

VIRTUAL LAB

By

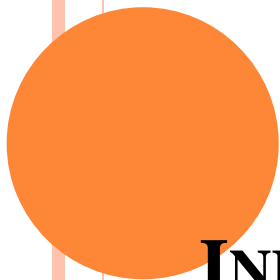
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R D GARG

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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

ROORKEE, INDIA



ACKNOWLEDGEMENT

We are very thankful to **“Ministry of Human Resource Development ”, Government of India, New Delhi** for providing financial support to develop Virtual Lab Experiment in 3D.



VIRTUAL LAB:

Well defined steps to carry out the experiment or work sequentially. Result can not be obtained if steps are not perform sequentially or carelessly.

VIRTUAL ENVIRONMENT:

Freedom for user to move in any direction and can do list of works not necessary sequentially.



VIRTUAL LAB

- To provide remote-access to Labs in various disciplines of Science and Engineering.
- To enthuse the students to conduct experiments by arousing their curiosity.
- To provide a complete Learning Management System- web-resources, video-lectures, animated demonstrations and self evaluation
- To share costly equipment and resources, which are otherwise available to limited number of users due to constraints on time and geographical distances



SALIENT FEATURES

- 3D virtual lab is very cost effective as instrument is required only one time for image capturing
- No breakage, wear and tear of instrument
- Very useful in education as less resources are required
- Remotely accessibly learning system
- Many users can download the file simultaneously and perform the experiment offline also



APPLICATIONS

- Enhances E- learning and quality of education
- Learning in 3D environment
- Anywhere, anyplace



USERS

- Students- UG and PG level
- Research Scholar
- Faculty Staff
- Novice Users

Virtual lab available at-
<http://www.vlabcivil-iitr.co.in>



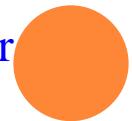
REQUIREMENT OF HARDWARE AND SOFTWARE

Software Requirement-

- 32 bit or 64 bit, Windows XP sp2 or higher version
- Microsoft Internet Explorer 8.0 internet browser or higher or Mozilla Firefox 3.0 internet browser or higher (Google Chrome recommended)
- Flash Player
- Internet connection for web downloads

Hardware Requirement-

- Intel Core 2 Duo Processor or equivalent AMD processor or higher
- 2 GB RAM (4 GB recommended)
- OpenGL-capable graphics card (256 MB or higher video card memory, 1 GB or higher recommended)



EXPERIMENTS DEVELOPED

- 1) Study of various parts of Auto Level and Carry out Fly Leveling using Auto Level.
- 2) Carry out Profile Leveling using Auto Level.
- 3) Observations of Vertical and Horizontal angles using Total Station.
- 4) Study of Plane Table and its Accessories.
- 5) Detail Plotting by Radiation Method (in 2D).

Continued...



EXPERIMENTS DEVELOPED

- 6) Detail Plotting by Intersection Method (in 2D).
- 7) Detail Plotting by Resection Method (in 2D).
- 8) Carry out Contouring in the field (in 2D)..
- 9) Study of Global Positioning System (GPS) and its Accessories.
- 10) Observations using GPS.



TOOLS USED FOR DEVELOPING EXPERIMENTS

For 3D Development-

- Autodesk 3ds Max 9
- Adobe Photoshop CS4
- Quest 3D version 4.3.2

For 2D Development-

- Adobe Flash CS5
- Adobe Photoshop CS5

For Website Development-

- PHP
- MySql
- JavaScript
- AJAX

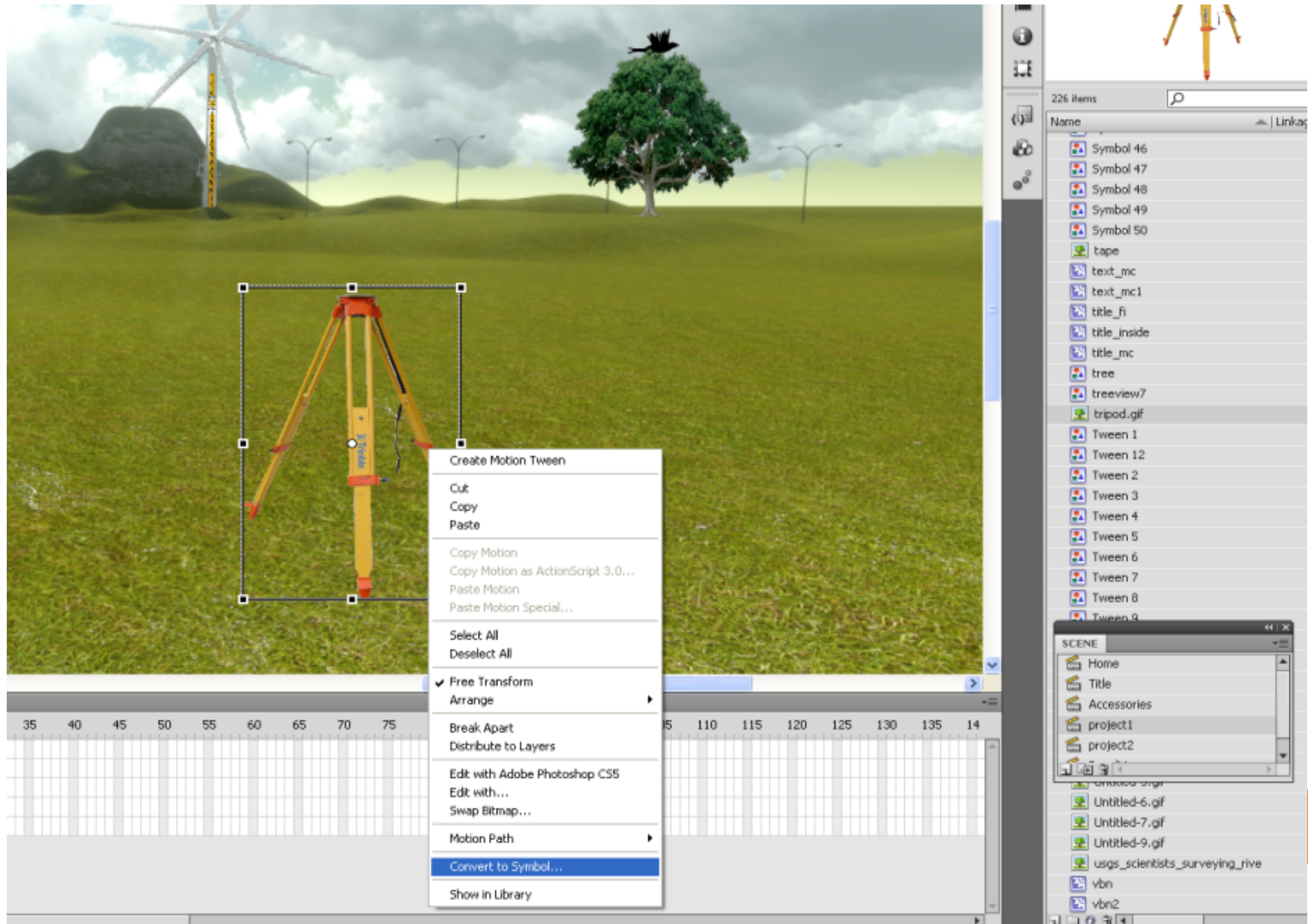


METHODOLOGY FOR 2D DEVELOPMENT

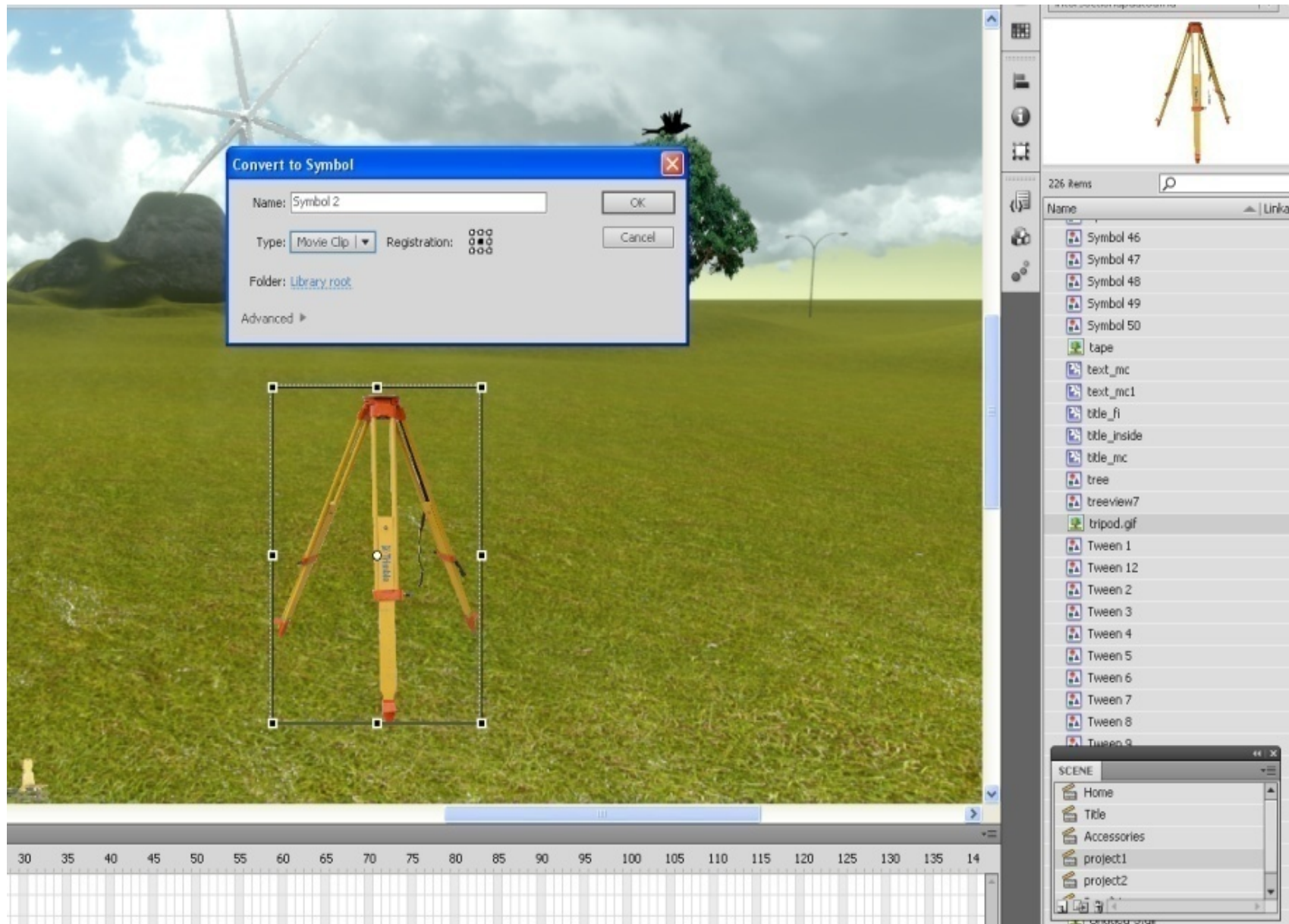
1) Taking Images and measurements and design sketches



