FFQ: FIRE, FLOOD AND EARTHQUAKE ALARM SYSTEM

Marielle Jane Cinco, Remington C. Cruz, Lauro Bartolome III, and *Elyca Tolentino,*
Adviser: ***Rowell Santos***

Abstract

The common natural calamities are fire, flood and earthquake. The mentioned calamities have taken a lot of lives due to the lack of immediate response. It is happening not just in the Philippines but from all over the world. The researchers conducted a research in the barangay of Marungko, Angat, Bulacan specifically to know the common problems that common occur when it comes to natural problems regarding fire, flood and earthquake. Even up to this day, the Philippines continues to experience a disastrous fire, flood and earthquake. The FFQ Alarm System is a device built for the houses of the Brgy. Marungko to alert the said barangay whenever there is an incident of the said disasters. This system will send a text message to the barangay hall of Marungko to alarm the authority of the barangay that the people with this system need help from them.

Keyword: Alarm system, fire, flood, earthquake

According to IFSEC Philippines, they recorded a total of 77, 724 fire incidents in year 15,545 fire incidents every year of 42 fire incidents in 2013 to 2017. The total estimated damage to property reached P23.273 billion or an average of P4.65 billion every year while the death during that period is 1,257 or an average of 251 every year.

There is no definite time when will an earthquake occur, that is why preparing for an earthquake could lessen the casualties. The relief web stated that the year June 2019,

at least 143,000 people were still displaced. Some of the people who survived the earthquake is still staying with their relatives. The government only have 48 evacuation centers in Region XI and XII open and according to the Philippine Institute of Vocanology and Seismology (PHIVOLCS), the 6.3-magnitude earthquake occurred in Cotobato in Mindanao causing 7 deaths and 215 injured.

Flood hits different than earthquake because flood is happening often than in earthquake. The past couple of years the level frequency of flood continues to rise albeit due to the weather worsening and bad sewage management. This problem arises not only in rural but also in urban areas. But with technological advances the researchers can tackle this problem more efficiently.

"The Internet of Things is a worldview where ordinary articles can be outfitted with recognizing, detecting, systems administration and preparing capacities that will enable them to speak with each other and with different gadgets and administrations over the Internet to achieve some target. Eventually, IoT gadgets will be pervasive, setting mindful and will empower surrounding insight. This article covers the ebb and flow condition of research on the Internet of Things by inspecting the writing, distinguishing momentum patterns, depicting difficulties that compromise IoT dissemination, exhibiting open research questions and future bearings and gathering an extensive reference rundown to help analysts" by Whitmore A., Agarwal A. and Xu L. in The Internet of Things: a survey of topics and trends (2015).

Moreover, this project is a critical task that will ensure the safety of the people. Especially that no one knows when a natural disaster like fire, flood and earthquake will happen. If could prevent the feeling of being anxious to the people.

This proposed project, FFQ Alarm System, automatically sends SMS notification to the barangay of Marungko, Angat, Bulacan, whenever the certain house need help or rescue from the barangay. The SMS that the device will contain are the type of disaster, name and address of the household, together with the corresponding date and time. This alarm system mainly focuses on the safety of the people on the area that had incident of the said three disasters, the Barangay Marungko. They could expect the substantial benefits from this project because of the convenience and safety it gives.

Project Context

The project seeks to integrate an innovative "FFQ: Fire, Flood and Earthquake Alarm System, the system will alarm the barangay whenever a house with FFQ needs help. There will be a sound alarm for the house and after, the system will automatically send a text message using SMS notification in the barangay that they need help. The proponents proposed are Fire Detector it has smoke detector when it reaches the volume of the smoke it will automatically alarm and send a text message. Flood Detector it has flood level indicator it will alarm when critical level was hit. Earthquake Detector it has accelerometer that will identify the movement of the ground when it reaches the level of movement it will automatically alarm.

The main objective of this study is to introduce a fire, flood and earthquake system, to help the citizens be prepared and knowledgeable whenever there is fire, flood and earthquake.

Objectives of the Study

The main objective of this project is to create a technologically advanced fire, flood and earthquake monitoring device that can alarm and send SMS notification regarding for the safety of the people in their barangay.

