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EARTHQUAKE EARLY WARNING SYSTEM

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ABSTRACT

In 2016 we have faced total 14221 earthquakes of magnitude greater than 4.0 and total no. of fatalities is 1339, the numbers are astonishing, but true. As we know earthquakes can't be predicted with our latest technology and we can't afford earthquake resisting structure, so the solution is to develop such a system that warns the people and systems to take action immediately before the arrival of strong waves and can avoid the loss of life.

The seismic waves generated during the earthquake are mainly two types the Primary waves (P-waves) and Secondary waves (S-waves), the main cause of destruction is the S-wave as it is transverse in nature it displace the earth crust and the P-waves are not harmful. The velocity of P-wave is greater than S-wave i.e. the primary waves reach before the secondary waves so by detecting the P-waves we can get enough time to send warning signal to people. The Earthquake Early Warning System is a developmental design that detects the P-waves and sends the warning message to people and systems through Cell Broadcast Messaging to take immediate action. This system is different than the earthquake prediction, which is currently incapable of producing decisive event warning.

The method used in Earthquake Early Warning System (EEWS) is combination of modern technology and earthquake science which detects the primary seismic waves using P-wave detectors and the sensors immediately send the data to the alert center and through Cell Broadcast Messaging, the message is sent to different systems like power station, hydrological structure, emergency responder and the public. The cell broadcast messaging is one-to-many geographical focused messaging service and it sends the message to the phones without internet. It is designed for delivery to multiple users in a specified area. So, the warning system can save several life and property!

Keywords: Seismic waves, P-Waves, S-Wave, Cell Broadcasting, Cell Broadcast Centre, Epicenter

I. INTRODUCTION

One of the most devastating natural calamities is Earthquake! They occur without warning and cause numerous deaths. The 2001 Gujarat earthquake occurred on 26 January killed nearly 13,805 were one of the deadliest of the 21st century. So the question arises can we avoid these fatalities? The biggest problem is we can't predict earthquake neither we can afford earthquake resisting structure!

So, is there a solution that is faster, better, economical and could protect the lives?

Yes!

The conventional warning systems are not effective. The system that was developed by United States of Geological Survey (USGS) is not much effective as it doesn't detect the primary wave and the main problem in

the design is that it transmit the signal through internet i.e. internet is must to receive the warning! As per Wikipedia only 47% of world population has internet connection and in India it is only 26%! By the time signal will reach to the common man it will be too late to take any action. Another system that was developed by Japan named Urgent Earthquake Detection and Alarm System (UrEDAS) is one of the real time Primary wave detector and other country have their own system some of them are effective up to some point. In India there are no such system that can detect the primary waves (P-wave) and effectively transmit the signal to the people and systems in real time!

The relatively sparse research on earthquake warning system left room for further research .Therefore the current study and developed system helps us understand the problem and to design a new warning system that could solve all problems. Many of the design can detect the Primary waves but are not effective to transmit the signal to the people and systems. So the warning system should be fastest that mean the signal should reach to the people before the secondary wave hit that region. The only way to send the signal to people is through cell phones that may or may not have an internet connection, but how?

The solution to the problem is Cell Broadcast message in other word CB message. Cell Broadcast is a one-to-many geographically focused messaging service. Cell Broadcast is a messaging service designed for simultaneous delivery to multiple users in a specified area. Whereas the Short Message Service is a one-to-one and one-to-a-few service (requires multiple SMS messages, as each message can only carry one phone number), Cell Broadcast is not as affected by traffic load therefore it can be used instead of internet and any other mode and the broadcast range can be varied, from a single cell to the entire network. Cell Broadcast Centre (CBC) is most effective it is automated and pre-established. People need a cell phone to receive the warning signal. As per Statista an online statistics portal the Number of mobile phone users worldwide is 4.7 billion! And as per Telecom Regulatory Authority of India (TRAI) in India total number of mobile phone user is 67crore thus mobile phones are the best way to receive the Cell Broadcasting messages.

