

ARMADEIRA

Network data collector

Mobile App User's Guide

Armadeira

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1. Introduction

1.1 Purpose and scope

The Armadeira app was developed for mobile devices (smartphones, tablets, or others) with the purpose of collecting information about the network to which the device is connected. It works by collecting network communication data. The name "Armadeira" was chosen for the app because it primarily collects wireless network data, and its network structure is similar to a spider web. Furthermore, the team wanted a name that was related to the Amazon region. The word "Armadeira" refers to a species of spider found in the Amazon region, and therefore, was considered an appropriate choice.

1.2 How/What kind of information is collected?

The Armadeira app's main objective is to collect network data on Android smartphones. This data includes Wi-Fi and mobile network information and is collected at a granularity of one second. To ensure user security and privacy, Armadeira stores the collected data in a .csv file on the device itself. This ensures that the data is not shared with third parties and that users have full control over their information. With the collected data, machine learning techniques can be used to analyze performance and predict uplink and downlink transfer rates, identify possible bottlenecks, and help users make informed decisions about their Internet connection.

1.3 Compatibility

To use the Armadeira application, you must have a smartphone with an Android operating system, at least version 12 of the operating system. In addition, your device must have at least 2 GB of RAM and 150 MB of free storage space (recommended). These requirements are essential to ensure the proper functioning of the application and to avoid performance and stability issues. Therefore, it is important to check device compatibility before downloading and installing the app in order to have a satisfactory experience.

1.4 Organization

This application was developed by the Intelligent Hardware (IH) group, part of the project characterized as Research, Development and Technological Innovation (RD&I), entitled Artificial Intelligence Techniques for Software Performance Analysis and Optimization (SWPERFI). Advanced data mining and artificial intelligence techniques, including deep learning and general computing, are being applied to analyze performance metrics. Specifically, the project is developing innovative methods to verify dependencies, establish correlations, determine possible problems, and create a new approach embedded in a prototype tool for verification, testing, and optimizing software performance using AI techniques. Any questions, concerns, or issues regarding the app may be resolved by contacting the SWPERFI project, and they will direct you to the IH team.

SWPERFI Website: <https://swperfi.icomp.ufam.edu.br/>

General Info Contact: swperfi@icomp.ufam.edu.br

Armadeira App E-mail: swperfi-ih@icomp.ufam.edu.br

2. Technical Specification

Name	Armadeira
Description	The Armadeira app's main objective is to collect network data on Android smartphones.
Performed by	SWPERFI
Responsible team	Intelligent Hardware - IH
Support	You must have a smartphone with an Android operating system, at least version 12 of the operating system. In addition, your device must have at least 2 GB of RAM and 150 MB of free storage space (recommended).
Current version	4.0.0
Download link	Armadeira App (http://swperfi-project.github.io/Pages-dev/ArmdNetworkDataCollector-app)

3. Installation

Note: In this new version, if you have the previous version of the Armadeira application installed, you will need to uninstall the application and remove the "/Armadeira" folder located at: InternalStorage/Documents/Armadeira

To install the Armadeira app on an Android device, follow the steps below:

1. Access the app file, which is stored on GitHub Pages, at the following link: Armadeira App (<http://swperfi-project.github.io/Pages-dev/ArmdNetworkDataCollector-app>);
2. The file is already available for public download, so it is not necessary to request permission to download it;
3. Download the application file on the Android device directly from the Google Drive app or using a web browser, once you have access to the file;
4. Make sure to allow the download of unknown files on your Android device by enabling the "Unknown sources" option in the security settings;
5. After the application file is downloaded, access the device's file management application and locate the Armadeira application file as illustrated in Figure 1;
6. Touch the file to start the installation process;
7. The device may display a security warning message informing that you are about to install an app from an unknown source. As the app comes from a secure source, tap on "Install" to continue;
8. The installation of the application may take a few seconds, and after completion, you can open it from the device's app menu.

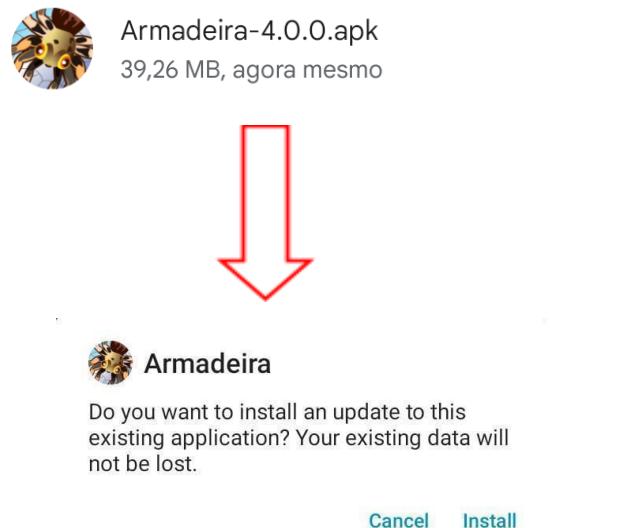


Figure 1. Example of the installer obtained through the link in this manual.

4. App overview

4.1 Splash screen

Figure 2 show the application displays a splash screen that shows the application logo and loads some project settings.



Figure 2. Loading screen (splash screen) of the Armadeira application.

4.2 Permissions screen

After the splash screen, the app is directed to a welcome screen, followed by a screen briefly explaining the purpose of the app and informing that it will be necessary to request certain permissions in order for the app to fulfill its purpose, as illustrated in Figure 3.

