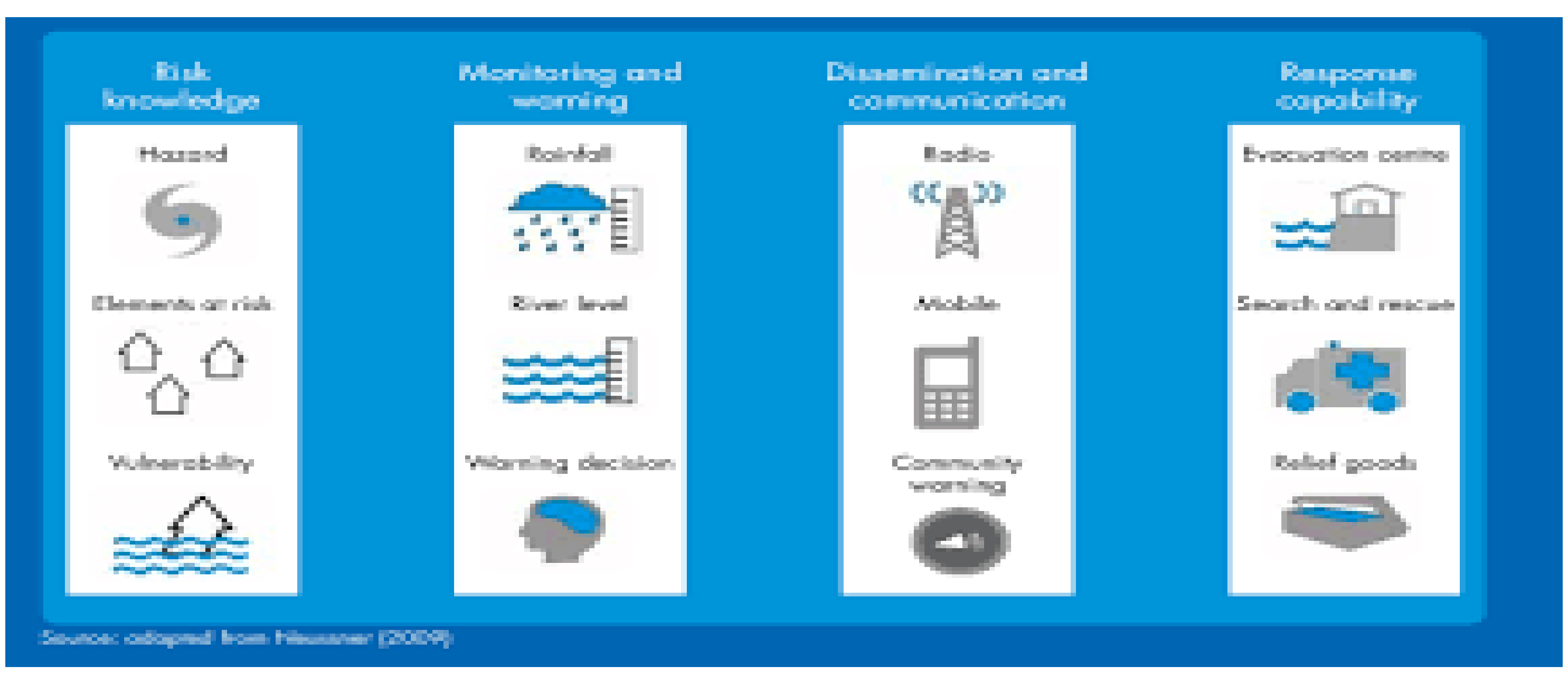
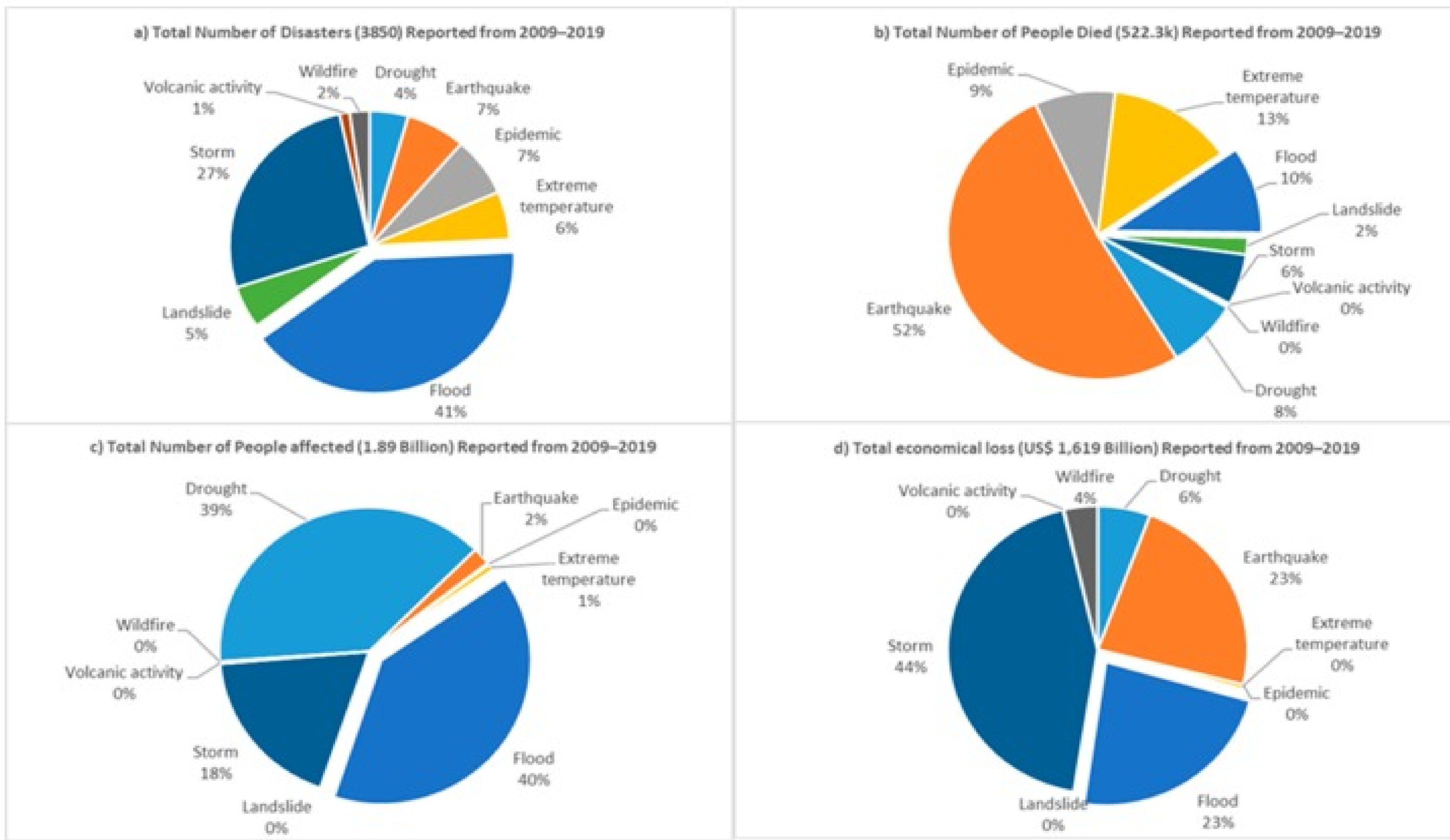


