

IITB Summer Internship 2014



Project Report

Virtual Labs

Principal Investigator

Prof. D.B. Phatak

Project In-Charge

Mrs. Kiran Khosla

Project Mentors

Miss. Charu Chaudhari

Mr. Mohan Pednekar

Project Team Members

Mr. Aneesh Kumar

Mr. Animesh Das

Mr. Ashutosh Nath Agarwal

Mr. Mahipal Myada

Mr. Sandeep Mekala



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Indian Institute of Technology Bombay

The project entitled “Virtual Labs” submitted by Mr. Aneesh Kumar, Mr. Animesh Das, Mr. Ashutosh Nath Agarwal, Mr. Mahipal Myada and Mr Sandeep Mekala is approved for Summer Internship 2014 program from 10th May 2014 to 6th July 2014, at Department of Computer Science and Engineering, IIT Bombay.

Prof. Deepak B. Phatak
Dept of CSE, IITB
Principal Investigator

Mrs. Kiran Khosla
Dept of CSE, IITB
Project In-charge

Place: IIT Bombay, Mumbai
Date: September 12, 2014

Declaration

We declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Mr. Aneesh Kumar
R.G.U.K.T.-Nuzvid

Mr. Animesh Das
B.I.T.S. Pilani

Mr. Ashutosh Nath Agarwal
N.I.T. Trichy

Mr. Mahipal Myada
R.G.U.K.T.-Basar

Mr. Sandeep Mekala
R.G.U.K.T.-Basar

Date: _____

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Abstract

The application aims to develop an Interactive platform for students through which they can learn, understand, practice and evaluate themselves. It provides flexibility of studying anytime, anywhere, and at one's own pace. The project consists of a Web portal and an application named Virtualis which also works as an aid in teaching. The Web portal and the application together provide a learning environment through which teachers can upload experiments and students can learn, understand and practice through Virtual Simulations and Videos and also evaluate themselves through quizzes.

Education always holds the key towards success. One of the drawbacks in Indian society today is a variation in the quality of education, depending on the wealth, or lack thereof, in particular areas. Education standards were hoped to be increased a decade back, perhaps the biggest concern now is the availability of resources. Due to an augment in job opportunities, teaching has become a secondary interest consequently lesser student participation at schools. This being one of the biggest concerns in India, our project team decided to bend the rules of teaching and provide student with means for self-learning through electronic teaching. We use the Aakash tablet as, in the future, the desktop and laptop computers will be replaced by more portable forms like tablets moreover Aakash is the cheapest tablet available, its popularity is much higher and is easily affordable by everyone, we aim at using this technology extensively in the learning process. Thus, having this objective we started our project to meet the needs of underprivileged students. Hence we attempt to raise the level of education available to the students.

The application targets the class group of 6 to 12, to learn experiments in a simple and interactive way. The web portal and the application is an Open Source Software and therefore is going to be freely available to a massive number of students and teachers.

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Chapter 1

Software Requirement Specification

1.1 Introduction

The document aims at defining the overall design, software requirements and features of "Virtual Labs". Efforts have been made to define the requirements exhaustively and accurately.

1.2 Document Purpose

The purpose of this document is to present a detailed description of the "Virtual Labs". It will explain the purpose and features of the system and what the system will do and also explain how the various modules work and how they communicate with each other for the successful working of the application.

1.3 Product Scope

The product aims to develop a Virtual Lab Environment for students through which they can learn, understand, practice and evaluate themselves. It provides flexibility of studying anytime, anywhere, and at one's own pace.

The web portal allows 3 different sets of people Student, Contributor and Reviewer. All three can view all experiments that are already uploaded on the Web Portal. The student can view all experiments also perform the following :

- View Theory
- View Method
- View experiment Video
- Perform Simulation
- Give a quiz for self-evaluation.

The contributor is supposed to add the experiment with all its content which includes performing the experiment simulation and saving it for the students to perform.

The reviewer checks the content and either approves it or makes suggestions to contributor.

The Android application is named Virtualis and is used to display all the content from the web on a mobile platform. It displays all the content in an easily accessible environment. For simulation, it has two options; a 3D animation of the whole experiment in Blender and a 2D drag and drop simulation for the student to perform himself in a guided manner.

Given the implications of the Right to Education act and the continued scarcity of quality content, we believe that making it available through Aakash tablet will enhance the quality of education in schools. We believe that our methodology will be adopted on a large scale and will benefit the children studying in various state board schools. The ability of this application is to establish vision and direction in order to help students and teachers, to empower and inspire them to achieve results or success. It is all about learning, teaching and getting things done, providing freedom to individuals and ultimately allowing people to develop and helping them discover their own strengths. The purpose of creation of this project is to provide a platform through which students can learn and teachers can teach Lab concepts in an easy and interactive way and building upon their skills and capabilities.

1.4 Intended Audience And Document Overview

The intended audience for this document is the development team, testing team and the end users of the product. The users are students of sixth to tenth classes. The rest of this SRS contains first and foremost the introduction part, which is further subdivided into different sections which includes purpose, then scope of the product. Here the scope of the product is specified including relevant benefits, objectives, and goals. The second section, the Overall Description section, of this document gives an overview of the functionality of the product.

It describes the informal requirements and is used to establish a context for the technical requirements specification in the next section. The third section, Requirements Specification section, of this document is written primarily for the developers and describes in technical terms the details of the both sections of the document describe the same software product in its entirety, but are intended for different audiences and thus use different language.

1.5 Definitions, Acronyms And Abbreviations

Term	Definition
Android	Linux based Operating System
Software Requirements Specification	A document that completely describes all of the functions of a proposed and the constraints under which it operate. For example, this document.
Unified Modeling Language(UML)	Programming Language used for object-oriented software development.
UML Diagram	It is a partial graphical(view) representation of a model of a system under design, implementation, or already existence.
Android 2D	The Android framework APIs provides a set of 2D drawing APIs that allow you to render your own custom graphics onto canvas or to modify existing Views to customize their look and feel

Table 1.1: Definitions,Acronyms and Abbreviations

Chapter 2

Overall Description

2.1 Product Perspective

The Virtual Labs application and Web Portal will help teachers and students to teach and learn concepts in an interactive manner. The product enables teachers to upload experiments on the web for any student to have free access to the information. It involves quizzes for self evaluation, simulation of the experiment for the student to perform and a video that helps the student see how it is performed in real life.

The android application will have all the above functionalities and more. The android application fetches the information from the web and presents all of it in an organized manner. The theory, method, video, quiz and simulation is shown. Along with the usual, a 3D Blender animation is also provided for a more interesting take on animation(if provided by the contributor). The application will help ensure that the student has a basic grasp of ideas and will help him move to more advanced concepts.

2.2 Product Functionality

2.2.1 Online Modules for Application

- Theory
- Procedure
- Video
- Simulation
- Quiz
- Resources

2.2.2 Offline Modules for Application

- Theory
- Procedure

- Video
- Simulation
- Quiz
- Resources

2.2.3 Web Portal

- Upload
- Review
- Contact Us
- Download

2.3 Users And Characteristics

Students:

Should be able to use touch-screen devices.

Teacher:

Construct a simulation using the product web portal to effectively teach students the concepts in the Experiment.

2.4 Operating Environment

This product is designed to work specifically on Aakash Tablet with Android(Version Ice Cream Sandwich).

2.5 Design and Implementation Constraints

- The small size of the device screen limits the amount of content visible at a given time.
- The application has been developed fully in English. Its effectiveness will depend upon the user's proficiency in English.
- It will work only on Android devices.
- It is developed specifically for Aakash tablet.

2.6 User Documentation

A detailed user manual and possibly on-line help will be delivered along with the software.

2.7 Assumption And Dependencies

- The deadline must be met.
- The product must be reliable.
- The architecture must be open so that additional functionality may be added later.
- The product must be userfriendly.
- From the very start of this project we are aware of time constraints so the main emphasis is on extensibility and parallel development. We shall try our best to ensure that project deadlines are met.

Chapter 3

Specific Requirements

3.1 External Interface Requirements

3.1.1 User Interface

User interface must be user-friendly. The user interface shall be designed using various components available in ADT plug-ins such as expandable list view to display the list of subjects and experiments and drag and drop ADT for simulation in Experiment.

3.1.2 Hardware Interface

The only hardware required is the Aakash Tablet. Users can also use headphones to listen to the videos associated with experiment more clearly and SD-Card to store Experiments.

3.1.3 Software Interface

Android 4.0(Ice Cream Sandwich).

3.2 Functional Requirement

Application

Home page is divided into two basic modules:

- Online Mode
- Offline Mode

3.2.1 Online modules

This module contains the questions related to the Experiment. The student can answer the quiz and can evaluate himself by going through the quiz summary report.

Experiments

Each Experiment of particular subject have divided into sub modules

3.2.1.1 Theory:

This module shows the theory part of Experiment which is helpful to the student to know about the experiment

3.2.1.2 Procedure

This module shows how to proceed the Experiment and gives the step by step procedure to perform the Experiment

3.2.1.3 Video

This module shows the available videos of Experiment. If there are more than one video then the student can view videos one after the other

3.2.1.4 Simulation

This module divided into two sub modules. One is Blender player in which the student can view the complete simulation in Blender and the other is guided simulation in which the student can perform the experiment steps by following the teachers guidance

3.2.1.5 Quiz

This module contains the Questions related to the Experiment .The student can perform the quiz and can able to evaluate himself by quiz summary report

3.2.1.6 Resources

This module shows the References of the Experiment

3.2.2 Offline modules

This module contains the previously saved Experiments of Online module.

Experiments

Each experiment of particular subject has been divided into sub modules

3.2.2.1 Theory:

This module shows the theory part of Experiment which is helpful to the student to know about the experiment

3.2.2.2 Procedure

This module shows how to proceed the Experiment and gives the step by step procedure to perform the Experiment

3.2.2.3 Simulation

This module contains guided simulation in which the student can perform the experiment steps by following the teachers guidance available as ghost mode

3.2.2.4 Quiz

This module contains the Questions related to the Experiment .The student can perform the quiz and can able to evaluate himself by quiz summery report.

3.2.2.5 Resources

This module shows the References of the Experiment

3.2.3 Web portal

web portal module contains all the functionalities of Application along with the following

3.2.3.1 Upload

This module opens after the contributor logins. It contains different fields such as experiment name,class , subject ,description ,theory, procedure ,video URL,quiz,resources and icon of the Experiment. The contributor can fill all the fields and upload an Experiment

3.2.3.2 Review

This module opens after the Reviewer logins. This module contains the Experiments which are uploaded by the Contributor .Reviewer goes through this Experiment and approve the Experiment if its meets the standards.

3.2.3.3 Contact us

This module provides opportunity to send a message to administration for communication purpose

3.2.3.4 Download

This module helps to download the Blender player to run the Blender simulation

Chapter 4

Non Functional Requirement

4.1 Software Quality Attributes

4.1.1 Reliability:

System must be reliable and data should persist even after suffering some system crashes or booting of android supported devices.

4.1.2 Maintainability:

Software needs to be upgraded if required in future.

Chapter 5

Design Document and Implementation

5.1 Resource Requirements

5.1.1 HW Requirements

The following hardware configuration is required for this project:

- Minimum RAM Required: 512 MB
- Minimum Capacity Required:
 - Internal: 4 GB
 - External: 2 to 32 GB
- Display Resolution: 800 x 480 Pixels
- Touch screen
- Net connectivity

5.1.2 SW Requirements

Following software are required for this project:

- Eclipse Juno , ADT Plugin along with Android SDK.
- Microsoft Windows and Ubuntu as our operating system.
- We used MySQL as the database to store the experiments

5.2 Software Development Life Cycle Model

The systems development life cycle(SDLC), or software development life cycle in systems engineering, information systems and software engineering, is a process of creating or altering information systems, and the models and methodologies that people use to develop these systems.

In software engineering the SDLC concept underpins many kinds of software development methodologies. These methodologies form the framework for planning and controlling the creation of an information system

A software development process is a structure imposed on the development of a software product. Similar terms include software life cycle and software process. There are several models for such processes, each describing approaches to a variety of tasks or activities that take place during the process. Some people consider life cycle model a general term and software life cycle development a specific term.

Iterative and Incremental development is at the heart of a cyclic software development process developed in response to the weaknesses of the waterfall model. It starts with an initial planning and ends with deployment with the cyclic interactions in between. Incremental development slices the system functionality into increments(portion). In each increment, a slice of functionality is delivered through cross-discipline work, from the requirements to the deployment. The unified process groups increments/iterations into phases: inception, elaboration, construction, and transition.

- Inception identifies project scope, risks, and requirements(functional and non-functional) at a high level but in enough detail that work can be estimated.
- Elaboration delivers a working architecture that mitigates the top risks and fulfills the non-functional requirements.
- Construction incrementally fills-in the architecture with production-ready code produced from analysis, design, implementation, and testing of the functional requirements.
- Transition delivers the system into the production operating environment. Each of the phases may be divided into 1 or more iterations, which are usually time-boxed rather than feature-boxed. Architects and analysts work one iteration ahead of developers and testers to keep their work-product backlog full.

The system has been developed using **Iterative Waterfall Model**.

The waterfall model is a sequential design process, often used in software development processes, in which progress is seen as flowing steadily downwards(like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation and Maintenance.

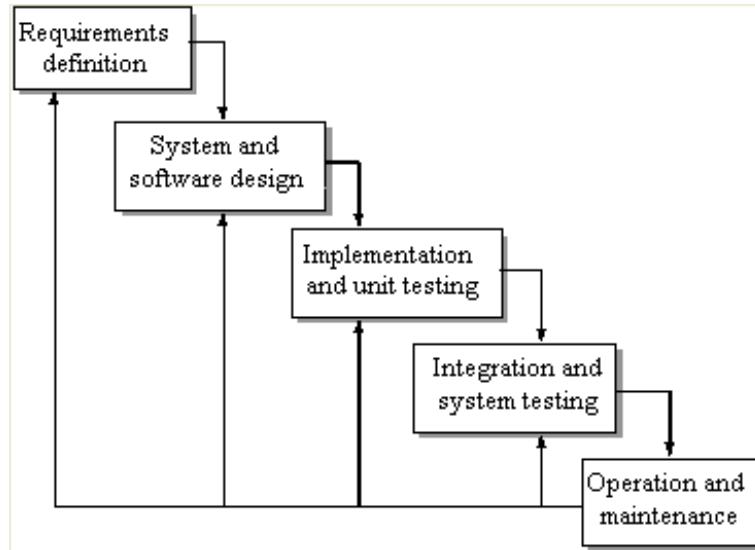


Figure 5.1: Iterative Waterfall Model

Advantages

- Simple goal. Simple to understand and use.
- Clearly defined stages.
- Well understood milestones.
- Easy to arrange tasks.
- Process and results are well documented.
- Easy to manage. Each phase has specific deliverable and a review.
- Works well for projects where requirements are well understood.
- Works well when quality is more important than cost/schedule.
- Customers/End users already know about it.

Disadvantages

- It is difficult to measure progress within stages.
- Cannot accommodate changing requirements.
- No working software is produced until late in the life cycle.
- Risk and uncertainty is high with this process model.
- Adjusting scope during the life cycle can end a project
- Not suitable for complex projects
- Not suitable for projects of long duration because in long running projects requirements are likely to change.

- Integration is done as a "big-bang" at the very end, which doesn't allow to identify any technological or business bottleneck or challenges early.
- Attempt to go back 2 or more phases is very costly.
- Percentage completion of functionality could not be determined in mid of the project because each functionality is undergoing some phase.
- Very risky, since one process can start before finishing the other.

5.3 High Level Design Document

5.3.1 Use Case Diagram

A use case diagram presents a graphical overview of the functionality provided by a system in terms of actors, their goals(use cases), and any dependencies between those use cases.

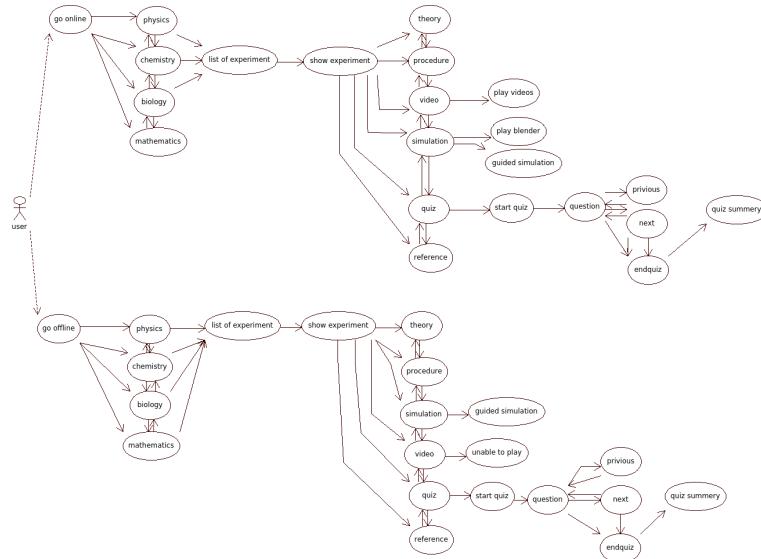


Figure 5.2: Use Case Diagram for Android App

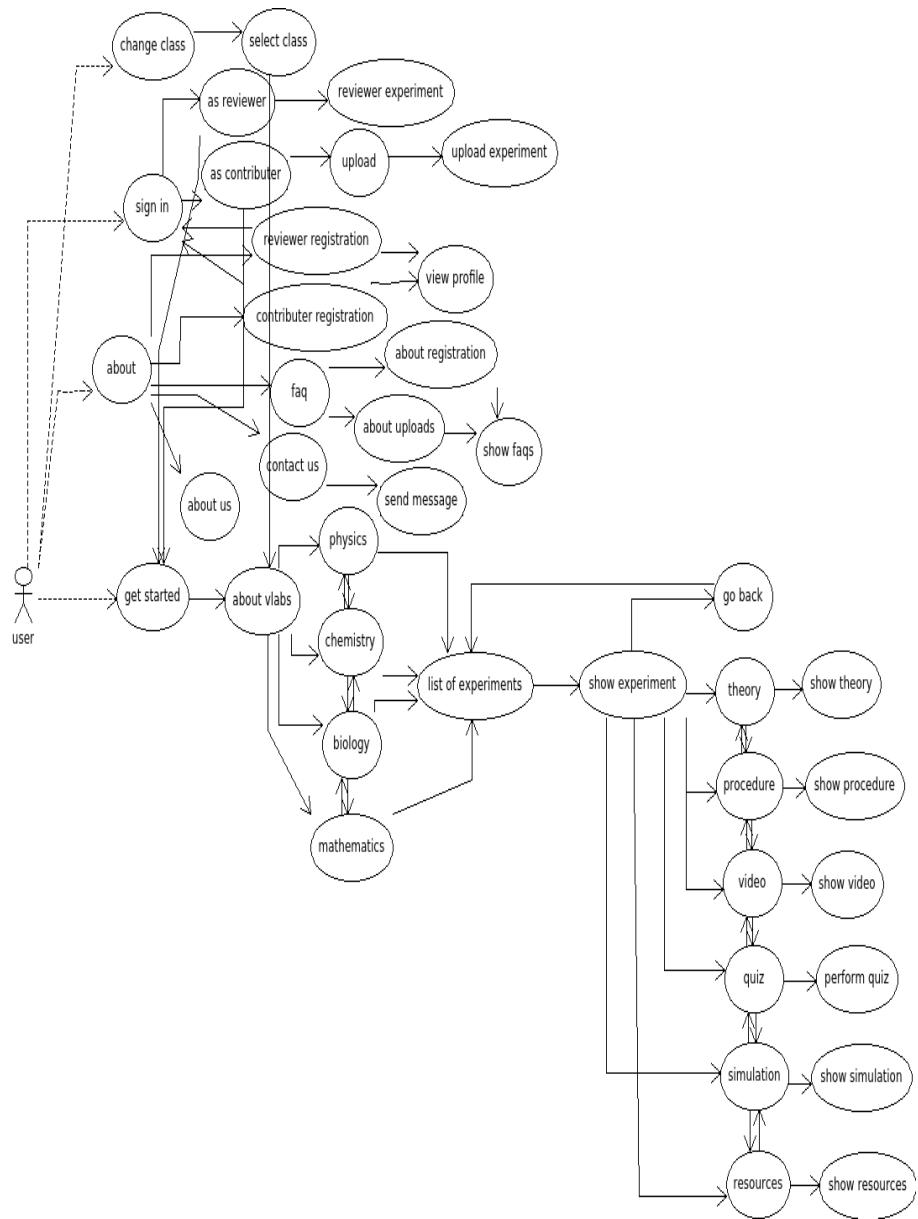


Figure 5.3: Use Case Diagram for Web Portal

5.3.2 Use Case Description

User is the main actor of the system. The user first launches the application and selects the appropriate module as required.

Go Online:

Brief Description: Go Online function enables user to enter into the Online modules of the application.

Flow of Events:

Basic Flow: User enters application with default class as 9th class.

Alternate Flow: User can change his class and go Online module or user enters to go Offline module.

Pre-condition: User opens Virtualis application with proper Internet connection.

Post-condition: Different modules(subject names) are displayed.

Go Offline:

Brief Description: go Offline function enables user to enter into the saved modules of the application.

Flow of Events:

Basic Flow: User enters application with default class as 9th class.

Alternate Flow: User can change his class and go Offline module or user enters to go Online module.

Pre-condition: User opens Virtualis application .

Post-condition: Different modules(subject names) are displayed.

Physics:

Brief Description: Physics function enables user to enter into the different physics experiments of the application.

Flow of Events:

Basic Flow: User enters application and tap on physics to view the physics experiments.

Alternate Flow: User enters application and tap on other subject.

Pre-condition: User opens Virtualis application with his class number.

Post-condition: Different modules(Physics experiments) are displayed.

Chemistry:

Brief Description: Chemistry function enables user to enter into the different chemistry experiments of the application.

Flow of Events:

Basic Flow: User enters application and tap on chemistry to view the chemistry experiments.

Alternate Flow: User enters application and tap on other subject.

Pre-condition: User opens Virtualis application with his class number.

Post-condition: Different modules(Chemistry experiments) are displayed.

Biology:

Brief Description: Biology function enables user to enter into the different Biology experiments of the application.

Flow of Events:

Basic Flow: User enters application and tap on biology to view the biology experiments.

Alternate Flow: User enters application and tap on other subject.

Pre-condition: User opens Virtualis application with his class number.

Post-condition: Different modules(Biology experiments) are displayed.

Mathematics:

Brief Description: Mathematics function enables user to enter into the different Mathematics experiments of the application.

Flow of Events:

Basic Flow: User enters application and tap on mathematics to view the mathematics experiments.

Alternate Flow: User enters application and tap on other subject.

Pre-condition: User opens Virtualis application with his class number.

Post-condition: Different modules(Mathematics experiments) are displayed.

Show experiment:

Brief Description: Show experiment function enables user to enter into the different experiment details of the application .

Flow of Events:

Basic Flow: User taps on experiment name to view the experiment details.

Alternate Flow: User tap on other subject name to view the experiments.

Pre-condition: User opens Virtualis application with his class number and subject name.

Post-condition: Different modules are displayed.

Theory:

Brief Description: Theory function enables user to view the experiments theory module .

Flow of Events:

Basic Flow: User taps on theory .

Alternate Flow: User tap on other module.

Pre-condition: User opens Virtualis application and selected an experiment.

Post-condition: Experiment Theory is displayed.

Procedure:

Brief Description: Procedure function enables user to view the experiments Procedure module .

Flow of Events:

Basic Flow: User taps on procedure .

Alternate Flow: User tap on other module.

Pre-condition: User opens Virtualis application and selected an experiment.

Post-condition: Experiment Procedure is displayed.

Video:

Brief Description: Video function enables user to view the experiments Video module.

Flow of Events:

Basic Flow: User taps on video .

Alternate Flow: User tap on other module.

Pre-condition: User opens Virtualis application and selected an experiment.

Post-condition: Experiment Videos are displayed.

Simulation:

Brief Description: Simulation function enables user to view the experiments simulation module .

Flow of Events:

Basic Flow: User taps on simulation .

Alternate Flow: User tap on other module.

Pre-condition: User opens Virtualis application and selected an experiment.

Post-condition: Experiments simulations are displayed.

Quiz: Brief Description: Quiz function enables user to practice the experiments quiz module .

Flow of Events:

Basic Flow: User taps on quiz.

Alternate Flow: User tap on other module.

