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Short Paper

Personal Emergency Alert Device Containing Real-Time Location

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Abstract

Purpose – The purpose of this study is to develop a Personal Emergency Alert Device Containing Real-time Location which can be used by anyone particularly women and children who need help especially in times of emergency.

Method – Arduino Nano, Global Positioning System, and Global System for Mobile Communication were utilized as the main components of the device, which was evaluated in the aspect of appearance through its size, weight, product design, casing, and functionality through its accuracy in displaying information, text messaging capabilities, and location tracking. In order to optimize the product's specifications, it underwent assessment and evaluation by experts in the field. The study used product development design. There were twenty (20) respondents in total, comprising of five (5) Electronics Engineer and fifteen (15) Electronics Engineering students who were selected using purposive sampling techniques. The responses were gathered from the students by handing out questionnaires, which were eventually tallied, tabulated, processed and treated using statistical treatment.

Results – The structure of the device is excellent. The product also passed the evaluation of the expert respondents in terms of functionality since it is excellent in accessing the information, delivering the right information, and finding exact locations. The device is thus functional as it serves its purpose.

Conclusion – The structure of the device is excellent. The product also passed the evaluation of the expert respondents in terms of functionality since it is excellent in accessing the information, delivering the right information, and finding exact locations. The device is thus functional as it serves its purpose.

Recommendations – It is recommended that the product developers should reduce the device size. They should also ensure that the casing and design are attractive to make the device noticeable. Moreover, to further improve the functionality of the device, product developers should track the exact location instead of coordinates. They should also consider which cellular network works best for different places. Lastly, to augment the results and findings of this study, further research undertakings on this topic should be conducted.

Research Implications – The users of this product can help summon assistance in case of emergency.

Practical Implications – Anyone who is experiencing emergency cases will just press the button for them to be tracked and be saved.

Keywords – Emergencies, location, text message, Arduino Nano, global positioning system, global system for mobile communication

INTRODUCTION

Crime is ubiquitous in the Philippines and remains to keep its status as a major national concern up to this very day, which is an indicator of a poverty-ridden society that still needs to be addressed. Innocent civilians are being subjected to physical and mental harassment. The mortality rate for women and children has reached new heights for the past few years. As reported in the article of Handley (2020), violence against women in children, in particular, has long been a silent emergency that is now threatening to escalate dramatically. Criminal activity has never been as publicized as it did before by traditional media, further amplified by social media, which further testifies to the fact that society's dilemma with criminality necessitates the development of the product.

Based on the observation on the Philippines' plight against criminality, the researchers have conceived the concept of a product that will aid in minimizing casualty in times of emergency - a personal emergency alert device containing a real-time location tracker. The product is designed in such a way that users will not find it bothersome to have wherever they go. It can be attached by the users onto themselves anywhere they see it comfortable and do not hinder them from their daily activities. The device has a button that acts as a trigger mechanism that will send a text message notifying that the user of the device is in danger, along with the real-time coordinates of the current location of the user to a programmed receiving cellular phone. The recipient's cellular phone must be capable of receiving text messages and supporting any application that could be used to efficiently trace the user's whereabouts. Through these features, the transmitted information by the user would then be utilized for efficient emergency response.

Fernandez, Fernandez, and Fernandez (2005) stated that local emergency services for cellular phone users are provided through wireless communication devices that allow the alerted person to provide immediate help to a certain emergency request. Also, since people use portable communicators, it is more convenient and safer to ask immediately for emergency assistance.

Based on the aforementioned statements, the researchers aim to develop a product that will ensure the security of users whenever they are on the brink of danger and emergencies. Since the product is capable of sending accurate coordinates in displaying information, text messaging, and location tracking, it will be of great help in ensuring the safety of users.

LITERATURE REVIEW

In the study of Stevens (2004), a system was created to alert mobile phone users about emergencies. The system also includes a controller that can locate the geographic area of the person who needs help. It would send a text message to at least one person around the area so that the person can ask for help.

Proctor and Rimkus (2003) proposed a system that can track the location of a wireless device. The system is intended to track stolen or misplaced valuables using the Global Positioning System and a mobile transceiver to easily locate and monitor the subject.
Haney (2013) conducted a study on a system that uses wireless devices such as mobile phones to interchange data-position using the Global Positioning System. This system is intended to be used for child location monitoring and other group coordination. An application is used for the said system. Mobile phone users may register to this application as a group or as an individual. In this way, exchanging and monitoring data-position becomes a lot easier.

A portable computing device was also once developed to have plenty of access points to connect to a certain geographic area. The user's geographic location may be determined within a radius of ten feet. The area can be located in various ways with surgical precision. Also, the device's signal strength can be determined by the access point, since the access point could send and receive signals with timestamps to determine the distance of the device's user (Stewart & Thompson, 2002).

