

Acceptability and relevance of an innovated Arduino-based microcontroller intrusion alarm system

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Abstract –This object of this study is to evaluate the acceptability and relevance of the innovated Arduino-based microcontroller instruction alarm system (ABMIAS). This research study uses the descriptive-developmental research method with 63 respondents who were determined using the purposive sampling. The data were gathered from the respondents using the researcher-made questionnaire to determine the analysis and relevance of the research output.

Result revealed that the extent of acceptability of this innovated ABMIAS based on the analysis of respondents is very high in all factors identified which are: financial requirements; resource availability; market feasibility; usability as instructional materials and household appliance; source, software and hardware; and programming environment. The device is perceived by the respondents as very highly effective and efficient on its relevance when used as instructional materials and household appliance. Based on the findings of the study, the following conclusions are drawn: Arduino products are low cost, affordable and can be easily purchased at the local market. The product output has the potential towards marketability. The device is easy and convenient to use and help augment effective and quality shop instructions and can be used as an intrusion alarm device at home.

In the light of the findings and conclusions of the study, the following recommendations are offered: Recommend the utilization of the output of the study as instructional materials to the students in electronics technology courses and to the household consumers as a protective security alarm device.

Keywords: Arduino, Alarm System, Intrusion, Microcontroller

INTRODUCTION

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs-light on a sensor, a finger on button, or a twitter message and turn it into an output. Arduino has been the brain of thousands of project for a couple of years from everyday objects to complex scientific instrument [1].

Arduino software is easy to use for beginners, yet flexible enough for advanced users. Arduino is a key tool to learn new things [2]. Anyone, children, hobbyist, artist, programmers can start designing just following the step by step instructions of a kit, or sharing ideas on line with other members of the Arduino community.

A simple intrusion alarm system is an ideal electronics project that can make use of any Arduino products with other microcontrollers as well, hence this is introduce to the students in electronics technology [3]. Electronics students as beginners are usually expected to start a project using basic simple processes, in order to do their task completely successful [4].

Thus, to design and develop an innovated Arduino-based microcontroller alarm system is also relevant to be used as instructional materials in Electronics Technology course. This enable the students to challenge their creativity to design and innovate an electronic-digital device and further enhanced their skills competencies in the field of

engineering technology. This innovated intrusion alarm system may not equally the same in quality and standard as those being manufactured by industries, however, it can be used as a security protective device when installed at homes and as instructional materials in teaching electronics engineering technology course [5].

Arduino-based home security system that has a special feature and which make a dial with the owner of the house to inform him that his house has been hacked [6]-[9]. Arduino card was used, which is considered one of modern programmable device and utilize from speed dial function in mobile phone [10]-[11].

With the increasing needs of many households today to have an intrusion alarm system installed at their homes, in order to secure their life and property, many would feel interested to produce this device, hence demand may be getting better at present [12].

Along this premise, the researcher aims to design and develop an innovated Arduino-based microcontroller intrusion alarm system that can be used as instructional materials in electronics engineering technology and as a household appliance to detect intruder or burglar [13].

This research study will determine its relevance when used as instructional materials and household appliance and determine the extent of acceptability based on the analysis of respondents of the output product.

OBJECTIVES OF THE STUDY

This study aimed to evaluate the functionality and relevance of the innovated Arduino-based microcontroller intrusion alarm system that can be used both as instructional materials and a household appliance.

MATERIALS AND METHODS

Research Design

The researcher used the descriptive developmental research method. Descriptive design was used to investigate the analysis of the innovated Arduino-Based Microcontroller Intrusion Alarm System

Research Environment

This study was conducted at Surigao State College of Technology, Surigao City Campus. Surigao State College of Technology and Surigao City locality.

Respondents

The respondents of this study are the 23 third year students, 10 instructors and professors in the electronics engineering technology course of Surigao State College of Technology, Surigao City campus. Likewise, 10 industry technicians and 20 household consumers are used as respondents. The participants are selected thru purposive sampling, to ensure that all perceptions are being represented. A purposive sampling is a sample selected in a deliberative and non-random way to achieve research objectives.

Research Instrument

The instrument to be used in this study is the researcher made questionnaire. The questionnaire addresses analysis and evaluation by which the respondents answered and rated them accordingly. The questionnaire is divided into four parts. Part 1 dealt on the analysis of the ABMIAS as to: financial requirements; resources availability; market feasibility; usability as household appliance and instructional materials; source, software and hardware; and programming environment.

