

Development of Earthquake Early Warning Dissemination System for Northern India

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ABSTRACT

Himalaya is one of the most seismically active and earthquake-prone region in the world. Recently an Earthquake Early Warning System (EEWS) for Northern India has been developed which includes around 165 strong ground motion accelerometers and 79 public sirens installed in Uttarakhand (India) at various public places such schools, hospitals, police stations, district emergency operation center etc. A timely early warning of earthquake can save more than 50% injuries and many casualties. So, the development of an automated Warning Dissemination System (WDS) component of EEWS is much required. We have developed a WDS, which disseminate the early warnings through low-cost public sirens and smartphone apps in public. The smart phone app is officially launched in public by Uttarakhand State Disaster Management Authority (USDMA) on 4th August 2021.

EEW SYSTEM FOR NORTHERN INDIA

The developed EEW is operational for public. The sensors are streaming the real time to central server situated at IIT Roorkee for detecting the events in real-time. On event detection information is passed to the developed warning server on cloud, from where it is disseminated to sirens, smartphones, and desktop apps based on different conditions.

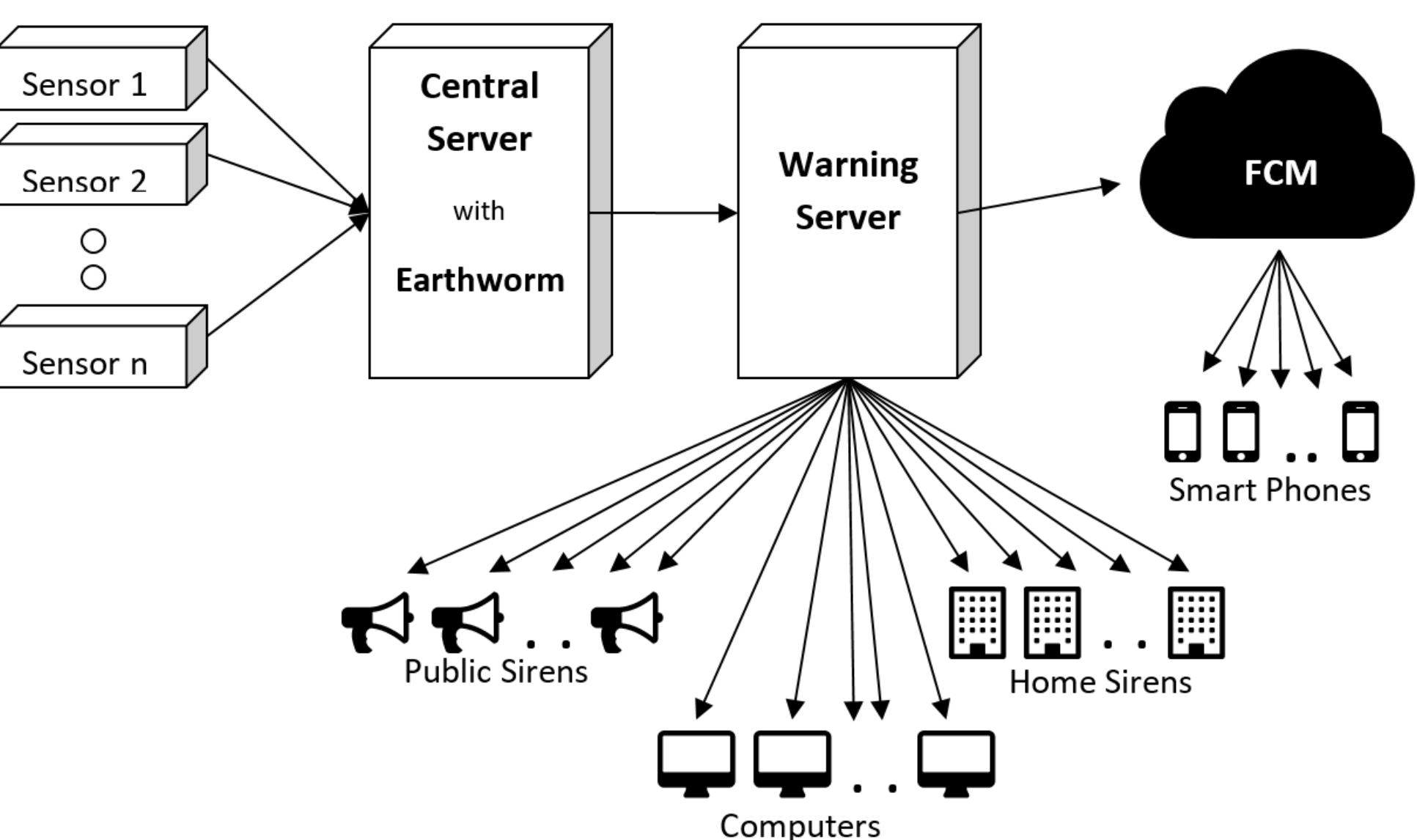


Figure 1: Architecture of the Complete EEW System for Northern India

EEW INFRASTRUCTURE

The locations of deployed sensors and sirens in Uttarakhand for EEW system are shown in figure 2. As shown in figure, most of the area is out of siren coverage, which creates a need for development of warning dissemination app for smart phones.