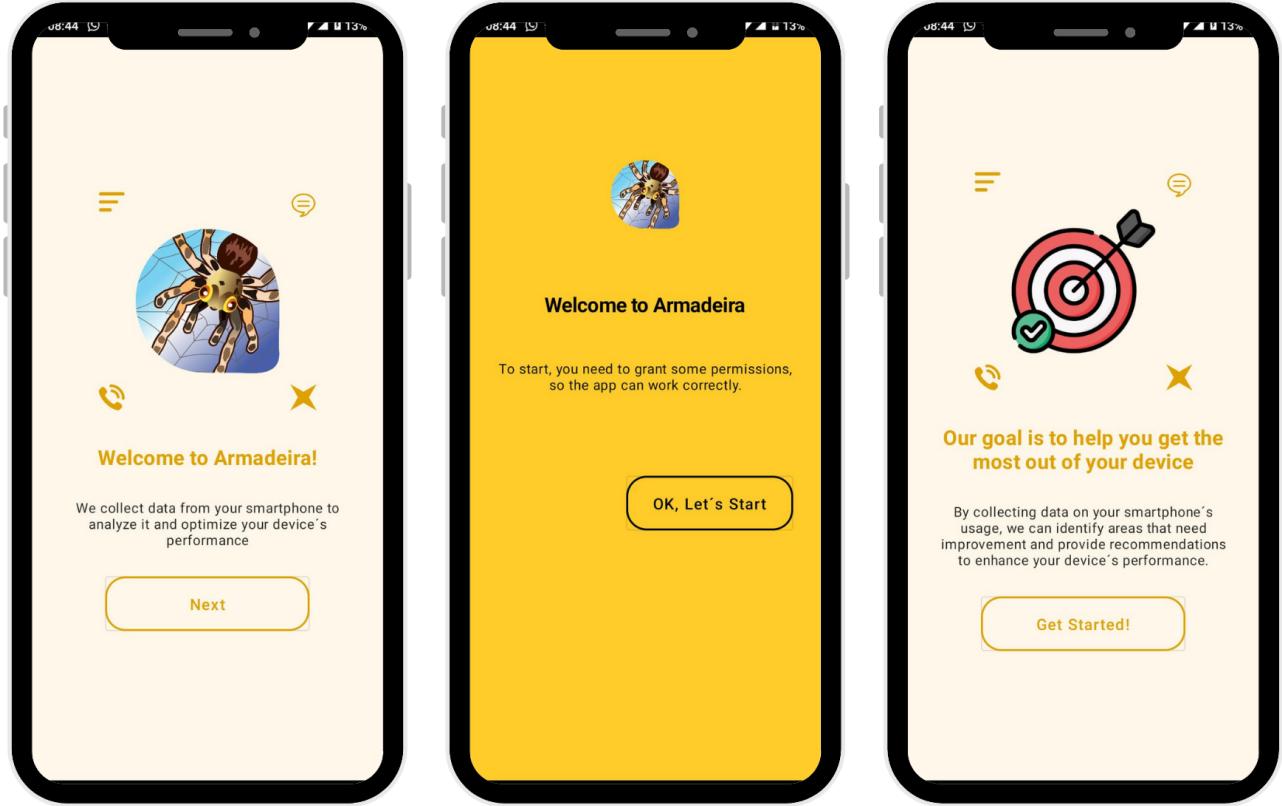


Figure 3. Initial screens welcoming the user, stating the app's purpose, and informing about permission requests.

In Figure 4, we have the first permission on the location screen 1, this permission can be granted by clicking on Permission "Allow all the time". The next permission, shown in Figure 4, is intended to assist in reading and writing CSV files generated by Armadeira on newer versions of Android. Simply activate the "Access to manage all files" option and go back to the previous screen.

