

Project I

"Novel Solution For Pharmacodynamics"

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Engineering

by

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CERTIFICATE



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This is to certify that the project entitled *Novel Solution for Pharmacodynamics* is a bonafide work of **Honnutagai Iqrazuddin Abdul Razak Mumtaz Begum** (Roll No. : 13CO71), **Tanaji Fauzan Nisar Kulsum** (Roll No. : 13CO65) **Shaikh Farooq Yasin Khatoun Bi** (Roll No. : 11CO39) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **Bachelor of Engineering in Department of Computer Engineering.**

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Project I Approval for Bachelor of Engineering

This project entitled *Novel Solution for Pharmacodynamics* by *Honnutagai Iqrazuddin Abdul Razak Mumtaz Begum , Tanaji Fauzan Nisar Kulsum* and *Shaikh Farooq Yasin Khatoon Bi* is approved for the degree of *Bachelor of Engineering in Department of Computer Engineering*.

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Declaration

I 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.

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Abstract

Title: Novel Solution for Pharmacodynamics.

The proposed system will be a computer software which is used for pharmacodynamics. The software will be developed by using and Microsoft Visual Studio and some kinds of simulation software. Pharmacodynamics is actually a mechanism of drug action. Pharmacodynamics is nothing but the experiments which are performed on living things like animals to show out the effects of certain medicines or chemicals or drugs. Pharmacodynamics is often summarized as the study of what a drug does to the body, whereas pharmacokinetics is the study of what the body does to a drug. The experiments has to perform on living things like on animal's body , nowadays the different pharma experiments like effects of given drugs on animal's bodies are banned. So we need an alternate to perform this kind of experiments which look like and real environment. The solution for this problem will be a software which do the experiments on animal bodies rather than to perform it on actual body of an animal. The software will do the experiments on simulated body of an animal. It is something like applying a drug on simulated body and see the changes on it and according to the result you can change the dose of drug.

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Keywords And Glossary

Keywords :

Anticonvulsant, Actophotometer, Anticatatonic, Ciliary, Diazepam, Drug, Learning tools, Phenothiazine, MAYA, Morphine, Oxytocin, PCI, Pharmacodynamics, Pharmacology, Pharmacokinetic, Simulator, Simulation, System architecture.

Glossary :

A:

Anticonvulsant : Used to prevent or reduce the severity of epileptic fits or other convulsions.

Actophotometer : Actophotometer consists of six built in photo sensors and 4 digit digital counters to indicate the locomotor activity. Digital actophotometer measures the spontaneous and indicated activity with digital totalizer. Digital actophotometer also incorporates electric shock of up to 100 volts for activating rats. The stimulus is variable from 0 to 100v indicating on meter.

Anticatatonic : Countering catatonia or not comparable.

C:

Ciliary : The ciliary muscle is a ring of smooth muscle in the eye's middle layer (vascular layer) that controls accommodation for viewing objects at varying distances and regulates the flow of aqueous humour into Schlemm's canal. It changes the shape of the lens within the eye, not the size of the pupil which is carried out by the sphincter pupillae muscle and dilator pupillae.

D:

Diazepam : A tranquillizing muscle-relaxant drug used chiefly to relieve anxiety.

Drug : A drug is, in the broadest of terms, a chemical substance that has known biological effects on humans or other animals. Foods are generally excluded from this definition, in spite of their physiological effects on animal species.

L:

Learning tools : A learning tool is any software or online tool or service that can be used for your own personal learning or for teaching or training.

M:

MAYA : 3D animation and modeling software.

Morphine : An analgesic and narcotic drug obtained from opium and used medicinally to relieve pain and feeling of pain.

O:

Oxytocin : Oxytocin is a nonapeptide hormone in mammals. It is also available as a medication. Oxytocin is normally produced in the hypothalamus and stored in the posterior pituitary gland.

P:

PCI : Pharmacy Council of India.

Pharmacodynamics : Pharmacodynamics is the study of the biochemical and physiological effects of drugs on the body or on microorganisms or parasites within or on the body and the mechanisms of drug action and the relationship between drug concentration and effect.

