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# CONVERGENCE

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# conVERGENCE

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# CONTENT

# INTRODUCTION

Virginia Woolf once said, “Every secret of a writer’s soul, every experience of his life, every quality of his mind, is written large in his works”. ICT Academy of Kerala proudly presents its 4th edition of the International Journal – “Convergence”, A multidisciplinary Journal of Engineering, technology & Employability. Convergence is a peer reviewed multi-disciplinary journal which aims to provide novel perspectives on Engineering, Technology &Employability were innovative and creative ideas and socially relevant based research outcomes can be showcased by academicians, research scholars and industry experts which can ignite the intellectual panoramas of many people across the world.

The articles were selected from academicians, research scholars and industry professionals who have presented their papers in the ICTAK International Conclave – ICSET 2018 on the theme “Rebuilding the New Kerala”.As you would have known, Kerala has faced one of its big floods of the century and we are deeply involved in various activities on rebuilding the state. Around 400 lives lost. Over one million people displaced. More than 3,000 relief camps opened. Crops lost in 54,000 hectares. Over three lakh farmers affected. As many as 221 bridges and 14,000 km of roads damaged. The flood-ravaged state has to embark on a massive reconstruction exercise - economic, social and political - to restore the status of God’s Own Country. On the above context there was plenty of discussions and deliberations on the above theme which was sub-divided into sub-themes like Purposeful use of Technology, Nurturing a Collaborative Culture, Educators role in building the new Kerala, Environment management for limiting future disasters, Governance Challenges for the New Kerala. We had papers presented on the above topic and the best 8 papers was selected to get published in the International Journal. All the articles included in this journal gives insights, suggestions and creative models to curb as well as to rebuild Kerala on different domains.

We wish you all a jubilant and productive reading!

# The Technology Movement-keralarescue.in

## (Artificial Intelligence for Flood Management)

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**Abstract :** Flood is considered to be a major natural disaster that affects many parts of the world. Flood warning is an integral component to counter disaster situations and protect the community at risk from flooding. Information technology in the form of Internet, GIS, Remote Sensing, satellite communication, etc. helps a great deal in planning and imple¬mentation of hazards reduction measures. In this paper proposed the integrated approach to monitor flood, using Artificial Intelligence (AI), cloud computing, wireless senor network technology and stochastic predictive models that can assessed for an excellent evaluation. The technology has been evolved into real-time sensor information with AI monitoring system for dam controllers. This paper shows the various logical concepts and an approach using block for monitoring of flood protections systems based on machine learning methods. The aim of warning system is to minimise loss of life and damage of property by flood system failure. An effective methodology model described for reducing an array of routine dam monitoring and release of water from storage in optimize conditions so that considerable water in the reservoir will be maintained based on intelligent decision. Geographical Information System (GIS) can be used to visualize the extent of flood to analyse the risk of disasters. Further, integration of space technology with this can monitor disaster and mitigate the hazard gravity reduction.

Keywords: Artificial Intelligence, Early warning system, Remote sensing, Weather Monitoring, Wireless Sensor Network

### 1. INTRODUCTION

India is one among the most natural disaster prone regions of the world that causes losses of several crores annually result of flood and cyclone damage. Flood is considered to be the most common natural disaster that we witness worldwide. This produces many environmental and socio-economic consequences within the affected flood plain. The impacts of severe floods cause huge losses in human lifes, as well as economic dimensions. Flood is a function of the location, intensity, volume, and duration of precipitation (Zhou et al., 2000). Flood hazard maps are useful tools for planning the future direction of state to identify flood-susceptible areas. Flood hazard mapping by Artificial Intelligence & Cloud network data considered to be efficient method for mapping flood hazard. It deals with the problem of inadequate data source in developing countries is a challenging factor. Geographic information system (GIS) and remote sensing techniques contributed significantly to the natural hazards analysis. The dams monitor by visual inspections considered as a conventional method. Many older dams, shows the sign of deterioration installed with old instruments which need to enhance. Although there are modern practices that is being followed in some of the dams which is build a decade ago using the sensor-control instruments. The technology is changing towards Artificial Intelligence (AI). The role of the AI component is to detect the abnormal behavior of the multi objects that provide early indicators for the decision support system. Modern and old dams need to incorporate with such instruments to handle large volumes of data with the use of AI.

Kerala has an average annual precipitation of about 3000 mm that is controlled by south-east and north-east monsoons. The high intensity of rainfalls and storms during the monsoon months result in high discharge in all the rivers. In the recent high rainfall that experienced in Kerala from 1st June 2018 to 19th June 2018 resulted in severe flooding in 13 out of14 districts in the state. As per Indian methodological data Kerala experienced 2346.6 mm rainfall which was about 42% above normal. Due to such heavy rainfall that experienced during 15th to 17th August 2018 it appears similar to 1924

flood in Kerala (Study Report, 2018). This has caused severe loss and damage to Kerala due to the devastating deluge which estimates of Rs. 20,000 crore.

More than two thirds of European cities are often confronted with natural disasters like floods, earthquakes, volcanic eruptions, etc. They use Early Warning Systems (EWS) which plays a crucial role in mitigating such disasters. The EWS detect and forecast the catastrophe conditions and impact evaluation. It provides decision support and information services to government, rescue agencies and general public (Alexander L et al., 2011). The EWS infrastructure blend with cloud and AI resources can challenge flood project impact for Kerala state. The advantage of a proposed EWS architecture can run with number of AI components on distributed resources, which are relatively complex computational tasks but will be effectively and efficiently, to provide real-time response in processing the sensor data.

Risk assessment using AI technology will form a key for planning, design, and operation of dams around Kerala (Andrew et al., 2015). As the gravity and probability of risk is getting high where consequences are significant, AI will result in greater analysis to predict the risk factor as well as to put in place a range to measure control and reduce the risk. The 58 dams sited in various places in Kerala state maintain water throughout the year irrespective of the random variation of rain falls can be optimized effectively by implementing machine learning technique. Usage of such technology will provide the information of detailed emergency plan, safe evacuation routes, evacuation routes, and maintain the regular water reservoir levels. The AI technology outlined allows for integrated modeling of the hazard and risk in both a planning and operation setting of all the interconnected dams.

Urban flooding is a serious problem in various areas. It cost from both physical and mental health issues that results disease, forced temporary or alternate relocation and damage property. In addition, flood water cause loss of small or big businesses. So there is need to use modern tools like artificial intelligence to measure the expected flood damage in terms of expected average infrastructure re-built costs of the state. In addition effective optimization tools applied on multi-task jobs using genetic algorithm will produce better result (Deb et al., 2002). The new methodology using neural network meta-models will estimate the cost of infrastructure damage using modern cloud computer.

## 2. LITERATURE STUDIES

- Flood studies with the geospatial technology have shown improved phases. There are mainly three phases of floods such as a) before floods, (preparedness phase), b) during floods (monitoring phase) and c) after floods (damage assessment and mitigation phase). All dams across the globe on waterways follow the natural stream flows and typically change the peak, timing and duration of floods.

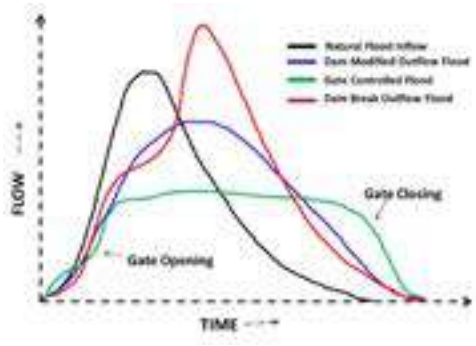


Figure 1: Flood-handling effect of dam

As shown (Figure 1) the natural flood inflow stream spectrum is having higher peak to that of modified exhaust controlled dam flood water outflow. This stage can be a critical or less critical for uncontrolled dam. The flow modifications are typically reducing the flood peak accompanied by a lengthening of flood duration. The automatic control dam during the pre and post situation can influence the impact of flood events by changing the use of gate, valves, fuse plugs and other control devices on flows downstream of dam. In such flood events, such device operates with a particular strategy, either to minimize the rise in storage levels or to reduce downstream flood flows and heights. Such release need intelligent controller otherwise downstream will be disproportion way effecting flooding or shortage of water in reservoir. Sometime dams also lead to fail and the subsequent dam-break may cause substantial damage of downstream. The effect of dam failure on flood flows may involves risk to life that is close to the dam and other infrastructures. (Source: Australian Disaster Resilience Manual).

- Space and Air based observations of earth provide a unique vantage point for monitoring as well as assessing the floods disasters. The traditional floods maps and studies is a conventional surveys for historical flood records. However, space technology has made substantial contribution in every aspect of flood disaster management such as preparedness, prevention and relief (Aggarwal et al 2004). Geographic information system (GIS) provides a broad range of tools to determine flood affected area and forecast that are likely to be flooded (Rao et al 1998). During flood only mi¬crowave remote sensing esp. active radars offers all weather day-night remote sensing capability. Hydrodynamic model HEC-RAS (Hydraulic Engineering Center-River Analysis System) is used to find the longitudinal profile, water level and routed discharge (Rastogi Ashish 2006). The integration of GIS and hydrodynamic modelling

is an efficient way to predict and map the flood areas.

## 3. TECHNOLOGY IN FLOOD DISASTER

Disaster is an event which threatens society with unwanted consequences during flood. The state of Kerala is in the midst of worst flood need to rely on technology to deal with grapple for survival, chaos and correct timely informations. With the advancement of technology it can be an instrumental and vital part to overcome the level of disaster management.

3.1 Weather Forecasting System : The weather forecast plays a vital role in environment conditioning. It has a wide range of activities such as observation, transfer, analysis, prediction and dissemination of various essential forecast services.

1) **Observation:** it is important to first obtain the meteorologist picture data and its accurate predication to determine the weather forecast. For this both the ground and satellite information from remote sensing system need to effectively transmit the data round the clock.

2) **Analysis:** the metro-logical observed data that represent the wind speed, temperature, pressure build up, cloud and other factors that makes up the weather analyze instinctively. The certain vital in¬formations like weather elements at certain location, wind patterns and weather system can assess important control centers.

3) **Prediction:** the analyzed weather data properly predict by the control models. The model can use the artificial intelligence to overcome the needs of human interventions. For this high computer can compute enormous number of calculations for prediction of wind speed, temp, rainfalls, storms, and other methodological elements.

4) **Forecast:** the best data analysis, Numerical Weather Prediction model, radar and satellite images, climatology of different areas, natural conditions, personal experience, past data history used by meteorologist prepare hourly / days changes forecast appropriately. At the same time alert situations such as orange, red situations can be made for the media, peoples, Govt. agencies and all other user sectors.

3.2 GIS and Remote Sensing Observation : The Geographical Information System (GIS) and Remote Sensing (RS) is considered to me the most visualize system with other datasets that flood shows the related information (Maxim et al, 2017). This is a modern technology that integrates the information extracted through it. The GIS can be used to provide tremendous potential for identification, monitoring and assessment of flood disaster. It shows the hazard mapping, landslides, storms warning, generate a flood hazard map using satellite image data, maps of various cities, districts and other critical informations. Remote sensing observation using space and air based observation is a unique vantage of informations

(S. P. Aggarwal et al, 2009). The Indian and other global remote sensing satellite provide the information about flood aerial recording, such as photograph and image. The uses various sensors on aircraft and remote satellite sensing system can be considered as hazard assessment in data gathering.

3.3 Flood risk control of dams : Evaluation of the water levels of the various dam due to flood risk need to monitor with flood regulation. The flood regulation of dams is correlated to the selection of flood regulation policies as well as the safety of the protected areas and properties. To control various dams the key understanding is to calculate the probability distribution and characteristic parameters of the upstream water level of reservoirs and the water level of river courses by establishing stochastic models for reservoir flood regulation. The theory of stochastic differential equations, which comprehensively consider various random factors during reservoir flood regulation determine the optimize condition on when and what decision system need to follow. Three stochastic mathematical models for calculation of the reservoir flood regulation process, river course flood release, and flood risk rate under flood control established based on the theory of stochastic differential equations for effective features of flood control systems (Zhen-kun MA et al., 2014) can employ machine learning technique.

- Stochastic model for reservoir flood regulation
- Stochastic model for flood water surface profile of river courses
- Method of calculating flood risk rate with flood regulation of dams

3.4 Flood Control and Disaster Management : Modern emergency planning requires a close integration between dam safety planning and emergency management planning. There are groups of stakeholders on emergency management planning for floods: Dam owner and control system, Emergencies management agencies and Dam safety regulatory. Thus dam owners, emergency managers and dam safety regulators must share information to develop strategies that reduce the impacts of floods caused or affected by dams. (Source: Australian Disaster Resilience Manual 23: Emergency Management Planning for Floods Affected by Dams, 2009, Australian Institute for Disaster Resilience CC BY-NC). The Integrated Planning Approach Emergency (IPAE) management planning, for floods affected by dams, involves the integration of plans that are the responsible to either dam optimized controls or the disaster management planner to follow the set (Figure 2) of flood planning relationship.


Figure 2: Flood planning relationship

The disaster management planning is important components for floods affected by dams that involve the integration of plans, and emergency management planner are set as follow:

- Dam owners have a responsibility to prepare emergency plans for all dams to monitor failure otherwise would threaten life and property.
- The community flood plans to cope effectively with the impact of hazards which will depend on emergency plans exist to cover prevention, preparedness, response and recovery.
- The community, dam owner emergency managers and dam regulators all should ensure emergency management planning undertaken to reduce the impact of floods caused or affected by dams.

3.5 Flood warnings in system : Flood warnings system is the large central monitoring mechanisms consist of flood detection, forecasting, warning, and response systems that resemble a chain of components supported by a number of processes (Dennis et al., 2017). The flood conditions are first detected by monitoring meteorological, river, and sea tidal conditions prediction. A simplified and idealized time sequence of flood forecasting, warning, and response is shown (Figure 3).

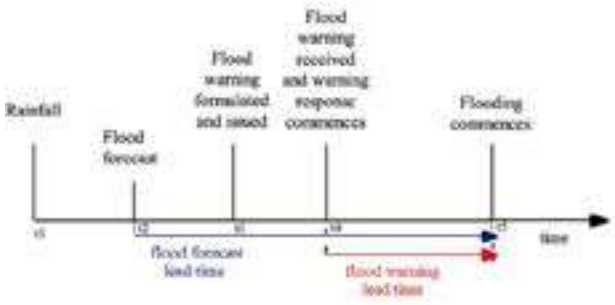


Figure 3: Flood Warning Lead time sequence

Flood warning system determine the lead time between a received warning and the onset of flooding or damage at any one location measure the flooding. Flood warning lead time is a critical factor in flood warning effectiveness, which explains the effort in improving flood warnings based on lengthening lead times. These types of forecasts are provided for European Union national authorities in advance to anticipate flood. Such forecasts prediction using modern machine learning intelligence provides progressive real-time weather and river flow observations.

3.6 Flood Warning Operations : Heinz Engel proposed the ideas of flood warning system (Heinz, 1997) stges. At each flood warning river height station, the severity of flooding described as minor, moderate or major according to the effects caused in the local area or in nearby downstream areas. The Flood Warning Centre (FWC) operates round the clock (24 hours per day) measures the severity and extent of flooding. This can be supported by here.