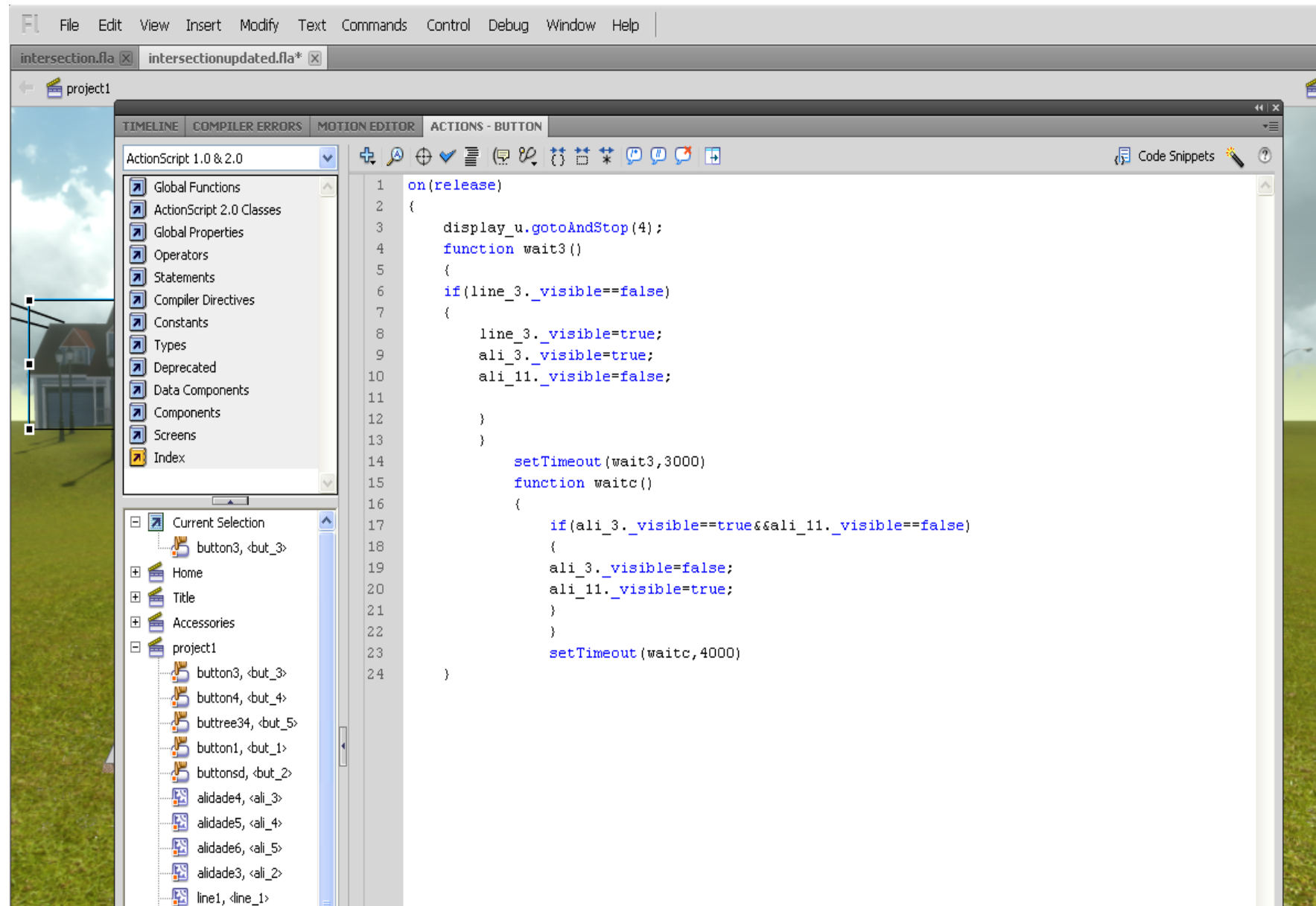
2) a. Designing and placing 2D Objects in the field



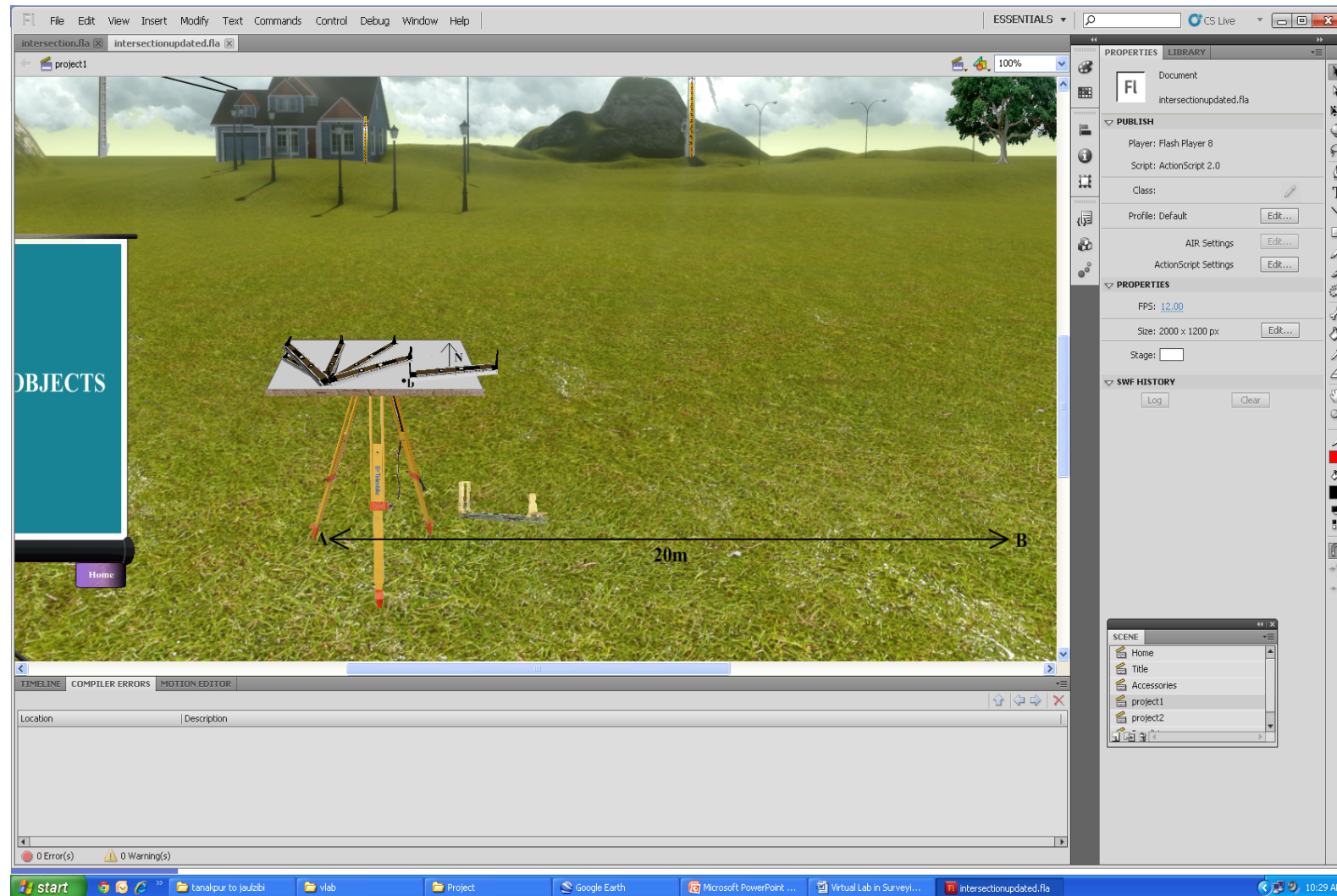
2) a. Designing and placing 2D Objects in the field



