Flood Monitoring System

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CHAPTER 1
INTRODUCTION TO THE PROBLEM

1.1. Problem overview

Disasters are one of the most pressing problems in India. It has resulted to the lost of infrastructures, homes, communities, most of all it has resulted to the lost of lives. According to the National Disaster Management Authority, India losses Up to 52500 crores of worth every year and an average loss of 500 people per year in north eastern India.

Some of the natural disasters in india includes; floods, cyclones, earth quakes, and droughts. Some of these disasters can be easily managed , but one that makes it difficult to manage are floods. According to the NDMA, floods are responsible for about 12% of the total disasters in a year. The problem with floods is that it is nearly impossible to manage its aftermath during the events.

To understand the real problem, let's talk about the Disaster Management Act of 2005 instituted under the NDMA.

Damage due to Floods in Northeastern States

State	2018-19				2019-20				2020-21				2021-22				2022-23 (as on 12.07.2022)			
	Humans Lost (Nos)	Livestock Lost (Nos)	Houses/Huts Damaged (Nos)	Crops Area Affected (in lakh ha.)	Humans Lost (Nos)	Livestock Lost (Nos)	Houses/Huts Damaged (Nos)	Crops Area Affected (in lakh ha.)	Humans Lost (Nos)	Livestock Lost (Nos)	Houses/Huts Damaged (Nos)	Crops Area Affected (in lakh ha.)	Humans Lost (Nos)	Livestock Lost (Nos)	Houses/Huts Damaged (Nos)	Crops Area Affected (in lakh ha.)	Humans Lost (Nos)	Livestock Lost (Nos)	Houses/Huts Damaged (Nos)	Crops Area Affected (in lakh ha.)
Arunachal Pradesh	33	47	1647	0.007	7	23	377	-	19	809	707	0.28	5	18	98	0.02	17	13	699	**
Assam	53	122	77948	0.31	101	250	140440	2	149	393	57931	2.67	13	-	2163	0.1	182	53781	223663	2.401
Manipur	25	142	10820	0.06	-	-	-	-	-	-	-	-	-	-	-	-	53	-	-	-
Meghalaya	7	4632	13100	0.02	23	-	37771	-	32	263	2374	-	2	20	1556	-	36	338	4863	0.011
Mizoram	22	-	-	-	3	-	1523	-	-	-	350	-	-	-	-	-	-	-	-	-
Nagaland	19	896	5202	0.05	19	5	1458	-	9	1	1030	-	2	3603	948	0.17	3	-	345	0.003
Sikkim	4	-	83	-	6	1304	485	-	18	134	1432	0.02	3	61	1085	0.02	8	11	3355	0.002
Tripura	22	4167	40897	0.32	8	15	44963	0.014	5	4	11650	-	6	33	1796	-	3	-	1816	-
Total	**195**	**10006**	**149697**	**0.767**	**167**	**1597**	**227017**	**2.014**	**232**	**1604**	**75474**	**2.97**	**31**	**3735**	**7646**	**0.31**	**302l**	**54143**	**234741**	**2.417**

Figure 1: An image showing the recent statistics of floods losses across north eastern Indian states (***Source:*** **National Disaster Management Authority**)

1.1.2 The Disaster Management Act.

The Disaster Management Act was instituted along side with the National Disaster Management Authority (NDMA) in 2005. This Act included the roles of each government agency, institutions, states, and the population in contributing to the combat against Natural disasters.

The key objective was to ensure a timely, effective, and efficient response to disaster management while ensuring no loss, or minimizing the loss of lives, properties, infrastructures, etc during disasters. Since 2005, the government has sought to institute solutions to ensure the safety of the nations. The population has also contributed endlessly to make sure this act was a success.

However, the terms of the Act has not been adequately fulfilled since its institution. One of the main reasons the objective of this Act is lagging behind is because of floods. Floods contributes to at least 12% of disasters in a year. Moreover, floods causes the highest disasters every year. According to the NDMA, floods causes the loss of about 4745 crores loss per year and about 1600 lives per year (including the 500 live in north east India since 2018).

