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Location Accuracy and Challenges in GPS-Based Safety Application for Women

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Abstract: *Womens safety is a worry these days because of all the crime happening. To make things better people have made phone apps that help women in emergencies. This paper is about an app that helps women stay safe by finding them accurately.*

Lots of apps only use GPS to find people. Gps is not always right especially inside buildings or in busy cities. This can be bad when someone needs help away.

The problem with GPS is that it can be slow to find someones location, which's really important in dangerous situations.

This study tries something by using GPS with other things like Wi-Fi and phone networks. It also uses the phones sensors to help find people when the signal's weak. The goal of the women safety application is to make it work better in life so women can feel safer when they are out and, about..

Keywords: GPS Accuracy, Women Safety, Real-Time Tracking, Location Error, Mobile Applications, Hybrid Positioning

I. INTRODUCTION

Women safety is a problem these days. There are crimes happening and people are worried about their security in cities and towns. When something bad happens it is hard to get help away.

This is an issue. Mobile phones have gotten better and better so some apps have been made to help with this problem. These apps have features like sending emergency alerts sharing where you are and calling people you trust or the police.

These apps try to get help to you and make it more likely that you will be safe in bad situations. Women safety apps are very useful.. They only work well if they can find your location correctly.

Most of these apps use something called GPS to figure out where you are. GPS works well when you are outside. Can see the sky.. It does not work as well when you are inside, underground or in a crowded city.

There are things like buildings and trees that get in the way of the GPS signals. This makes it hard for the app to know where you are. Another problem with GPS is that the signals can bounce off buildings before they reach your phone.

This makes it hard to know how away you are from something. The weather and the time of day can also make GPS less accurate. These problems are very important in emergency situations.

If the app does not know where you are it can be hard to get help to you. Most women safety apps also need to be connected to the internet to work.. Sometimes you are in a place with no internet.

Then the app cannot send for help. Using GPS all the time also uses up a lot of battery. This is a problem because you need your phone to work in an emergency.

In the world these problems mean we need a better system. This system should be able to work even when things are not perfect.

So this paper is talking about a way of finding your location. It uses GPS, Wi-Fi and cell phone signals. By using all these things the system can know where you are in hard conditions.

It also uses sensors to help it work. This makes the system more reliable and accurate.

The goal is to make women safety apps work better and be more useful, in life. Women safety apps should be able to help you when you need it.

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II. RELATED WORK

A. Literature Review

Over the years people have tried a lot of ways to make location tracking better in applications. The old systems only used GPS, which worked well when you were outside in the open but it did not work very well when you were inside a building or in a city.

The people who study this have found some problems, like when the signal gets blocked or bounces off things and something called the urban canyon effect which makes GPS not work very well. To make this better they came up with hybrid positioning systems that use GPS and also Wi-Fi and cellular network data. These systems are more accurate because they use than one way to figure out where you are.

Some recent studies have also tried using sensors and ma- chine learning to guess where you are accurately. Even though we have made some progress a lot of safety applications still mostly use GPS. Do not use the hybrid approaches, which means they are not as good in the real world.

We know that GPS is really good when you are outside in the open. It does not work very well in cities or inside buildings.

Things, like the canyon effect and when the signal gets blocked make it not work very well.

The people who study this have said that we should use systems that combine:

* GPS
* Wi-Fi
* Cellular networks

Some studies also say that we should use machine learning and sensors to make tracking better.. Most of the time real applications still mostly use GPS, which means they are not as good as they could be.

B. Problem Statement

GPS-based safety applications are really popular. They have a lot of issues that make them unreliable.

Existing GPS-based safety applications have problems. These problems include:

* location accuracy
* Weak signals when we are indoors
* Delay in getting real-time updates
* battery consumption
* Dependency, on internet connection

Because of these problems GPS-based safety applications do not work properly during emergencies. Sometimes the user of GPS-based safety applications may not even be able to send their location when they need to.

So there is a need to improve GPS-based safety applications in terms of accuracy, battery usage and network dependency. We need a GPS-based safety application that will work even in difficult conditions. GPS-based safety applications should be improved to work better.

C. GPS Overview

The Global Positioning System or GPS is a system that uses satellites to figure out where you are on Earth.

It works by getting signals from satellites. GPS uses something called trilateration. Here's how it works:

* The distance between a satellite and your device is calculated based on how it takes for a signal to travel from the satellite to your device.