Pre-condition: User opens Virtualis application and selected an experiment.

Post-condition: Experiments related questions are displayed.

Resources: Brief Description: Resources function enables user to view the experiments Resources .

Flow of Events:

Basic Flow: User taps on resources .

Alternate Flow: User tap on other module.

Pre-condition: User opens Virtualis application and selected an experiment.

Post-condition: Experiment Resources are displayed.

Run Blender: Brief Description: Run Blender function enables user to view the experiments simulation in Blender Player .

Flow of Events:

Basic Flow: User taps on run Blender .

Alternate Flow: User tap on guided simulation.

Pre-condition: User opens Virtualis application and selected simulation module.

Post-condition: Experiments Blender simulation is played.

Guided simulation: Brief Description: Guided simulation function enables user to view the experiments simulation in Android Application .

Flow of Events:

Basic Flow: User tap on guided simulation .

Alternate Flow: User taps on run Blender .

Pre-condition: User opens Virtualis application and selected simulation module.

Post-condition: Experiments simulation is shown to perform experiment.

5.3.3 Activity Diagram

Activity diagrams are graphical representations of work flows of step-wise activities and actions with support for choice, iteration and concurrency. An activity diagram shows the overall flow of control.

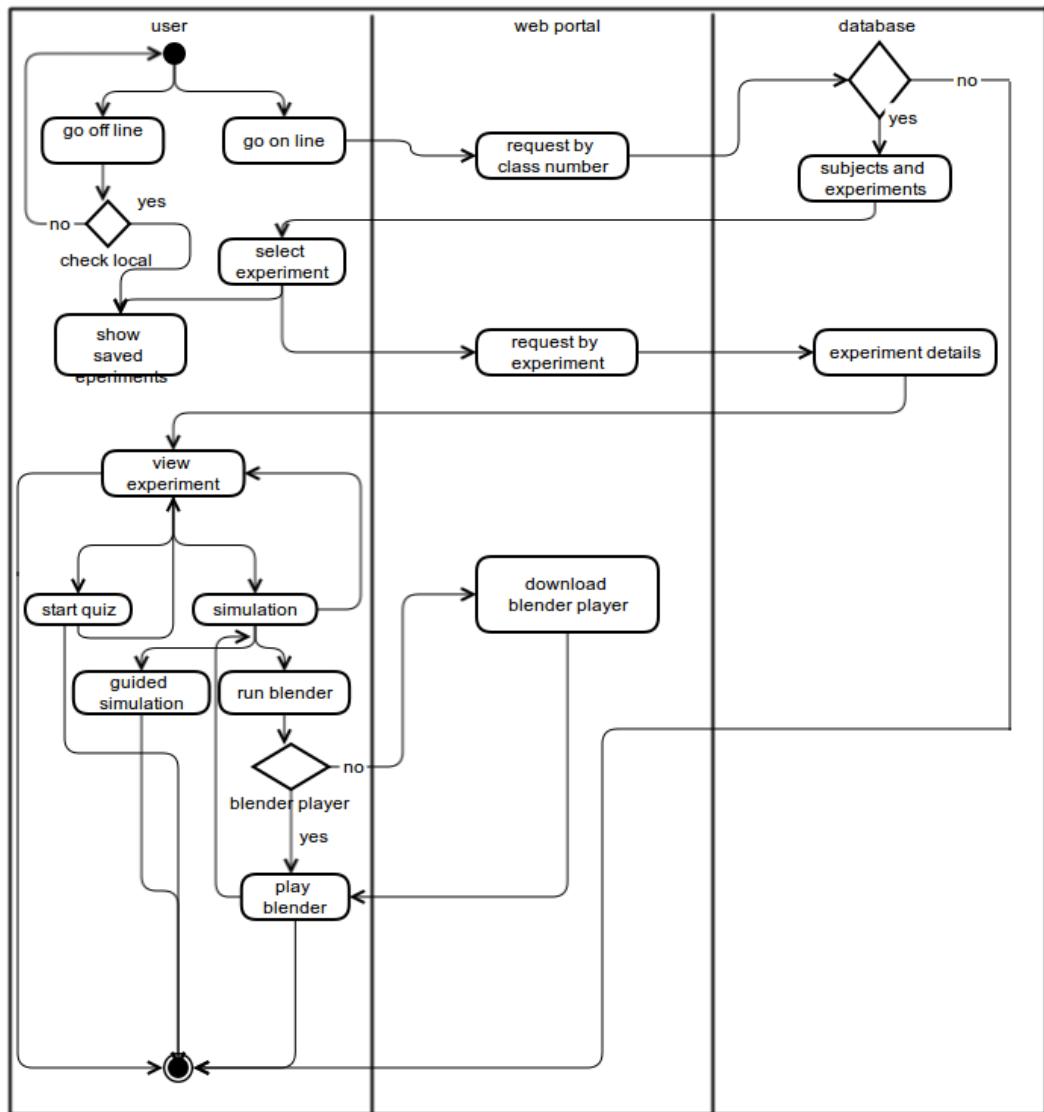


Figure 5.4: Activity Diagram

5.3.4 Class Diagram

Activity diagrams are graphical representations of work flows of step-wise activities and actions with support for choice, iteration and concurrency. An activity diagram shows the overall flow of control.