Pharmacology : Pharmacology (from Greek , pharmakon, "poison" in classic Greek; "drug" in modern Greek; and -, -logia "study of", "knowledge of") is the branch of medicine and biology concerned with the study of drug action.

Pharmacokinetics : Pharmacokinetics, sometimes abbreviated as PK (from Ancient Greek pharmakon "drug" and kinetikos "moving, putting in motion"; see chemical kinetics), is a branch of pharmacology dedicated to determining the fate of substances administered externally to a living organism.

S:

Simulation : Simulation is the imitation of the operation of a real-world process or system over time.

Simulator : The device which has an ability to simulate.

System architecture : A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.

Chapter 1

Introduction

1.1 Novel Solution for Pharmacodynamics

Animal simulation software are human education aids and teaching approaches that can replace harmful animal use and typically used to meet the existing teaching objectives and to provide outcomes that cannot be met through animal experiments. The Pharmacy Council of India (PCI) prescribes the theory and practical curriculum for all pharmacy subjects in undergraduate pharmacy course in various universities in India[2].

Pharmacology is branch of science that deals with the study of drugs, is taught for 24 months in B.Pharmacy during third and fourth year and is also taught for Pharm D course in second and third year. Previously animal experiments are taught to students in practical class and they have to perform these animal experiments to get hands on experience[8]. Students are also evaluated in practical examination at the end of the year and those who fail to clear examination are not promoted. Currently, all the animal experiments in pharmacology subject for B.Pharm and Pharm D are need to be replaced by animal simulation software.

In 2008, the practical curriculum prescribed by PCI, India for Pharm.D in Pharmacology subject includes more than 10 experiment and in 1970s, for D.Pharm and B.Pharm includes more than 20 experiments were taught to pharmacy students using smaller animals such as frog, mouse, rat, rabbit and guinea pig and larger animal such as dogs were used for M.Pharm students having specialization in Pharmacology[1].

1.1.1 Project Architecture

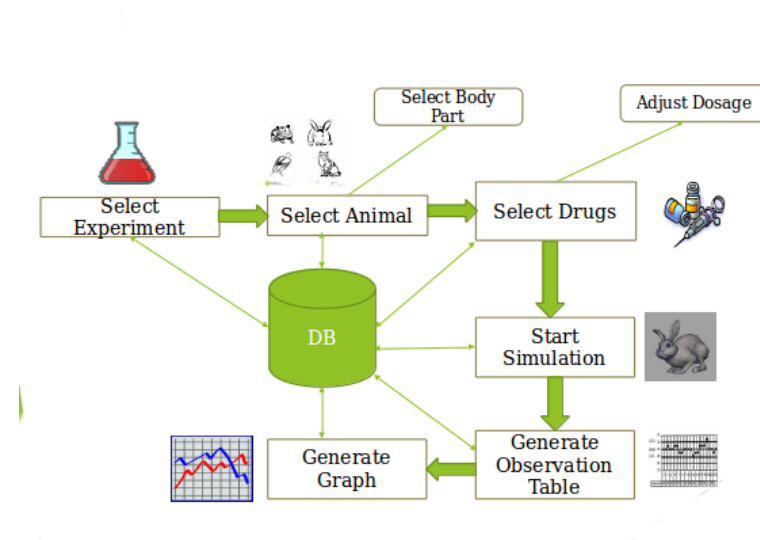


Figure 1.1: System Architecture

The proposed system architecture contains different modules. The flow of the system architecture starts from selecting the experiment. After selecting the experiment we've to choose on which animal we've to perform the experiment. After selecting the animal, how much dosage of drugs we have to inject on a particular animal's body or part. After all this process the animal reacts and changes its behaviour. In the simulation process the animal starts changing its behaviour according to the dosage of the drug. For example if we inject 30mm of drug into rabbit's eye then the diameter of the rabbit's eye changes. After the simulation process the observation table is generated related to the animal experiment. The observation table varies according to the experiments. The last module of the system architecture is to generate the 3D graph.