Data Gathering Procedure

The researcher personally administered the survey instrument to the respondents, and to ensure that the respondents fully understand all the items being asked, further explanations were provided. After the conduct, copies of the distributed survey instrument were retrieved, and the data collected were analyzed and interpreted.

Data Analysis

The following statistical tools were used to analyse the collected data of the study. Frequency Count and Percent were used to determine the profile of the respondents. Frequency Median was used to measure the ratings of respondents on the analysis and relevance of innovated ABMIAS. Lastly, Ordinal Rank was used to measure the extent of respondent’s analysis and relevance on the innovated ABMIAS.

RESULTS AND DISCUSSION

Table 1. Analysis of Innovated ABMIAS as to Financial Requirements by the Respondents

Items Description	Factors	Median	Rank	Interpretation	
1.Arduino Hardware needed to be used is at low price.		4	2	Strongly Agree	Very Highly Attainable
2.Arduino Software needed to be used is at low price.		4	2	Strongly Agree	Very Highly Attainable
3.Arduino board are inexpensive		3	4.5	Agree	Highly Attainable
4.Variety of microcontrollers are affordable.		3	4.5	Agree	Highly Attainable
5.Arduino sensors can be purchased easily at low price.		4	2	Strongly Agree	Very Highly Attainable
	Over All	4		Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Revealed in Table 2 the results of ratings of the respondents on their analysis as to financial requirements and shows that three items were rated very highly attainable and two were rated highly attainable. Analysis as to financial requirements got an overall rating of very highly attainable with an overall median of 4.

This infers that the respondents believed that creating this innovated device the expenses to incurred in buying all the materials needed is at low cost and affordable [13]-[15].

Arduino platform was designed to produce a cheaper and easy way for students and professionals to create devices that interact with the environment using sensors and actuators.

Financial requirements are one of the important factors to consider when one design and develop a new product. To prepare all the needed materials, other resources like labor and capital are likewise essentials to make the work smoothly undergoing and prevent problems that may come along the process [16].

Table 2. Analysis of Innovated ABMIAS as to Resource Availability by the Respondents

Items	Factors	Median	Rank	Interpretation	Description
1.	Arduino software can be easily acquired being published as open source tools.	4	2	Strongly Agree	Very Highly Attainable
2.	Arduino boards are very accessible and cost effective.	4	2	Strongly Agree	Very Highly Attainable
3.	Microcontroller-based kit is accessible to be purchased at local market.	4	2	Strongly Agree	Very Highly Attainable
4.	Arduino sensors are of wide variety that can be easily purchased at local market.	3	4.5	Agree	Highly Attainable
5.	Arduino shields are of wide variety that can be easily purchased at local market.	3	4.5	Agree	Highly Attainable
	Over All	4		Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Table 2 presents the results of ratings by all respondents on their analysis as to resource availability and shows that three items were rated very highly attainable, and two others were highly attainable. Analysis as to Resource availability got an overall median of 4 and a rating of very highly attainable.

The findings entail that the respondents believed that the needed materials and resources in constructing the innovated device is available and accessible to be purchased at the local market. Thru online marketing and purchasing the acquisition of these materials become more simple, easy and convenient [17].

As to the needed resources of this innovated device it is available, hence using Arduino boards entirely open source, enabling users to prepare and build their project independently and will likely adopt them to their specific needs. The software is also open source, which is made freely available that can be modified, thus, making it available and accessible for all users.

Disclosed in Table 3 the results of ratings of the respondents on their analysis as to market feasibility and shows that all the items were rated very highly attainable. Analysis as to Market feasibility got a rating of very highly attainable.

The data explains that the respondents strongly agree that the items mentioned on the factors of market feasibility were very highly attainable. In other words, they believed that the marketability of this device is feasible hence this can be sold at the local market. Supported with the idea that many would need it for family home safety and protection against any possible crime and danger of life and property feel interested to acquire and purchase this alarm device.