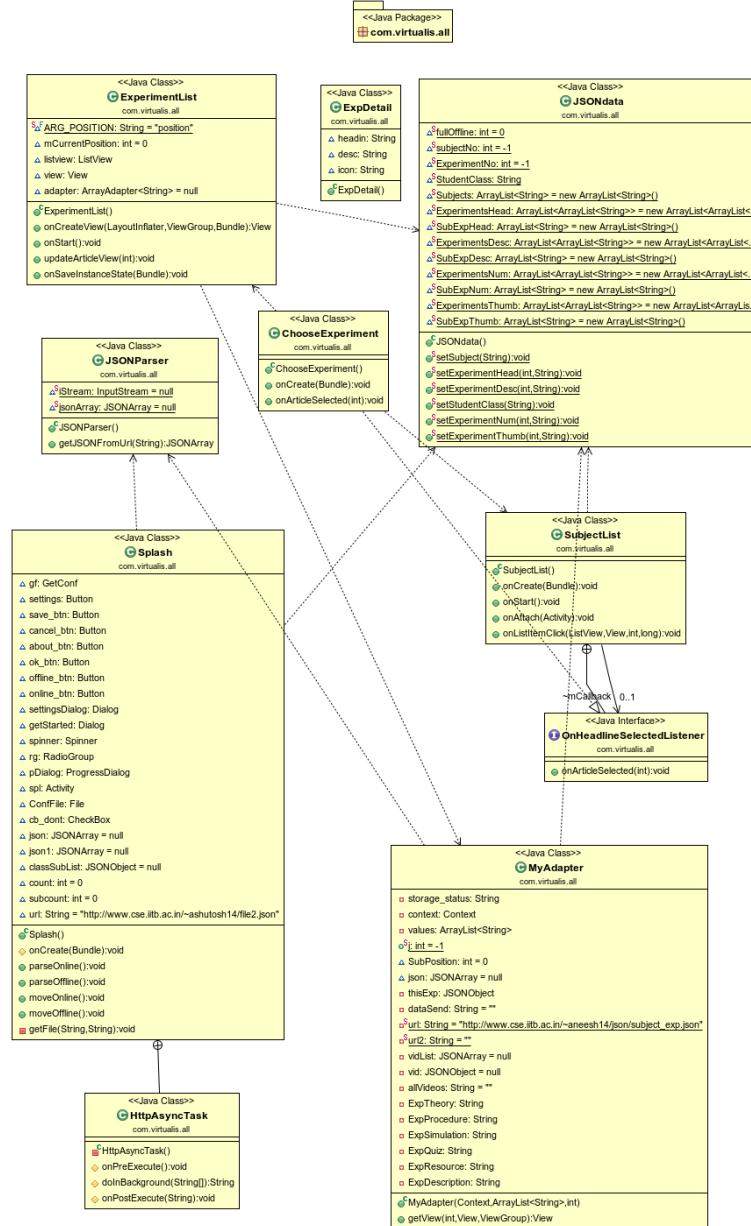


Figure 5.5: Class Diagram

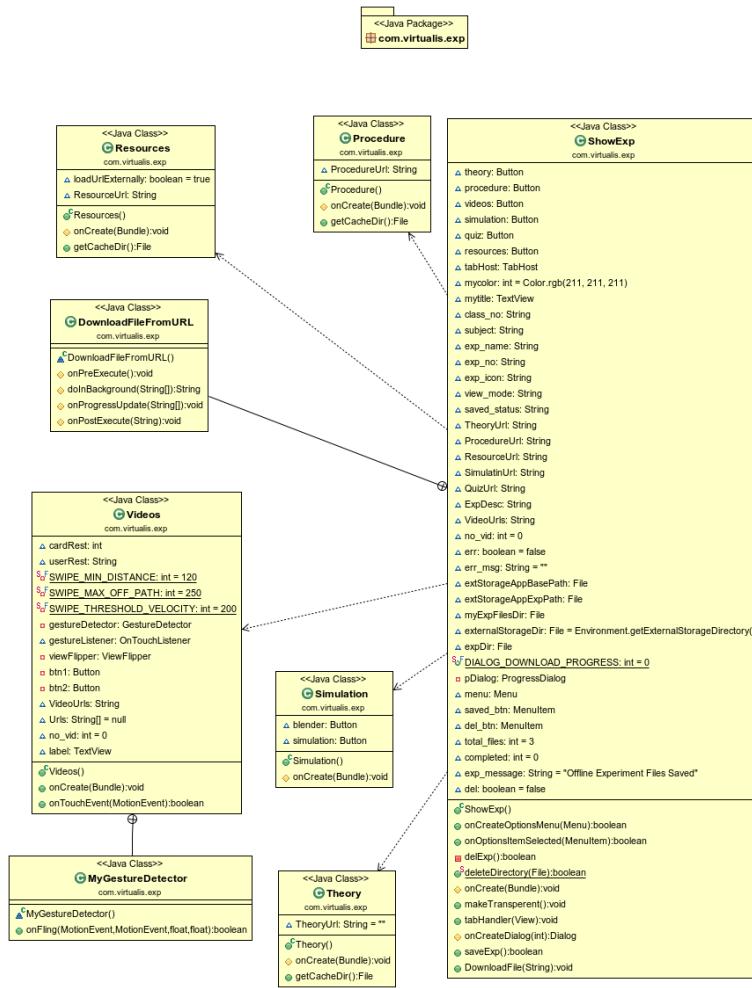


Figure 5.6: Experiment Class Diagram

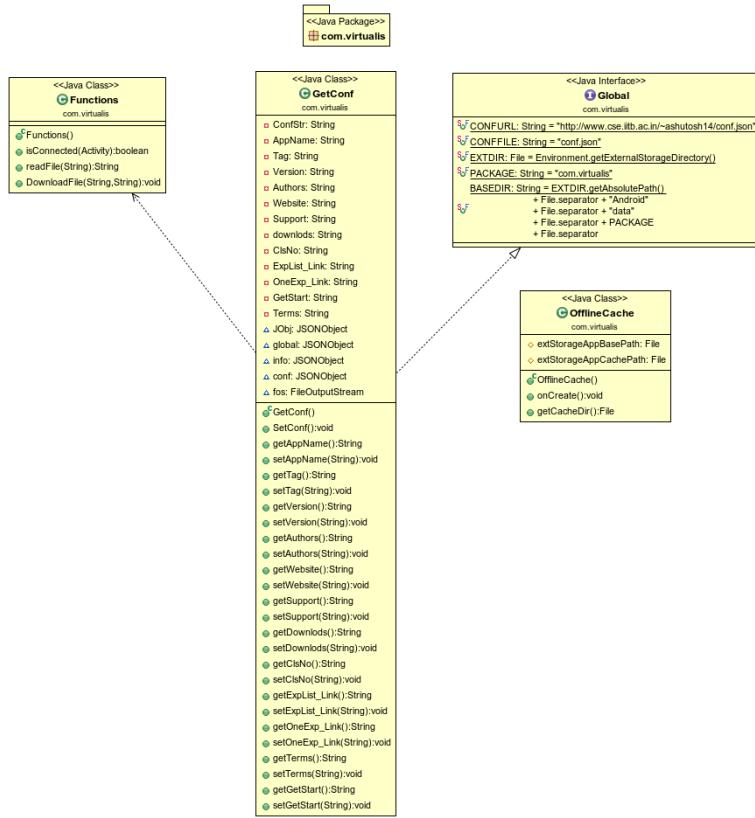


Figure 5.7: Main Class Diagram

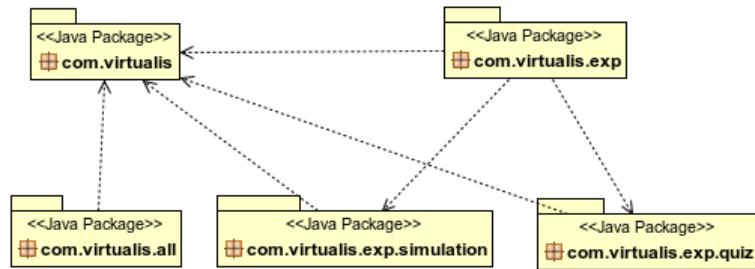


Figure 5.8: Package Class Diagram

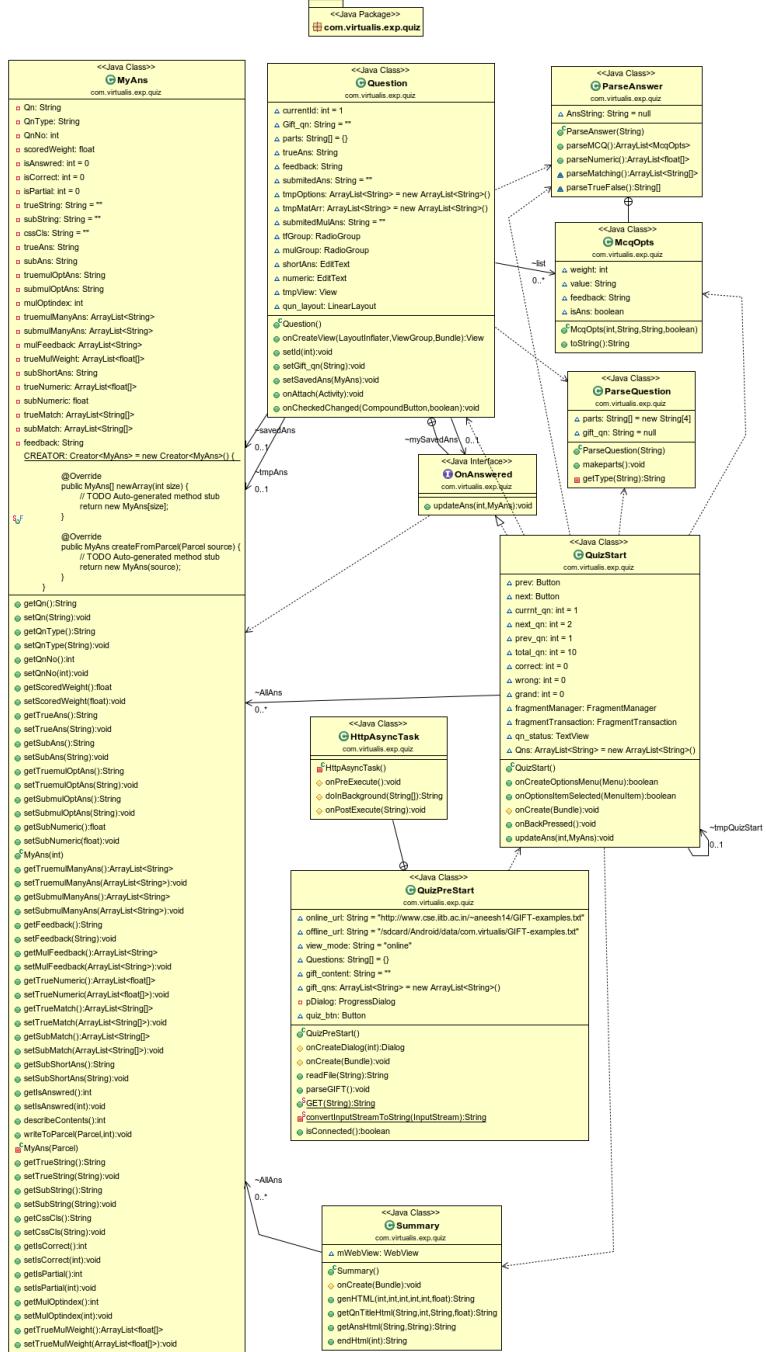


Figure 5.9: Quiz Class Diagram

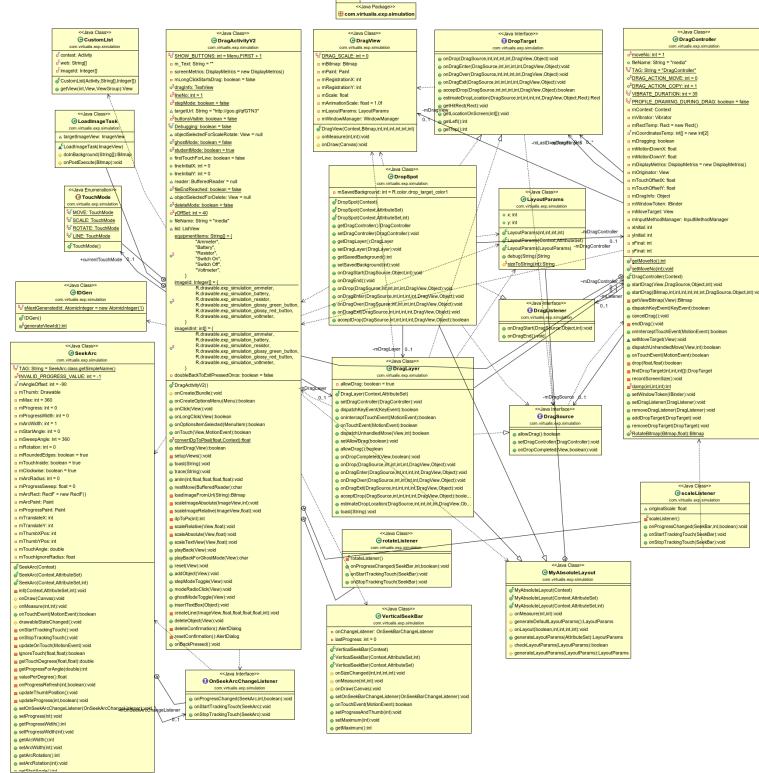


Figure 5.10: Simulation Class Diagram

5.3.5 Data Flow Diagrams

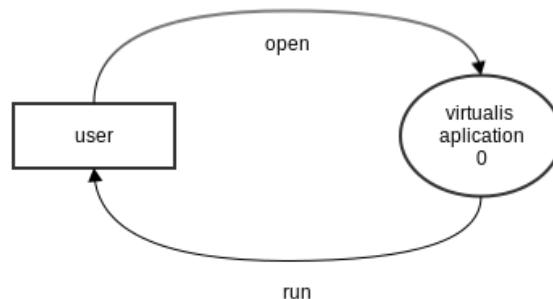


Figure 5.11: DFD Level 0

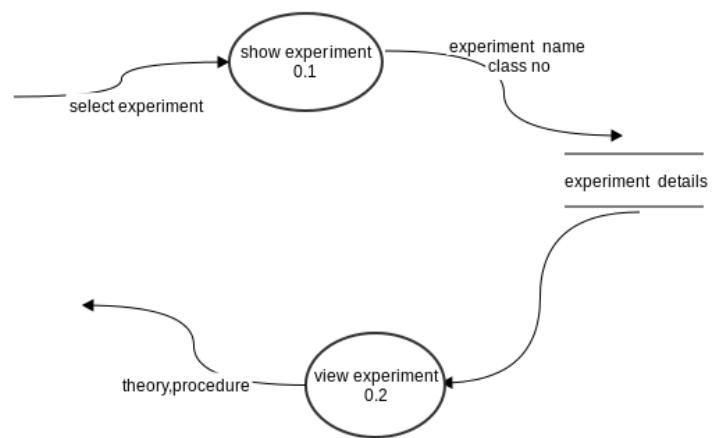


Figure 5.12: DFD Level 1

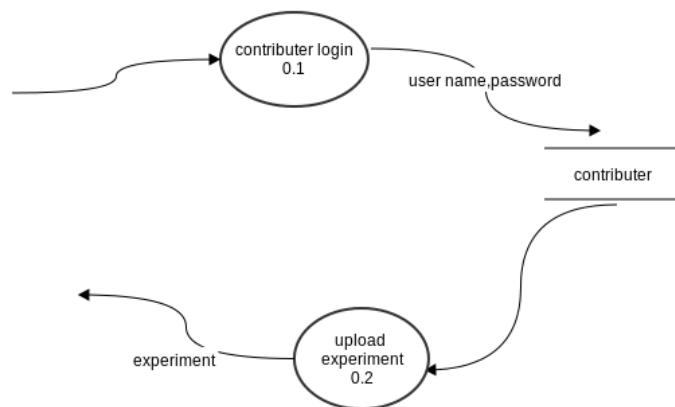


Figure 5.13: DFD Level 1

5.3.6 Sequence Diagram:

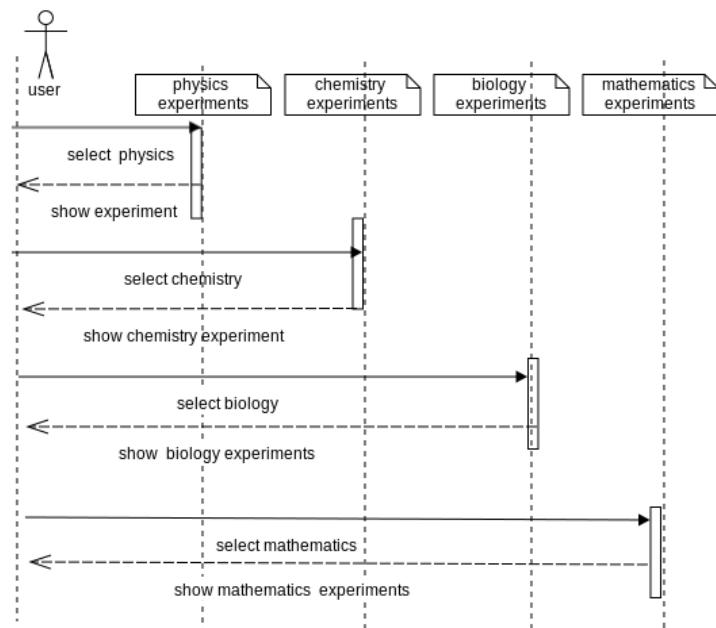


Figure 5.14: Sequence Diagram

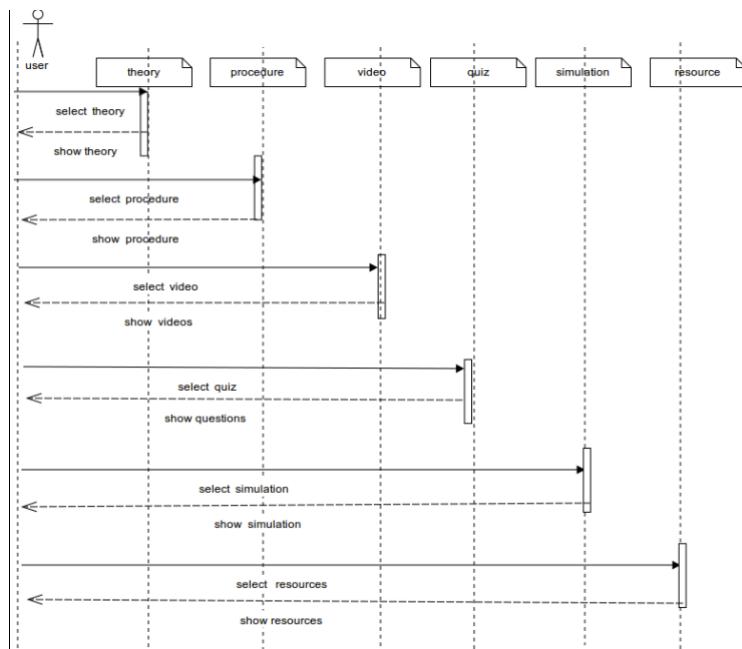


Figure 5.15: Sequence Diagram

5.3.7 E-R Diagram :

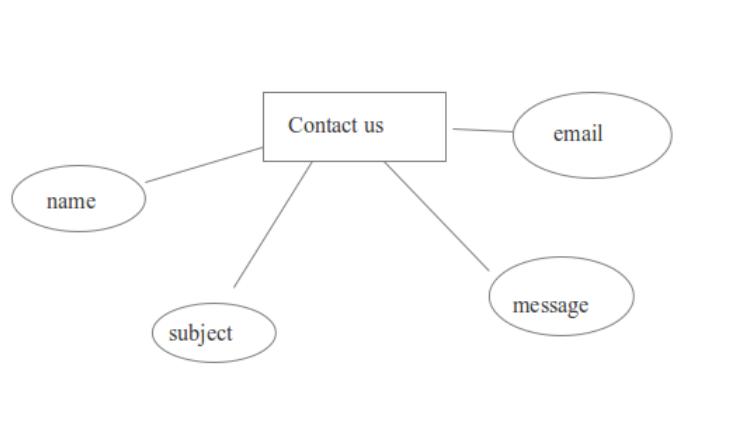


Figure 5.16: Contact ER Diagram

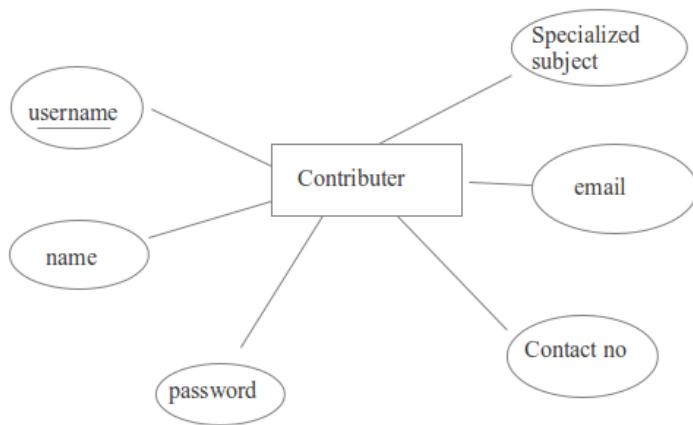


Figure 5.17: Contributor ER Diagram

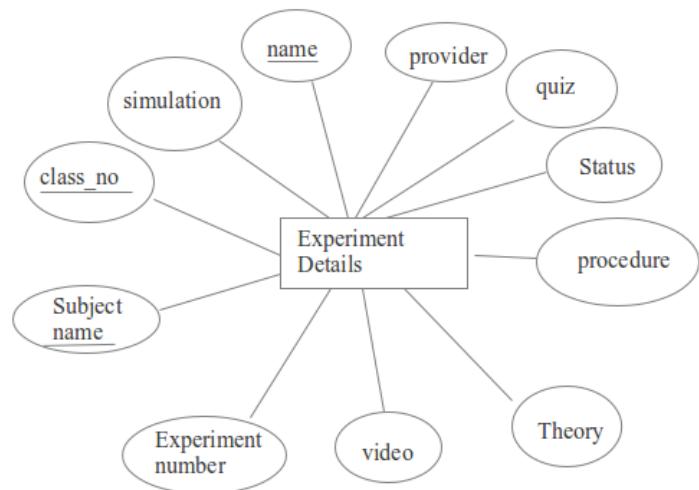


Figure 5.18: Experiment ER Diagram

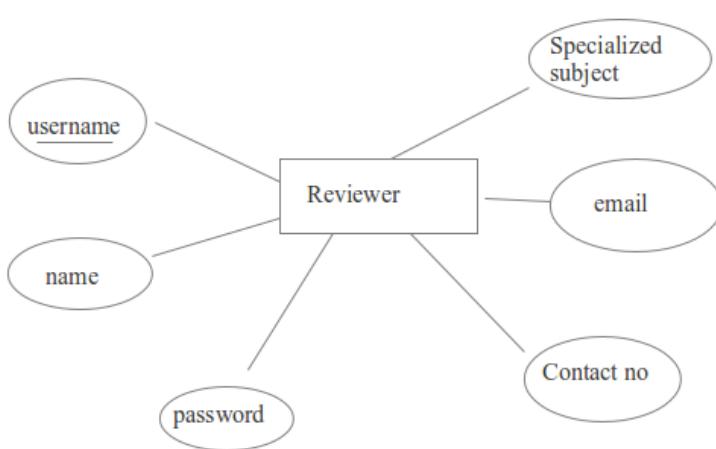


Figure 5.19: Reviewer ER Diagram

Chapter 6

Testing

Software testing is an investigation conducted to provide information about the quality of the product or service under test. Software testing also provides an objective, independent view of the software to allow the business to appreciate and understand the risks at implementation of the software. Test technique includes the process of executing a program or application with the intent of finding software bugs. Software testing can be stated as the process of verifying and validating that a software program/application/product:

- Meet the requirements that guide its design and development
- Work as expected
- Can be deployed with the same characteristics.

Software testing can be implemented at any time depending on the testing method employed in the development process. However, most of the test effort traditionally occurs after the requirements have been defined and the coding process has been completed. It is observed that fixing a bug is less expensive if found earlier in the development process. Although in the agile approaches most of the test effort is, conversely, on-going. As such, the methodology of the test is governed by the software development methodology adopted.

6.1 Testing technique used

Several testing techniques have been performed on the system such as unit testing, integration testing and system testing.

6.1.1 Unit Testing:

Unit testing, also known as component testing refers to tests that verify the functionality of a specific section of code, usually at the function level. Unit testing is a software development process that involves synchronized application of a broad spectrum of defect prevention and detection strategies in order to reduce software development risks, time, and costs.

6.1.2 Integration Testing

The purpose of integration testing is to verify functional, performance, and reliability requirements placed on major design items. Integration testing is any type of software testing that seeks to verify the interfaces between components against a software design. Integration testing works to expose defects in the interfaces and interaction between integrated components (modules).

Black-box testing- It is a method of software testing that examines the functionality of an application(e.g. what the software does) without peering into its internal structures or workings.

White-box testing - It is a method of testing software that tests internal structures or workings of an application, as opposed to its functionality. In white-box testing an internal perspective of the system, as well as programming skills, are used to design test cases. In this testing, we performed Boundary Value Analysis.

6.1.3 System Testing

System testing tests a completely integrated system to verify that it meets its requirements. In addition, the software testing should ensure that the program, as well as working as expected, does not also destroy or partially corrupt its operating environment or cause other processes within that environment to become inoperative.

System testing of software or hardware is testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. System testing falls within the scope of black box testing, and as such, should require no knowledge of the inner design of the code or logic. In this testing we performed Alpha testing.

Chapter 7

User Manual - Virtualis

7.1 Introduction

Virtualis v0.1 is an Android App, created to provide android interface of accessing the virtual lab experiments. Here student can read all the theory, procedure, resources, watch the videos, take the quiz that is associated with the give experiment and finally he can also follow the guided simulation or Blender simulation. He can access the contents in two modes

- Online Mode
- Offline Mode
- Online - Offline Mode

7.2 Online Mode

The online mode can be opened if there is a proper net connectivity. In Online mode the user can view list of subjects along with the list of experiments of that subject Saved experiments and unsaved experiments are differentiated by View saved button appearing at experiment name

- If user selects the saved experiment the application goes to offline mode and shows the saved experiment
- If user selects unsaved experiment the application opens the experiment in online mode
- Once the user selects an experiment he is able to view the theory , procedure, video, quiz,simulation and resources of the Experiment by clicking on respective modules

7.2.1 Function for Experiment

Users is provided with below options to work with a Experiment for offline mode

- Save Experiment
- Update Experiment
- Delete Experiment

7.2.1.1 Save Experiment

Here, user can save the current experiment for offline view mode

7.2.1.2 Update Experiment

Here, user can Update the current experiment which is already saved for offline view mode

7.2.1.3 Delete Experiment

Here, user can Delete the current experiment which is already saved for offline view mode

7.2.2 Parts of an Experiment

One Experiment is divided into various parts that are namely

- Theory
- Procedure
- Videos
- Simulation
- Quiz
- Resources

7.2.2.1 Theory

This section displays the theory related to selected experiment

7.2.2.2 Procedure

This section displays the procedure related to selected experiment

7.2.2.3 videos

This section plays the different videos that are provided for a selected experiment

7.2.2.4 Simulation

This section provide two modes of simulation for a selected experiment

- Run Guided Simulation
- Open Blender Simulation

7.2.2.5 Run Guided Simulation

This module guide the student to follow the steps that followed by the teacher while doing the experiment in the android platform. It includes

- Addition of Object
- Rotation of Object
- Scaling of Object
- Drawing the new Object

7.2.2.6 Run Blender

This module plays the interactive animation of that experiment if the Blender player is installed in that device else it asks user to download and install the Blender player.

7.2.2.7 Quiz

This section displays the procedure related to selected experiment
Quiz module having next and previous buttons to switch between the questions quiz module having submit quiz button to submit the quiz .once he submitted then the summery report of his performance will be displayed through which he can evaluate himself.

It includes

- Displaying the Question
- Walk through around all the question
- Summary of the all the questions

7.2.2.8 Resources

This section displays the extra resources related to selected experiment

7.3 Offline Mode

In offline mode the previously saved experiments are shown to user. The user views list of subjects along with the list of saved experiments of that subject once the user selects an experiment he is able to view the theory , procedure, video, simulation and resources of the Experiment by clicking on respective modules

7.4 Online - Offline Mode

Online - Offline mode, is similar to Online Mode the difference is he can switch from Online to Offline that's why this mode is named like that, this can be done by clicking the "view saved exp" button in the list of experiment, then he can view the previously saved experiments are shown to user in like Online Mode. The user views list of subjects along with the list of saved experiments of that subject once the user selects an experiment he is able to view the theory , procedure, video, simulation and resources of the Experiment by clicking on respective modules