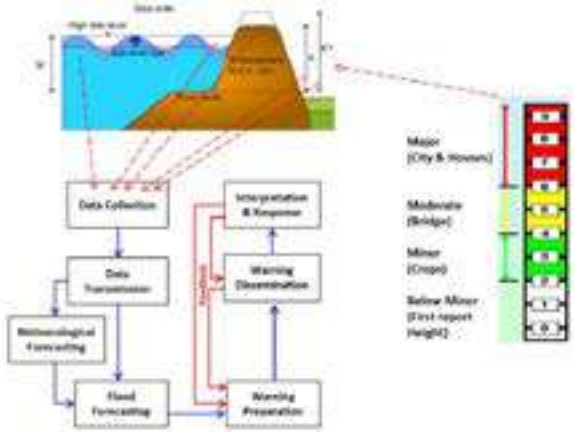


Figure 4: Components of flood warning operation

AI for development and provision of flood warning services. The basic components of the flood forecasting system in Queensland is the role of the Bureau's Flood Warning Centre in Brisbane is shown (Figure 4) The major components that include are:

- Data Collection & Transmission: the data collection from various dams and river using automatic radio stations, remote web application, or social media warning informations from volunteer.
- Meteorological Forecasting: the technique to analyse data using simulation model to predict real time data like gravity and time factor of flooding.
- Flood Warning Services: data of such type of services includes:-i) The impact of forecast weather and rainfall conditions access. ii) River height at selected locations within a river basin continuous monitoring. iii) Flood warnings of existing dam conditions, river basin and predictions of river heights at key locations (towns, bridges, rural centres). iv) Experts advice to provide direct assessments of flood conditions to emergency agencies and

Government agencies. v) Media briefing of radio television and newspapers news services as vital informations. vi) Hum Radio, Radio stations, FM stations, local commercial stations, to broadcast flood warnings information to large extents.

3.7 Anti-flood system from rising sea : Anti-flood system aims to protect model (like historic Italian city) from rising waters structure designed to protect ground water from sea water. Similar, model was installed in Venice that has been exposed to floods which cripples the city by sea (Corey 2014).

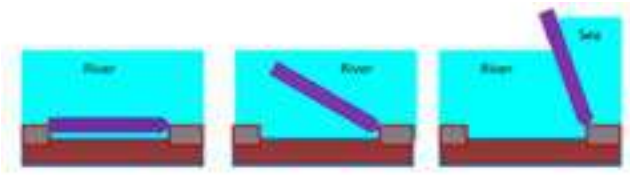

Figure 5: Anti-flood sea water blockage

As shown (Figure 5) during the tidal the individual blocks which comprise of hollow structure are filled with water rest on the bridge floor. Rise of sea water above the river level, makes the compressed air to inject into blocks by expelling the water from the structure. Finally, the structure raise will create a barrier isolating the sea from the river water. This electromechanical module can successfully implement with control mechanism.

3.8 Roles & Responsibilities : Responsibility for flood risk management is to share the critical information to various organizations and individuals. The main organisations with responsibility are designated as Risk Management Authorities. Its roles and responsibilities are:

- Their responsibility is for flood forecasting and warning services that receive from Meteorology department.
- To set up: State counter disaster organization-Coordination centre, Local Government-Disaster plan implementation, Disaster district coordination centre and Media-to broadcast bureau warning and flood related informations.
- Coordinate the actions plans of all agencies involved during the course of a major flood incident.
- Responsible for saving lives, co-ordinating evacuation and public information in an appropriate way.
- To control the scene by setting up cordon points and setting up a traffic management system in conjunction with the local authority.
- Provide emergency assistance to remote location points.
- Internal Drainage Boards (IDBs) responsible for managing water levels in low-lying areas for public.

3.9 Rescue and Social service : Below are a few technologies that can use to reach for individuals in the place of a natural disaster.

- Rescue missions: One of the challenges of communicating during natural disasters is when the telecommunication service collapse; innovative apps, a walkie-talkie app, and social media posts can allow people to send a call for help and reaches the rescue team. Volunteer rescuers can able to rescue thousands of people using these tools. Therefore it is essential for a rescue team to provide with walkie talkies and radios. Such technology including Hum radio can able to identify and communicate with those trapped in homes, buildings, and other places.
- Coordinating relief packages: When thousands of people are displaced from their homes, then relief efforts can be provided with the help of new technology in more organized and properly delivered. The non-profit groups, National Social Service groups, can quickly provide relief and recovery.
- Google Person Finder: The Google Person Finder, like Facebook, Twitter, and other social media can get in touch with their friends or relative using advance social apps in these disastrous moments.

## 4. INTEGRATED PROPOSED METHODOLOGY

Integrated design methodology for flood protection using the Artificial Intelligence System block diagram structure in shown (Figure 6).

Figure 6: Proposed block diagram

Various activities are associated with sustainable integrated catchment planning, as depicted block wise consists of 1. Remote sensing, 2. Monitoring, 3. Decision and Controller, 4. Flood risk information, 5. Warning and feedback, and 6. Flood post event. A multidisciplinary approach on various elements involved in weather forecast, flood detection, warning, emergency organizations, users rescue, warning response, hazard delimitation, planning organizations, hazard prevention and responses to predictions are integrated in flood for sustainable management. The main purpose of a

flood forecasting, warning and response systems is to avert or minimize loss of life. This is a cost effective options of flood reduction and loss.

## 5. CONCLUSION

In this paper proposed the concept of abnormal behaviour detection for flood warning system. According to the study of the state-of-art on various flood technique the best approach using artificial intelligence is blended with the technology to protect the state from any future hazardous. An integrated proposed system with efficient method for mapping flood control has been presented. This includes remote sensing technologies useful in flood monitoring and damages evaluation. Also, use satellite remote sensing data that can increase the complement of ground-based network data, and field observations for disaster assessment and response is discussed. With the advancement in Information Technology the GIS, Remote Sensing, Satellite communication, etc. can help a great deal in planning and implementation of hazards reduction. The real-time data considered in this strategy can be implemented with the AI component for integrated flood forecasting, warning and response system. Most of the classical models are resource-intensive, whereas application of an AI component is an efficient method for real-time data processing.

The system can integrate on wireless sensor network system over cloud applications using machine learning. The machine learning combined with classical models will make the system more robust. Every instance of data with advance computational model used for generating training sets by AI component can make system very intelligent.

More research is required to integrate digital topographic data and river networks measurements in order to improve the spatial accuracy and develop new algorithms for flood analyzing. These are the suitable emphasis on development of new technologies in disaster mitigation. Kerala disaster preparedness and awareness is the only effective way of mitigating the impact of future disasters.

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# Digital Humanitarian Network System Based on Block Chain Technology

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**Abstract-** Information Technology is changing every aspect of human life. It enhances the quality and services, aspects of human life such as education, research, culture, entertainment, communication, national security, etc. Disaster management needs drastic improvements in its sources to decrease damage and save the life of people. IT plays an important role in rapidly transforming humanitarian crisis response and changing the traditional roles and powers of its actors. The phenomenon of digital volunteers and their role in collecting and analyzing social media data provided by disaster affected populations has brought unprecedented opportunities and challenges to the humanitarian system. It is absolutely necessary to create awareness amongst the public as well as decision makers for allocating resources for appropriate investments in information technology. In this paper an attempt has been made to highlight the effective utilization of resources based on blockchain technology. The blockchain has the potential to transform the humanitarian digital network sector by providing cost savings and traceability of information flows, and by reducing transaction times.

Keywords - Humanitarian system, blockchain technology, disaster management

## 1. INTRODUCTON

Natural disasters strikes both developed and developing countries, causing huge destruction and creating human sufferings and producing negative impacts on national economies. Due to various geo-climatic conditions prevalent in different parts of the globe, different types of natural disasters like floods, droughts, earthquakes, cyclones, landslides, volcanoes etc. strikes according to the vulnerability of the area. India is considered as the world's most disaster prone country as per Times of India report in 2017. India ranks the highest among the world's most disaster-prone countries for displacement of residents. In fact, eight of the 10 countries with the highest levels of average annual displacement or probable risk of future displacement and loss of housing are in South and Southeast Asia.

The disaster management is the range of activities to maintain control over disaster and provide a framework to help, avoid or recover from the impact of the disaster. Disaster management includes Prevention, Mitigation, Preparedness, Response, Recovery and Rehabilitation. Disaster management involves all levels of government. All government, nongovernmental and community-based organizations play a vital role in the process. Modern disaster management goes beyond post-disaster assistance. It now includes pre-disaster planning and preparedness activities, organizational planning, training, information management and public relations.

The disasters in India are mainly managed by the government. The government at central level, state level, district level has various roles to play during the disaster situation. Now the voluntary sectors like non-government organizations are also becoming increasingly important because of the various functions they can perform [3]. Effective and reliable communication is vital for disaster reduction. Communication technologies, skills and media are essential for the various important roles they perform in disaster management.

We are proposing a digital humanitarian network based eco system to manage the un predictable events occur in human life. We are proposing a system to manage the civilians and make them capable of handling such situation with enough support.

Digital Humanitarian Network - The Digital Humanitarian Network is a network-of-networks, enabling a consortium of Volunteer and Technical Communities to interface with humanitarian organizations that seek their services. As a community-based network, the DHN has a growing list of member-groups and organizations. Matching needs to rescue and aid efforts in time for them to be effective is one of the major challenges in humanitarian response. Governments, humanitarian organizations and publics have an explicit demand for relevant, findable, and actionable information during crises; yet, compared to the key needs of food, water and shelter, information is "the most perishable" (Meier 2015a) as the delay between information and action is significant and

information often becomes outdated before action is taken. In fact, what is considered fast is often slow: media that have traditionally been accused of sensationalism in crises (Cottle and Nolan 2007; Lewis 2008) have also been blamed for returning inaccurate, outdated, and repetitive information as reporters are unfamiliar with local communities and conditions (Novak and Vidoloff 2011), access to crisis zones is limited, and so is the ability to provide real-time updates. In turn, humanitarian organizations predominantly develop their response based on local authorities' requests and evaluations by their own assessment teams sent into the affected areas (Tapia et al. 2011). Collecting accurate and actionable information takes time, from a few hours to several weeks, for example, as in the case of UN interview-based two-week "rapid surveys" to assess disaster damage and key needs (Meier 2015a; 39). There is a clear demand for reaction time-improving solutions, but also organizational conservatism in adopting them (Burns 2015; Hughes and Tapia 2015) due to institutional policies, established verification procedures, and the critical value of accurate information in dealing with humanitarian tasks.

Recent developments in digital technologies, including social media, ever growing accessibility of mobile technologies to global populations, and new methods of aggregating and processing data during emergencies, have opened a number of opportunities for both media and aid organizations in reshaping their response to humanitarian crises. One of the most profound changes has been the ability to involve populations themselves in identifying needs, crisis locations, local constraints and other critical information via digital channels of communication. Through digital means, affected communities have become a new information source—a "crowd source"—that can inform both humanitarian response and media coverage. Likewise, digital channels have also been used for disseminating information to local populations about shelter locations, availability of aid, and recommended behaviours.

Digital volunteers are playing an increasingly visible role in humanitarian response. There are two important differences that distinguish digital volunteers (or digital humanitarians) from the more conventional conceptualizations of citizen journalists and make them a newly available digital source. First, the definition of digital volunteers as an "informal response community" is still different from the understanding of non-professionalism in citizen journalism. Digital humanitarian networks depend on volunteers (non-professionals, as opposed to professional "formal" responders), but even the first volunteer networks during the 2010 Haiti crisis developed internal training mechanisms in mapping, data privacy and protection (see Meier 2015a). Today, digital volunteer organizations such as SBTF describe themselves as "trained and experienced volunteers" across 100 countries (STF, n.d.) and have a Code of Conduct, activation protocols and verification procedures. Digital humanitarian networks are becoming increasingly experienced and frequently activated by the formal emergency response. Second, unlike citizen journalists as eyewitnesses on the ground (Ande´n-Papadopoulos and Pantti 2013; Novak and Vidoloff 2011), digital volunteers do not have to be in the crisis zone itself, witness the events, or be directly exposed to risks. They may still have a connection to the affected community (for example, come from a diaspora or speak the language), but in general, digital humanitarians are an international and remote online network. Therefore, as a distinct digital source, they offer a unique combination of speed (providing verified updates that are closer to real-time that any other source) and safe distance/access (acting remotely from the crisis location, but producing content that would otherwise be unavailable because of limited or unsafe access). Both criteria can make a significant difference for media reporting. Humanitarian aid has become a dynamic ecosystem that encompasses amateurs and experts, one-off participants and long-term professionals, drone operators and satellite imagery analysts.

## 2. RELATED WORK

The Digital Humanitarian Network's (DHNetwork) website was launched on April 9, 2012. The purpose is to support humanitarian organizations in their disaster response efforts around the world.[1] The network consists of member Volunteer & Technical Communities (entities that manage networks of technically trained volunteers around the globe, who can be activated to backstop disaster response operations and produce information with limited turn over time). These groups have a wide range of skills from GIS mapping, crowdsourcing, and data analysis and collection, to volunteer management and process design. The DHNetwork puts groups that have existed for years under one umbrella and provides a single outlet for traditional responders to access the organizations.

In the past year, the DHNetwork has been activated five times by OCHA South Sudan, ACAPS, OCHA Philippines, Samoa government and UNHCR (Syria). In each case, the requesting entity sent a central request to the DHNetwork. These efforts resulted in such things as rapid data collection, social media filters to augment traditional assessments, and a translation of the UNHCR Syria portal into Arabic allowing regional civilians to access normally inaccessible information.

1) OCHA South Sudan. Searching the internet for 3 days looking for reports, articles, and data, the team collected 15,271 unique pieces of information.

2) ACAPS. The team surveyed the internet for Democratic Republic of Congo-related assessments, population statistics, historical IDP numbers, humanitarian events, and indicator values. The group also created several maps.

3) OCHA Philippines. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) activated the DHNetwork on December 5, 2012, to track the real-time effects of Typhoon Pablo in the Philippines and collect all relevant tweets about the typhoon; identify pictures and videos of damage/flooding shared in those tweets; geolocate, time stamp, and develop real-time maps of displaced people, fatalities, crop damage, broken bridges. [2] The team searched through over 20,000 social media messages within 24 hours of the crisis for photos and videos. Results were compiled and organized in a structured database. The Solution team used a variety of methods ranging from automated algorithms to micro-tasking. They used Geofeedia to identify all relevant pictures/videos that were already geo-tagged by users, PyBossa and a free and open-source micro tasking platform. UN OCHA published a map that is entirely sourced from social media analysis.[1]

4) UNHCR (Sy ria). Translation of UNHCR's English portal to Arabic, which allows responders, refugees (2 million), internally displaced populations, and the global public, and professional's easier access to information.

**Blockchain** - "What the internet did for communications, I think Blockchain will do for trusted transactions." This was told by the CEO of IBM Ginni Rometty in June 2017 (Rapier 2017). Blockchain technology has become popular since the introduction of bitcoin as a digital currency. The bitcoin mechanism was introduced by Satoshi Nakamoto in 2008 in a paper entitled Bitcoin: A peer to peer Electronic Cash System (Satoshi Nakamoto, 2008). This paper described a peer to peer version of electronic cash that allows online payments to be sent directly from one party to another without any intermediary financial institution. The technology behind this idea is Blockchain. Though Blockchain technology is typically associated with Bitcoin and other virtual currency platforms, the underlying innovation of Blockchain is likely how societal disruption will occur (Kevin D. Johnson, 2018). Blockchain has the potential to completely change the way international trade, taxation, real estate, and even healthcare takes place (Alexis, 2017). Almost any system of recording, transferring, storing and the processes built around it can be replaced by Blockchain (Knight, 2017; Johnson, 2018).