Table 3. Analysis of Innovated ABMIAS as to Market Feasibility by the Respondents

Items	Factors	Median	Rank	Interpretation	Description
1.	More households demand highly for their safety and protection at home, hence need an alarm security device.	4	3	Strongly Agree	Very Highly Attainable
2.	Local department store/market find the alarm system or any security device very essentials and timely for selling.	4	3	Strongly Agree	Very Highly Attainable
3.	More households feel interested to install a warning/ alarm system device at their houses, for security reason.	4	3	Strongly Agree	Very Highly Attainable
4.	Other government and private buildings and or offices requires to install an alarm system device, hence need to acquire it.	4	3	Strongly Agree	Very Highly Attainable
5.	There is greater possibility that the innovated product can be sold out at the local market.	4	3	Strongly Agree	Very Highly Attainable
	Over All	4	3	Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

The need for and importance of a market study is quite simple. This analysis is to provide a disinterested third party point of view toward a given project based on the project's competitive position within a specific market, likewise, determining the demand for the proposed project within the market [18].

Table 4. Analysis of Innovated ABMIAS on the Usability as Instructional Materials by the Respondents

Items	Factors	Median	Rank	Interpretation	Description
1.	Design of ABMIAS is simple and clear for the students to perform.	4	2.5	Strongly Agree	Very Highly Attainable
2.	The flow process of development starts from basic to a more complex tasks.	3	5	Agree	Highly Attainable
3.	The device has serve the purpose as model to design and develop another electronic alarm system.	4	2.5	Strongly Agree	Very Highly Attainable
4.	Become a typical guide for students during project making	4	2.5	Strongly Agree	Very Highly Attainable
5.	The output help augment effective and quality shop instructions	4	2.5	Strongly Agree	Very Highly Attainable
	Over All	4		Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Analysis on the usability as to instructional materials got an overall rating of very highly attainable. The finding infers that the respondents strongly agree that the usability of this device as instructional materials is significant since this help promote effective, efficient, and quality shop instructions.

Instructional materials always support learning content and let students engaged in the application of concepts and give an opportunity for evaluation. They are made to help facilitate learner's understanding. For instructors choosing the right instructional materials is

paramount to the success of the course, because not all instructional materials are made equal. Some are effective than the others, whereas others may not as clear and effective, therefore, one must pick the best that fits the level and type of course.

Table 5. Analysis of Innovated ABMIAS on the Usability as Household Appliance by the Respondents

Items	Factors	Median	Rank	Interpretation	Description
1.The alarm system can be used as a protective device at home.		4	3	Strongly Agree	Very Highly Attainable
2.The device is easy to operate and control.		4	3	Strongly Agree	Very Highly Attainable
3.The security/ alarm system is functioning well.		4	3	Strongly Agree	Very Highly Attainable
4.Design, size and features of the device are commendable for use.		4	3	Strongly Agree	Very Highly Attainable
5.The device is beneficial to every household and profitable to use.		4	3	Strongly Agree	Very Highly Attainable
	Over All	4		Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Table 5 revealed the data on the analysis of the usability as household appliance and shows that all items stated were rated Very Highly Attainable. Analysis on the usability as household appliance got an overall rating of very highly attainable. The results implied that the respondents strongly agree that all items stated were very highly attainable, which means the innovated device has really serve its purpose to be used as protective alarm device at home and beneficial to every household.

Security has becoming an important issue everywhere. Security of one’s life and property are becoming very important nowadays as the possibilities of intrusions are highly increasing day by day. Therefore, alarm system practically made to protect man’s life and properties from any intruder, burglar and robbers and help ensure safe living.

Table 6 presented the results of ratings of the respondents as to source, software and hardware and shows that the three items were rated very highly attainable, and two others were rated highly attainable. Analysis as to source, software, and hardware got an overall rating of very highly attainable.

The findings inferred that the respondents believed that the source, software, and hardware to be used in the development process were very highly attainable, hence, there are many variations of Arduino products to choose from and have an open-source features.

Table 6. Analysis of Innovated ABMIAS as to Source, Software and Hardware by the Students

Items	Factors	Median	Rank	Interpretation	Description
1.The Arduino has many variation to choose from to allow you to pick one that suit the project.		4	2	Strongly Agree	Very Highly Attainable
2.The software can be used with any Arduino board.		4	2	Strongly Agree	Very Highly Attainable
3.It come from an open source software features.		4	2	Strongly Agree	Very Highly Attainable
4.It come from an open source hardware features.		3	4.5	Agree	Highly Attainable
5. It can be powered either from the PC through USB.		3	4.5	Agree	Highly Attainable
	Over All	4		Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Arduino as a microcontroller developed to be an open-source system. It is powered by a chip and consisted of different parts soldered on the board. It resembles a mini motherboard used in a series of projects. Arduino comes in various models and types. Each model holds unique features and performs a specific function.

