

# Authors

- 1. Amila Jayasinghe
- 2. Harini Sawandi

Reviewed and edited by

- 1. Samith Madusanka
- 2. Chethika Abenayake

#### Reviewed by

- 1. XXXXX (University Name)
- 2. XXXXX (University Name)

This manual was produced by the Department of Town & Country Planning, with invaluable support of the Erasmus+ Capacity Building in Higher Education (CBHE) project 'Curricula Enrichment for Sri Lankan Universities delivered through the application of Location-Based Services to Intelligent Transport Systems' (LBS2ITS <u>https://lbs2its.net/</u>)

Project Number: 618657-EPP-1-2020-1-AT-EPPKA2-CBHE-JP

Programme: Erasmus+

Key Action: Cooperation for innovation and the exchange of good practices

Action Type: Capacity Building in Higher Education

Co-funding: Erasmus+ Programme of the European Union

# Description

This manual serves as an essential educational resource for both undergraduate and postgraduate degree programs, offering a detailed, step-by-step guide to GPS and GNSS data collection using modern devices such as the Stonex S70 and S70G tablets. Designed to bridge the gap between theoretical knowledge and practical application, this guide is meticulously crafted to meet the needs of students, educators, and practitioners alike.

Within the manual, readers will find comprehensive instructions on setting up and configuring smartphone and GNSS devices, collecting high-accuracy spatial data, and employing GIS software to analyze this information. It covers various applications, including tree mapping, urban planning, environmental monitoring, and more. The manual not only enhances learning in academic settings by providing real-world applications and case studies but also equips industry professionals with the skills necessary to conduct advanced spatial analysis and contribute meaningful insights in their fields.

Key topics include detailed steps on initializing and configuring GNSS devices to ensure optimal accuracy and reliability, along with guidelines on effective field data collection to achieve high-quality GNSS data. The manual provides comprehensive instructions on downloading, processing, and managing collected data using GIS software. It features real-world examples and case studies that demonstrate the practical applications of GNSS data collection, as well as techniques for analyzing spatial data to derive meaningful insights and support decision-making processes.

Whether you are a student aiming to master GNSS and smartphone data collection and geographic information systems, a teacher looking for robust educational tools, or a practitioner in need of refining your technical expertise, this manual offers invaluable guidance and support. It ensures that users at all levels gain proficiency in leveraging modern technologies to explore and solve geographic challenges effectively.

# TABLE OF CONTENT

TABLE OF CONTENT4
LIST OF FIGURES
1.INTRODUCTION TO TRAINING MANUAL10
2. OVERVIEW OF ENVIRONMENTAL MAPPING AND ITS SIGNIFICANCE
3.REQUIRED TOOLS / SOFTWARE AND EQUIPMENT12
4.DATA COLLECTION13
4.1 Different between Smartphone (Global Positioning System) and Global Navigation satellite system
4.2 Data Collection using Smartphones (Global Positioning System)15
4.2.1 Overall Data Collection Process15
4.3 Steps (Mobile Phones)18
4.4 Data Collection using GNSS (Global Navigation Satelite System)
4.4.1 Overall Data Collection Process35
4.4.2. S70 G Data Collection36
4.4.3.S70 Data Collection71
5. MEASURE AND MAP NOISE POLLUTION WITH MOBILE PHONE
5.1 Introduction112
5.2 Overview of Mobile Apps for Noise Measurement113
5.2.1 Features of NoiseCapture App:113
5.2.3 Architecture Diagram and Workflow114
5.3 Steps

# LIST OF FIGURES

Figure 1- Overview of the Environment	11
Figure 2 - Process of Data Collection	15
Figure 3- Interface of the Kobo Tool Box	
Figure 4 - Create Account	19
Figure 5 - Registration Process	19
Figure 6 - Create a New Data Collection Form	20
Figure 7 - Interface of Create a new project	20
Figure 8 - Create Project	21
Figure 9 - Project Interface	21
Figure 10 - Add Question Interface	21
Figure 11 - Insert Questions	22
Figure 12 - Selecting Type of the Questions	22
Figure 13 - Proceed to the next Questions	23
Figure 14 - Save the Project	23
Figure 15 - Preview the Project	23
Figure 16 - Redirected to the project page	23
Figure 17 - Created Form	24
Figure 18 - Deploy	25
Figure 19 - Download and Install the app	25
Figure 20 - Interface of the ODK Figure 21 - ODK Details	
Figure 22 - Kobo Tool Box	
Figure 23 - Link the Form	
Figure 25 - Download the Form	29

Teaching and Learning Manual Step By Step Guide: Environmental problem mapping using smartphone and GNSS

Figure 26- Collect Data	29
Figure 27 - Data Exporting Process	30
Figure 28 - Collected Data	31
Figure 29 - Data Downloading	31
Figure 30 - Excel File	32
Figure 31 - Add Data to QGIS	33
Figure 32 - Collected Data point of trees	33
Figure 33 - Edit the Data	34
Figure 34 - Share the Details	34
Figure 35 -Data Collection from GNSS	35
Figure 36 - Two types of S70G	36
Figure 37 -Cube a v6	37
Figure 38 -Project Manager	
Figure 39 - Create New File	
Figure 40 -Create Project	40
Figure 41 - Set Coordinates	41
Figure 42 -Stonex Cube	42
Figure 43 - Coordinate Systems	43
Figure 44 - Set the Coordinates	44
Figure 45 - Set up the Device	45
Figure 46 - Disconnecting	46
Figure 47 - Connect the Device	47
Figure 48 -Working Mode	48
Figure 49 - Select Rover	49
Figure 50 - Setting the Rover	50
Figure 51 -Enable the GPS	51

Teaching and Learning Manual Step By Step Guide: Environmental problem mapping using smartphone and GNSS

Figure 52 -Get Acess Point	
Figure 53 -Select the point	53
Figure 54 - Finalize the Rover Setup	
Figure 55 -Setup the Antenna	55
Figure 56 - Select the Antenna Type	
Figure 57 - Point Survey	57
Figure 58 -Survey Map	
Figure 59 -Topo Point	
Figure 60 - Quality Check	60
Figure 61 -Map Page	61
Figure 62 -Get the point	62
Figure 63 - Save the Point	63
Figure 64- Collected Point	64
Figure 65 - Point Library	65
Figure 66 - Export Data	
Figure 67 -Click Export	67
Figure 68 - Export Formats	
Figure 69 -User Action	
Figure 70 -Share	
Figure 71 -Cube a v6	71
Figure 72 -Project Manager	
Figure 73 -Create New File	73
Figure 74Create Project	74
Figure 75 -Enable GIS	75
Figure 76 -Set Coordinates	
Figure 77 -Stonex Cube	77

reaching and Learning Manual	
Step By Step Guide: Environmental problem	mapping using smartphone and GNSS

Figure 78 - Coordinate Systems	78
Figure 79 -Set the Coordinates	79
Figure 80 - Tree Mapping Sub-Category	80
Figure 81 -Naming	81
Figure 82 -Activate GIS Features	82
Figure 83 -Edit	83
Figure 84 -ADD	84
Figure 85 -Edit GIS Features	85
Figure 86 - Edit GIS Features	86
Figure 87 - Edit GIS Features	87
Figure 88 -Set GIS Features	88
Figure 89 – User Action Required	89
Figure 90 -Set Repository	90
Figure 91 -User Action	91
Figure 92 -Set Gis and Repository	92
Figure 93 -Set up the Device	93
Figure 94 - Disconnecting	94
Figure 95 -Connect the Device	95
Figure 96 -Working Mode	96
Figure 97 -Rover	97
Figure 98- Set the parameters	98
Figure 99- Enable the following satellite system	
Figure 100-Point Survey	100
Figure 101 -Map page	101
Figure 102Get the point	102
Figure 103-Topo point	103

Teaching and Learning Manual

reaching and Learning Manual	
Step By Step Guide: Environmental problem	em mapping using smartphone and GNSS

Figure 104- Add description	
Figure 105-Enter GIS attributes	105
Figure 106 - Collect the data	
Figure 107- Point Library	107
Figure 108 -Export Data	
Figure 109 -Exporting	
Figure 110 -Export Format	110
Figure 111 -Export	111
Figure 112 -Noise Capture App	113
Figure 113 - Work Process	114
Figure 114 - Install the app	116
Figure 115 - Setup the app	117
Figure 116 -3 Main Tabs	118
Figure 117 – Recording	119
Figure 118 -Stop the Recording	119
Figure 119 -Validate	
Figure 120 -Results	
Figure 121 -Map Features	121
Figure 122 -Export Data	121
Figure 123 - Add to QGIS	
Figure 124- Add Symbology	124

# **1. INTRODUCTION TO TRAINING MANUAL**

This manual offers comprehensive guidance for individuals and groups engaged in evaluating and tackling environmental issues employing gathering and analyzing spatial information. This guidebook provides users with the required tools and approaches to map and comprehend environmental problems in their communities by utilizing GPS and GNSS technology, as well as open-source applications including QGIS.

Because of the growing environmental issues the world is confronting, such as climate change, biodiversity depletion, pollution, and habitat destruction, the demand for accurate and feasible data has become exceedingly crucial. Environmental problem mapping is an essential initial process in recognizing, ranking, and addressing environmental concerns, facilitating well-informed decision-making and focused solutions.

Smartphone / GPS (Global Positioning System) and GNSS (Global Navigation Satellite System) technologies are crucial for mapping environmental problems. They enable users to gather accurate position data while in the field. Through the utilization of GPS/GNSS data-gathering techniques, individuals can precisely record environmental observations, monitor variations over a period, and pinpoint areas of concern with spatial detail.

This manual is intended for a wide range of readers, who are interested in tackling environmental issues at the local, regional, or global level. Our goals are to equip users with the information and abilities needed to carry out efficient environmental problem mapping projects

The manual is structured into three chapters, each focusing on key aspects of environmental problem mapping:

- 1. Introduction to the manual and overview of environmental mapping.
- 2. Detailed methodology for data collection, analysis, and interpretation using GPS
- 3. Detailed methodology for data collection, analysis, and interpretation using GNSS technologies and open-source software.

# 2. OVERVIEW OF ENVIRONMENTAL MAPPING AND ITS SIGNIFICANCE

Environmental mapping involves the systematic **collection**, **analysis**, **and visualization of spatial data** to understand and address environmental issues.



Figure 1- Overview of the Environment Source - https://www.edrawmind.com/article/environment-mind-map.html

Environmental mapping provides a comprehensive perspective on environmental conditions and trends, including recording changes in land cover and vegetation, monitoring pollution levels, and assessing habitat loss. This comprehensive understanding allows us to pinpoint areas that cause concern, such as locations with high levels of pollution, the breaking up of habitats, and ecosystems that are at risk, and want immediate attention and intervention. Furthermore, environmental mapping facilitates evidence-driven decision-making and policy development by supplying policymakers with information and spatial analysis to inform the allocation of resources, land-use planning, and environmental management methods. Environmental mapping facilitates the communication of intricate environmental data in a visually comprehensible manner. Additionally, it encourages the involvement of stakeholders, enhances transparency, and encourages collaborative efforts towards achieving sustainable environmental management.