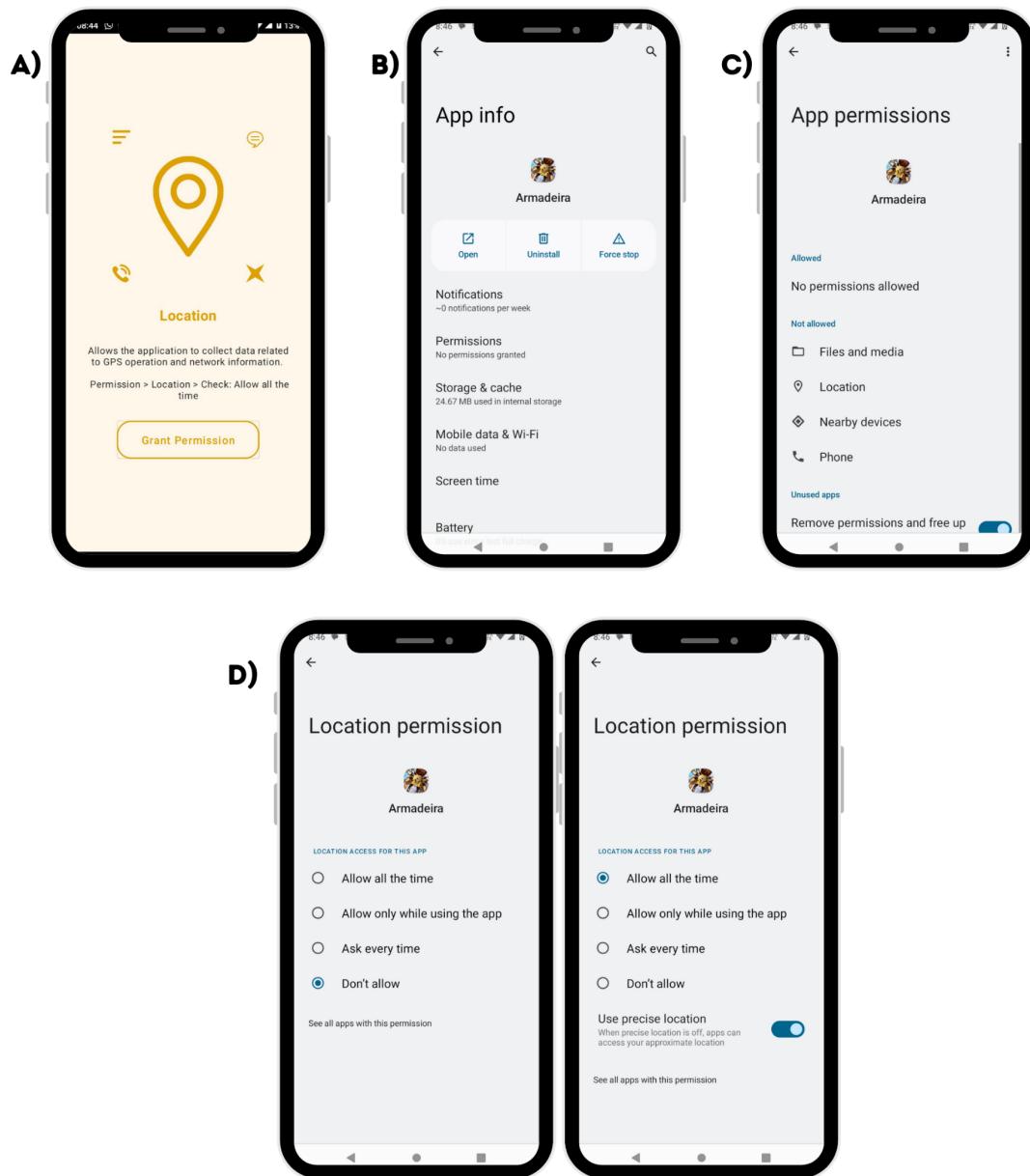


Figure 4. Required permissions for: a) Obtaining location; b) Access Permissions; c) Access Location permissions; d) change the permissions to Allow all the time

OBS: to correct collect of data, it is necessary to give the permission to “Allow all the time” in the “Settings”

In Figure 5, the first permission requested allows collecting information about mobile networks. The other permission, shown in Figure 5, requires a bit more time. The steps are to click "OK" on the message that appears on the app screen. After that, a new screen titled "Overlay other apps" will appear, with a list of apps. In this list, you need to locate the "Armadeira" app, possibly having to scroll to the end of the list. Once you find the app name, simply click on it and accept the overlay permission. Once the process is complete, just go back until you reach the Armadeira screen again.

