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# Smart Bracelet: Empirical Multi-Purpose Bracelet GPS Tracker

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**Abstract**

This research aimed to develop and evaluate a smart multi-purpose GPS tracker bracelet designed to enhance user safety by enabling emergency location sharing and alerts through an SOS button with SMS functionality. The participants of the study were the researchers, who designed, assembled, and tested the prototype device within Iligan City, Philippines. An experimental research design was employed to assess the device's detection range and response time for both calls and text messages. Data was collected through multiple field trials conducted at varying distances, and results were analyzed using descriptive statistics, including mean response times. Findings revealed that the device performed optimally in open spaces, with an effective detection range of up to 2.54 km and average response times of 12.3 seconds for calls and 13.6 seconds for texts. Although minor limitations were observed in coordinate detection speed, the smart bracelet demonstrated potential for improving child and student safety by providing parents and guardians with real-time location monitoring.

**Keywords**: Smart bracelet, SOS, SMS, GPS tracker, detection range, response time

## 1. Introduction

Kidnapping and hostage-taking have long been serious global issues, raising constant concerns for both individuals and communities. Children and the elderly are particularly vulnerable to becoming missing due to various factors. Although today's youth are often tech-savvy and street-smart, they remain at risk in dangerous situations that may lead to abduction or loss of life. This issue is critical for both clinical and academic reasons, as professionals in mental health and security are frequently consulted to provide strategies for managing hostage incidents and addressing the long-term consequences for victims (Alexander & Klein, 2009; Rainham et.al., 2008).

Location-based services enable individuals to locate objects, machines, vehicles, or people. Inspired by this, the researchers developed an intelligent multi-purpose GPS tracker bracelet designed to enhance personal safety. Wearing such a bracelet can provide peace of mind, especially for children, women, and individuals who have been stalked or harassed. The GPS tracker bracelet ensures that vulnerable populations feel protected in various situations, including traveling alone or living in high-risk areas (Bouten et. al., 2013; Ehn et.al., 2021).

GPS tracking technology offers advantages in preventing kidnappings and locating lost individuals. With real-time monitoring, parents and guardians can quickly identify a child's whereabouts in emergencies. However, its use also raises ethical and legal concerns, such as privacy issues and potential misuse (Bouten et.al., 2013; Casale et.al., 2012; Trotter et.al., 2010).

This study aims to address the problem of missing individuals by evaluating the effectiveness and reliability of a smart bracelet GPS tracker. Specifically, the researchers tested the prototype's properties, performance, and data outputs during the school year 2022–2023.

This chapter presents the methodology used in developing the Smart Bracelet: Empirical Multi-Purpose GPS Tracker. It explains the research design, conceptual framework, flowchart, materials required, data gathering procedures, instruments, and statistical treatments.

## 2.Research Design

The study utilized an experimental research design, which enabled the researchers to measure the detection range and response time of the device. This design was chosen to directly test the bracelet's performance and determine its practical application in ensuring safety.

Additionally, the study applied an applied research design, which focuses on solving real-world problems and providing innovative solutions for individuals, groups, or society. By combining both approaches, the researchers were able to evaluate the prototype while also addressing the practical need for improved safety and security devices.

### 2.1 Conceptual Framework

The framework of the study was based on developing a bracelet tracker capable of sending the exact latitude and longitude of its location through SMS. The process involved three stages:

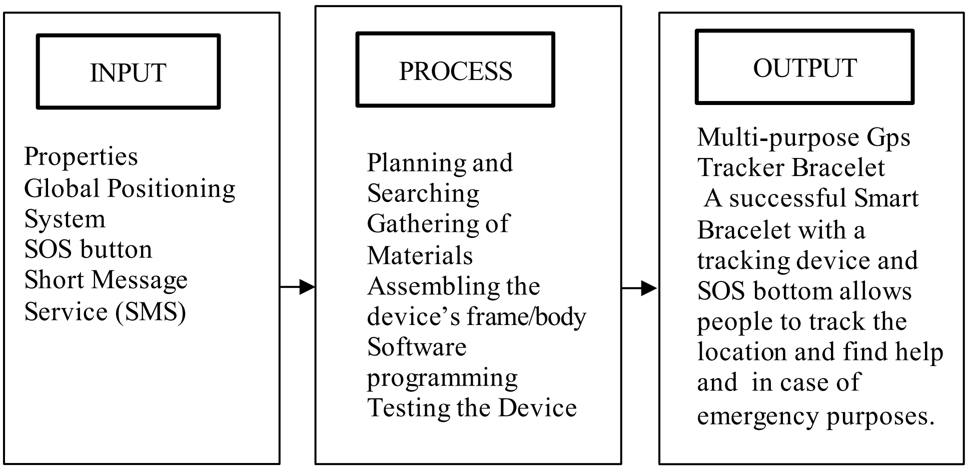


Figure 1 Conceptual Framework of the Study

This framework allowed the researchers to anticipate potential challenges during development and ensure the device was both functional and reliable.