7.5 Flow of Virtualis

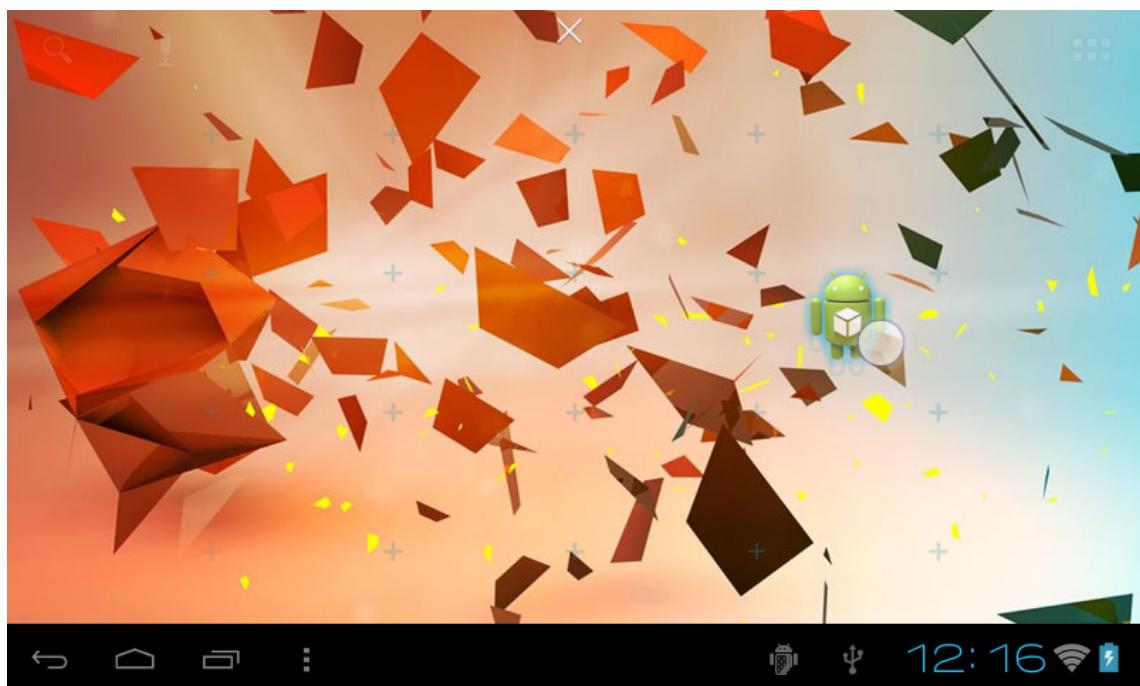


Figure 7.1: Open Virtualis

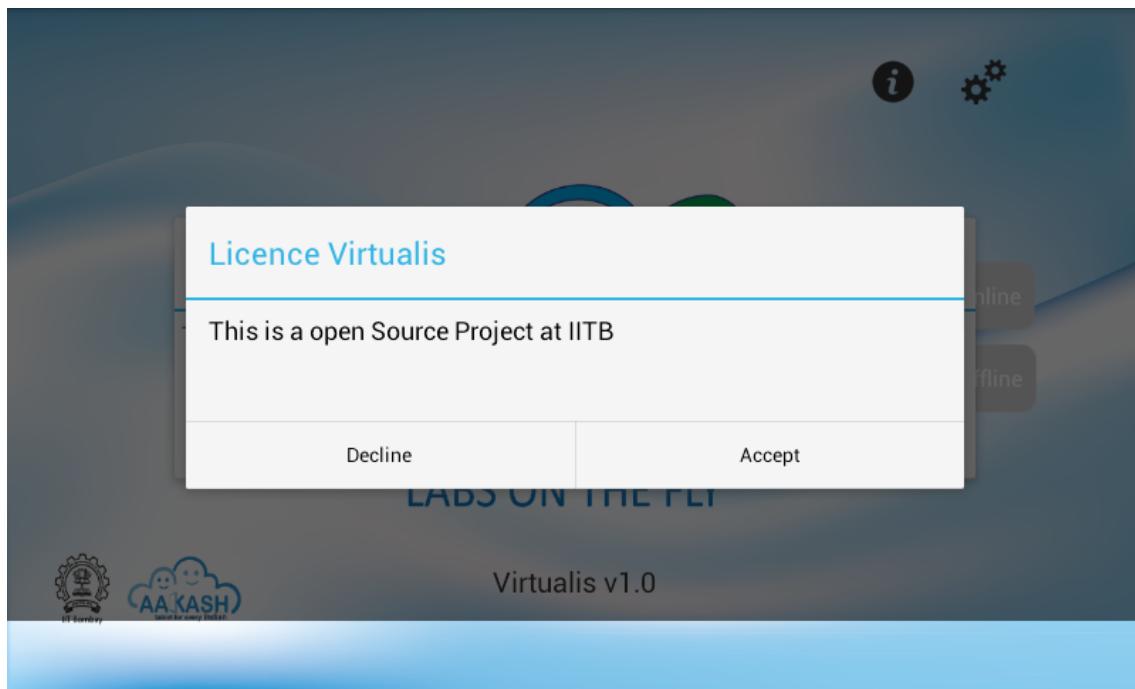


Figure 7.2: Accept The License

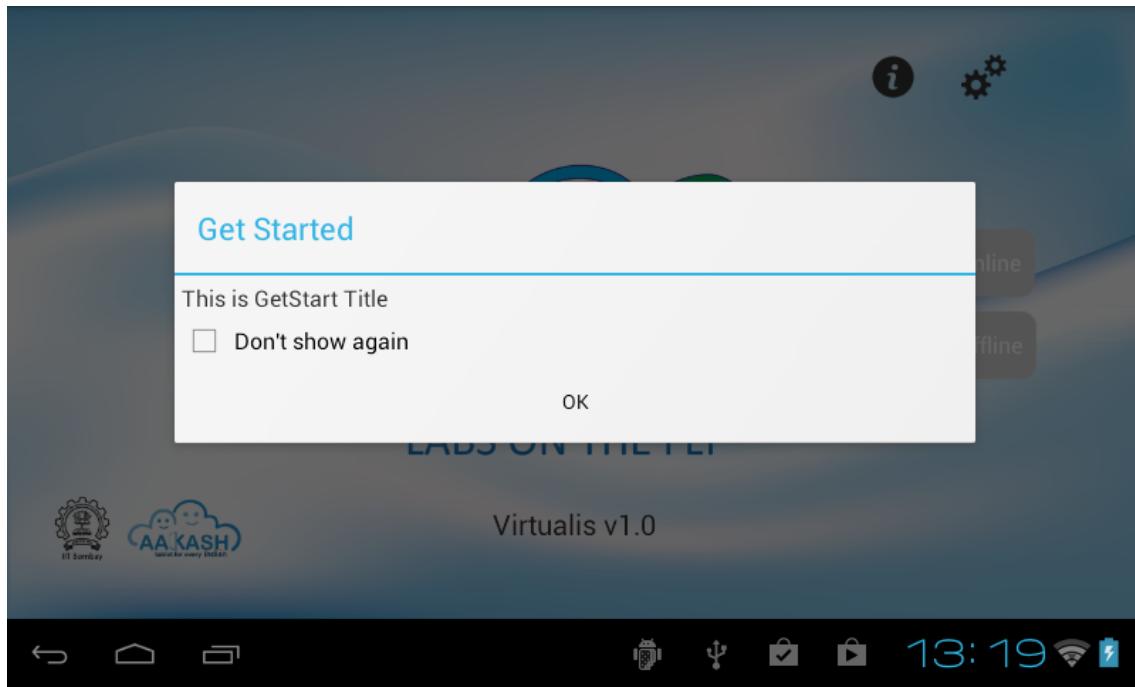


Figure 7.3: Get Started

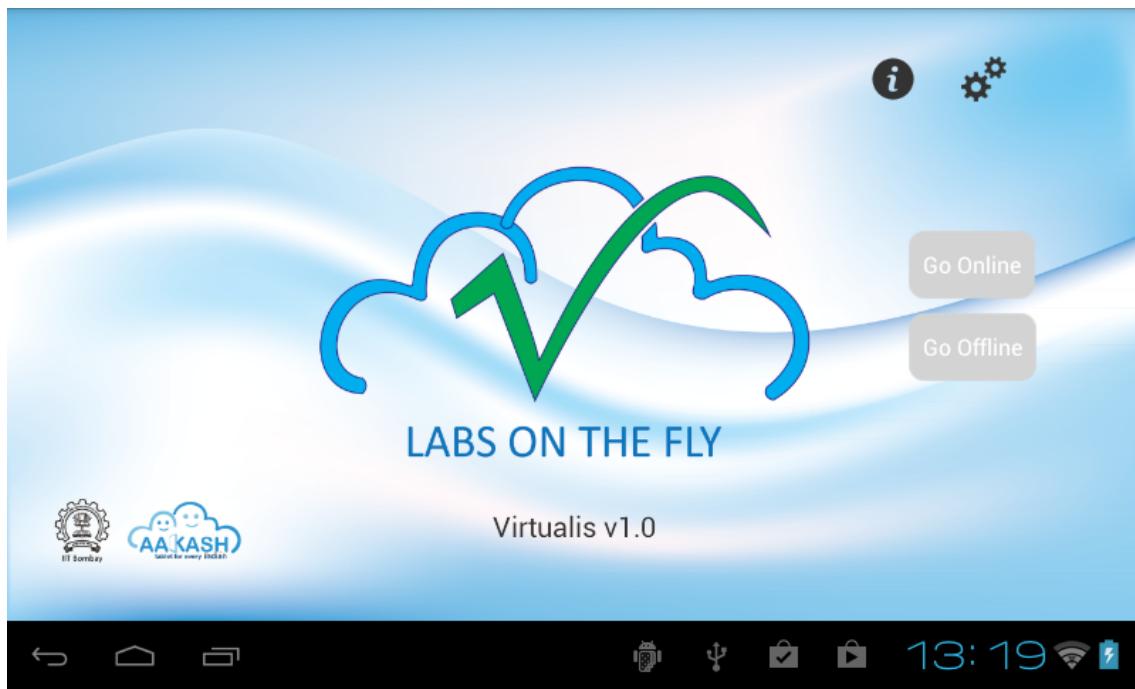


Figure 7.4: Virtualis Splash Screen



Figure 7.5: About us Button

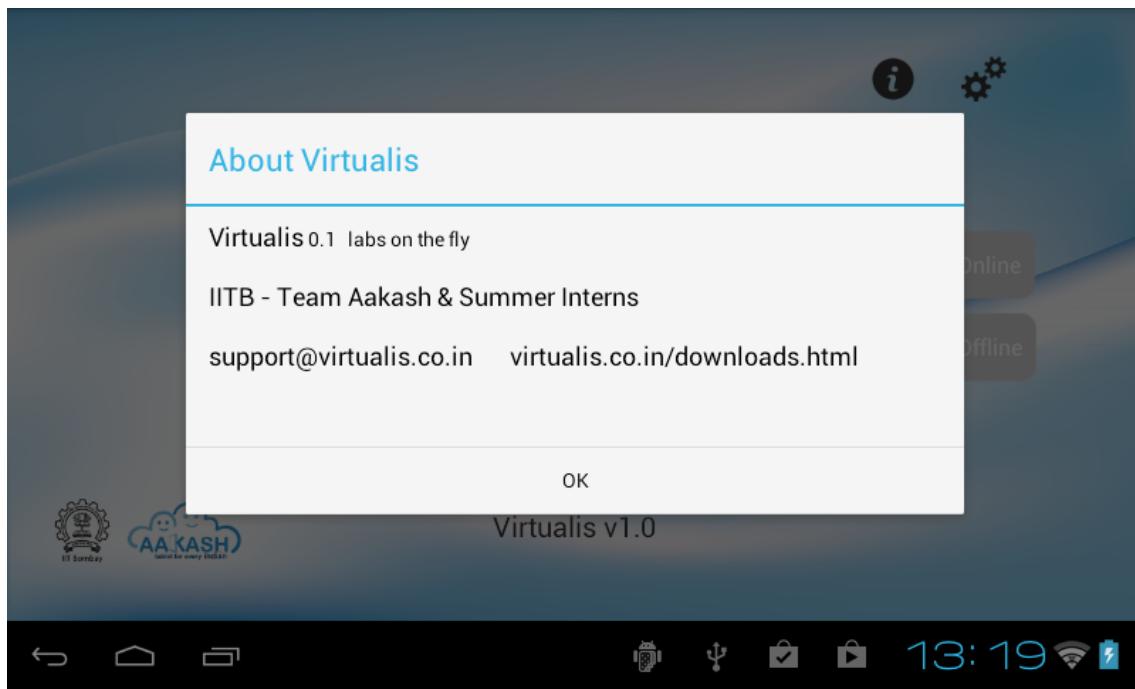


Figure 7.6: About us

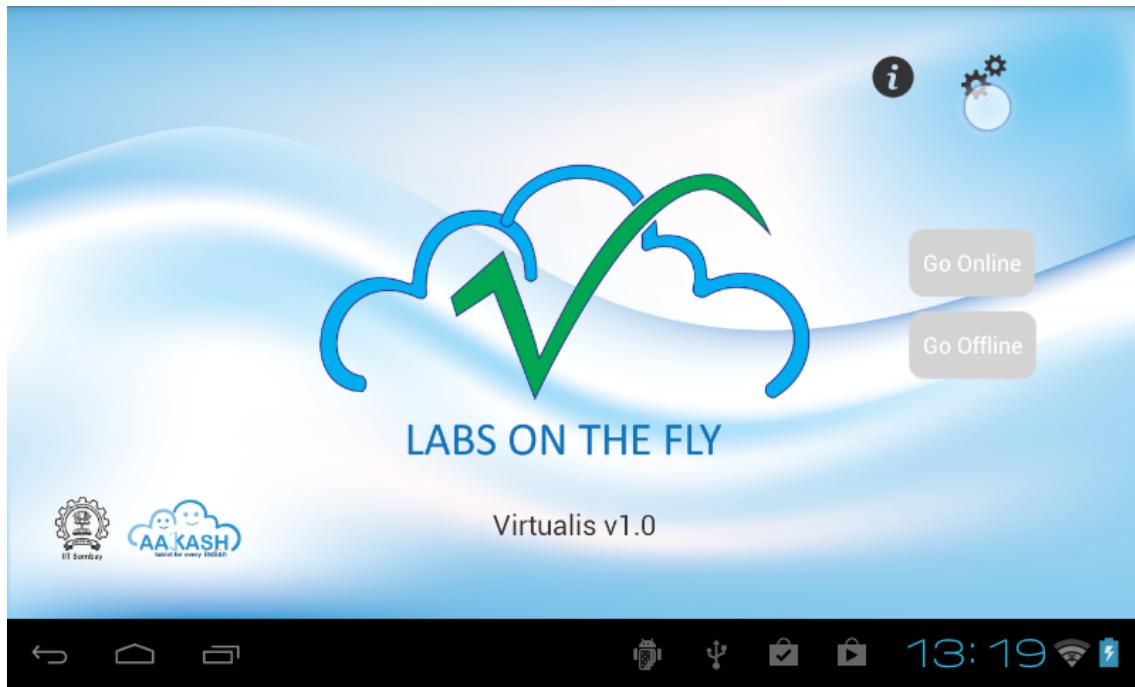


Figure 7.7: Settings

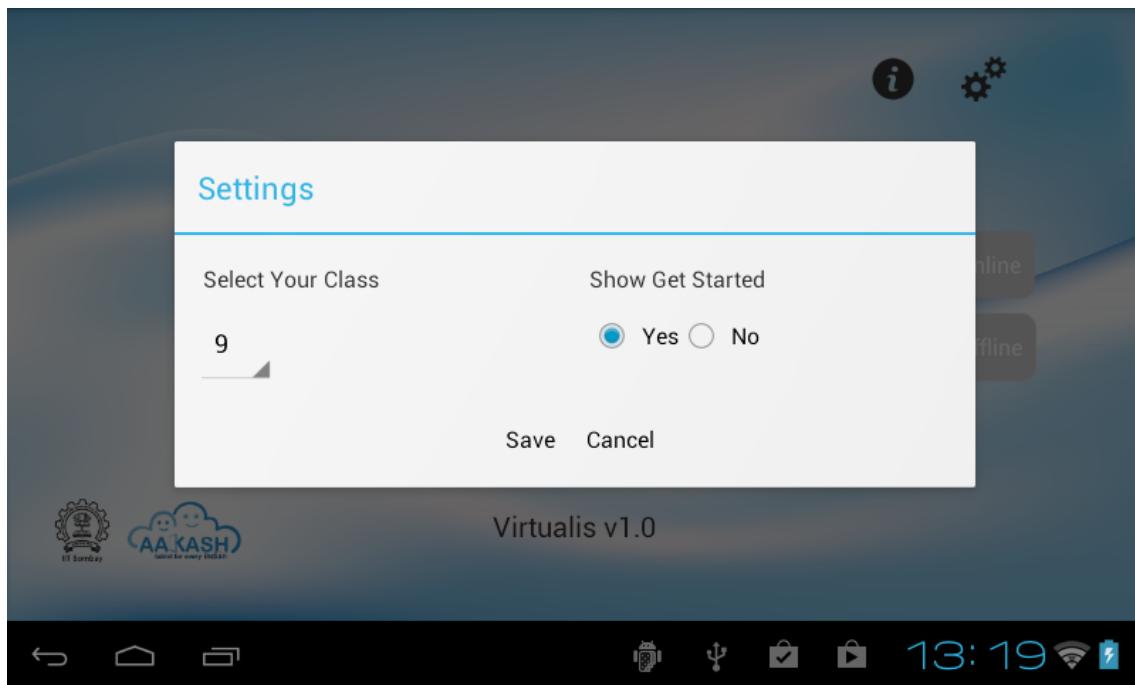


Figure 7.8: Settings

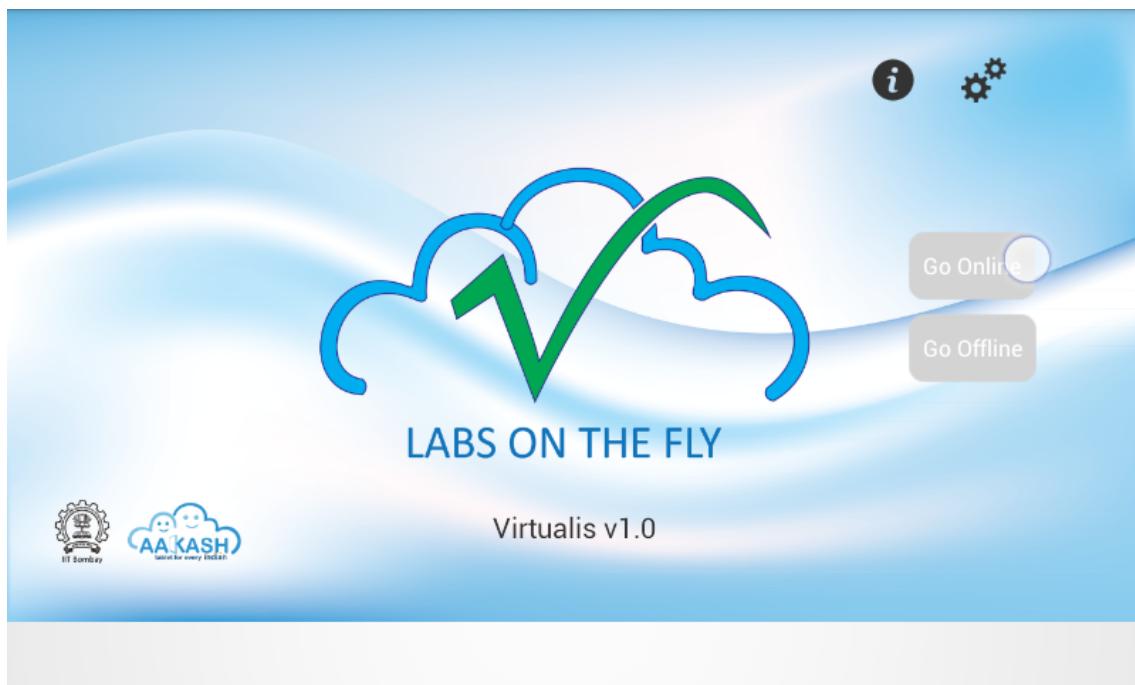


Figure 7.9: Go Online

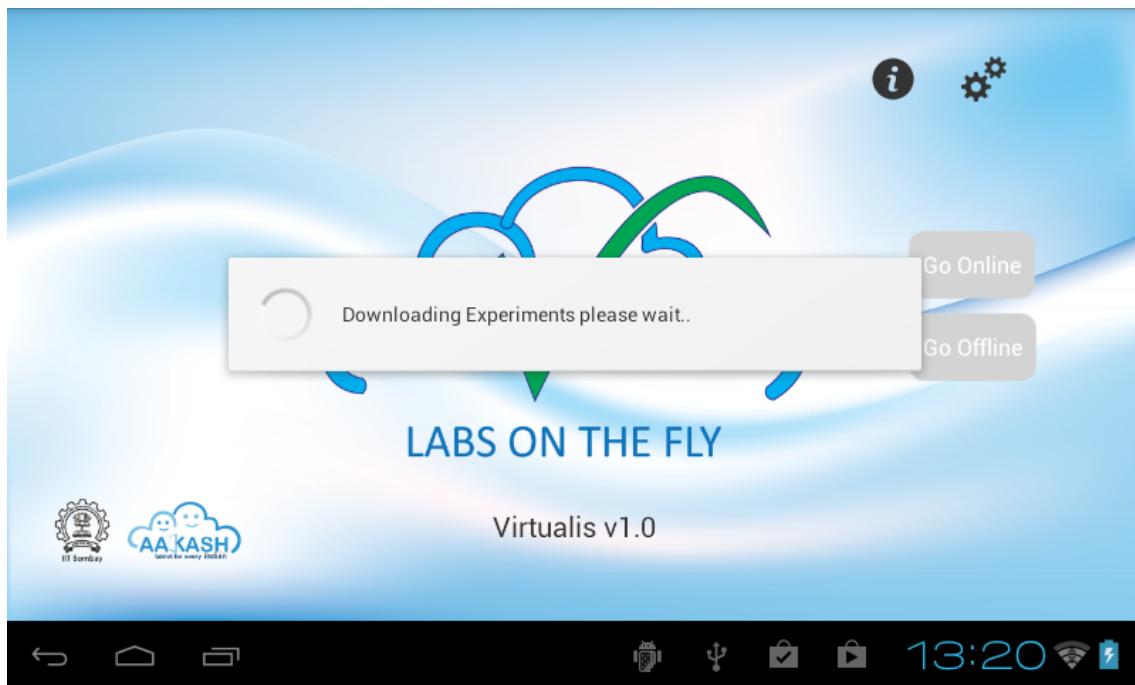


Figure 7.10: Downloading Experiments

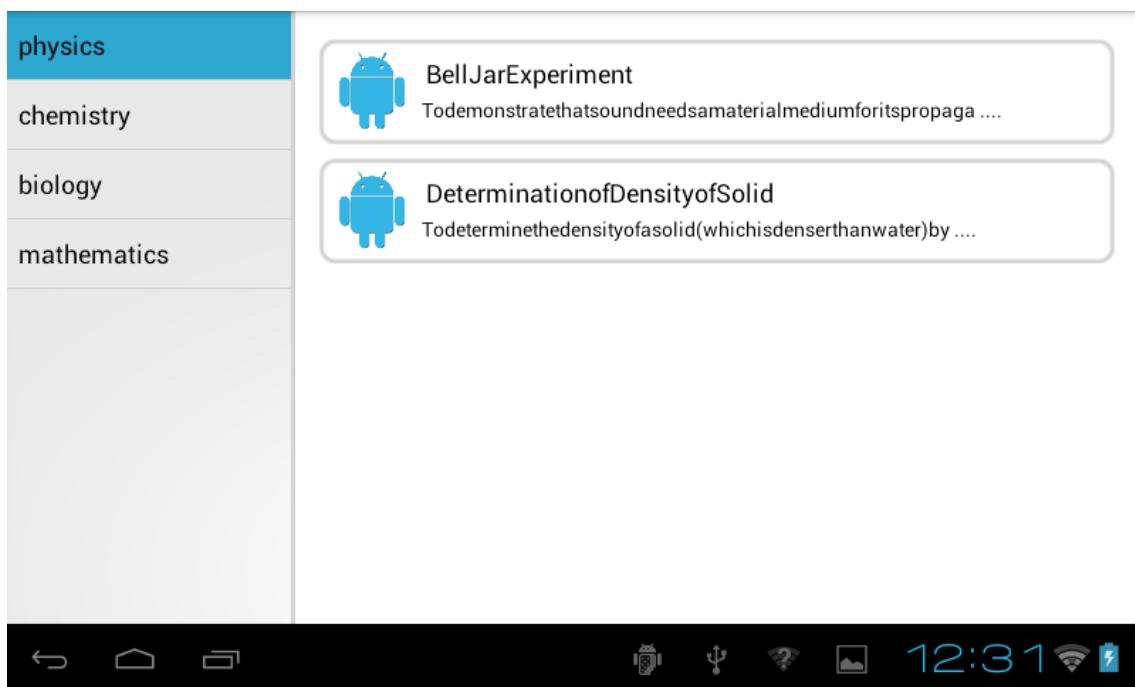


Figure 7.11: List of Experiments and Subjects

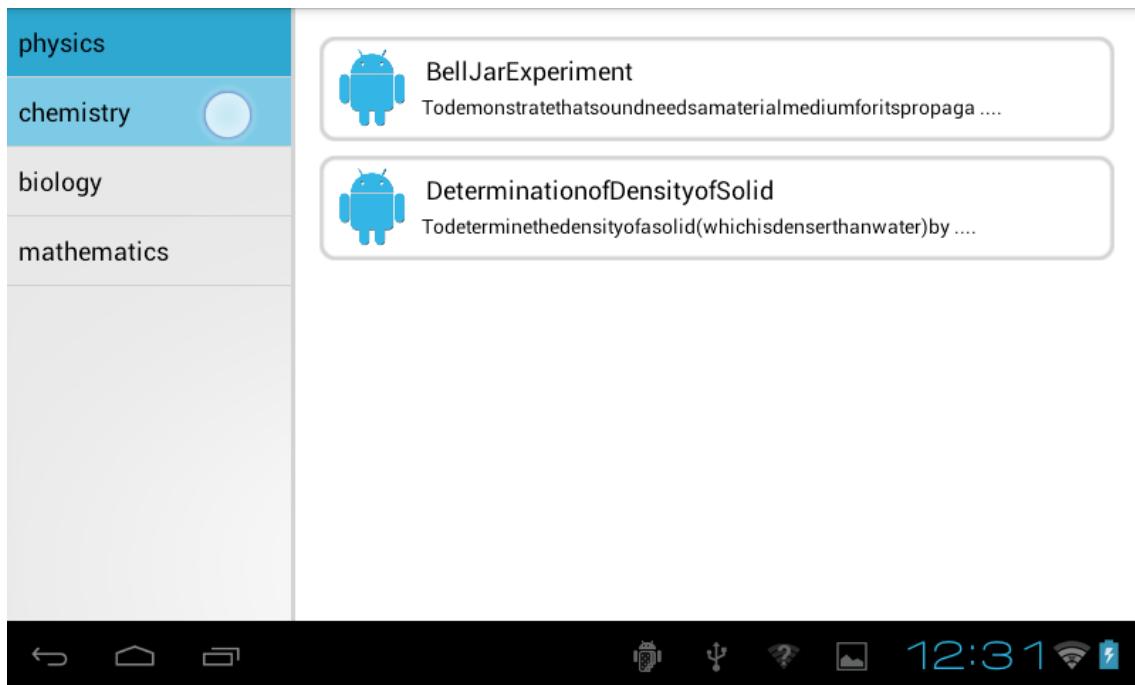


Figure 7.12: Select subject

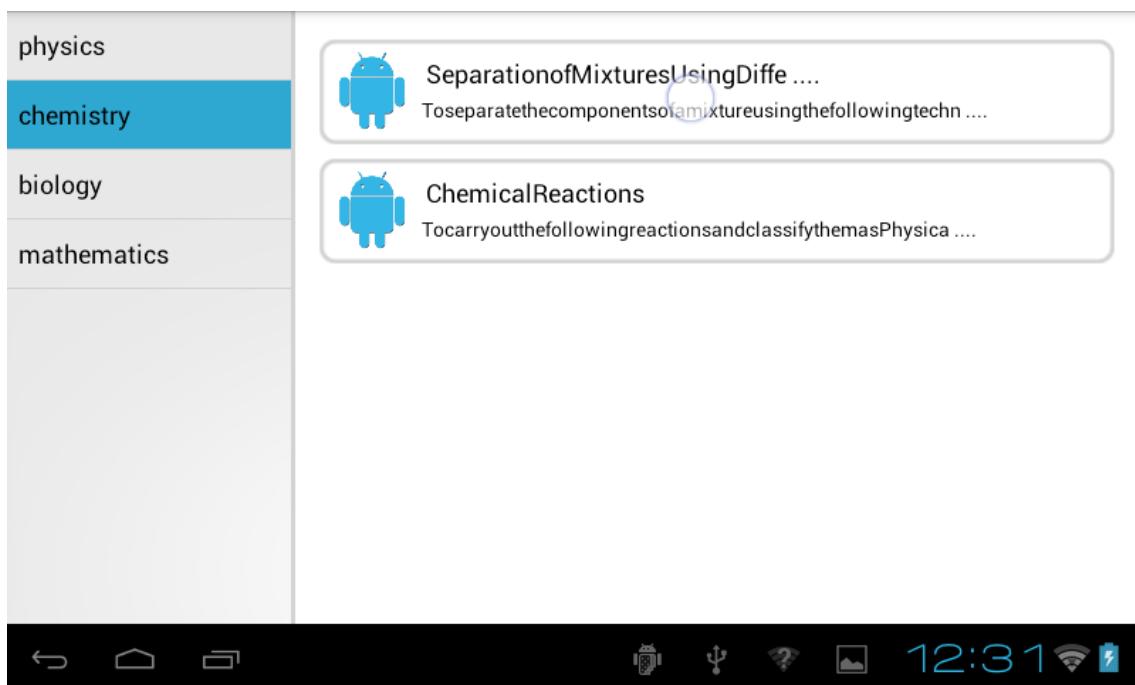


Figure 7.13: Select experiment

Class 9 - chemistry - 1. SeparationofMixturesUsingDifferentTechniques **SAVE EXPERIMENT**

Our Objective

To carry out the following reactions and classify them as Physical or Chemical changes.

- Burning of magnesium in air
- Sodium sulphate with barium chloride in the form of their solutions in water
- Iron nail with copper sulphate solution in water
- Zinc with dilute sulphuric acid
- Heating of copper sulphate

Theory is Loading...

Figure 7.14: Theory Loading

Class 9 - chemistry - 1. SeparationofMixturesUsingDifferentTechniques **SAVE EXPERIMENT**

Our Objective

To carry out the following reactions and classify them as Physical or Chemical changes.

- Burning of magnesium in air
- Sodium sulphate with barium chloride in the form of their solutions in water
- Iron nail with copper sulphate solution in water
- Zinc with dilute sulphuric acid
- Heating of copper sulphate

The Theory

What is a chemical change?

In a chemical change, chemical reaction takes place and the substances undergo a change in their state. During chemical reactions, one substance reacts with another to form a new substance. The chemical composition of the new substance is different from that of the reacting species. Due to a chemical change, the chemical properties of matter also change. That means the product is entirely different from the reactants.