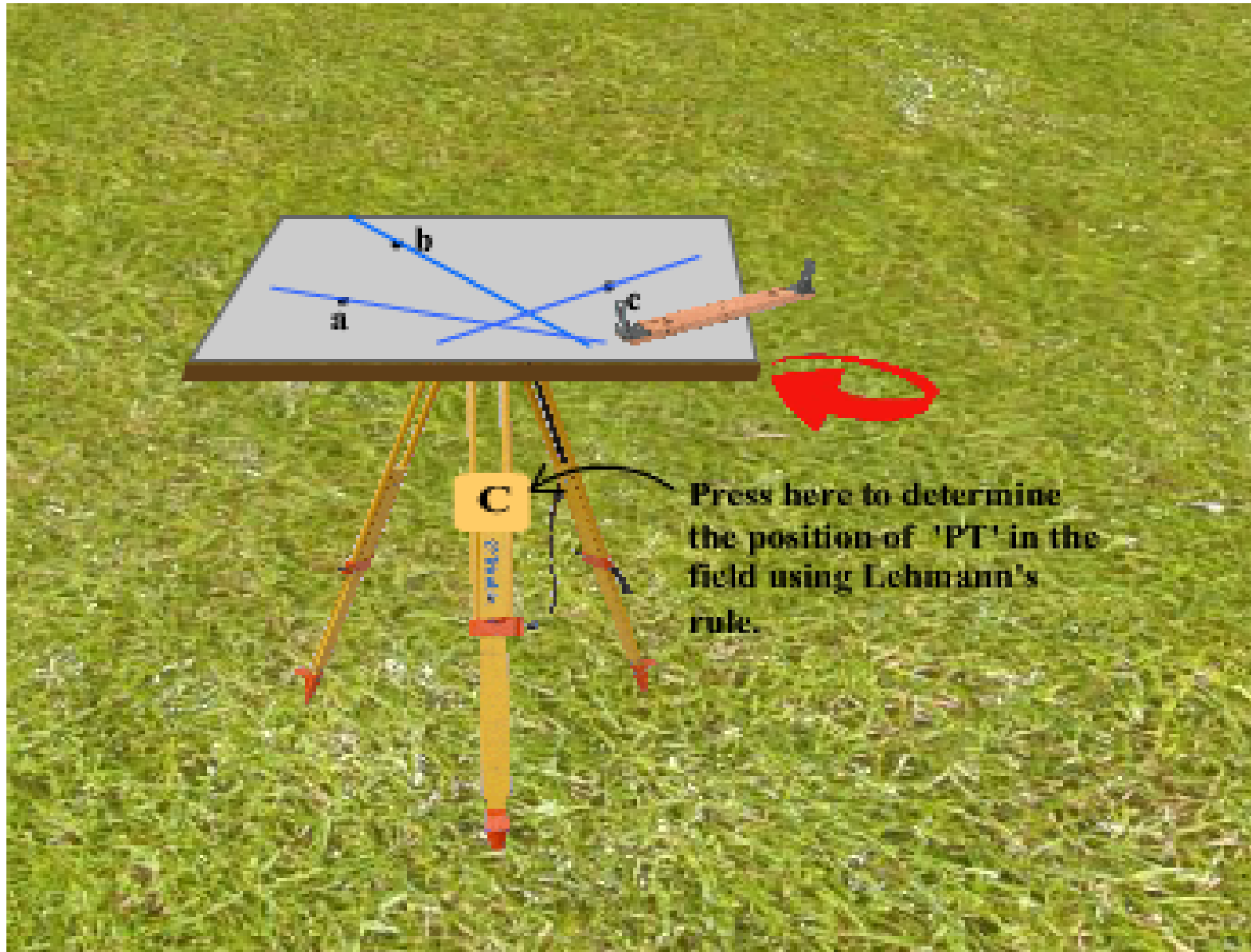
2) b. Coding in Flash



3) Placing Objects in the field



4) Instructions on screen to perform



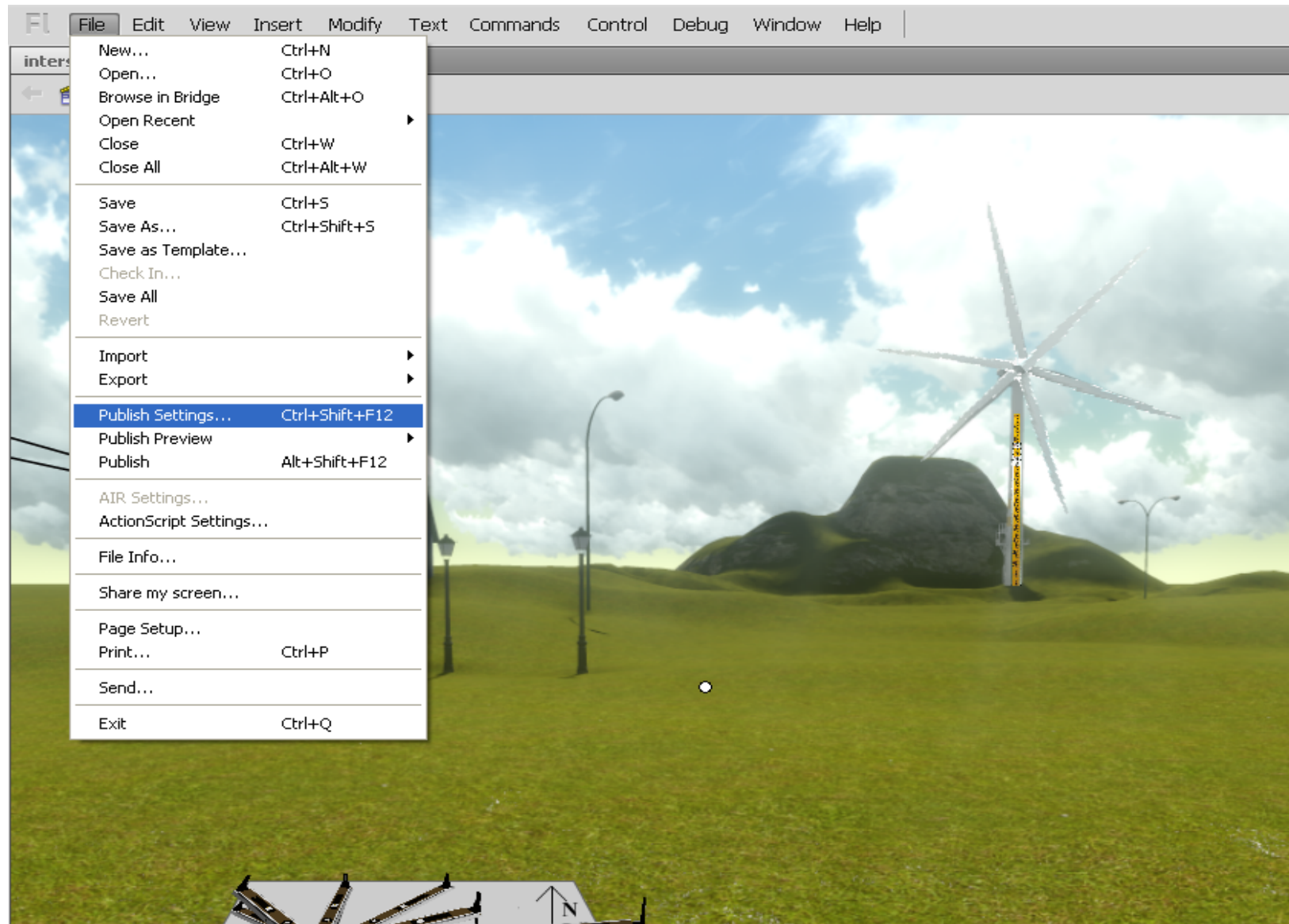
4) Instructions on screen to perform

Plane table is set up at station A and details are to be plotted by method of radiation. First the plane table is set over the station A, levelled and properly oriented. Position of A is plotted on paper as point a. Alidade is pivoted at a, and objects present in the area, such as tree, water tank, solar panel, street light, and house corner etc. , are bisected. Radial lines are drawn from point a on paper showing their respective directions. The corresponding field distances are measured and scale off on respective radial lines. For these objects, staff values are measured either using a theodolite or a level. Elevations are computed and written on the map.

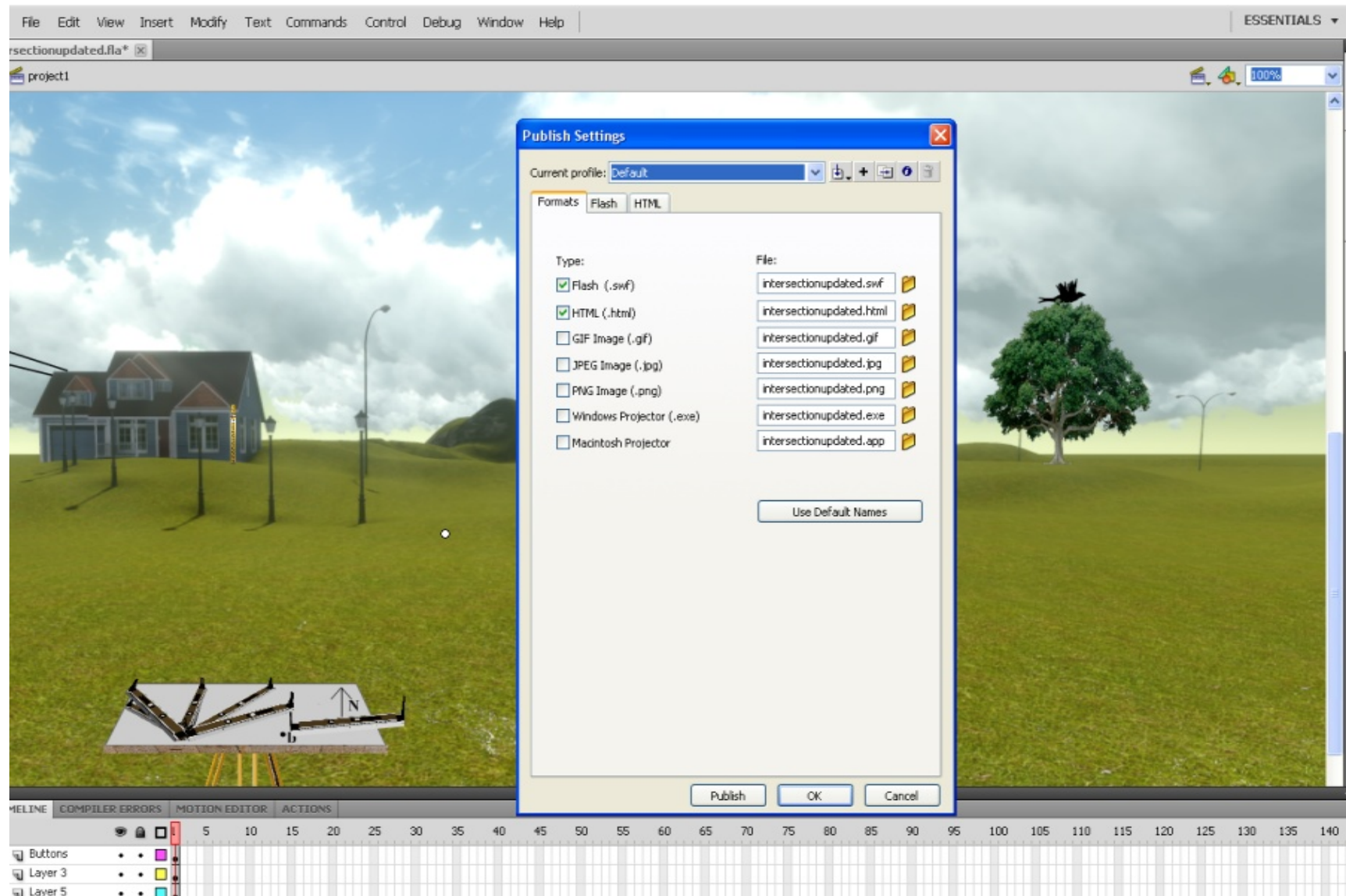
(Note-After taking all the observations click on 'result' to get the final result which is displayed in graphical form)