# 3. REQUIRED TOOLS / SOFTWARE AND EQUIPMENT

Category	GPS Data collection	GNSS Data Collection				
Equipment	Smartphone (Android or iOS)	Stonex S70 / S70G GNSS Receiver				
Software/Apps	CODK Collect, KoBoToolbox: (These apps allow users to create custom forms, collect GPS coordinates, and input field data efficiently) QGIS (open-source GIS software used for data analysis and visualization post-data collection, offering powerful tools for spatial analysis and mapping.)	(Data collection is done with the device itself) QGIS (for data analysis)				
Other Tools and Inputs	<ul> <li>Base Map of the Site: A base map provides contextual information about the area you are mapping, such as existing infrastructure, land cover, and topographic features</li> <li>Field Equipment (If necessary): Depending on your project needs, you may require additional measuring tools such as tape measures, or surveying equipment for collecting site-specific data.</li> <li>To ensure uninterrupted operation of your GPS/GNSS devices and smartphones, carry power banks or spare batteries for extended fieldwork sessions</li> </ul>					

Table 1 -Required Items

# 4. DATA COLLECTION

# 4.1 Different between Smartphone (Global Positioning System) and Global Navigation satellite system

• What are GPS and GNSS?

GPS stands for Global Positioning System, which is a satellite-based navigation system that provides location and time information anywhere on Earth. GNSS stands for Global Navigation Satellite System, which is a generic term that encompasses all satellite navigation systems, including GPS.

GPS receivers determine their location by utilizing a constellation of GPS satellites that orbit the Earth. The GPS was first developed for military applications, but it has since become accessible to civilian users. GPS has a wide range of applications, such as navigation, tracking, and mapping.

GNSS, short for "Global Navigation Satellite System," refers to any satellite navigation system utilized for positioning. GNSS, or Global Navigation Satellite System, encompasses various satellite navigation systems, of which GPS is one example. Additional Global Navigation Satellite Systems (GNSS) encompass the Russian GLONASS system, the European Galileo system, the Indian Regional Navigation Satellite System (IRNSS) known as NavIC (short for Navigation with Indian Constellation), and BeiDou, the Chinese system. Many GPS receivers are compatible with multiple GNSS systems, allowing them to utilize the unique benefits offered by each system.

• What are the disparities between the two?

GPS and GNSS are satellite-based technologies used to ascertain the precise location of a receiver on Earth. The Global Positioning System (GPS) is widely recognized as the most renowned navigation system, with a user base of millions of individuals who rely on it daily. GNSS is an all-encompassing system that encompasses GPS as well as other satellite constellations.



The number of satellites in a system can affect the accuracy of location information provided to users. GPS currently has 31 operational satellites in its network, while GLONASS has 24, Galileo has 30, BeiDou has 35, and QZSS has 7. Consequently, GNSS exhibits greater precision than GPS and can be employed in situations when GPS would be unsuitable. GNSS is commonly employed in aviation navigation to provide accurate positioning data of the aircraft. GPS is utilized in numerous consumer items, such as automotive navigation systems and mapping applications for smartphones. GNSS exhibits better resistance to disruption, making it a preferred choice for scenarios where GPS would be unsuitable.

• How can they be used in different applications?

GNSS/GPS applications include Tracking/Mapping Devices, Industrial Machinery, Sea vessels, Air Navigation etc.

Automobile GPS devices are becoming more and more common, whether they are separate from a phone or built into it. This gives them a very accurate idea of where they are. GPS can be used for a wide range of applications, such as navigation, tracking, and surveying. GNSS is a similar system that uses a network of satellites to figure out where something is. However, GNSS systems typically use more satellites than GPS, providing greater accuracy and coverage. GNSS is often used in mission-critical applications where high accuracy is required, such as aircraft and missile guidance systems.

• Pros and cons of GPS and GNSS

There are several pros and cons to GPS and GNSS. One advantage of GPS is that it is relatively inexpensive to set up and maintain. GPS is also widely available, with most smartphones now featuring GPS capabilities. Another advantage of GPS is that it can be used in a variety of settings, including urban and rural areas. One thing that can go wrong with GPS is that buildings and other things can interfere with it. A GPS signal can also be blocked by bad weather conditions. GNSS systems cost more than GPS systems, but they work better and are more accurate. Also, interference or bad weather is less likely to mess up GNSS systems.

In summary, while GPS is a specific satellite navigation system, GNSS encompasses multiple satellite navigation systems, including GPS. Many smartphones utilize GNSS technology, allowing them to access signals from multiple satellite systems to determine their precise location on Earth's surface. Therefore, smartphones with GPS functionality are a subset of devices that utilize GNSS technology for location determination

https://www.linkedin.com/pulse/differences-between-gps-gnss-santosh-kumar-bhoda/

 <sup>&</sup>lt;u>https://globalgpssystems.com/gnss/the-difference-between-gnss-and-gps-</u>
 <u>explained/#:~:text=Number%20of%20Satellites%20and%20Accuracy&text=Due%20to%20the%20larger%20number.of%20any%20in</u>
 <u>terference%20or%20obstructions.</u>

# 4.2 Data Collection using Smartphones (Global Positioning System)

#### 4.2.1 Overall Data Collection Process



Figure 2 - Process of Data Collection

The collection of urban trees served as the main dataset for this example. Data collection followed a systematic technique, as shown in Figure 3. At first, the data-gathering forms were created using the KoBoToolBox application. Later on, these forms were connected with the ODK data gathering application, which is available for download on the Google Play Store. The data-gathering approach entailed performing field surveys utilizing the ODK program and the associated data collection forms. After gathering all the essential data, it was downloaded and imported into the QGIS application for data cleaning, processing, analysis, and mapping, if needed. This is a comprehensive overview of the complete process used to acquire data. In the next part, all the specifics are explained for each data type in data collection, accompanied by relevant photos and information.

Alternative Data Collection Methods:

KoBoToolbox & KoBoCollect: Utilize KoBoToolbox for both form creation and data collection by designing forms directly within the KoBoCollect mobile app. This approach streamlines the process by eliminating the need for integration with external applications.

ODK Build & ODK Collect: Design custom data collection forms using ODK Build, a user-friendly form designer tool, and collect data in the field using ODK Collect. This method offers flexibility in form design and customization while leveraging the robust data collection capabilities of ODK Collect.

Paper-Based Surveys: In scenarios where digital data collection tools are not feasible, traditional paper-based surveys can be employed. Design paper forms to capture relevant tree data and manually record observations in the field. Once completed, data can be transcribed into digital format for analysis.

Mobile Apps with GPS Functionality: Explore alternative mobile applications with GPS functionality for data collection, such as GeoODK Collect or Epicollect5. These apps offer similar features to ODK Collect but may have different user interfaces and additional functionalities.

Crowdsourcing Platforms: Consider leveraging crowdsourcing platforms like OpenStreetMap (OSM) for tree mapping initiatives. Engage volunteers and community members to contribute tree data through OSM-based mapping projects, fostering collaboration and community involvement.

Alternative Mobile Application for Data Collection:								
Platform	Text	Photo	Audio	Video	Shapefile			
Android	1	1	~	~	×			
Android	~	~	~	~	×			
Android	~	~	~	~	×			
Android, iOS	~	~	~	~	×			
Android	~	~	~	~	×			
Android, iOS	~	~	~	~	×			
Android, iOS, Web	~	~	~	~	×			
Android, iOS, Web	~	~	~	~	×			
iOS, Web	~	~	~	~	×			
Web	1	1	~	~	×			
Web	<b>√</b>	×	×	×	×			
Android	×	×	×	×	✓			
Android	✓	✓	×	×	~			
	Platform Android Android Android Android, iOS Android, iOS Android, iOS, Web Android, iOS, Web iOS, Web iOS, Web Web Web Android	Platform Text   Android ✓   Android ✓   Android, iOS ✓   Android, iOS, Web ✓   Android, iOS, Web ✓   Android, iOS, Web ✓   Veb ✓   Web ✓   Android ✓	PlatformTextPhotoAndroidImage: Colspan="2">Image: Colspan="2">PhotoAndroidImage: Colspan="2">Image: Colspan="2">Image: Colspan="2">Image: Colspan="2">Image: Colspan="2">PhotoAndroid, iOSImage: Colspan="2">Image: Colspan="2"Android, iOSImage: Colspan="2">Image: Colspan="2"Image: Colspan="2">Image: Colspan="2"Image: Colspan="2">Image: Colspan="2"Image: Colspan="2"Image: Colspan="2">Image: Colspan="2"Image: Colspan="2">Image: Colspan="2"Image: Colspan="2">Image: Colspan="2"Image: Colspan="2"Image: Colspan="2"Image: Colspan="2"Image: Colspan="2"Image: Colspan="2"Image: Colspan="2"Image: Colspan="2" <td< td=""><td>PlatformTextPhotoAudioAndroidIIIIAndroidIIIIIAndroidIIIIIAndroid, iOSIIIIIAndroid, iOSIIIIIAndroid, iOS, WebIIIIIAndroid, iOS, WebIIIIIIOS, WebIIIIIWebIIIIIWebIIIIIAndroidIIIIIIOS, WebIIIIIWebIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIIIIIIIIIIIIIIIIIIIIIIII<t< td=""><td>PlatformTextPhotoAudioVideoAndroidIIIIAndroidIIIIAndroidIIIIAndroidIIIIAndroid, iOSIIIIAndroid, iOSIIIIAndroid, iOSIIIIAndroid, iOS, WebIIIIAndroid, iOS, WebIIIIIOS, WebIIIIWebIIIIMadroid, iOS, WebIIIIOS, WebIIIIOS, WebIIIIAndroid, iOS, WebIIIIOS, We</td></t<></td></td<>	PlatformTextPhotoAudioAndroidIIIIAndroidIIIIIAndroidIIIIIAndroid, iOSIIIIIAndroid, iOSIIIIIAndroid, iOS, WebIIIIIAndroid, iOS, WebIIIIIIOS, WebIIIIIWebIIIIIWebIIIIIAndroidIIIIIIOS, WebIIIIIWebIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIAndroidIIIIIIIIIIIIIIIIIIIIIIIIIIII <t< td=""><td>PlatformTextPhotoAudioVideoAndroidIIIIAndroidIIIIAndroidIIIIAndroidIIIIAndroid, iOSIIIIAndroid, iOSIIIIAndroid, iOSIIIIAndroid, iOS, WebIIIIAndroid, iOS, WebIIIIIOS, WebIIIIWebIIIIMadroid, iOS, WebIIIIOS, WebIIIIOS, WebIIIIAndroid, iOS, WebIIIIOS, We</td></t<>	PlatformTextPhotoAudioVideoAndroidIIIIAndroidIIIIAndroidIIIIAndroidIIIIAndroid, iOSIIIIAndroid, iOSIIIIAndroid, iOSIIIIAndroid, iOS, WebIIIIAndroid, iOS, WebIIIIIOS, WebIIIIWebIIIIMadroid, iOS, WebIIIIOS, WebIIIIOS, WebIIIIAndroid, iOS, WebIIIIOS, We			

Table 2 - Other Mobile Applications for Data Collection

## 4.3 Steps (Mobile Phones)

#### 4.3.1 Prepare data collection form.

#### Step 1

The KoBoTook box is the platform that we used to prepare the data collection form. The following weblink and Figure 4 show the interface of the KoboTool Box application.