## 2.2 Process Flow Diagram of the Study

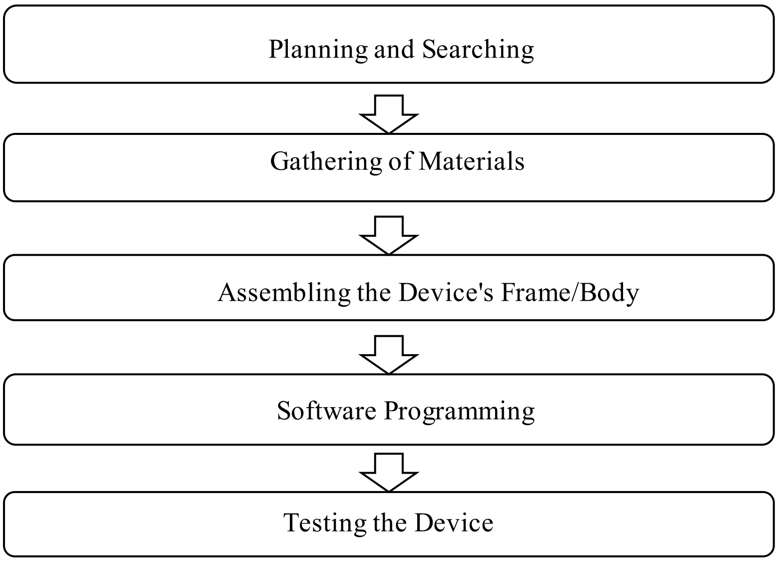


Figure 2 Process Flow Diagram

## 2.3 Planning and Searching

Planning and searching were the first steps in the total procedure. Without careful planning and research, it would be difficult to connect the method and the goal. It takes extensive investigation to locate some of the materials that could be used in the device's construction because they can be purchased from the internet and local electrical retailers. Choosing the materials to use and how to assemble them are crucial steps in the production process.

***Gathering of Materials***

The materials needed to build the device were gathered by the researchers. Researchers make a list of all potential materials and then execute a search plan. Researchers must truly intend to collect each item of information individually.

***Assembling the Device's Frame/Body***

At the assembling stage, after gathering the necessary materials, a device could be constructed more quickly and affordably without sacrificing quality. During the frame, researchers started to come into their own. New framing methods really assist researchers in determining the device's structural stability, quality, and long-term usability. The device framing process brought the design plans to life once they were in place.

***Development of the system***

This part was created by the researchers to be tested and connected to other components to determine its functioning. The connections would be examined, the code would be debugged, as well as the device will be tested once more till the test is successful.

***Software Programming***

The software of the device needed to be programmed in order to be able to manipulate it. This device needed programming in order to compute longitude and latitude, send messages and perform all required functions.