5) Generation of flash file for standalone system

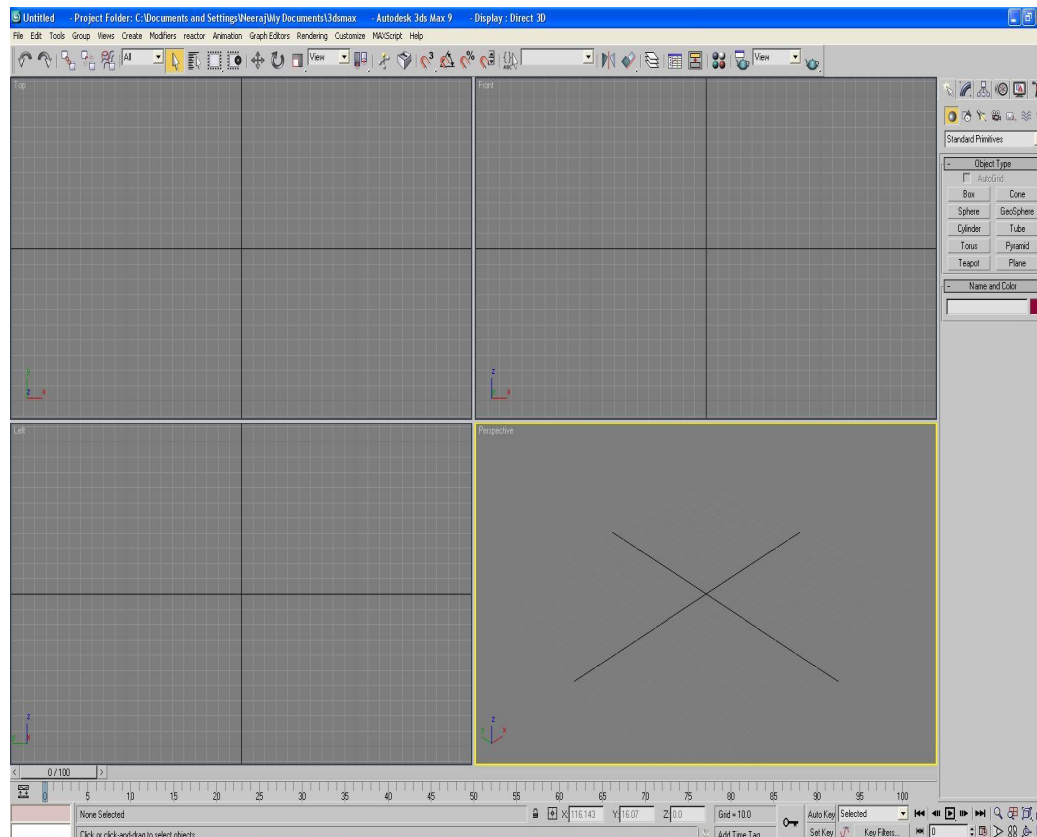


5) Generation of flash file for web compatible for online purpose

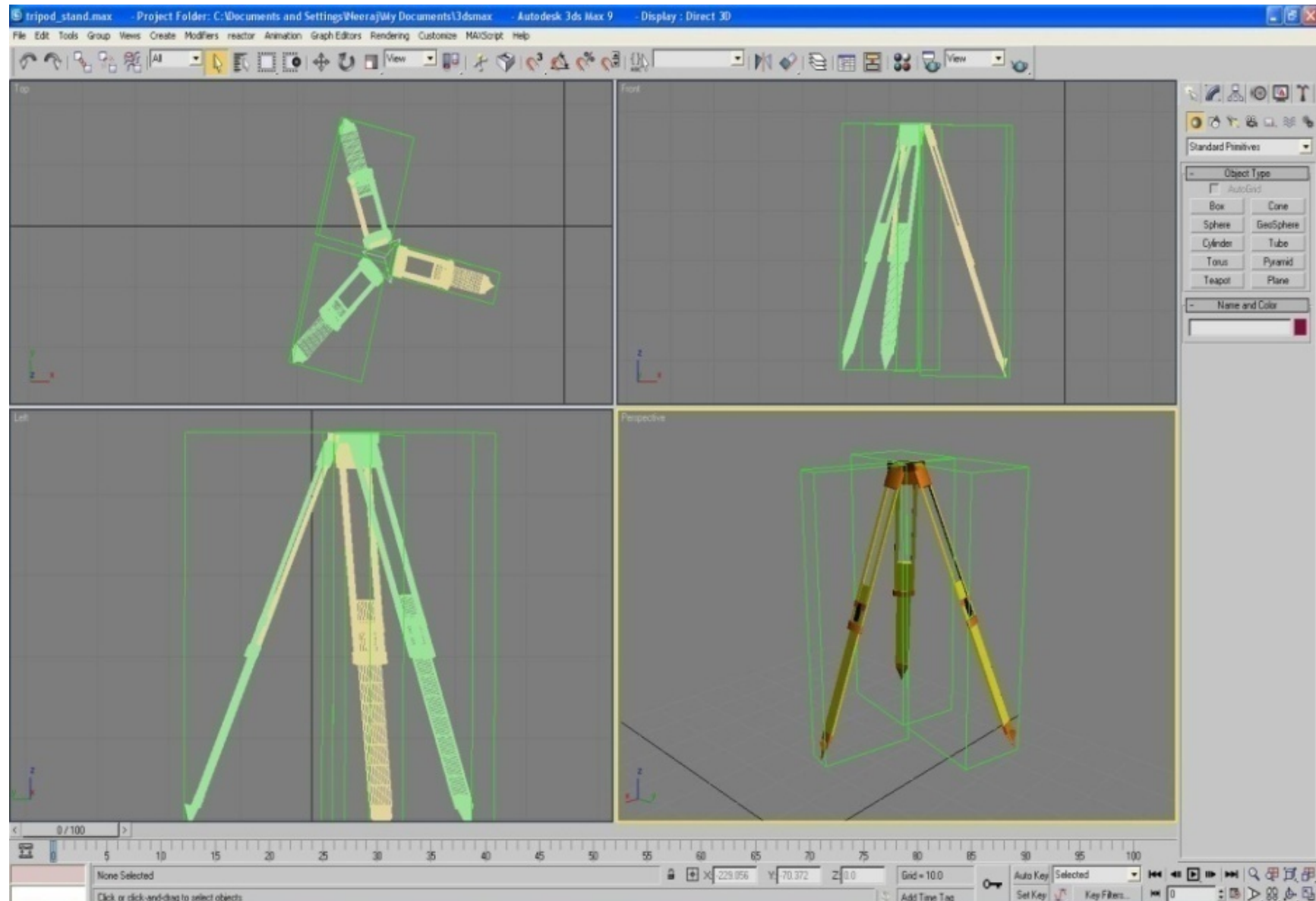


METHODOLOGY FOR 3D DEVELOPMENT

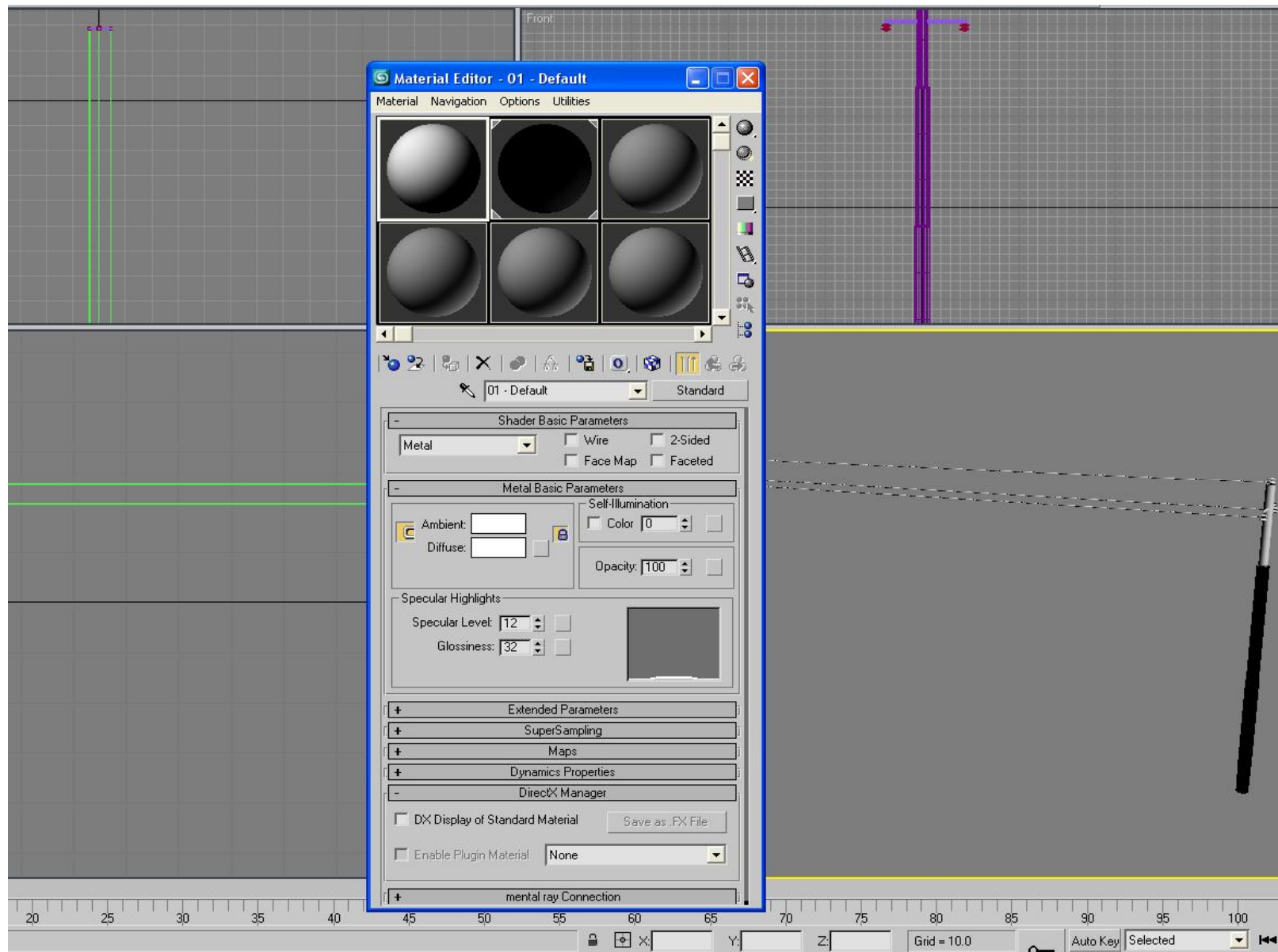
1) Taking Images of original instrument, measuring components and sketch design



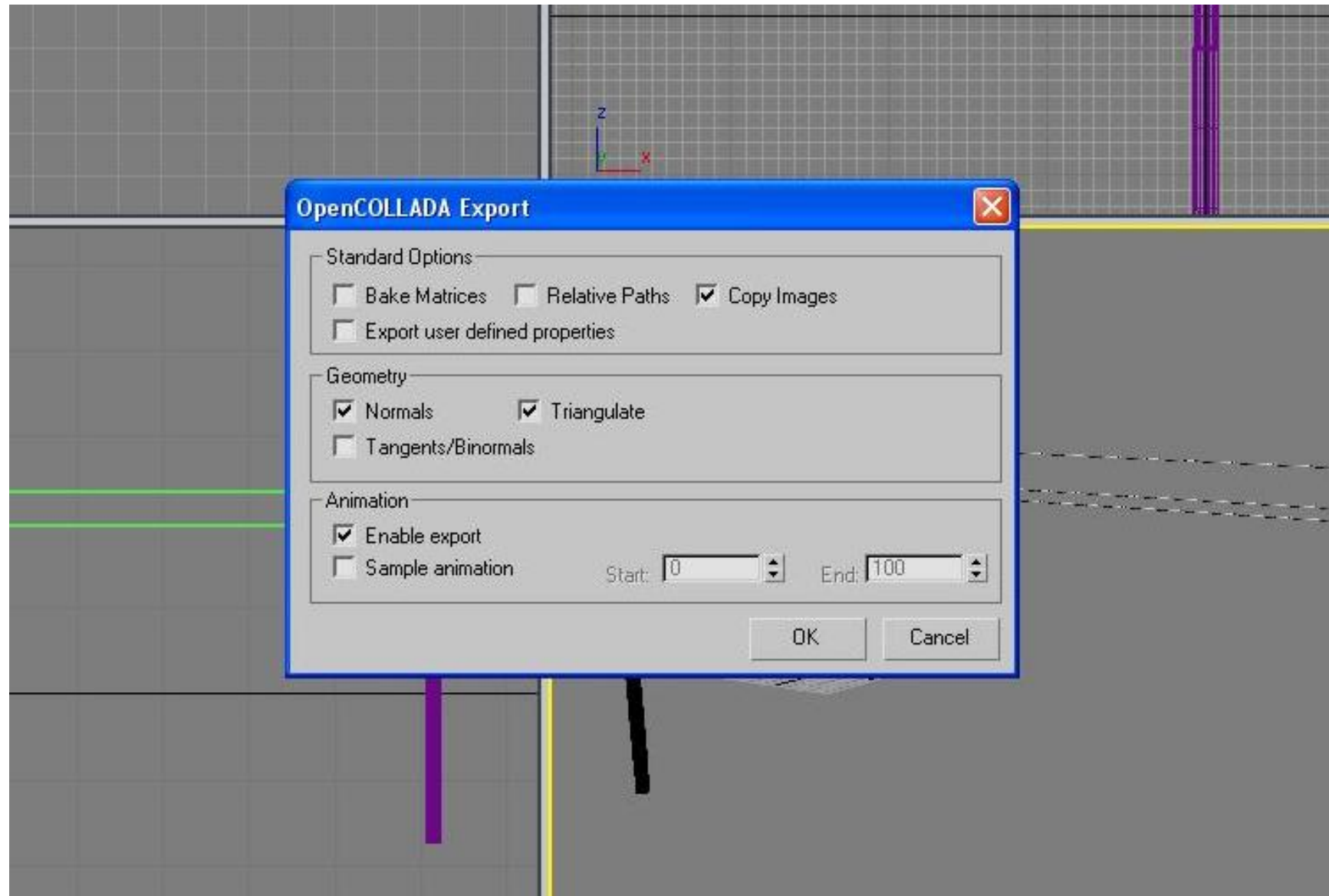
2) 3D Modeling of Objects in 3Ds Max software