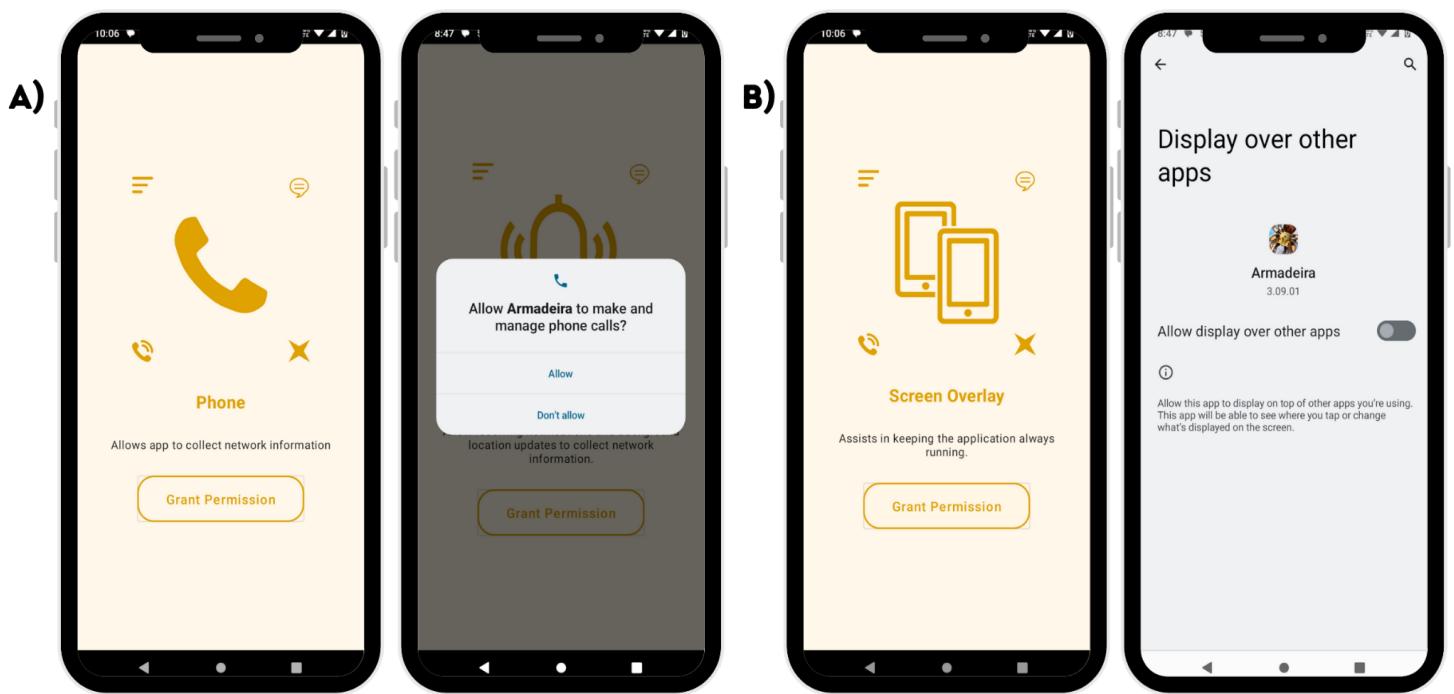


Figure 5. Required permissions for: a) Accessing information about mobile networks; and b) Running Armadeira app in the background.

Finally, a new tab of "Required permission" will appear, where you just need to click "Ok" and "Allow access to usage" before returning to the app. Once the process is completed, the user can click on the "Start App" button at the end of the screen to access the main screen of the application, as shown in Figure 6.

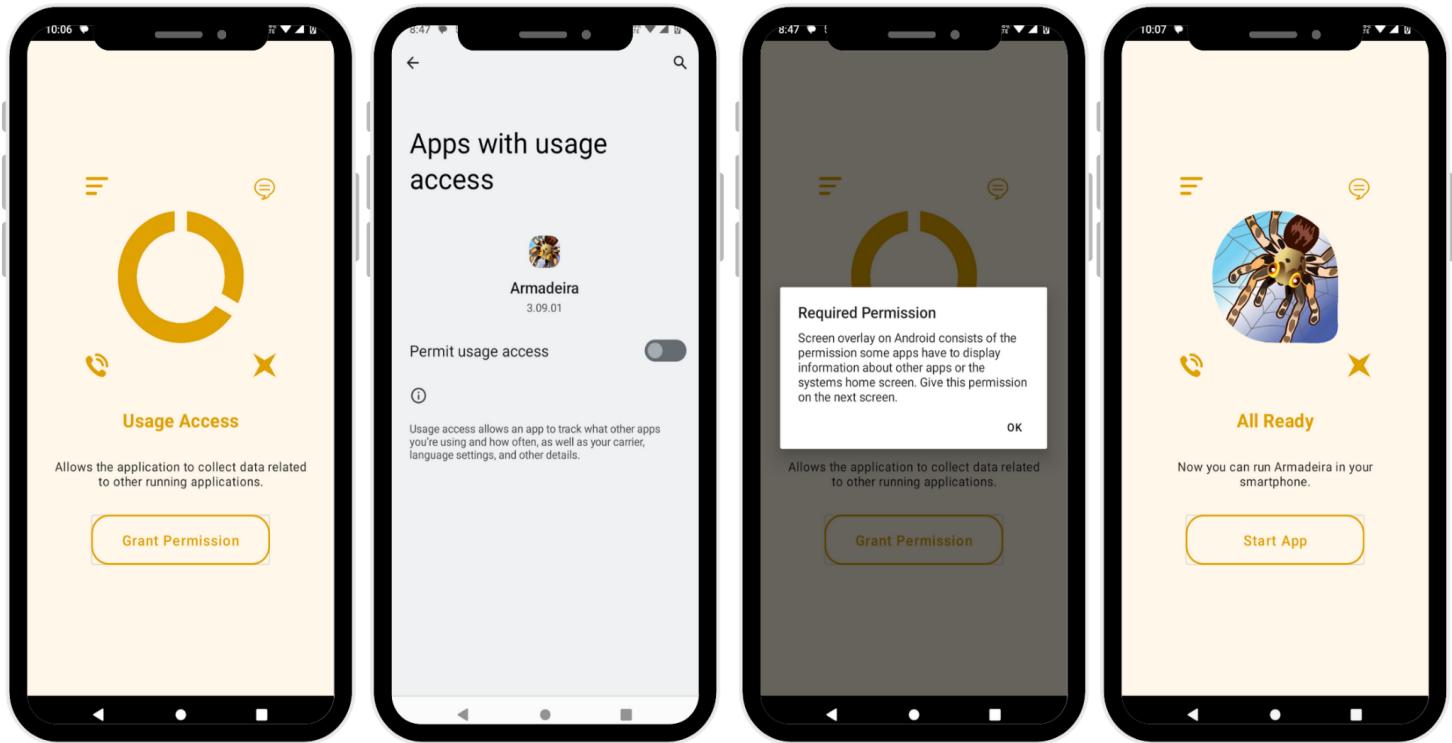


Figure 6. On the first screen, permission to manage files for reading and writing data in ROM memory. On the fourth screen, it is possible to start the app.

4.3 Home screen

The Figure 7 shows Home screen displays some information such as the Android version that the device is using, as well as the device model. As for the Network information, the application informs whether the device has Wi-Fi, mobile data, and Bluetooth enabled or not. Additionally, it checks whether the device has location services enabled.