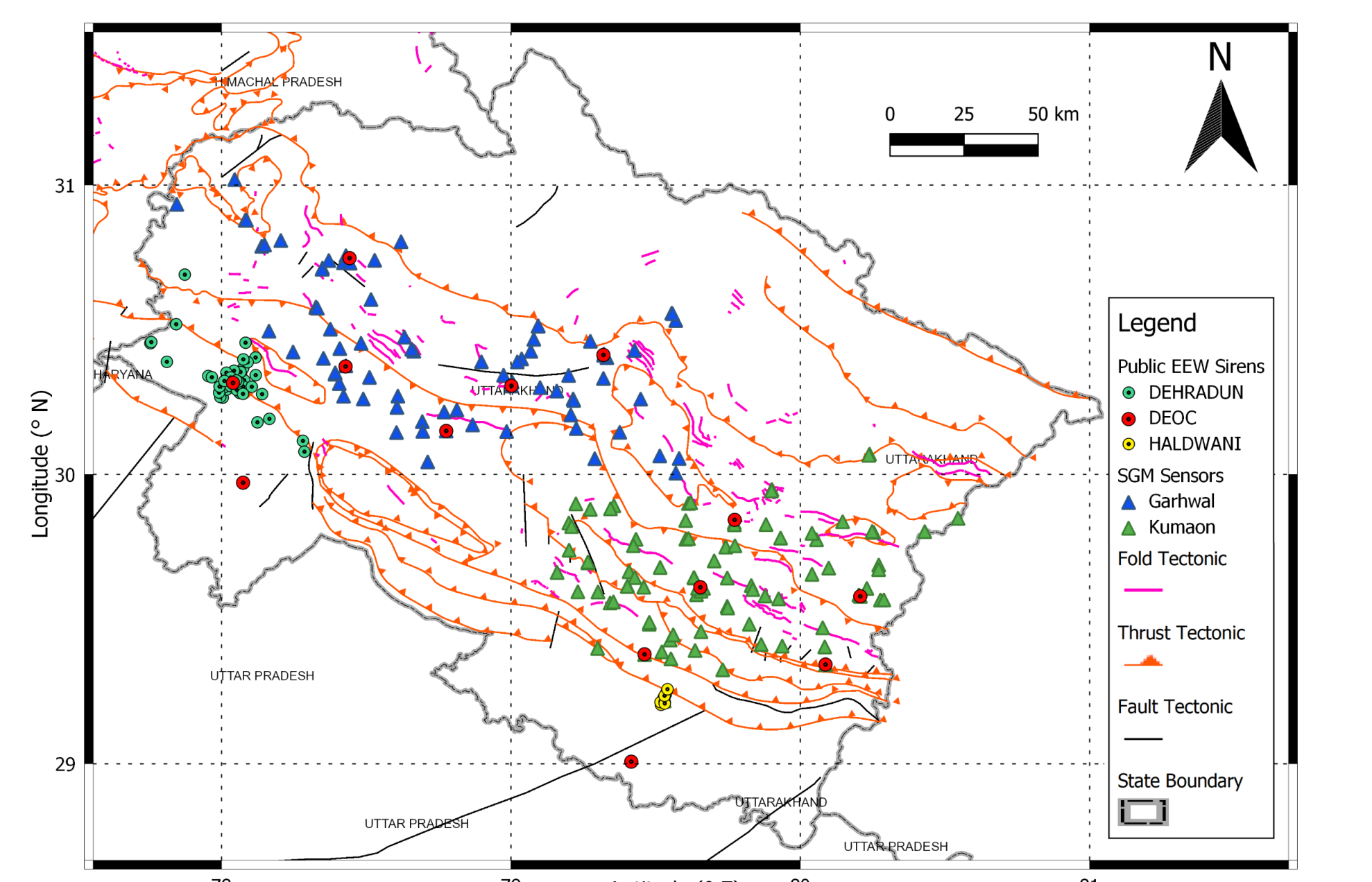


Figure 2: Installed EEW Sensors and Sirens in Uttarakhand

WARNING DISSEMINATION SYSTEM

The warning server has a MQTT broker installed, which is used to connect all sirens and desktop/laptop apps and a dedicated web portal for providing assistant to our maintenance team. Further, a database is created to store all information related to sirens, desktop apps and smart phone applications. A program (Siren Manager) is developed for logging the status of all sirens into the database. Warning to smartphones is disseminated through Firebase Cloud Messaging (FCM) service.