3) Applying Texture in 3ds Max software



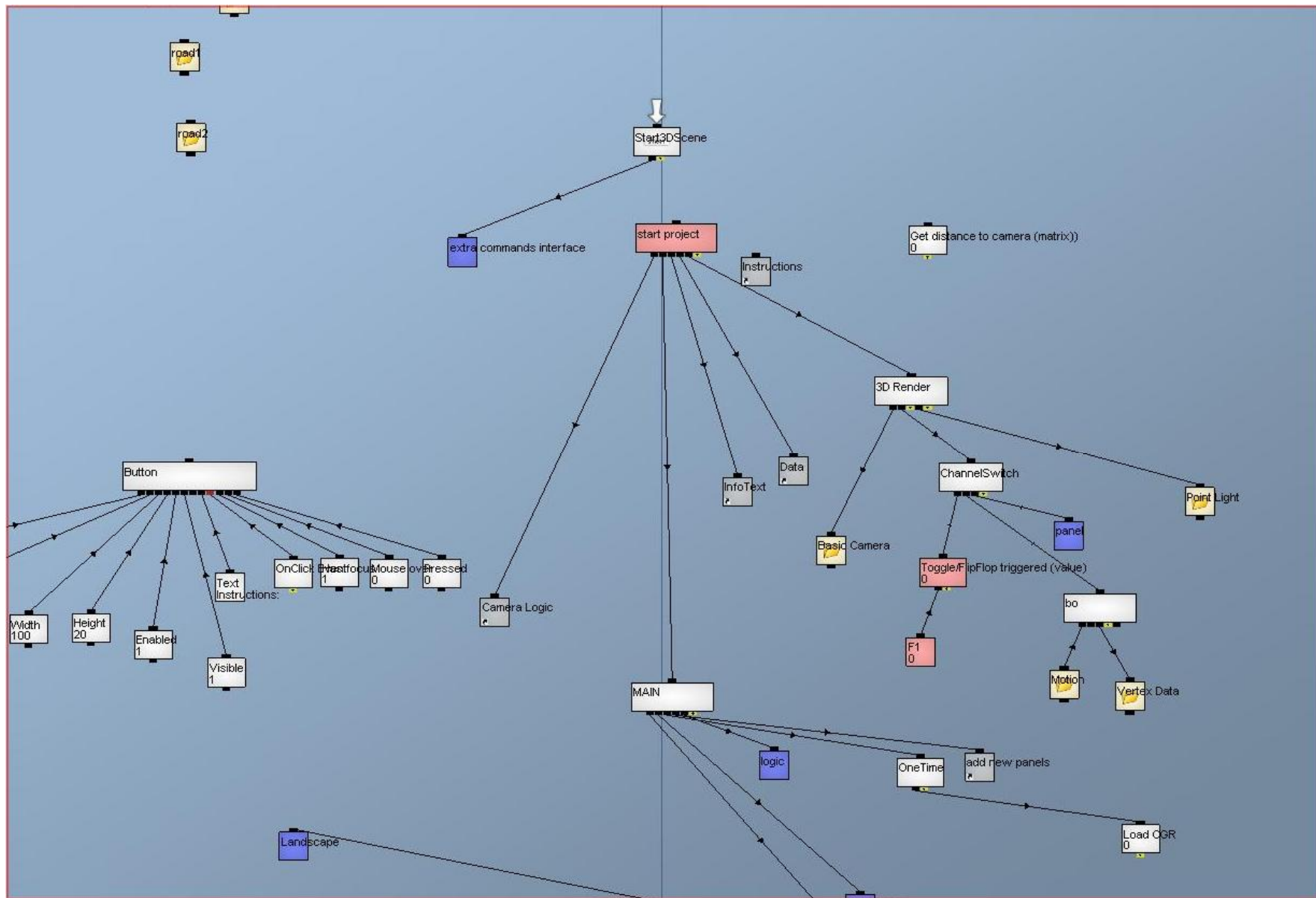
4) Exporting 3D designed objects to another software using Open Collada



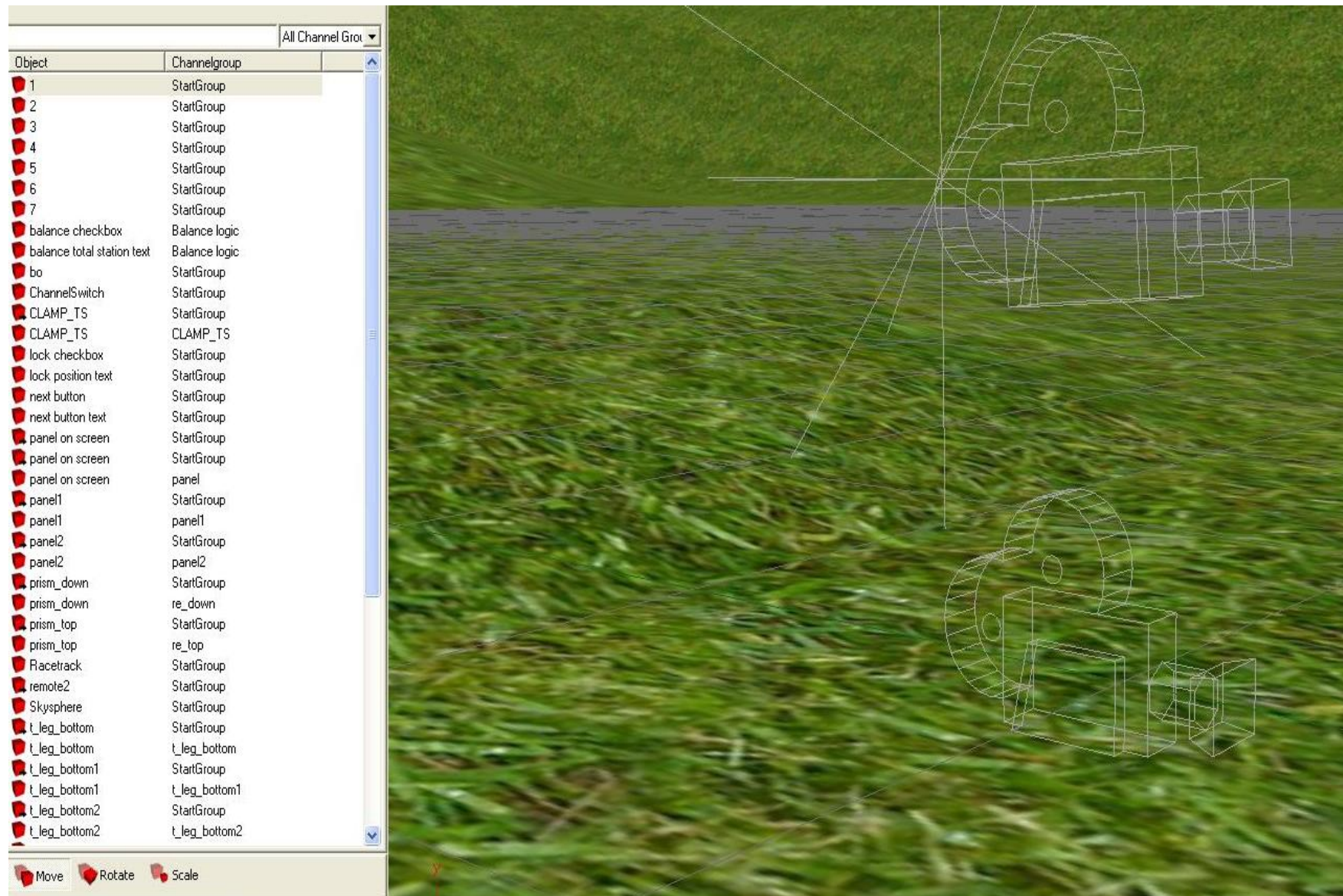
5) 3D Environment design in Quest 3D software



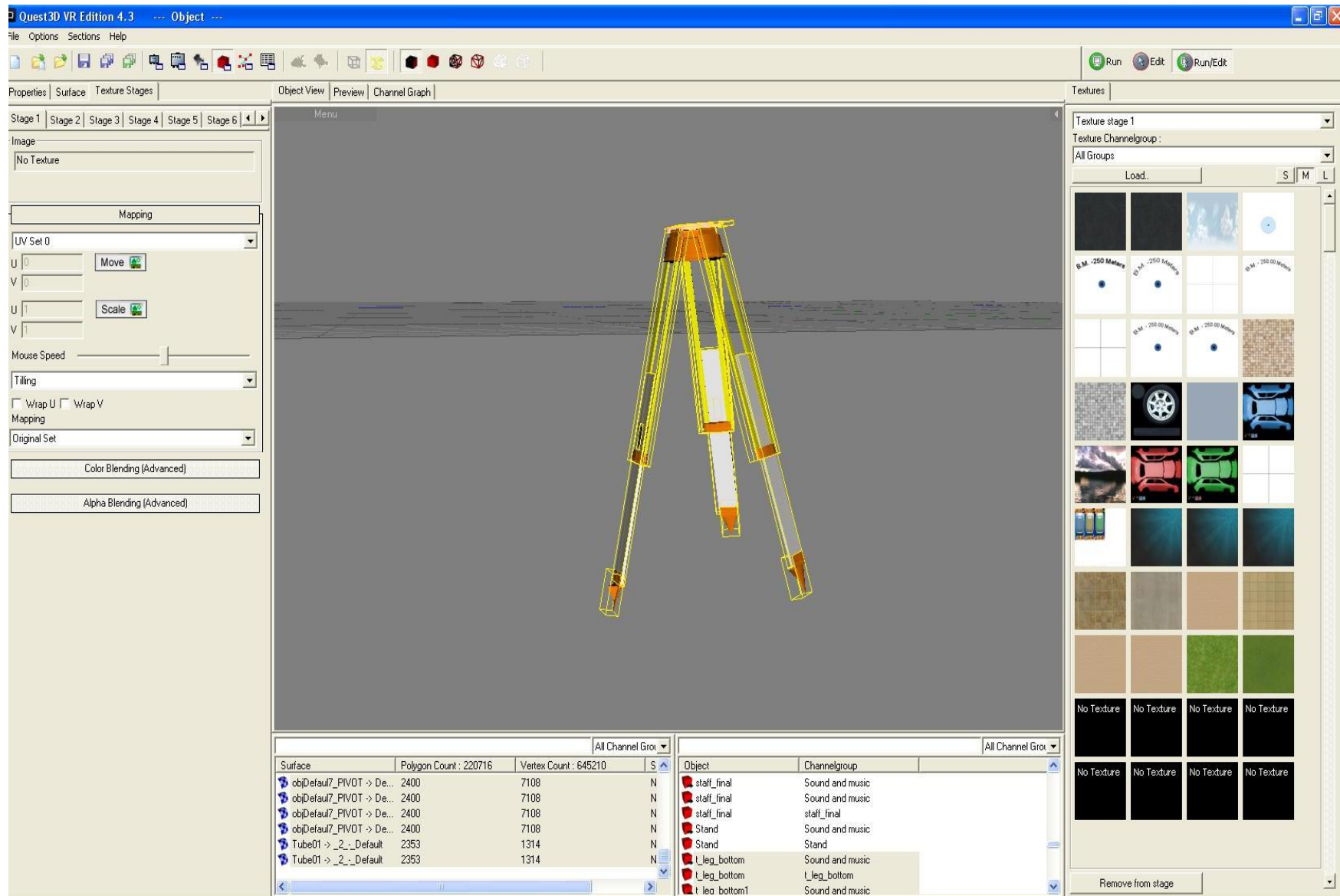
6) Applying animation and simulation to objects in Quest 3D Software