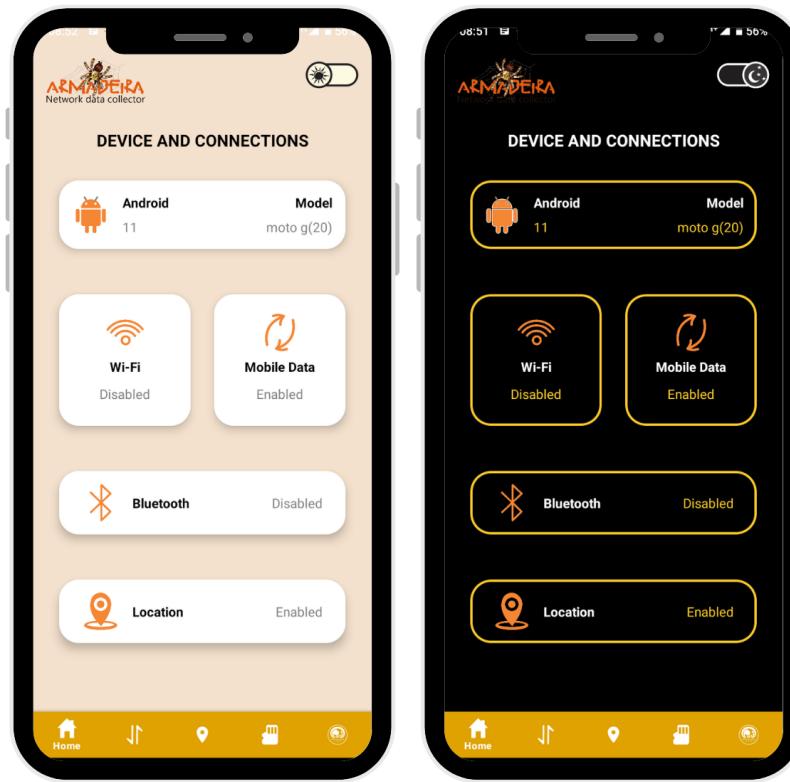


Figure 7. Home screen.

4.4 Device screen

Figure 8 shows the Device screen, the application shows which signal provider the device is using, as well as the type of connection used. It also displays the network band used by the device and shows uplink and downlink throughput that occurs on the network. It also displays the frequency and signal strength.

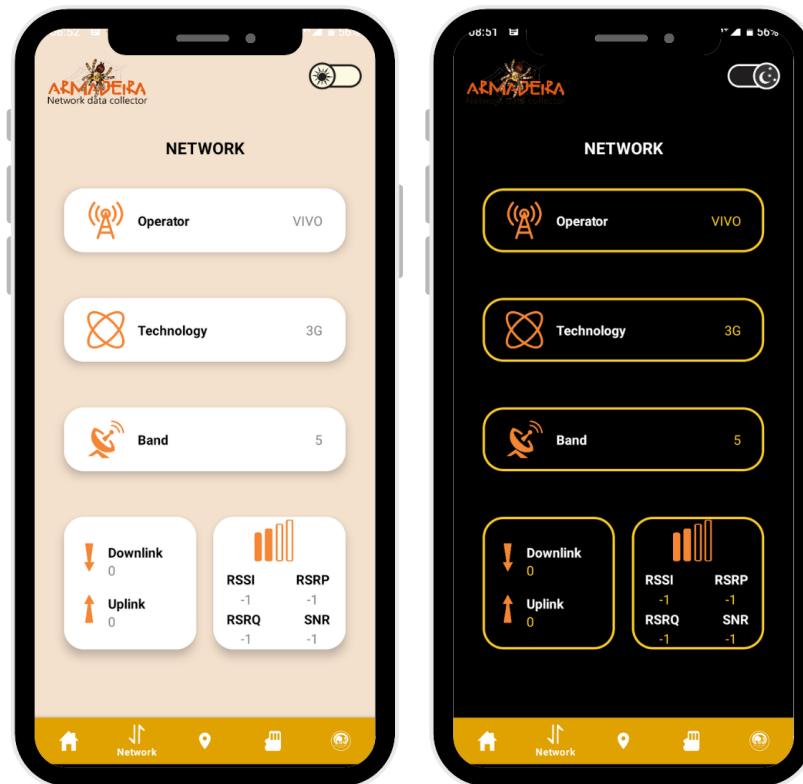


Figure 8. Device screen.

4.5 Memory screen

Figure 9 shows the Memory screen that shows the total space available on the device's internal storage, as well as the amount of memory that is already being used. It also displays the amount of RAM memory in the device and the amount of memory that is being used.