Specific Objectives:

The following are the objectives of FFQ: Fire, Flood and Earthquake System:

1. To prevent fire in their household.
2. To detect the critical level of water.
3. To response immediately the authority of Barangay Marungko.
4. To send text message using SMS notification to the Barangay Marungko, Angat, Bulacan.

Scope and Limitation

The FFQ Alarm System can detect the danger of one's household. The device will detect the smoke if there is a fire, the water level for flood and the seismic activity for the earthquake. For fire detection, the device will detect the smoke and when the smoke detector was exposed in a certain amount of time the device will send an emergency message to the barangay. This will also be applied in flood and earthquake detector. When the water reaches the level where it could endanger the lives of the people in the house, the device will send an alert message to the barangay to ask for help. Lastly, the earthquake detector will be based on the magnitude of the ground if they will need help.

Using HTML, the owner of the device should register its house to collect its data. In this way, the device will have a record of the house address and it will be easier for the device to send SMS notification to the barangay. The SMS that the barangay will receive will contain the name, address, type of disaster that the family is experiencing. This device will be using an adapter for its power source.

This device cannot: identify the level of fire, flood, and earthquake. This cannot control the reduction of fire, removing flood in the house or area, or lessen the damage for earthquake and remind the owner before the incident occurred.

Significance of the study

The result of the study could benefit the following:

Residents of the Barangay Marungko, Angat Bulacan

This project will help the residents of the barangay to lessen the possible casualties during the disaster. The safety of the residents will more likely to be secured.

Barangay Officials

This could help the barangay officials to be more cautious. The officials could respond immediately to the residents who needs help.

Future Researchers

This project will help the future researchers to enhance what the current researchers has done. This study will help the futures researchers to be innovative and to enhance their knowledge and skills that could prepare them to be globally competent.

Related Literature

Based on the article of Sachin Kumar, Prayag Tiwali and Mikhail Zymbler (2019), described the Internet of Things (IoT) as the "new paradigm" that lead people to a more high-tech lifestyle. It enables the communication between devices and sensors. In whole IoT, is an innovation that puts extensive variety of smart systems, frameworks and intelligent devices and sensors. The security, assurance, and interoperability can make the novel innovative plans more utilized.

As said by Carsten Maple (2017), there has been a rapid growth in the number of devices connected to the internet. Cisco and Erickson in particular, have predicted that in year 2020, there will be 50 billion devices connected to the

internet. Whilst there are not consistent figures for the number of connected to the internet, it can be seen that the number of devices is enormous.

According to the article of Sridhar Iyengar (2020), to enhance the human productivity and efficiency, the Internet of Things (IoT) is all about machines and systems together via sensors and actuators were collecting this meaningful information. This technology trend is leading the people for a cleaner environment, productive and a better quality of life the particular reason for circumstance is that IoT reduce wastes, costs and inconvenience while increasing efficiency.

As stated in the article of Mahar A., Lagmay F. and Racoma B. et al. (2017) the Philippines being a locus of tropical typhoons, tidal waves, seismic tremors and volcanic emissions, is a hotbed of calamities. These common dangers cause loss of lives and expensive harm to property. Arranged in an area where atmosphere and geophysical storm is normal, the Philippines will definitely experience the ill effects of disasters like those accomplished as of now. Proceeded with improvement and populace development in peril inclined regions, it is relied upon that harm to foundation and human misfortunes would endure and even ascent except if proper measures are promptly actualized by government.

Center for Excellence in Disaster Management and Humanitarian Assistance (CFE-DMHA) (2018) expressed that Philippines is a country that has a high vulnerability to natural hazards which are attributed to the nation's geographic position in Southeast Asia. Flood, Fire and Earth-quakes are related to the continental plate activity around "Ring of Fire".

During fire prevention month, the Bureau of Fire Protection stated that during year 2017, there were total of 14,000 fires that occurred, killing 304 civilians, P7.8 billion worth of property. Based on their study, the top 3 causes of

fire in the country are faulty electrical connections, lit cigarette butts, and open flame from unattended stoves.