II. METHOD

Earthquake usually occurs without warning. There is a sudden slip in the earth's crust, which makes the earth shake. Earthquake mostly occurs in fault plane. When the fault plane bends strain energy stored in it up to a certain limit until the point of breaking and when it snaps a huge amount of energy transmitted to the earth's surface by the mean of waves. The waves generated due to earthquake called seismic waves, these waves are basically two types, the P-wave and the S-wave. The P-wave is the primary wave that is the first wave to arrive, followed by the transverse wave or S-wave, Seismic waves are waves of energy that travel through the Earth's layers, and are a result of earthquakes, volcanic eruptions, magma movement, large landslides . The propagation velocity of the waves depends on density and elasticity of the medium. Velocity of P-waves tends to increase with depth and ranges from approximately 2 to 8 km/s in the Earth's crust, up to 13 km/s in the deep mantle but the speed of S-wave is about 60% of P-wave. First the P-wave (longitudinal in nature) will reach the earth surface which is not harmful and after that S-wave will hit the earth surface and the time lag between the waves is very useful to warn the people about the earthquake by the help of Cell Broadcasting message. The time lag between P-wave and S-wave plays a vital role bellow the graph represents the time lag relation between S-wave and P-wave.

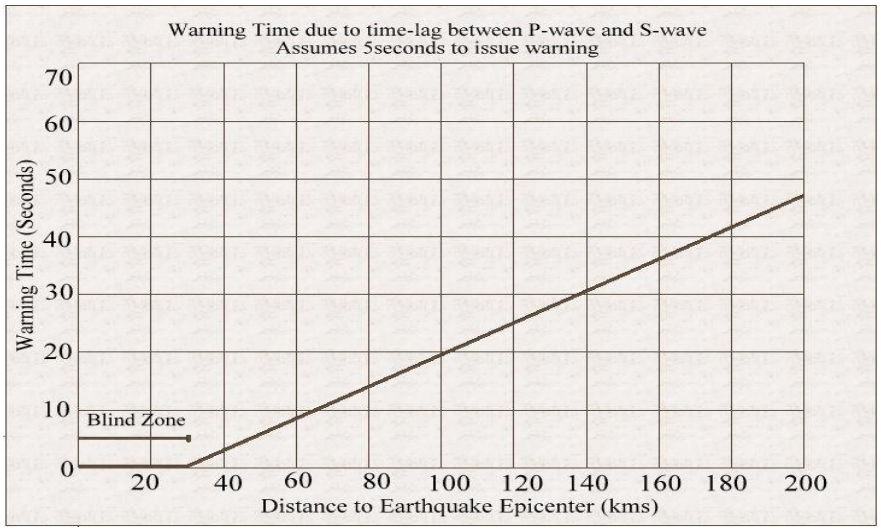

Figure 1: Graph showing the Warning time at different distance to Epicenter

First the fault plane has to be find out because the chance of earthquake due to fault plane is major, then the primary wave detectors (Like UrEDAS) has to be setup nearby fault plane and vicinity area with 10km spacing from one another and some in ocean, when the fault plane will break the P-waves will be generate and will reach at the detectors the sensors will detect the Primary waves and immediately transmit the data to the nearby detectors and Cell Broadcast Center, a message (Cell Broadcasting) from Cell Broadcast Centre (CBC) is sent automatically without any time lag and human interfere to all the people and emergency responder by which enough time will be available to take major steps. After getting the warning signal people may evacuate building and low level areas of dams and reservoir. The coastal people can move to a safe place, tsunami warning can be sent to the fishing trawlers and boats in the sea. The emergency responders like fire fighters, paramedics, power stations are warned to take immediate action.

III. CONCLUSION

"We can't stop natural disaster but we can arm ourselves with knowledge: so many lives would not have to be lost if there was enough disaster preparedness"

Literally we need an earthquake early warning system to save thousand lives and the above system is one of the fastest and economical methods.

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