1.1.2 Motivation

Due to issues related to the procurement of animals, strict regulations and ethical issues. Previously, the practical classes in pharmacology for undergraduate pharmacy course in India included more than 15 animal experiments with frog, mouse, rat, guinea pig, and rabbit and were mandatory for the students to carry out animal experiments to pass the exam. As an alternate to this we need some kind of software which can perform such experiments for students with proper outcome. So we had the opportunity to use the development technologies to overcome the ban on usage of live animals for conducting experiments on them.

The other thing which motivated us to work on this project is that our college AIKTC is an integrated campus comprising of school of pharmacy, architecture and engineering. We thought that our project should become beneficial across various schools in our campus.

1.2 Objective and Scope

1.2.1 Objective

- The objective of this project is to give ease of access to the students.
- Students can adjust the dosage of drugs.
- Students can select the animal and their body parts very easily.
- The observation table can be generated according to the dosage given to the animal's body.
- 3D graph can be generated using observation table.
- Stages of different Pharmacological response properly differentiated.
- There will be also voice interface for better understanding.

1.2.2 Scope

- Animal simulator software will be useful for students in performing practicals as well as it can be extended to other colleges and institutions.
- Simulation techniques are human education aids and teaching approaches that can replace harmful animal use and typically used to meet the existing teaching objectives and to provide outcomes that cannot be met through animal experiments.
- Moreover it can be used as learning tool.
- This simulation software helps the B.Pharm and D.Pharm students to understand the experiments performed on live animals.
- This tool will also have a great market potential as it has many additional features such as 3D model, graph generation etc.

Chapter 2

Literature Review

2.1 Alternatives to animal experimentation in teaching pharmacology: computer assisted learning Techniques in pharmacy curriculum

Computer assisted (CAL) techniques as an alternative to animal experiment is having a greater advantage due to increasing difficulty to perform animal experiments, because of issues related to the procurement of animals, strict regulations and ethical issues. Previously, the practical classes in pharmacology for undergraduate pharmacy course in India included more than 15 animal experiments with frog, mouse, rat, guinea pig, and rabbit and were mandatory for the students to carry out animal experiments to pass the exam. At present in 2014 with the notifications by Pharmacy council of India (PCI) and University Grants Commission (UGC) the animal experiments have been replaced by alternatives with CAL techniques. Typically these techniques can fulfill the learning objectives of B. Pharmacy and Pharm D students to a greater extent and must be implemented with practice in institutes to overcome the barriers[1].

Computer assisted learning (CAL) techniques are human education aids and teaching approaches that can replace harmful animal use and typically used to meet the existing teaching objectives and to provide outcomes that cannot be met through animal experiments. The Pharmacy Council of India (PCI) prescribes the theory and practical curriculum for all pharmacy subjects in undergraduate pharmacy course in various universities in India. Pharmacology is branch of science that deals with the study of drugs, is taught for 24 months in B.Pharmacy during third and fourth year and is also taught for Pharm D course in second and third year. Previously animal experiments are taught to students in practical class and they have to perform these animal experiments to get hands on experience[1].

2.1.1 Weaknesses

- In this system simulation process is not available.
- The CAL technique used in this system deals with a specific range of computer based packages.
- Video material,tutorial and examination mode programs are not available in online version.
- If the student fail to clear the examination then he wont be allowed to promote.

2.1.2 How to Overcome

- Adding the feature of simulation and showing the behavior of the animal.
- CAL technique can be implemented by having platform independent
- In the online and offline version we can add video tutorial and examination mode.
- Demonstration of the effect of drugs on various models like tissues or on whole animal is an integral and essential part of practical pharmacology teaching for pharmacy students.