Web Link: https://www.kobotoolbox.org/



Figure 3- Interface of the Kobo Tool Box



**Prepare the account in the KoBoToolBox:** To begin the process, it is essential to create an account on the KoBoToolBox application, which allows us to allocate space on their servers for storing the collected ground data. By following the provided link, you will be directed to the registration page.

2.1 Click on the "Create new account" option.

2.2 Then select "Global KoboToolbox Server" and then create an account.



Then it will prompt the following interface to appear:



Figure 5 - Registration Process

Provide all the necessary information and complete the account registration process. Once your account setup is complete, you will receive an email to confirm your account. Click on the received link and confirm your account. Once your email is confirmed, you will be directed to the login page where you can enter your username and password.

**Create a new data collection form**: Upon successful login, you will be directed to the following interface. Then as shown in Figure 7 click the "new" option.

©к	<b>obo</b> Toolbox		<b>Q</b> Search							•
	NEW	0	My Projects	<del>∓</del> filter	🖪 fields					<b>u 2</b> â
	Draft	0							- Date deployed	- Submissions
	Archived	0				There	e are no projects to disp	lay.		
0										
0										

Figure 6 - Create a New Data Collection Form

#### Step 4

After clicking on the option "new" the following interface will appear as shown in Figure 08.

Gκα	xodlooT <b>od</b>		Q Search	•
	NEW Coployed Draft Archived	0	My Project:       Defete         Create project: Choose a source       X         Project       Choose one of the options below to continue. You will be prompted to enter name and other details in further steps.         Build from scratch       Use a template         Upload an XLSForm       Way of the initial strength of the init	■ Late deployed

Figure 7 - Interface of Create a new project

Users can use inbuilt data collection form templates if user need to use those templates by selecting the **"use a template"** option. If not select the **"Build from scratch**" option to create our template for our data collection forms. Here for this study, Build from Scratch has been selected.

After selecting the templates, it will display the following box and then it will ask following information as Figure 9. Place the appropriate project name (1) and a short description (2) of the project. Specify the sector (3) and country (4) of the project. After that select "Create Project (5)"

Θĸ	<b>obo</b> Toolbox		Q Search							•
E Rop	NEW		My Proj	ects \Xi filter	🖽 fields					<b>a r</b> g
	Peployed	0		Create project: Pro	oject details				×	- Submissions
	Archived	0		Project Name (required) Urban Trees Survey Description The urban tree surve environmental stress resilience.	1 ey aims to assess fors affecting tree	the health and o vitality, and info	condition of trees in urban green sy m management strategies for ent	paces, identify nancing urban forest	2	
				Sector (required) Environment	3 CREATE PROJE	x ~	Country (required)	X v	_ 4	
0										

Figure 8 - Create Project

After that following interface will appear as shown in Figure 10

C	project Urban T	Trees Survey												SAVE	×
• # !	5										808	Add from Libr	ary	Cayout & S	ettings
		Đ		You can add	questions, not	This form is tes, prompts, o	currently em r other fields b	<b>npty.</b> by clicking on t	the '+' sign below	и.					

Figure 9 - Project Interface

The user now can create a data collection form for data collection. To initiate this process, the user should click on **the plus symbol** as depicted in the above figure which will open the interface displayed below.



Figure 10 - Add Question Interface

Figure 12 illustrates the interface where the user can input the first question.

6.1 So for that click on "Add Question"

#### 6.2 Select the type as your Question type as shown in the figure below

C	project Urban Trees Survey				SAVE
• 🗄 🖫	5			Add from Library	Layout & Settings
			+ ADD QUESTION	×	
					Step

#### Figure 11 - Insert Questions



Figure 12 - Selecting Type of the Questions

#### The objective of this example is the carry out the urban tree survey aims to assess the health and condition of trees in urban green spaces, identify environmental stressors affecting tree vitality, and inform management strategies for enhancing urban forest resilience.

In this case, the first question is designated as Tree ID. As this data collection form pertains specifically to tree data, it is essential to gather information on each tree individually. This unique identification number serves as a reference for data collection, allowing the data collector to gather information for each tree by associating it with its respective identification number. Subsequently, after the data collection process is complete, the collected data can be linked with the corresponding Geographic Information System (GIS) layers by utilizing the identification numbers. The inclusion of the identification number in both the GIS layer and the collected database ensures seamless integration between the two, enabling efficient data management and analysis.

This section serves as the user interface where the user can select the appropriate data type for the desired field. Here tree ID is to be entered as a numerical value. Therefore, it is necessary to choose the "number" data type from the provided list. Alternatively, if the user intends to capture a visual representation for this particular question, the data collection form creator should assign the data type as "photo." This will enable the data collector to access a camera option specifically designed for this question, allowing them to capture and save an image. Once the user has selected the appropriate data type for the initial question, a subsequent interface will be displayed. To proceed with entering the second question into the form, the user needs to click on the plus symbol (+), as illustrated in Figure 14. This action will provide a designated space to type the second question. The same process should be followed to prepare all the questions about road data collection.



Figure 13 - Proceed to the next Questions

Save the project: Figure 15 shows an example data collection form for tree data collection prepared under this project. The data collection form has included **only 11 variables for this example**. After including all the questions click on the save button and then click on the close button located near the save button.

C	project Urban Trees Survey					SAVE* X
• =	5 <u>5</u>	_		80	Add from Library	Cayout & Settings
	Insert cascading sele	ct 👘				
		123	Tree ID Question hint			
		abc	Name of the tree species Question hint			
		•	Location Information: GPS Coordinates Question hint		<ul> <li>○</li> </ul>	•
		123	Height of Tree in meters Question hint		¢ ii iii iii	
		≔	Health Status of Tree     Question hint			
		<b>a</b>	Excellent	AUTOMATIC		
		<b>a</b>	Good	AUTOMATIC		
			Health Status of Tree Question hint Excellent Good	AUTOMATIC AUTOMATIC		

Figure 14 - Save the Project

You can preview how your survey will look after entering your questions by clicking the eye icon in the top left-hand corner. To check for errors, enter some information and click on the 'Validate' button.



Figure 15 - Preview the Project

To return to the default project page, click the Kobo icon in the upper right-hand corner. You will be redirected to the project page.



Figure 16 - Redirected to the project page

After saving the project then it will be directed to the below section as shown in Figure 18.

ßκ	o <b>bo</b> Toolbox		Urban Trees Survey		8
8	NEW  Coployed  Cont  Archived	0	2     SUMMARY     FORM     DATA     SETTINGS    Draft version  If you want to make these changes public, you must deploy this form.  If you want to make these changes public, you must deploy this form.  If undeployed) Last Modified : Today at 5:27 PM - 11 questions  I ancurate: This project has no languages defined use	3	СЕРLОУ
0					

Figure 17 - Created Form

Under number 01, three tabs are visible: "Deployed Forms," "Draft Forms," and "Archived Forms." Currently,	2 The second section encompasses the metadata section of the forms, which consists of four tabs:
The data collection form we have prepared is listed under the "Draft" tab, indicating that it has not yet been deployed. Once deployed, it will be listed under the "Deployed" tab.	"Summary of Collected Data," "Form," "Collected Data," and "Settings" for the selected form. Presently, only the "Settings" and "Form" tabs are active since the form has not been deployed or used for data collection. These tabs allow for customization and configuration of the form's settings and structure
(3) The third section offers options for editing, previewing, replacing the form, and additional functionalities for downloading the form. Users can make modifications to the form, preview its appearance, replace it with an updated version if necessary, and access various download options	The fourth section features the "Deploy" button. Once all the necessary work on the form has been completed, clicking on the "Deploy" button will publish the form on the KoboToolbox server. This enables data collection applications to link to the form, allowing collected data to be sent directly to the KoboToolbox server through this specific form.

Table 3 - Tabs in Form Interface

8.1 The subsequent procedure entails the deployment of the meticulously prepared form. It is essential to identify the correct form from the options available under the "Draft" tab and proceed by clicking on the deploy button. Subsequently, the deployed form will be listed under the "Deploy" tab. **Once the form is deployed, it can be accessed through an external application such as Open Data Kit (ODK).** 

8.2 After you deploy the form, you can select **'Online-Offline (Multiple submissions)**' under collect data. You can copy the link by clicking the 'COPY' icon to share with your team or paste the link into a search engine to open the questionnaire in a browser.

Βĸ	oboToolbox		🦻 Urban Trees Survey					•
	NEW			SUMMARY	FORM	DATA	SETTINGS	
	Deployed	0	Draft version					/ ⊙ [] …
	Archived	0	If you want to make these changes public,	you must deploy this form.				
			v1 (undeployed) Last Modified : Today at 5:27 Pl	M - 11 questions				DEPLOY
			Languages: This project has no languages define	led yet				Step 8.1
0								
Figure	e 18 - Deploy							

#### 4.3.2 Download and Install ODK Application

#### Step 1

**Download and install the ODK application**: Figure 20 provides a detailed methodology that outlines the step-by-step process for downloading and installing the ODK application.



Figure 19 - Download and Install the app

#### ODK

Open Data Kit (ODK) is an open-source software suite designed for data collection using mobile devices. It provides a flexible and customizable platform for creating digital forms, collecting data, and managing the collected data efficiently. ODK is widely used in various fields such as research, humanitarian aid, public health, and environmental monitoring. ODK consists of several components that work together to facilitate the entire data collection process. These components include:

ODK Build: A web-based form designer that allows users to create forms using a drag-and-drop interface without requiring programming skills. It enables the easy creation of digital forms for Android devices that serves as the data collection tool. It allows field workers to download the digital forms created with ODK Build and collect data using their mobile devices, even in offline or low connectivity areas. ODK Collect supports GPS location capture, image and audio attachments, and can handle complex skip logic within forms.

ODK Aggregate: A server application that acts as a central repository for collected data. ODK Collect syncs with ODK Aggregate to upload the collected data securely. ODK Aggregate provides data management features like data storage, data export in various formats, data visualization, and user access control.

ODK Briefcase: A desktop tool that allows users to pull data from ODK Aggregate and export it to a local machine.



