Belt bag-button SIM800l-based safety device system with SMS and phone call alert for persons with disabilities

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Abstract

This study employed the quantitative method and applied-experimental research design to create practical solutions for developed devices. The Belt Bag-Button SIM800L Based Safety Device System, which utilizes a compact belt bag with a button interface and a SIM800L module for GSM communication, is an innovative safety device system designed for persons with disabilities (PWDs). The primary objective is to enhance the safety and security of persons with disabilities by providing them with a dependable mode of contact in times of emergencies or assistance needs. The device is designed to be portable, allowing PWDs to carry it comfortably without hindering their mobility. Users can easily trigger buzzer notifications and SMS alerts through the button interface or initiate phone calls to predefined contacts, including caregivers, family members, or emergency services. The research encompasses the design, implementation, and evaluation phases, including developing the hardware and software components, experimental stages, and surveys. Preliminary testing demonstrates the effectiveness and reliability of the system in real-world scenarios, highlighting its potential to provide valuable support and peace of mind to PWDs and their guardians. Overall, the Belt Bag-Button SIM800L Based Safety Device System represents a significant advancement in assistive technology for PWDs, offering a practical solution to address their safety and communication needs. Future work will focus on refining the system, expanding its features, and conducting broader user trials to validate its efficacy and usability across different contexts and user groups.

Keywords: belt bag-button, SIM 800I module, safety device system for PWDs, GSM communication, experimental research

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1. Introduction

In an article from the United Nations Department of Economic and Social Affairs (2016), experience has shown that in catastrophes and conflicts, Persons with Disabilities are more likely to be abandoned or left behind during emergencies because of inadequate planning and preparedness, inaccessible facilities and services, and inefficient transportation networks. As of 2016, 3,272 recorded PWDs in Occidental Mindoro and 859 in San Jose Occidental Mindoro, according to Maquiñana and Jarabejo (2019). The field of police, local Municipal Disaster Risk Reduction and Management Council (MDRRMC), and medical authorities are the ones regularly concerned with handling and protecting, evacuating, and providing necessities for the affected citizens. Usually, mobile phones are used to alert ambulances and the authorities in times of emergencies to communicate and provide responses to people's needs. However, humans still find it demanding to meet emergency requirements, especially for Persons with Disabilities (PWD), who most often are overlooked or forgotten. Whenever there are any critical or unexpected situations and a person with a disability is in danger, they become highly vulnerable and incapable of protecting themselves, which can cause difficulty or even operating their mobile phone immediately. People with specific disabilities like blindness, deafness, and mobility impaired individuals make it even harder for them to communicate in times of crisis (Mordini et al., 2018).

As stated by Chaware et al. (2020), to help in difficult situations, a clever, intelligent system was also created, including numerous mechanisms, helpline numbers, and various systems. With that said, standard assistive devices are available for these citizens, such as Hearing aids, wheelchairs, canes, crutches, and prosthetic devices that are beginning to be more available with the help of local authorities such as San Jose's MSDWO, which recently awarded 55 PWDs with their own assistive devices. Concerning these creations, the researchers intend to implement such a device that is an advanced emergency tool that combines communication and essential survival features. Its intuitive design and multifunctional capabilities make it an invaluable asset in safeguarding a person with disabilities in emergencies. Thus, the belt-bag safety device system is a beacon of hope and assistance when it matters most.

In light of the emergence of numerous social orders and commercial locations, the emphasis on these facilities has significantly developed due to computerization (Nalina et al., 2021). On top of that, Oyebola (2017), establishes evidence that using SIM 800L signals alarm or text alert through GSM. This Belt Bag-Button Safety Device System incorporates a GSM Module, allowing users to transmit prompt assistance and coordinates to emergency responders or contacts. This information aids in quick and targeted rescue operations, improving the efficiency of emergency services. Even though it is a user-friendly device, a prominent setback of this device would be the battery life of the 3.7 lithium battery. Nevertheless, the researchers will still ensure that the Belt Bag-Button Safety Device System is reliable and durable in times of emergency. Furthermore, the researchers aimed to improve emergency preparedness and address a variety of difficulties that Persons with disability (PWDs) encounter during emergencies by developing a Belt Bag-Button Safety Device System SIM800L based via sending a distress signal in times of emergencies.