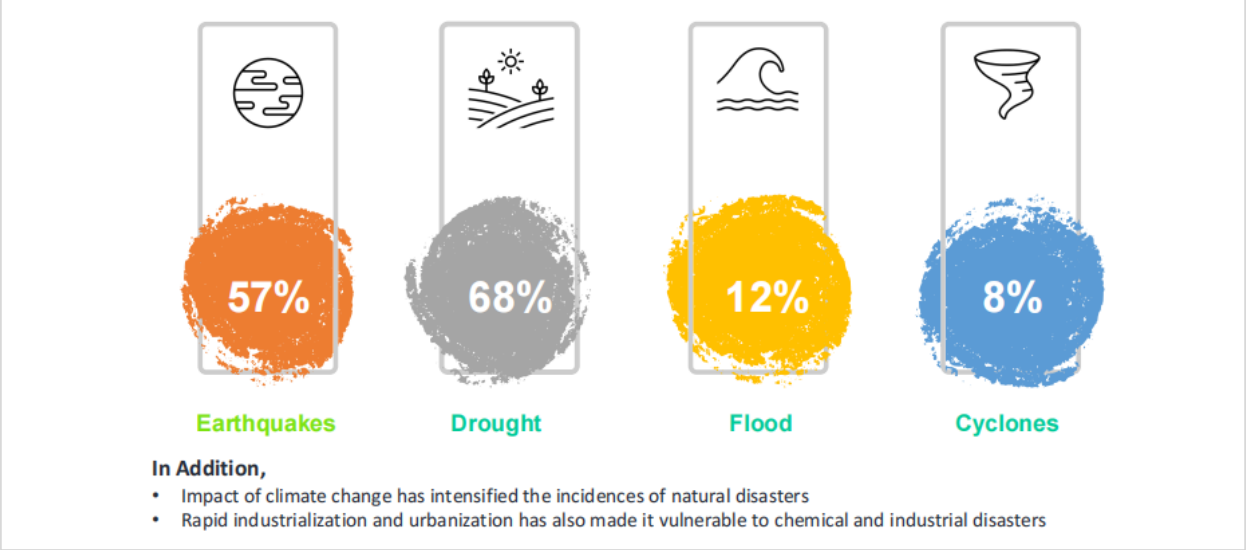


Figure 2: An image showing the percentage distribution of the four highest disasters in india including floods contributing to 12% (***Source:*** **NDMA**)

CHAPTER 2
OVERVIEW OF THE SOLUTION

2.1 Introduction

With the secondary research I conducted, I noticed that the greatest flaws in the improvement of disaster management (flood maangement) is the lack of solutions to improve in disaster monitoring and response during flooding events.

2.2 The Flood Monitoring System (FMS)

The flood monitoring System is a hybrid solution that uses the power of hardware and software technologies to improve on flood disasters responsiveness during flooding events.

2.2.1 Understanding the solution

The flood monitor uses technologies such as Robotics, the internet of things, artificial intelligence, and cloud computing improve on the flood response, prediction, and flood warning systems.

Figure 3: An image showing the disaster management cycle (***Source:*** **NDMA**)

According to the Disaster Management Cycle above, the second step in every disaster is response. The flood nonitoring system is a platform where the government, disaster agencies, and other institutions can use to easily respond during flood events.

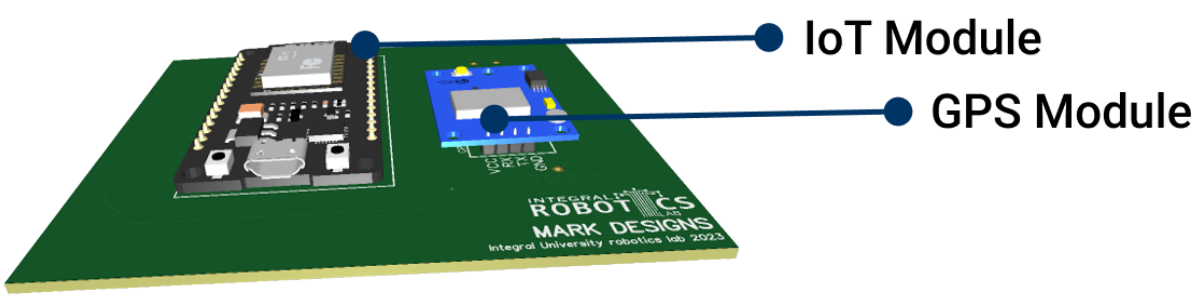
Reading this, the audience will be asking the question, “how?”. To successfully do this we must embrace the power of the Internet of Things (IoT).

2.2.2 How will the Internet of Things Contribute?

From its name, “Internet of Things”, it is a revolutionizing technology that focuses on connecting equipments to share data amongst themselves. The internet of things can be a great tool to effectively monitor severe flooded areas and less flooded areas during flooding events so disaster rescue agencies can know how to plan and dispatch resources.