#### Setup ODK and link prepared data collection forms to ODK application

- **2.1** The initial interface encountered upon opening the ODK application for the first time is depicted in Figure 22.
- 2.2 Subsequently, users need to click on "Manually enter Project Details" as shown in Figure 22.
- **2.3** The ODK application necessitates three essential pieces of information: URL, Username, and password. As illustrated in Figure 24, the URL can be obtained from the KoboToolbox platform. Additionally, after deploying all the forms, users need to navigate to the "**Collect Data**" section located at the bottom of the webpage. Within that section, there is a dropdown arrow that, when clicked, displays a list of options for linking the data collection form with other third-party applications. To proceed, users should select the "Android Application" option from the list and copy the link of the KoboToolbox platform, Subsequently, the username associated with the KoboToolbox profile, under which the data collection forms were prepared, needs to be appended to the link.
- 2.4 Then paste it in the ODK as shown in Figure 25.
- 2.5 After that, you will proceed to the new interface as shown in Figure 26. Click on "Download Form".
- **2.6** After you see the form, you prepared and then follow the steps in Figure 27.



Figure 20 - Interface of the ODK

Figure 21 - ODK Details



Figure 23 - Link the Form

Figure 24 - New Interface





Data collection using ODK application: Click on "Start new form" as shown in Figure 28.





**Export data:** After completing the data collection process, as shown in the figures below follow the steps.

4.1. Go to the "Ready to Send" tab and select all the collected data.

**4.2.** Click on the "Send" button and allow time for the sending process to complete.

4.3. Once the sending process is finished, click "OK."

**4.4**. Return to the main interface. As depicted in Figures 32 and 33, the sent data will now be displayed under the "**Sent**" tab.



Figure 27 - Data Exporting Process

**Downloading data from Kobo Toolbox:** Once the data collection process is complete, follow these steps to download the collected dataset:

**5.1** Proceed to the "**Data**" tab within KoboToolbox. The list of data can be found in a table as shown in figure 30.

**5.2** Next, click on the "**Download" option**, and within the ensuing step, ensure that the data type selected for download is "**CSV Legacy**."

**5.3** Click on the "**New Export**" option. This will generate a link (this will take some time), which you can utilize to download the data associated with the selected data collection form.

**5.4** Once the link is prepared, simply click on it to initiate the download of the data for the specific data collection form.

Θĸ	C KoboToolbox Virban Trees Survey 9 submissions													
Ē	NEW						SUMMARY	FORM	DATA	SE	TTINGS			
		1	Table	💋 hide fields										æφ
	Urban Trees Survey		. Reports	1 - 9 9 results	Validation	•	t≣ start ▼	t≣ end ▼	123 Tree ID	•	abc Name of the ▼ tree species	Location     Information:	123 Height of Tree in meters	r i≣ He Status
	🦻 Draft	0	Gallery		Show All	Ŧ	Search	Search	Search		Search	GF3	Search	Show
	Archived	0	Jownloads		-		May 15, 2024	May 15, 2024	9		Psidium guajava 🛛	6.7955938 79.8947	1	Excelle
			🔮 Мар		_	~	May 15, 2024	May 15, 2024	8		Anacardium oc	6.7954936 79.8941	3	Poor
			•		-	~	May 15, 2024	May 15, 2024	7		Madhuca longif 🛯	6.7955268 79.8940	2	Good
					-	~	May 15, 2024	May 15, 2024	6		Terminalia arju 🛯	6.7953937 79.8947	10	Good
				. • /	-	~	May 15, 2024	May 15, 2024	5		Sesbania gran 🛛	6.7955705 79.8953	10	Poor
					-		May 15, 2024	May 15, 2024	4		Solanum melon 🛛	6.79543 79.894970	1	Poor
					-		May 15, 2024	May 15, 2024	3		Phyllanthus em	6.7957992 79.8950	3	Good
				□ • /	-		May 15, 2024	May 15, 2024	2		Annona Murica 🛛	6.7957531 79.8950	1	Excelle
				□ • /	-		May 15, 2024	May 15, 2024	1		Mango (Mangif 🗈	6.7962886 79.8949	4	Good
¢	Step 5.1				<pre> </pre>			Page 1	of 1		30 rows 🗸		NEXT	

Figure 28 - Collected Data

C K	xodlooT <b>odo</b>		Vrban Trees Survey		9 submissions
Ē	NEW		-	SUMMARY FORM DATA SETTINGS	
809	Peployed Uthan Trees Survey      Draft     Archived	1	<ul> <li>Table</li> <li>Reports</li> <li>Gallery</li> <li>Downloads</li> <li>Map</li> </ul>	Downloads         Select export type         CSV (legacy)         Step 5.2         Image: This export format will not be supported in the future. Please consider using one of the other export types available.         Image: New Export         Advanced Export	
				#         Filename         Date Created           1         afjq7Go2VPfhcXYj8ePDkE_2024_05_16_02_13_34.csv         16 May 2024, 2:13 a.m.	Delete 🖻
🥐 Figure	e 29 - Data Dov	vnloa	ading		tep 5.4

### 4.3.3 Data Analysing

#### Step 1

**Import those data to QGIS:** After downloading data normally it downloads as a CSV file type which opens directly via Excel as shown in Figure 31.

x	AutoSar	re 🔘	off) [	Щ Сч П		⊽ afje	q7Go2VPf	hcXYj8ePI	0kE_2024_	05_16_0	2_13_3													Harin	Sawandi	HS		o ×
File	Ho	me	WPS P	DF Ins	sert Pa	age Layc	ut Fo	rmulas	Data	Review	View	/ Auto	omate	Develo	per H	elp										🖓 Comi	nents	🖻 Share
Pa:	∼ □ \ ste ✓ ≪		Aptos N B I	larrow		→ A^ & → A		≡ ≡ [ ≡ ≡ 3	<b>_ % ∙</b> ≣   ⊡ :	·   85	Wrap T Merge	ext & Center		Seneral \$ ~ %	5 <b>9</b>   5	~ % -%	Condit Formati	ional Fo	rmat as able ~ _ :	Cell Styles ~	🚰 Inse 🎫 Del	nt v ∑v ete v ⊈v mat v ∳v	AZY Sort & Find & Filter * Select *	Add-ins	Analyze Data	Create PDF	sign	
Cli	pboard				ont				A	lignment				Nu	mber			Styl	les		Ce		Editing	Add-ins		WF	S PDF	
A1		~ ::		/ fx	start																							,
4	A																											AB ,
start	t en	1	Tree_ID	Name_of_	Location_	Location	_Location	Location	Location_H	Height_of_	Health_Sta	Health_St	a Health_S	ta Health_St	Presence	Presence	_ Descripti	Evidence	Evidence	Presence	Presence	Photo_of_Tree	Comments_or_Obse	rv_version_	neta/insta	uuid	submissic_	tags _not
2024	4-05-1 20	24-05-1	1	Mango (Ma	£ 6.7962886	6.796289	79.895	-93.5	7.673	4	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	No	FALSE	TRUE	FALSE	TRUE	1715773290131.jpg	No	vHRC2okq	uid:024c1	024c743f-2	024-05-16	01:52:33
2024	4-05-1 20	24-05-1	- 2	Annona M	6.795753	1 6.795753	79.89508	-93.5	25.427	1	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	No	FALSE	TRUE	FALSE	TRUE	1715773651368.jpg	No	vHRC2okq	Juid:56d4	56d44020-2	024-05-16	01:52:54
2024	4-05-1 20	24-05-1	3	Phyllanthu	6.7957993	6.795799	79.89503	-93.5	7.5	3	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	n/a	FALSE	TRUE	TRUE	FALSE	1715773821961.jpg	n/a	vHRC2okq	Juid:2497(	24978c41-2	024-05-16	01:53:14
2024	4-05-1 20	24-05-1	4	Solanum r	16.795437	6.79543	79.89497	-93.5	17.721	1	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	Fungus	TRUE	FALSE	TRUE	FALSE	1715773957230.jpg	n/a	vHRC2okq	Juid:96ac	96ac3c4f-2	024-05-16	01:53:24
2024	4-05-1 20	24-05-1	6	Sesbania (	(6.7955705	6.795571	79.8953	-93.5	8.5	10	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	Worms	TRUE	FALSE	IRUE	FALSE	1/15//4268258.jpg	Diseases	vHRC2okq	Juid:4c3214	tc328027 2	024-05-16	01:53:34
2024	4-05-1 20	24-05-1		Madhuaa	e 7055093.	0.795394	79.69472	-93.6	20.756	10	FALSE	TOUL	CALSE	CALSE	TRUE	TOUL	worms	TALEC	TOUL	TOUL	CALCO	1/15//4638543.jpg	n/a	vmnC20kg	uiu:u/9010	17900082-2	024-05-16	01:03:42
202	4-00-1 20	24-00-1		- maufluca Anocordiu	0.7900208	C 0.795527	79.69407	-93.0	12.100	2	EALOE	EALSE	EALSE	TRUE	TRUE	EALSE	Depaded	TRUE	EALGE	TRUE	EALCE	1715775116952 ind	n/a	vHRC20kg	uiu.9374 1	0040041	024-05-10	01.03.03
202	4-05-1 20	24-00-1		Psidium di	6 705503	6 705504	70 8047	-93.6	9.01	3	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	n/a	FALSE	TRUE	FALSE	TRUE	1715775319262 ind	n/a	vHRC20kg	uid-f9hoc t	Obee147- 2	024-05-16	01:54:02
102			•	oronourin Br			10.0047	-90.0	0.0					- ALUL		MOL			mor	- ALUL	moc	1.100010202.jpg			ana navee i	0000147-2		0410-114/

Figure 30 - Excel File

#### Step 2

To begin working with the downloaded data in QGIS, please follow the steps illustrated in Figure 33.

- 2.1 Firstly, open QGIS software (Refer to the link below to download and learn the basics of Qgis), and go to the new map template. Then, to the "open data source manager", select the "Add Delimited Text Layer" option, which will prompt the corresponding tool to open. Within the tool, click on the "Browse" button to locate and select the downloaded CSV file. Provide a suitable name for the file in the designated field.
- 2.2 The next step involves assigning the x and y fields. Under the "Geometry Definition" section, ensure the correct x and y coordinate fields are selected. These fields should correspond to the specific x and y coordinate information mentioned in the CSV file that you intend to import into QGIS. As you make the appropriate selections, a preview of the data will be displayed in the empty area of the tool.
- 2.3 Once you have confirmed the correct assignment, click "Add." The data will then be displayed within the QGIS interface, allowing you to process and utilize it for various purposes, such as creating customized maps and facilitating informed decision-making.
- 2.4 If you want to add a base map Click on the "Plugin > Manage and Install Plugins > search bar of the dialog box, type "QuickMapServices" and press Enter > Install" or "Update" button next to the "QuickMapServices" > After installing the "QuickMapServices" you should see a new window appear on the right side of the screen. If you don't see the QMS window, you can open it by going to the "Web" option > search for a suitable base map



https://www.youtube.com/watch?v=CLuSZB95ly0

How to install QGIS on a Windows 10 compute

https://www.youtube.com/watch?v=kCnNWyl9qSE

This video is a basic look at QGIS for Absolute Beginners.