Statement of the Problem - This study aimed to determine the level of effectiveness of the Belt Bag-Button Sim800l Based Safety Device System with SMS and Phone Call Alert for Persons with Disabilities in terms of speed in sending distress signals for Persons with Disabilities in emergencies. Specifically, the researchers would like to answer the following questions: (1) What is the level of effectiveness of the Belt Bag-Button SIM800L Based Safety Device System for persons with Disabilities in terms of speed in sending SMS alerts and call alerts? (2) As assessed by the respondents, what is the level of effectiveness of the Belt Bag-Button SIM800L Based Safety Device System in terms of Convenience Speed, and distance? (3) As assessed by the respondents, what is

the level of effectiveness of the Belt Bag-Button SIM800L Based Safety Device System in addressing the emergency needs of Persons with Disabilities in terms of enhanced safety measures, efficient communication, and prompt assistance? (4) Does the range affect the effectiveness of the Belt Bag-Button SIM800L Based Safety Device Systems in addressing the emergency needs of Persons with Disabilities?

Significance of the Study - This study aimed to provide rapid and practical assistance to Persons with Disabilities who were always left behind during emergencies. This compact and portable device combines advanced features to ensure the safety and well-being of Persons with Disabilities. This study is being conducted to benefit the following: This research study will benefit people with disabilities who find it difficult to call for help when they are at risk. The Belt Bag-Button Safety Device System can help to ensure the safety of an individual, especially those with disabilities such as mobility impairments or deaf, etc. in emergencies because this device provides three buttons for Call alert, SMS, and Emergency Alarm or Buzzer for a short distance, as well as helps cooperation, enabling people with disabilities to rapidly access help and guidance, maintaining their safety during emergencies. This research study aims to improve the disabled and well-being of individuals. It not only offers direct benefits to the users but also holds significant importance for their guardians. The Belt Bag-Button Safety Device System has the potential to have a positive impact on the lives of both individuals with disabilities and their guardians. This study will help future researchers extend the use of the belt bag-button safety device system for emergency purposes using Arduino Uno and explore how this study will help individuals with disabilities.

Scope and Delimitations of the Study - This study focused on determining the level of effectiveness of the Belt Bag-Button SIM800L Based Safety Device System with SMS and Phone Call Alert for Persons with Disabilities in sending distress signals for Individuals with Disabilities in times of emergencies. The primary subjects of this research only consisted of individuals with disabilities. The respondents are limited to 18 residents in San Jose Occidental Mindoro. This investigatory project was conducted during this school year, 2023-2024. The study is confined to integrating the SIM network for emergency detection, identification, and connection. The device's battery capacity for this product and the number of rescuers that can be contacted in case of emergencies are limited. The device's signal range and connection are also limited, so the GSM Module might struggle with network connectivity, hindering its ability to transmit data or communicate effectively. Since the device can only assist in requesting help, these limitations may restrict the utmost efficiency of the device in aiding Persons with Disabilities. The rescue of individuals with disabilities depends on the response received from the message sent by the device. Therefore, while the device aids in signaling for assistance, it does not directly ensure that immediate action or help will be sent to disabled individuals who are in need.

2. Methodology

Research Design - The development of this study's application employed the quantitative method. It used an applied-experimental research design to create practical solutions to develop a belt bag-button Sim800l-based safety device system with SMS and phone call alerts for persons with disabilities for emergency uses. It is a type of research method frequently referred to as a "scientific process" since it employs scientific instruments to get answers. It uses empirical methods and experiments for data collecting in the researcher's field of interest. This data is then analyzed and interpreted to produce valuable results or conclusions. Applied research holds significant value in the scientific community as it aids organizations in identifying practical solutions to particular issues while boosting output and productivity (Urmita, 2023).

Participants of the Study - In this study, the researchers purposively surveyed 18 respondents to determine the level of effectiveness of the Belt bag safety device. These groups encompass 18 individuals with a person with disabilities and guardians residing in San Jose, Occidental Mindoro. Each group represents a specific perspective that is essential in understanding and evaluating the effectiveness and relevance of the product in emergencies. The perspective of each respondent helped the development and optimization of the proposed product, ensuring that it effectively addresses the emergency needs of persons with disabilities, enhances safety measures, and facilitates

efficient communication and response in times of emergencies. Participants indicated how much they agreed with each statement on the Four-Likert scale components (strongly agree, agree, disagree, strongly disagree). The scales are used to evaluate the proposed product among users to gather feedback on its functionality, level of effectiveness in sending distress signals, accuracy of location, and overall satisfaction for the researchers to make improvements if necessary.