A Blockchain is a shared, distributed, tamper-resistant database that every participant on a network can share, but no one controls it entirely. It has two fundamental features: The Blockchain is public. Anyone can view it at any time because it resides on the network and not within a single governing institution which has the responsibility of maintaining and recording of any event. It is also encrypted. Encryption is one of the most important functioning/ feature of Blockchain. Even though the information and records of all the events, transactions or communication are present in the network and available for everyone, it uses encryption involving private and public keys in order to provide better security.

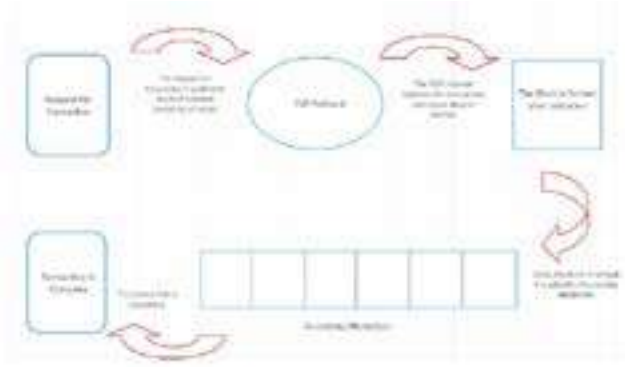

Figure 2.1 the explanatory functioning of a blockchain network

It can be defined as an incorruptible digital method of transacting anything and everything of value. It is shared by a group of network participants and all of them can provide new records for inclusion. However, these new records can only be added if the majority of the group agrees on that. The record once created cannot be changed or manipulated. Transactions such as payments, notarization, voting, registration, contracts etc. are key in the operation of government or any other organization. Traditionally, these transactions are done and supported by a central unit which is a third party such as government agencies, legal firm, brokers, banks and service providers. Blockchain provides a different method to validate and perform these transactions. Instead of trusting third parties, it depends on the majority of the members of the network and the accuracy of their shared platform.

A Blockchain works on a distributed ledger technology, which was publicly introduced for the transfer and record keeping of Bitcoin. The major advantage of the technology is that it provides a trustable path to transfer an asset without the need of a third party which acts as a central authorization. In order to work efficiently, it requires a secure protocol to transfer assets, protection against assets being transferred twice, and a sacrosanct record of ownership that can be automatically updated.

## 3. PROPOSED METHOD

We are proposing an online digital humanitarian eco system for managing the civilian volunteers for disaster management.

**•Tracking of civilian volunteers and NGO's on geographical basis**

The Digital Humanitarian Network (DHN) was created in order to improve collaboration between V&TCs and formal humanitarian organizations, to facilitate communication between V&TCs, and to support the development of all. Officially, the DHN is an umbrella organization for V&TCs and their networks of digital humanitarians. DHN provides humanitarian organizations a one-stop-shop for its vast network of experts, professionals, and volunteers, with a range of skills including social media monitoring, crisis mapping, and big data analysis. Whenever a crisis arises track the civilian volunteers and the NGO's on the geographical location is one of the major activity in the DHN system.

**•Early warning system to the civilian volunteers**

Early warning is a major element of disaster risk reduction. It prevents loss of life and reduces the economic and material impact of disasters. To be effective, early warning systems need to actively involve the communities at risk, facilitate public education and awareness of risks, effectively disseminate messages and warnings and ensure there is constant state of preparedness.

The objective of early warning systems is to empower civilian volunteers and communities threatened by hazards to act in sufficient time and in an appropriate manner to reduce the possibility of personal injury, loss of life and damage to property and the environment. A complete and effective early warning system comprises four inter-related elements, spanning knowledge of hazards and vulnerabilities through to preparedness and capacity to respond. Best practice early warning systems also have strong inter-linkages and effective communication channels between all of the elements.

**•Maintaining communication with the central disaster management and the civilian volunteers**

A number of organizational challenges have been described in reports that contain discussion about collaboration between aid organizations and V&TCs. These challenges relate to (1) limited resources; (2) the management of volunteers; (3) different levels of engagement between V&TCs and aid organizations; (4) level of commitment by V&TCs; (5) different ways of working between V&TCs and aid organizations; and (6) aid organizations' lack of knowledge about V&TCs expertise. We have to maintain a proper communication channel between the central digital humanitarian system and the volunteers.

**•Insurance assurance for the volunteers**

In the recent past during the flood disaster in Kerala few persons have sacrificed their lives during the relief operations. Few of them seriously injured and their valuable efforts gone unnoticed. Due to this some youngsters may get away from becoming volunteers for such disaster relief activities. Hence we have to motivate those people by providing them rewards, life insurance coverage etc.

**•Training for the volunteers**

Training can enhance the relationship between V&TCs and aid organizations as well, by helping to align levels of engagement. Aid organizations or V&TC volunteers with significant experience can train volunteers to better understand the humanitarian perspective. Similarly, training for aid organizations can help them better understand the perspective of V&TCs. Further, training by V&TC volunteers can also add a new layer of participation within the V&TC.

3.1 Private Blockchain

In a private blockchain, the ability to perform or record a function is limited to one organization / user. Whereas, the ability to read may be public or can be restricted to any extent. Private Blockchain is a way of capitalizing on Blockchain technology by establishing groups and participants who can verify transactions from within the system.

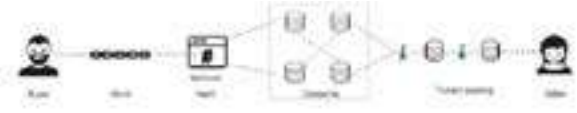

Figure 3.1 The characteristics of a private blockchain

**3.2 Public Blockchain**

Public Blockchain network provides the ability to anyone in this world who is a part of the network to access the data. This includes writing, developing and recording of blocks, information, and transactions. Public Blockchain network is secured by the concept of crypto economics and is an open source system. It is a framework based on calculations, algorithms, and processes such as proof of work (PoW) and proof of stake (PoS).

In this type of Blockchain network new blocks can be added to the Blockchain, but already present blocks cannot be replaced or removed. Bitcoin is a very good example of Public Blockchain.

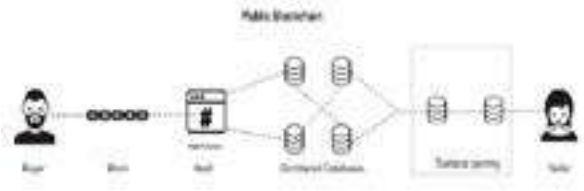

Figure 3.2 The characteristics of a public blockchain

| Characteristics | Private | Public |
|---|---|---|
| Identity | Known Identities | Pseudonymous |
| Security | Participants are Pre-approved | Pow/Pos |
| Access | Permission needed to access the database | Open Source, access to the database. |
| Speed | Faster | Slower |

Tab 3.1: Characteristics of private and public Blockchain

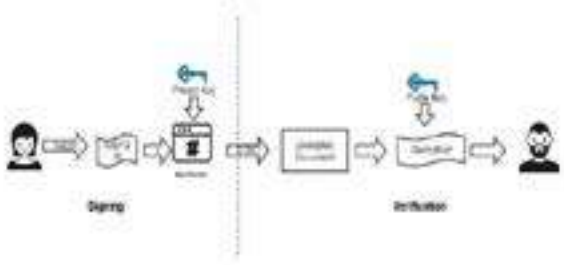

Figure 3.3: Digital Signature Used in Blockchain. Adapted from Blockchain Challenges and Opportunities (Zheng, 2016)

**3.3 Consensus**

A consensus is a process that enables "a set of distributed process to achieve agreement on a value or an action despite a number of faulty processes" (Correia, 2011). Blockchain requires verification and acceptance by all the members of the network, usually called as consensus. To achieve consensus in distributed mechanism there are four algorithms that can be applied. In a blockchain network, a consensus is utilized to obviate mendacious actors from indicting potentially invalid information to the database (Swanson, 2015). The concrete consensus mechanism utilized for any given blockchain depends on a number of posits, including the amount of trust between parties and the alignment of their intrigues, as well as factors concerning the shape and synchronization of the network (Correia, 2011).

**3.3 Blockchain architecture**

Block - For recording transactions, a distributed ledger is facilitated by the Blockchain, attributing them to a specific node in a network, and ordering them in time. Blocks are the files which have the data stored in them in a network. It generally records most recent transactions that have yet to be recorded in prior blocks.

A block consists of the block header and block body (Zheng, 2016). Three sets of block metadata combines together to form the header of the block i.e. block header. First, there is information regarding the previous block hash, which connects the block to the previous block in a blockchain. The second being difficulty, timestamp, and nonce in the case of Bitcoin, relates to the mining competition. The last being Merkel tree root, a data structure used to summarize all the transactions in the block (Antonopoulos, 2005).

Digital signature- In order to create and authenticate the transaction on the blockchain, a digital signature is required. The signing phase and the verification phase combine together to be a part of a typical digital signature.

For example, when a member who is part of the network wants to sign a transaction, s/he will first generate a hash value. This hash value is later encrypted with the help of the user's private key and sends the other person or member who is at the receiving end of the transaction process. The other users/ member verify the transaction by decrypting the hash using the first person public key and the hash value will be the same for the received data as well.

Digital signature- A decentralized network as the name suggests is a type of network with no central authority or governing unit. Every member of the system is a part of an open transaction process which is visible to everyone and need verification by the network members in order to complete the transactions (Kikitamara, 2017). The interactions among user on blockchain principally use a decentralized network in which each user represents a node at which a blockchain client is installed. When a user performing a transaction with another user or when a node receives data from another node, it verifies the authenticity of the data. It then broadcasts the validated data to every other node connected to it. Within such a mechanism the data spreads across the whole network.

Disaster management- According to the International Federation of Red Cross and Red Crescent Societies; a disaster is a sudden, calamitous event that seriously, disrupts the functioning of a community or society and causes human, material and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. As World Health Organization (WHO) defined in other words that, a disaster is an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community.

**3.3 Disaster management phases**

Disaster Management consists of four well-defined process.

Mitigation- Any activities that can prevent an emergency, reduce the damaging effects of the hazard or reduce the likelihood of occurrence are Mitigation. The mitigation phase

is different from other phases because it focuses on long-term measures for reducing or eliminating risk. The implementation of mitigation strategies can be considered a part of recovery process if applied after the disaster occurs. This phase can be of two types; structural or non-structural. It is one of the most cost-efficient methodologies for reducing the impact of hazards. The main activity for the mitigation is the identification of risks. The process of identifying and evaluating hazards is referred as risk assessment. Each hazard poses a risk to the population within the area assesses. The hazard-specific risk (Rh) combines both the level of impact and probability.

Rh=Vh * H, (Component of Risk Management)

Where Vh = vulnerability and H = Hazard

Preparedness- It means to be prepared and ready to face a hazardous situation by developing plans for what to do, where to go, or who to call for in case of occurrence of any hazard. Any actions that could improve one's chances of successfully dealing with a hazard would be considered a part of preparedness. Common preparedness measures include communication plans with easily understandable terminology and chain of command, development and practice of multi-agency coordination and incident command, proper maintenance and training of emergency services, development and exercise of emergency population warning methods.

**Response-** The ability to act responsibly and safely in a crisis situation in order to protect one's family, oneself and individuals around you at the time of disaster would be considered a response. It includes the mobilization of the necessary emergency services and first responders in the disaster-affected area. The emergency services include medical suppliers, firefighters, police, food suppliers, and ambulance crew. They may be accompanied individuals who are compelled to volunteer directly after a disaster.

**Recovery-** is best defined as the ability to quickly resume a normal life by rearranging your life and the environment after the hazard and the immediate danger is over. The recovery phase starts after the immediate threat to human life has subsided. The aim of this phase is to restore the affected area to its original state.

Figure 3.4 The comprehensive approach to disaster management

### 3.4 Disaster management using Blockchain

Even though different governmental and non-governmental organizations of a country are quick to respond to the disaster strikes, these efforts often fail because of lack of transparency between different functionality. There is no doubt and denial of the fact the mankind has come way ahead in terms of progress in the field of disaster management and rescue operations. Different countries, various NGO's and people within the affected country and from around the world make sure that the disaster-stricken country is not the lone fighter in the battle against the disaster and crisis situation. They try to donate in one way or another to the affected community. The help is generally in the form of food, shelter, money, medicines, rescue operations, transportation etc. Governmental organizations that are sent to hazardous situations regularly include defence forces which are, by nature, not enthusiastic about giving insights into their frameworks of activity. Sadly, this sensible hesitance to uncover sensitive data can prompt conceivably lifesaving data being deferred or out of reach.

Blockchain technology can be a boon in the area of disaster management as it can behave as the central system of all the operations. All the respective parties can come together and join the blockchain network making it a transparent and distributed way of help provision. A blockchain solution empowers the key players/associations during disaster management to communicate adequately and follow up on time. It enables the associations to utilize their current ecosystem to facilitate a service and distribute on this system. All transactions are recorded on the system. The record once generated cannot be edited or tampered once created. This way blockchain provides a secure environment. This leads to a generation of trust which supports governance and accountability.

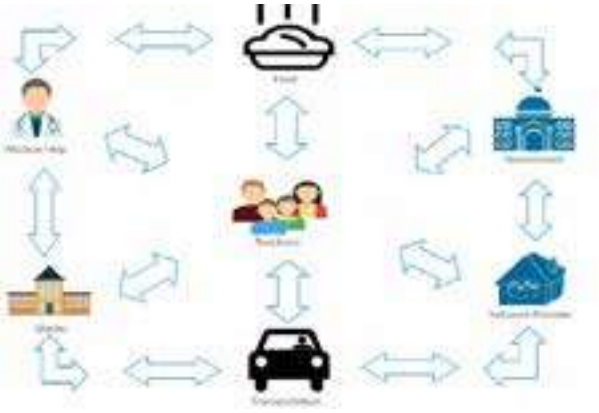

Figure 3.4 The comprehensive approach to disaster management

Thus blockchain makes sure that a shared distributed ledger is used which ensures transaction, information and data reaches all parties as soon as they are created which leads

to early settlements (Mohan, 2017). The main components of the new proposed method of disaster management using the blockchain technology are the government, medical suppliers, shelter providers, food providers, telecom service providers, residents, transportation providers.

The government should develop an application based on Blockchain where all residents can register by providing their basic information. This application should contain a list of financial institutions, telecom service providers, medical support providers, transportation, relief centers and shelters that individuals can access. With the help of this application, the government can analyze the conditions of the hazard affected citizens in real time and can provide help.

Furthermore, with this Blockchain enabled application, victims can request to locate a missing person. The application can identify a missing person if present in any of the registered shelters. Additionally, this application will be connected to the database in the Blockchain network which would make it next to impossible to tamper with available information. The government can request for the GPS location of the missing people from telecom network providers and then move forward with rescue operations. As the information flow is directed to the government from telecom service providers, rescue time should decrease for affected persons.

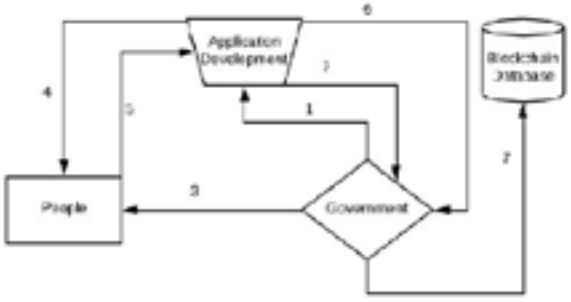


Figure 3.5 Application development model including government

Where,

1. Request of generation of application by government to the application development team
2. The confirmation of generation and active working of the application
3. Government reaching out to people to download and register themselves using their personal information on the application
4. The application development team reaching out to people with the installation details
5. Confirmation of downloading and registering over the application from people
6. All the information regarding the registered users are provided to the government
7. Information gets stored in the blockchain database

**Telecom Service providers** can join the application and become a part of the Blockchain network. The Blockchain developers can add the new service provider into the network by updating their contract of operation. The telecom service providers are one of the most important pillars of advanced disaster management as they verify the registered resident's identity and enroll them as the part of the network. These registered service providers should have the ability to share spectrum as the number of people using the network would be higher during crisis situations. The service providers should offer satellite phones and other sorts of wireless communication devices in case the phones of affected individuals stop working. These phones can be used to track their locations and might turn out to be an important tool in the rescue operations. They can also provide emergency wallet to all their registered users and with the help of Blockchain can transfer a certain amount of fund to their wallet, which would be a secure, safe and fast way of performing the transaction (Mohan, 2017).