□ -		, Q, + W, + B + <mark>1</mark> , II II III III Σ III + <b>7</b> II + <b>3 4 5 5 5 1 Q Q Q 2 2 3 5 5 5 1 1</b>	2	
Vorear     Vorear	Contract of the server of the	vit     File name [CuturerIDELI/Desktoplafty76207VPHCVYgletFI3E_2624_05_16_02_13_4/c       Layer name [ree Mappin]     • File format       • CDV (comma separated value)     • Regular corpression delimiter       • CDV (comma separated value)     • Regular corpression delimiter       • Coutom delimiters     • Coutom delimiters       • Record and Fields Options     • Decimal separater in       • First record has field names     • Trim fields       • Decimal tip baser lines to discord 0     • Decimal empt fields       • Decimal tip baser lines to discord 0     • Decimal empt fields       • Decimal tip baser lines to discord 0     • Decimal empt fields       • Decimal tip baser lines to discord 0     • Decimal empt fields       • Decimal tip baser lines to discord 0     • Decimal empt fields       • Decimal tip baser lines to discord 0     • Decimal empt fields       • Decimal tip baser lines     V field _location_Informatio ~ M field       • No esenethy (attribute only table)     Geometry ODS Emp50-4929 - WGS 84       • Layer Settlings     Use subset lindex     We       • Use subset lindex     We     Con	CV Excoding UTF-8 Step 2.2 d d stdf file the Step 2.3	Processing Toolbox

Figure 31 - Add Data to QGIS



Figure 32 - Collected Data point of trees

To update existing data using Google My Maps, follow these steps: Access Google My Maps through this link [ <u>https://www.google.com/mymaps</u> ].

- **3.1** Import the CSV file into Google My Maps by clicking on the "Import" option.
- **3.2** Select the GPS coordinates and Tree ID from the CSV file. Once imported, the points will be displayed on the map.
- **3.3** Click on any point to view its details, and you can edit them as needed. After editing, save the changes.
- 3.4 You can share the map with others by using the sharing options, as shown in Figure 36



Figure 33 - Edit the Data



Figure 34 - Share the Details

# 4.4 Data Collection using GNSS (Global Navigation Satellite System)

Global Navigation Satellite Systems (GNSS) have revolutionized surveying and mapping by providing accurate positioning data. GNSS surveying methods employ satellite signals to determine precise coordinates, enabling professionals in various industries to carry out accurate measurements





Figure 35 -Data Collection from GNSS

The primary difference between the Stonex S70 and S70G lies in their capabilities: the S70G is an RTK (Real-Time Kinematic) device, offering high-precision positioning with superior accuracy, ideal for demanding surveying tasks. In contrast, the S70 functions as a standard GNSS receiver, similar to the one in your mobile phone, providing basic positioning capabilities suitable for general applications.

## 4.4.2. S70 G Data Collection



Figure 36 - Two types of S70G
Click on the below icon (Cube a v6) to start.



Figure 37 -Cube a v6

- 2.1 Go to the Project tab.
- 2.2- Click on Project Manager to create a new file.





Figure 38 -Project Manager

Then you will get the below interface and then go to the "New"



Figure 39 - Create New File

Then give the project name as per the study and click on next.

05:40	ॹ 🕅 🕫 🖬 33%
<	New Project
Project Name	Sample Project 3
Configuration	Standard 🗸
	Configurations
Operator	
Device	
Notes	
Date Created	2024-05-20 05:40:23





Then you will get this interface and click on " file".

11:34 🗖	<b>N O</b>	🔽 🖥 54%
<	New Project	
Coordinate System		
<b>Coordinate systems parameters type:</b> Warning: do not select the RTCM1021 CORS sends them out.	Local parameters	e that the
Select the Reference System to use in	the new project	
CPj: Default		~
Type Standard Name Default Country Unknown Projection Transverse Mercator Geoid File 	Ellipsoid Everest-1830(1937 Adjustment) Proj. S.F. 0.99992384	List File Proj. Geoid Info
☐ I want to work with real/grou Bring me to the "One Point G	Ind distances. IPS Localization" after creating the proj	ect
Previous	> Create	

Figure 41 - Set Coordinates

Then you will get this interface and in there click on "Stonex cube"

05:41 🗖			🔝 🕅 🕕 ≑🗣 🖬 32%
<	Impor	t File	
Path: Internal Storag	je/	<b>^</b>	
Android	Y	Ň	
com.stonex.cube	.v6		
Cube-a			
DCIM			
Download			
들 Movies			
들 Music			
☐ Notifications			
Pictures			
Podcasts			
📑 Ringtones			
StonexCube			
StonexCubeConn	ector		
tcp			
File Name			
File type	Files (*.SP;*	.JXL;RMGEO*.*)	$\checkmark$
X Cancel		✓ Import	

Figure 42 -Stonex Cube

Click on the "Coordinate" to set the coordinate system

05:42 🗖			<b>S</b> 0	心 🗘 🛱 🗐 32%	
<	Impor	: File			
Path: Internal Storage/StonexCube					
Go to internal stor	age root dire	ctory			
Go to appl. root di	rectory				
Return					
Config Config					
Coordinate					
Debug					
Export					
Geoid					
☐ GISFeatureSets					
Input					
LalyIGM					
Log					
Map					
Project					
	1	1			
File Name					
File type	Files (*.SP;*	.JXL;RMGEO*.*)		$\checkmark$	
X Cancel		✓ Import			

Figure 43 - Coordinate Systems

Click on the Coordinate System and select the import.

05:42		<b>S</b>	"□" 🕈 🗣 🖬 32%		
<	Import File				
Path: Internal Storag	ge/StonexCube/Coordinate				
Go to internal storage root directory					
Go to appl. root d	irectory				
Return					
SLD99 New.SP					



Figure 44 - Set the Coordinates

- 9.1 Then go to the main page and click on the "Device Tab"
- 9.2 Then select on Communication





Figure 45 - Set up the Device

Then you will see the interface below. Click on the Disconnect button first, which belongs to the previous task



Figure 46 - Disconnecting

11.1-Then, click on the drop-down menu, select "Stonex 70G,"

11.2 - Then click on "Connect."

05:45 🖿	<b>1</b>	▶ ‡ 🗣 🖬 31%
Con	nmunication Settings	DEBUG
Device Type:	Stonex GNSS	~
Communication Mode: <ul> <li>Internal GPS (UDP)</li> </ul>	Stonex S5	Step 9.2
	Stonex S500	
	Stonex S580	
	Stonex S9	
	Stonex SC2000	
	Stonex SC600	
	Generic NMEA	
	Internal GPS (TTY)	_
	Stonex S70G - Internal GPS (RAW-R	гк)
	Stonex S70 - Internal GPS (RAW)	



Then go back and select the "Working mode" under the device tab

05:45 🖿		🔝 🕅 💷 🖘 🖬 31%
Project	t: [SAMPLE PROJECT] [sample project.p	od]
	NO	₹Rover
H: 99999.000	FIX	
V: 99999.000	<b>X</b> 0/0	
	N? E? Z?	
	Q	0
GPS Status	Datalink Status	Communication
Working Mode	<b>Datalink Settings</b>	Information
Antenna Type	Distance Meter	Utility Locator



Figure 48 -Working Mode

Select "Rover"

05:47	` <b>▶</b> (			🔝 \land 🕕 🗸 🛱 30%
<		Working Mode		
		NO		Rover
_	H: 99999.000	FIX		
	V: 99999.000	<b>X</b> 0/0		<b>(()</b>
		N? E? Z?		
0	<b>Q</b>			
С	ommunication	Rover	Sa	aved configurations

Figure 49 - Select Rover

Set the following parameters:

- 13.1 Elev. mask: Set it between 10 and 15.
- 13.2 Communication mode: Select "Phone network."

05:47			🔝 🕅 🕕 ‡🗣 🖬 30%
<	Rover n	node settings	
Options			
Elev. Mask angle (0 <sup>,</sup>	~45):	10	٢
Record raw data			O Step 14.1
Datalink			
Communication Mo	de:	None	
		Phone Network	
Antenna Param	eters	Bluetooth Radio	Step 14.2
Measured Height:	2.000		
Measurement Type:	Vertica	al height	$\sim$
Antenna Height:	2.076		
Satellite System	IS	♦	
R Save to Configu	rations	🗸 Apply	
1	2	3	_
4	5	6	L
7	8	9	$\overline{\mathbf{X}}$
,	0		→I

Figure 50 - Setting the Rover

#### Step 15:

then enable the following "satellite system" options and select apply.

14:20 🖿			🔊 🕩 ≑ 🔽 🗋 9%
<	Rover mo	ode settings	
Options			
Elev. Mask angle (0~45):		10	
Record raw data			•
Datalink			
Communication Mode:		Phone Network	$\checkmark$
	Phon	e Network	
Antenna Parameters			
Measured Height:	2.000		
Measurement Type:	Vertical	height	$\checkmark$
Antenna Height:	2.065		
Satellite Systems			
GPS enable			
GLONASS enable			
BEIDOU enable			0
GALILEO enable			•
QZSS enable		≽	0
Save to Configurations		Apply	

Figure 51 -Enable the GPS

Then, this interface will appear. Click on "Mount Point" and select "Get Access Point."