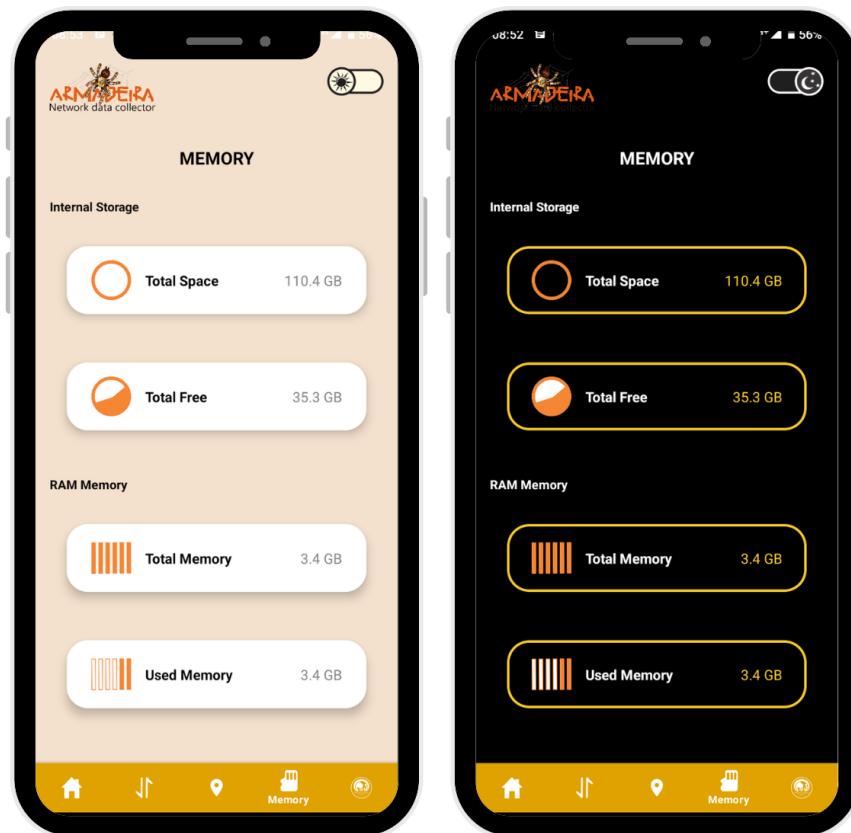


Figure 9. Memory screen.

4.6 Location screen

In this latest update, Figure 10 shows a new feature was introduced: a dedicated screen for displaying the user's location. Now, when accessing this new version, users will be able to view the map clearly and accurately, with their current location highlighted. This addition will provide a more intuitive and practical experience when using our application.

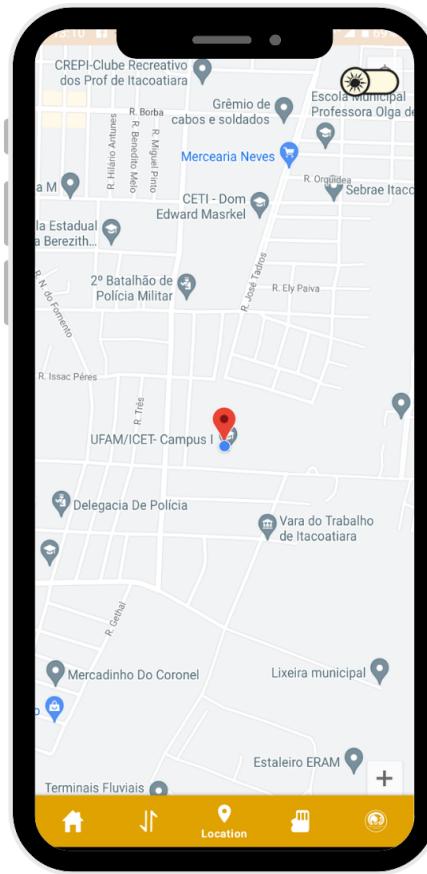
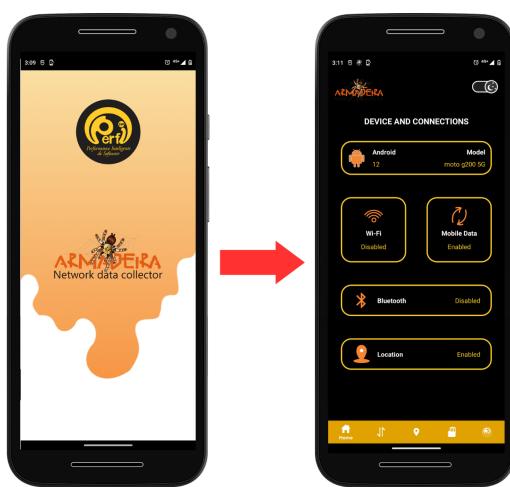


Figure 10. Location screen.

5. How to use

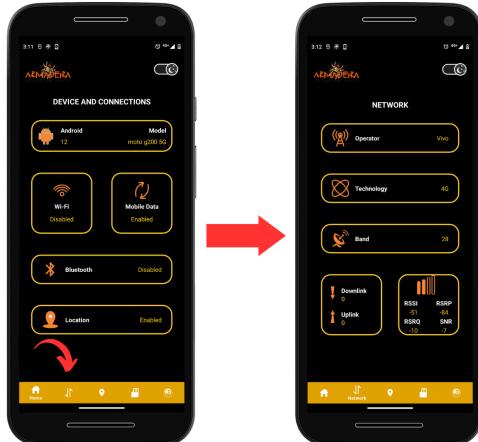
To use the Armadeira Network Data Collector application, you need to select the application by clicking on the app icon in your device. The app will open in a splash screen and in sequence will show you the home screen, as shown in Figure 11.



- ❖ In the home screen you can see the information about:
 - See if the Wi-fi, Mobile Data, Bluetooth and Location are enabled or not
 - Operational system version
 - Model's device
 - Network information

Figure 11. How to access the home screen.

To see more information about the Network, you need to click on the Network icon, to move to the Network Screen, as shown in Figure 12.



- ❖ In the network screen you can see information about:
 - Operator
 - Technology
 - Band
 - Uplink and Downlink
 - Frequency
 - Network quality parameters

Figure 12. How to access the network screen.

To see more information about the current location of the device, you need to click on the location icon and you will move to the Location Screen, as shown in Figure 13.