Figure 3.6 Telecom service providers joining the blockchain network

Where,

1. People registering themselves over the blockchain operated application using their mobile number, and other identification details
2. The respective telecom provider is notified regarding the registration
3. Information regarding mobile wallets is provided to the people through blockchain network
4. The information is further made available for people through blockchain network

5. People register for mobile wallets

6. Funds and money are transferred to the mobile wallets through blockchain

7. Money is provided to the people without any extra charges and delay

**Shelter** - An individual, a group of individuals or an organization that wants to provide their services by offering shelter to affected people can register themselves on the application and give proper information about the type of services they have, examples of that would include information such as the number of beds they have, the amount of food, the types of food and medicines available etc. The application can then match the shelter seeking people to the nearby shelter according to their need. The shelter can constantly update the vacancy information over the app so that more people have knowledge about the availability of space. With the help of this application and the Blockchain network a shelter can directly communicate with the government regarding necessary fund or with the other service providing organizations about their needs and since the communication is direct without the involvement of any third party the needs can be fulfilled faster and without any confusion. The shelter can also notify the government about any individual present at the shelter whose missing report has been filed.

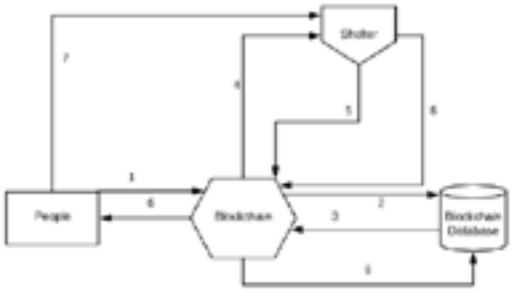

Figure 3.7 Shelter providers joining the blockchain network

Where,

1. People search for shelters by providing information regarding their location and preferences

2. The blockchain network looks in the database for nearby shelter providers

3. Information is provided to the blockchain network

4. The nearby shelter providers are informed about the request raised

5. The shelter provider who believe that they are able to provide the requested services accept the request

6. Information is directly provided to the people through blockchain network regarding the shelter provider

7. People gets in touch with the shelter

8. Information regarding the arrival and the individuals are provided to the blockchain network

9. All this information and data is further stored in the blockchain database for future consideration

**Medical service providers** can also register themselves in the application for free and Blockchain developers can add them to the network. There is no need for a third party for communication. If residents want to communicate directly with the medical service provider, they can connect with them over the application without relying on the first responders. In that case, no misuse of the patent information can take place and confidential information can remain confidential. Medical service providers can update the information regarding medicines and can send medical practitioners to the requested area. The medical service providers can work closely with the telecom company to work on the basis of electronic priority.

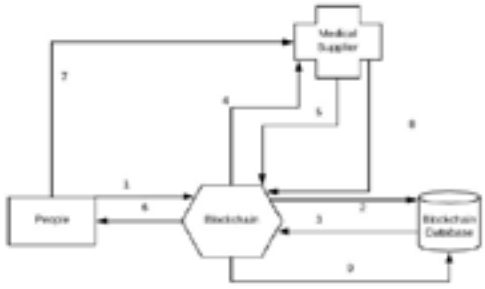

Figure 3.8 Medical service providers joining the blockchain network

Where,

1. Request for medical supplies from people with specific requirements

2. Blockchain network provides ability to the app to look for nearby medical service providers in the data base

3. Information regarding these suppliers are provided to the blockchain network

4. The request is being published in the network and all the nearby medical service providers are notified

5. The medical service providers accept the request

6. People are notified about them

7. Medical services are provided to people

8. All the information and data is published in blockchain network

9. Everything gets stored in the blockchain database for future consideration

**The transportation** organizations can also register on the application for free and then can be added to the Blockchain network. These service providers can offer information regarding the area and the location supported. They can also update the information regarding the type of transportation they can provide and can publish data on the application regarding all the people they have helped to move from the disaster site to a shelter. The shelter can contact these organizations directly through the Blockchain network and request for the necessary transportation facilities.

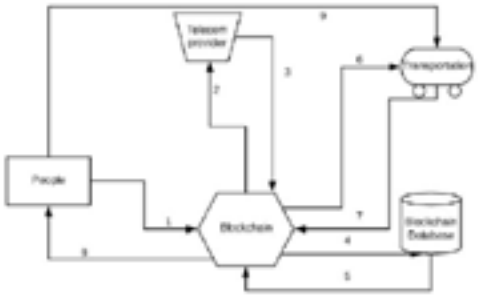

Figure 3.9 Transportation service providers joining the blockchain network

Where,

1. The person in need raises a request in the blockchain network for transportation

2. The blockchain network requests for GPS location of the person who requested services

3. Telecom service provider provides the GPS location

4. Nearby service providers are selected from the database

5. The information regarding the nearby providers are provided to the blockchain network

6. The request is published in the network for the nearby service providers

7. The one willing to help responds to the network so that everyone can keep a track of it

8. Information regarding the service provider is provided to the people in need

9. People and service provider communicate directly

**Fund Allocation**- There are times when an affected person or family runs out of money and are in need of some funds and as per the current way of fund allocation the money will get transferred from government to different departments in a chained format which eventually delays the fund transfer process and increase the chances of corruption and manipulation of the allocated money. If the victim requests for funds through a blockchain network the request will get published in the network and all the members can check and verify the transaction while the anonymity of the requester is intact. The government official may verify the authenticity of the request by asking for the GPS location of the requester from the telecom department and tallying it with the condition of the area so that no fraud can be committed (Mohan, 2017). The whole process is quick, safe and reliable and the funds are updated in the mobile wallet of the requestor which can be cashed out at certain government verified offices.

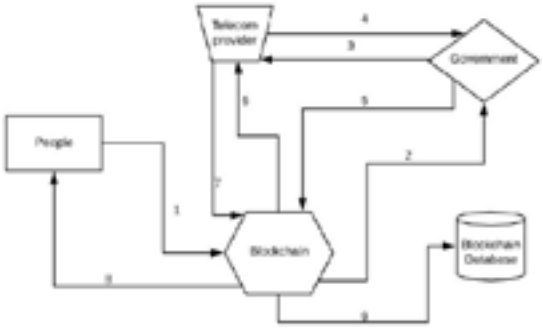

Figure 3.10 Fund allocations from government to the person in need with the help of blockchain network

Where,

1. Request for funds are initiated by the victim and is published in the network

2. Government officials dealing with fund allocation is notified

3. Government official asks for GPS location for the verification of the losses and request

4. GPS location is provided and condition is confirmed

5. Access of funds

6. Request for updating funds in mobile wallet

7. Request is accepted by the telecom service provider and money is transferred through blockchain network

8. Money reaches the victim directly without the transfer of

funds from one department to another

9. All the information gets stored from the network to the blockchain database

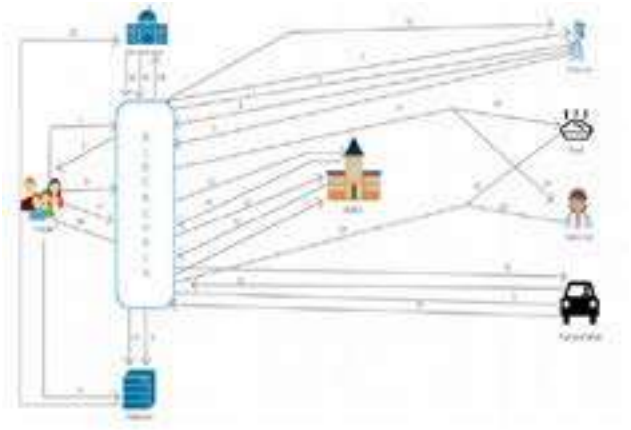

Figure 3.10 A combined model containing all the components working together in a blockchain network.

Where,

1. The people register on the application with their mobile number (Name, address, profession, etc.)
2. The telecom provider verifies the user request that is sent to them based on the basis of the user's mobile number
3. After the verification the user profile is created on the application
4. All the information is stored in the Blockchain database
5. The telecom network providers request to join the network
6. The identity of the service provider is verified and they are enrolled as a member of the network
7. Through Blockchain, service providers receive requests for supplies and services
8. People who are stuck in the hazardous areas can request for transportation
9. The request is further sent to all relevant transporters via Blockchain
10. The transporters accept the request and Blockchain helps to link the respective parties on the basis of their response to request. (First come first serve basis)
11. The shelter is informed of the new booking by Blockchain regarding the people who requested for transportation from an unsafe place to the shelter.
12. The shelter then update the vacancy and the individual's detail in the network
13. All this information is stored in the database which can be used for future study
14. The government analyses the data and study the conditions of the effected people
15. If there is a missing person request, the government requests for GPS coordinate of missing residents from the telecom service provider via Blockchain
16. The telecom service provider gives the information to the government in a fast and secure way
17. People request shelter for necessities like food, water, medicines and medical help
18. Shelter requests the network to provide the necessary supplies
19. The Blockchain network directly connects the shelter to the food and medical suppliers
20. The service providers request for transportation of supplies and medical practitioners
21. They are connected to the respective transporters and communication is fast and effective
22. The information regarding the respective shelter is provided to the transporter
23. Supplies are provided to the shelter and the data base is updated about the resources
24. The supplies thus reach the respective resident who requested for it
25. All the information stored in the database can be analyzed by the government and studied to provide better relief in future
26. The government keeps all the information in the Blockchain network, so that no one change, manipulate, tamper or delete it

All these models can work together in order to provide efficient disaster management, reducing the delay in provision of funds, help or services to the affected individual or a group of individuals.

During the whole process, the identity of the individual is safe in the Blockchain network and all the personal information is kept confidential. The whole purpose of the proposed

model is to reduce the delay in time and provision of faster, safer, secure and effective disaster management and rescue operation. Consider a specific area under the effects of the hazard. Without the application, there would be no direct communication between the medical supplier, food supplier, water supplier, transportation supplier etc. This may result in uneven distribution of resources or allocation of resources without the actual need at a specific region. With the help of the application, all the providers can be in contact with each other and the residents who are looking for resources. It will reduce the time of delivery, the waste of resources and all members of the network will get what they need. On the other hand, all the information would be updated on the application as it works on the Blockchain principle, the government can directly analyze the situation and needs of the residents and provide more funds in order to rescue people.

## 4. CONCLUSION

Blockchain allows organizations to facilitate a service and publish on the network using their existing ecosystem. All the transactions taking place are stored in the network. It provides an immutability feature by offering a secure network where a record once created can't be tampered or deleted. Since it works on a shared distributed ledger system, it ensures that the data and transactions reach the respective parties as soon as they are created. This leads to early settlements.

The study was focused on how blockchain technology and the network can be used to provide relief and better disaster Throughout the study, various models are introduced with the implementation of which all these problems can be reduced to a certain extent. The traceability functionality of blockchain is one of the most important tools when it comes to keeping the track of shipment or transportation of radioactive goods from one place to another. And it is hard to say whether using Blockchain in the disaster management and rescue operations techniques will completely eradicate the loss of life and property, but it should help to reduce the intensity of the losses. The measurable gains in efficiency, transparency, and immutability obtained by using blockchain in relief and disaster management will save lives which will save more than time and money. With the help of blockchain network concerning parties can communicate with each other while keeping all the information confidential and secure. Blockchain would make it really hard for anyone to steal funds or information as in order to do so, the person or group of people will have to overcome not only the specific block but the entire chain linked to it. As blockchain works on these 3 'Ds', Decentralized network, Distributed ledger, and Data Structure which help to keep the network as a community where there is no single party which owns it and all the parties have the power to execute the transactions in real time. Validation of a transaction is done by all the members of the network. As the blocks keep on piling over each other with validation to the preceding block it is hard to delete or alter anything. Although all the members will have the visibility on all the transactions, they will not know about who owns the transaction unless you are part of the transacting parties. This helps to keep the identity of a person safe, reduces the chances of misuse and theft. During the use of personal information, the hash encrypted documents would be transferred using the blockchain network and no one can see the decrypted version except the concerned parties with private and public keys. Blockchain techniques and technology can be used to develop a better performing system for better disaster management, reducing the frequency of identity theft, and provision of better national security if implemented properly

## 4. FUTURE WORKS

The blockchain is a rapidly growing technology around the globe. It represents an exciting new technological resource that has a huge potential in international development. Let it be disaster management, national security, economic growth, digital currency, supply chain and many other areas. There are new applications of blockchain being adapted by various organizations every day. The implementation of smart contracts along with blockchain has the ability to change how the countries around the globe function and how they frame their policies. Various studies are taking place in this direction in order to provide better supply chain, healthcare, national security, third-party risk management etc. Blockchain can save time, money, assets, and more importantly, lives.

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# Intelligent Waste Management Application

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The paper discusses about an IoT based solution for intelligent waste management. The aim of the solution is to help the local officials clear the garbage bins before they overflow intelligently, by monitoring the fill level of each bin. The product is not only designed with a vision to incorporate the latest technologies but also uses solar panels in the sensors for eco friendliness. The interface is presented in the form of a mobile app which gives a graphical view of the bins and fill level of each bin. Also, the app provides optimal route for clearing away the bins which are full and the visual representation of the fill level of the bins. The solution is designed keeping in mind the scalability, robustness and usability of the application.

**Keywords** - Internet of Things (IoT), waste management, remote monitoring, sensors

## I. INTRODUCTION

Waste management is one of the most important necessity for the development of any country. From an environment standpoint, it is important to manage waste generated at every household intelligently. There has been several researches and studies on intelligent waste management such as iEcoSys [6], Garbage Monitoring using RFID [7] and many more.

This paper presents an intelligent waste management solution which handles the complete workflow from Smart Bin installation to Waste collection from these Smart Bins. Also note that implementation of any smart technology requires educating the users with method of using the application and the need for waste segregation and effective disposal. Future of this solution would be to include management of waste recycling and dump yard units which would in turn provide a platform for informed decision making.

## II. HIGH LEVEL SYSTEM ARCHITECTURE

The proposed solution has mainly three components:

- The Smart Bins with ultrasonic sensor to measure the fill level of a bin
- The Mobile Application used by the container for effective waste clearance from Smart Bins
- The IoT server and cloud server which interfaces the Smart Bins and the Mobile Application

The high level architecture of the proposed solution is depicted in Fig 1. The workflow begins with the installation of Smart Bins at various locations. Registering of Smart bins can be enabled in the mobile application which in turn registers the location as a mapping of the latitude and longitude in the cloud server. The sensor installed in the Smart Bin can also be enhanced to share a unique ID for the bins as discussed in the upcoming section on location tagging in the hardware unit.

Once smart bins are in use, it sends the fill level at regular intervals to the IoT server. The cloud server which interfaces the IoT server and the mobile application now populates its database with the latest fill level from the Smart Bins. The containers which are ready to clear the bins can retrieve the optimal route to be followed for clearance from the mobile application. Only the bins which is filled more than 70% appear in the route map shared in the mobile application.