Research Instrument - After testing the device, the chosen participants were requested to answer the researcher-made instrument to determine if the device was working and effective. The researcher-made instrument was checked and validated by the adviser and experts in Science and Technology at Divine Word College of San Jose using face and content validation. All the suggestions and comments from the experts were incorporated into the final copy of the instrument.

Data Gathering Procedure - The researchers conducted a series of tests and observations of the developed product to assess its effectiveness. This provides a comprehensive understanding of the problems that researchers seek to address. Once the product was completed and completely working, the researchers conducted a survey explicitly targeting 18 persons with disabilities. The goal was to gather their insights and feedback to improve the final product. The researchers surveyed for the whole day on March 24, 2024. After gathering the needed data, the researchers recorded, organized, and analyzed the data.

Research Process; Stage 1 Preparation and Gathering of Materials - To develop a successful product, innovative materials are necessary for the proposed device. To complete the suggested product, researchers opted for reliable and cost-effective resources. These materials came at a total cost of 4,000 and were purchased online. The device's housing was built out of recyclable elements. The list of materials needed to make the Belt Bag-Button Safety Device System is as follows:

➢ Materials for connecting wires: Wires, Soldering wire, Soldering Iron and Printed Circuit Board

➢ Materials for installation of the product clear fiberglass: 1k Resistor, Push Buttons, 3.7v Lithium Battery, 1k ohms Resistor, Arduino Uno, Customized Belt Bag Container, Piezo Buzzer, SIM800I GSM Module, and Sim Card.

Stage 2: Building and Development of the Project - The researcher's primary purpose for conducting this study is to develop a belt bag-button safety device system to send distress signals to predetermined contacts for persons with disabilities in case of emergencies. The researchers began by creating the proposed product in Tinkercad for almost 2 days. The researchers ensured that the significant components worked well, and they integrated every component and made it work as a whole for the final product. It took 1 week for the researchers to ensure that the product functioned well and was complete and assembled. Lastly, the researchers also determined the product's effectiveness in terms of the speed in sending SMS and Call alerts and if it is affected by distance based on its performance in the survey conducted for 1 whole day. Using the components to make a belt bag- a button safety device system, the general aim of this study is to determine the level of effectiveness in terms of speed in sending distress signals to persons with disabilities in emergencies. The researchers used the SIM800L Module to send distress signals and alerts. Once the users push the button intended for sending message alerts, the exact location is sent along with the encoded message saying that they are in an emergency and need help. Another button was integrated to enable the call feature of the proposed device for immediate communication. These are all capable of using the SIM800L GSM Module. The researchers utilized resistors and connecting wires for the proposed Belt Bag-Button Safety Device System.
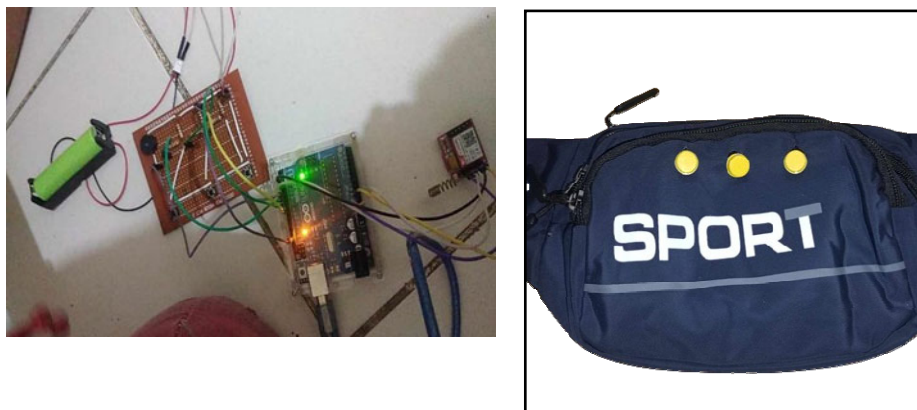
Figure 1. Actual Product of Belt Bag-Button SIM800l Based Safety Device System with SMS and Phone Call Alert for Persons with Disabilities