The basic idea is simple:

Distance is equal to Speed multiplied by Time.

Even a tiny mistake in calculating the time can lead to a mistake in finding your location.

There are three parts to GPS:

* Space Segment: These are satellites that send out signals.

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* Control Segment: These are ground stations that help manage the satellites.
* User Segment: This includes devices like smartphones that receive the signals.
To make GPS work better some devices use Assisted GPS or A-GPS.
A-GPS uses GPS data and information from towers and Wi-Fi to get a better reading.
With A-GPS GPS can be a bit off in places like indoors or areas, with lots of obstacles.

D. Research Gap

Although many studies have looked into GPS-based track- ing and safety applications there are still some problems. Most current systems mainly use GPS. It does not work well indoors and in cities, which leads to incorrect location tracking.

Some new approaches have suggested using Wi-Fi and cellular networks but they are not really used in many real-world applications. Also using sensors to make tracking more accurate is not very common.

There are issues like high battery usage and needing internet connection, which make these systems less reliable during emergencies. Most existing applications are not very flexible as they do not automatically switch between positioning methods based on where you are.

So we need a system that uses many technologies to give accurate and consistent location tracking.

A system that can switch between GPS, Wi-Fi and mobile sensors would be more reliable.

This way we can get an accurate location, even indoors or, in cities.

It would also help in emergencies when we need to know where someone is.

III. SYSTEM ARCHITECTURE

The system we are talking about is a mix of technologies that work together to track locations. This is really useful for women safety applications. It has parts that are connected and work together to collect, process and send location data. You can see how it all works in Fig. 1.

It starts with the users device, where we get location data from things like GPS, Wi-Fi and cellular networks. This information is then sent to the part of the system that processes the data. The system looks at how good each source of information's decides which ones to use. It uses an algorithm that chooses the best sources based on what is happening around it.

We also use information from sensors like accelerometers and gyroscopes to help the system keep tracking the location when GPS is not working well. The system then filters out any wrong location information to make sure it is stable and accurate.

When we have the location the system sends it to the SOS alert part. If there is an emergency this part sends the users location and a message to people who can help or to emergency services. The system is also designed to use battery power by sending location updates less often when the user is not moving around much.

So this system is really good at tracking locations in time and it can adapt to different situations, which makes it perfect, for women safety applications. The women safety applications are the focus here and the system is designed to work well in these applications.

A. Overview

The system we are suggesting is a mix of location tracking methods to help keep women safe. This system uses GPS, Wi-Fi and phone networks to make sure it can always find the location no matter whats going on outside.

* It has parts that work together to get, process and send location information.
* First it gets location data from sources.
* Then it uses a way of picking the best data.
* It also uses information from sensors to keep track of where someone's when the main signals are weak.

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The data is then made accurate by removing any mistakes. This helps make sure the information is stable and correct. The system then connects with a part that sends out emergency alerts.
This allows people to quickly contact others for help in an emergency.
This design makes the system work well be flexible and easy to add to.
That's why it's good for use, in real-life situations where safety's a big concern.
The system is made to help keep women safe by knowing where they are.
It does this by using different methods to get the right location.
This way it can always help when its needed.
As shown in Fig. 1, the system processes data in a step- by-step manner using multiple location sources to provide accurate tracking.

B. Data Collection and Input Sources

The system starts by getting location information from a lot of places like GPS, Wi-Fi and cell phone networks. The GPS system is really good at figuring out where you are when you are outside.. When you are inside a building or in an area, with a weak signal the Wi-Fi and cell phone networks help out. The system uses all of these location inputs to make sure it can find the user location no matter what is going on around them. The system gets location data from sources, including GPS, Wi-Fi and cell phone networks to determine the user location.

C. Data Processing and Hybrid Algorithm

After we collect the data the information is sent to the part of the system that processes the data. At this point the system checks how reliable and available each source of the data is. The system uses a kind of algorithm that picks and combines the best data sources on the fly. This makes the location more accurate because the system does not have to rely on one technology. The data sources are selected based on how they work and the location accuracy is improved by using multiple data sources like the data, from the data sources.

D. Sensor Integration

The system uses sensors like accelerometers and gyroscopes to work better. These mobile sensors are really helpful when the GPS signals are not strong or we cannot get them. The data, from these sensors also helps us see when the user is moving and makes the tracking more stable. The mobile sensors are very important for the system to track things properly.