The findings of Kumar, Ramchandran, and Srinivasan (2009) commended the use of a cellular wireless call in developing a security system. In this system, the user and the helper who monitor an object are connected through wireless communication. Once the monitored object is at risk, the programmed wireless call is activated prompting a quick response to the call. The researchers stated that this is the compatible and most effective security solution for a cellular wireless network.

A mobile emergency alert device was also made for emergency personnel to store emergency data for wireless communication. The device has a processor which communicates with the wireless communication components. The computer or the processor is programmed to connect to an emergency call and provide immediate instruction on what to do in that current emergency (Lontka, 2012).

DiGiovanni et al. (2012) discussed that mobile phone users can subscribe to the alerting services wherein their call for help can be directed to the service. However, some people are scared to subscribe to the said service because they think it might be able to hack through their data.

Emergency Alert Device has different purposes, which depends on the situation that a person is actually in. The different studies conducted by a handful of researchers show that the Emergency Alert Device is indeed useful to society. Thus, the researchers thought of this product - to at least have a quick response device for life-threatening situations and to equip users with a faster way to ask for help. The product is made using Arduino Nano, Global Positioning System, and Global System for Mobile Communication.

Cvjetkovik and Matijevic (2016) stated that Arduino boards are made to function independently. They are complete small computer platforms that can perform tasks, be

programmed, and can be combined with other boards for production. In a different study, Arduino boards are controllers that are marketed in different stores and are readily available for use in home-based projects. They are developed to achieve faster communication with the different sensors attached to it through the pins of the connectors (Ádám et al., 2016).

Global Positioning System (GPS) is made for the development of the traditional paper and pencil method in traveling as it can determine exact locations for travel activities in an instant (Deng & Ji, 2010). Global System for Mobile Communication (GSM) is well-suited in wide-based location information for indoor and outdoor use. In terms of accuracy and wide range, it has the potential to track places where people have visited in their everyday lives (Sauter, 2014).

As claimed by several researchers, an emergency alert device with a location tracker is made to be used by anyone who needs help (Fernanez et al., 2005; Stevens, 2004; Proctor & Rimkus, 2003; Haney, 2013; Stewart & Thompson, 2002; Kumar et al., 2009; Lontka, 2012; DiGiovanni et al., 2012). Besides, Cvjetkovik and Matijevic (2016), Ádám et al. (2016), Deng and Ji (2010), and Sauter (2014) claim that the use of Arduino Nano, Global Positioning System, and Global System for Mobile Communication can make the Personal Emergency Alert Device containing Real-time Location successful. Thus, the present study is conducted.

METHODOLOGY

Research Design

The experimental design used in new product development was utilized in this study. According to Ellekjaer and Bisgaard (1998), an experimental research design is a tool for conducting informative, time- and cost-effective experiments. This design is used during new product development. This research design can contribute to building quality into products as well as shortening the development cycle time. This design makes it possible to study the effect of many factors (metrics/indicators) simultaneously to select the factor combination that results in both improved quality and reduced cost and hence allows for the development of reliable and robust products of high quality. This design requires a clear vision of the desired outcome enabling the researchers to maximize the development time and resources necessary to finish the product.

Research Participants

The respondents of the study are 20 experts comprised of five (5) Electronics Engineers and fifteen (15) Electronics Engineering students from Don Honorio Ventura State University for S.Y. 2019-2020 who participated as respondents of the study. The purposive sampling technique was employed in selecting the experts who are considered as information-rich individuals on the matter of occupational safety and health.

Specifically, the Maximum Variation Purposive Sampling Method was applied to obtain a diverse range of insights relevant to the subject under consideration. Crossman (2018) held forth that this sample design offers as much perception as possible into the phenomenon under investigation.