Figure 7.15: Experiment Theory

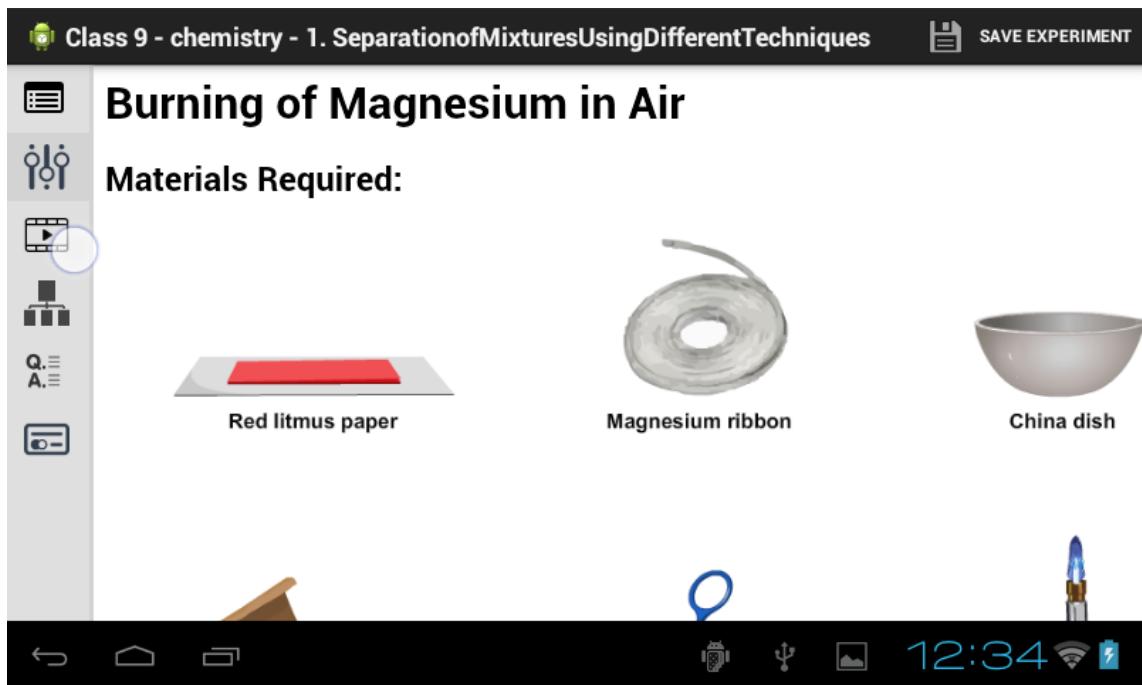


Figure 7.16: Procedure

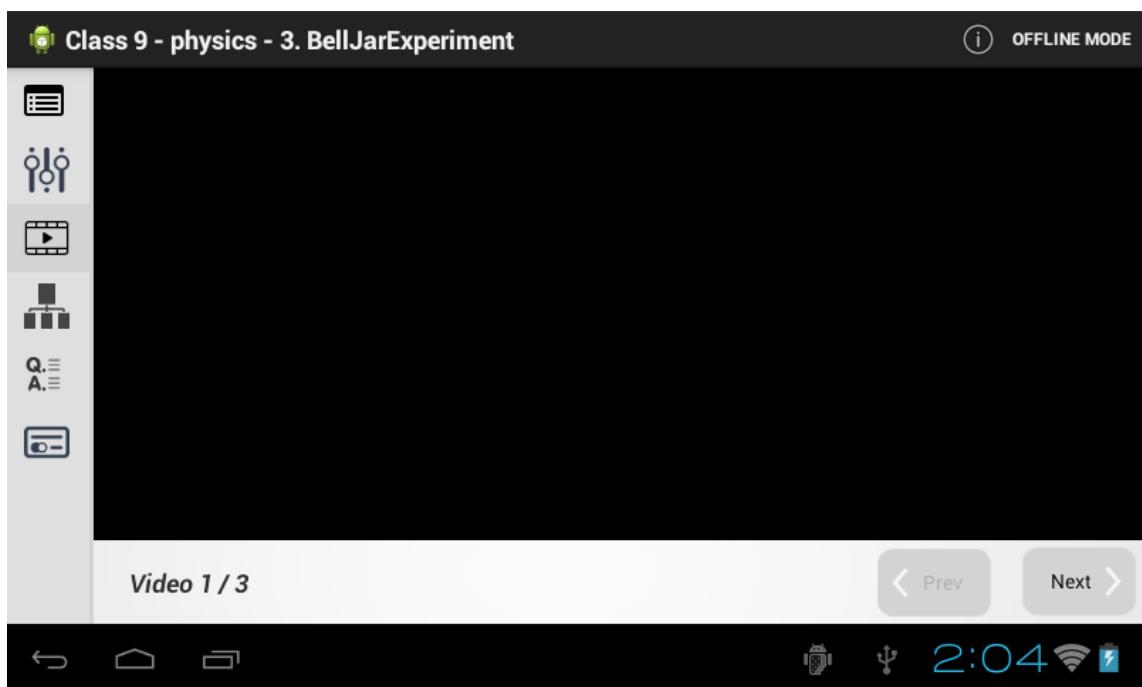


Figure 7.17: Videos

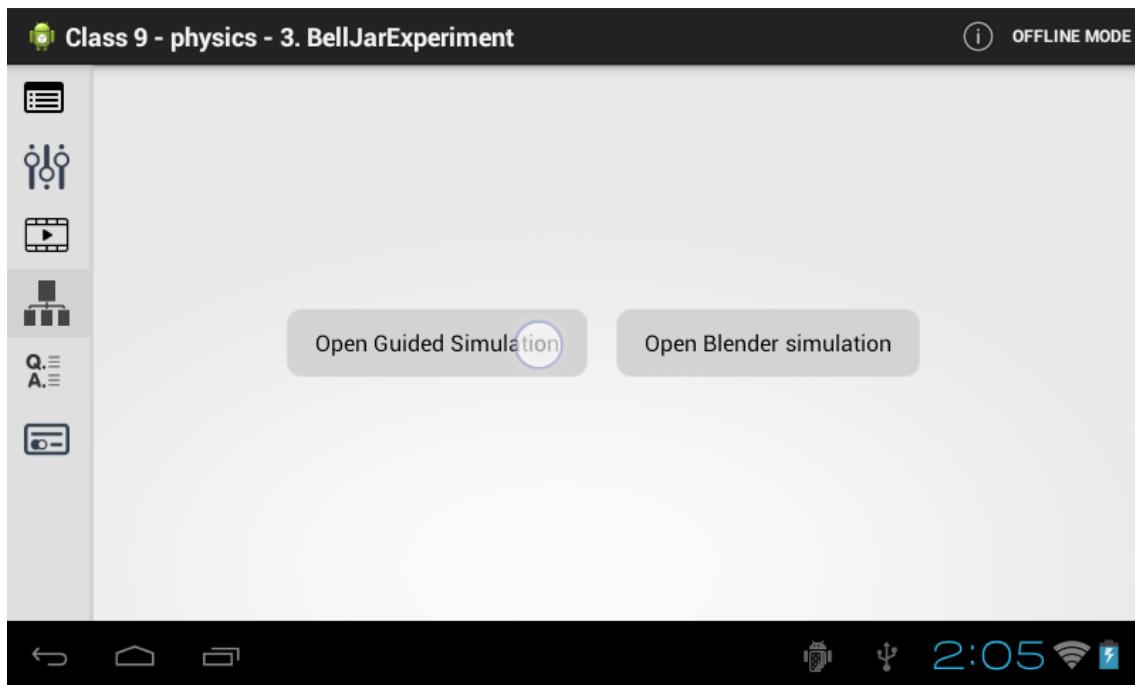


Figure 7.18: Open Guided Simulation

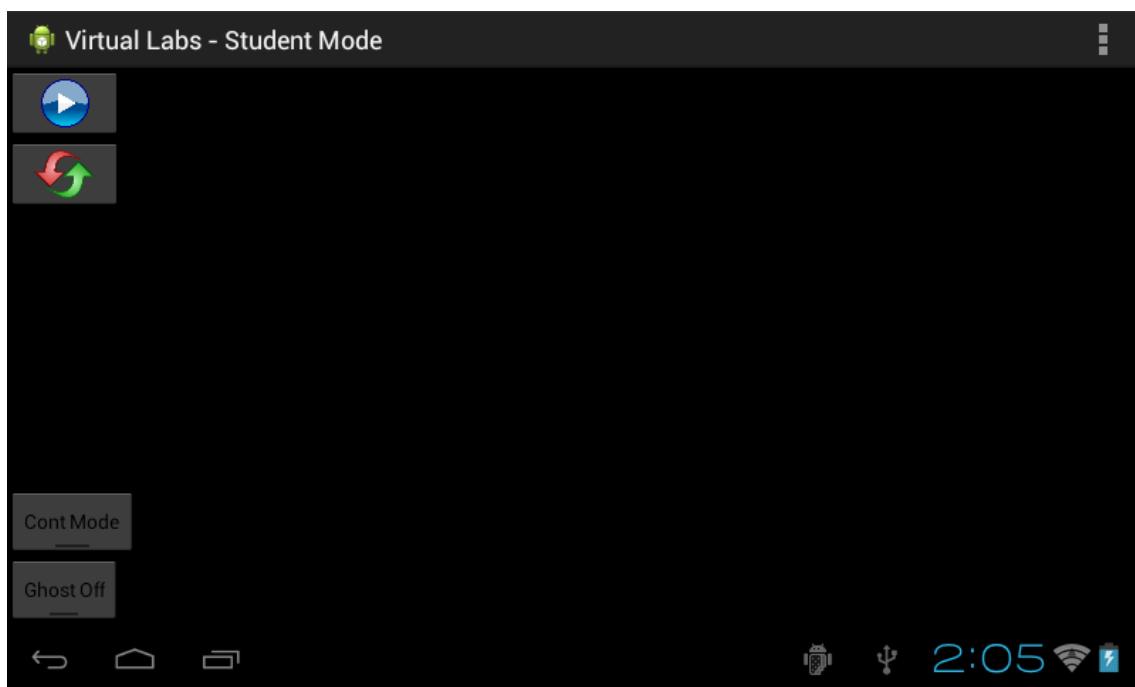


Figure 7.19: Guided Simulation Portal

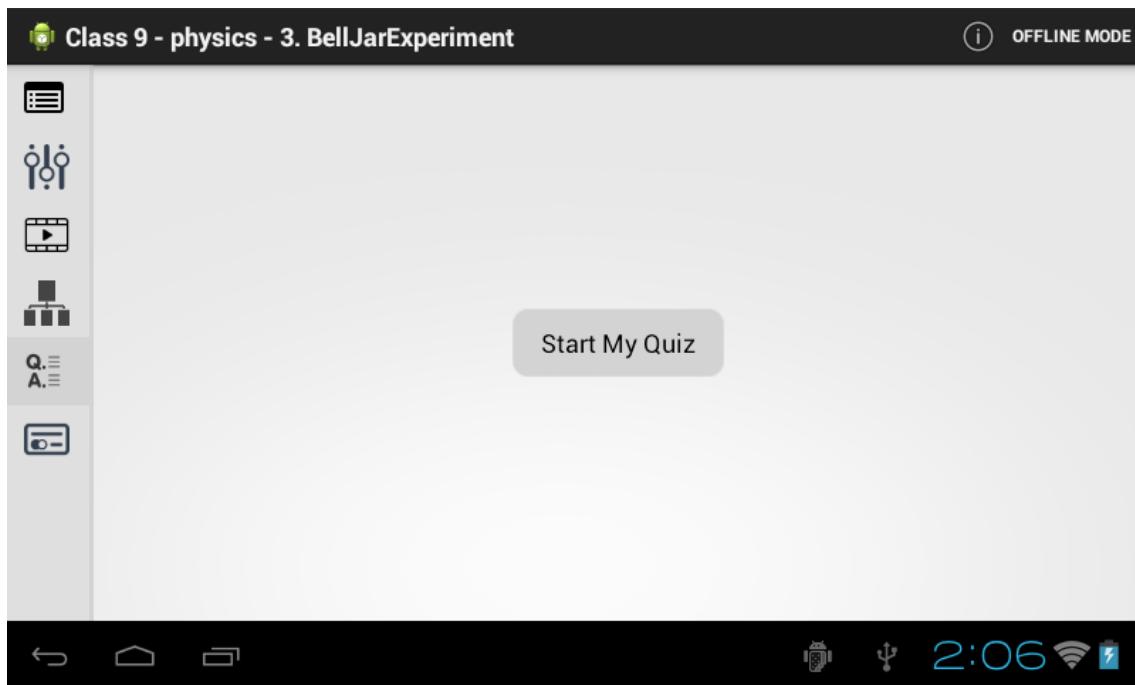


Figure 7.20: Start My Quiz



Figure 7.21: Displaying Question

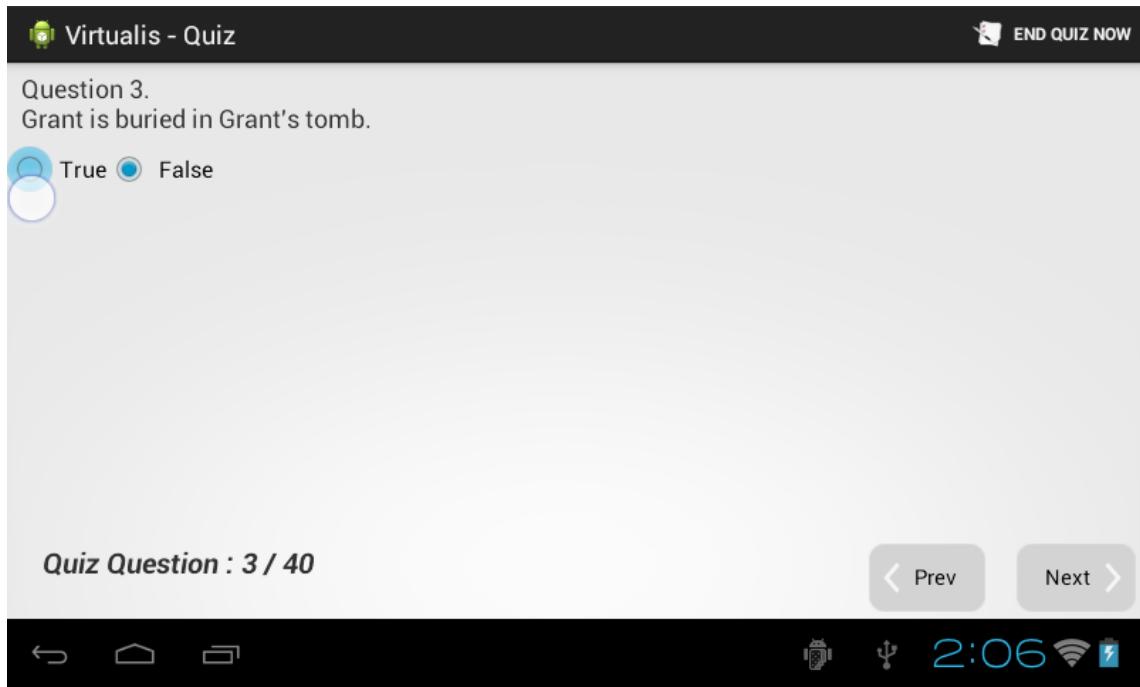


Figure 7.22: Answering Questions

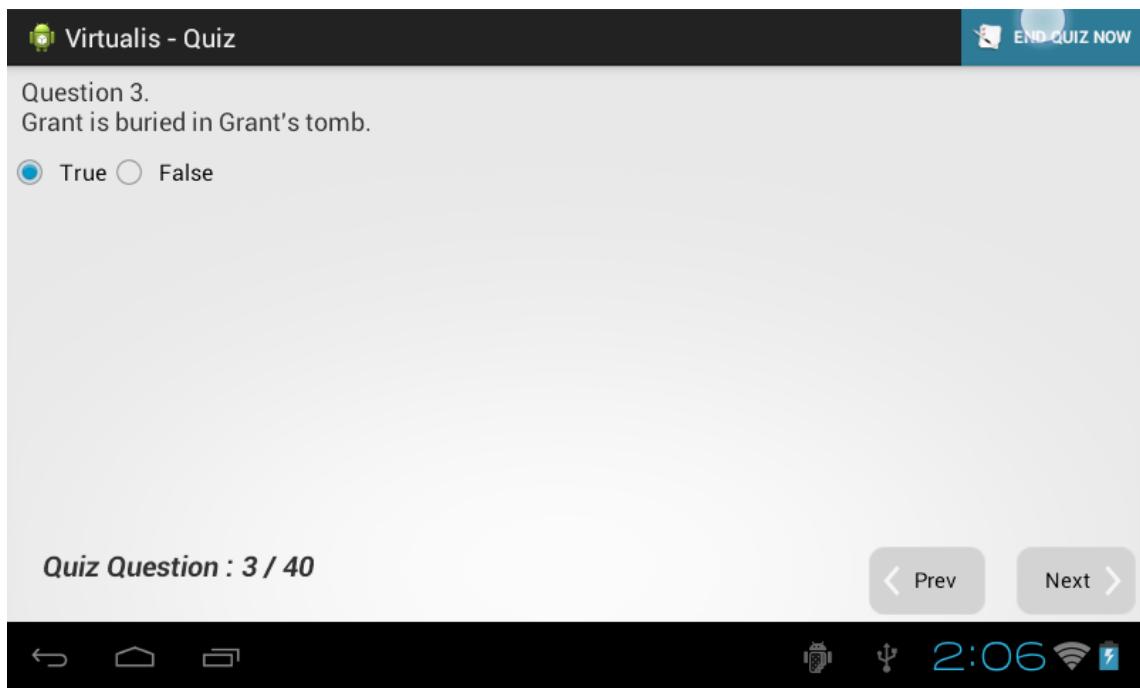


Figure 7.23: Submit Quiz

Virtualis - Quiz Summary	
Attempted Questions	1
Correct Questions	0
Wrong Questions	1
Partial Correct Questions	0
Grand Total Score	0.0 pt

Questions and Answers

Question 1 »	0.0 pt
Who's buried in Grant's tomb?	
<i>Correct Ans : no one</i>	Not Answered

← ⌂ ⌂ 2:07 ⌂ ⌂

Figure 7.24: Summary of Quiz

Virtualis - Quiz

END QUIZ NOW

Question 5.
When was Ulysses S. Grant born?

0.0

Quiz Question : 5 / 40

← Prev Next →

← ⌂ ⌂ 2:07 ⌂ ⌂

Figure 7.25: Go Back

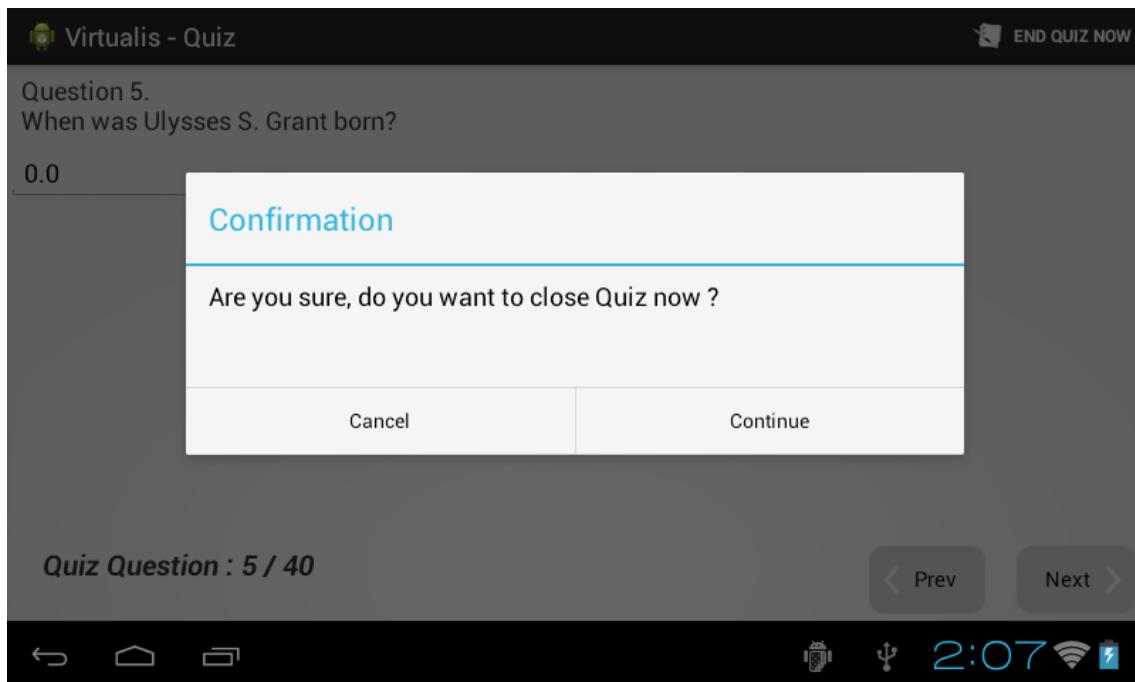


Figure 7.26: Confirm Quiz Close

A screenshot of a mobile application titled "Class 9 - physics - 3. BellJarExperiment". At the top, there is a navigation bar with icons for back, home, and recent apps. On the right side of the bar, there is a "SAVE EXPERIMENT" button. Below the bar, the title "Our Objective" is displayed in large bold text. To the left of the title is a sidebar with icons for document, video, and network. The main content area contains the text "To carry out the following reactions and classify them as Physical or Chemical changes." followed by a bulleted list of six experiments. Below this is the section "The Theory" in large bold text. Under "The Theory", the heading "What is a chemical change?" is shown in bold. The main content area contains the text: "In a chemical change, chemical reaction takes place and the substances undergo a change in their state. During chemical reactions, one substance reacts with another to form a new substance. The chemical composition of the new substance is different from that of the reacting species. Due to a chemical change, the chemical properties of matter also change. That means the product is entirely different from the reactants." At the bottom of the screen, there are standard Android system status icons for battery, signal, and time (2:12).

Figure 7.27: Save Experiment

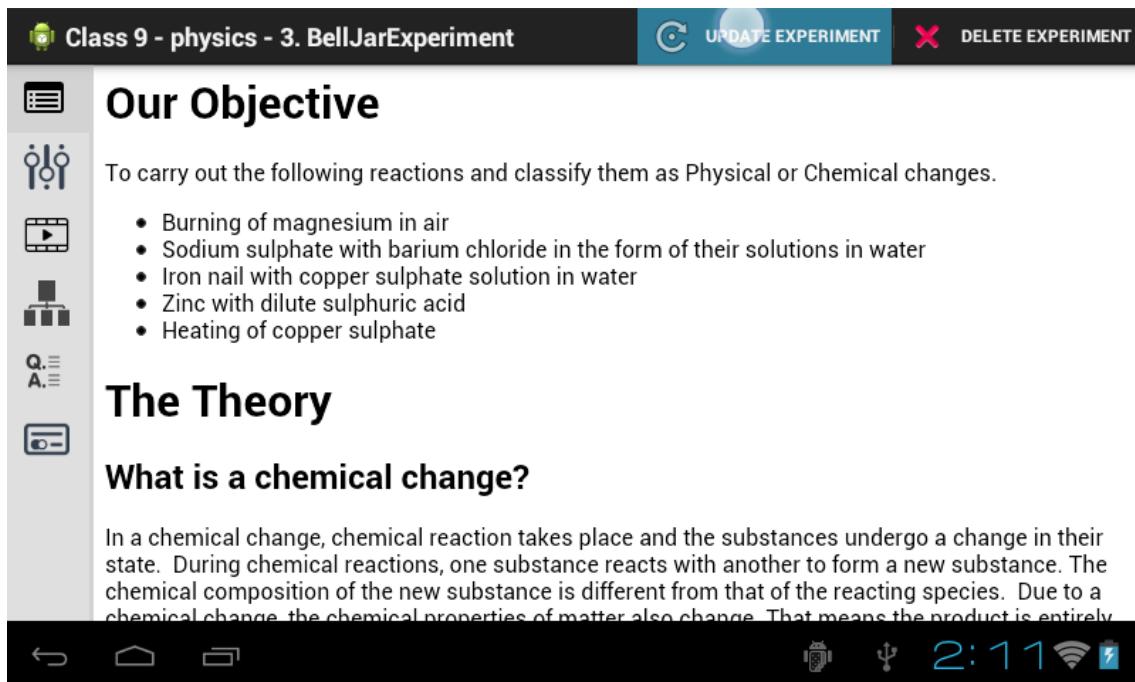


Figure 7.28: Update Experiment

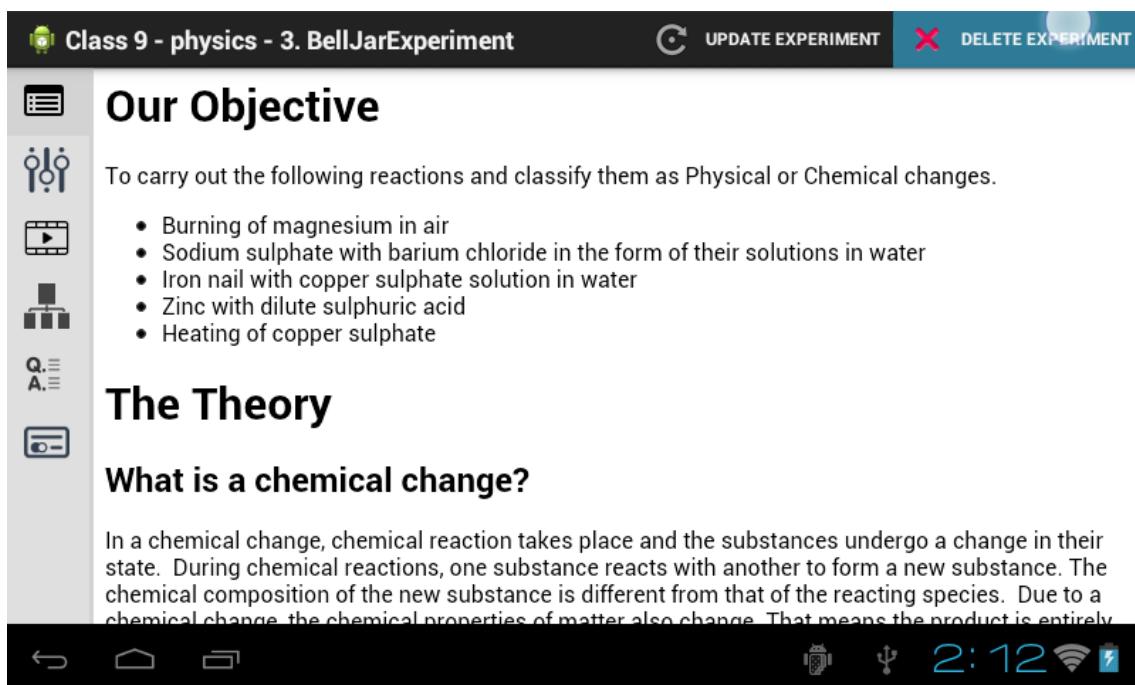


Figure 7.29: Delete Experiment

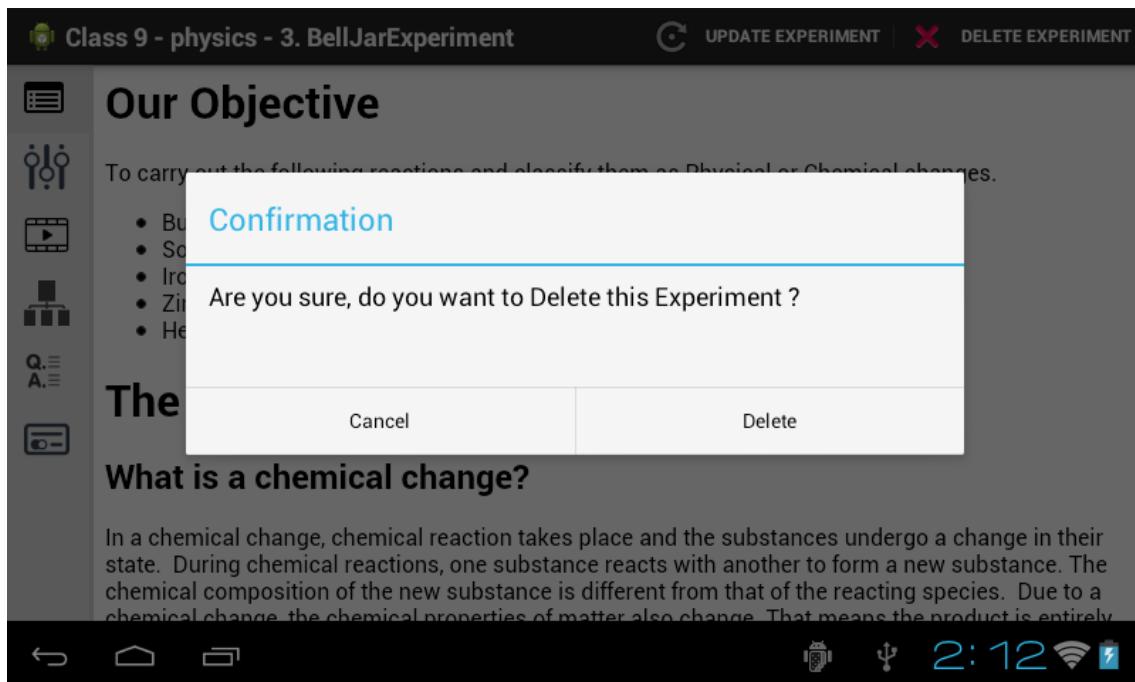


Figure 7.30: Confirm Delete Experiment

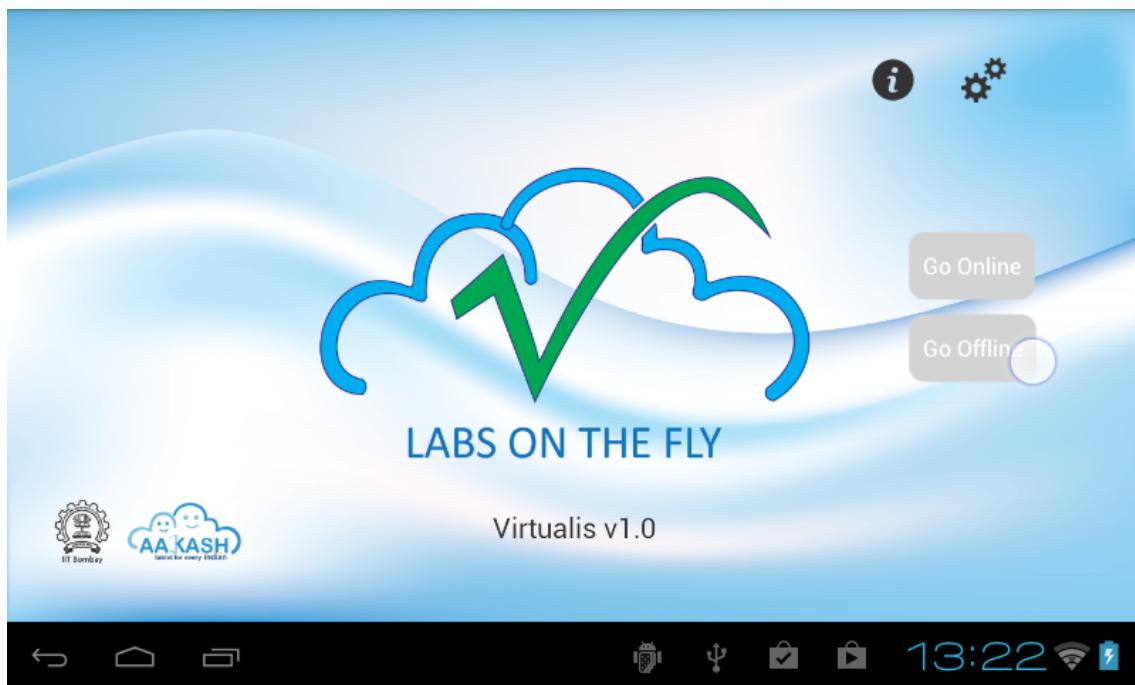


Figure 7.31: Go Offline Mode

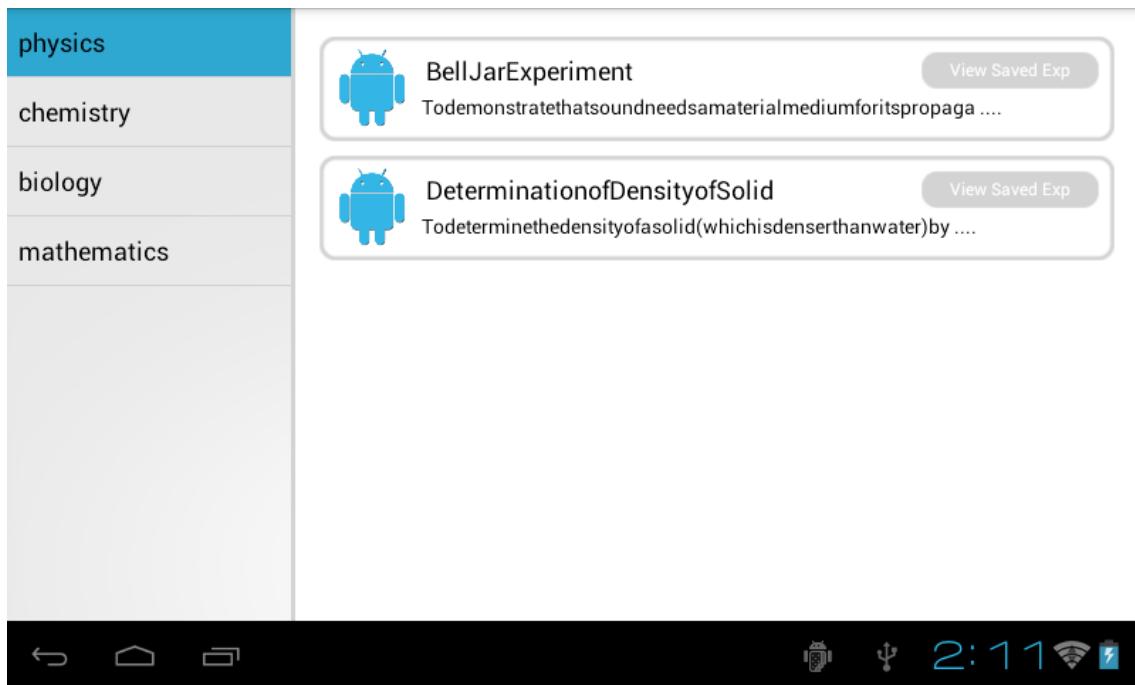


Figure 7.32: View Saved Exp - Online Offline Navigation

A screenshot of the app's content page. The title bar indicates "Class 9 - physics - 4. DeterminationofDensityofSolid" and shows an "OFFLINE MODE" status. On the left is a vertical toolbar with icons for file operations (New, Open, Save, etc.) and navigation (Back, Home, Recent). The main content starts with a section titled "Our Objective" which contains a list of tasks: "To carry out the following reactions and classify them as Physical or Chemical changes." followed by a bulleted list of reactions. Below this is a section titled "The Theory" with a sub-section titled "What is a chemical change?". The text explains that in a chemical change, substances undergo a change in their state due to a reaction, resulting in new substances with different properties. At the bottom is a black navigation bar with icons for back, home, and recent apps, along with the time "2:11" and signal strength indicators.