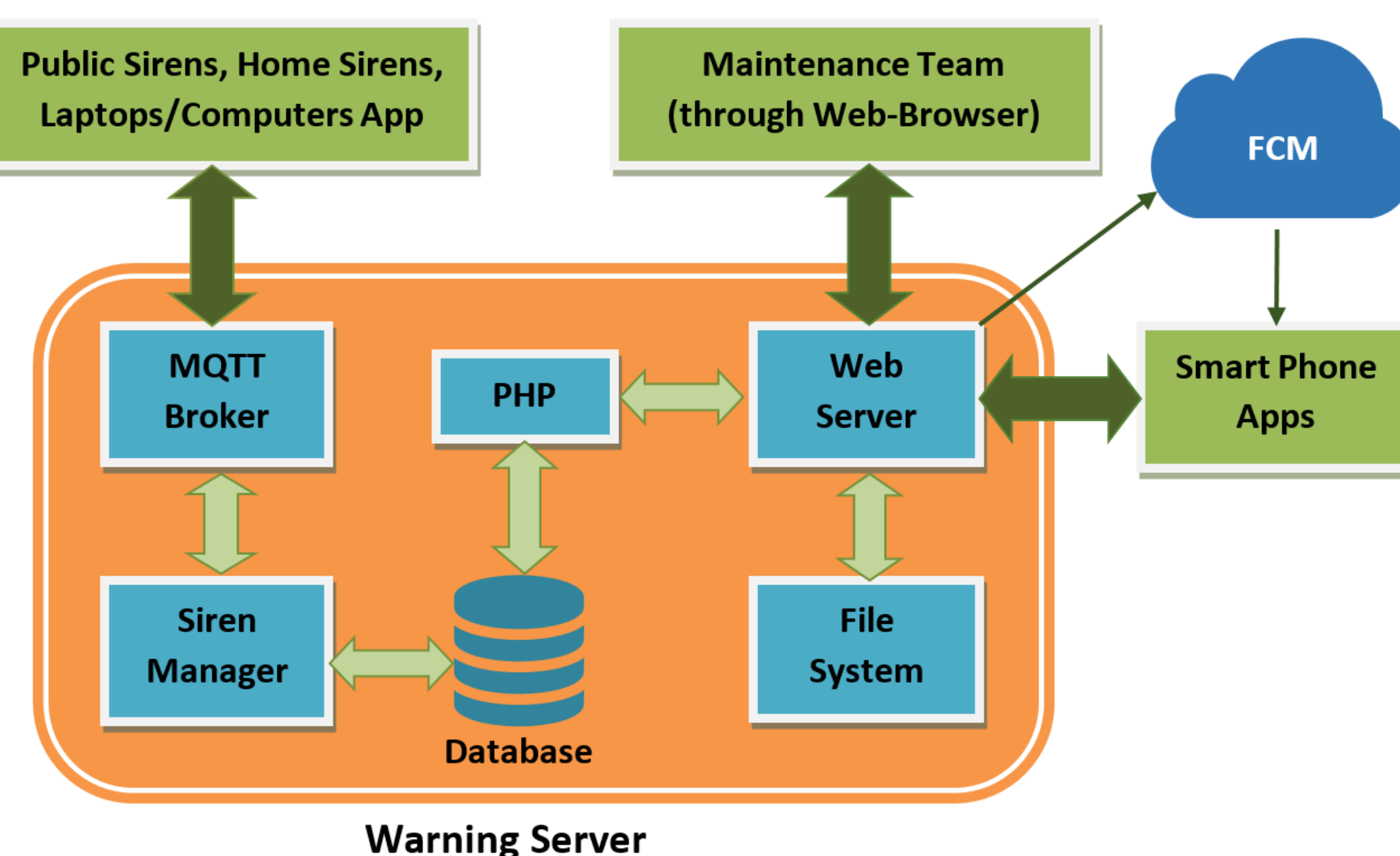