E. Accuracy Filtering and Optimization

The data that has been processed is then sent through a stage that checks for accuracy.
This step gets rid of location values that're not reliable or are inconsistent.
These values can be caused by errors in the signal or by things in the environment that interfere with it.
The system also tries to make the battery longer.
It does this by changing how often it updates the location, based on what the user's doing and the conditions, around them.
The system adjusts location updates to save battery.
It looks at user activity and environmental conditions to make adjustments.

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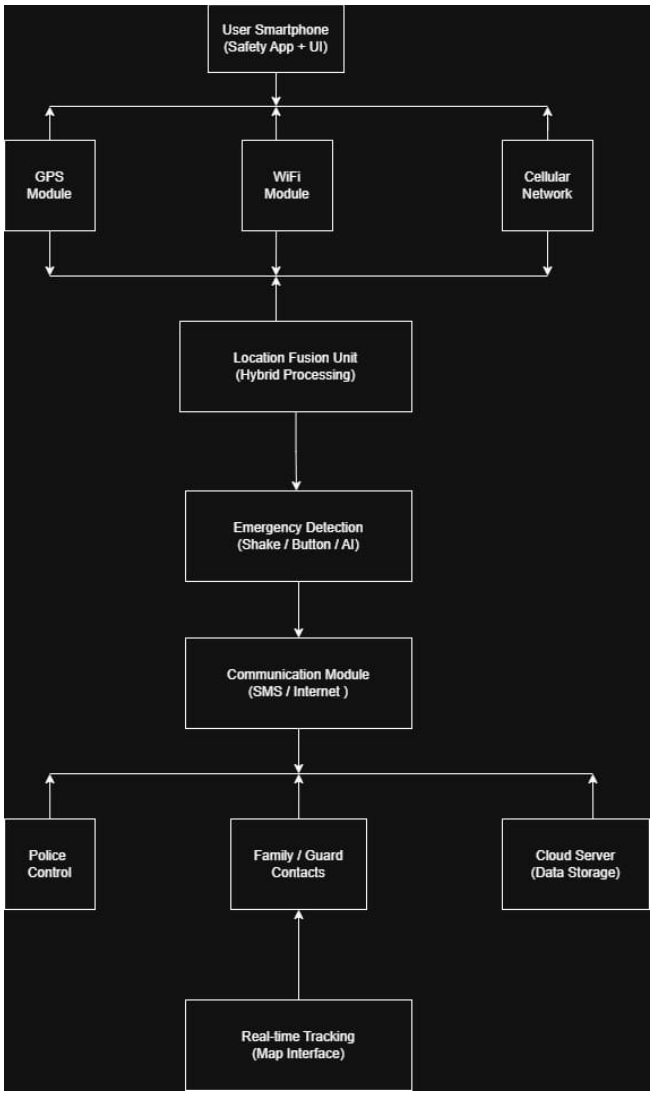

Fig. 1. Block diagram of the hybrid GPS, Wi-Fi, and cellular-based location tracking system for women safety.

F. SOS Alert and Communication Moduler

In the part the system works with the SOS alert module. When something bad happens the user can send out an alert that shares where they are now and a message to the people they have chosen or, to emergency services. This means that people can react fast and talk to each other effectively when the SOS alert system is really needed. The SOS alert system is important because it helps the user get help quickly.

IV. METHODOLOGY

The new system is a mix of things that helps make women safety applications better at finding locations. It does things one, after the other from getting data to sending out alerts. You can see how it all works in Figure 2. Every part of the system is important to make sure it can track things correctly and quickly no matter what is going on around it. The women safety applications need this to work well in places and situations.

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A. Data Collection

The first step is to gather location information from places.
* We get this data from GPS, Wi-Fi and cellular networks. GPS works outdoors.
* Wi-Fi and cellular networks help when the GPS signal is weak, like indoors.
This way we make sure the system works in different situations.
The system uses GPS, Wi-Fi and cellular networks to get location data.
In scenarios these sources ensure the system functions properly.
The use of GPS, Wi-Fi and cellular networks provides results.

B. Preprocessing and Validation

The data we collect can have mistakes in it because things can get in the way of the signal or the environment can interfere. So we do some preprocessing to make sure the data is good and correct. We take out the bad or wrong data points to make the data we use better. This helps us get results when we process the data further.