International Journal of Scientific and Research Publications, vol. 7 (November 2017) stated that the level of knowledge about fire disaster preparedness was low. The lack of awareness to fire disaster can result into a serious disaster. Men are more likely to be more knowledgeable than women when it comes to fire safety issues. Gaps in knowledge and misconceptions have a clear implication and reduce the potential to mitigate fire disasters. Based on studies, the people have poor attitude towards these types of knowledge.

As said by Che D. and May L. (2017) the use of a streamlining/reenactment model for the mimicked continuous flood control for waterway repository frameworks to the cataclysmic May 2010 flood on the Cumberland River at Nashville, Tennessee is depicted. The advancement/reenactment model incorporates five significant parts, including a hydrologic precipitation spillover model, a water driven temperamental stream model, a momentary precipitation estimating model, a supply activity model, and a hereditary calculation improvement model.

As stated in the article of Rahman M., Rahman A. and Chowdhury S. (2017) this examination has utilized a survey of the existence cycle of flood moderation extends, an audit of manageability evaluation procedures, meetings with specialists and contextual investigations including two flood alleviation extends in Australia.

According to Ghanbarpour M.R, Saravi M. and Salimi S. (2014) the outcomes have demonstrated that expressed WTPs essentially fluctuates with family unit pay, separation individuals live from the stream and the land use sort of properties. Discoveries of this investigation propose that most of respondents view flood peril as the most significant

cataclysmic event. Moreover, WTPs are altogether higher for the individuals who have elevated level of flood hazard recognition.

According to Tahir W., Jani J. and Endut I. et al. (2016) flood is a characteristic climate related fiasco as often as possible happening in Malaysia. Perhaps the best challenge that Malaysia faces today is perceiving the greatness of dangers presented by flooding. The general population, private and NGOs should ponder the measure of speculations required to lessen the flood chance, including making proper crisis arrangements, fortifying the current Standard Operating Procedures (SOPs), and finding new answer for limiting danger identified with flood catastrophe. The current existing SOPs show that there is still absence of all-encompassing flood chance administration framework to limit this issue. The nation ought to be resolved to set up a national approach on flood chance administration that requires viable, affordable, reasonable, and steady administration of flood hazard to individuals, properties, and networks.

Related Studies

As stated in the study of Azid S., Sharma B. and Raghuwaiya K. et al. (2015) environmental change because of a dangerous atmospheric deviation has caused an expansion in eccentrics of climate designs on the planet today. It has expedited colossal effect the high rugged icy masses bringing about enormous release of water. A worldwide temperature alteration has caused ascent of ocean levels because of softening of day off ice and with a regularly expanding normality of flood harm, a clear need has developed for an early notice framework for individuals in the locales considered to be 'at high hazard' from flooding. Elevated level of harm to properties and loss of lives are the fundamental factor in the improvement of such an early cautioning framework.

According to the study of Castro J., Badenas G. and Caldit W. et al. (2015) the low-lying geology, meteorological and hydrological states of the Metropolitan Manila makes it powerless against floods and tempest water. Different measures have been led for relief of flood and immersion harms, yet the waste issue is as yet one of the significant errands. Generally, Manila endured significant floods that happened in 1940's to 1980's. The flooding dispensed genuine harm over the past 50 years; these floods have turned out to be both progressively broad and increasingly extreme as experienced in ongoing tempests, for example, Ondoy and Habagat. So as to address the issue, distinctive designing works were used to give flood insurance and decrease flood harms. One elective flood control measure is the arrangement of impeding bowl with the end goal of decrease of the pinnacle release of flood.

As stated by Abon C., Kneis D. and Crisologo I. et al. (2015) this contextual analysis shows the absolute first endeavor to assess the capability of the new Philippine radar system to help streamflow recreation and gauging. For the early flood cautioning in the Philippines, it is of imperative enthusiasm to investigate whether the standard of climate radar perceptions and radar information handling is adequately high for a satisfactory portrayal of run-off procedures in circulated hydrological models. Specifically, we explore whether radar-based precipitation assessments can beat customary precipitation appraisals dependent on inserted downpour measure perceptions, as far as the decency of hydrological recreation results.

As mentioned by Dhonde K. (2016) Internet of Things (IoT) is a system of physical items or things that are inserted with gadgets, programming, sensors, and system availability - which empower the article to gather and trade information. Fast multiplication of IoT is driving the knowledge in things utilized day by day in homes, working environments and industry. The IoT gadgets regularly impart by means of radio recurrence (RF, for example, Wi-Fi and Bluetooth.