The mobile application can further be used as a platform for analyzing the fill level of the bins. The data collected can also be fed to the IBM Waste Management Platform [1] which provides a wide range of analytics and visualization capabilities.

## III. SYSTEM ARCHITECTURE -HARDWARE

The design of the smart bin involves two components:

- The bin
- The electronics

### A. Design of the Bin

An ultrasonic sensor is proposed to be used to measure the fill level of a bin. The sensor has to be placed on the top of the bin facing down. This requirement places the following design

restrictions for the physical design of the bin:

- The opening should be on the side wall near the top.
- The bin can either be circular or a square/rectangle when viewed from the top.
- All the sidewalls need to be nearly vertical.

**B. Design of the electrical circuit used in the Bin**

To measure the fill level in a bin and transmit the data to a central server, the following is required:

a) Sensor -Various types of sensors were evaluated for their feasibility in this project and an ultrasonic sensor was finally chosen.

The sensor works by emitting ultrasonic sound waves and waiting for its arrival after being reflected back by obstacle. By measuring the time taken for the sound waves from the time it was emitted until it is received back, the distance from the sensor to the obstacle can be calculated.

If an ultrasonic sensor is mounted at the top of a bin facing down, the fill level can be calculated by measuring the distance to the top of the garbage.

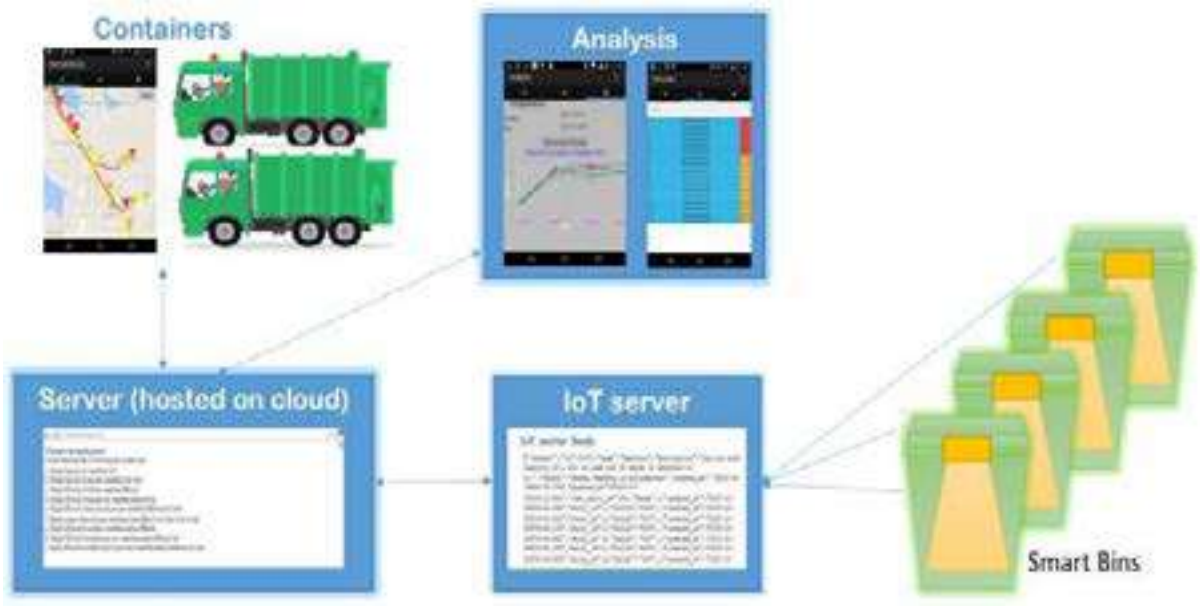


Fig 1: High level architecture

b) Wireless module -A wireless module is used to transmit data from the bin to a central server. Several types of wireless technologies were evaluated and the most suitable one is LoRa. LoRa is a long range, low power wireless platform that has become the de facto technology for Internet of Things (IoT) networks worldwide. Most LoRa modules have an integrated microcontroller which can be used to poll the ultrasonic sensor. For the smart bin application, the fill level of the bin needs to be sent to the central server only once or a couple of times a day. Hence, the LoRa modules needs to be active only for a very short time each day. As LoRa is already highly power efficient, all the electronics including the sensor and the wireless modules can run on an ordinary battery for months at a time. Also note that LoRa modules can access public networks such as Tata Docomo network in India and as these modules use very low power, batteries will also last for very long.

c) Power supply with optional solar panel - As explained above, the power requirements for the circuit are very minimal. Also, the circuit can be powered down and put into standby for most of the time. Only at predetermined times, the circuit will wake up automatically, measure the fill level, send the data and then sleep again. There are two options for powering the electronics of the smart bin.

- Battery only: If only a battery is used, depending on the type of battery, it will need to be charged/replaced only every couple of months.
- Battery with solar panel: This might be the ideal solution, as there is no need to replace/monitor the battery when they run out.

**C. Prototype circuit**

The prototype for the circuit is shown in Fig 2. The prototype includes the sensor, the wireless module and a power supply.

- Sensor: HC-SR04 ultrasonic sensor
- Wireless module: ESP8266-ESP01 WiFi module
- Power Supply: 9v alkaline battery with two voltage regulators, 3.3v for the ESP module and 5v for the sensor

**D. Other possibilities**

In addition to the ultrasonic sensor to detect the fill level of the bin, more types of sensors can be installed in each bin.

a) Environmental sensors - Various types of sensors to measure data such as temperature, humidity, particulate matter (such as PM2.5), smoke, rain and wind direction could be added to the bins. Data from such sensors can provide valuable insights into the environmental quality of a location. And combining data from multiple locations can be used to better predict localized weather conditions.

b) Emergency buttons - A button can also be installed on top of the bin that anyone can press to alert authorities in case of either a personal or a public emergency.

c) LED indicators - Data about environmental quality can be received from the central server and displayed as various colors in LED lights on the bin. This can alert people about potentially hazardous conditions such as high particulate matter concentration in a location which can be injurious to health.

d) Location Tagging – Location tagging does not really require a GPS module. The app needs to have the location data of each bin so that it can calculate a route for the collector. The process by which this can be done without a GPS modules in each bin is as follows:

i. Each of the bins will be initially programmed with a unique ID. This will be the ID that is sent to the central server every time with the fill level data.

ii. This unique ID of the bin can be converted to a QR code (or just a plain alphanumeric code) and printed on top of the bin

iii. When the bin is installed at a particular location, the smartphone app can scan the QR code (or the alphanumeric code) of the bin and then tie with the GPS data from the smartphone and then send both to the central server. The server will store this ID to GPS data combination in its database for each bin.

iv. Whenever the central server receives data from a smart bin, it will use the unique ID in the incoming data and get its corresponding GPS data from the database.

## IV. SYSTEM ARCHITECTURE - SOFTWARE

**A. Cloud Server**

The cloud server is an interface between the mobile application and the IoT server which receives the feeds from the sensor.

The cloud server provides a REST interface which are accessed by mobile application for providing the optimal route and analysis of the smart bin data. REST interface is the architecture used for faster and simplified component interactions. RESTAPI is considered a light weight alternative to Remote Procedure Calls and thus helps in improving the scalability of the server to support large number of client interactions at any point in time.

The services offered by the cloud server can be implemented using the light weight micro-framework like Flask [2] provided by Python. Python also offers packages such as geopy [3] which provides geolocation services such as resolving co-ordinates to an address and vice-ersa, distance calculation between two co-ordinates using models like geodesic distance and the great-circle distance and so on. There are many more packages offered by Python for backend database access, for URL access which can be used to interact with the IoT server, for scheduling jobs to access IoT server at frequent intervals and many more.

The cloud server can be hosted on any cloud computing

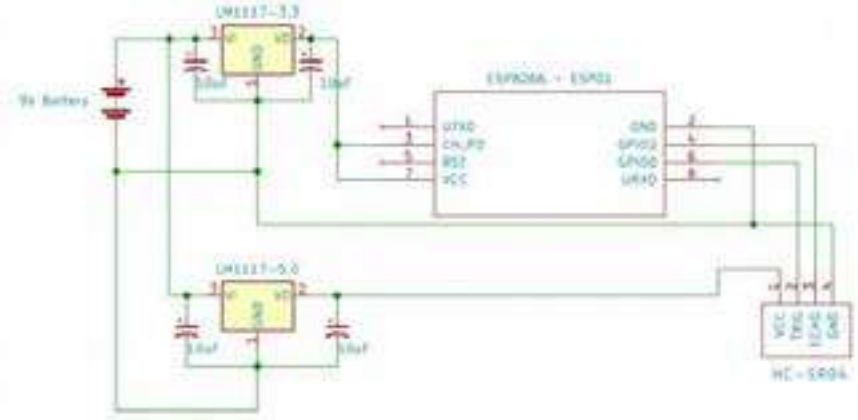

Fig 2: Prototype Circuit

platforms such as Microsoft Azure, Amazon Web Services (AWS), Google App Engine, and IBM computing on demand or on any physical server hosted within a data center.

The cloud server also requires a backend database for storage of data for future analysis. The backend database used for this application should service queries faster and hence databases such as MongoDB can be used. MySQL which is most suited for web applications can also be used by tuning the same for better performance.

**B. IoT server**

The electronic circuit has been designed to poll the fill level at configured intervals of time. The polled distance is available in the IoT server at real time

Microsoft, IBM, Amazon, Cisco offers IoT cloud based analytics solution which can be leveraged to aggregate, visualize and analyze data sent by the sensors. ThingSpeak [5] is an open source IoT analytics platform service which can be leveraged to collect data from the sensors. The feeds can be easily accessed by the cloud server which in turn can use this information for optimal route computation and additional analytics.

**C. Mobile Application**

Mobile apps have gained traction over the years and hence a mobile app is an ideal platform to provide more management features.

Features offered via mobile app are listed below.

- Optimal Route for clearance of smart bins - The cloud server shares the optimal route based on the bins with fill levels greater than 70%. The optimal routes can be retrieved based on the current location of the user as shown in Fig 6 or based on the location entered by the end user as shown in Fig 7. This helps in clearing the bins without allowing them to overflow and causing health hazards
- Platform for analytics – Mobile application can be enhanced to analyze the fill levels within a given period and at any given location. The same can be enhanced to manage the containers, dump yards and recycling units, waste characterization, for example wet and dry forms and much more.

## V. IMPLEMENTATION AND RESULTS

A prototype of the solution was implemented and the results are discussed below. Over 52 smart bins were registered along the several areas in Bengaluru. Around 1700+ entries were added to the cloud server backend database to simulate the fill levels for these 52 bins.

**A. Sensor Circuit**

The sensor circuit was implemented based on the prototype circuit discussed in the earlier section. Fig 3 shows the circuit using the HC-SR04 ultrasonic sensor, ESP8266 Wi-Fi module and 1.2V Nmh rechargeable battery.

**B. IoT server using ThingSpeak**

The sensor circuit was configured to interact with ThingSpeak server in order to post fill levels of the smart bin at regular intervals. The feeds in the ThingSpeak server is shown in Fig 4.

**C. Cloud Server**

The REST interfaces were exposed from the cloud server hosted on Google App Engine WSGI application server [4]. The responses were sent to the mobile app in JSON which is considered as one of the lightweight data-interchange format. Fig 5 shows the responses in JSON format for various requests from the cloud server.

**D. Mobile App**

Mobile App was built using the Android developer tool for Eclipse. The app has been integrated with GPS which helps in retrieving the current location (latitude and longitude) of the smartphone. The app has options to register a Smart Bin, view the optimal routes for clearing the Smart Bins based on fill levels as shown in Fig 6 and Fig 7, Options to view the fill levels of the bins at various locations requested by the user as shown in Fig 8 and graphical representation of average fill levels at a given area as shown in Fig 9.

Color Coding for fill levels were provided to easily identify the fill levels of the bins.

- Fill levels greater than (or equal to) 70% is considered 'High'; this is displayed in 'red.
- Fill levels greater than (or equal to) 40% and less than 70% is considered 'Medium'; this is displayed in 'orange'
- Fill levels less than 40% is considered 'Low'; this is displayed in 'green'

## VI. CONCLUSION

The solution has been designed keeping in mind that it has to be scalable, reliable, user friendly and easily extendible.

The design helps to scale, in terms of number of clients and in terms of number of bins. This design ensures that multiple clients can access the server at any point in time. This design also ensures that the parameters of multiple bins can be updated in server database by polling the IoT server periodically. The data shared by the sensors are available real time. Hence, the information is reliable and the stale entries

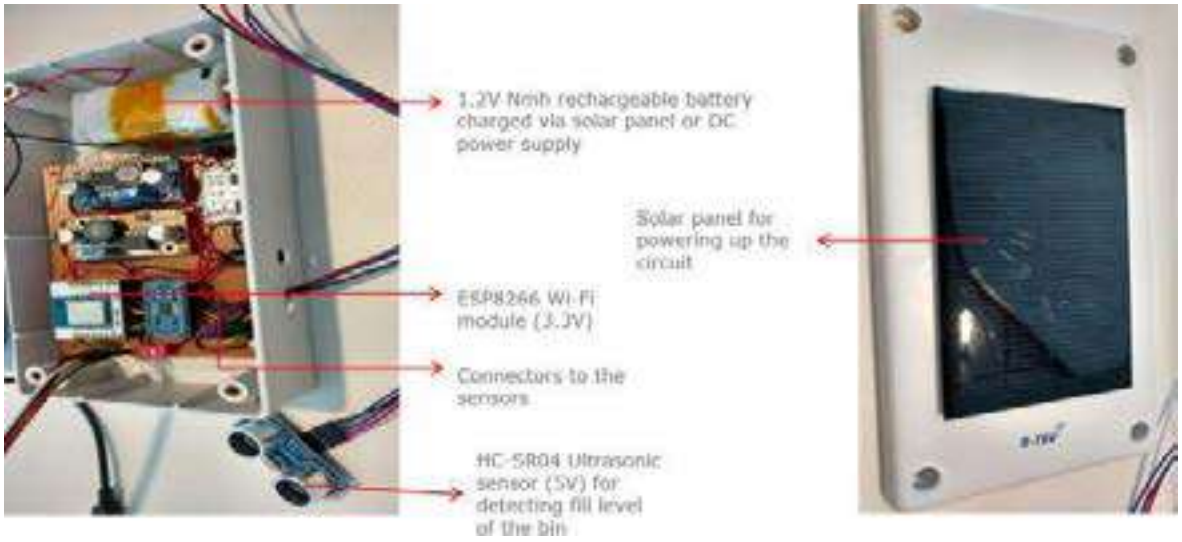


Fig 3: Implementation of prototype circuit


Fig 4: ThingSpeak IoT analytics platform and sensor feeds

can be easily removed by the administrator once the clearance and analysis is complete.

Usage of several application over mobile has increased over past couple of years. Since the features are available via a mobile application, it is easy for end users to operate the same. Mobile applications have gained traction now and hence is easy to use.

As mentioned earlier, implementation of any smart technology requires complete co-operation from the users which includes the population in that area, those involved in clearing the bins and the administration who takes decision based on the data shared by the app.