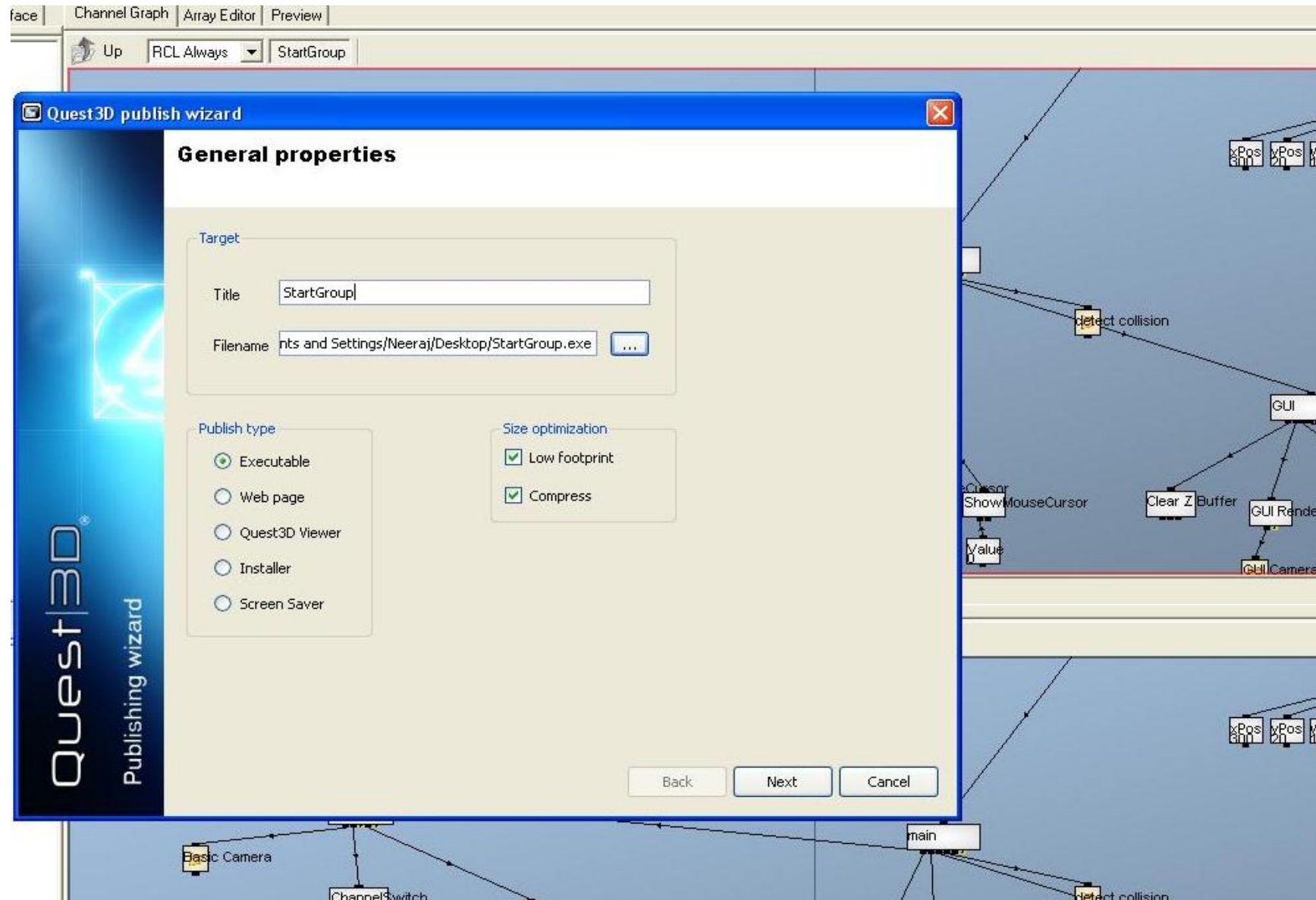
7) Positioning Cameras and Lighting in Quest 3D software



9) Rendering in Quest 3D software



10) Generation of executable and web compatible file to use




METHODOLOGY FOR WEBSITE DEVELOPMENT

1) Design user interface




2) Create login form



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Login

Login with your account

Not registered? [Sign-Up!](#)

Username:

Password:


☐ Remember me next time

Forgot password! [Click here](#)

Member Total: 323


There are 0 registered members and 1 guests viewing the site.

3) Create Registration form



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Total Station

Plain Table and its Accessories
Plain Table and its Accessories

Details plotting by Radiation Method
Details plotting by Radiation Method

Details plotting by Intersection Method
Details plotting by Radiation Method

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Login
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Create an Account

If you are already registered, [Login here](#)

Fill up the given form for registration.

First name:

Last name:

Username:

Don't use email id as username.

Password:


Confirm Password:

Security Question:

If you forget your password we will ask for the answer to your security question.

Answer:

Email:



Please enter the image text:

[Join!](#)

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4) Embedding classroom video lecture and experiment video in the website

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[Profile Leveling Using Auto Level](#)

[Measurement of Vertical angle Slope](#)


[Distance and Horizontal Distance](#)

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Logout

Total Station Gallery



Total Station with carrying box

5) Validate pages and user using java script and PHP

Prepare a Report


Experiment No.	<input type="text" value="9"/>
Experiment Name	<input type="text" value="GPS and its Accessories"/>
Name	<input type="text" value="Anuj Kumar"/>
Status	<input type="text" value="Select"/>
Address	<input type="text"/>
Contact No.	<input type="text"/>
Email	<input type="text"/>
Date	<input type="text" value="26"/> <input type="text" value="March"/> <input type="text" value="2012"/>
Remarks	<div></div>
<input type="button" value="Submit"/>	

The page at vlabcivil-iitr.co.in says:


You didn't choose status from the drop-down list.
Please enter your Address.
The phone number is the wrong length.
Please enter a valid email address.❏

OK

6) Report generation in PDF



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Prepare a Report

Experiment No.	9
Experiment Name	GPS and its Accessories
Name	Anuj Kumar
Status	Student
Batch	
Branch	
Year	Select
Programme	<input checked="" type="radio"/> UG <input type="radio"/> PG
Course	
College/Inst/Univ	
Address	
Contact No.	
Email	
Date	24 March 2012
Remarks	

7) Photo gallery and slideshow using PHP and Flash




8) Do's and Don'ts for Total station experiment



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[Profile Leveling Using Auto Level](#)

[Measurement of Vertical angle Slope](#)

[Distance and Horizontal Distance Using Total Station](#)

[Measurement of Vertical angle Slope](#)

[Distance and Horizontal Distance Using Total Station](#)

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Dos and Don'ts

Dos:

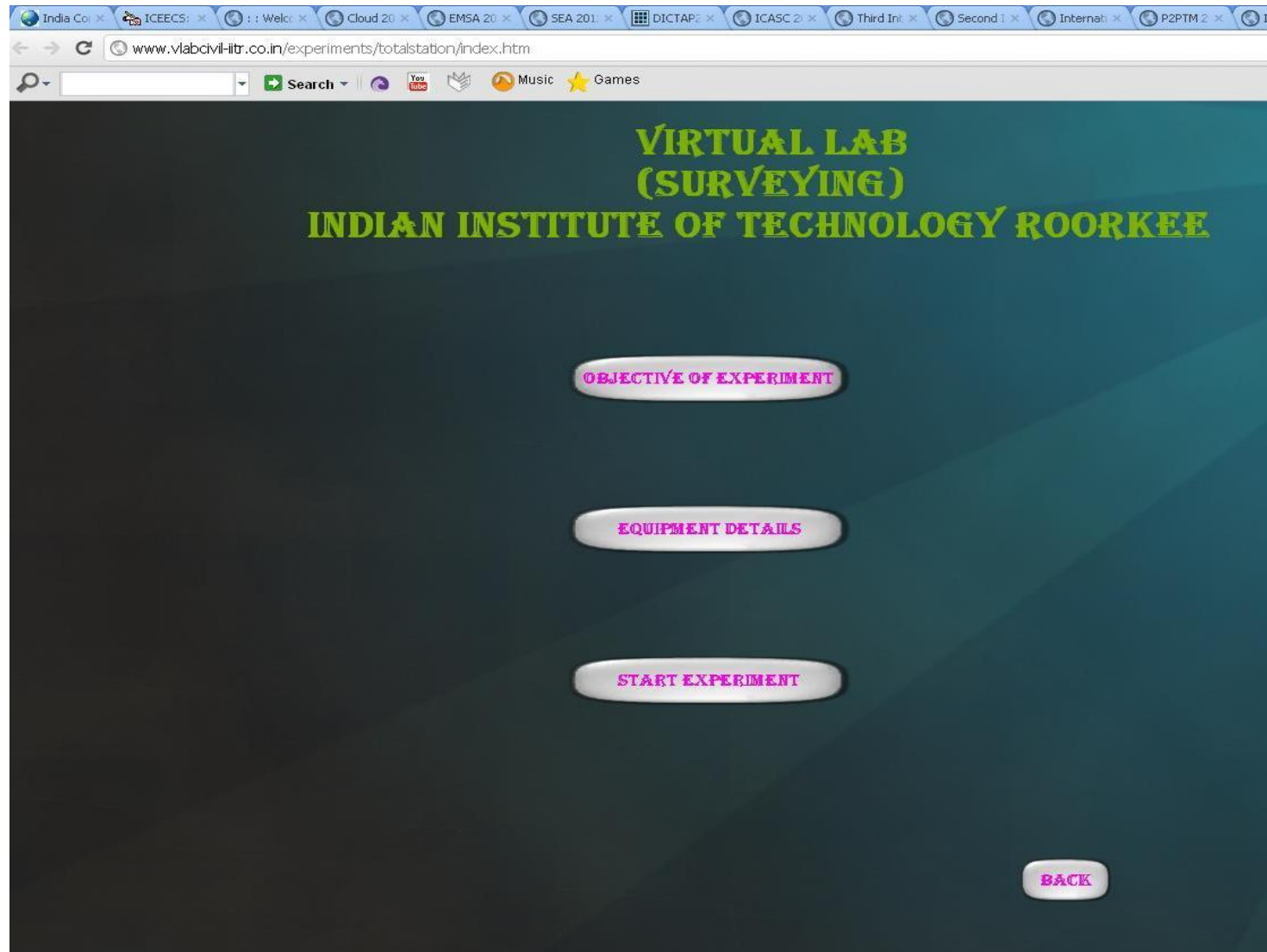
- 1) Center and level the base of Total Station accurately.
- 2) Crosshairs must be focused sharply.
- 3) Measure height of the instrument and height of prism above ground.
- 4) Always take 3 or more observations of each point to take the average.
- 5) Apply check for horizontal angles.