Stage 3: Experimental Stage, Observation and Data Recording - To evaluate whether the proposed device was functional, the researchers began by creating the proposed product in Tinkercad. The various components were purchased from different online shops. The researchers then finalized all needed materials before making the product. From there on, the researchers assessed the effectiveness of the proposed Belt Bag-Button Safety Device System Arduino Uno based on its purpose for each of the participants. The significant components of the proposed device were then tested to determine if the device would work well with the encoded program, depending on its purpose and functionality in emergencies. At the earliest convenience, the researchers tested the proposed device's unique features, where the designed device will send a distress signal with the user's location information to designated contacts, ensuring prompt assistance in emergencies. The researchers immediately started to conduct the structured survey of the 18 persons with disabilities together with their guardians to obtain needed data and quantitative responses; it took almost two (2) days to finish the survey. Lastly, the researchers also determined the product's effectiveness in terms of the speed of sending SMS and Call alerts and the accuracy of location based on its performance.

Statistical Treatment of the Data - For statistical treatment, all the data gathered from the distributed questionnaires from the participant's responses were determined through the data's weighted mean. It aimed to determine the product's overall performance and the researchers' goal to provide a quality Belt-Bag Safety Device System. In addition, the researchers used the T-test analysis to determine the difference between the range of effectiveness of the belt bag-button safety device system. The combined t-test analysis and weighted mean calculation are thoroughly examined to uncover statistically significant differences between groups and to derive a comprehensive, weighted average measure that reflects the importance of the data collected from the survey.

1. Results and Discussions

Table 1

Level of the effectiveness of the Belt Bag-Button in terms of speed in sending SMS alerts and Call Alerts (in seconds)

Interface (d<10m)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
Speed in sending SMS	2.1s	5.0s	7.10s	30.1s	9.85s	**10.83s**
Speed in sending call alert	3.0s	10.0s	8.25s	58.2s	9.21s	**17.72s**

Table 1 presents the level of effectiveness of the Belt Bag-Button in terms of speed in sending SMS and Call alerts (in seconds) from the 5 trials conducted during the experiment. Based on the presented data, the SIM800L GSM module integrated with the Piezo Buzzer effectively sends SMS (10.83s) and Call Alert (17.72s) upon pressing the designated button for each alert. The device processing speed and response time are evaluated, showing its efficacy in sending SMS and Call Alerts on time. Moreover, the research conducted by Oyebola (2017) demonstrates that the SIM800L module efficiently transmits messages and call notifications during emergencies. This module is designed for wireless surveillance and emergency response. Testing has confirmed that the SIM800L module successfully sends SMS and call alerts upon pressing the button, offering valuable support for addressing safety requirements promptly. Thus, the SIM800L GSM module integrated with the Piezo Buzzer effectively sends SMS and Call alerts upon pressing the designated button for each alert. The device processing speed and response time are evaluated, showing its efficacy in promptly sending SMS and Call Alerts.

Being a user-friendly and lightweight device for everyday use. Based on the results, the majority of the respondents have positive feedback when it comes to being a user-friendly device. Sixteen strongly agreed that the device is user-friendly, and fourteen percent strongly agreed that the device is lightweight enough for everyday use. According to Nalina et al. (2021), the system that integrates SIM800L is a user-friendly device that provides security for emergencies and is helpful in critical times.

Table 2

Mean Level of Effectiveness of the Belt Bag-Button in terms of Convenience and Speed and Distance

Indicators	4 (SA)	3 (A)	2 (DA)	1 (SDA)	Weighted Mean	Descriptive Rating
1. The device is user-friendly.	16	2	0	0	3.89	Very high
2. The device is lightweight enough for everyday use.	14	4	0	0	3.78	Very high
3. The device's speed of sending SMS messages and call alerts is on time.	11	5	2	0	3.50	Very high
4. The distance from the source does not affect the performance of the device.	13	3	2	0	3.61	Very high

Legend: 3.25-4.00 - Very High; 2.50-3.24 - High; 1.75-2.49 - Fair; 1.00-1.74- Low

Table 2 consists of the participants' evaluation of the Belt Bag-Button Safety Device System regarding the device's user-friendliness, a key focus during the design and development process. The positive perceptions from the participants aligned and built upon perceptions that the device is remarkably lightweight and easy to use. In terms of speed and distance, the survey gained an average of 3.50, which means a very high effectiveness in terms of the speed in sending SMS and call alerts, and 3.61, a very high effectiveness in terms of the distance. This proved that the device is convenient and user-friendly, and it can send SMS and call alerts on time to the participants. Conforming to Chindiyababy et al. (2023), who proved a sense of comfort and security for individuals who need them by utilizing reliable components such as a GSM Module with an SMS function. The mechanism notices odd motions or sounds utilizing sensors and instantly notifies the user's emergency contacts to make the atmosphere safer and never feel helpless in times of emergency.