*Flowchart Diagram of the Study*

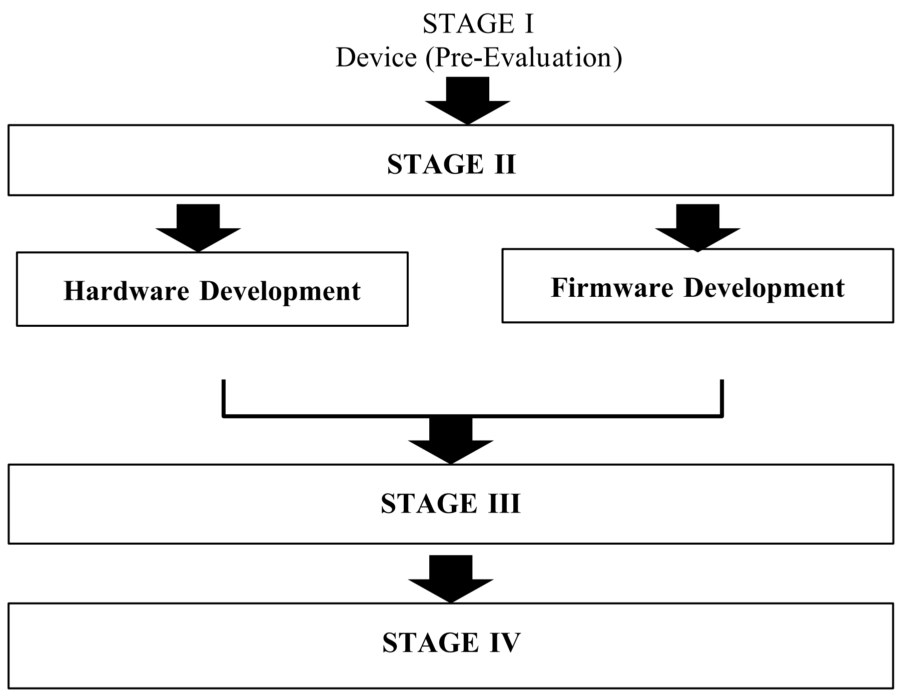


Figure 3 Software flowchart

**2.4 Device (Pre-Evaluation)**

A pre-evaluation screening that focuses on the usage of the global positioning system (GPS), SOS button, and short message service (sms) for the transmission of the location information was undertaken in order to monitor and evaluate the operation of the device. This would initially provide the researchers the opportunity to correct any potential inaccuracies.

***Design and Development***

At this stage, all potential risks and problems that the device might experience when attempting to use the product to learn its location were examined. The circuit connections should be observed to make sure that nothing disrupts the circuit's functionality and that the predetermined goals were achieved.

***Integration, Recording of Results***

The hardware and firmware should be tested thoroughly as a finished product to make sure they would function as intended. All tests should be finished and verified as genuine; any mistakes or delays should be addressed and the software should be updated. The researchers would finish integrating all of the hardware and software components during this stage. The system had been repeatedly checked after being extensively checked for any signs of malfunctions or faults that might have happened throughout the integration process. The researcher should keep a record of the outcomes and decide which ones could be sufficient to move forward with the device's post-evaluation.

## 2.5 Evaluation of Data (Post-Evaluation)

The researchers analyzed the data and carried out a testing method after integrating and recording device outcomes. It was important for researchers to assess the device's capabilities.

***Material and Equipment Used***

These materials and equipment are classified as the following material/equipment needed in this study.

Figure 4: GPRS GSM GPS BDS A9G Module

The A9G is a complete quad-band GSM / GPRS module that supports GPRS and GPS / AGPS technologies. The A9G development board is a versatile development board based on EMC's A9G GPRS / GSM + GPS / BDS module that can be used to validate the basic communication functions and peripheral functions of the A9G module.

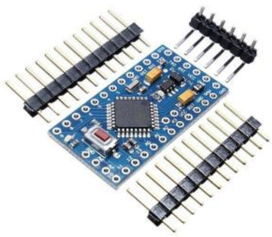

Figure 5: Arduino Pro Mini Atmega328

The Arduino Pro Mini ATmega328 is a small and compact microcontroller board based on the ATmega328P microcontroller. This will send commands to the A9G Module.

Figure 6: CP2102 Module

The CP2102 module is a compact USB-to-UART bridge module that enables serial communication between a computer and other devices. This will connect the Arduino Pro Mini Atmega328 to a computer to put codings.

Figure 7: Solid Wire 22 AWG

The Solid Wires are used to connect the CP2102 module, A9G module, and Arduino Pro Mini Atmega328 together.


Figure 9: 3.7V Rechargeable battery

The Battery will be used to make the GPS module function.

Figure 10: Slide Toggle Switch

This Slide toggle switch is used as an on/off switch for the device.

Figure 11: Tactical Push Button Switch

This Tactile button switch is used as an SOS button to activate the other features of the A9G module.

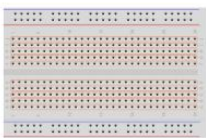

Figure 12: BreadBoard

A Breadboard is used for prototyping to connect and control electronic components in various devices.

Figure 12: USB micro cable

Micro USB is a scaled-down variant of the Universal Serial Bus (USB) interface designed for connecting small and mobile devices.

Figure 13: SIM Card

Subscribers can use their mobile devices to receive calls and send SMS messages using this card. This card can be used to send SMS messages to your emergency contacts.

Figure 14: Smart Phone

A smartphone is a mobile device that combines cellular and mobile computer features. It is utilized to track and locate the user of the bracelet.

Figure 15: Wire Cutter

Soldering electrical wires definitely need to have a wire cutter. It is used to properly cut the wire with minimal damage to the insulation or internal conductors of the wire

Figure 16: Tweezers Set

Tweezers are used to grab, handle or hold small objects or electronic parts which may not be possible to pick up by hand and require precision and care.

Figure 17: Solder Stand

A solder stand is used to safely keep the soldering tools when not in use.

Figure 18: Soldering Iron

Soldering iron is used to heat solder at high temperatures over the melting point of the metal alloy, typically from an electrical source. As a result, the solder can flow more easily between the workpieces that need to be bonded.