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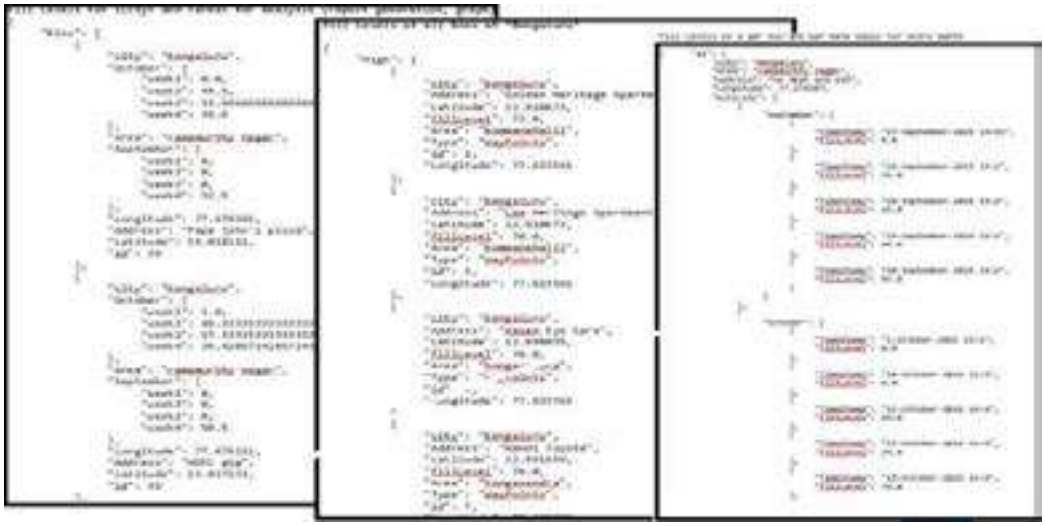

Fig 5: Sample Data response from cloud server

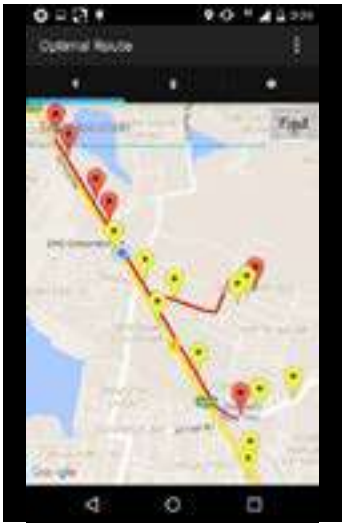


Fig 6: Optimal Route based on current location of the user


Fig 7: Optimal Route based on location requested by the mobile app user

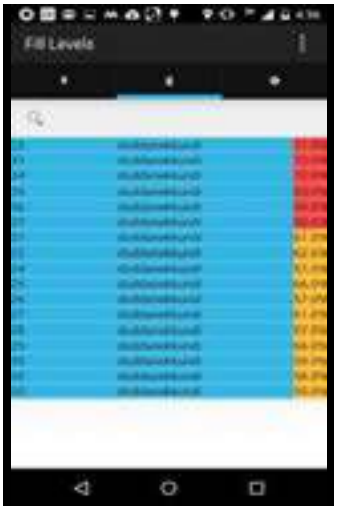


Fig 8: Fill levels based on current location of the mobile app user

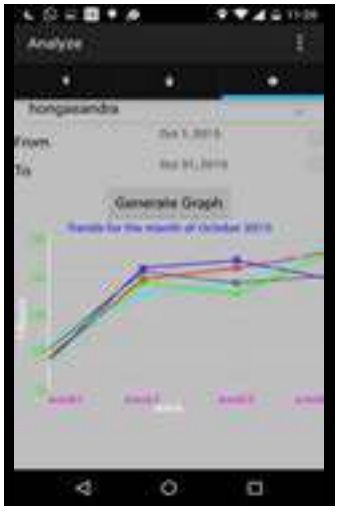


Fig 9: Graphical representation of average fill levels of bins in a specific area

# Retrofitting and Rebuilding of Small Homes - Experiences from Post Flood Interventions in Kerala

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Abstract - Disasters would continue to challenge the countries and its communities -and forcing them to relook at the preparedness and sustainability initiatives taken. The experiences across the world have shown that irrespective of the precautions taken, calamities place both the governments and their people in total disarray and thrust upon huge responsibility to bring the life back to normal. The recent floods in Kerala, which occurred at unanticipated magnitude, too culminated in very high damage levels. The redemption of the lost property or damaged dwelling unit and making it inhabitable is the biggest challenge faced by the authorities. Adoption of building technological components that enable rapid recovery, creating adequate structural retrofits to ensure safe living conditions and enabling the communities to realize the need for sustainable living conditions are the major initiatives attempted as part of the post flood interventions. This paper highlights the approaches taken in the selection and implementation of above mentioned details at a selected flood hit region in Kerala.

**Keywords -** flood damage, retrofitting, rebuilding, cross corrugated panels.

## I. INTRODUCTION

Chaotic and operationally complex situation emerges in any post-disaster reconstruction activity and it would turn further difficult due to various issues like lack of resources, restricted access to resource procurement and reduced solution alternatives. Hence, the reconstruction process need to address the issues relating to inappropriate sourcing of raw materials especially for the production of building components or products and hence to eliminate any direct threat to the natural environment and secondary hazards [1, 2]. Other than the rebuilding process, another important intervention is in the retrofitting of damaged houses that are not categorized as heavily damaged ones. Retrofitting would cause significantly much lesser damage to natural environment compared to any other method of developmental initiatives. The process is primarily to undertake modifications to structural components like foundations, walls beams, columns, roof and various connections in the buildings to eliminate or reduce the occurrences of any future damage. Retrofitting process is not without any disadvantages, even though being very cost effective, it would find it very hard to get implemented due to inadequate technical support at the ground level [3, 4]. The experience have shown that the existence of political, organizational, environmental and logistical constrains often make the reconstruction process ineffective inspite of huge amount of funds being made available [3,4].

Further, a flurry of different technological options was a common phenomenon of any post disaster rehabilitation process. Also, technologies that claim to have more sophisticated scientific component and that is said to hold better reliability in performance have often failed to get wider acceptance due to lack of inclusiveness in its promotion [3]. The use of light weight prefabricated structural components have become very common in the construction of both small residential units and large multistoried building systems. These units have become more preferred due to their inherent advantages like suitability for large clear spans, better quality control in construction and maintenance, reduction in construction time, flexibility of expansion, architectural versatility and improved energy efficiency [5.6]. In order to improve the performance of the existing panels and to enable them to be used for rapid slab construction, an innovative approach of providing cross-corrugations was found very successful based on laboratory based studies [7,8].

The objective of this paper is to communicate the reflections from various field level demonstration studies undertaken as part of post flood restoration works. One such initiative was to undertake retrofitting exercise on a damaged structural unit and to establish confidence among the occupants and local authorities about various options for post disaster recovery. Further, field level assessment of cross corrugated sheets as a new structural material to accelerate the construction process at a lesser cost and using the local skill was another exercise evaluated here. Also, an improved on-site sanitation system by effectively integrating phytoremediation and biofiltration was also implemented to improve the prevailing practice of using a septic tank alone for wastewater disposal. Thus all the three attempts were to establish the concepts of reduce, reuse and recycle among the local community and government agencies in the post flood restoration initiatives.

## II. METHODOLOGY

Sustainable rehabilitation of the damaged habitat systems need to have innovations in process planning, choice of construction materials and methods. Severe shortage in the supply of building materials pose serious threat to any post-disaster rebuilding process. Thus prioritization of activities that demand restoration and those that require rebuilding need to be identified for the effective utilization of resources and also to reduce the activity turn over time. The buildings affected by flood at Chenganoor and Vaikkom regions were subjected to rapid visual assessment to identify and assess the degree of structural damage. Based, on the information collected from the field, retrofitting project was designed with clearly earmarked roles and responsibilities with appropriate participation from the community, teachers and students to understand the whole aspect of disaster risk reduction and creation of safe homes for the stay. As this process is very different from new building construction, the task involved specific and detailed investigation into the structural response of the building unit with the objective of generating a unique solution.

In addition, the rebuilding is also seen as the opportunity to inculcate resource reuse approaches towards establishing sustainable habitat conditions. Also, if any new technology or process change need to be introduced it has to be adopted in an inclusive manner with effective participation of local community. As part of the rebuilding initiative, incorporation of innovative cross corrugated slab components that could significantly improve the housing construction was demonstrated. The field demonstration to establish the utility of cross-corrugated cold form sections in housing development programmes was based on the results obtained from detailed experimentation [7,8] . For preparing cross corrugation in cold form sheets, steel ribs are cut out from the sheets and placed across the longitudinal corrugations providing provisions to have connectivity along the corrugations. These are connected through riveting and also welded together so as to ensure simultaneous action along both directions of rib [Figure 1]. The corrugated slabs fabricated in the above manner was placed over walls and fixed using anchor bolts. It was covered with cement concrete to have better diaphragm action similar to any concrete roof slab. In addition, damage caused by the waste water, that is discharged untreated into the soil and water bodies, was a major health hazard experienced during the flood situation. Thus, better on-site wastewater disposal systems for residential units, designed using natural materials like coir fibre and vetiver plants, to improve the water footprint of residential units are field tested [9.10.11].

Fig.1 Cross corrugated panel

## III. RESULTS AND DISCUSSIONS

Retrofitting exercise couldn't be contracted to a local builder unlike a new construction process. It required a team of trained engineers along with skilled workers who are trained on-site to take up similar problems in future. As it is a technically challenging activity, too much emphasis on community based initiative was not attempted due to very low level of traditional knowledge components involved in it.

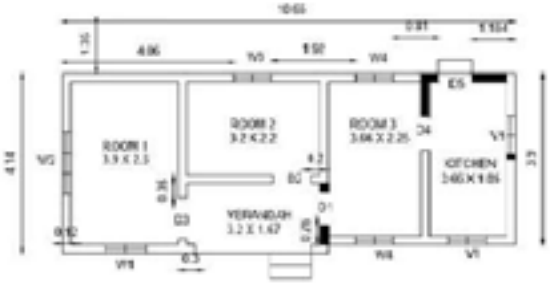


Fig. 2 Plan of the building that was retrofitted (darkened walls were damaged in flood)

**A. Steel appendages for structural retrofitting**

Based on the data observed from the field, an immediate intervention was suggested to one of the houses that was damaged in the flood. The plan of the building chosen is given in figure 2. The chosen unit is constructed in brick masonry and is covered by tiled roof. The building systems under flood are subjected to three types of forces – buoyancy forces, hydrodynamic forces and hydrostatic forces. Under such situations, light weight and irregular buildings would experience unexpected displacements based on the effect of water pressure. In addition, the type of roof also play a major role in deciding the building response. The roof slab is expected to play the role of a diaphragm which would act as a lateral load resisting member. Being a tiled roof, the walls of the chosen building were not acting uniformly due to absence of a rigid diaphragm. Thus structure experienced local failures at three locations (indicated as dark bands in fig. 2). The retrofitting process consisted of two distinct steps – to limit the local failure situations that might emerge in the structure and to ensure an alternate load transfer for roofs thus reducing the load on the wall. The wall stiffness was improved by stiffening at plinth level, sill level and lintel level using mild steel flats of dimension 15 mm × 6 mm. The flats are provided around the structure and bolted into the walls using 7 cm long and 8 mm diameter anchor bolt. As the repair of the cracks could not be undertaken directly on the weak structure, the stiffening was initially completed and then masonry repair work was completed. As the walls provided in the building is only 10 cm thick, the flats are provided only on one side of the walls. Further, the load from the ridge beam was transferred into the ground using a mild steel angle of dimensions 15 mm× 3 mm. This was adequate to ensure reduction of load on the walls. The figure 3 and 4 gives the picture of the aforementioned house that was retrofitted.

Fig. 3 The house after retrofitting exercise

Fig 4 Repaired walls after strengthening the house

**B. Role of cross corrugated sheets**

The laboratory experiments followed by numerical simulation undertaken on cold form cross corrugated panel have helped to arrive at an appropriate configuration of roof slab for small residential units. The better stiffness achieved through cross-corrugations have resulted in improving the load carrying capacity and improving the material efficiency in the construction process. The figure 5 gives the image of the cross corrugated panels used in the field demonstration. Unlike the currently available prefabricated elements, the proposed system could be effectively integrated into the conventional process of roof slab construction. The proposed approach has eliminated the need for shuttering work and alternate reinforcement as the cross corrugated cold form sheet panels are able to act as both the shutter and the reinforcement. Thus significant time required for the shuttering work, laying and tying of reinforcement is saved. In addition, the entire space below the roof is available for continuing further construction process as the sheets don't require extensive form work as in any conventional concreting work. The new approach showed a saving of 30 percent, which required Rs 140 per square feet while the conventional accounted for Rs 210 per square feet. Further, the proposed building components would be amenable for necessary modifications to incorporate advanced technologies like machine learning and artificial intelligence that could capture the displacement history and analyze the structural health rather than the current approach of interpreting from visual observations. Cost barrier in the implementation of such ICT solutions can significantly reduced by designing appropriate structural components.

Fig. 5 Constructed facilities using cross corrugated panels

### C. Implementation of engineered micro-wet lands

The integrated phyto-biofiltration system represented engineered micro-wet lands developed for the treatment and disposal of sewage that could be easily installed at any locations. The designs were installed at two different scales – at small residential level to improve the domestic onsite wastewater disposal process and at community level for large quantity of sewage disposal. These units are standardized in their manufacture and hence the reliability in their operations is ensured irrespective of the site conditions. Often, adaptability to the newer environment is the prime issue facing natural systems based waste water treatment. But here, fully grown vetiver plants are directly planted in the reactor to help the entire system to function to its full capacity from the day of installation itself. Also, as the roots expand during the course of treatment the efficiency of the vetiver unit would certainly go up. The coupled action of biofilter bed along with the phyto segment of the treatment plant results in the effective removal of organics and nutrients from the waste water. The biofilter fibre packing at density of 70 to 80 kg /m3, could accommodate organic loading rate of 2 kg BOD/m3/day. The 24 hour retention of waste water is observed to result in 75 to 85 percent reduction in the organic load. Also as these systems can be promoted as packaged unit, a cost effective solution for energy efficient sewage treatment and disposal can be achieved. Also in the case of high water table regions these systems can be integrated with toilets as they can be placed above the ground as closed units without any mixing of external water with the sewage.

Fig. 6. Phyto-biofiltraion units

## CONCLUSIONS

The paper has discussed various interventions that were undertaken as an immediate retrofitting solution, cross corrugated structural components providing significant improvement from conventional delivery of building systems and energy efficient on site waste water treatment units -all aimed to ensure sustainable and safe habitat systems. The steel appendages for strengthening the damaged masonry buildings would enable a new domain of intervention for the restoration of building units that are found to be vulnerable against disaster. Further, it could also be extended to assess the structural health of high importance buildings like hospitals, schools, fire and rescue stations etc and initiate appropriate steps for their safety. Incorporation of cross corrugated cross corrugated slabs, using cold-form steel panel, would not only help to eliminate the prevailing problems in the construction but also provide added opportunity to use the panel response for structural health monitoring. Further, integrated phyto¬biofiltration unit using coir geotextiles and vetiver plant species is an appropriate solution for domestic waste water treatment that could also be implemented in the conventional type sewage treatment units for ensuring the sustainability of habitat systems.

## ACKNOWLEDGEMENTS

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# Revamping The Post-Flood Kerala: An Educational Perspective

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Abstract - Kerala had victimized an incomparable and unparalleled natural calamity during August, 2018, a remarkable and unforgotten year in the history of Kerala. Even in the midst of this agony, Kerala stood as an ideal for others through our unity and strength. During the rescue and relief operations, Keralites displayed a high level of intra¬and inter-community trust, helping mentality, mind power, empathy and networking. The fine coordination of the authorities and the ever salutable commitment of fisher folks made the situation acquiescent.The tech-savvy coordinated the rescue works effectively through social media platforms from various parts of the globe, saving thousands of lives and mitigating the suffering of many others. Student fraternity undoubtedly did amazing voluntarily work which highlighted the collaborative unity of young Kerala. The State faced its worst disaster since 1924, and it is now important to rebuild infrastructure and rehabilitate the displaced population. It will be a long road ahead, for the authorities as well as to each individual of the state to restore normalcy.