Table 7. Analysis of Innovated ABMIAS as to Programming Environment by the Students

Items	Factor	Median	Rank	Interpretation	Description
1.The environment is written in Java and based on processing and other open-source software.		4	2.5	Strongly Agree	Very Highly Attainable
2. Arduino IDE makes easy to write code and upload in the Arduino board.		3	5	Agree	Highly Attainable
3.The program is cross-platform which means able to run on windows, Mac OS x and Linux.		4	2.5	Strongly Agree	Very Highly Attainable
4.Code can be loaded in Arduino IDE with a USB cable.		4	2.5	Strongly Agree	Very Highly Attainable
5.The program uses a simplified version of C++ with syntax highlighting.		4	2.5	Strongly Agree	Very Highly Attainable
	Over All	4		Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Presented in Table 7 the results of ratings on the programming environment and shows that four items were rated very highly attainable, and one was rated highly attainable. Analysis on the programming environment got an overall rating of very highly attainable. The data expresses that the respondents strongly agree that the programming environment in the design and development process is very highly attainable. Arduino has “a multi-platform environment. The Arduino IDE is capable of running on a number of platforms including Microsoft, Linux, Mac OSX making the user community even larger and provides a simplified

integrated platform which can run on regular personal computers and allows users to write programs for Arduino using C or C++". Making Arduino board function easier and available anywhere these boards presented with a USB cable for power requirements and functioned as a programmer. This development board are also used to install (upload) a new code to the board by simply using a USB cable to upload.

Table 8. Summary of Analysis of the Innovated ABMIAS by All Factors by the Respondents

Factors	Median	Rank	Interpretation	Description
Financial Requirement	4	3.5	Strongly Agree	Very Highly Attainable
Resource Availability	4	3.5	Strongly Agree	Very Highly Attainable
Market Feasibility	4	3.5	Strongly Agree	Very Highly Attainable
Usability as Instructional Materials	4	3.5	Strongly Agree	Very Highly Attainable
Usability as Household Appliance	4	3.5	Strongly Agree	Very Highly Attainable
Source, Software and Hardware	4	3.5	Strongly Agree	Very Highly Attainable
Programming Environment	4	3.5	Strongly Agree	Very Highly Attainable

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Table 8 presents the results of analysis by all factors by the respondents and shows that all factors obtained the same median of 4 and were all rated very highly attainable.

This can be inferred that the respondents strongly agree that all factors identified are very highly attainable. This explained that the financial requirements are at low cost and affordable; the materials needed are available and accessible to be purchased at the local market; marketing the product is feasible; the innovated alarm device is very highly usable to be used as instructional materials being a guide and or model for students during project making; the device is very highly usable as a protective alarm device at home; the source, software and hardware are accessible to use; and the programming environment is simple and clear to follow.

Table 9 presents the results and ratings on the relevance of innovated ABMIAS when used as Instructional materials by the respondents and shows that all items identified were rated very highly effective and efficient and obtained the same median of 4. In other words, all items occupied the same ranked which were: "Use as guide for students during project making",

The findings disclosed that the respondents strongly agree that the innovated ABMIAS is very highly effective and efficient when used as instructional materials, not only being used as guide or model but more so it can help augment effective shop instructions.

Table 9. Relevance of Innovated ABMIAS when used as Instructional Materials by the Respondents

Items	Factors	Median	Rank	Interpretation	Description
1. Use as guide for students during project making.		4	3	Strongly Agree	Very Highly Effective and Efficient
2. Design and mechanics of development of the device demonstrated well during instructions.		4	3	Strongly Agree	Very Highly Effective and Efficient
3. An ideal model for students/ beginners to start innovating an alarm system.		4	3	Strongly Agree	Very Highly Effective and Efficient
4. To enhance better technology skills in electronics.		4	3	Strongly Agree	Very Highly Effective and Efficient
5. Effective tool for a quality shoproom instructions.		4	3	Strongly Agree	Very Highly Effective and Efficient
	Over All	4		Strongly Agree	Very Highly Effective and Efficient

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Instructional materials are those materials prepared and used by a teacher to improve their teaching. They include both visual and audio-visual aids and could either be concrete or non-concrete. Instructional materials are important since they help the teacher and learners to refrain doing or overemphasis on recitation and rote learning that can easily dominate a lesson. Also, these materials encourage learners to have practical experience which help develop their skills and concepts while doing in a variety of ways.