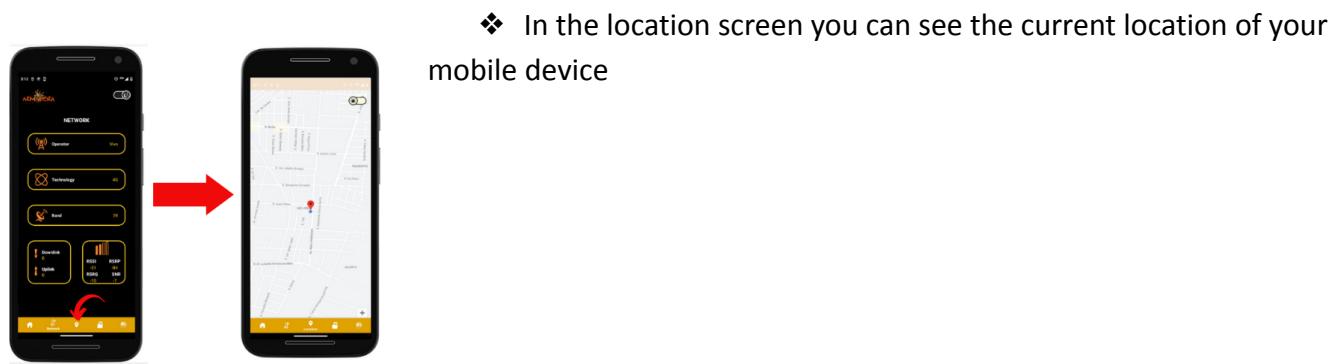


Figure 13. How to access the location screen.

To see more information about the memory of the device, you need to click on the memory icon and you will move to the Memory Screen, as shown in Figure 14.

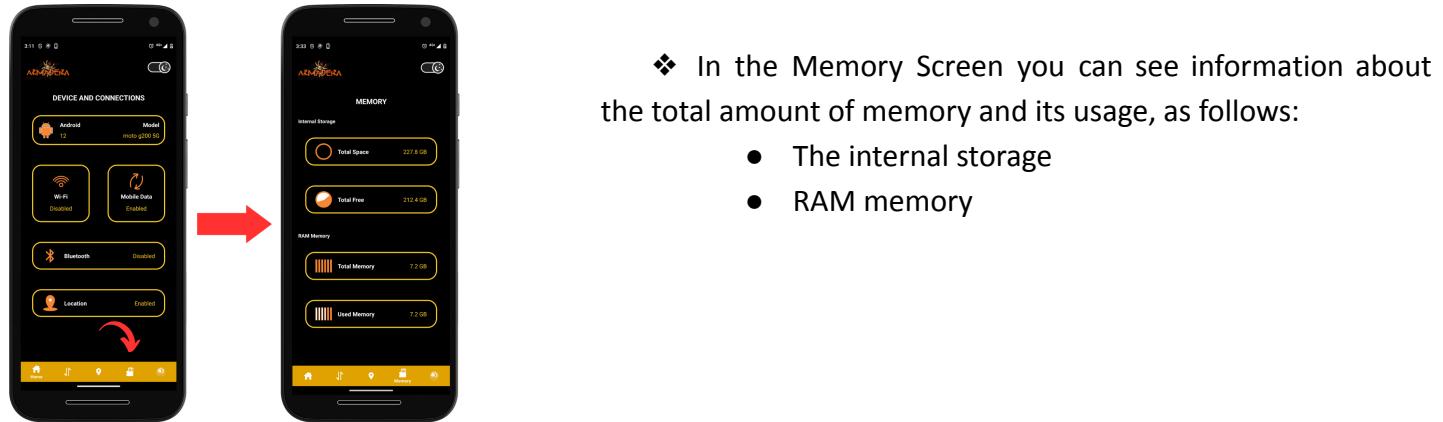


Figure 14. How to access the memory screen.

To see more information about the app and the developer group, you need to click on the SWPerfi icon and you will move to the About Screen, as shown in Figure 15.

- ❖ In the About Screen you can see information about the Project that developed the app, and some ways to contact and know more about the project.

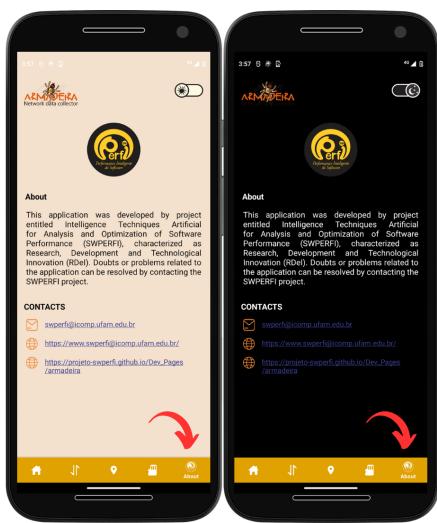


Figure 15. How to access the About screen.

6. Description of application's functions

The Armadeira offers several functionalities that aim to collect and store data from mobile devices, mainly related to device connectivity. This data is stored locally on the device itself, in the "Armadeira" folder, and can be accessed through the file manager. One of the main features of Armadeira is real-time data collection, which is updated every second in CSV spreadsheets. This data includes information about the device's internet connection, such as frequency, signal strength, bandwidth, among others. Other important data is also collected throughout the day and stored in the CSV spreadsheet, such as latitude and longitude, amount of RAM being used, amount of free memory on the device, among other information.

7. Additional information about the collected data

7.1 Device

Feature name	Type	Value	Measure	Description
deviceId	string	string	no	A unique identifier assigned to a specific device.
model	string	string	no	Indicates the device model.
androidVersion	string	string	no	Indicates the android version.
currentDateTime	string	string	no	Indicates the date and time the data was generated or logged.