As stated in the study of Twumasiwaah K. (2016) floods are a genuine worldwide issue standing out and examine from the scholarly community, the media and other global talk. Subsequently, they turned out to be basic national issues particularly with African nations who come up short on the monetary assets and specialized expertise to relieve its effects. The Aboabo people group (a suburb of Kumasi), situated in the transitional timberland zone of Ghana has turned out to be powerless against the staggering impacts of flooding lately because of environmental change, exponential populace development, and quick urbanization. So as to turn around this pattern and reduce the weakening effects of flooding on this network, there is a requirement for the advancement of a flood hazard map which will frame the premise of any future flood the executives and arranging exercises.

As said by Rahmtalla A. and Mohammed A. (2015) PC based control framework likewise can be executed for streamlining a waterway flow management to limit flood brought about by water flood. The board can be performed based on height of water level on the waterway as an info information and control the conduits along the river stream dependent on this information.

According to the research of Prime T., Brown J. and Plater A. (2015) the UK is likewise defenseless to seaside flooding. A great recorded model is the North Sea tempest flood that happened in 1953 causing pulverization in the UK and mainland Europe, with the loss of more than 1800 lives in the Netherlands and 300 passing in east and southeast England. This demonstrated something of a 'tipping point' in seaside arranging, in light of this occasion ocean dividers were fixed and raised to expand the versatility of the nation to waterfront flooding. The Delta Plan in the Netherlands was set up and prompted development of obstructions over a few of its estuaries throughout the following decades. In 1953 numerous individuals did not know about their powerless-ness to tempest flood flooding and got no admonition,

implying that they were caught off guard for the floodwater.

According to Mendez J. (2017) the reason for this investigation is to build up a continuous flood checking and early cautioning framework for the northern segment of the area of Isabela, especially the regions close Cagayan River. This examination concentrates just on the water level identification and early cautioning framework (by means of site as well as SMS) that alarms concern organizations and people for a potential flood occasion. Besides, request framework is additionally remembered for this examination to turn out to be progressively intuitive wherein people in the network could ask the real water level and status of the ideal territory or area influenced by flood through SMS watchword.

Methodology

This chapter includes all the information gathered by the researchers for the project to integrate Internet of Things (IoT) by developing a system that will monitor Fire, Flood and Earthquake in their household and to notify barangay rescue via SMS notification.

Requirement Analysis

This section includes the analysis of the information that the researchers have obtained through their observation and study.

User Need Analysis

The researchers developed a project that will cater the concern of the barangay residents. A system will monitor the possible fire, flood and earthquake in their household and barangay rescue will notify automatically via SMS notification

Methods to create the project

The researchers first researched in the Barangay

about the said calamities. The researchers gathered data and conducted an interview on the Brgy. Marungko, Angat, Bulacan to get information about the incidents of fire, flood and earthquake and how frequent these events happen.

Requirements Documentation

This section includes the sources that are needed for the documentation that are acquired by the researchers through data gathering.

Source of Data

The researchers concluded an interview with barangay officials about the corresponding incidents related to fire, flood and earthquake. The researchers also made the project progressive through the use of the following source of data:

Internet

The researchers were able to obtain information on the scholarly articles through browsing the internet. The researchers utilized educational websites and e-books for further information about the project.

Conclusion, Interpretation and Discussion

The proponents used an evaluation form to assess the operational function of the IoT devices. Seventy (70) respondents were chosen to evaluate the proposed device.

The information gathered by the proponents from evaluation determined the overall performance of the proposed network. The information were tabulated, analyzed, and computed in order to get the totality of its results. It used fixed choices response format and designed to measure the network's effectiveness. The measurement levels range from excellent which is equivalent to 5 points,

very satisfactory which is equivalent to 4 points, satisfactory which is equivalent to 3 points, poor which is equivalent to 2 points, and bad which is equivalent to 1 point. The tabulation of data also includes the total number of votes, frequency, percentage, and the statistical means.