Figure 19: Solder

Solder is the filler material that melts and joins the two materials.

***Testing Procedure***

The researchers went through procedures to obtain the necessary data in order to know the device's range, speedy response, and effectiveness. The empirical multi-purpose bracelet GPS tracker had been put to the test by the researchers in a specific place using mobile phones in addition to testing the features of the gadget that were included in the mobile application.

***Detection Range***

The researchers created the necessary tables in order to obtain records and collect data. The tables were used to calculate the GPS strength of the smart bracelet with multi-functional intelligence in the range it occupies. The researchers would see how far each device could be reached using the smart bracelet and the smartphone on which the app was installed.

Table 1 Detection Range

| Place (from SMC BEd) | Distance from the phone (km) | Able to Send an SMS |
|---|---|---|
| Bagong Silang | 0.39 km | |
| Gaisano Mall, Villa Verde | 1.28 km | |
| Jollibee, Roxas Avenue | 1.63 km | |
| Iligan City National High School | 1.84 km | |
| Robinsons Mall, Tubod | 2.54 km | |

***2.16 Rapid Response***

The researcher defined the study based on how long it took for the device to alarm, to locate the person exceeding its parameter, as well as the time it took for a person or a system to respond to a given stimulus or event.

Table 2 Rapid Response

| Place | Distance from the phone (km) | Elapsed time record (CALL) | | | Average time elapsed time record |
|---|---|---|---|---|---|
| | | 1st Trial | 2nd Trial | 3rd Trial | |
| Bagong Silang | 0.39 km | | | | |
| Gaisano Mall, Villa Verde | 1.28 km | | | | |
| Jollibee, Roxas Avenue | 1.63 km | | | | |
| Iligan City National High School | 1.84 km | | | | |
| Robinsons Mall, Tubod | 2.54 km | | | | |

**2.6 Treatment of the Data**

The data had been gathered, presented, analyzed, and interpreted using the statistical formula that follows.

***Average Mean***

To get the mean of the range and rapid response, the sum of the time speed and response time of the 3 trials on the device had been divided by the number of trials which was 3 to get their average.

***Organization of Data***

The researchers organized the data in a column to better understand the capabilities of the Smart Bracelet GPS Tracker. There are separate columns for the existing device's data and the data from the three trials.

Table 3 Rapid Response

| Place | Distance from the phone (km) | Elapsed time record (Text) | | | Average time elapsed time record |
|---|---|---|---|---|---|
| | | 1st Trial | 2nd Trial | 3rd Trial | |
| Bagong Silang | 0.39 km | | | | |
| Gaisano Mall, Villa Verde | 1.28 km | | | | |
| Jollibee, Roxas Avenue | 1.63 km | | | | |
| Iligan City National High School | 1.84 km | | | | |
| Robinsons Mall, Tubod | 2.54 km | | | | |

***Analyzing the Data***

To determine how dispersed the data from each column was, the researchers would compute the average of the three trials as well as the standard deviation. This would then assist researchers in data interpretation.