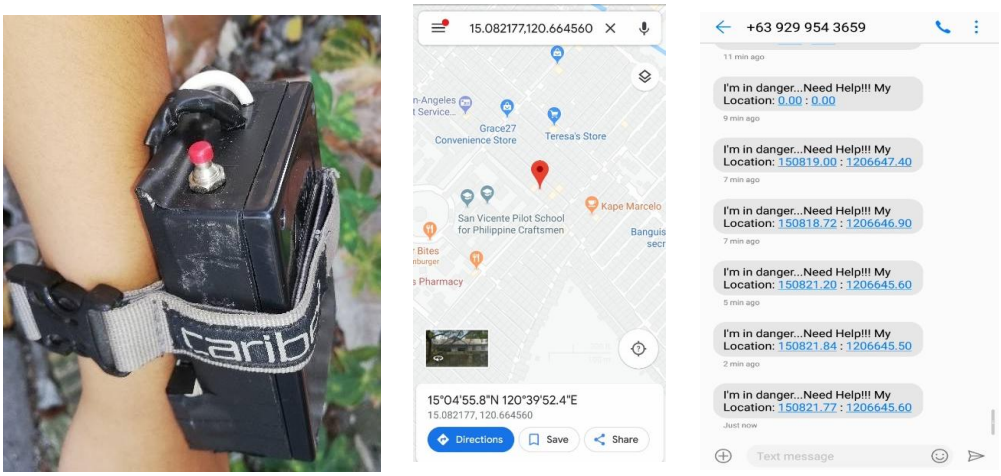

Figure 1. This figure shows the image of the actual product, the content of the text message, and the exact location of the user, respectively.

Research Instruments

The researchers developed a self-made questionnaire which was based on the inputs of selected validators who are experts when it comes to hard technology research. Further, the questionnaire was tested and passed the content validity index (CVI) and reliability or internal consistency before it was administered to the respondents.

The questionnaire is divided into two (2) parts containing questions about the product's structure and functionality. Part I deals with the physical design of the product particularly size, weight, product design, and casing. Part II deals with the functionality of the product through its accuracy in displaying information, text messaging capabilities, and location tracking.

A structured interview was also conducted to validate the quantitative results of the study. The interview focuses on the comments and suggestions of the participants regarding the features of the product. The data gathered were used as bases for further improvements of the product.

Ethical Consideration

Before the conduct of the study, communications were made to ask for consent to gather the needed data. Upon approval, the respondents were informed regarding the purpose of the study and they were guided accordingly. The researchers also made it clear that their participation is voluntary and they are free to withdraw from the study at

any time. More importantly, the responses and personal information of the respondents will be treated with the utmost confidentiality under the Data Privacy Law of 2012 and its implementing rules and regulations.

RESULTS AND DISCUSSION

Table 2 presents the descriptive analysis of the product in terms of its size. Data show that the respondents find the product handy and do not occupy much space as indicated by the computed grand weighted mean of 3.13. Transcript of responses from the experts about the size of the product is shown below:

- "Given the materials used, the device is really compact" (E1), (E2) & (E3)
- "The device is compact, but make it smaller" (E18)
- "The size needs to be reduced" (E9) & (E10)

The device is handy and the users are comfortable with it. However, based on the comments of the experts, although the device's size is acceptable, it still needs to be improved.

Table 2. Descriptive Analysis of the Size of the Device

Indicators	Mean	Description
Handy	3.20	Agree
Saves space	3.05	Agree
Grand Mean	**3.13**	**Agree**

Table 3 shows the descriptive analysis of the product in terms of weight. The weight is evaluated so that the researchers would know whether the product needs to be optimized. As reflected on the table, the device is excellent in terms of its weight as indicated by the computed weighted mean of3.55. The comments indicate that the respondents are very satisfied with the device's weight. Some of the respondents' comments about the weight of the device are as follows:

- "Surprisingly, it is really lightweight." (E8) & (E10)
- "The device's weight makes it easy to bring everywhere." (E4)
- "The use of plastic casing to make the weight of the device to be acceptable is a good idea." (R1)

Table 3. Descriptive Analysis of the Weight of the Device

Indicators	Mean	Description
Lightweight	3.55	Strongly Agree
Grand Mean	**3.55**	**Strongly Agree**

Table 4 shows the descriptive analysis of the product in terms of design. The computed means of 2.75 and 3.65 respectively indicate that the product is well designed and aesthetically pleasing. Also, the button is easily pushed and functions properly as assessed by the expert respondents. Based on the views of the participants, it shows that the design of the product is appropriate. Below are the comments of the respondents about the design of the product:

- "Make the appearance of the device look more attractive." (E3)
- "The wires should be hidden." (E16)
- "Avoid using too much electric resistance." (E8)
- "If possible, put the antennas inside the case." (E9)
- "Don't make the push button too elevated to prevent accidentally pressing it." (E5)

Table 4. Descriptive Analysis of the Design of the Device

Indicators	Mean	Description
Properly designed	2.75	Agree
Accessible push button	3.65	Strongly Agree
Grand Mean	**3.20**	**Agree**

Table 5 exhibits the respondents` assessment of the device in terms of its casing. The result shows that the expert-respondents find the product durable and it has a proper label as supported by the computed grand mean of 3.18. Some of the comments about the casing of the product are:

- "Improve the color of the device for it to be easily identified" (E2)
- "If possible, avoid using plastic for casing because it's not that durable" (E20)
- Based on the respondents' comments, the casing of the product still needs to be improved to make it more durable.