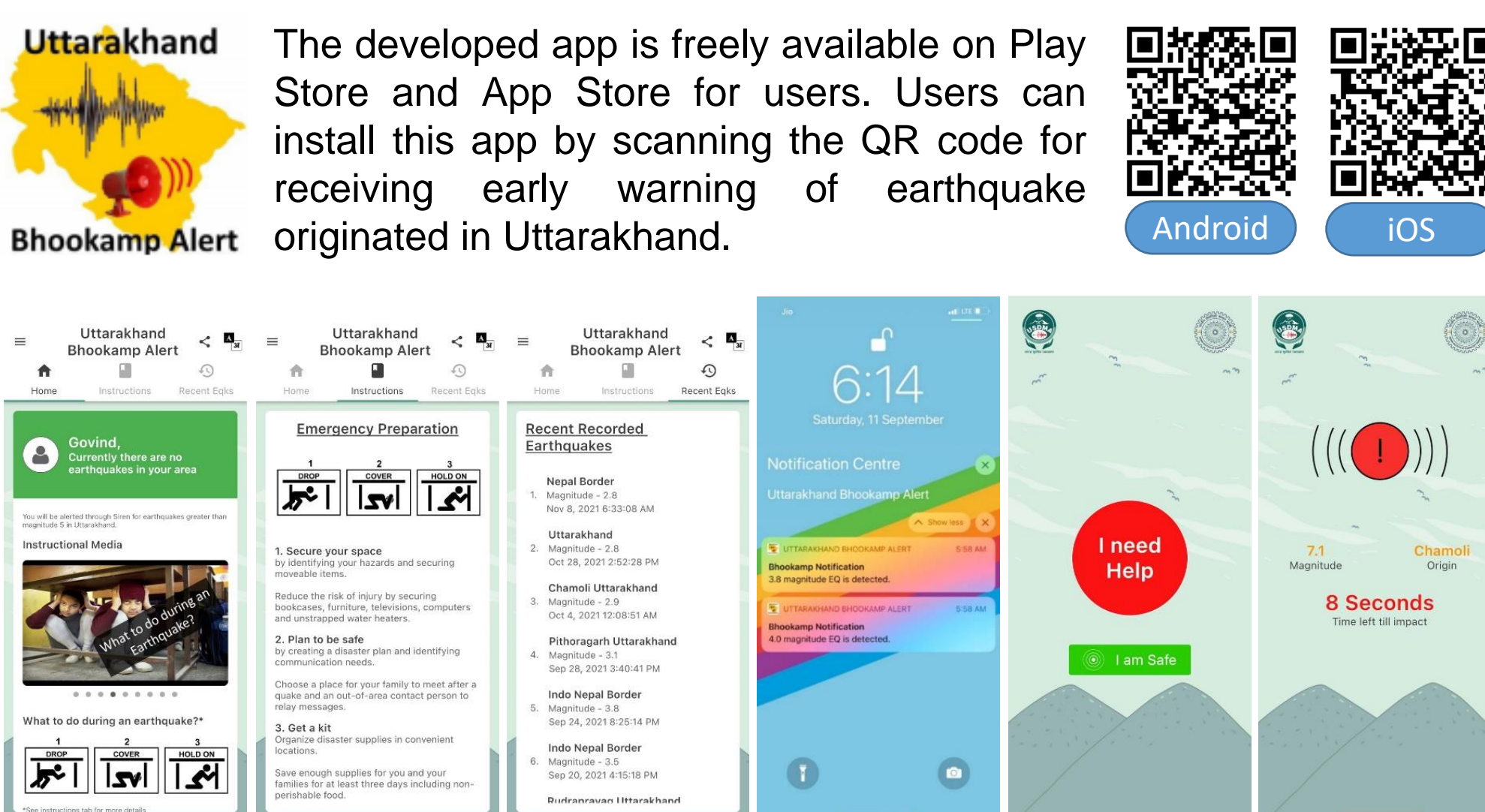