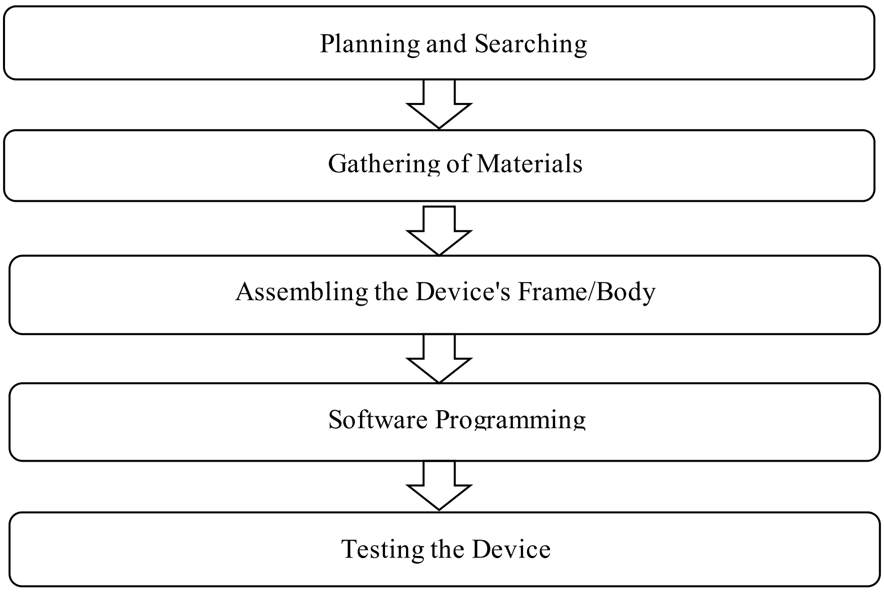


Figure 20: Analyzing the data

## 3.Procedures in Making the Smart Bracelet

### 3.1 Assembly

1. The ATmega328P Arduino Pro Mini will be the microcontroller, while the A9G Development Board handles GPS, GPRS, and GSM functionalities.
2. The ATmega328P can send AT commands to A9G through the RX and TX pins serial communication. The RX pin of A9G is connected to ATmega328P's Digital pin 5, while the TX pin of A9G is connected to ATmega328P's Digital pin 4.
3. GPS and GSM antenna are connected to the A9G.
4. For the SOS button, Digital pin 3 and Ground Pin is connected using a push button.
5. For uploading the code into the microcontroller, a 5-pin USB to TTL converter with a CP2102 driver is used with the following connections.

Table 5 Code into the microcontroller

| CP2102 | ATmega328P |
|---|---|
| +5V | VCC |
| GND | GND |
| TX | RX |
| RX | TX |

### 3.2 Coding

1. The internal connections are made using the SoftwareSerial library, to repurpose Digital pins 4 and 5 as the RX and TX pins of the ATmega328P.
2. The logic of the code is divided into 2 methods:
    a. Setup - Initializes all values for the variables used and other preparatory procedures of the A9G.
    b. Loop - It runs after the Setup method is done and will continuously loop until the whole system will get cut off of power.
3. In the Setup Method:
    a. The SOS button, the Digital pin 3 of the ATmega328P, is assigned to an INPUT_PULLUP state. This state enables the ATmega328P to read a signal from a push button.
    b. Using the AT commands, the ATmega328P will send the following in order:
        i. AT+GPS=1
        ii. AT+CMGF=1
        iii. AT+CNMI=2,2,0,0,0
    c. The *toggle* and *lifted* variables are set to False initially. These two variables are used to indicate the logical states of the push button.
4. The Loop Method will have two states:
    a. IDLE state - The IDLE state persists until the SOS Button is pressed.
    b. SOS state - SOS Button will trigger the SOS state and will trigger the following AT commands and processes:
        i. AT+LOCATION=2
            - This command shows the GPS data in a longitude and latitude form.

- The GPS data will not always give a result, depending on the GPS signal strength and coverage.

ii. AT+CMGS=**<any phone number>**

- This command sends the GPS data that is formatted as a Google Maps link to the intended SOS receivers' phone numbers.
- If the GPS data is unavailable, the text is instead changed indicating that the GPS data is unavailable.

iii. ATD+**<any phone number>**

- This command will dial the number of one of the SOS receiver's phone numbers, turning on the mic until the receiver ends the call or calling the number that is out of reach.

c. The Loop Method will go back to the IDLE state once the sequence of commands as indicated in the SOS state is sent to A9G.

Table 5 Cost Analysis

| MATERIALS | QUANTITY | UNIT PRICE |
|---|---|---|
| GPRS GSM GPS BDS A9G Module | 1 unit | ₱ 728 |
| Arduino Pro Mini Atmega328 | 1 unit | ₱ 417 |
| CP2102 Module | 1 unit | ₱ 111 |
| 3.7v Rechargeable battery | 1 pcs | ₱ 185 |
| Solid Wire 22 AWG | 1 meter | ₱ 10 |
| USB micro cable | 1 pcs | ₱ 50 |
| Sim card | 1 pcs | ₱ 50 |
| Slide Toggle Switch | 1 pcs | ₱ 20 |
| Tactical Push Button Switch | 3 pcs | ₱ 30 |
| PCB circuit board | 1 pcs | ₱ 120 |
| Wire Cutters | 1 pcs | ₱ 80 |
| Tweezers Set | 1 set | ₱ 167 |
| Solder Stand | 1 pcs | ₱ 120 |
| Soldering Iron | 1 pcs | ₱ 299.75 |
| Solder | 10g 0.8mm | ₱ 62 |
| Programmer | 1 person | ₱ 11,000 |
| TOTAL: | | ₱ 13,449.75 |

## 4. Findings

The findings discussed the analyses and interpretation of the data collected for the study. The data were gathered through various methods, including formulation, tallying, and presentation in tabular form. The properties evaluated in the study, which include Device's range, Rapid response, and Effectiveness are presented in tables along with their corresponding results.