Table 5. Descriptive Analysis of the Casing of the Device

Indicators	Mean	Description
Durability	3.10	Agree
Labeling	3.25	Agree
Grand Mean	**3.18**	**Agree**

Table 6 presents the respondents' assessment of the structure of the device. The result shows that the device is good in terms of size, design, and casing. As regards weight, the respondents find the device excellent as shown by the computed mean of

3.55. This means that the device is very handy but the other aspects may still be improved.

Table 7 exhibits the expert respondents' assessment on the accuracy of information coming from the device. Result reveals that the device is excellent in terms of its accessibility and accuracy of information as indicated by the computed grand mean of 3.60. Therefore, users will be able to access accurate information easily. The device thus functions well as supported by the comments of the expert-respondents. Below are some of the respondents' comments on the accuracy of information of the device:

- "There is nothing really hard on accessing the information from the device" (E9)
- "The information from the device meets the purpose of the study" (E19)
- "Accessing the information is nothing different from reading a text message from someone" (E4)

Table 6. Summary of *Respondents` Assessment on the Structure of the Device*

Indicator	Mean	Description
Size	3.13	Good
Weight	3.55	Excellent
Design	3.20	Good
Casing	3.18	Good
Grand Mean	**3.27**	**Excellent**

Table 7. Respondents` Assessment on the Accuracy of Information from the Device

Indicators	Mean	Description
Information is easy to access	3.60	Strongly Agree
Accurate information	3.60	Strongly Agree
Grand Mean	**3.60**	**Strongly Agree**

Table 8 presents the assessment of the text messaging service of the device. Data reveals that the respondents strongly agree that the device delivers the text message to the phone numbers accurately and the text message contains the right information. The computed grand mean of 3.65 indicates that the device serves its purpose as it delivers the right information. Some of the respondents' comments are the following:

- "It's good that it only takes about 10-15 seconds before receiving the text message" (E10)
- "Make the text message more personal, like include the name of the user" (E3) & (E4)

Hence, from what the respondents have observed, the device has an excellent text messaging service but it can still be improved.

Table 9 shows the assessment of the location tracking service of the device. It indicates that the device has exact coordinates, useful in finding a location, and is accessed using Google Maps. The computed grand mean of 3.60 indicates that the device is excellent in its location tracking service. Some of the respondents' comments on the location tracking service of the device are:

- "Much better if it can determine the exact location name as well." (E4)
- "Find an offline map so that the coordinates can be accessed even without internet." (E7)

Table 8. Respondents` Assessment on the T*ext Messaging Service of the Device*

Indicators	Mean	Description
Delivers the text message	3.60	Strongly Agree
The text message contains the right information	3.70	Strongly Agree
Grand Mean	**3.65**	**Strongly Agree**

Responses indicate that the expert respondents are very pleased with the tracking service of the device as it delivers exact coordinates to find the exact location. However, the device could be modified by using offline maps so that it could be used when there is no internet.

Table 9. Respondents' Assessment on the *Location Tracking Service of the Device*

Indicators	Mean	Description
Exact coordinates	3.50	Strongly Agree
Useful in finding the location	3.50	Strongly Agree
Accessed using Google Maps	3.80	Strongly Agree
Grand Mean	**3.60**	**Strongly Agree**

Table 10. Summary of Respondents` Evaluation on the Functionality of the Product

Indicator	Mean	Description
Accuracy of information	3.60	Excellent
Text Messaging Service	3.65	Excellent
Location Service	3.60	Excellent
Grand Mean	**3.62**	**Excellent**

Table 10 shows the summary of respondents' evaluation of the functionality of the product. The computed grand mean of 3.62 indicates that the device is excellent as regards the accuracy of the information, text messaging, and location service. This just means that the device serves its purpose.

CONCLUSIONS

Based on the findings of the study, it can be concluded that the Arduino Nano, Global Positioning System, and Global System for Mobile Communication are proven to be effective in developing a personal emergency alert device containing a real-time location tracker. The structure of the device is excellent. The product also passed the evaluation of the expert respondents in terms of functionality since it is excellent in accessing the information, delivering the right information, and finding exact locations. The device is thus functional as it serves its purpose.

RECOMMENDATIONS

In line with the conclusions, it is recommended that the product developers should reduce the device size. They should also ensure that the casing and design are attractive to make the device noticeable. Moreover, to further improve the functionality of the device, product developers should track the exact location instead of coordinates. They should also consider which cellular network works best for different places. Lastly, to augment the results and findings of this study, further research undertakings on this topic should be conducted.

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