## INTRODUCTION

Natural hazards such as floods, storms, tsunamis and others pose a significant threat to lives and property around the world . Without proper monitoring and effective mitigation measures, these natural perils often culminate in disasters that have severe implications in terms of economic loss, social disruptions, and damage to the urban environment . Historical records have shown that flood is the most frequent natural hazard , accounting for 41% of all natural perils that occurred globally in the last decade . In this period alone (2009 to 2019), there were over 1566 flood occurrences affecting 0. 754 billion people around the world with 51,002 deaths recorded and damage estimated at $371.8 billion. Put in context, these statistics only account for “reported” cases of large-scale floods, typically considered flood disasters. A flood disaster is defined as a flood that significantly disrupts or interferes with human and societal activity, whereas a flood is the presence of water in areas that are usually dry . The global impact of a flood would be more alarming if these statistics incorporated other numerous small-scale floods where less than 10 people may have died, 100 or more people may have been affected or where there is no declaration of a state of emergency or a call for international assistance. Nevertheless, the current situation calls for improved ways of monitoring and responding to floods. The importance of improved flood monitoring cannot be overemphasized given the growing uncertainty associated with climate change and the increasing numbers of people living in flood-prone areas .

## Comparison of different disaster types reported from 2009 to2019




This study provides an opportunity to update readers on recent advancements in flood monitoring.This study presents a systematic review of the literature focusing on the use of computer vision and IoT-based sensors in flood monitoring, mapping and prediction for both occupied lands and coastal sites such as lagoons. The main contributions of this article are as follows:

- A detailed survey is presented on the use of computer vision and IoT-based sensors for flood monitoring, prediction and inundation mapping. The scope covers the state-of-the-art applications of computer vision and sensor integrated approaches for managing coastal sites and other flood-prone urban areas.
- The study highlights gaps in the literature and recommends directions for future research.