Moreover, Devikiruba (2014) also proves that the system can transmit information in real time. To track a location, a prototype model for the Global System for Positioning Systems (GPS) and the technology of GSM (mobile communication) is the foundation for the development because it offers flexibility and portability, enabling the user to access the data from any location. Due to the increased frequency range of these GPS technologies, the user can obtain the information as soon as possible. When used to regulate speed in some emergencies, this technology is beneficial.

Table 3

Mean Level of Effectiveness of the Belt Bag-Button Safety Device System in Addressing Emergency Needs

Indicators	4 (SA)	3 (A)	2 (DA)	1 (SDA)	Weighted Mean	Descriptive Rating
As assessed by the respondents, Is the Belt Bag-Button Safety Device System effective in addressing the emergency needs of Persons with Disabilities in terms of:						
A. Enhanced Safety Measure	12	5	1	0	3.61	Very High
B. Efficient Communication	13	4	1	0	3.67	Very High
C. Prompt Assistance	13	4	1	0	3.67	Very High

Legend: 3.25-4.00 - Very High; 2.50-3.24 - High; 1.75-2.49 - Fair; 1.00-1.74- Low

Table 3 shows the level of effectiveness of the belt bag-button safety device system in addressing emergency needs as assessed by the participants of the experiments. The descriptive ratings for the 3 indicators were all very high after computing the weighted mean based on the frequency. Based on the overall weighted mean, the products meet the needs of the respondents upon receiving a very high overall descriptive rating. The consistency of data, in which the indicators were observed by the participants to be satisfying, tells the project's success reflected by the overall mean of 3.61 in enhancing safety measures, 3.67 in having efficient communication, and 3.67 for prompt assistance that is all equal to very high written rating. According to Abid et al. (2022), the SIM8000L can handle quad-band frequencies, contributing to the low-cost module. It is, therefore, the best option for tasks requiring long-distance communication. As a result, integrating a GSM Modem with SIM800L in the device increases the performance of the Arduino Uno-based belt-bag button safety device system, especially in long-distance communication between the responders and the respondents, providing comfort and security.

Table 4

Range of the Effectiveness of the Belt Bag-Button Safety Device System

Trial	Long Range (>10m)	Short Range (<10m)
1	0	1
2	0	1
3	1	1
4	1	1
5	1	1
Average	0.6	1

Legend 0 - The Message & Call Alert didn't send; 1 - The Message & Call Alert were Sent

Table 4 presents a comprehensive understanding of the data from the trials in terms of the range of effectiveness of the device from long (>10m) and short-range (<10m) distances. Throughout the experiment, the researchers tested whether the safety device could send messages and make calls at varied distances. The SIM800L sends SMS (Short Message Service) and call alerts directly to the cell phone number defined in the safety device system software module. Within its vicinity during the experiment, with a range of less than 10 meters away, directed towards the individual receiving the SMS and Call Alert.   Moreover, Mela et al. (2019) state that the GSM module's range sends SMS directly to the user. It guarantees continuity of sending alerts but requires an access point and connection availability.   When the person with a disability is more than 10 meters from the Safety Device System, the message and call alert function, wherein the researcher observes that the device still sends messages and call alerts successfully. The same is true when the individual is in the shooter range less than 10 meters from the Safety Device System. The message and call alert functions successfully. However, this is an if-and-only-if situation wherein the GSM Modem with SIM800L must have a strong signal connection with the signal provider for the GSM Modem with SIM800L to function effectively. This finding aligns with the result found by Olalekan (2017) entitled "Development of a Sim800l-Based Reprogrammable Household Smart Security System with Recipient Phone Call Alert". He proved that the Device, which integrated a GSM Module SIM800L, had a positive performance, proving that the component is promising for the safety needs of individuals.