05:47 🖿		🔊 🛇 🕕 ፍ 🖥 30%
K s	end diff. from controller	
Connect Mode:		
O TCP Client		
CORS Settings		•••
Name:	LKA: Suleco	$\checkmark$
IP:	222.165.151.170	
Port:	60606	
Notify when base coordin	ates change:	
CORS Account		
User:	LBSUOM1	
Password:	••••	
		Show password 🔲
MountPoint:		
Corrections		
CLMB_MSM4		$\checkmark$
	GET ACCESS POINT	
Receive:	*	
START		ОК

Figure 52 -Get Acess Point

Then, from this drop-down menu, you need to select the point. Since this project is done in Colombo, select "Colombo," and always select "MSM4"

05:48	` <b>•</b> (		‱ ⊘	心 †⊊i 🖬 30%
	С	[RTCM3X-MSM]		
с	С	AMPR_MSM4		- 1
ι (	С	AMPR_NBDS3		
F (	С	ANRP_MSM4		
(	С	ANRP_NBDS3		
	С	BDLL_MSM4		
	С	BDLL_NBDS3		J
- (	С	CLMB_MSM4		ļ
(	С	CLMB_NBDS3		
R	С	CMR		
4 (	С	DAMB_MSM4		ſ
e (	С	DAMB_NBDS3		J
	С	DOWT_MSM4		
	С	DOWT_NBDS3		Ŋ
F (	С	DVLP_MSM4		
(	С	DVLP_NBDS3		J

Figure 53 -Select the point

Select Apply

05:51 🖿			<b>&gt;</b>	心 🕯 🗊 🖬 29%
<	Rover m	ode settings		
Elev. Mask angle (0~45):		18		8
Record raw data				0
Datalink				
Communication Mode:		Phone Network		$\checkmark$
	Pho	ne Network		
Antenna Parameters				
Measured Height:	2.000			
Measurement Type:	Vertica	l height		$\checkmark$
Antenna Height:	2.076			
Satellite Systems				
GPS enable				
GLONASS enable				
BEIDOU enable				
GALILEO enable				
QZSS enable				0
SBAS enable		¥		
Save to Configurations		🗸 Apply		

Figure 54 - Finalize the Rover Setup

Then it will direct to the main page. Then click on "Antenna Type"

05:52	` <b>▶</b> (		🔝 🛇 🕕 🗘 🖬 29%
	Projec	: [SAMPLE PROJECT] [sample pr	oject.pd]
		NO	™Rover
	H: 99999.000	FIX	<b>★</b> り
	V: 99999.000	30/0	<b>∄</b> ∑ 0.0
		N? E? Z?	
		Ø	3
	GPS Status	Datalink Status	Communication
V	Working Mode	Datalink Settings	Information
,	Antenna Type	Distance Meter	Utility Locator



Figure 55 -Setup the Antenna

Then, select the antenna type as "S70G on a tablet." The other option is "on pole," but for this study, since it connects to the tablet, select the "S70G on tablet" option

05:53 🖿		氛 ⊘	巾 🗘 🗊 🖣 🖓
<	Antenna Type		
Ext. antenna type:			
Stonex SA15 (S70	G - ON TABLET)		$\sim$
В	rand : Stonex		
М	odel : SA15 (S70G -	ON TABLET)	
	L1 offset from ARP : <b>6</b>	5.000	[mm]
	L2 offset from ARP : 6	5.000	[mm]

APPLY

Figure 56 - Select the Antenna Type

Then, go back to the main page

- 21.1 Go to the "point" tab
- 21.2 -Select point Survey





Figure 57 - Point Survey

Then this interface will appear. Through the below icon, you can get the open street map

05:56	•			♥ 🔊	巾 🗘 🕶 🖬 27%
		Project: [SAMPLE	PROJECT] [sample project.pd]		
					⊤Rover
<		H: 0.015	FIAED		*)
•		V: 0.017	🄉 21/31		₹∑2.0
		N 477160.846	E 403633.905 Z 22.1	79	
<b>£</b>		Q			and a start of the



Figure 58 -Survey Map

Click "Topo Point"



Figure 59 - Topo Point

### Step 23:

Then you will be directed to the "Topo Point Settings."

- Solution Limit: Set it to "Fixed."
- HRMS Setting: Set this according to your preference. This setting determines the accuracy level for data collection. Data will only be collected if it meets the specified accuracy level.
- If you do not need high accuracy, you can set the Solution Limit to "Float," or if you do not want to enforce any accuracy requirements, tick the "Ignore this quality check" option.
- Select save

07:01 📋 💷 🌨	🔊 🔊 🕕 † 🗣 🗋 12%
С Торо Ре	oint Settings
Quick mode	
Quality Checks	
Solution Limit: FIXED	$\sim$
HRMS Limit:	0.020
Ignore this quality check	
VRMS Limit:	0.020
Ignore this quality check	
PDOP limit:	2.0
Ignore this quality check	
Diff. corr. delay limit [s]:	5.0
Record Options	
Average GPS Count:	1 ~
Averaging delay [s]:	15

SAVE

Figure 60 - Quality Check

Then you will be directed to this page and select the below icons.



Figure 61 -Map Page

Then, click on the icon below to start collecting data. While collecting data, ensure that the "H & V" indicators are green, indicating high accuracy.



Figure 62 -Get the point

## Step 26:

Then select ok

10:50 👖 💷 🔊 💿 🗘 🖬							
<	Topo F	Topo Point					
Name:	1	1					
Code:			ૼૢૼૺ				
Measured Height:	2.000						
Measurement Type:	Vertical heig	Jht	~				
	Measured p	oint info					
	Record	<1/1> Collected					
	Solution	(14/20) FIXED					
	HRMS	0.01414					
	VRMS	0.01697					
	PDOP	1.4					
	GDOP	99.0					
	Northing	477512.54695					
	Easting	403345.13541					
	Elev.	18.11658					
	Delay	2.0					
C	ist. from prev.	?					
	Longitude	079°53'57.555402"					
	Latitude	006°47'47.939688"					
	Altitude	-86.27100					
	Local Time	10:50:48					
	Local Date	2024-05-20					
	Base Distance	6738.2977					

Noto And Sketch	📀 ок	

Figure 63 - Save the Point

Similarly, you can collect the data. For this project, we conducted a survey on trees at the University of Moratuwa.

Click on the below icon to see the collected data.



Figure 64- Collected Point

This is the point Library

11:1	6 🚺 🖬	(							🔊 🛇 🐨	<b>≑</b> ¶₄ 🗍 3%
<						Po	int Library			
	Poi	nt Nar	ne or Co	de	ò					_ Q
Ø € • Ø	Ø □ Ø □→□ □→ Ø □ Ø	000						¥² ↑?	z A <mark>↓</mark> ∰	
	No.	N	ame	Ρ	G		Northing	Eas	sting	Elevatior
	#22	Ał	ala3			4	77501.751	4034	48.117	26.171
	#21	Ar	aliya			4	77499.599	4034	73.988	25.634
	#20	Ał	ala1			4	77499.284	4034	93.586	26.912
	#19	Koh	omba			4	77501.593	4035	08.043	26.809
	#18	m	ango			4	77522.386	4035	13.049	23.875
	#17		Na			4	77539.031	4035	14.112	20.782
	#16	А	hala			4	77549.791	4035	16.919	21.169
	#15	Kott	amba8			4	77557.573	4035	14.051	22.163
	#14	Kott	amba7			4	77558.787	4035	06.889	23.564
	#13	Kott	amba6			4	77558.077	4034	97.792	22.579
	#12	Kott	amba5			4	77561.740	4034	87.256	26.940
	#11	Pih	ibiya6			4	77561.292	4034	83.096	23.902
	#10	Pih	ibiya5			4	77561.728	4034	74.406	26.059
	#9	Kott	amba3			4	77559.665	4034	62.038	20.221
	#8	Pih	ibiya4			4	77559.791	4034	56.216	19.324
	#7	Pih	ibiya3			4	77560.487	4034	46.959	20.040
	#6	Pih	ibiya2			4	77563.593	4034	42.551	22.382
	#5	Pił	nibiya			4	77563.022	4034	35.859	20.430
( <del>)</del>	Add		🛃 Edit				Details		X Tools	
<b>F</b>	mport		Delete	9			Delete all		🕑 ок	

Figure 65 - Point Library

Again, go to the main Project tab and click on the export icon to export the data.

12:16		🔝 🕅 🕕 ≑🗣 🖣 26%
Project: [TF	REEMAPPING] [treemapping.pd]	
	NO	Rover
H: 99999.000	FIX	<b>*</b> 1)
V: 99999.000	30/0	.00
	N? E? Z?	
Project Manager	Project Details	File Manager
<b>F</b> o		
Point Library	Import Data Ir	nport Raster Image
Evert Data		Chara hu WiEi
Export Data	reature coues	Share by WIFI



Figure 66 - Export Data

28.1 -Tick the "Share after exporting" option, which will allow you to share the data through different platforms. If not, the file will only be saved to the device.28.2 -Then, select "Export.

12:16	<b>5</b> 0	心 🗘 🕶 🗖 🖉
<	Export File	<
Export Path /s	storage/emulated/0/StonexCube/Export/	>
File Name	Treemapping	
Data file	Treemapping.PD	$\sim$
File type	Name,Easting,Northing,Elevation,C	code 🗸
Share after exporting		ထို
		Step 28.1



Figure 67 -Click Export

Select the Export Type

12:18 🛛	1	<b>2</b> ()	마 🗘 🕶 🖬 26%
<	Stakeout Report		<
Export P	RW5		>
Data file	DXF (with CAD entities)		
File type	Points and CAD entities to shapefile		
Shar	LandXML Cube-3d		ŝ
	Cube-fly		
	Custom File Format (Survey)		
	Name,Northing,Easting,Elevation,Code		
	Name,Easting,Northing,Elevation,Code		
	Name,Latitude,Longitude,Altitude,Code		
	GoogleFarth File Format (kml)		
	Name,Code,North,East,Height (Cass)		
	Raw measurement data format (csv)		
	DXF-height(code)		
Optio			

Figure 68 - Export Formats

#### Step 30 Click Ok



Figure 69 -User Action

Share through any platform



Figure 70 -Share

## 4.4.3.S70 Data Collection

## Step 01

Click on the below icon (Cube a v6) to start.



Figure 71 -Cube a v6

2.1 - Go to the Project tab.

2.2- Click on Project Manager to create a new file



Figure 72 - Project Manager
Then you will get the below interface and then go to the "New"



Figure 73 -Create New File

Then give the project name as per the study.

11:34 🖿		© 🗣 🖥 55%
<	New Project	
Project Name	Treemapping	0
Enable GIS		•
Configuration	Standard	~
	🖉 🖉 Cor	nfigurations
Operator		
Device		
Notes		
Date Created	2024-05-20 11:33:41	
X Cancel	> Next	

Figure 74 --Create Project

Here, compared to S70G, for S70, you need to enable the GIS option.



Figure 75 -Enable GIS

Then you will get this interface and click on " file".

11:34 🖿	<b>a 0</b>	▼4 🖬 54%
<	New Project	
Coordinate System		
<b>Coordinate systems parameters type:</b> Warning: do not select the RTCM1021 CORS sends them out.	Local parameters	e that the
Select the Reference System to use in	n the new project	
CPj: Default		~
Type Standard Name Default Country Unknown Projection Transverse Mercator Geoid File 	Ellipsoid <b>Everest-1830(1937 Adjustment)</b> Proj. S.F. <b>0.99992384</b>	List File Proj. Geoid
☐ I want to work with real/grou Bring me to the "One Point G	und distances. SPS Localization" after creating the proj	ect
Previous	> Create	

Figure 76 -Set Coordinates

Then you will get this interface and in there click on "Stonex cube

11:34 🖿			5 ⊘	🗣 🖬 54%
<	Impor	t File		
Path: Internal Storag	le/			
		<		
Return				
📑 Alarms				
Android				
Cube-a				
DCIM				
Download				
Movies				
Music				
☐ Notifications				
Pictures				
Podcasts				
☐ Ringtones				
StonexCube				
StonexCubeConne	ector			
File Name				
File type	Files (*.SP;	*.JXL;RMGEO*.*)		$\overline{}$
X Cancel		✓ Import		

Figure 77 -Stonex Cube

Click on the "Coordinate" to set the coordinate system

11:35 🖿		♡ 🗣 🖬 54%					
<	Import File						
Path: Internal Storage	Path: Internal Storage/StonexCube						
$\mathbf{\hat{h}}$ Go to internal stora	age root directory						
Go to appl. root dir	ectory						
Return							
Config							
Coordinate							
Debug							
Export							
Geoid							
GISFeatureSets							
Input							
LalyIGM							
Log							
Map							
Project							
	*						
File Name							
File type	Files (*.SP;*.JXL;RMG	E0*.*)					
X Cancel		t					

Figure 78 - Coordinate Systems

Step 09 Click on the Coordinate System and select the import

11:35 ■ <b>〈</b>	Impor	t File	🔊 🍳 🗖 🖥 54%				
Path: Internal Storag	Path: Internal Storage/StonexCube/Coordinate						
Go to internal stor	rage root dire	ctory					
Go to appl. root di	irectory						
Return							
SLD99 New.SP							
File Name							
File type	Files (*.SP;*	JXL;RMGEO*.	*) ~				
X Cancel		✓ Import					

Figure 79 -Set the Coordinates

Click on "Edit" and give a name for your study. Under "Tree Mapping," we are going to do Ahala tree mapping at the University of Moratuwa.