4.1 What are the properties of a Smart Bracelet Multi-Purpose Bracelet GPS Tracker with SMS notification?

The Smart Bracelet Multi-Purpose Bracelet GPS Tracker with SMS notifications is a wearable device that incorporates the A9G module as its main component. Here are some of the key properties of this device:

Table 6 the key properties of Smart Bracelet Multi-Purpose Bracelet GPS Tracker

| Properties | Description |
|---|---|
| GPS tracking | The A9G module in the Smart Bracelet Multi-Purpose Bracelet GPS Tracker provides accurate GPS tracking, allowing the wearer's location to be tracked in real-time |
| SMS notifications | The A9G module supports SMS notifications, allowing the device to send and receive short messages over the cellular network. This feature is useful for alert systems or emergency situations. |
| Dual-band GSM/GPRS modem | The A9G module in the Smart Bracelet Multi-Purpose Bracelet GPS Tracker is equipped with a dual-band GSM/GPRS modem that supports 900/1800 MHz frequencies, making it compatible with most cellular networks around the world. |
| Low power consumption | The A9G module is designed to operate on low power, making it suitable for battery-powered applications. The Smart Bracelet Multi-Purpose Bracelet GPS Tracker can operate for extended periods of time without needing to be recharged. |
| AT command set | The A9G module uses an AT command set to communicate with external devices or software. This makes it easy to integrate the device into existing systems and applications. |
| SIM card support | The A9G module supports standard SIM cards, which are used to identify the module on the cellular network and provide access to network services. |
| Data transfer | The A9G module supports data transfer over GSM/GPRS networks, allowing it to send and receive data such as text messages, emails, and internet connectivity. |

4.2 How effective is the Smart Bracelet Multi-Purpose Bracelet GPS tracker?

4.2.1 How is it effective in terms of Detection Range?

Table 7 Detection Range

| Place (from SMC BEd) | Distance from the phone (km) | Able to Send an SMS |
|---|---|---|
| Bagong Silang | 0.39 km | Successful |
| Gaisano Mall, Villa Verde | 1.28 km | Successful |
| Jollibee, Roxas Avenue | 1.63 km | Successful |
| Iligan City National High School | 1.84 km | Successful |
| Robinsons Mall, Tubod | 2.54 km | Successful |

This table shows the ability of Smart Bracelet GPS Tracker to send an SMS to the registered number and In this table, it shows that the Smart Bracelet GPS Tracker has been successfully sent an SMS in Bagong Silang, Gaisano Mall, Villa Verde, Jollibee Aguinaldo, Iligan City National High School, Robinsons Mall, Tubod.

The Smart Bracelet GPS Tracker has been successfully sent an SMS in different location and distance from the origin (St. Michael's College BEd). It provides convenient and accessible means of tracking and monitoring the bearer of the Smart Bracelet GPS Tracker. However, users should consider the limitations and costs associated with SMS-based tracking when choosing the most suitable solution for their specific tracking needs.

A possible implication of the study is that the Smart Bracelet GPS Tracker's detection range has been successfully tested in different location and distance and the farthest distance that the Smart Bracelet GPS Tracker has been tested is 2.54 km from the origin and it has still been able to detect despite the distance. Gps signals could struggle to penetrate indoor environments, especially buildings with thick walls or underground structures. The detection range of a GPS tracker affects its ability to provide accurate location updates indoors.

4.2.2 How is it effective in terms of Rapid Response in terms of call?

Table 8 represents the rapid response specifically on call feature of the Smart Bracelet GPS Tracker. In Bagong Silang response for the first trial, it took 8 seconds, In the second trial it took 6 seconds, and in the third trial for rapid response in Bagong Silang it took 10 seconds, the average response time in Bagong Silang was 8 seconds. In Gaisano Mall, Villa Verde response for the first trial, took 3 seconds, in the second trial it took 6 seconds, and in the third trial it took 5 seconds and the average time response in Gaisano Mall, Villa Verde was 4.6 seconds. In Jollibee, Roxas Avenue response for the first trial took 17 seconds, In the second trial it took 9 seconds, In the third trial, it took 13 seconds and the average time response in Jollibee, Roxas Avenue was 13 seconds. In Iligan City National High School response for the first trial took 11 seconds, In the second trial it took 10 seconds, In the third trial it took 8 seconds and the average time response in Iligan City National High School was 9.6 seconds. In Robinsons Iligan response for the first trial it took 16 seconds, in the second trial it took 8 seconds, In the third trial it took 13 seconds and the average time response in Robinsons Iligan was 12.3 seconds.