Figure 7.33: App in Offline View Mode

7.6 Simulation Flow View

There are 2 Modes in which the whole application can be used in :

- Play Mode
- Ghost Mode

Play Mode : The play mode has further 2 modes :

- Step Mode
- Continuous Mode

7.6.1 Continuous Mode :

Continuous Mode will play the whole experiment animation in one go whereas the Step Mode will play the experiment step by step for the user to understand it carefully.

7.6.2 Ghost Mode :

The Ghost mode is the mode in which the student performs the experiment along with a guide. The guiding images will be transparent and will show the student what the next move is supposed to be and the student will have to perform that move.

There is a correction mechanism also , i.e. If the student doesn't perform the right move the animation will not proceed forward and will wait till the student performs the right move with an error margin of 10%.

The modes in Ghost Mode are :

- Move Mode
- Scale/ Rotate Mode
- Delete Mode

7.6.2.1 Move Mode :

The student can select an object and perform a translational movement by simple drag and drop and the application will guide him and also correct him.

7.6.2.2 Scale/ Rotate Mode :

In the scale and rotate mode the student can scale and rotate the selected object and proceed with the experiment.

7.6.2.3 Delete Mode :

In the delete mode the student can delete the selected object from the screen.

7.6.2.4 Play Button

The play button performs a variety of functions

- If the application is in Continuous Mode It will play the whole animation/experiment in one go.
- If the application is in Step Mode It will play the experiment in step by step manner on every click
- If the application is in the Ghost Mode It will start the guided mode for the student to follow and perform the experiment.

7.6.2.5 Reset Button :

It resets the whole experiment/application to its default state and then one can start over. There is a confirmation popup for the reset button in case the student touched it unintentionally.

7.6.2.6 The GhostMode Toggle:

This toggle Button toggles the ghost Mode of the application.

7.6.2.7 The Cont/Step Mode Toggle:

This toggle button toggles the Step/Continuous Mode of the application

7.6.2.8 Mode Group :

This appears only when the ghost mode is selected and is used to switch between the different touch modes.

7.6.2.9 The scale and Rotate bar :

These bars appear only when the Scale/Rotate mode is selected.

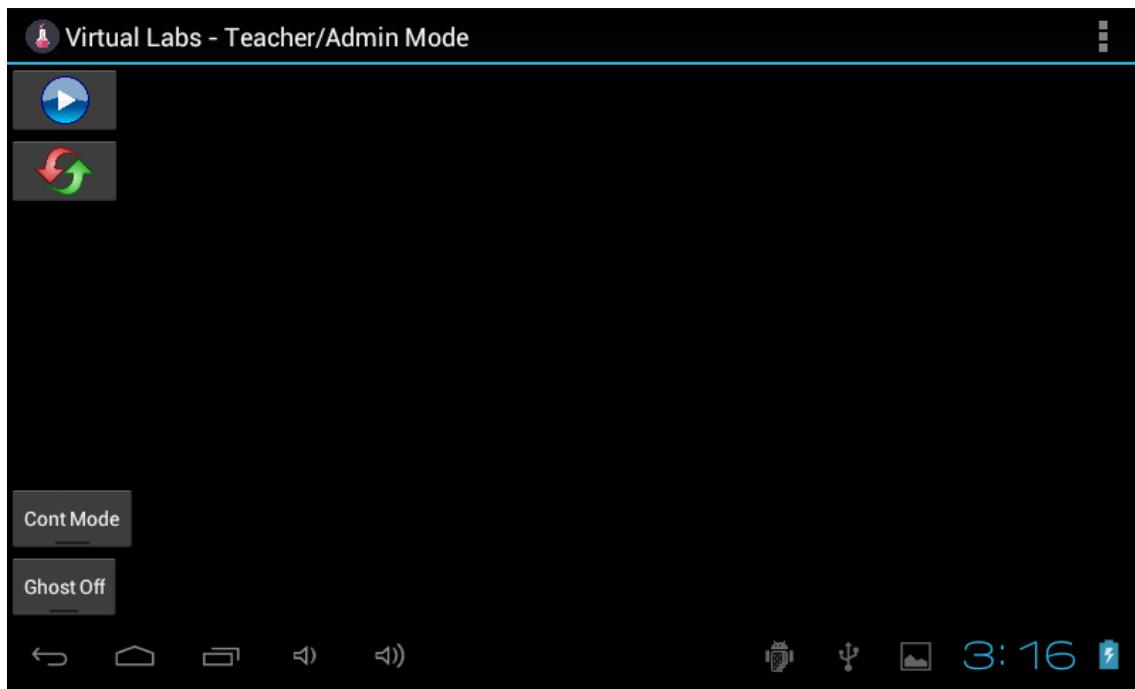


Figure 7.34: The starting screen of the simulation part of the Application.

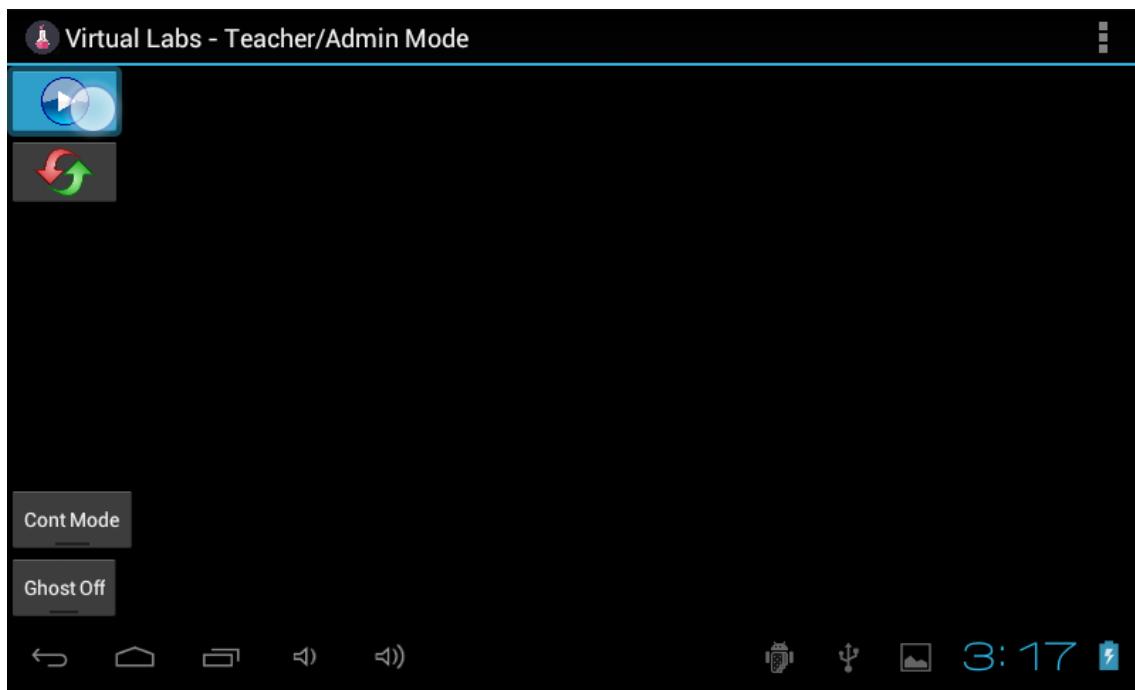


Figure 7.35: To play the whole animation click the following Play Button Note the Mode Button shows Cont Mode i.e. Continuous Mode

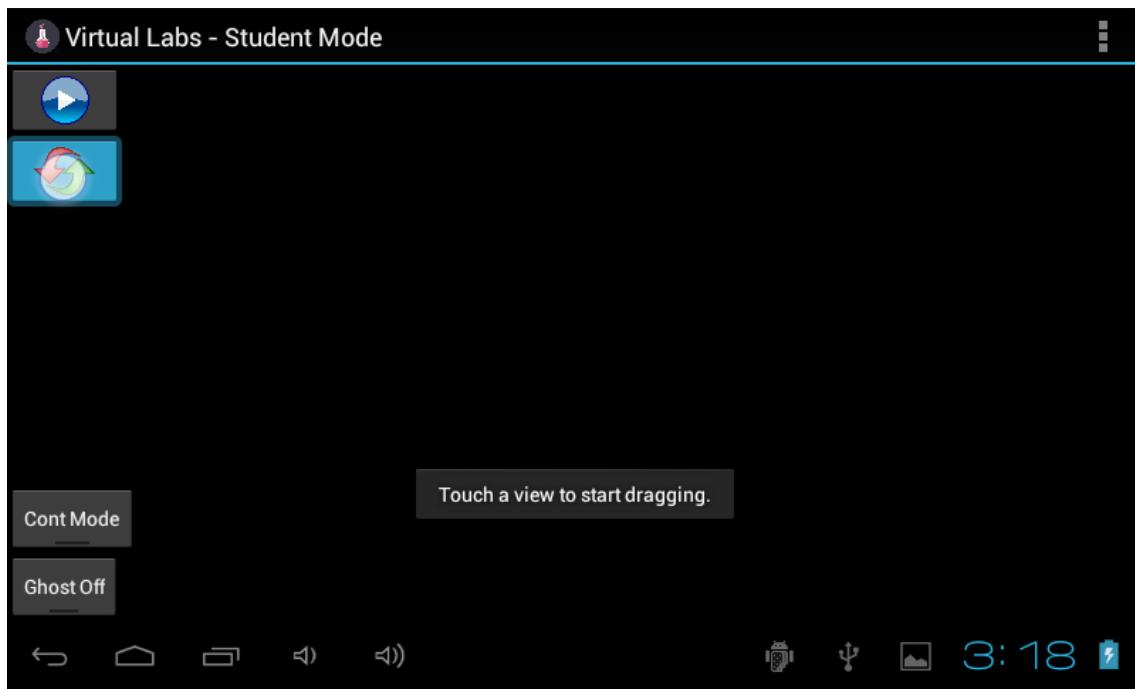


Figure 7.36: To reset the whole simulation/experiment Touch the Reset Button

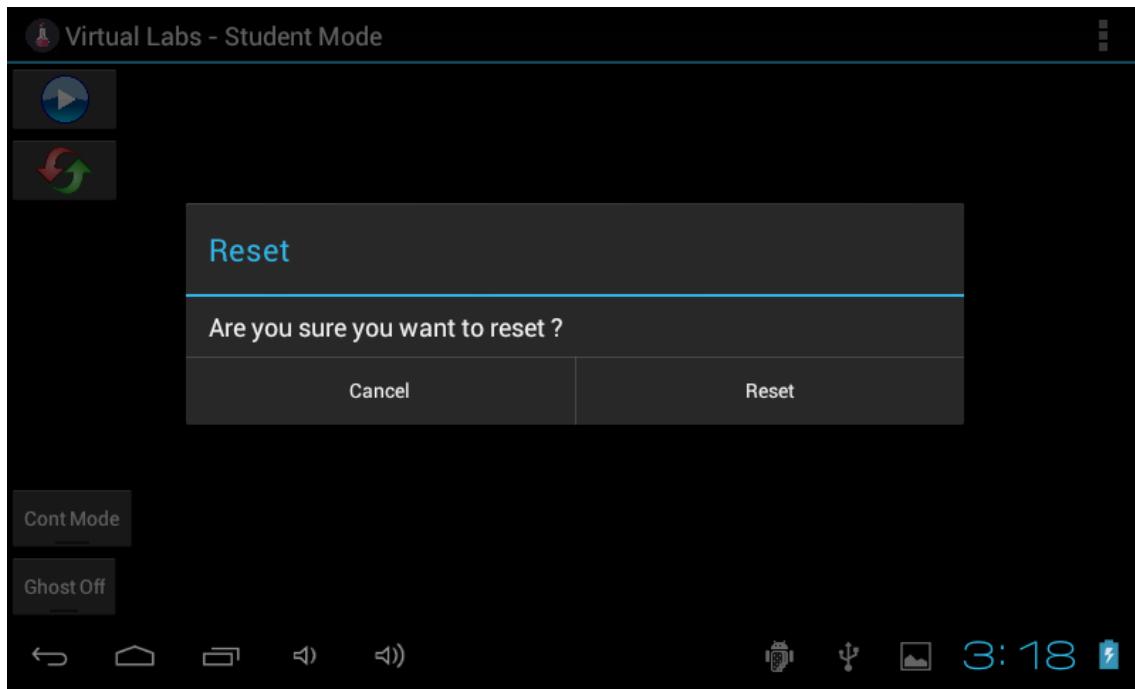


Figure 7.37: Confirmation Prompt for reset

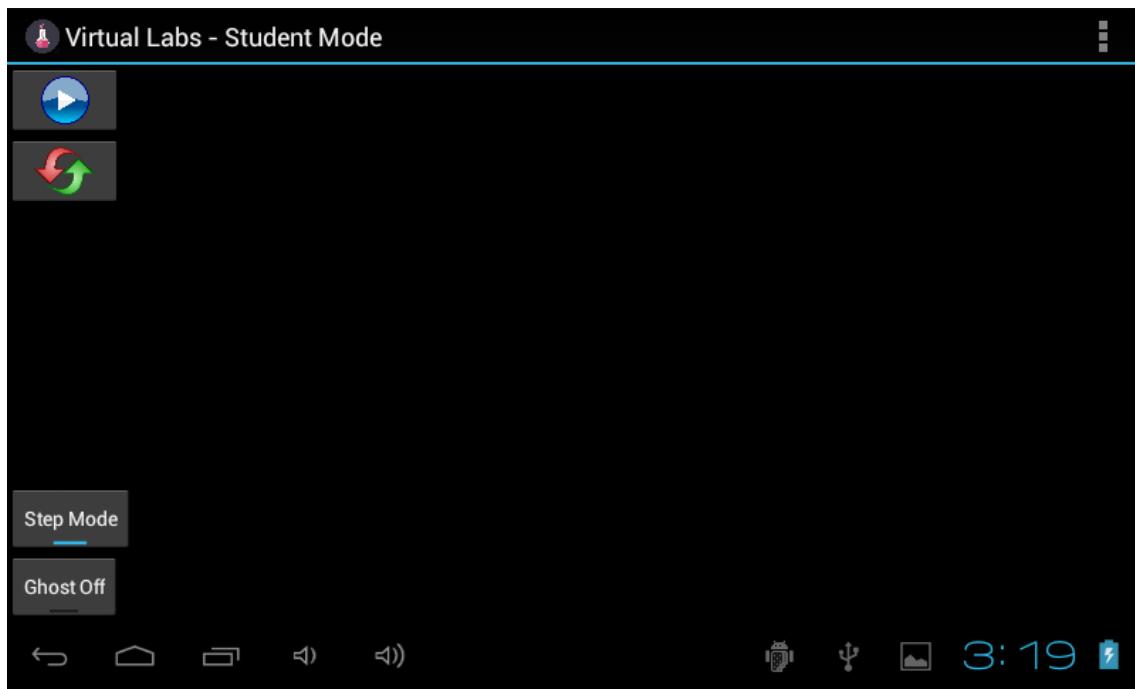


Figure 7.38: For changing the mode from Continuous to step Mode Touch the Cont Mode/Step Mode button

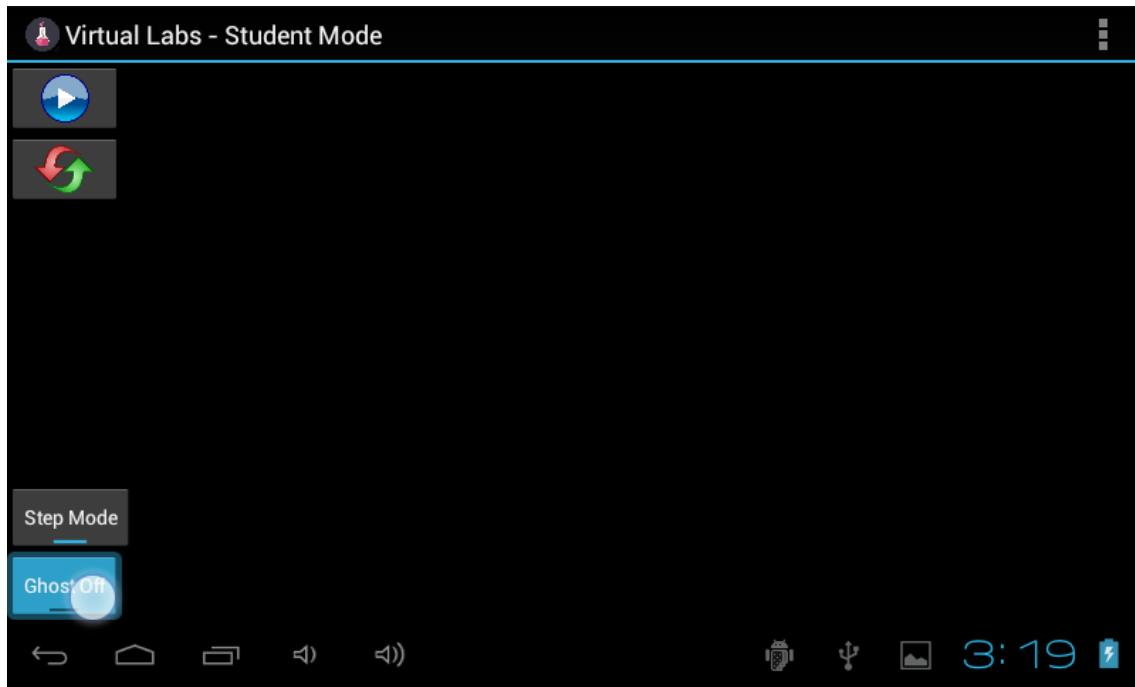


Figure 7.39: To go to the guided Simulation mode or Ghost Mode Select the Ghost Mode button

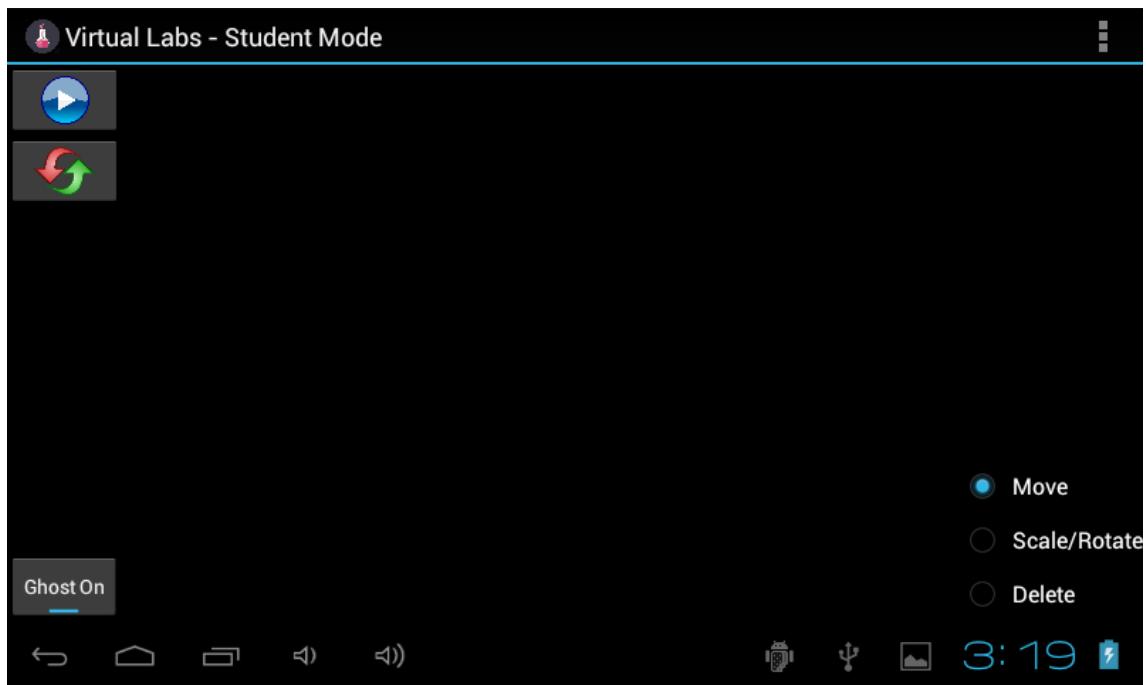


Figure 7.40: In the ghost mode the step mode/continuous mode button will be removed and the Move/Scale/Rotate.Delete Mode buttons will come up