C. Hybrid Location Estimation

At this point the system uses a kind of algorithm that puts together information from many different places. The system picks the source of information based on what is available and what is going on around it. This way of doing things makes the information more accurate because the system is not relying on one way of figuring out where something is. The system is using this algorithm to make the information, from multiple sources work together.
As illustrated in Fig. 2,Location data from different sources is processed step-by-step to produce an accurate result..

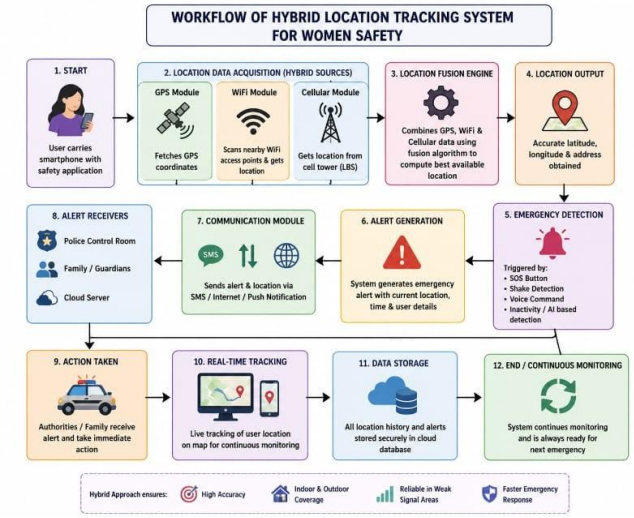

Fig. 2. Workflow of the proposed hybrid location tracking system.

D. Sensor-Based Enhancement

To make tracking better we use data from sensors, like the accelerometer and gyroscope.
These sensors help us keep track of where something's even when GPS signals are weak or not working.
This way we can keep detecting movement without any breaks.
The accelerometer and gyroscope provide information that helps with this.

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E. Accuracy Filtering

The location we think is right gets improved by using filters. These filters help get rid of jumps and wrong values. This makes sure that the final location we get is steady and smooth and gives us an idea of where something really is. The location is more precise because of this.

Fig. 3 shows the step-by-step process of the hybrid tracking system for generating accurate location output

F. SOS Alert Generation

In the part the system works with the SOS alert module. The system does an important thing when it is triggered. It sends the users location now along with a message to the people the user has chosen to contact in an emergency or to the authorities. This helps people get to the user quickly when the user needs help in an emergency situation, with the SOS alert module.

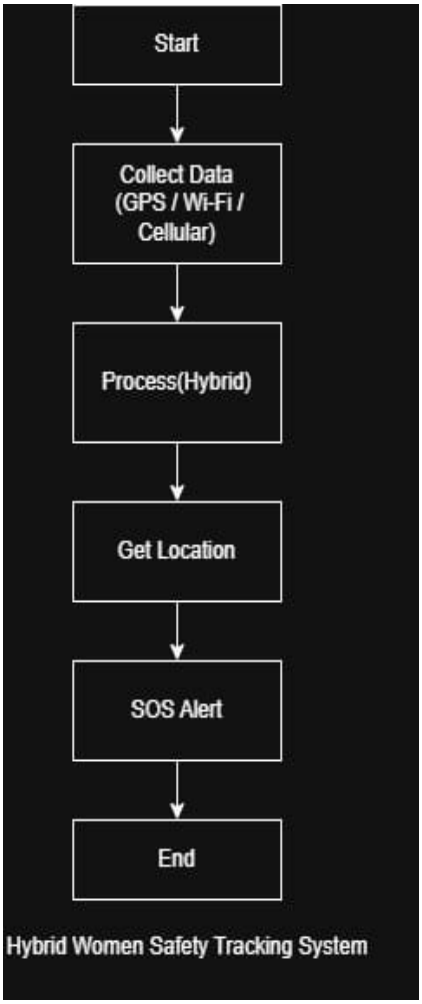

Fig. 3. Hybrid Women Safety Tracking System

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V. RESULTS AND ANALYSIS

The hybrid location tracking system was tested in places like open areas, cities and indoors.
The results show that GPS works well in areas but not so well indoors or in cities because of signal blockage and interference from buildings and other things.
* By using GPS with Wi-Fi and cellular networks the system gets accurate and reliable location information.
This hybrid system also works steadily by cutting down on sudden mistakes and inconsistencies in location.
The system can also quickly send out location updates and alerts which's important during emergencies.
The system saves battery life by not using much power, which makes it work better overall.
The test results prove that this approach is better than using
GPS and gives a more reliable way to help keep women safe.
The hybrid system provides a reliable solution for women safety applications.
The results confirm that the proposed approach works better, than GPS-based systems.