System Functionality

Question	E	VS	S	P	B
1. The device can be used as an alarm system for emergencies.	33	31	6		
2. The device can send alert notifications to the phone.	44	25	1		
3. The device can identify the smoke when there is fire.	40	29	1		
4. The device can identify the water level when there is flood.	40	25	5		
5. The device can identify the movement of the house when there is earthquake.	30	34	6		
6. The accuracy of the device.	42	27	1		

System User Interface (UI)

Question	E	VS	S	P	B
1. The device is easy for users to do what is required within the tool.	37	27	5		
2. The web server is user-friendly.	35	35			
3. The design of the website is appealing.	40	28	2		

System Reliability

Question	E 5	VS 4	S 3	P 2	B 1
1. The device can function in any environment.	54	16			

Continuation

Question	E 5	VS 4	S 3	P 2	B 1
2. The device is user intuitive.	46	24			
3. The device can be easily maintained.	50	19	1		
4. The device can help the residents.	48	20	2		
5. The parts of the device are durable.	45	23	3		
6. The device can be controlled easily.	55	15			

Based on the evaluation results gathered the system is reliable, functional and user friendly.

Conclusions and Recommendations

FFQ: Fire Flood and Earthquake Alarm System that can alert the authority when there is fire, flood or earthquake is a great help especially in a country like Philippines where due to storm and typhoons running rampant all year long, being at the center of equator and part of the Ring of Fire.

The researchers would like to recommend future researchers to improve the FFQ device by taking different approach such as visual studio-based interface where instead of HTML format they can use an .exe file type. The researchers would like to recommend future researchers to improve the FFQ device by having a web interface for it to be more user-friendly. For the instance where the location you want to place a FFQ device can work on houses and it would be beneficial for buildings and other establishment as well. Future researchers are allowed to use and to improve the FFQ device given that it will improve the features of the system.

References

Lee, K. (2015) *The Internet of Things (IoT): Applications, investments, and challenges for enterprises.* Indiana University. Elsevier Inc. from: https://www.sciencedirect.com/science/article/pii/S0007681315000373

Madakam S. and Tripathi S. (2015) *Internet of Things (IoT): A Literature Review.* India. Scientific Research Publishing. from: https://www.researchgate.net/publication/280527542_Internet_of_Things_IoT_A_Literature_Review

Souza A., Curvello A. and Souza F. et al (2017) *A flood warning system in critical region.* Procedia Computer Science. from: https://www.sciencedirect.com/science/article/pii/S1877050917311353

Whitmore A., Agarwal A. and Xu L. (2015) *The Internet of Things: a survey of topics and trends.* Information Systems Frontiers. from: https://link.springer.com/article/10.1007/s10796-014-9489-2

Kundzewicz Z., Kanae S. and Seneviratne S. et al. (2014) *Flood risk and climate change: global and regional perspectives.* from: https://www.tandfonline.com/doi/full/10.1080/02626667.2013.857411?src=recsys

Brooks G. and George S. (2015) *Flooding, Structural Flood Control Measures, and Recent Geomorphic Research along the Red River, Manitoba, Canada.* Canada. from: https://link.springer.com/chapter/10.1007/978-1-4939-2380-9_5?fbclid=IwAR2D1XTu_orjE4Oid0pl0PaTN0Sd1yVu-6g-OyGJwEw60Wqc_Nw4109u87w

Che D. and May L. (2017) *Application of an Optimization/ Simulation Model for Real-Time Flood-Control Operation of River-Reservoirs Systems.* USA. from: https://link.springer.com/article/10.1007/s11269-017-1644-3?fbclid=IwAR1mMSGzi4pYReByQGdU1SFtQCP7rOS2KfJS8Dkvi6t8Va_UoVuXIWTUuow

Rahman M., Rahman A. and Chowdhury S. (2017) *Sustainability assessment of flood mitigation projects: An innovative decision support framework.* Griffith University. Australia. from: https://www.sciencedirect.com/science/article/pii/S2212420916307026?fbclid=IwAR2N4UbBeCy9T-icfmG073qX-g2o3Tqfo8fwXatgBNAjNx8RWWWvOjk1E90