Table 8 Rapid Response

| Place | Distance from the phone (km) | Elapsed time record (CALL) | | | Average time elapsed time record |
|---|---|---|---|---|---|
| | | 1st Trial | 2nd Trial | 3rd Trial | |
| Bagong Silang | 0.39 km | 8 seconds | 6 seconds | 10 seconds | 8 seconds |
| Gaisano Mall, Villa Verde | 1.28 km | 3 seconds | 6 seconds | 5 seconds | 4.6 seconds |
| Jollibee, Roxas Avenue | 1.63 km | 17 seconds | 9 seconds | 13 seconds | 13 seconds |
| Iligan City National High School | 1.84 km | 11 seconds | 9 seconds | 8 seconds | 9.6 seconds |
| Robinsons Mall, Tubod | 2.54 km | 16 seconds | 8 seconds | 13 seconds | 12.3 seconds |

A possible implication of the study is that the Smart Bracelet GPS Tracker's rapid response specifically on call feature may vary depending on the location or environment where it is being used. The results show that the response time for rapid response differs in each location, with some places having faster response times than others. This information can be useful for individuals or organizations who are considering using the Smart Bracelet GPS Tracker in specific locations, as it highlights the need to consider the potential differences in response time based on the environment. Additionally, this finding could potentially lead to further research aimed at understanding the factors that may contribute to differences in response time across different locations.

According to Alba (2021), the first three hours are the most essential while attempting to locate a missing kid, and death most usually happens during those three hours. A previous study on GPS tracking devices for children focused on trust difficulties, device performance, the child's location-time pattern, the growth of technology used from infancy to adolescence, and comprehending children's daily mobility.

4.2.3 How is it effective in terms of Rapid Response in terms of text?

Table 9 represents the rapid response specifically on the SMS feature of the Smart Bracelet GPS Tracker. In Bagong Silang response for the first trial took 23 seconds, in the second trial it took 6 seconds, in the third trial rapid response took 9 seconds, and the average time response in Bagong Silang took 12.6 seconds. In Gaisano, Villa Verde the response for the first trial took 18 seconds, in the second trial it took 6 seconds, in the third trial it took 9 seconds and the average time response in Gaisano Mall, Villa Verde took 10.6 seconds. In Jollibee, Roxas Avenue response for the first trial took 16 seconds, in the second trial it took 47 seconds, in the third trial it took 78 seconds and the average time response in Jollibee, Roxas Avenue was 47 seconds. In Iligan City National High School response for the first trial took 14 seconds, in the second trial it took 18 seconds, in the third trial it took 6 seconds and the average time response in Iligan City National High School was 12.6 seconds. In Robinsons Iligan response for the first trial, it took 5 seconds, in the second trial it took 20 seconds, in the third trial it took 13 seconds and the average time response in Robinsons Iligan was 13.6 seconds.

Table 9 Rapid Response

| Place | Distance from the phone (km) | Elapsed time record (TEXT) | | | Average time elapsed time record |
|---|---|---|---|---|---|
| | | 1st Trial | 2nd Trial | 3rd Trial | |
| Bagong Silang | 0.39 km | 23 seconds | 6 seconds | 9 seconds | 12.6 seconds |
| Gaisano Mall, Villa Verde | 1.28 km | 18 seconds | 6 seconds | 8 seconds | 10.6 seconds |
| Jollibee, Roxas Avenue | 1.63 km | 16 seconds | 47 seconds | 78 seconds | 47 seconds |
| Iligan City National High School | 1.84 km | 14 seconds | 15 seconds | 5 seconds | 12.6 seconds |
| Robinsons Mall, Tubod | 2.54 km | 16 seconds | 20 seconds | 6 seconds | 13.6 seconds |

A possible implication of the study's findings on the rapid response specifically on the SMS feature of the Smart Bracelet GPS Tracker is that the response time for the SMS feature is generally longer compared to the response time for the call feature in the locations tested. The results show that the response time for the SMS feature varied across different locations, with some locations having faster response times than others. This information can be useful for individuals or organizations who are considering using the Smart Bracelet GPS Tracker in specific locations and need to prioritize either the call feature or the SMS feature depending on the location. Additionally, this finding may lead to further research aimed at understanding the factors that may contribute to differences in response time across different locations and how to improve the SMS feature's response time.

According to Pratama (2021), to overcome all this, a motor vehicle security system was created using SMS with an Arduino-based GPS tracking method, to create a GPS Tracker that can control vehicles via SMS (short message service) that can track or assist the vehicle's position using the Arduino Uno GPS (global positioning system).