2.2 X-cology pro

X-cology Pro is a software used for demonstrating experiments on pharmacodynamics. Dr. C R Patil has presented the X-cology Pro at various global platforms and has generated interest in this software for simulations in Pharmacology.[9]

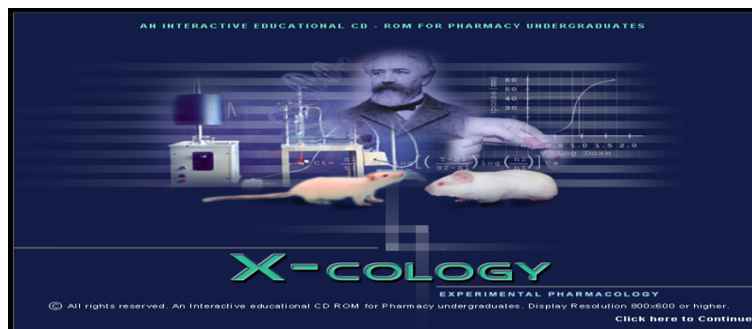


Figure 2.1: X-Cology Pro
[9]

2.2.1 Weaknesses

- The existing system doesn't have any audio interface or or audio included.
- They harm the live animal as they uses the video to demonstrate the experiment
- There is no proper method to calculate the observation table.
- No 3D graph.

2.2.2 How to Overcome

- The proposed system will have audio include for the better understanding.
- The proposed system will have 3D model instead of live animal, so no harm to animals.
- It will have proper way to calculate observation table.
- The Proposed system will have 3D graph generator which generate 3D graph for the given observation table.

2.3 ExpharmaPro

Author of this software is R. Raveendran Prof. of Pharmacology JIPMER, Pondicherry - 605 006. ExPharmPro is a computer assisted learning package containing five programs which simulate animal experiments in Pharmacology. These programs can be used to demonstrate drug on different animals systems. The package is user friendly, highly interactive and full of animated sequences which make simulation appear realistic.[8]

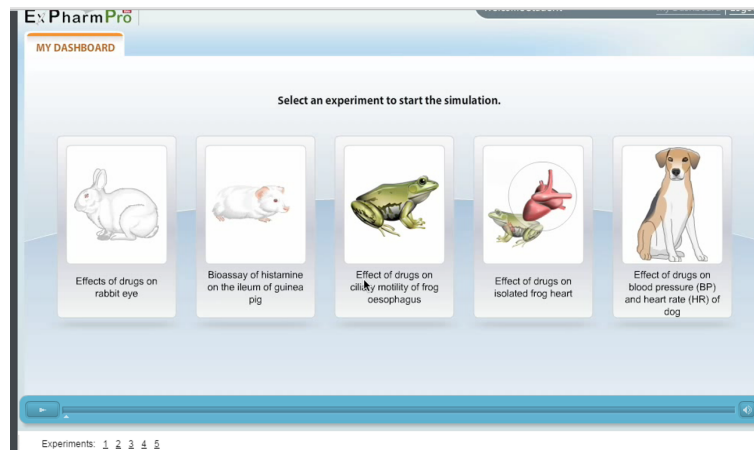


Figure 2.2: Expharm Pro [8]

2.3.1 Weaknesses

- The software contained 2D visualization of the animal.
- Selecting the quantity of drugs is not available.
- There is no proper method to calculate the observation table.
- No 3D graph.
- Stages of different Pharmacological responses not properly differentiated.

2.3.2 How to Overcome

- The proposed system will have audio include for the better understanding.
- The proposed system will have 3D model instead of live animal, so no harm to animals.
- It will have proper way to calculate observation table.
- The proposed system will have stages of different Pharmacological responses.

Chapter 3

Technical Details

3.1 Methodology

The proposed system architecture contains different modules. The flow of the system architecture starts from selecting the experiment. After selecting the experiment we've to choose on which animal we've to perform the experiment. After selecting the animal, how much dosage of drugs we have to inject on a particular animal's body or part. After all this process the animal reacts and changes its behavior. In the simulation process the animal start changing its behavior according to the dosage of the drug. For example if we inject 30mm of drug into rabbits eye then the diameter of the rabbits eye changes. After the simulation process the observation table is generated related to the animal experiment. The observation table varies according to the experiments. The last module of the system architecture is to generate the 3D graph.

3.1.1 Select Experiment

In this module, the student has to select the experiment. There would be different experiment lists in the select experiment module.