Figure 80 - Tree Mapping Sub-Category

Give the name



Figure 81 -Naming

Then it will appear as below figures:

11:39 🖪			🔝 🛇  🖬 49%
Activ	ate GIS Featu	re Set Repository	
	Feature set	s repository	
		stepeenery	
Ahalatree_mapping			
	(+)	Image: state sta	一一一
Edit	Add	Clone	Delete
	Repository	description	
	No Des	cription	
	Repositor	y contents	
	Rena	me Me	
	No Des Compatible	cription	
	© Compatible	Point	
X Cancel		🗸 ОК	

Figure 82 -Activate GIS Features

Click on "Edit"

11:39 🖿							
Edit	C Edit GIS Feature Set Repository						
	Reposito	ory name					
Ahalatree_mapping		Jy hame					
	Repository	description	J				
		p					
No Description							
	Repositor	y contents					
	Renar	ne Me					
	No Des	cription					
	Compatible • F	geometries Point					
EDIT	A		DELETE				
CANCEL			ОК				

Figure 83 -Edit

Then, give a name for the details you want to include in the survey. As shown in the figures (84,85,86,87), by clicking on **"Add,"** you can include additional details.

11:40 🛤	🔝 🍳 📬 🖬 48%							
C Edit GIS Feature Set								
	Name							
Tree			0					
	Desci	ription						
No Description								
	Opt	ions						
Autofill from la	st stored/collected GI	S Feature Set data.						
	Compatible	geometries						
• •		$\Box \subset \bullet$						
$\otimes$	Featu	re List	≈					
Name: <b>F1</b> Prompt: <b>F1</b> Type: TEXT Interpretation: GENERIC Flags: ④ 🕥 🖍 🖗 📉 🔀								
ADD	EDIT	CLONE	DELETE					
MOVE UP	MOVE DOWN	CANCEL	ок					

11:41 🌑 🛤			🔝 🍳 🗣 🖬 47%
<	Edit GIS Featu	ıre	
	DB field nan	าย	
Color			
	Prompt		
Color			0
Data type	W	idth	Decimals
ТЕХТ	∽ 50	┛ 🔽	⊻ ∨
	Data interpreta	ation	
GENERIC			
	Lookup lis	t	
None			
	Default valu	ie	
Visible			
(!) 🔲 Mandatory			
💉 🗹 User editable			
😰 🔲 Allow user to add custo	om values		
🕂 🔲 Auto-increment			
× Cancel	~	ок	

11:42 🌑 🛤						⊘ 🗣 🖬 46	%
<	Edit	GIS Fe	ature				
	C	)B field r	name				
Height							
		Prom	pt				
Height						C	)
Data type			Width		v	Decimals	
DECIMAL		20		⊻ ∨	0	⊻ ~	•
	Dat	a interp	retation	I	<u> </u>		
GENERIC						~	• ]
		Lookup	list				
None						$\sim$	
	[	Default v	/alue				
💿 🗹 Visible							
() 🗌 Mandatory							
💉 🔽 User editable							
😰 🔲 Allow user to add cus	stom v	alues					
🕣 🗌 Auto-increment							
X Cancel		8	🗸 ок				

Figure 86 - Edit GIS Features

$\boldsymbol{\boldsymbol{X}}$	Edit GIS Feature	
	DB field name	
Specialnote		
	Prompt	
Data type	Width	Decimals
ТЕХТ	✓ 100   ✓	0 🖌
	Data interpretation	
GENERIC		
	Lookup list	
None		$\mathbf{\sim}$
(	Default value	
✓ Visible		
(!) Mandatory		
User editable		
Allow user to ac	dd custom values	
+1 Auto-increment		
N /		

Click Ok

11:45 🗖			🔊 🍳 🕈 🗣 🖣 43%			
C Edit GIS Feature Set						
	Na	ame				
Tree						
	Desc	ription				
No Description						
	Opt	tions				
Autofill from las	st stored/collected G	IS Feature Set data.				
•		geometries				
	Featu	ire List	≈			
lnterpr	Name: <b>F1</b> Prompt: <b>F1</b> Type: TEXT etation: GENERIC Flags: ⓒ 🚯 🖍 Name: <b>Color</b>	' 😧 🔀 🛣				
Interpr	Prompt: <b>Color</b> Type: TEXT etation: GENERIC Flags: <b>()</b> ()	' 🗑 🗮 🛣				
l Interpr	Name: <b>Height</b> Prompt: <i>Height</i> Type: DECIMAL etation: GENERIC Flags: <b>()</b>	) 🗑 🧮 🌠				
Name: Specialnot Prompt: Specialnot						
ADD	EDIT	CLONE	DELETE			
MOVE UP	MOVE DOWN	CANCEL	ок			

Figure 88 -Set GIS Features

**Click Yes** 



Figure 89 – User Action Required

Click Ok



Figure 90 -Set Repository

**Click Yes** 



Figure 91 -User Action

Click Ok

11:45 🛤				🗣 🖬 43%				
K Edit	GIS Feature	Set Reposito	ory					
Repository name								
·								
	Repository	description						
No Description								
	Repositor	y contents						
	Tr	ee						
	No Des Compatible							
	©	Point						
EDIT	A	DD	DELET	Ē				
CANCEL			ОК					

Figure 92 -Set Gis and Repository

- 18.1 Then go to the main page and click on the "Device Tab"
- 18.2 Then select on Communication



Figure 93 -Set up the Device

Then you will see the interface below. Click on the Disconnect button first, which belongs to the previous task



Figure 94 - Disconnecting

20.1-Then, click on the drop-down menu, select "Stonex 70G,"

## 20.2 - Then click on "Connect."

11:47 🛤				🗣 🖬 41%		
Cor	nmunicatio	on Settings		DEBUG		
Device Type:	Stonex G	NSS		~		
Communication Mode:	Stonex S	5				
	Stonex S	500				
	Stonex S	580				
	Stonex S	9				
	Stonex S	C2000				
	Stonex S	C600				
	Generic N	Generic NMEA				
	Internal (	SPS (TTY)	Step 2	0.1		
	Stonex S70G - Internal GPS (RAW-RTK)					
	Stonex S	70 - Internal GPS	(RAW)			
			Step	20.2		
Settings		C	Connect			

Figure 95 -Connect the Device

Then go back and select the "Working mode" under the device tab



Figure 96 -Working Mode

Select "Rover"



Figure 97 -Rover

Set the following parameters: Elev. mask: Set it between 10 and 15.

11:48 🛤		🔝 🕅 🗖 🖬 40%
<	Rover mode settings	
Options		
Elev. Mask angle (0~45):	5	0
Record raw data		0
Datalink		
Communication Mode:	None	$\checkmark$
	None	
Antenna Parameters		
Measured Height:	2.000	
Measurement Type:	Vertical height	$\checkmark$
Antenna Height:	2.000	
Satellite Systems		
GPS enable		
GLONASS enable		
BEIDOU enable		0
GALILEO enable		0
QZSS enable	≫	0
Save to Configurations	🗸 Apply	

Figure 98- Set the parameters

Enable the following "satellite system" options and select apply

11:49 🔵 📭				40%
<	Rover m	ode settings		
Elev. Mask angle (0~45):		10		0
Record raw data			0	
Datalink				
Communication Mode:		None		$\overline{}$
		None		
Antenna Parameters				
Measured Height:	2.000			
Measurement Type:	Vertical	l height		$\overline{}$
Antenna Height:	2.000			
Satellite Systems				
GPS enable				
GLONASS enable				
BEIDOU enable				
GALILEO enable				
QZSS enable				
SBAS enable		≽		
Save to Configurations		🗸 Apply		

Figure 99- Enable the following satellite system

Then, go back to the main page 25.1 – Go to the "point" tab 25.2 -Select point Survey



Figure 100-Point Survey

Then you will be directed to this page and select the below icons.



Figure 101 -Map page

Then, click on the icon below to start collecting data. While collecting data, ensure that the "H & V" indicators are green, indicating high accuracy.



Figure 102 --Get the point

**Step 28** Then select ok

12:10 ■ <b>〈</b>	Topo Point				
Name:	2				
Code:		۲Õ۶			
Measured Height:	2.000				
Measurement Type:	Vertical heiç	jht 🗸 🗸			
	Measured p	point info			
	Record	<1/1> Collected			
	Solution	(13/13) SINGLE			
	HRMS	8.04301			
	VRMS	12.00000			
	PDOP	1.5			
	GDOP	99.0			
	Northing	477516.55750			
	Easting	403436.14638			
	Elev.	42.38565			
	Delay	0.0			
Dis	st. from prev.	9.8685			
	Longitude	079°54'00.519000"			
	Latitude	006°47'48.075600"			
	Altitude	-62.00000			
	Local Time	12:10:33			
	Local Date	2024-05-20			
Ba	ase Distance	None			

Noto And Sketch

🕑 ок

Figure 103-Topo point

Step 29 Add descriptions

12:11 🌑 📭			♥ ▼4	ū 22%
<	Enter GIS A	Attributes		
	Use the arrows to sel then enter the	ect a GIS Feature Class Feature Values		
	Тг	ee		
	No Des	cription		
F1				
				$\mathbf{\otimes}$
Color				
Height				
Specialnot				_
X Cancel		🗸 ОК		

Figure 104- Add description

12:12 🛤		 ¥ 🖣 22%
<	Enter GIS Attributes	
•	Use the arrows to select a GIS Feature Class then enter the Feature Values	
	Tree	
	No Description	
F1	1 of 1	
		 $\mathbf{x}$
Color		
Dark green		$\mathbf{X}$
Height		
10		$\boldsymbol{\otimes}$
Specialnot		
it looks healthy		$\boldsymbol{\otimes}$
× Cancel	🗸 ОК	

Figure 105-Enter GIS attributes

Similarly, you can collect the data. For this project, we conducted a survey on trees at the University of Moratuwa.