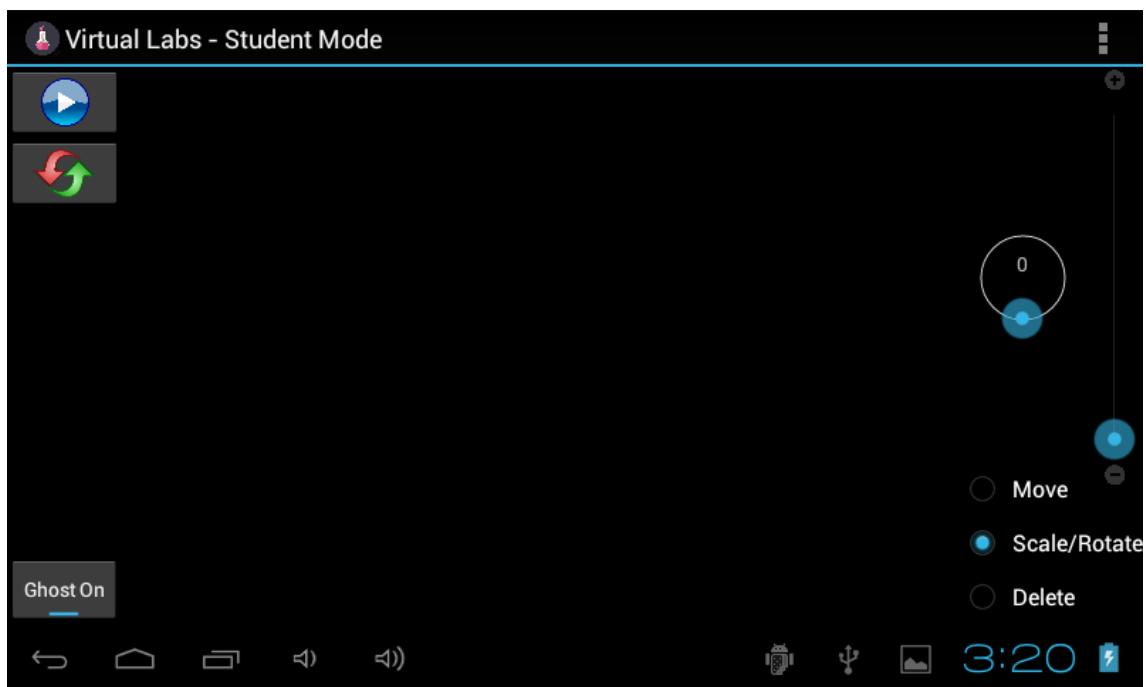


Figure 7.41: When selecting the Rotate/Scale Mode The rotate seekBar and Scale SeekBar will appear for rotation and scaling

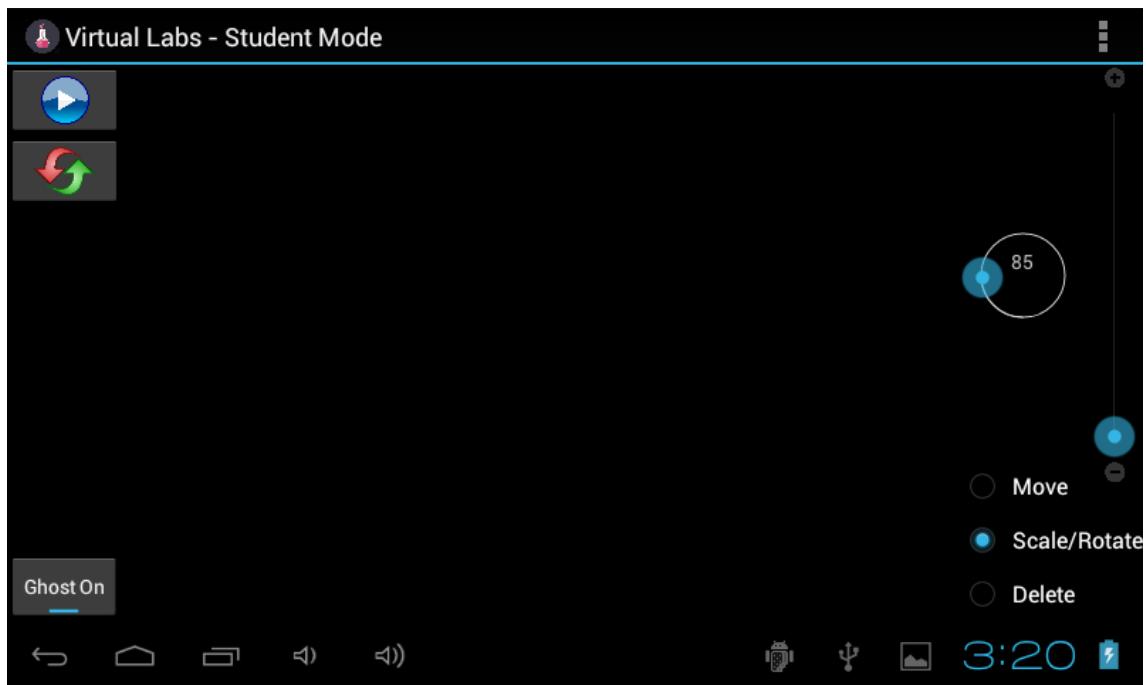


Figure 7.42: The text inside the Circular Rotate bar denotes the angle.

Chapter 8

User Manual - Web Portal

8.1 Introduction

The web interface is the one that providing many features like providing the interface for the contributors to upload the experiments, for the reviewers to review the experiment, for all users to view the experiment details and perform simulation and allow to play quiz. And also this site is acting like a backend to the android application, it is providing the all required content to the android application depending on its request. There are many functionalities in the site that are convenient for users to upload, view and approve experiment and for the student to study and theory, procedure and to view videos and to perform simulation and to play quiz. And there are also extra references.

Different functions that are provided in the web site.

- Uploading the experiment
- Viewing the experiment
- Contributor registration
- Reviewer registration
- Performing simulation
- Playing quiz
- Sending messages to admin
- Acting as backend for the android application

8.1.1 Uploading the experiment

This is an interface to upload entire experiment in one go. Here in this form we are providing the following fields to upload

- Enter experiment name(text field)
- Choose subject of the experiment(select field)
- Choose experiment class(select field)

- Small description about the experiment(text area)
- Upload Theory(summernote)
- Upload Procedure(summernote)
- Upload Video URL's(URL field)
- Enter URL for Simulation(URL field)
- Choose GIFT file for quiz.
- Upload Resources(summernote)
- Upload Icon for experiment(file field)

In Enter experiment name field he needs to upload name of the experiment.
 In Choose subject of the experiment field he has select the experiments subject.
 In Choose experiment class field he has to select the experiment class.
 In Small description about the experiment field contributor has to write small description about the experiments

Upload Theory field is field to upload theory of the experiment, this is basically a summernote where contributor can add content from his system or can copy and paste content form any webpage. All the images and tables are taken care by the summernote itself contributor has to just copy and paste his content into the summernote. Contributor can also design web page in summernote itself.

In Upload Procedure field is also summernote to upload procedure of the experiment.

Upload Video URL's field is a field which can generate dynamically to add more than one URLs. And contributor has upload you tube URLs only.

In Enter URL for Simulation field there are two parts one is URL for Blender simulation and another one is a link to generate guided simulation after performing guided simulation the CSV file will be generate the stores in the server.

Chose GIFT file for quiz is field where the contributor will be choosing GIFT file for the quiz. In Upload Resources field is the one where contributor can provide multiple references. Upload Icon for experiment field is a field to upload icon for the experiment and the icon has to be in PNG format only.

In this form we added two buttons for the video URL field to generate extra fields dynamically if the user wants to enter more URLs. He can click on '+' button to add one more URL field and can click '-' button to remove one URL field.

8.1.2 Viewing the experiment

This portal is for viewing the experiment. We will be displaying the list of experiments according to subject wise. Whenever the user chooses the experiment he/she will be directed to a web page where he can view the experiment details like theory, procedure, videos, can perform simulation, can play quiz, and can view additional references.

8.1.3 Contributor registration

This portal is the registration for contributor that is who will be uploading the experiments. In the contributor registration he/she has to provide the following details.

- Username
- Password
- First name
- Last name
- Email
- Contact
- Profile picture
- Specialized subject
- Validation document

Contributor has upload any validation document depending on that he will be give privileges to upload the experiment.

8.1.4 Reviewer registration

This portal is the registration for reviewer that is who will be reviewing the experiments and approves the experiment.

In the reviewer registration he/she has to provide the following details.

- Username
- Password
- First name
- Last name
- Email
- Contact
- Profile picture
- Specialized subject

The privileges for the reviewer will be given by the admin.

8.1.5 Performing simulation

This is an interface where contributor will perform the guided simulation whenever he is uploading the experiment.

There are different modes of in the simulation

- One is contributors mode
- Another one is student mode

8.1.5.1 One is contributor's mode

There are different functionalities like

- Selecting apparatus
- Moving the apparatus
- Zooming the apparatus
- Rotating the apparatus
- Deleting the apparatus
- Replacing the apparatus
- Adding tag text to apparatus
- Moving tag text
- Drawing lines

There are two modes of playing and verifying the simulation

- Continuous mode of simulation
- Step simulation

8.1.5.2 Student mode

In the Student Mode of Simulation, student can view the guided simulation performed by the teacher all at a time or step wise or ghost mode

- Viewing continuous mode of simulation
- Viewing step simulation
- The simulation ghost mode - Ghost mode is the one in which simulation will be performed in ghost mode and waits for the student to perform that step. If student make any mistakes it does allow him/her to go to next step.

8.1.6 Playing Quiz

This is a functionality that allows the students to play the quiz and evaluate themselves. This quiz will be generated from the GIFT file that is uploaded by the contributor. There are 7 different formats of questions that can be provided in the GIFT file. They are -

- True or False
- Multiple Choice
- Multiple Choice with many Answers
- Numeric Answers
- Missing word
- Matching
- Short Answer

8.1.6.1 Quiz Evaluation

The Student's Answers are evaluated based on the Answers given in gift file. Gift file includes the weightage and feedback for options and answers. In Numeric Answer Question it also have the precision part to have correct Answers in limited range.

8.1.6.2 Summary of quiz

Summary of the quiz question wise and also total quiz summary will be displayed.

8.1.7 Sending messages to admin

Everybody like student, contributor and reviewer can send messages to the admin using contact us. Admin will be replaying them after solving their problems.

8.1.8 Key Notes about Web Portal

It acts as backend for the android application. Site acts as a backend for the android application. There are some server side scripts that will be running in the server to generate responses to android application.

Whenever user chooses some subject or experiment it sends request to the server script which generates JSON in the server. Android will be retrieving the JSON again from the server. Basically JSON contains the URLs that are stored in the data base.

8.2 Flow View of Web Portal

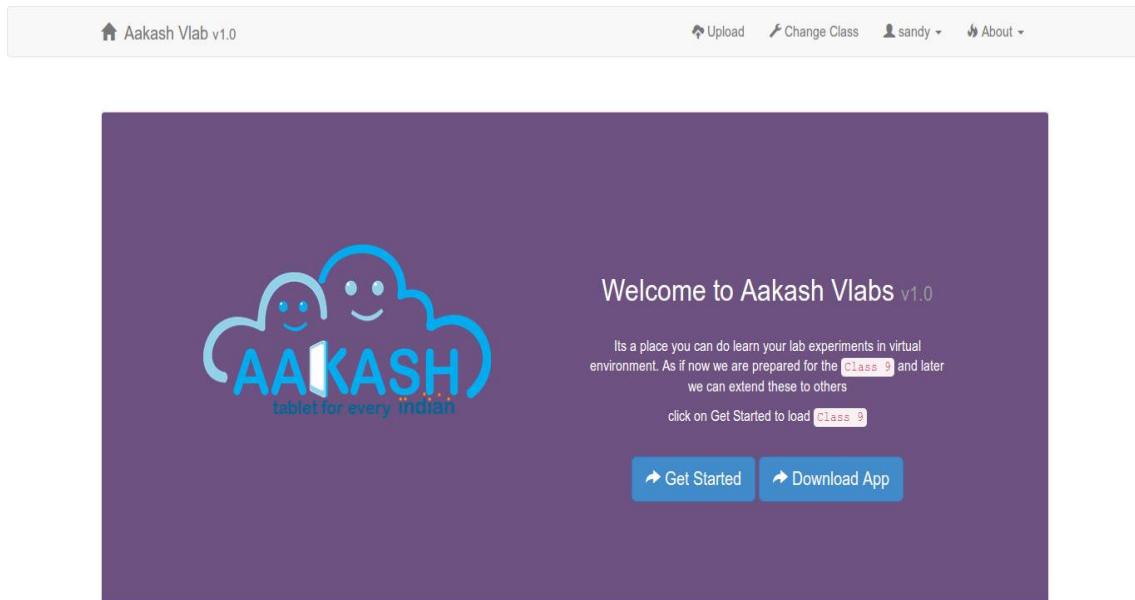


Figure 8.1: Web Portal View

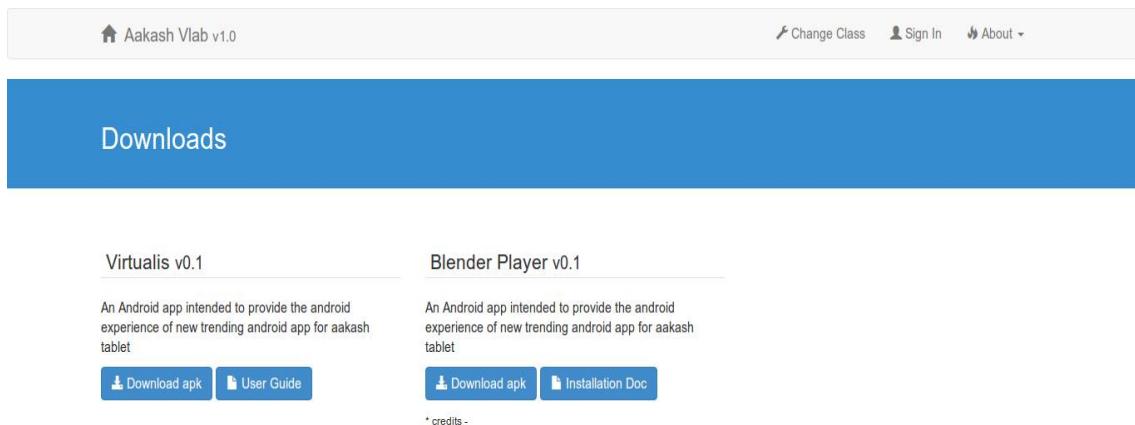


Figure 8.2: Downloads Page

Aakash VLab v1.0

Upload Change Class sandy About

Experiments Details

See Your Uploads

Info

Class 9 Subjects 4

Subjects

Physics 1 Chemistry 0 Biology 0 Maths 0

Aakash VLab's for school children

About VLab's

To perform hands-on experiments of science is a vital need for learning science. Due to lack of facilities students are unable to perform experiments. Aakash based virtual science lab will provide a platform for students to do the same with the help of a virtual Lab environment .

Aakash Vlabs can reach to students in two ways

1. Aakash based Android application
2. General Web based application

The application provides a complete background for an experiment such as theory, procedure , video ,quiz and most importantly an interactive simulation of the experiment . Student can perform the experiment by following steps included in procedure part or by watching the video provided. After completing the experiment the student can attempt the quiz regarding the experiment and can also refer the complete reference of the experiment by choosing resources.

Figure 8.3: Student Experiments View

Aakash VLab v1.0

Upload Change Class sandy About

Experiments Details

See Your Uploads

Info

Class 9 Subjects 4

Subjects

Physics 4 Chemistry 1 Biology 0 Maths 0

physics

List of Experiments:

 test1 des

 Force required to move a wooden block
To establish relationship between weight of a rectangular wooden block lying on a horizontal table and the minimum force required to just move it using a spring balance.

 Verification of Newtons Second Law
Newtons Second Law of motion states that the rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of the force.

Figure 8.4: All Experiments

Aakash Vlab v1.0

Upload Change Class sandy About

Info	
Class	9
Subjects	4
Experiment	10

Subjects	
Physics	4
Chemistry	1
Biology	0
Maths	0

Bell Jar Experiment

Go Back

Theory

Videos

Simulation

Quiz

Resources

The Theory

What is sound?

Sound is a mechanical wave that needs a material medium like air, water, steel, etc., for its propagation. We can describe a sound wave by its frequency, wavelength and velocity. The sound wave is a longitudinal wave, i.e., the particles of the medium vibrate in a direction parallel to the direction of the propagation of the wave.

A sound wave needs a medium to travel

A sound wave travels in the form of a longitudinal wave and it requires a material medium for its propagation. Sound always originates from some vibrating body. These vibrations are produced by tuning forks, drums, bells, the strings of a guitar, etc.

Human voice originates from the vibrations of the vocal chords and the sound from the musical instruments is due to the vibrations of the air columns. In some cases, the vibrating frequency of the source may be so very small or so very large that it is not audible to the human ear. The audible frequency ranges from 20 Hz to 20 kHz. The frequency below 20 Hz is called infrasonic and the frequency above 20 kHz is called ultrasonic.

The bell jar experiment is a common experiment used to demonstrate that sound needs a medium to travel.

Figure 8.5: Experiment Theory

Aakash Vlab v1.0

Upload Change Class sandy About

Info	
Class	9
Subjects	4
Experiment	10

Subjects	
Physics	4
Chemistry	1
Biology	0
Maths	0

Bell Jar Experiment

Go Back

Theory

Videos

Simulation

Quiz

Resources

Materials Required:



Air tight glass bell jar



Electric bell



Cork



Key



Vacuum pump



Battery



Connecting wires

The Procedure

Figure 8.6: Experiment Procedure

Aakash Vlab v1.0

Upload Change Class sandy About

Info

Class 9 Subjects 4 Experiment 10

Subjects

Physics 4 Chemistry 1 Biology 0 Maths 0

Bell Jar Experiment

Go Back Theory Procedure Videos Simulation Quiz Resources

robot insect

0:00 / 1:34 YouTube

Figure 8.7: Experiment Videos

Aakash Vlab v1.0

Upload Change Class sandy About

Info

Class 9 Subjects 4 Experiment 10

Subjects

Physics 1 Chemistry 0 Biology 0 Maths 0

test1

Go Back Theory Procedure Videos Simulation Quiz Resources

Click to view Blender Simulation Click to do guided Simulation

Figure 8.8: Experiment Simulations

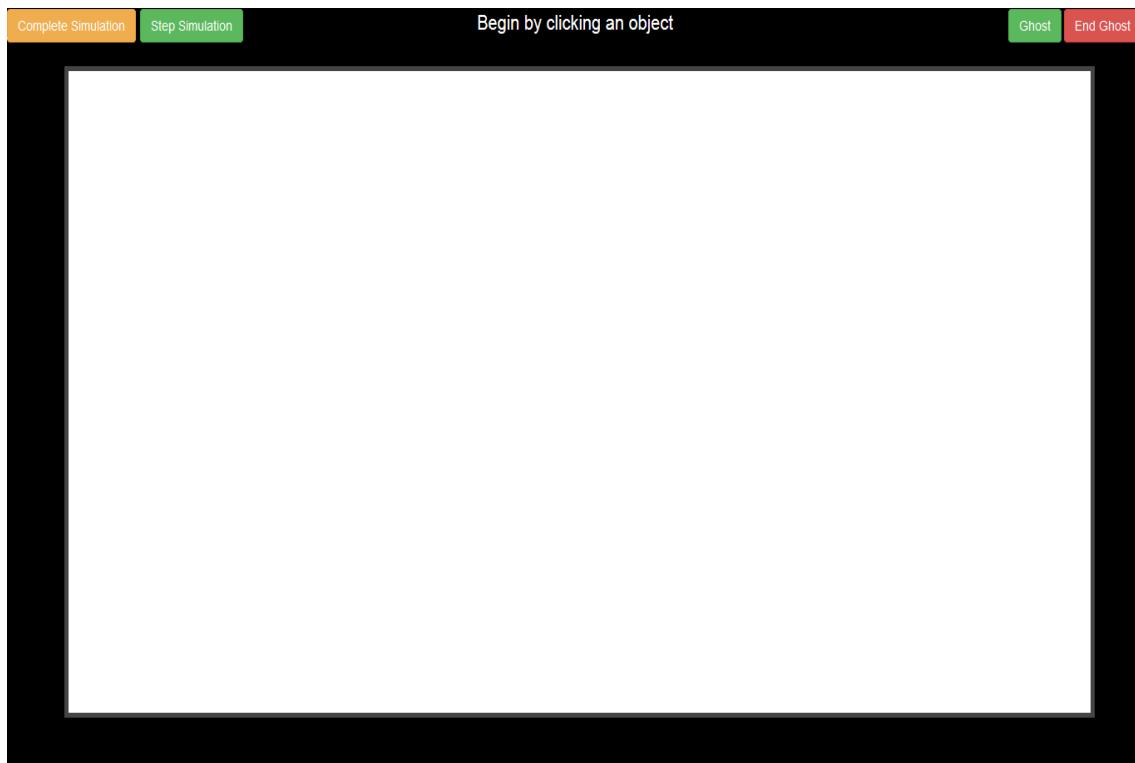


Figure 8.9: Guided Simulation - Student Start

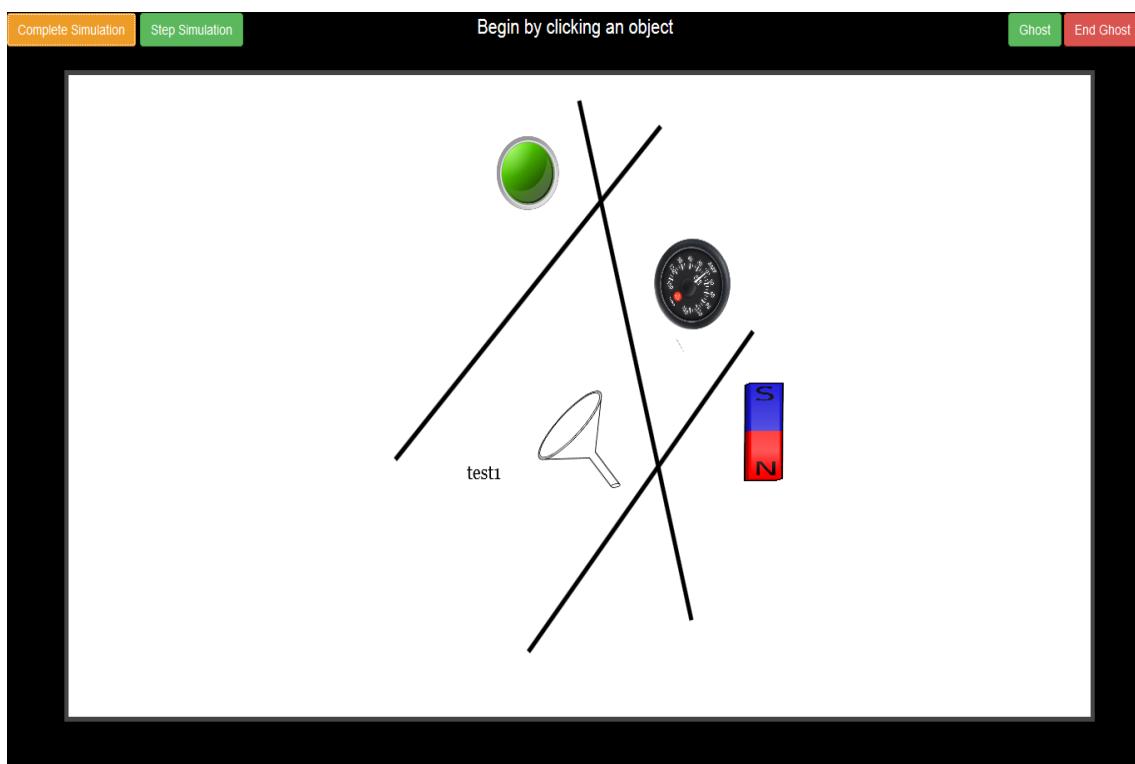


Figure 8.10: Guided Simulation-completed

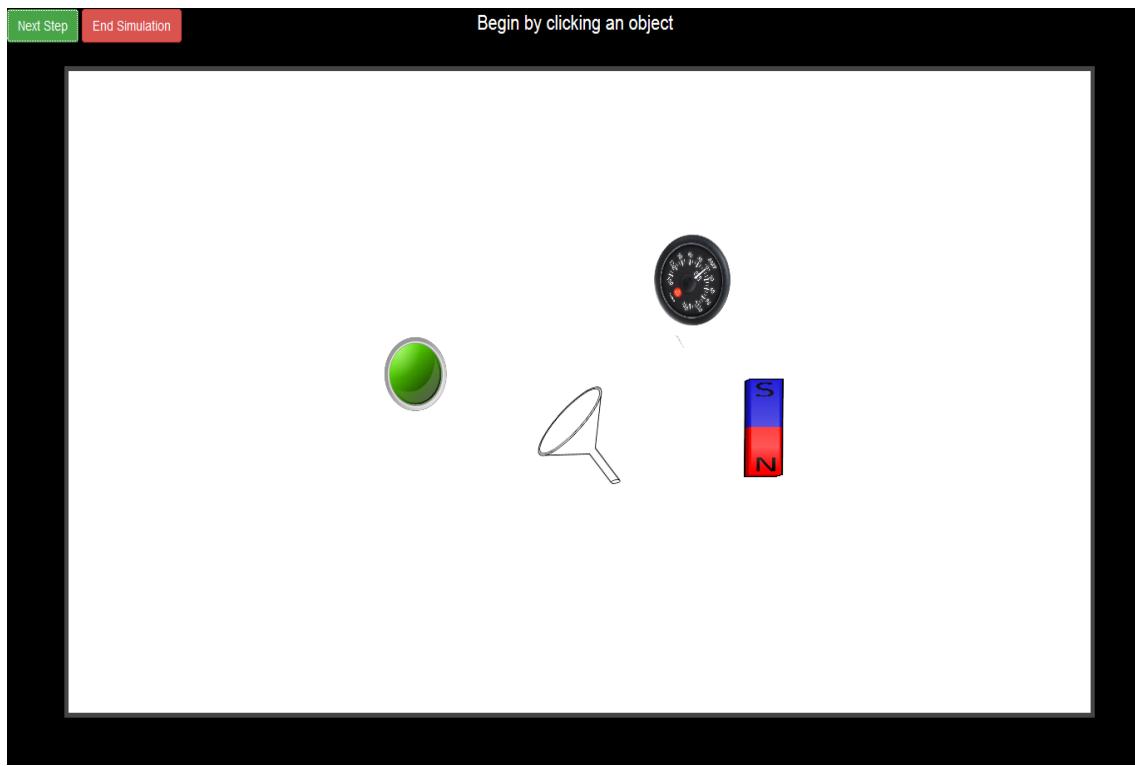


Figure 8.11: Guided Simulation Step Simulation

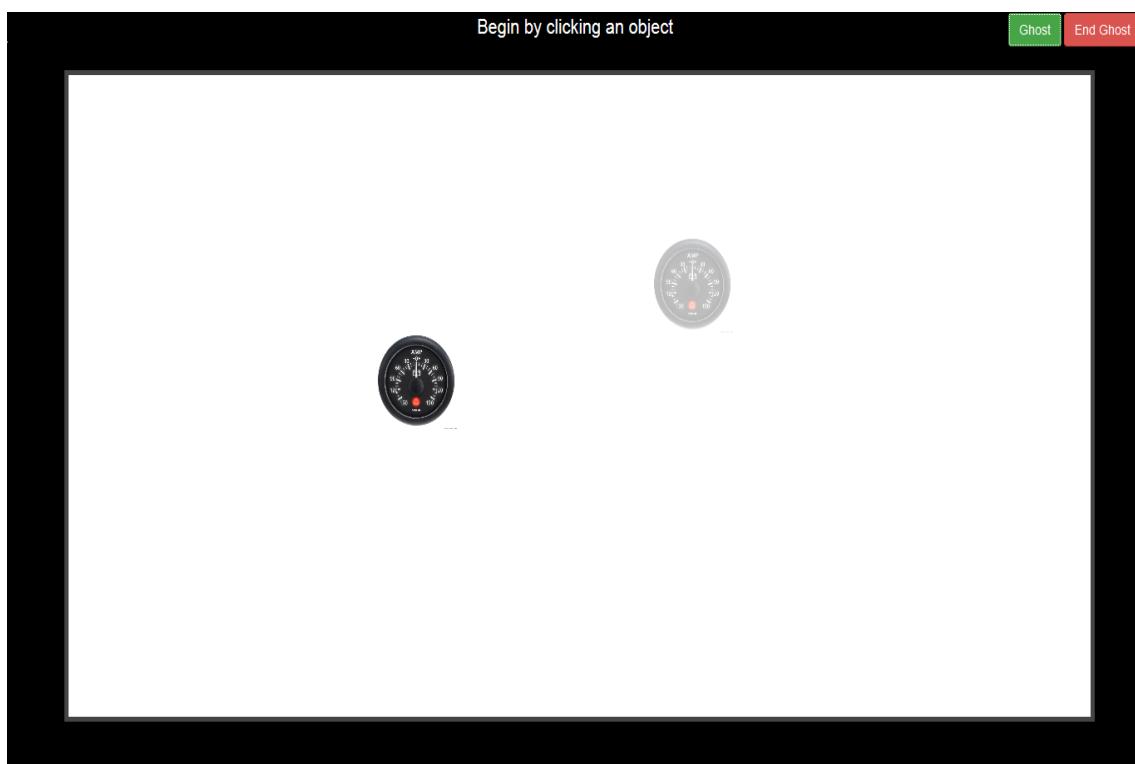


Figure 8.12: Guided Simulation Ghost Mode

Aakash Vlab v1.0

Upload Change Class sandy About

Info	
Class	9
Subjects	4
Experiment	10

Subjects	
★ Physics	4
Chemistry	1
Biology	0
Maths	0

test1

Go Back

Theory

Procedure

Videos

Simulation

Quiz

Resources

1. Who's buried in Grant's tomb?

- Grant
- Jefferson
- no one

2. Grant is _____ in Grant's tomb.

- buried
- entombed
- living

3. Grant is buried in Grant's tomb.

- True
- False

4. Who's buried in Grant's tomb?

Figure 8.13: Experiment Quiz Questions

Aakash Vlab v1.0

Upload Change Class sandy About

Info	
Class	9
Subjects	4
Experiment	10

Subjects	
★ Physics	4
Chemistry	1
Biology	0
Maths	0

test1

Go Back

Theory

Procedure

Videos

Simulation

Quiz

Resources

Questions and Answers

Question 1 » Correct

1 pt

Who's buried in Grant's tomb?

Correct Answers:

Your Answers:

no one

Feedback:

#No feed back is provided.

Question 2 » Correct

1 pt

Grant is _____ in Grant's tomb.

Correct Answers:

Your Answers:

entombed

Feedback:

#No feed back is provided.

Figure 8.14: Experiment Quiz Summary

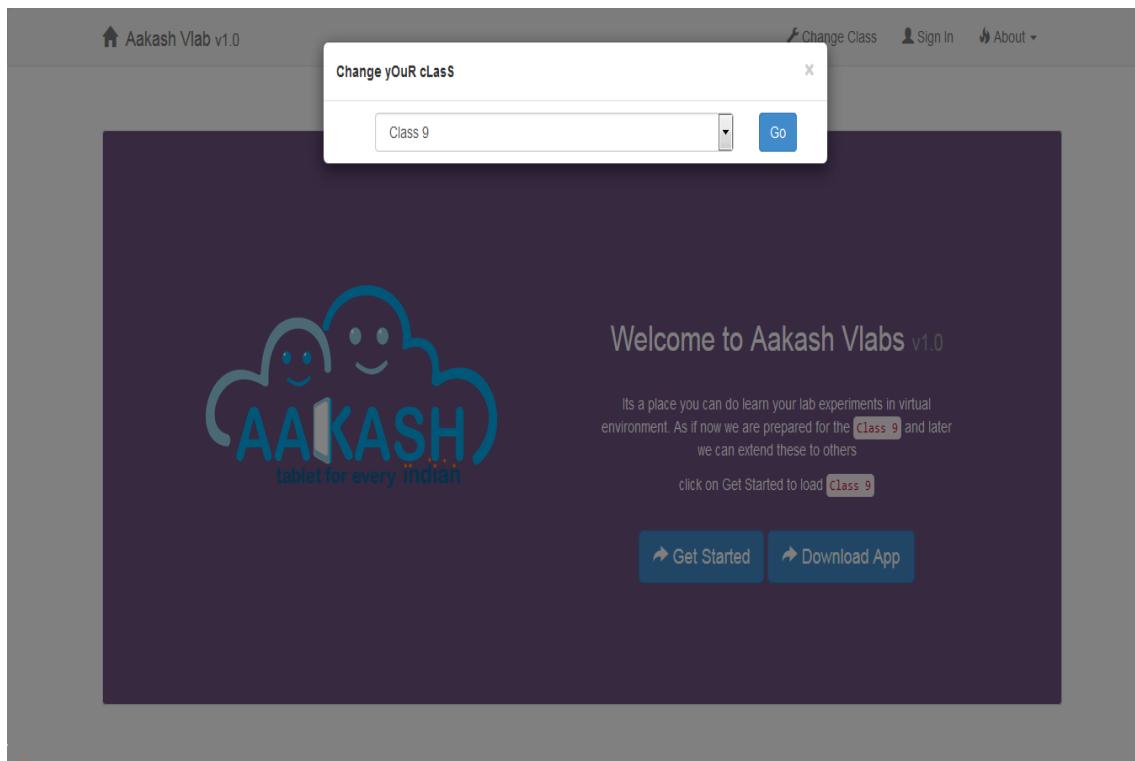


Figure 8.15: Student Change Class

A screenshot of the "Contact us" page on the Aakash Vlab v1.0 website. The header includes the Aakash Vlab v1.0 logo and navigation links for change class, sign in, and about. The main section has a blue header bar with the text "Contact us Feel free to contact us". Below this, there is a form with fields for Name (text input), Email Address (text input with placeholder "Enter email"), and Subject (dropdown menu with placeholder "Choose One"). To the right of the form is a "Message" area with a text input field. On the far right, there is a sidebar titled "Our office" containing the address of Aakash Lab at IIT Bombay, Mumbai, and contact information: phone number (+91) (022) 25764708 and email aakashtechsupport@cse.iitb.ac.in. A "Send Message" button is located at the bottom of the form.

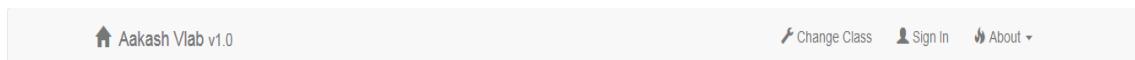
Figure 8.16: Contact Us

The screenshot shows a web application interface. At the top, there is a header bar with the logo 'Aakash Vlab v1.0' and navigation links for 'Change Class', 'Sign In', and 'About'. Below the header is a blue banner with the text 'FAQs Feel free to ask question'. Underneath the banner, there are two tabs: 'About Uploads' and 'About Registration'. A modal window titled 'FAQ Item Category 1' is open, displaying placeholder text about food trucks and wolf moon. Below this, another panel titled 'FAQ Item Category 1' is shown with a '+' button to expand it.

Figure 8.17: FAQ Page

The screenshot shows a registration form titled 'Contributor Registration: (Reviewer registration)'. The form consists of several text input fields: 'Username' (placeholder 'Username...'), 'Password' (placeholder 'Password...'), 'Firstname' (placeholder 'Firstname...'), 'Lastname' (placeholder 'Lastname...'), 'Email' (placeholder 'Email...'), and 'Contact' (placeholder 'Contact...'). Each field has a corresponding label to its left.

Figure 8.18: Contributer Restration



Reviewer Registration:(Contributor registration)

Username:

Password:

Firstname:

Lastname:

Email:

Contact:

Figure 8.19: Reviewer Registration

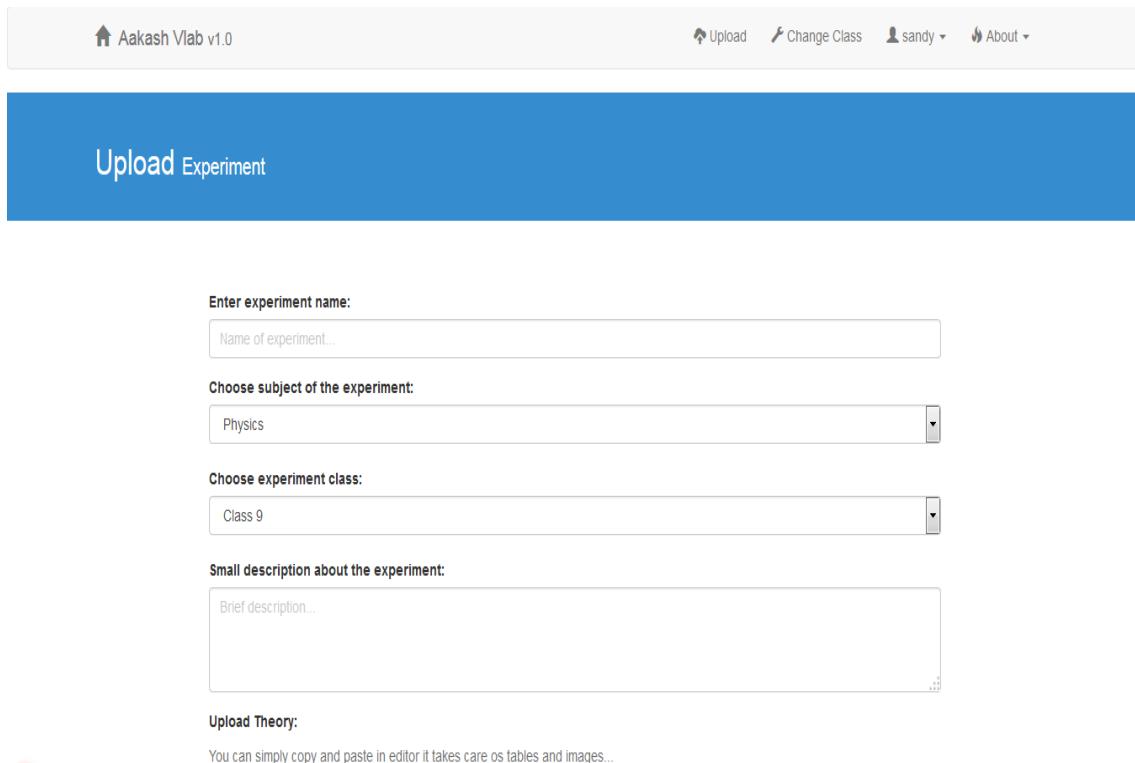
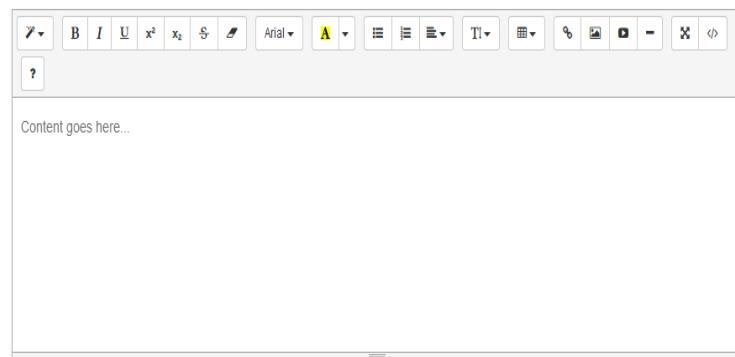


Figure 8.20: Upload Experiment

Upload Procedure:

You can simply copy and paste in editor it takes care of tables and images...



Upload Video URL's:

Enter url...



Enter youtube url for videos...

Enter url for Blender file:

Enter url...

Perform guided simulation and upload:

[Click here](#)

Figure 8.21: Upload Experiment - Summernote Text Editor

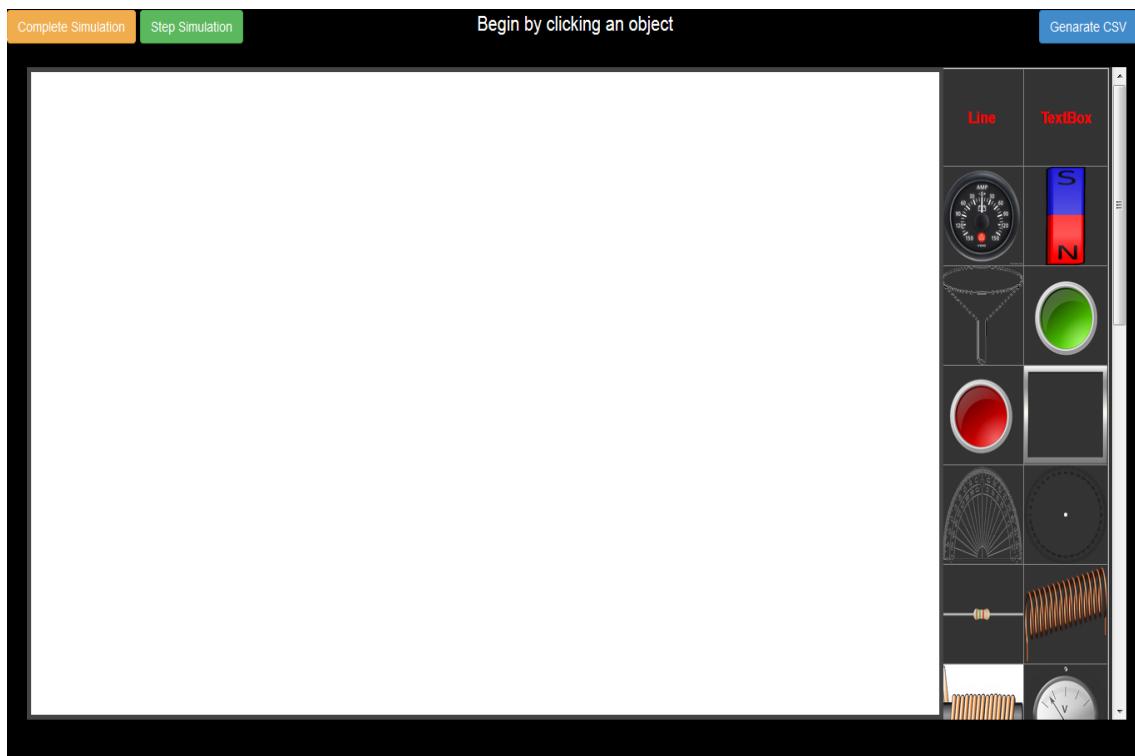


Figure 8.22: Contributor Simulation 1

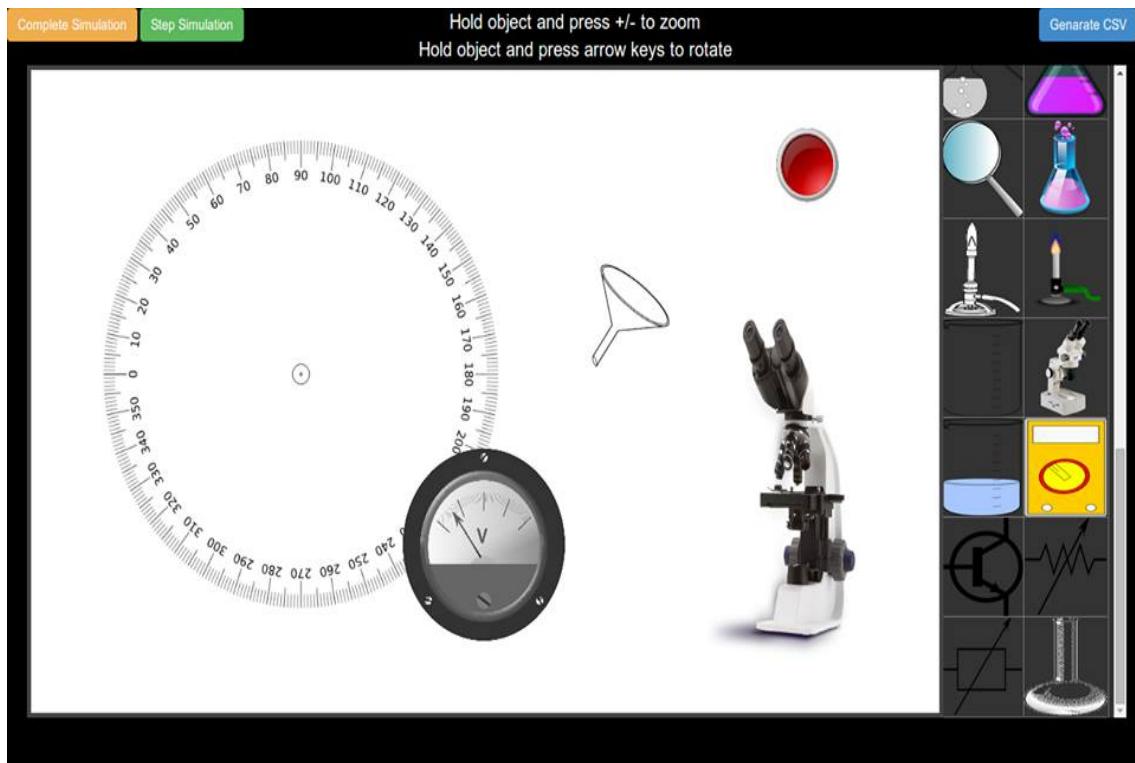


Figure 8.23: Contributer Simulation 2

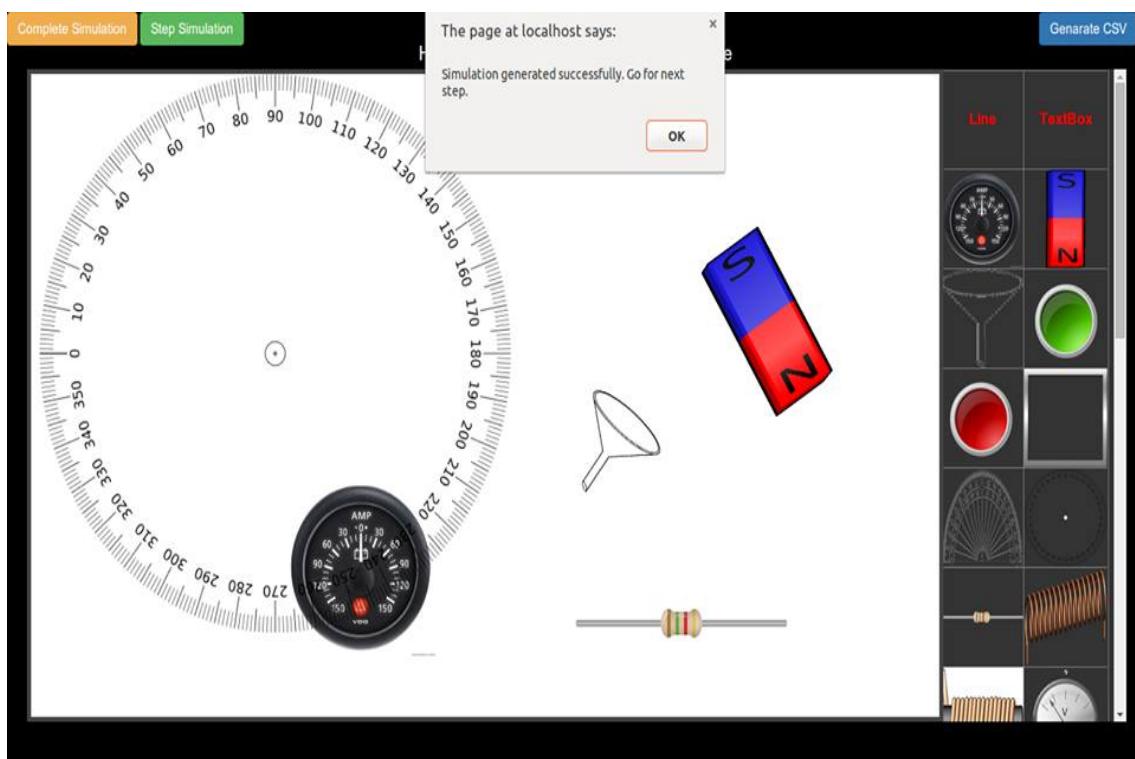


Figure 8.24: Contributer Simulation CSV File Generation

Chapter 9

Conclusion

The application aims to develop an Interactive platform for students through which they can learn, understand, practice and evaluate themselves. It provides flexibility of studying anytime, anywhere, and at one's own pace. The project consists of a Web portal and an application named Virtualis which also works as an aid in teaching. The Web portal and the application together provide a learning environment through which teachers can upload experiments and students can learn, understand and practice through Virtual Simulations and Videos and also evaluate themselves through quizzes.

Although we have been successful in implementing our desired aim of the project functionalities, there is always a future maintenance possible in order to overcome the limitations in the current system.

9.1 Future Enhancement

- Extending the Laboratory to the higher level Educations like Engineering.
- Improving Application to perform experiment by speech recognition.
- Improving simulation to get automated result depends on the procedural steps
- Embedding of content in various Indian Regional Languages.

Chapter 10

References

10.1 Web References

- Android Developer Website, <http://developer.android.com/>
- Android Tutorial Website, <http://en.wikipedia.org/wiki/Android>
- w3School Javascript <http://www.w3schools.com/js/DEFAULT.asp>
- jSon <http://json.org/>
- Stack Overflow <http://stackoverflow.com/>
- Eclipse <http://www.eclipse.org/>
- ADT <http://developer.android.com/tools/sdk/eclipse-adt.html>