After the flood relief activities, the major threat faced was the sanitation and flood waste disposal activities. To a great extent, it was also managed through our collective efforts. It has outshined various critical aspects such as the roles and responsibilities of the institutions involved in relief and cleaning, deployment of increased number of volunteers to ensure quick action and the manner in which people should segregate and store flood waste at the household level for collection by local authorities later. Within one month itself, cleaning and allied activities could attain the aim. Now, it's time to move ahead more courageously, more consciously, with more determined mind for an enlightened Kerala which consists of all brightness of sustainable future. The paper discusses certain drop balls in the perspective of education which can act as pillars while revamping the post-flood Kerala

Keywords - Revamping, Post-flood Kerala, Educational Perspective

## INTRODUCTION

Kerala's achievements in social welfare growth and quality of life are commendable and inspiring. The State's human development index is in tune with that of developed countries in the world. These achievements are attained through continuous hard work, great struggle and excellent supervision in education, economic and other allied sectors for a long time. The society attaches so much importance to education and schools like educational institutions in Kerala have become the key to societal development.

Kerala had victimized an incomparable and unparalleled natural calamity during August, 2018, a remarkable and unforgotten year in the history of Kerala. Even in the midst of this agony, Kerala stood as an ideal for others through our unity and strength. During the rescue and relief operations, Keralites displayed a high level of intra¬and inter-community trust, helping mentality, mind power, empathy and networking. The fine coordination of the authorities and the ever salutable commitment of fisher folks made the situation acquiescent.

The tech-savvy coordinated the rescue works effectively through social media platforms from various parts of the globe, saving thousands of lives and mitigating the suffering of many others. Student fraternity undoubtedly did amazing voluntarily work which highlighted the collaborative unity of young Kerala. Even schools and other educational institutes have been affected, as many of them have been converted to relief camps. This has affected students, especially those who are in Class X and XII. This is an important challenge to a state where education is a top priority aspect.

The State faced its worst disaster since 1924, and it is now important to rebuild infrastructure and rehabilitate the displaced population. It will be a long road ahead, for the

authorities as well as to each individual of the state to restore normalcy.

After the flood relief activities, the major threat faced was the sanitation and flood waste disposal activities. To a great extent, it was also managed through our collective efforts.It has outshined various critical aspects such as the roles and responsibilities of the institutions involved in relief and cleaning, deployment of increased number of volunteers to ensure quick action and the manner in which people should segregate and store flood waste at the household level for collection by local authorities later. Within one month itself, cleaning and allied activities could attain the aim. Now, it's time to move ahead more courageously, more consciously, with more determined mind for an enlightened Kerala which consists of all brightness of sustainable future.

Involving each and every people to the rebuilding process of our state will be a better strategy so that they can be more aware of the reality of the situation as well as they all will get a sense of 'we feeling' towards the essentiality. Combined effort with complete involvement will make the process much easier with all avenues of Social capital, Revenue generation, managing perfect time and above all in avoiding future criticisms in terms of unknowingness. Social capital created by reciprocal relationships in society will be vital in 'rebuilding Kerala' because recovery and reconstruction after mega disasters cannot take place through infrastructural or economic endeavour alone. The reconstruction and rebuilding of the state is a long and costly process. It is a greater matter of fact that the people of Kerala have proven that they are stronger than any adversity and there is unity even in the midst of many diversities. It is very important for better planning, policy development, which ensures the futuristic vision taking into account of similar disasters, to increase the dignity and quality of life of every people of Kerala.

The major objective of any reformation or development program is to increase the current status of the beneficiaries in terms of dignity of life, economic and social up gradation. Such a goal can be attained through material, non-material and ethical grounds. One of the most powerful tools for reforming the traditional social structure is education, which provides values, training and skills to persons otherwise held back. In addition, education in a progressive political environment can enhance the self-conceptions of the poorest and most oppressed individuals so that they will participate more fully and consciously in the development process. Kerala stands out among all the states and regions of India for its remarkable achievements in raising the literacy level of its people. We have achieved the 100% literacy status. Hence, in that sense, all our deeds should be as much as ideal that become model to others. It would be grateful, if the points mentioned in the paper would be useful in the rebuilding process of Kerala. While thinking in an educational perspective, the following points are presented. Let's see one by one.

1. Social service should be a compulsory part of curriculum for Education.

   Students pick up good values and habits during their studentship days. When they grow up, these values go a long way in moulding them into responsible adults. Even though National Service Scheme (N.S.S.) and National Cadet Corps (N.C.C.) are functioning in Colleges, they are not compulsory to all students. If social work is made mandatory just like other subjects and activities in Institutions, they will learn the importance of living together and giving back to the society. It teaches them to share what they have with others, for the greater good. They learn to be more tolerant. When students step outside of their colleges, they get busy in building a career and making a living. They weigh everything with money. If there is a previous exposure to social community work in their early years of education, chances are they will be more grounded and not be tied down by the materialistic worldly things.

2. Life skills should be a part of Curriculum for all courses

   Connection of education and community is fruitfully possible through the application of Life skills. The three pillars of education such as Knowledge, Skills and Values should be attained through the process of education. Our educational scenario is more theoretical. Equal importance should be given to both theory and practice. Through the theoretical aspects, students can gain knowledge, but the skills and values are to be attained only through practical aspects. Improving the skill development of learners in higher education would contribute to placing higher education as the foremost pillar on which our society is built. The academic world has serious doubts on the movement of our society in many respects. We all know that the students going through higher education become the citizens who determine the future of our society. Thus, education has a crucial opportunity to affect the future of our society. Hence it is imperative to include life skill education in the curriculum of all courses so that the 'value' concept be ensured in education.

3. Swimming, driving, diving etc. should be given options even in school education itself Swimming, driving, diving etc. like the essential skills should be given provision in school education days itself.

4. Documents including textbooks, notebooks and other learning materials etc. to be kept in digital formats even

by students

Flood experiences show that it would be safe if students also keep their notebooks, text books and all other learning materials in digital formats, especially through digital communication media.

5. Voluntary community-service by teachers

   Community-service by teachers should also get due recognition. As an acknowledgement, it should be entered into the service book which can be considered as mandatory requirement for promotion by Accreditation agencies like NAAC, UGC, and AICTE etc.

6. Introduction of cloud storages in Education

   Cloud storage is growing in popularity due to the benefits it provides, such as simple, lower costs, anywhere access and the removal of maintenance and storage management. It is the delivery of data storage as a service, from a third party provider.

7. Mobile App development for viewing the classes taken by teachers

   The educational value of mobile app design and development activities, and the possibility and practicality of teaching/learning mobile app design online, which can further encourage educators to explore and experiment on the potential of incorporating these learning activities in their diverse settings.

8. Disaster Management training

   Disasters may happen anywhere at any time. Our Disaster Management Cells to be strengthened at any cost. Disaster awareness as well as Disaster Management Training should be included in education, especially school level onwards, so that our grooming generation will be more sensitized on the manmade environmental issues which indirectly make them prepare to lead a sustainable lifestyle.

9. Community Extension activities for all courses

   Extension and outreach programs, we sensitize the students to develop social values, widespread their responsibilities and knowledge in societal issues and problems by making them to involve with the community people.

10. Localization of Education to be promoted

    Education should be made more localized. The curriculum, text books etc. should be made society centered.

11. Always be ready to face and manage any disasters

    As becoming the most densely populated state, Kerala has to be ready at any time to face any disasters. It is not only a factor of Kerala, but the global scenario. The resources are being utilized, getting reduced; man is encountering into the ecosystem and thereby disturbing it. It is the reality that nothing can be done on the resource utilization as because of the population growth. What we have to do is that we should have a clear picture on how the ecosystem is getting losing its naturality, where it affected much and what are the precautions to be taken in order to save the life of people through protecting our earth. Hence we should be ready to face and manage any disasters at any time.

12. Rebuilding should be done with due consideration of environmental issues

    The rebuilding and reconstruction processes must consider the future environmental needs also. Integrating ecosystem management and environmental sustainability are inevitable. Experts are of the opinion that the impact of the floods could have been mitigated if prior environmental assessments had not been ignored. The Western Ghats, which have naturally served as a water reservoir for Kerala along with five other States, were the subject of a 2010 environmental protection assessment report, which recommended a ban on mining and quarrying, and limited various economic activities in the Ghats. The report was not implemented and subsequently ignored down, and this excessive stone quarrying and deforestation of sensitive areas may have contributed to the scale of flooding and destruction. Hence an urgent discussion on the matter is crucial which is not only for disaster prevention, but also for human sustainability and existence.

13. Conscientization programmes on Insurance literacy to be done

    It is felt necessary to educate youth and adults on the importance of pursuing insurance as a secure step in ensuring financial security to their assets. It is essential to make people aware and recognize the role insurance in protecting wealth and valuable belongings. People should be made aware of their insurance rights even before and after flood, so that they can avail the flood insurance and like coverages.

14. Construction and Rebuilding should be done in a varied format in tune with climatic and environmental conditions of places

Ravi Chander, a Bengaluru-based activist for proper urban planning, said rebuilding efforts should not involve repeating some of the same mistakes. "It is important to respect nature's lines. Do not build along the valleys, contours and the low points. We should also learn not to repeat our mistakes and build houses in the same area where they have been affected, because they interfere with nature's path,"

15. Sustainable development should be planned and implemented

    To establish an environment that fosters sustainable development, it is imperative to include flood management strategies in the development processes. Capacity building activities are to be planned and implemented.

16. Village Disaster Management Plan to be done-before, During and After the disaster

    The village level activities of risk and disaster management to be well planned and strengthened at any cost and should be equipped in all means for a better management before, during and after any disaster.

17. There should be well coordinated communication among different sectors of government for the successful implementation of the plan.

    It is seen that various government departments are functioning as watertight compartments. There is no communication and coordination among the departments which ultimately results in heavy workload or no work progress to the society. Correct information is not being transmitted to people. To avoid misconceptions and get clarity of information, there should have well coordination among the departments.

18. Rehabilitation Centers should not be the Schools

    Rehabilitation centers should not be in a school or educational institutions since students are missing their golden time for education even though they are not the direct victims. Whenever a disaster happens or any other public occasion like Election and all, we always point out educational institutions as the centers of work. If one or two days or at least for one week, it would be considerable. But, more than that, as policy implementers, we do total injustice to the students as they miss a lot unknowingly. Time once lost means, lost forever. Even though, the lessons and portions will be cleared afterwards, it cannot do justice to students. Students may enjoy the holidays. But, as responsible elders, it's our duty to protect their rights. Hence government should take initiative to start permanent rehabilitation centers which some other states possess.

## CONCLUSION

The responsibility of reconstructing and rebuilding an achieved and progressed State through commitment and hard work is not an easy task. It is a huge responsibility upon the government. As sensible citizens of the state, we all can share the task with sincerity and futuristic vision. Kerala has achieved great positions, especially in educational field. The characteristics of an educated society should be revealed and reflected upon our actions. Thus let our actions become intellectually mature, socially committed, spiritually inspired, culturally awakened and innovative in all means for the fulfillment of the dreams of around four crores of people of our Kerala. Let it be a role model to others so that they can follow our unity of strength and ideas. This holds equally true for rebuilding Kerala with the additional goal of people-centric adaptation.

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# REBUILDING KERALA: MODEL HOME

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Abstract - Rehabilitation of the flood hit areas of Kerala is undertaken by the technical community of the state along with government and other non-governmental organizations. The rebuilding process cannot be limited to the construction of buildings, roads and other essential amenities. The sustainability of the complete resurrected system has to be ensured in this process, where the individuals should be able to find their livelihood. The provision to sustain in an isolated state can be cultivated at last in a community system for food, water and energy.

The history of any civilization starts within the success story of community living. The most urban like system prevailing in Kerala leaves even more vivid evidences for this concept. But, the urbanization and the cultural changes have made each house, a single unit. In this scenario, the rebuilding should be done keeping in mind, the networking of all resources including the essential amenities.

## I. INTRODUCTION

The rebuilding process of Kerala is being done in a wider scale, through several agencies. The process has to be undertaken in three different dimensions i) construction of sustainable environment friendly long lasting houses ii) provision for environment friendly sustainable energy resources and iii) train every earning member of family to involve in sustainable income generating procedure. The housing methodology include the preparation of sustainable water resources procurement and maintenance. The proper sanitation and drainage are also treated as a part of the same. The self-sustainable system of a single unit(house) can be further improved by group forming, colony supply of water and waste disposal. This can be easily done by means of biogas or biomass solutions and waste treatment, which are not affordable otherwise.

### II.1 SUSTAINABLE CONSTRUCTION TECHNOLOGY

The proposed Design also aims at conforming to the Building Regulations and Mandatory Norms yet delivers in its promise to improve the living/working conditions of the user group. The preliminary design stages comprised a study into the local architectural character of the region, Materials, Climatology, Various Site Conditions, Adaptive Technology and how to improve the present living conditions of poor/flood victims. The typical local architectural character mainly comprises single storey detached houses composed of either brick, hollow concrete blocks with timber raft tile roofs which are either pitched or hipped in form. with a climatological component of tropical behaviour with high humidity during monsoons, the average precipitations of 165 millimeters, the nature of the climate requires adequate ventilation and shading from the sun and rain. Incidentally the traditional architecture of Kerala utilized passive solar design with regards to form and with ingenious use of traditional materials like laterite, brick, timber and terracotta.

The water pressure after the devastating flow throughout the state due to the continuous heavy rain has opened the research among the structural engineers to develop different construction methods. The method should provide structural stability to face the risk of flood and earthquakes. This gave rise to the concept of designing homes as a strong unit from foundation to roof. This concept has been developed by several teams [1]. The suggested foundation can be grillage in nature which certainly has latitude and longitude network connectivity helping the unity. This is only way to safeguard the houses from earthquakes, landslides and other natural calamities. The deep excavation of soil and the very expensive pile foundation procedures can be avoided while ensuring the safety.

### II.2 ENERGY RESOURCES

The solar energy is utilized in the most efficient way for the maximum light / heat energy during the day time. The grid energy is also made use of, since the reliability is to be maintained. Housing system should have uninterrupted supply of power from renewables. Solar panel is provided at the roof top of the building to harvest electricity from solar. The energy storage hour is limited to reduce the battery size. This leads to cleaner and healthier energy usage cycle. Since the grid energy

is used only as an alternate energy source for working heavy motors, the total electricity bill will not be considerable for consumption up to 300 units. This will save from the wastage of money also.

DC equipment are used to improve efficiency and reduce losses. Since the power extracted from the solar PV is in dc, it should be converted into ac for utilization. Since inverters have to be used to convert dc into ac, it can cause conversion and switching losses [2]. In addition to conversion cost and losses, over half the solar power is lost before it reaches the load. 62% of domestic load is comprised of ceiling fans and lighting. With the advent of Brushless DC(BLDC) motors a dc powered ceiling fan consumes only 40% of the power consumed by conventional ac powered induction motor based ceiling fans [3-5]. Similarly, conventional ac powered compact florescent lamp lighting is being replaced by light emitting diode(LED). If the solar power is directly delivered to the load without inverters we can achieve much higher efficiency than that of using inverters. Excess power will be utilized for charging the battery which can be used for critical loads when no solar is available [6].

Utility is already borrowing 70% of the required power from outside sources. They are bound to supply the underprivileged with quality power. If solar can reduce the burden (both technical and financial) of the utility, the deficit power availability can be met to a certain level. The state government can use the result of the project for further implementations.