A. Experimental Setup

The system was tested using a smartphone setup in places. These places included areas, cities and buildings.
The location data was gathered using GPS, Wi-Fi and cellular networks.
The systems performance was compared to traditional GPS tracking.
This was done to see if the hybrid system was more accurate and reliable, than GPS tracking.
The system used GPS, Wi-Fi and cellular networks to get location data.
It was tested in areas, urban environments and indoor locations.
The goal was to check if it worked well in conditions.

B. Location Accuracy Analysis

TABLE I: LOCATION ACCURACY COMPARISON

System	Open Area(m)	Urban Area(m)	Indoor(m)
GPS Only	5-10	15-30	Not Accurate
Hybrid System	5-8	10-20	15-25

The results show that the hybrid system improves accuracy, especially in urban and indoor environments.
The GPS system works well when you are outside in an open area. It can tell you where you are.. When you are inside a building or in a city with a lot of tall buildings the GPS system does not work as well.
The new system that we are talking about is better because it uses than one way to figure out where you are. This makes the location more accurate. The new system is an approach that combines multiple data sources, like the GPS system to get a better idea of your location.
Results show that this hybrid approach really helps to improve the accuracy of the location. So the hybrid approach is good because it uses the GPS system and other data sources to give you an accurate location.

C. System Performance Comparison

TABLE II: SYSTEM PERFORMANCE COMPARISON

Parameter	GPS Only	Hybrid System
Accuracy	Medium	High
Stability	Low	High
Reliability	Low	High
Battery Usage	High	Optimize

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The hybrid system performs better across all parameters compared to GPS-only tracking.
A study compared GPS- hybrid tracking methods.
The hybrid system worked better in terms of accuracy, stability and consistency.
It helped reduce location mistakes and made tracking more reliable in situations.
The hybrid system performed well with GPS and other methods together.
It gave accurate results than using GPS alone.
The hybrid approach was more stable and consistent.
It worked well in environments where GPS signalsre weak. The hybrid system is a choice, for tracking.

D. Response Time Analysis

TABLE III RESPONSE TIME ANALYSIS

System	Response Time(sec)
GPS Only	3-5 sec
Hybrid System	1-2 sec

The hybrid system provides faster response, ensuring quick alert generation during emergencies.
The system was checked to see how fast it can process location information and send out alerts. This new system is better because it responds faster and people can count on it to work properly. The new system helps people get help on time when they are, in a situation.

E. Scalability and Efficiency

The system is made to work with many users at the same time. It does this without getting much slower. The system uses methods to make the battery last longer and to process data in a smart way. This means the system uses resources in a way, which makes the system a good choice for use in the real world. The system is designed to handle users efficiently and the system is suitable, for real-world deployment because the system uses battery optimization techniques and adaptive data processing.
As shown in Fig. 4, the system demonstrates sublinear latency growth with increasing dataset size.
The system works well even when it has to deal with a huge number of documents we are talking about up to 100k documents. It does not take a time to respond and it always performs in a consistent manner. This is what makes the document retrieval system so great for world applications that need to look through a lot of information. The document re- trieval system is very good, at handling large scale information retrieval tasks.

F. Key Observations

- Hybrid tracking significantly improves location accuracy.
- Performance is more reliable in indoor and urban envi- ronments.
- Sensor integration enhances tracking continuity.