## Sample of collected images

## Image data preprocessing

We filtered all the images individually to store only those images which were related to the flood events. This results in more than 9200 images. We resized more than 9200 images to the dimension of 800 × 600. Furthermore, we separated the images collected into two parts: train and test sets. The train set contains 80% of the total images which is 7,360 images and the test set contains 20% of the total images which is >1,800 images. . These images can be used for Canny Edge Detection to perform flood severity level and inundated area. illustrates more details about these technique applications. Given an input image, the image was first resized and converted into a grayscale.Once the skyline was eliminated, only a portion of images consisting of the water surface were included into Flood img

**Image annotation**

We annotated the images for eight objects: car, house, truck, traffic sign, tree, person, bridge, and boat. All the images were annotated using a rectangular bounding box or polygon primitive. All the rectangular bounding box annotations were saved as XML files in PASCAL VOC (Visual Object Classes) format, and all the polygon annotations were saved in JSON file format are the sample of image annotation which has been annotated using polygon and rectangular primitive, respectively. These annotated images can be used for object detection algorithms like fast RCNN which is illustrated .

## Conclusion

The system will alert you with appropriate information about the Flood. It can detect even an inch raise of water level and give alert. We have tested this system by real time for water level measurement successfully. If the water level increases, it will send an alert immediately.

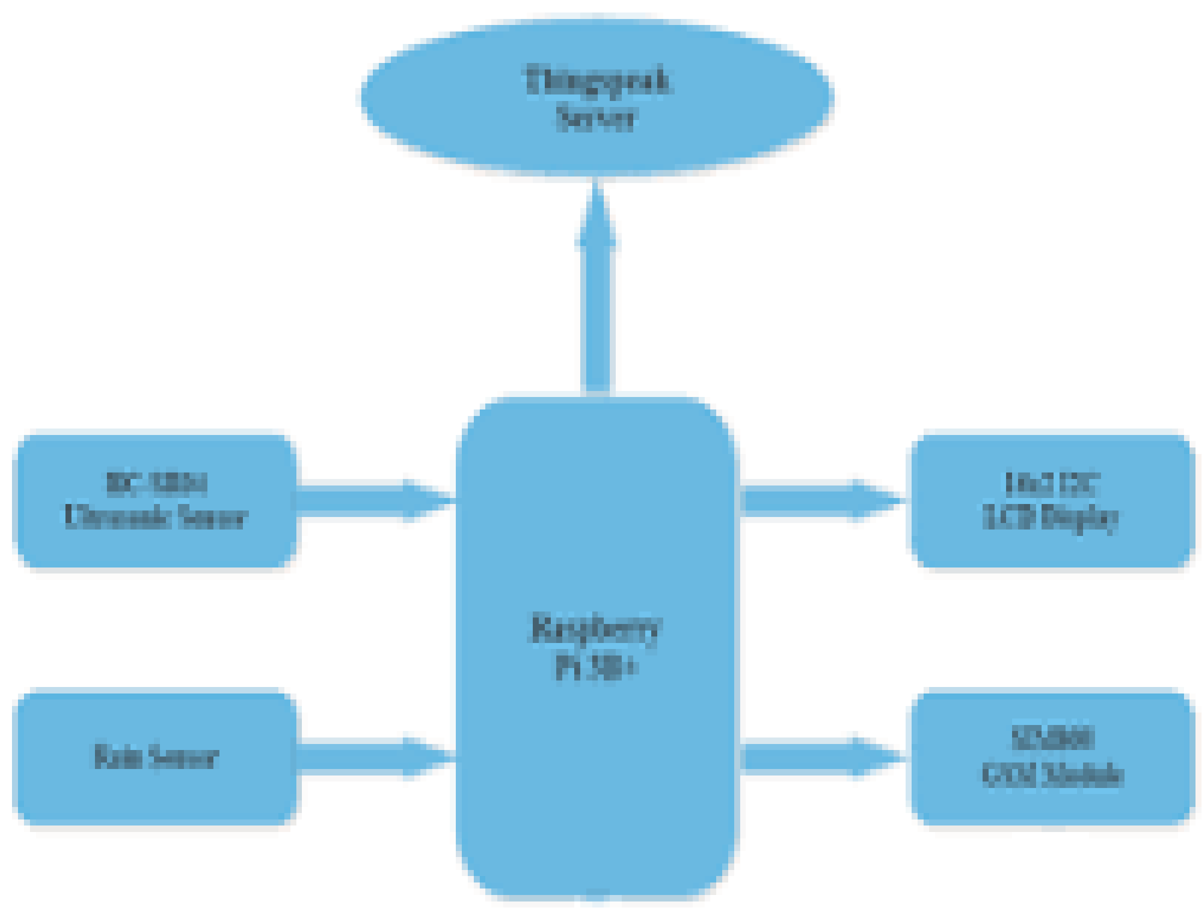



Fig-1: Flood Monitoring and Alerting System