### II.3 SUSTAINABLE LIVELIHOOD

Once the house is completely finished and the electricity is supplied with complete reliability, the family should be supported with a sustainable income earning livelihood

This is to be done with a clear understanding of the surroundings. The survey of the educational background of all affected people, the availability of raw materials in the area, their local market nature, the market requirement etc. The complete analysis gives the product that can be developed and identify the ideal community to handle the unit. The technical training is to be provided to initiate them in facing any complication in the process.

The agencies can also extend the support to finding the market. The assistance is to be provided till the breakeven point is reached.

The beneficiaries are to be made responsible for maintaining the complete sustainability by means of agreement with agency doing the rehabilitation and the beneficiary. The social setup in the state of Kerala makes it essential to do the multidimensional rebuilding work, since the people here will not be ready to face such a calamity as in August 2018.

## III. CONCLUSION

The Model Home Project aims to rebuild and rehabilitate the people at affected area at the earliest. Rather than using an existing system it will be beneficial to move on to greener environment friendly construction and power generation. Social and economic benefit of this would be far reaching as it is sustainable and environment friendly.

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# SELF-SUSTAINING HOUSING: REBUILDING KERALA

## "Purposeful use of technology"

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Abstract - As we know Kerala have been worst-hit with the flood of the century. The devastating flood took away more than 400 lives and more than 220,000 became homeless. More than 14.50 lakh people are displaced and taken shelter in relief camps. Flooding and landslides have caused significant damage to roads and infrastructure across the state. The current scenario of Kerala in which thousands are homeless where 'Advance in Modular construction' finds to be a proper solution instead of conventional methods as it swifts the construction process and making it ready for occupancy faster with lesser site disturbances as the workers access the site for a little period of time and with a lesser project cost.

Keywords - conventional, modular, sustaining

### I. INTRODUCTION

The construction industry is continually changing and evolving, but more builders are beginning to adopt modular construction to its range of benefits. New methods of construction are being developed every year, innovative materials are being used in production, and new ways of doing business are appearing. As the world becomes environmentally conscious and the construction industry becomes increasingly competitive, alternative sustainable methods should be chosen instead of traditional processes. Modular construction Techniques are gaining popularity nowadays due to its relevant features. It reduces construction cost, sustainable and a house can be constructed within very short period than conventional methods. This type of construction involves creating the structure in sections off site and importing it to the site and installed. Many areas of Palakkad district did not witness flooding after 15 August, when rest of the state did, the inundation on 8 and 9 August had destroyed almost 300 houses in the town and adjacent areas. A total of 10,000Kms of public road and thousands of houses including multi-storied are damaged and a lot houses were completely destroyed.

Out of these, the damaged houses can be repaired but the completely destroyed houses should be rebuilt. Homelessness is a large problem and creating an adequate shelter to protect these vulnerable individuals is a daunting task. In this case a solution instead of following conventional methods is, to make a Self-sustaining Housing Apartments for a group of families.

In the areas like Paravoor near to Kochi were only few houses are completely destroyed; self-sustaining green houses can be built using above said modular construction technique along with the conventional foundation.

### II. DESCRIPTION

The wall is made from precast frames made from gypsum panel with cavities, which is later filled at site. It is designed in such a manner, which consists of three layers. Since the inner and outer layer is exposure to environment, it is made with glass fibre reinforced gypsum. The middle layer or the cavity consists of crushed plastic chips (made from waste plastics) blended with mud and cement mortar and it is reinforced with treated bamboo. A well planned process can change this to an efficient, cost-effective construction. As we know that gypsum a byproduct of many fertilizer industries, has been accumulated as waste in tones daily. It can be used as a useful construction material. The material is treated with various chemical and waterproofing agents so as to retain with maximum strength and to adapt with the situations.

### WHY CAN'T WE DESIGN FOR A SUSTAINABLE FUTURE?

In this current scenario it is adequate to design for a sustainable housing in Kerala, but how can a government create affordable permanent housing solutions for these homeless by using conventional methods of construction without putting a

financial strain on their available funds.

Advance in Modular construction' finds to be a proper solution instead of conventional methods as it swifts the construction process and making it ready for occupancy faster with lesser site disturbances as the workers access the site for a little period of time and with a lesser project cost. In some areas a lot of houses has been washed away by the flood and in such cases, instead of following conventional methods is, to make a Self-sustaining Housing Apartments for a group of families in a plot which is a flood-free area for those, who lost their houses and has no land to build a new home.

Self-sustaining housing apartments made through Modular construction can save money, time and space by the government. A team of engineers and specialists under the guidance of government can directly assists the construction process and can complete it faster.

Fig. 1 Picture representing self-sustaining apartments

As in the case of housing apartments many blocks can be constructed from the factory and finally it can be installed at the site as in the case of modular construction. Three storied apartments can be built and can accommodate maximum blocks. In the areas like Paravoor near to Kochi were only few houses are completely destroyed; self-sustaining green houses can be built using pre-fabricated GFRG panels which is installed at the site with conventional foundation.

Fig.2 Self-sustaining house models

These houses are built with carpet area of 430-500 sq.ft. which meets the needs of a family. It can be built with half cost compared to conventional method. In mass construction, it costs 1000 INR per sq.ft. So a house of 400 sq.ft. can be completed with 4 lakhs which is already sanctioned by the government. It includes a kitchen, a master bed room, a central hall, toilet and a stair room for future expansion or a bed room (as per requirement).


Fig. 3 Plan of a Self-Sustaining house with an area of 430 sq.ft.

In flood prone areas, construction of houses should be controlled and if no other way consider the maximum flood level. The single blocks or the apartments can be built above columns made out of steel or concrete depending upon the conditions.

Fig.4 Self-sustaining housing apartments built above columns

Since the blocks are lighter, columns with minimum sizes are needed and these ground floor areas can be segmented into

parking area, a central tank for rain water harvesting system were the rain water is collected from the roofs by providing appropriate channels, which is filtered and can be used for toilet flushes and for washing purposes in kitchen, and the remaining area is used for planting vegetation and a separate area for bio-gas plant in which all the bio wastes can be effectively converted into energy for cooking.

In flood-free zones, above the conventional foundation a plinth beam is made and the GFRG panels are placed over it.

GFRG panels have hollow spaces and depending on the load above the wall, the hollow space in the panel is filled with suitable materials. Reinforcing bars extending from plinth beam passes through specific sections made in the wall frame and then filling these with concrete can also make this structure framed.

This framed nature makes the building resistant to flood, earthquake forces and wind loads. Since the thickness of this wall is about 15 cm, which is lesser compared to 2 layered brick and laterite walls, carpet area also increases.

We can also implant solar panels for the roofs of every houses so that energy can be saved and it should be made mandatory so as to save energy.

The presence of mud-cement composite in the cavity provides a cooling effect inside the house.

These makes it self-sustaining housing project.

## III. CONCLUSION

Advance in Modular construction is beyond the limits of low rise residential and commercial construction structures. The time required for construction is also reduced as finished products are obtained from the factory, which only have to be installed on site. Hence, the need for temporary sheds for labours and the labour cost is again minimized which reduces the overall project cost. It generates less waste on site because the building elements are developed in the factory and transported to the site for their final installation only. As this technique saves time, it can be used for disaster management such as floods, earthquakes, hurricanes, and other calamities that require emergency shelters. Generally, it is too difficult to reuse or recycle the components or parts of a demolished structure, but in this technique the modules are designed to be Reused or Recycled which is truly innovative and sustainable. Considering today's labour cost, material cost and availability of materials like sand this method of construction will be efficient, cheaper and consistent.

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# New Pedagogy demands for Indian Higher Education System.

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Abstract: It is a well acknowledged fact that innovative research plays an important role in the overall development of a country. Research refers to the systematic investigation of a specific problem, concern or issue using scientific methods and reaching new conclusions. The research in the context of education may be referred to as, solving educational problems in a scientific and systematic way. Based on some facts published in various education institutions government and non-government agencies around the world, I am trying to give an outline to tune our pedagogy in higher education as per the new technologies and job demand forecasts.

**Keywords:** economic growth, higher education pedagogy, job skills, employable graduates.

In India, the prestigious institutions of national importance and repute are doing excellently well in research and development activities. The Indian Government has taken a number of steps to promote educational research. For example our current Indian Prime minister's maiden Independence Day message, clearly pointed out the 'make in India' program, mainly aimed at our country becoming a global leader. He recommended that, international technological players need to set up their manufacturing bases within the country so that the country benefits not only in terms of technology availability and revenue, but also would provide a way to leverage our skilled manpower. Innovation is crucial to the continued economic progress of any country and will add improvement to the quality of life as well.

In India the services and manufacturing sectors will play a dominant role in the economic growth [1, 2]. Building a culture of research, innovation, and entrepreneurship would enable high economic growth of the country. This means that new innovations will need to drive the next phase of economic growth. These global and domestic economic changes will require a significantly increased number of sophisticated workers, innovators, and thinkers who can thrive in an advanced and technologically connected world.

As per FICC higher education report [3], the global economy is undergoing structural transformation and there will be a need of a workforce of 3.3 billion by year 2020, increasingly in the services and capital intensive-manufacturing sectors. The phenomenon is also expected to play out in India. By 2020, 90% of India's GDP and 75% of employment is expected to be contributed by the services and manufacturing sectors [4]. This certainly will require the workforce to have appropriate educational qualifications and adequate skill set adept to the changing demands of the marketplace.

As per MHRD, we have 677 universities in India. Out of these, there are 45 central universities, 328 state universities, 185 state private universities, 129 deemed to be universities. 51 institutions of national importance and the number of colleges were 37204 as on 31st March 2013. This shows that the Indian higher education system has made considerable progress in terms of capacity creation, knowledge base and enrolment. However; it lags significantly in terms of global relevance and competitiveness. I believe that the key gaps are attributed to low employability of graduates, which is mainly driven by several factors including out-dated curricula, shortage of quality faculty, high student-teacher ratio, lack of industry-institutional interactions and linkages, and lack of autonomy to introduce new and innovative courses as and when needed.

It has been reported by many studies that [5, 6, 7], there is an urgent requirement of a highly skilled and innovative workforce to cater to the rising need for labour in manufacturing and services as well as to cater to multinational enterprises. It is high time to create and develop a globally relevant and competitive higher education system that can produce competent and

skilled graduates. The main area where Indian educational firms need to explore more is to nurture creativity and imbibe out-of-the-box thinking.

There are several reports that reflect that the Indian higher education institutions are not producing candidates competent enough for research and innovations. For instance, the QS (Quacquarelli Symonds) 2018 rankings [8] feature only 20 Indian institutions and THE (Times Higher Education) [9] ranks 42 institutions, while ARWU (Academic Ranking of World Universities) 2018 rankings [10] feature only one institution from India, the Indian Institute of Science, Bangalore (IISc), that too ranked between 301– 400.

The significant weightages given for world ranking of universities are innovative research, citations of publications and patents [11]. Unfortunately most of the Indian institutions are lagging behind in all these resulting in performing poorly in these university rankings. It is reported that even though there are some exceptions, ranking are not a priority for most of the Indian institutions. Another reason for poor ranking noted is the limited number of PhDs, limited international outlook and less international collaboration.

Situations are progressively changing and recent news shows that new collaborations have started between Indian educational institutions and foreign universities. Institutions have realised the relevance of cross border knowledge exchange. These collaborations are highlighted in the institute's websites. For example IIT Madras has been included as a participant in the CMS experiments of CERN [12]. Another example worth mentioning is that Amrita viswa vidyapeetham has many foreign university collaborations for full-time and part-time student exchange programs, dual-degree masters programs, study abroad programs, internships, summer school programs, and joint PhD programs [13].

Other areas in which Indian universities are lagging are, relatively low research output publications, less number of patents filed per year [11], insufficient number of doctoral/ post-doctoral students, missing research focus in education and limited funded research projects in emerging and demanding areas. Now it has been seen that the government has recently started taking adequate steps to invest on research and entrepreneurship.

New encouraging trend is that technical educational institutions are giving emphasis and directive to encourage innovations and entrepreneurship among students [14] and the government is extending their help for this move as well. We should understand and appreciate very well that, a very vibrant entrepreneurial system; research and innovation can incubate and develop new ideas and businesses that can empower the economic growth and job creation in the country.

According to an employability assessment company, Aspiring Minds, 2018 reports [15], there would be tremendous progress in the areas of artificial intelligence, machine learning and robotics and a new momentum for automation around us. It is true that the automation of tasks results in the increase of process efficiency by improving quality and speeding up processes simultaneously with the added advantage of resultant reduction in prices. This leads to increased demand of improved, cheaper products and services which further leads to more production resulting in creating new opportunities of employment of a different nature. This is a new cycle in itself resulting. This inference is not neglecting the fact that automated production may have left some people out of conventional jobs, but it can definitely create new jobs in revolutionary innovative cutting edge segments and traditional domains like sales, marketing and operations, with newer positions, requiring a different skill set.

Hence it is certain that there must be changes needed in academic curriculum and pedagogy not only on new age technologies but also to focus on cognitive and soft skills as communication skills, interpersonal skills etc., which lead to producing candidates who are excellent team players with excellent problem solving, critical thinking numerical ability, information gathering & synthesis (IGS) and emotional intelligence from an early age. Skills of highest demands in India are, English comprehension, deductive reasoning, inductive reasoning, agreeableness, information gathering and synthesis, extroversion, emotional stability and quantitative ability. English Comprehension has topped the chart with 100% demand, among all other skills [16].

Communication in the English language has become an important part of the knowledge economy and employees are expected to be competent in this skill, irrespective of the sector in which they work. It is only the level of proficiency that varies from one job to another. These soft skills are making a student more trainable to be able to take up newer challenges and make them ready to take. Jobs that cannot be automated but are of high demand like creative and strategic thinking, people management, data analysis, marketing, human resource management, training & development and project management in various domains.

Another area in which we need to focus is the computer programming ability of the students. As per the study done by Aspiring Minds, only 4.77% of engineering students can write the correct logic for a program, which obviously are the minimum requirements for any programming language. The above mentioned skills are not only applicable for young budding undergraduate students but also equally important for working professionals. This gap can be bridged by undertaking training and development programmes to enhance their

current skills and building new demanding skills as well.

Another area we have to give importance is internship and apprenticeship for our students. National web portal for apprenticeship training and board of apprentice training under MHRD are doing efficient implementation on the same. Both apprentice and internships programs bring cost effectiveness for employers along with trained high quality employees. The trend shows the employers are much more likely to hire someone with internship or apprenticeship than those who do not. Ample evidence is 89% of employable workforce now needs young graduate trained either through internship or apprenticeship compared to 69% in previous year.

In India, one such gap is the lack of information about the job availability by the industry in a particular region and the appropriate relevant skills required for the same [17]. Such regional segmentation of jobs by region would be of great benefit for both job seekers and educational institutions by knowing potential skills and their demands across India. Similarly, the training institutions and stakeholders need to understand what is required by the industry in their state and across India. Such insights will give a fair picture to the job seekers about which skills correspond to more jobs and in which state can they utilise those skills to a greater extent. For a large diverse country as India, such segmentation by region and building skills specific to that would work wonders. This would help overcome two major doubts among job seekers, i.e.

1. Which skills should I garner to find employment in a particular state?

2. In which states and union territories can I most easily find job for a given skill set that I possess?

So finally I would like to recommend that the education institutions and training institutes can fine tune their curriculum and pedagogy as per job and skill demand so that to design a better industry program and could cut down the gap between the industry and the institute resulting in more employable candidates.

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