Table 5

t-Test: Two-Sample Assuming Unequal Variances: Range of the Device

	Variable 1	*Variable 2*
Mean	0.6	1
Variance	0.3	0
Observations	5	5
Hypothesized Mean Difference	0	
df	4	
t Stat	-1.632993162	
P(T<=t) one-tail	0.088903904	
t Critical one-tail	2.131846786	
P(T<=t) two-tail	0.177807808	
t Critical two-tail	2.776445105	

Legend: *P-value ≤ 0.05 Significant; reject H$_0$.*

Table 5 shows the t-Test: Two-Sample Assuming Unequal Variances in terms of the range of the device. The t-statistic is -1.632993162, and the t-critical is 2.776445105; this indicates that the t-statistic is smaller than the t-critical value. Therefore, this study accepts the null hypothesis and rejects the alternative one. Additionally, the p-value (0.177807808) is greater than 0.05 alpha level, supporting the acceptance of the null hypothesis. Thus, distance does not affect the belt bag-button safety device system's efficiency. It was proved that when the button is touched, the recipient receives SMS and Call alerts directly from the GSM range. When the radiation is measured beyond the threshold, the GSM module is checked to send an SMS alarm. This function is helpful for timely or early emergency notifications in radiation monitoring and security. This caused researchers to determine that the efficiency of the belt bag-button safety device system does not vary significantly depending on how far it is from the source. The results of the experiments were found to be similar to Rao's (2024) experiment, wherein he also used a buzzer and GSM module as an electronic device; in his study, the buzzer module and GSM module activate continuously and give out a siren which helps to grab the attention of nearby

people. This showed that the materials used by the researchers in developing the device were effective. The different components of the above-mentioned are considered in this study to address the problems and issues regarding the safety of individuals with disabilities. This section describes the communication technologies and their integration into the communication network to help secure persons with disabilities.

According to Rahman et al. (2018), the GSM Module enables bidirectional communication for data transfer, status inquiries, and configuration establishment. GSM Module pertains to communication between the device and host server handled by the firmware. It processes all incoming SMS, retrieves and stores updated settings from the host, sends alarm or notification SMS upon reaching or surpassing the radiation data threshold, and sends SMS data at predetermined intervals following the setup. This module can be integrated with a buzzer or any component with a radiation survey or monitoring device to produce a wireless, mobile radiation monitoring system that can promptly notify users of high radiation levels to lend a helping hand to Persons with Disabilities in times of emergency.

3. Conclusions

Having the summary of findings stated, the following conclusions were drawn that also correspond to the order that is previously presented: The level of effectiveness of the Belt Bag-Button Sim800l Based Safety Device System with SMS and Phone Call Alert for Person with Disabilities in sending SMS and Call alerts is very high in terms of speed. As assessed by the respondents, the belt bag button has a very high level of convenience. As assessed by the respondents, the belt bag button has a very high level of effectiveness in speed and distance. The level of effectiveness of the Belt Bag-Button Sim800l Based Safety Device System with SMS and Phone Call Alert for Persons with Disabilities is very high in enhancing safety measures. There is a high level of product efficiency using the Belt Bag-Button Sim800l Based Safety Device System with SMS and Phone Call Alerts for Persons with Disabilities in terms of efficient communication. The Belt Bag-Button Sim800l Based Safety Device System with SMS and Phone Call Alert for Persons with Disabilities has a very high level of effectiveness in terms of prompt assistance based on the data gathered from the self-made survey questionnaires. The range does not affect the efficacy of the belt-bag button SIM800L-based safety device systems in addressing the emergency needs of persons with disabilities.

3.1 Recommendation

The researchers propose the following recommendations based on the conclusions derived from the study and the insights obtained from the collected data. The researchers recommend that users may place the product in an open area with good signal reception, enabling the GSM Module (SIM 800L) to directly send a message and call when they push the button on the device and upgrade it to a more accessible model, may look for smaller alternatives to the Arduino Uno to make the device more convenient. The safety device may be wirelessly programmable, allowing the owner to activate or deactivate it while not in use to help preserve battery life and utilize a smartphone app. Since it functions properly, the user may use the device. Future research may enhance the Belt Bag-Button for Persons with Disabilities by integrating GPS for precise location tracking and upgrading the Piezo buzzer to ensure audible alerts.

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