Likewise, instructional materials are "essential tools in learning every subject in the school curriculum". With these materials presented students find interested to interact with words, symbols and ideas in the way that develop their abilities in reading, listening, solving, viewing, thinking, speaking, writing, and using media and technology.

Table 10. Relevance of Innovated ABMIAS when used as Household Appliance by the Respondents

Items	Factors	Median	Rank	Interpretation	Description
1. Provide safety and security to life and property of individuals.		4	3	Strongly Agree	Very Highly Effective and Efficient
2. To detect burglar or intruder quickly.		4	3	Strongly Agree	Very Highly Effective and Efficient
3. Produce laudable siren to recognize possible intrusion fastly in restricted area.		4	3	Strongly Agree	Very Highly Effective and Efficient
4. Deter criminal activity or other threatening situation.		4	3	Strongly Agree	Very Highly Effective and Efficient
5. Monitor and transmit notification/information to the system.		4	3	Strongly Agree	Very Highly Effective and Efficient
	Over All	4		Strongly Agree	Very Highly Effective and Efficient

Legend: 3.50-4.00 = Strongly agree; 2.51-3.49 = Agree; 1.50-2.50 = Disagree; 1.00-1.49 = Strongly Disagree

Table 10 presents the results and ratings on the relevance of innovated ABMIAS when used as household appliance by the respondents and shows that all items

identified were rated very highly effective and efficient and obtained the same median of 4. Relevance of ABMIAS when used as household appliance rated by the respondents obtained an overall rating of very highly effective and efficient.

The findings disclosed that the respondents strongly agree that the innovated ABMIAS is very highly effective and efficient when used as a household appliance being a protective alarm device.

This innovated ABMIAS is designed as household appliance to serve as a protective alarm device to all households against any possible intrusion at homes.

One primary concern in present day living is security for life and property of the family, thus, an intrusion alarm system is needed. Supported by the idea of insecurity can lead to loss of lives and properties in our society". Due to the need to improve the security of life and properties in our home to avoid any untoward incident or damages, important thing to decide considering the accessibility of the location and personal traits of the user.

However, some observation and comments of the respondents about the innovated ABMIAS are stated herein as follows: having this security system at home is very pleasant and one can sleep well and reduce the worrying for security of life and property during bedtime, the innovated device is nice and strongly effective, the materials to be used is inexpensive and affordable, very much useful as home appliance for safety and protection of individuals, it is very efficient and effective to use to alarm those inside the house if any unwanted intruders came in, it's a good way to use to detect movement that alerts and alarm when it is triggered, convenient to use at home and very economical, useful and helpful for security purposes at homes, easy to use and operate, materials are accessible to purchase at local market, not hard to install and reliable in terms of alarm, functioned very well, sensors when demonstrated respond quickly, produce laudable sound, useful to be used as instructional materials, good model for project making, and packaging and casing needs to be improved.

Likewise, most of the respondents had recommended to use this innovated ABMIAS with some supporting reasons they express, like: it is a very useful protective device, easy to set programs, convenient and easy to use, used by individuals or students for innovative projects, detects movement quickly and alert the alarm immediately when triggered, good for household safety and security purposes, low cost and affordable, and a reliable alarm system.

CONCLUSION AND RECOMMENDATION

Premised from the findings, the study concluded that the innovated ABMIAS is commendable and ready to use as instructional materials and household appliance.

However, the following specific conclusions are drawn: most existing intrusion alarm system possessed more expensive higher quality components and circuitry that can better detect a true event and can avoid false alarm. The innovated alarm device is inexpensive, easy, and convenient to use. The innovated alarm device is a very useful protective device at home, beneficial to every household. Arduino materials or products are low cost and affordable. Arduino materials or products are available and accessible that can be easily purchased at the local market. The product output has the potential towards marketability. Innovated ABMIAS as an instructional material help augment effective and quality shop instructions. Innovated ABMIAS as a household appliance greatly provide safety and security to life and property of individuals as it detects burglar or intruder very quickly. The use of this innovated ABMIAS is highly recommended both as an instructional material and a household appliance as an intrusion alarm device. Premised from the findings and conclusions of the study, the strong support and supervision from the school administration be provided to the researcher to help improve the output and increased its design and usability.

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