13:39 • ` **\$**  48% Project: [TREEMAPPING1] [treemapping1.pd] ™Rover DGNSS < H: 24.839 8 9/14 V: 30.000 X E 403434.068 Z 44.986 N 477498.295 Lanka Hydraulic Institute Department Departr of Textile Lily's Bridals Bridal shop Civil En and Clothing 4 University Grounds L Block Tree Faculty of Info Tree Technology Department of Com Div Tree4 f Maritime Stur Science & Engineering Tree Tree Bank of C nn University of .. Main St **PROMISE LUSH** ? Promise Land Develop creen Polishing **Registrar Office** ection Sri Lanka... and Examination Siribara Manike Rd University 0 of Moratuwa Bandaranayake Mawatha 2nd Ln Shady Residence Polwatta Rd REC gle 126m ©2024 ABC DEF GHI • POINT NAME DDE/NOT нŢ 2.000 Tree9

Click on the below icon to see the collected data.

Figure 106 - Collect the data

This is the point Library

13:4	10 🗖						🗣 🖬 47%
<					Point Library		
	Poi	nt Name or Co	bde	)			Q
Ø \$0 Ø \$0	Ø □ Ø □→□ □→ Ø □ Ø	0 0				↓ A A Z ↓ ∰	
	No.	Name	Ρ	G	Northing	Easting	Elevatior
	#8	Tree8		G	477551.258	403511.195	30.884
	#7	Tree7		G	477567.452	403474.947	29.984
	#6	Tree6		G	477571.112	403407.853	26.786
	#5	Tree5		G	477576.960	403334.038	22.787
	#4	Tree4		G	477542.727	403295.838	27.588
	#3	Tree3		G	477515.580	403334.959	35.988
	#2	Tree2		G	477505.335	403404.086	38.086
	#1	Tree1		G	477510.000	403413.233	40.386
( <del>+</del> )	Add	🛃 Edit			Details	X Tool	s
¥	Import	ााि Delete	Э		Delete all	📀 ок	

Figure 107- Point Library

Again, go to the main Project tab and click on the export icon to export the data.



Figure 108 -Export Data
#### Step 32

32.1 -Tick the "Share after exporting" option, which will allow you to share the data through different

platforms. If not, the file will only be saved to the device.

#### 32.2 -Then, select "Export.

13:41 🛤		▲ 🖬 45%		
<	Export File	<		
Export Path /s	xport Path /storage/emulated/0/StonexCube/Export/			
File Name	Treemapping1			
Data file	Treemapping1.PD	$\checkmark$		
File type	Raw measurement data format (csv)	$\sim$		
Share after exporting		ზ		
Step 32.1				
	Stop 22.2			
	- Step 32.2			
Coptions	Export			

Figure 109 -Exporting

Select the Export Type (Here you can export the shapefiles)



Figure 110 -Export Format

GIS Data	GIS Data Export					
elect a GIS repository set to export						
Ahalatree_mapping		~				
elect a geometry type to export						
Point		~				
ased on your selection, the following wil	l be exported:					
- Geometry type	Item count					
Point	8					
Polyline	0					
Polygon	0					
Arc of circle	0					
Circle	0					
Job ref.sys Grid coords		-				
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						
Job ref.sys Grid coords						

Figure 111 -Export

# 5. MEASURE AND MAP NOISE POLLUTION WITH MOBILE PHONE

# 5.1 Introduction

Noise pollution, which is frequently ignored, has a major impact on human health and the environment. Urbanization, industrial activity, and transportation are major contributors to growing noise levels, which can cause stress, hearing loss, and other health problems. Addressing noise pollution is critical to building healthier, more livable communities.

With the advancement of technology, the general population may now measure and map noise pollution using their mobile devices. Modern smartphones are equipped with sensitive microphones and strong processors, allowing them to serve as portable noise meters. Various applications use these characteristics to assist users monitor noise levels in their surroundings, allowing them to make educated decisions.

This section of the manual will walk you through the process of measuring and mapping noise pollution using your mobile device. It will go over how to choose the right apps, how to take precise measurements, how to interpret data, and how to create noise maps. By the end of this manual, you will have the knowledge and skills you need to help raise awareness and reduce noise pollution in your community.

Monitoring noise levels is important. Monitoring noise pollution is critical for a variety of reasons.

- Health Protection: By evaluating noise levels, people and communities may decrease exposure and safeguard their health.
- Understanding noise patterns is useful in urban planning and environmental management.
- Regulation and Policy: Accurate noise data facilitates the development and implementation of noise rules and policies.
- Public Awareness: Educating the public about noise pollution and its effects can lead to more community-led noise-reduction measures.

# 5.2 Overview of Mobile Apps for Noise Measurement

Mobile apps have made it easier to measure noise pollution accurately and conveniently. These apps leverage the microphone of your smartphone to capture sound levels in decibels (dB) and provide valuable data for noise monitoring and analysis. One such app is NoiseCapture, which is popular for its comprehensive features and ease of use.



Noise Capture is an open-source mobile application designed to measure environmental noise levels. It is available on the Google Play Store and is widely used for its accuracy and user-friendly interface

Figure 112 -Noise Capture App

#### 5.2.1 Features of Noise Capture App:

- Accurate Noise Measurement: The app measures sound levels in real time using your phone's microphone.
- Data Logging: It allows you to log noise data over time, providing a detailed record of noise levels.
- GPS Integration: Noise Capture integrates with GPS to tag noise measurements with geographic coordinates, enabling the creation of noise maps.
- User-Friendly Interface: The app is easy to navigate, making it accessible for both beginners and experienced users.
- Data Sharing: You can share your noise measurements.
- Graphical Analysis: The app provides graphical representations of noise data, helping users visualize noise patterns.

## 5.2.3 Architecture Diagram and Workflow



Overview of Other Mobile Apps for Measuring Noise Pollution					
Арр	Android	IOS	Key features		
Sound Meter	<b>~</b>		Real-time noise measurement, sound level charts, calibration.		
Decibel X	✓	<b>~</b>	Real-time noise measurement, spectrum analyzer, data logging, calibration, exporting data, and sharing options.		
NIOSH Sound Level Meter		<b>√</b>	Accurate noise measurement, occupational noise exposure assessment, real-time data, and reporting features.		

#### Selecting the Right App for Your Needs

- Accuracy: Look for apps with good reviews and those that offer calibration features.
- Ease of Use: Select an app with an intuitive interface and clear instructions.
- Additional Features: Depending on your needs, you may require features like data logging, GPS integration, or data sharing.
- Platform Compatibility: Ensure the app is available for your mobile operating system (Android or iOS).

# 5.3 Steps

## Step 1: Download and Install the Noise Capture Application

Figure 116 provides a detailed methodology that outlines the step-by-step process for downloading and installing the application.



Once you have downloaded and installed the NoiseCapture application, follow these steps to set it up.

Figure 117 guides this process.





Figure 115 - Setup the app

#### Step 3: Start Recording

## 3.1 - Identify the interface

Once the Noise Capture app is set up, familiarize yourself with the app's interface. The main interface includes three main tabs: Spectrum, Spectrogram, and Map. Each tab provides different functionalities to help you record and analyze noise levels effectively.

- Spectrum: The Spectrum tab displays real-time noise level measurements in decibels (dB). It shows a bar graph indicating the noise levels over time.
- Spectrogram: The Spectrogram tab provides a visual representation of the noise frequency spectrum over time. It shows how the sound frequency components change, with different colors representing different intensity levels. The graph represents two dimensions. The horizontal axis shows the time, while the vertical axis shows the frequency, and the color shows the dB level.
- Map: The Map tab displays your current location and geo-tagged noise levels. It shows where noise measurements are being taken and provides a spatial view of noise pollution.



Figure 116 -3 Main Tabs

## 3.2 – Start Recording

First, start the recording by clicking the recording icon shown below.



Step 4: Once finished with the recording click on the below icon to stop the recording.



Figure 118 -Stop the Recording



#### Step 5: Add Description and press validate.

Then you can view the results as shown in the figure



#### Step 6 – Map features

Click on "Show Map" to visualize your location and access the editing features for your map.





Figure 121 -Map Features

#### Step 7 – Export Data

To export the data, follow the below steps



Figure 122 -Export Data

#### What is a Decibel (dB)?



A decibel (dB) is a unit of measurement that indicates the intensity of a sound. It is a logarithmic scale used to describe sound pressure levels, where each 10 dB increase represents a tenfold increase in sound intensity.



Noise Standards for Specific Locations:

Various organizations have established guidelines and standards for acceptable noise levels in different environments. These standards aim to protect public health and welfare by minimizing noise pollution.

- World Health Organization (WHO) Guidelines: <a href="https://www.ruidos.org/Noise/WHO\_Noise\_guidelines\_4.html#:~:text=To%20avoid%20heari-ng%20impairment%20in,field%20equivalent%20sound%20pressure%20levels">https://www.ruidos.org/Noise/WHO\_Noise\_guidelines\_4.html#:~:text=To%20avoid%20heari-ng%20impairment%20in,field%20equivalent%20sound%20pressure%20levels</a>.
- Occupational Safety and Health Administration (OSHA) Standards <a href="https://www.osha.gov/noise/exposure-controls">https://www.osha.gov/noise/exposure-controls</a>
- Environmental Protection Agency (EPA) Recommendations : <a href="https://www.epa.gov/archive/epa/aboutepa/epa-identifies-noise-levels-affecting-health-and-welfare.html#:~:text=The%20document%20identifies%20a%2024,preventing%20activity%2">https://www.epa.gov/archive/epa/aboutepa/epa-identifies-noise-levels-affecting-health-and-welfare.html#:~:text=The%20document%20identifies%20a%2024,preventing%20activity%2</a> <u>Ointerference%20and%20annoyance</u>.

#### Step 8 – Add Data into QGIS

- 1. Start QGIS on your computer.
- 2. Go to the Layer menu.
- 3. Select Add Layer, then choose Add Vector Layer.
- 4. In the dialog that opens, set the Source type to File.
- 5. Click Browse to locate your **GeoJSON** file on your computer.
- 6. Select the **GeoJSON** file and click Open.
- 7. Finally, click Add to load the GeoJSON file into QGIS.







Figure 123 - Add to QGIS

#### Step 9 – Categorized the data

- 1. Go to properties in the data and select "Graduated" in the Symbology panel.
- Choose the leq\_mean (leq\_mean appears to be the mean equivalent continuous sound level, which is a common metric used in noise studies to represent average noise levels over a specified period) field as the value to be used for the classification.
- 3. Select a Color Ramp that will represent the range of noise levels.
- 4. Classify the data by clicking the "Classify" button.
- 5. Apply the settings and visualize the data on the map



Figure 124- Add Symbology