4.3 How accurate is the Smart Bracelet GPS Tracker in regards with tracking the location?

Table 10 Location Accuracy

| Place (from SMC BEd) | Distance from the phone (km) | Location Accuracy |
|---|---|---|
| Bagong Silang | 0.39 km | Successful |
| Gaisano Mall, Villa Verde | 1.28 km | Successful |
| Jollibee, Roxas Avenue | 1.63 km | Successful |
| Iligan City National High School | 1.84 km | Successful |
| Robinsons Mall, Tubod | 2.54 km | Successful |

Based on the trials conducted, the researchers found out that locating GPS of the Bracelet was successfully and accurately detected. However, it has different kilometers in Bagong Silang it was accurately detected with a kilometer of 0.39. In Gaisano Mall, Villa Verde with 1.28 km. In Jollibee, Roxas Avenue with 1.63 km. In Iligan City National High with of 1.84 km. Lastly, in the Robinsons Mall, Tubod it was accurately detected with a kilometer of 2.54 from the base (St. Michael's College).

A possible implication of the study's findings on the accuracy of the Smart Bracelet GPS Tracker's location detection is that the device is generally successful in accurately detecting its location across different locations tested. However, the results show that the distance from the base location (St. Michael's College) varied across different locations, with some locations having a shorter distance (i.e., Bagong Silang) and others having a longer distance (i.e., Robinsons Mall, Tubod). This information can be useful for individuals or organizations who are considering using the Smart Bracelet GPS Tracker and need to understand the device's accuracy in specific locations. Additionally, this finding may lead to further research aimed at understanding the factors that may contribute to differences in location accuracy across different locations and how to improve the device's accuracy.

According to Van Dorp (2002), where tracking signifies the gathering and management of information related to the current location of products or delivery items, whereas tracing relates to storing and retaining the manufacturing and distribution history of products and components.

## 5. Conclusions

The findings of the study indicate that distance, mobile signal strength, and environmental factors influence the rapid response performance of the smart bracelet GPS tracker. Despite these variables, the device consistently functioned across all trials, successfully sending both calls and SMS messages within the tested range.

In terms of accuracy, the bracelet reliably detected and transmitted its location in every trial. The maximum tested distance of 2.54 km still produced accurate location results, demonstrating the device's effectiveness in real-world conditions.

Overall, the smart bracelet GPS tracker proved to be a reliable safety tool. It successfully delivered location information via SMS to a registered phone number, verified through repeated testing. The assembly, programming, and integration of components ensured the device's stability and functionality. Although minor challenges such as signal delays were observed, the results confirm that the device achieved its primary goal of providing accurate, rapid, and accessible location tracking to enhance personal safety.

## 6. References

Alexander, D. A., & Klein, S. (2009). Kidnapping and hostage-taking: A review of effects, coping, and resilience. Journal of the Royal Society of Medicine, 102(1), 16–21. https://doi.org/10.1258/jrsm.2008.080347

Badamasi, Y. A. (2014). The working principle of an Arduino. In 2014 11th International Conference on Electronics, Computer and Computation (ICECCO) (pp. 1–4). IEEE. https://doi.org/10.1109/ICECCO.2014.6997578

Bouten, W., Baaij, E., Shamoun-Baranes, J., & Camphuysen, C. J. (2013). A flexible GPS tracking system for studying bird behaviour at multiple scales. Journal of Ornithology, 154(2), 571–580. https://doi.org/10.1007/s10336-012-0908-1

Bracelet. (2023). In Encyclopædia Britannica. https://www.britannica.com/art/bracelet

Casale, P., Pujol, O., & Radeva, P. (2012). Personalization and user verification in wearable systems using biometric walking patterns. *Personal and Ubiquitous Computing, 16*(5), 563–580.

Ehn M, Richardson MX, Landerdahl Stridsberg S, Redekop K, Wamala-Andersson S. (2021). Mobile Safety Alarms Based on GPS Technology in the Care of Older Adults: Systematic Review of Evidence Based on a General Evidence Framework for Digital Health Technologies. J Med Internet Res, 23(10): e27267

Pratama, A. Y. (2021). Motor vehicle security system using SMS and Arduino-based GPS tracking. International Journal of Engineering Research & Technology, 10(7), 150–154.

Rainham, D., Krewski, D., McDowell, I., Sawada, M., & Liekens, B. (2008). Development of a wearable global positioning system for place and health research. International Journal of Health Geographics, 7(59), 1–14. https://doi.org/10.1186/1476-072X-7-59

Trotter, M., Lamb, D. W., Hinch, G. N., & Guppy, C. N. (2010). Global navigation satellite system livestock tracking: System development and data interpretation. Animal Production Science, 50(6), 616–621. https://doi.org/10.1071/AN09203

Van Dorp, K-J. (2002). Tracking and tracing: A structure for development and contemporary practices. *Logistics Information Management*, 15 (1): 24 – 33 https://doi.org/10.1108/09576050210412648