Ghanbarpour M.R , Saravi M. and Salimi S. (2014) *Floodplain Inundation Analysis Combined with Contingent Valuation: Implications for Sustainable Flood Risk Management.* USA and Iran. from: https://link.springer.com/article/10.1007/s11269-014-0622-2?fbclid=IwAR0UrdPzYNgkxpB7chUwsBa_o-2G2JmoZNGONLI68TfEbVD6VpF2qMQzmVs

Castro J. , Badenas G. and Caldit W. et al. (2015) *Study on Flood Control System Introducing Storage Tank in Manila City Hall Area.* Adamson University. from: https://www.researchgate.net/publication / 278968140_A_Study_on_Flood_ Control_System _Introducing_Storage_Tank_in_Manila_City_Hall_Area

Prawiranegara M. (2014) *Spatial Multi-criteria Analysis (SMCA) for Basin-wide Flood Risk Assessment as a Tool in Improving Spatial Planning and Urban Resilience Policy Making: A Case Study of Marikina River Basin, Metro Manila – Philippines.* Ministry of Publick Works. from: https://www.sciencedirect.com/science/article/pii/S1877042814042475

Abon C. , Kneis D. and Crisologo I. et al. (2015) *Evaluating the potential of radar-based rainfall estimates for streamflow and flood simulations in the Philippines.* Philippines. from: https://www.tandfonline.com/doi/full/10.1080/19475705.2015.1058862?

scroll=top&needAccess=true

Mahar A., Lagmay F. and Racoma B. et al. (2017) *Disseminating near-real-time hazards information and flood maps in the Philippines through Web-GIS.* National Institute of Geological Sciences. University of the Philippines. from: https://www.sciencedirect.com/science/article/pii/S1001074216314693

Dhonde K. (2016) *A Dissertation in Telecommunications and Computer Networking And Computer Science.* University of Missouri. Kansas City. from: https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/61363/Dissertation_2016_Dhondge.pdf?sequence=1&isAllowed=y

Rahman S. (2014) *IMPACTS OF FLOOD ON THE LIVES AND LIVELIHOODS OF PEOPLE IN BANGLADESH:A CASE STUDY OF A VILLAGE IN MANIKGANJ DISTRICT.* Bangladesh. from: http://dspace.bracu.ac.bd/bitstream/handle/10361/3802/13168004.pdf?sequence=1

Twumasiwaah K. (2016) *URBAN FLOOD RISK MANAGEMENT: A CASE STUDY OF ABOABO,KUMASI.* Kwame NkrumahUniversity of Science and Technology. Geomatric Engineering Department. from: http://ir.knust.edu.gh/bitstream/123456789/10343/1/THESIS-WORD.pdf

Rahmtalla A. and Mohammed A. (2015) *REAL TIME WIRELESS FLOOD MONITERINGSYSTEM USING ULTRASONIC WAVES.* TianJin University. from: https://www.academia.edu/34443185/REAL_TIME_WIRELESS_FLOOD_MONITORING_SYSTEM_USING_ULTRASONIC_WAVES

Prime T. , Brown J. and Plater A. (2015) *Physical and Economic Impacts of Sea-Level Rise and Low Probability Flooding Events on Coastal Communities.* from: https://doi.org/10.1371/journal.pone.0117030

Mendez J. (2017) *Flood Monitoring and Early Warning System using Ultrasonic Sensor*. Lorma. from: https://research.lorma.edu/xmlui/handle/123456789/68

Beven K. and Hall J. (2014) *Applied Uncertainty Analysis For Flood Risk Management.* World Scientific. from: https://books.google.com.ph/books?id=rdC3CgAAQBAJ&source=gbs_navlinks_s

Tahir W. , Jani J. and Endut I. et al. (2016) *Flood Disaster Management in Malaysia: Standard Operating Procedures (SOPs) Review.* Malaysia. from: https://link.springer.com/chapter/10.1007/978-981-10-0500-8_3

Azid S. , Sharma B. and Raghuwaiya K. et al. (2015) *SMS BASED FLOOD MONITORING AND EARLY WARNING SYSTEM.* The University of the South Pacific. Suva, Fuji. from:https://www.researchgate.net/profile/Bibhya_Sharma2/publication/283101853_SMS_based_flood_monitoring_and_early_warning_system/links/5c3bfd3892851c22a3735e66/SMS-based-flood-monitoring-and-early-warning-system.pdf