Don'ts:

- 1) Handle the Total Station and Prism with utmost care. If dropped accidentally, Digital display of Total Station may get damaged and Prism may also be broken.
- 2) While shifting the instrument from one station to another station, always keep it in box for transport.
- 3) Protect the instrument from heavy rains.



8) Finally, embedding 3D experiments in the website using PHP and Quest 3D Software



USING VIRTUAL LAB WEBSITE

Step 1: Go to the below URL in Web Browser:

<http://www.vlabcivil-iitr.co.in>

<http://www.vlab.co.in>

Step 2: To perform experiment online, first you have to register yourself on the website and get username and password.

Step 3: After registration you have to login with your username and password.

Step 4: Now you will see a list of experiments. Choose your experiment to perform online.

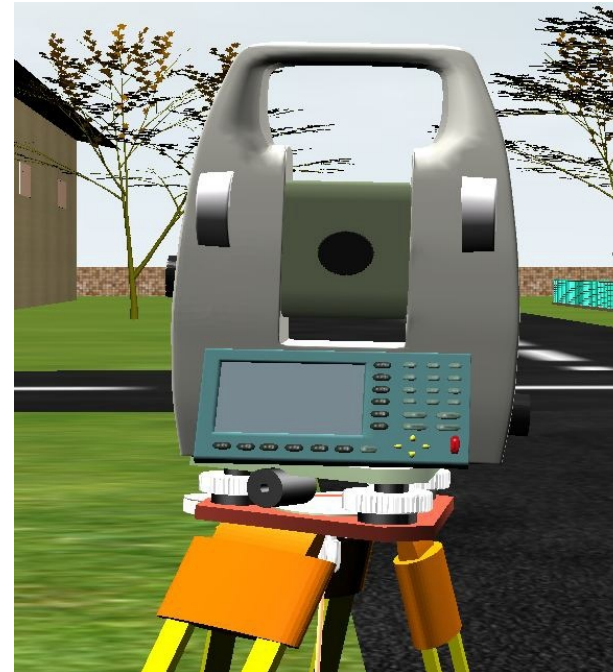


EXAMPLES

- Observations of Vertical and Horizontal angles and Distance using Total Station
- Observations using GPS



EXAMPLE 1: OBSERVATIONS OF VERTICAL AND HORIZONTAL ANGLES USING TOTAL STATION



Original Total station and 3D model of Total station



STEPS TO FOLLOW

- First logon to website using username or register yourself.
- Click on experiment list and select the total station experiment. Options available are as-

Instructions: Screen will show the following links:

- 1) Summary of Experiment
- 2) Objective
- 3) Equipment Used
- 4) Principle
- 5) Methodology
- 6) Manual for Total Station Working



STEPS TO FOLLOW

7) Working of Instrument

8) Download Executable File

9) Observations

10) Results

11) Total Station Gallery

12) Quiz

13) Dos and Don'ts



- Click on **“Methodology”** to see a video tutorial about performing experiment in real time environment in the field.
- Click on **“Manual for Total Station Working”** to see PDF documentation of the experiment manual in details. In this manual, all the information about the keys to be used to perform the experiment is given.
- Click on **“Working of Instrument”** to start the experiment in a virtual 3D environment. Brief steps are given below:



1. Set the Tripod over a known point. (Use keys: Ctrl + Up, Down, Left, Right (Arrow Keys))



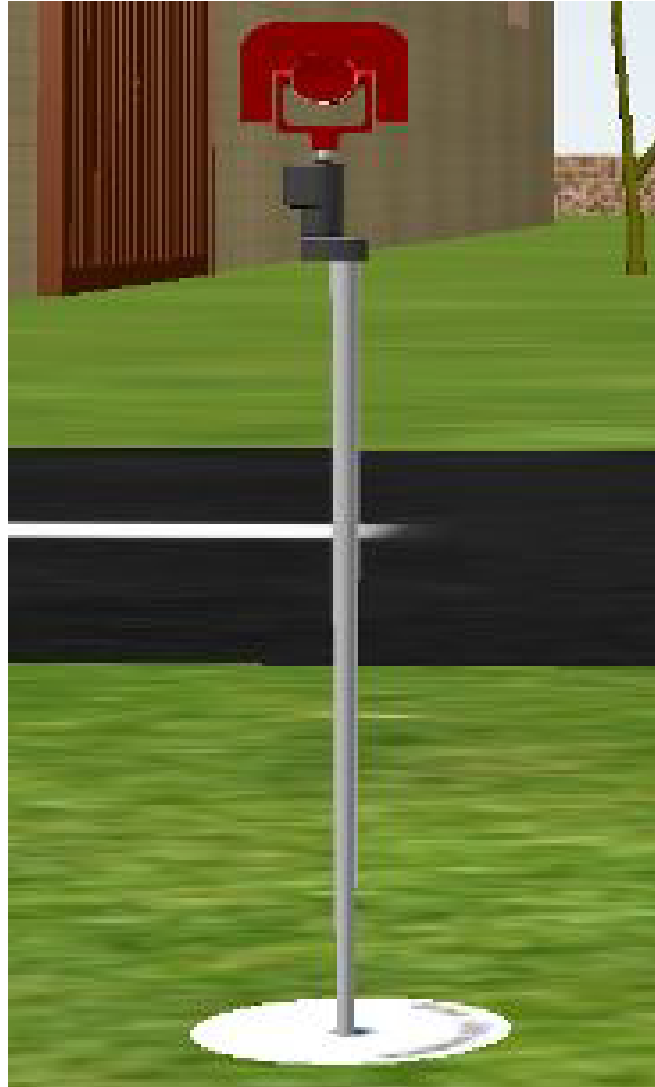
2. Fix the Total Station equipment over tripod. Level it and center it precisely over the ground point. (Use keys: Alt + Up, Down, Left, Right (Arrow Keys))



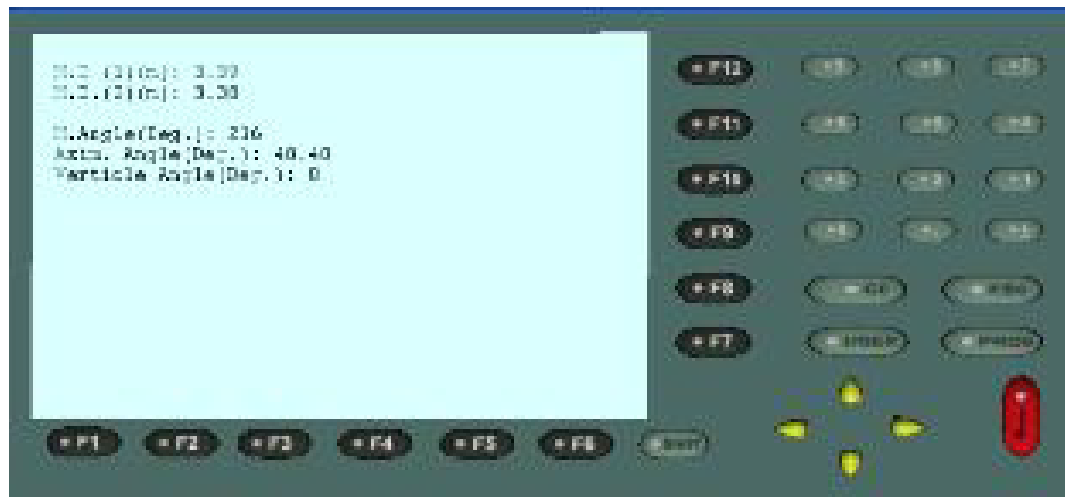
3. Focus cross hairs. (Use keys: 0, 8, 9)

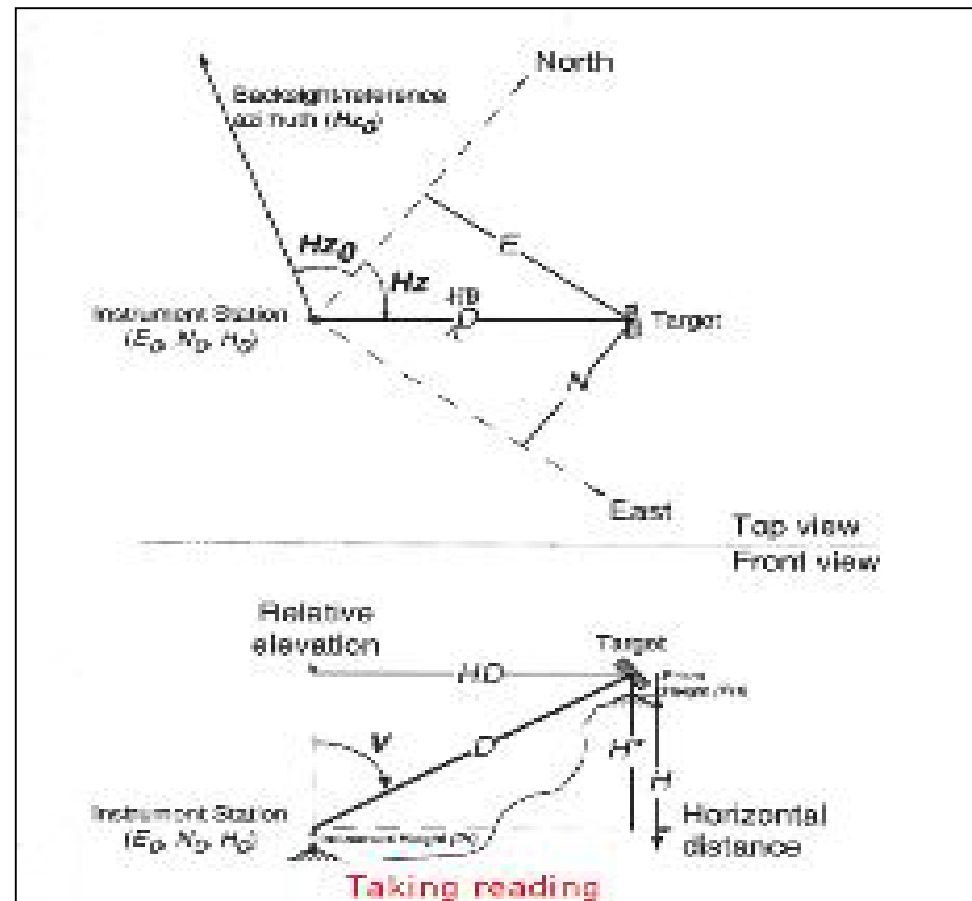


4. Keep the Prism Pole on a point whose observations are to be taken. Focus and bisect the center of the Prism.



5. Use the function buttons to measure horizontal and vertical angles. Store the data using function key of total station.