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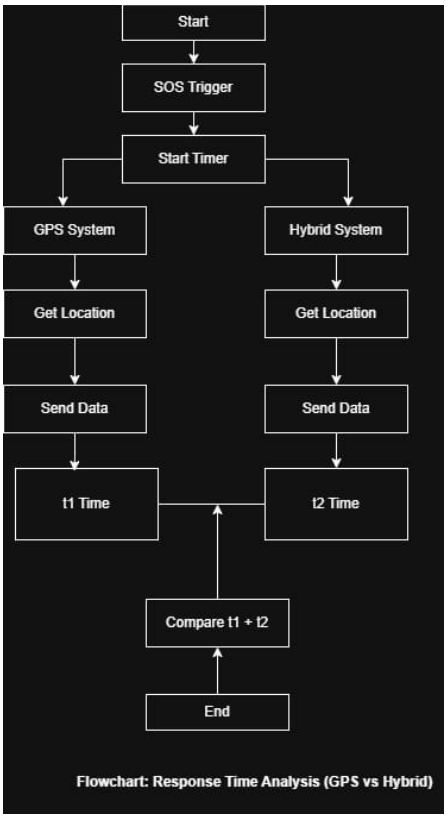

Fig. 4. Response time analysis of GPS-only and hybrid tracking systems.

• The system reduces dependency on GPS alone.
• Faster response improves emergency handling.

These findings highlight the effectiveness of the proposed approach in balancing accuracy, efficiency, and scalability.

VI. DISCUSSION

The Omni Query system does a job of finding a good bal- ance between being accurate working quickly and handling a lot of work. This is because the Omni Query system combines a lot of parts, like hybrid retrieval, semantic chunking and model quantization which all work together to make the Omni Query system perform well.

A. Impact of Hybrid Tracking

When we use an approach that combines GPS and Wi-Fi and cellular networks the location accuracy is a lot better than it is with systems that only use GPS. This hybrid approach works well in places like inside buildings and, in cities where the GPS signal is not very strong or we cannot get it at all. The hybrid approach ensures that we get results in these places.

B. Effect of Sensor Integration

The use of sensors like accelerometers and gyroscopes makes tracking better.
These sensors help keep track of location even when main signalsre weak.
This makes the whole system more reliable.
Mobile sensors such, as accelerometers and gyroscopes help to improve tracking.
They help to keep location estimation stable even when primary signalsre not strong.

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This improves reliability of the system.

C. Trade-offs in Accuracy and Battery Usage

The hybrid system is really good at making things more accurate. It might make the computer work a bit harder though.. That is okay because we use special methods to make the battery last longer. These methods stop the system from checking the location many times and that helps to save power. The hybrid system is good, at what it does. These special methods help to balance things out.

D. Scalability and Efficiency

The system is made to help users at the same time. The system is a model that changes as the environment around it changes so the system can keep working well without slowing down or using up too many resources. The hybrid model is really good, at dealing with the environment so the system can keep performing. The system and the hybrid model work together to make sure everything runs smoothly.

E. Limitations

Despite improvements some limitations still exist.
For example extreme indoor settings, with no signal sources can still impact accuracy.
Also relying on sensors can cause mistakes when estimating movement.
These issues are important to consider when using this technology.
The accuracy can be affected in indoor environments.
Sensor dependency is another factor that can introduce errors.

F. Practical Implications

The women safety system that is being proposed can really be used in the world to help keep women safe.
The women safety system provides a response when women need help it is more reliable so women can count on it and it is easier for women to use when they are, in an emergency situation, which makes the women safety system very practical to use.

G. Summary of Insights

The study shows that hybrid tracking is better, than the way of using GPS. When you combine technologies and sensors it makes the system more accurate and stable. This means hybrid tracking works well. Hybrid tracking is more reliable because it uses things together like multiple sensors to get the best results.

VII. CONCLUSION

This paper is about a way to track locations that is helpful for women safety applications. The old way of using GPS to track locations has some problems. For example it does not work indoors or in cities the signal can be blocked it uses up a lot of battery power and it needs a stable internet connection. These problems make it hard to use safety applications in emergency situations when you really need to know where you are.
To fix these problems the new system uses a combination of GPS, Wi-Fi and cellular networks well as sensors to help with tracking. This way the system can always find the way to track your location no matter where you are. It also uses techniques to make sure the location information is accurate and stable.
The new system was. It works better than the old GPS-based system. It is more accurate, reliable and faster. It even works well in places where GPS does not like indoors or in cities. The system is also designed to use battery power so it can be used on mobile devices.
The new system is a solution for women safety applications because it can track locations reliably and respond quickly in emergency situations. This makes users feel safer and more confident.

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In the future the system can be made better by using new technologies like artificial intelligence to predict safety problems or by using wearable devices to track locations all the time. New communication technologies, like 5G can also help make the system faster and more reliable. These changes can make the system work better and be used in many different situations.

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