Figure 3: Architecture of Warning Dissemination System

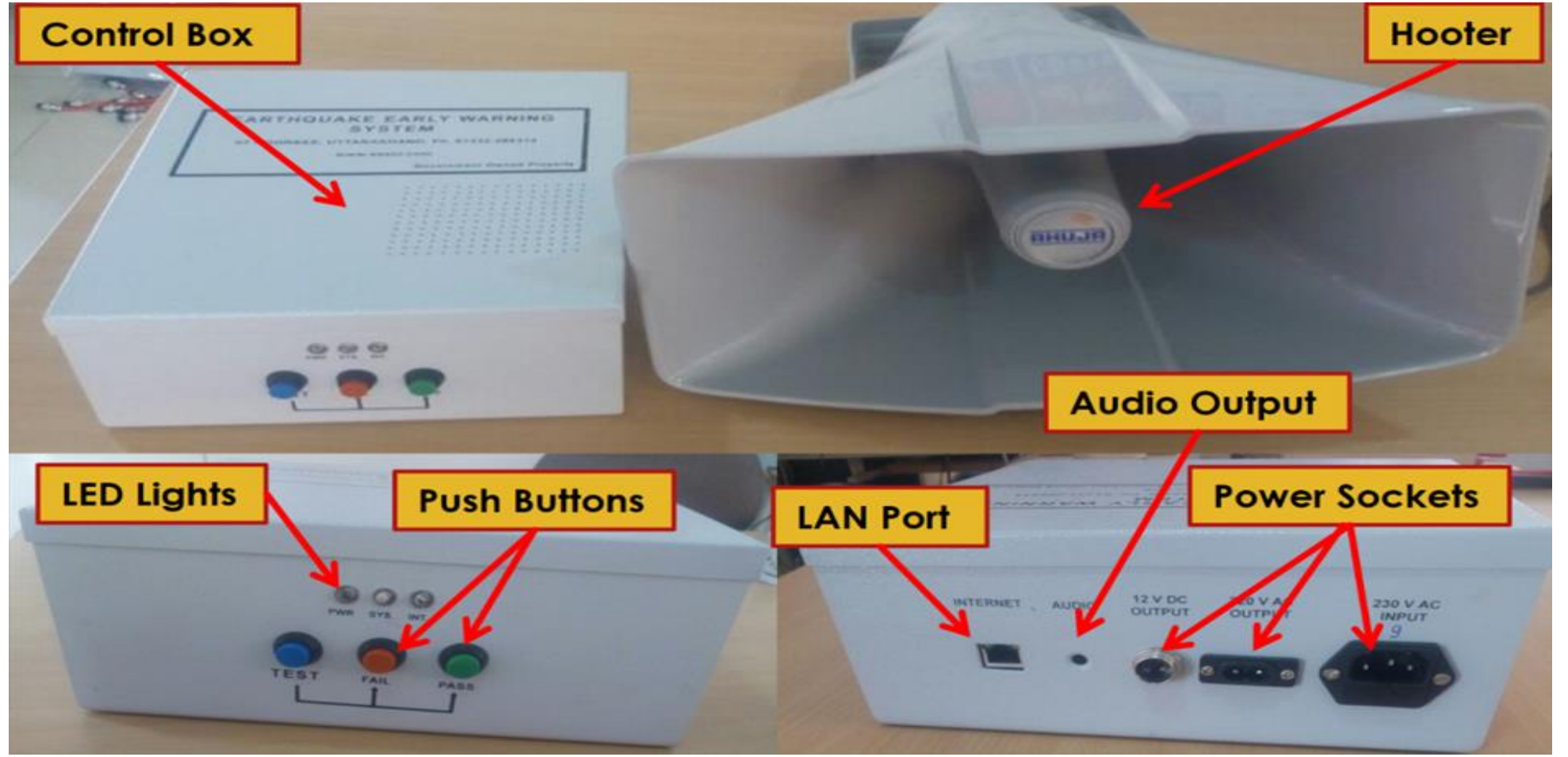
WARNING DISSEMINATION APP



The home screen has three tabs Home, Instructions and Recent Earthquakes for instructional video tutorial about safe-guarding users during earthquakes, textual instructions for safety and details about past earthquake in this region. Early warning is send through a notification with a loud human voice to alert users. On tapping alert notification user get information about origin, magnitude and time left. 1 minute after when timer stops, users are asked for their conditions. If user presses "I need Help" then this information is shared disaster management authority and if user presses "I am Safe" then user is marked as safe.

DEDICATED EEW SIRENS

EEW Public Sirens for public were developed in-house and are being used in the fields more than 3 years. Further a new low cost EEW Public Siren along with a low cost Home Siren are being developed, which are ready for deployment in fields.



Siren installed in the fields

Three LEDs for giving information about Power, System, Internet. Push buttons for validating connections at the time installation for easy testing of siren, creating easy test records. Panel power connector for making installation easy.

SUCCESS STORY

On 11th September, 2021, Uttarakhand Bhookamp Alert App sent a early notification of earthquake to public within few seconds after the earthquake originated. As magnitude was less than 5.0, therefore non-alarming notification was sent on smart phone apps only and public sirens were not activated as earthquake was not damaging. This notification on smart phones created confidence in public and encouraged people to install the app for their safety. 3 mock drills are also successfully conducted in public through public sirens and smart phone app.

ACTIVITIES & AWARENESS OF EEWs



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