3.1.2 Select animal

In this module, the student has to select the animal. On which animal the students has to perform the experiment. The select animal module consist a sub module ie. "Select body part". This module selects a specific body part of an animal. For example if the student has to perform experiment on rabbit eye so first the student has to select the animal (rabbit) and body part (eye).

Name of the animal	Experiment
Rat	1.To Record The Concentration Response Curve of Oxytocin Using Rat Uterus Preparation. 2.To Study Effect Of Diazepam On The Muscle Grip Strength Using Rota Rod Apparatus.
Mice	1.To Study Analgesic Activity Of Morphine On Mice Using Hot Plate Method. 2.To Study Anticonvulsant Activity of Phenytoin in MES induced convulsion in mice. 3.To Study Effect of Drug on Locomotor Activity of Mice Using Actophotometer. 4.To Study Anticatatonic Activity of Scopolamine and l-Dopa in phenothiazine induced catalapsy in mice.
Rabbit	1.To Study Effect of Drug on Rabbit Eye.
Frog	1.To Study Effect of Drug on Isolated Frog Heart. 2. To Study Effect of Drug on Ciliary Motility.

Table 3.1: List of experiments
[1]

3.1.3 Select Drug

In this module,how much quantity of drug we have to inject in the animal or body part.The drug selection quantity is predefined in the module.The drug injection varies the animal body behavior.

3.1.4 Start simulation

This is the main module of this software.The actual behavior of the animal is shown in this module.At every stage the behavior of the animal is shown.

3.1.5 Generate observation table

After the simulation process a observation table is generated where the student gets easily understand the experiment.The values of the observation table is based on the simulation.

sectionProject Requirements

3.1.6 Software Requirements

- Microsoft Visual Studio
- Blender or MAYA
- SQL Server

3.1.7 Hardware Requirements

- Microsoft® Windows® 8/7/Vista (32 or 64-bit)
- 2 GB RAM minimum, 4 GB RAM recommended
- 400 MB hard disk space
- At least 1 GB of Graphics Card
- 1280 x 800 minimum screen resolution

Chapter 4

Market Potential

4.1 Market Potential of Project

- The proposed system contains features such as 3D visualization. This feature makes the software more attractive because of this the project will have more potential in market.
- The proposed system can adjust drug injection in the software and can be used on different animals simultaneously.
- The proposed system will contain the audio for better understanding of the project.
- The system will contain 3D model simulation.

4.2 Competitive Advantages of Project

- The project will contain the 3D model simulation which is not available in existing systems.
- The project will contain 3D graph generator which is not present in existing software.
- The system will have the ability to generate observation table which is not possible in existing ones.

Chapter 4. Market Potential

- There will be a proper usage of drug by selecting proper quantity which is not available in existing systems.
- The proposed system will have the ability to generate the observation table for performed experiment.
- Stages of different Pharmacological responses are properly differentiated.

Chapter 5

Conclusion and Future Scope

5.1 Conclusion

This project fulfill the practical scope and objectives of pharmacology curriculum of B.Pharm and Pharm D students to an acceptable reasonable extent with the reference to understanding the mechanism of action of drugs.

The emerging trends of using this software as an alternative to animal experiments has a greater significance of reduction of time, human source and repeatability. It may help and motivate pharmacy students to study the mode of action of drugs and develop analytical skills and to prepare them for rational use of medicines.

Growing awareness and restrictions implemented by CPCSEA, UGC and DMC. Most of the Universities in our country implemented the above techniques as an alternatives to animal experimentation and has now become a integrated part of practical teaching of pharmacology curriculum for B.Pharmacy and Pharm D. Students and thereby can avoid unnecessary pain and sufferings to the animals and animal welfare.

5.2 Future Scope

- Animal simulator software will be useful for students in performing practicals as well as it can be extended to other colleges and institutions.
- Simulation techniques are human education aids and teaching approaches that can replace harmful animal use and typically used to meet the existing teaching objectives and to provide outcomes that cannot be met through animal experiments.
- Moreover it can be used as learning tool.

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Own Publication

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