2.2.3 Introducing the flood tracking sensor

To solve this problem, my team is building a sensor that can be implanted at homes, communities, and areas susceptible to flood so they can be easily monitored. Here is an image of the sensor below.



2.2.4 The Flood Monitor (FM)

The Flood Monitor (FM) is a web application we are equally developing to ease the use of the sensor. With this platform, disaster management agencies can monitor flood events in real time. This real time experience can improve flood response. Below are images of the platform.

Features of Flood Monitor (FM)

1. Realtime display of flood intensity in flooded areas
2. Emergency alert
3. Easy retrieval of data from the platform
4. Realtime display on an interactive map

Features of the sensor

1. Realtime flood tracking interactive sensing
2. Realtime GPS location sensing
3. IoT sensor for cloud communication
4. Fast bluetooth connectivity

Flood tracker sensor **Tracking Platform**

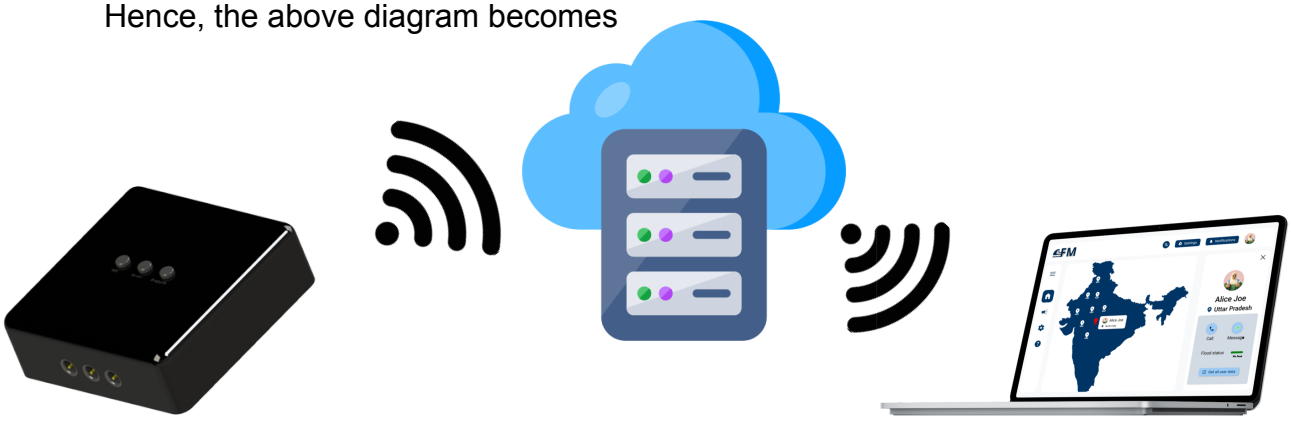
2.3. How Communication is established and stabilized in the System

For effective communication in this system, this is where cloud computing comes in. Looking first instance at this system, it will be impossible to connect the software directly to the hardware. That's true, and even if it is done, stabilizing the communication will be the problem.

To solve this problem, we will leverage cloud computing. With cloud computing, we can link billions of sensors to one platform. How does it works? The sensor uses its IoT capabilities to connect to the cloud, then in the application, we pull all the realtime data from the cloud.

Cloud computing does not only helps to connect the sensor to the software, it also makes the realtime communication stable and faster. Since many devices will be sending data to this single platform, cloud computing solves the problem of data conflict, and the software still runs as fast as if just a single sensor was connected. In this solution we will be using **google cloud**.

Hence, the above diagram becomes



Flood tracker sensor **Tracking Platform**

2.4. How AI will impact this solution?

We have covered how the IoT, cloud computing, electronics, and how the web powers this solution. To get a more overview on this, let's understand how AI will benefit this solution. By the 2005 Disaster Management Act, the main objective was to improve on quick response to disaster incidents. With AI in this solution we can do predictive analysis by training a model to under how specific regions are affected by floods.

With the flood sensors for example, the model can predict which region will be most affected by a particular flood incident and this can help disaster management agencies to be ready on how to tackle regions that are affected by flood.

2.5 Flood tracker mobile application

In addition to the web-based application, we are building a mobile app that can help individuals to monitor their homes from anywhere they are. This will be one of the smoothest routes to easily implement this solution. With the mobile, individuals will receive realtime status of their flood tracker sensor. In addition to the tracking information, they will also receive daily updates of their weather forecasting information that will help them plan in case of any bad weather situations.