7.2 Location

Feature name	Type	Value	Measure	Description
locationStatus	boolean	1 or 0	no	(1) indicates if the user's location is enabled, (0) indicates disabled.
latitude	double	floating	no	The latitude value of the user's location.
longitude	double	floating	no	The longitude value of the user's location.

7.3 Mobile

Feature name	Type	Value	Measure	Description
mobileStatus	boolean	1 or 0	no	(1) indicates if the mobile device is turned on, (0) indicates turned off.
netType	string	1G, 2G, 3G, 4G or 5G	no	A parameter that indicates the type of mobile network currently in use by the mobile device.

roaming	boolean	1 or 0	no	Indicates whether the device is roaming on a network outside of its home network.
downstreamBandwidth	int	floating	Kbps	The download speed of data on a mobile network, measured in kilobits per second (Kbps).
upstreamBandwidth	int	floating	Kbps	The upload speed of data on a mobile network, measured in Kbps.
rx	long	floating	Bytes	Received data rate in Bytes.
tx	long	floating	Bytes	Transmitted data rate in Bytes.
networkOperator	string	Ex. “Vivo”, “Claro”, “Tim”	no	Identifies the mobile network operator to which the mobile device is connected.
chipOperator	string	Ex. “Vivo”, “Claro”, “Tim”	no	Identifies the operator of the SIM card in the mobile device.
mcc	string	Ex. 724	no	Mobile country code (MCC) - a unique identifier assigned to a country for mobile network purposes.
mnc	string	Ex. 11	no	Mobile network code (MNC) - a unique identifier assigned to a mobile network within a country.
asuLevel	int	Ex. 32	no	Absolute signal strength value in GSM (ASU) units.
cqi_lte	int	floating	no	Channel quality indicator - a measure of the quality of the communication channel. in 4G
cqi_nr	int	floating	no	Channel quality indicator - a measure of the quality of the communication channel. in 5G
dbm	int	floating	dbm	Received signal power in decibels relative to one milliwatt (dBm).
level	int	floating	dbm	Received signal strength indicator (RSSI) in dBm.
rsrp_lte [dBm]	int	floating	dbm	Reference signal received power (RSRP) in dBm. in 4G
rsrp_nr [dBm]	int	floating	dbm	Reference signal received power (RSRP) in dBm. in 5G

rsrq_lte	int	floating	db	Reference signal received quality (RSRQ) in dB. in 4G
rsrq_lte	int	floating	db	Reference signal received quality (RSRQ) in dB. in 5G
rssi [dBm]	int	floating	dbm	Received signal strength indicator (RSSI) in dBm.
rssnr	int	floating	db	Reference signal received quality (RSRQ) in dB.
sinr	int	floating	db	Reference signal received quality (RSRQ) in dB. in 5G
earfcn	int	floating	no	E-UTRA Absolute Radio Frequency Channel Number (EARFCN) - a unique identifier for a radio channel in a cellular network.
band	int	floating	no	The frequency band on which the mobile device is operating.
frequency [MHz]	int	floating	Mhz	The frequency in MHz at which the mobile device is operating on a cellular network.
ci	int	floating	no	Cell identity (CI) of the current mobile network cell to which the device is connected.
pci	int	floating	no	Physical cell identity (PCI) of the current mobile network cell to which the device is connected.
tag	int	floating	no	A user-defined label or tag assigned to the data.
downLinkFrequency	int	floating	Mhz	uplink frequency channel.
upLinkFrequency	int	floating	Mhz	downlink frequency channel.

7.4 Battery

Feature name	Type	Value	Measure	Description
levelBattery	int	0-100	%	Indicates the current battery level of the device, ranging from 0% to 100%.

batteryHealth	int	1-7	no	Indicates the health status of the device's battery, ranging from 1 (very poor health) to 7 (excellent health).
batteryConnectionStatus	int	0-1	no	Indicates whether the device's battery is currently connected or disconnected
batteryChargingStatus	int	0-3	no	Indicates the current charging status of the device's battery, ranging from 0 (not charging) to 3 (fully charged).
batteryTemperature	float	-50 to 150	Celsius	Indicates the current temperature of the device's battery in Celsius.
batteryCurrent	double	floating	mA	Indicates the current flow of electrical charge through the device's battery in mA
batteryVoltage	float	floating	Volts	Indicates the current voltage of the device's battery in volts.
batteryPower	double	floating	Watts	Indicates the current power output of the device's battery in watts.
batteryCapacity	double	floating	mAh	Indicates the current capacity of the device's battery in milliampere-hours (mAh).
batteryPresence	boolean	1 or 0	no	Indicates whether a battery is present in the device.



8. Release Notes

In this feature, the focus is on optimizing code efficiency to make it more accurate to 3GPP table specifications. We also introduced a new data collection method based on object-oriented models, eliminating old functions that impacted application performance. The main improvements that this version present are:

Frequency Capture Optimization- We have refactored the frequency capture logic to more accurately align with the standards in the 3GPP table. This results in more efficient and reliable collection of 4G and 3G network information.

Additionally, we replaced the old functions with an object-oriented model for data collection. This not only improves code organization, but also contributes to more efficient execution and, consequently, reduces battery consumption.

We review and update the calculations performed when collecting network uplink and downlink information. This ensures improved accuracy in measuring and reporting this important data to the csv file.

In this version was implemented optimizations that resulted in a significant decrease in the size of the application. This not only improves the overall performance of the app, but also contributes to a more responsive user experience.