7. Download the data into a computer and use the total station software to compute horizontal angles and vertical angles.

8. Results can be saved and printed.

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Distance and Horizontal Distance

Using Total Station
Measurement of Vertical angle Slope

Distance and Horizontal Distance

Using Total Station

Plain Table and its Accessories
Plain Table and its Accessories

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Station	Angle			Target/Comment	V or H	
	°	'	"			
A	000	00	00	Zenith		
	71	33	00	Top of building	α1	V
	110	15	00	Ground level of building	α2	V
	59	50	00	Peg B	A	H
B	000	00	00	Peg A		
	62	30	00	Top of building	B	H
				Lineal between pegs	10.250 m	

V = vertical angle, H = horizontal angle

Quiz

Recent Updates

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Auto Level Features

[Profile Leveling Using Auto Level](#)
Profile Leveling Using Auto Level

[Measurement of Vertical angle Slope](#)

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Related Links

Q2. A theodolite may be used for

- | | |
|---|--|
| (a) <input type="radio"/> Laying off horizontal angles | (b) <input type="radio"/> Locating points on lines |
| (c) <input type="radio"/> Determining difference in elevation | (d) <input type="radio"/> Setting out curves |
| (e) <input type="radio"/> Any of the curve | |

Q3. In a theodolite the line passing through the intersection of the horizontal and vertical cross hairs and the optical centre of the object glass and its continuation, is known as

- | | |
|--|---|
| (a) <input type="radio"/> Horizontal axis | (b) <input type="radio"/> Vertical axis |
| (c) <input type="radio"/> Line of collimation | (d) <input type="radio"/> Line of sight |
| (e) <input type="radio"/> Either of (C) or (D) above | |

Q4. A geodimeter is used for the measurement of

- | | |
|--|----------------------------------|
| (a) <input type="radio"/> Distances | (b) <input type="radio"/> Angles |
| (c) <input type="radio"/> Areas | (d) <input type="radio"/> Volume |
| (e) <input type="radio"/> Bearing of a point | |

Q5. A geodimeter is based on the principle of

- | | |
|--|---|
| (a) <input type="radio"/> Optic | (b) <input type="radio"/> Reflection of light waves |
| (c) <input type="radio"/> Propagation of modulated light waves | (d) <input type="radio"/> X-rays |
| (e) <input type="radio"/> Radio-waves | |

Q6. A tellurometer works on the principle of

- | | |
|--|--|
| (a) <input type="radio"/> Optics | (b) <input type="radio"/> Reflection of light waves |
| (c) <input type="radio"/> High frequency radio waves | (d) <input type="radio"/> Propagation of modulated light waves |
| (e) <input type="radio"/> X-rays | |

Q7. In case of theodolite, centring is the process of

- | | |
|---|--|
| (a) <input type="radio"/> turning telescope in vertical direction | (b) <input type="radio"/> setting the theodolite exactly over the station mark |
| (c) <input type="radio"/> Rotating the telescope in clockwise direction in the horizontal plane | (d) <input type="radio"/> rotating the telescope the telescope in anti-clockwise direction about the vertical axis |
| (e) <input type="radio"/> None of the above | |


Q8. A theodolite may be used for

- | | |
|---|---|
| (a) <input type="radio"/> Laying off horizontal angles | (b) <input type="radio"/> Locating points on line |
| (c) <input type="radio"/> Determining difference in elevation | (d) <input type="radio"/> Setting out curves |

Q9. In a theodolite the line passing through the intersection of the horizontal and vertical cross hairs and the optical centre of the object glass and its continuation, is known as


- | | |
|---|---|
| (a) <input type="radio"/> Horizontal axis | (b) <input type="radio"/> Vertical axis |
| (c) <input type="radio"/> Line of collimation | (d) <input type="radio"/> Line of sight |

Dos and Don'ts in the experiment



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Measurement of Vertical angle Slope

Distance and Horizontal Distance Using

Total Station

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Dos and Don'ts

Dos:

- 1) Center and level the base of Total Station accurately.
- 2) Crosshairs must be focused sharply.
- 3) Measure height of the instrument and height of prism above ground.
- 4) Always take 3 or more observations of each point to take the average.
- 5) Apply check for horizontal angles.

Don'ts:

- 1) Handle the Total Station and Prism with utmost care. If dropped accidentally, Digital display of Total Station may get damaged and Prism may also be broken.
- 2) While shifting the instrument from one station to another station, always keep it in box for transport.
- 3) Protect the instrument from heavy rains.



Example 2: OBSERVATIONS USING GPS



Original GPS and 3D model of GPS



STEPS TO FOLLOW

- First logon to website using username or register yourself.
- Click on experiment list and select the GPS experiment. Options available are as-

Instructions: Screen will show the following links:

1. Summary of Experiment
2. Objective
3. Equipment Used
4. Principle
5. Methodology
6. Working of Instrument (Compatible with Win XP SP2)



STEPS TO FOLLOW

7. Download Executable File

8. Observations

9. Additional Details

10. Quiz

11. Do's and Don'ts



- Click on **“Methodology”** to see a video tutorial about performing experiment in real time environment in the field.
- Click on **“Manual for Total Station Working”** to see PDF documentation of the experiment manual in details. In this manual, all the information about the keys to be used to perform the experiment is given.
- Click on **“Working of Instrument”** to start the experiment in a virtual 3D environment. Brief steps are given below:



1. Press P button on keyboard to show/hide GPS



2. Click on Power Button to turn GPS receiver ON/OFF

3. Click on Enter Button to confirm



4. GPS detects satellite and confirm operation for navigation.



5. Click on IN Button to know the current latitude and longitude.

6. Press ESC Button to stop operation at any time or enter values in the ID text box to store different values and click on GOTO Button.



7. If GOTO Button is pressed then readings are saved.



8. Press OUT Button to generate text files having all readings.

9. Press 'Q' Button on keyboard to stop the data collection.



Dos and Don'ts in GPS experiment



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Dos and Don'ts

Dos:

- 1) Always calibrate the GPS Receiver to a known benchmark.
- 2) Always take the observations when more than four satellites are tracked as it will give a better intersection.
- 3) Spend more than 5 minutes for observation on each point in order to have better mean value.
- 4) Use DGPS technique if higher accuracy of observation is desired.

Don'ts:

- 1) Never take single observation of a point from GPS, as it may give incorrect reading.
- 2) Never keep the GPS instrument surrounded by high rise buildings, forest area etc., as these surrounding features will block the signals from satellites.

Feedback form for the user

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Plain Table and its Accessories
Plain Table and its Accessories

Details plotting by Radiation Method
Details plotting by Radiation Method

Details plotting by Intersection

Method
Details plotting by Radiation Method

Feedback

How did you come to know about our website:
☒ Through Internet ☐ Through Friend ☐ Through MHRD Site

First Time User: ☒ Yes ☐ No

Status:

Name:

Institute:

Branch/Speciality:

Year/Semester:
(only for students)

Email-Id:

Which experiment did you perform:

1. Please tell your agreement with the following statements: Excellent, Very Good, Good, Average, Poor


(a) To what degree was the actual lab environment simulated.
☒ Excellent ☐ Very Good ☐ Good ☐ Average ☐ Poor

(b) The manuals were found to be helpful.
☒ Excellent ☐ Very Good ☐ Good ☐ Average ☐ Poor

(c) The results of experiment were easily interpretable.
☒ Excellent ☐ Very Good ☐ Good ☐ Average ☐ Poor


2. How helpful do you feel the system is?

FAQ to check student knowledge



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Details plotting by Radiation Method

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Method
Details plotting by Radiation Method

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Q1: What do I need to make use of this website?
Ans: You just need to have a PC with Broadband Internet connection. Register yourself for Virtual Lab in Surveying (VLS) at www.vlabcivil-iitr.co.in.

Q2: How do I get a VLS account? Is it free or do I have to pay for it?
Ans: Go to "Experiment" menu on the main page then click on "Sign-up" link and Fill up the registration form and register yourself to perform Experiment as per your convenience. Yes it is free.

Q3: How do I make use of this website?
Ans: Basically, the main purpose of this website is to allow you to perform 2D and 3D experiments virtually online. After registration, clicking on "Experiment" menu, login with your account, it takes you to a list of experiments. Choose an experiment according to your interest. There you will find links to "Summary of Experiment", "Objective", "Principle", "Methodology", "Manual", "Working of Instrument", "Download Executable File", etc. We strongly recommend that you go through the "Manual" and "Methodology" before performing the experiment virtually.

Q4: What are the software/hardware or other requirements?
Ans: An Internet Browser (Chrome recommended), minimum 1GB RAM, Intel Core 2 Duo processor or above, Windows XP or above, NVIDIA GEFORCE GTX 580m.

Q5: Will it work if my internet connection is slow?
Ans: Yes, you may have to wait for a while to receive data. The faster your net connection is, the faster you will get data. A broadband connection with 256 kbps is ideal for performing the experiment.

Q6: Who can perform these experiments?
Ans: These experiments are basically a part of Surveying Lab. Anyone having an interest or a basic knowledge of Surveying Instruments and Surveying Methodology can be benefitted. In general, anybody who wants to explore the field of Surveying can make use of it.

Q7: Whom to contact in case I am having any problem with the website?
Ans: There is a "Contact Us" tab on the website. Feel free to contact us. Visiting FAQ in query page can also help.

Q8: Can I find some relevant reading material?
Ans: There is a "References" menu on the webpage where you find relevant references and links. When you go through particular experiment, there you can find a link to "Additional Details" which will help you getting relevant material.

Q9: Can I perform the experiment if I am from some different college other than IIT?

References for extra knowledge on the experiment can be find at the links mention below

- 1) Arora, K.R. (2005). Surveying, volume 2. Standard Book House. 675 p.
- 2) Chandra, A.M. (2002). Plane Surveying. New Age International (P) Limited. 652 p.
- 3) Davis, Raymond E. and Foote, Francis S. (1953). Surveying: Theory and Practice. 4th Ed. McGraw-Hill Book Company. 1021 p.
- 4) Duggal, S.K. (2004). Surveying, volume 1. Tata McGraw-Hill Publishing Company Limited. 630 p.
- 5) Charles D. and Wolf, Paul R. (2008). Elementary Surveying: An Introduction to Geomatics. Pearson Prentice Hall. 931 p.
- 6) Moffitt, Francis H. and Bouchard, Harry (1990). Surveying. 8th Ed. Harper & Row Publishers. 876 p.

Online Resources

<http://www.bilawchuk.com/mark/index.html>

<http://science.howstuffworks.com/virtual-military.htm>

<http://accad.osu.edu/~mlewis/VRML/Class/syl.html>

<http://www.x3dom.org><http://virtualenvironments.pbworks.com/f/monahan.pdf><http://www.isprs.org/proceedings/XXXV/congress/comm6/papers/697.pdf>

<http://www.ccis2k.org/iajit/PDF/vol.8,no.1/6.pdf><http://diglib.eg.org/EG/DL/Conf/EG2004/short/short48.pdf>

