Diabetes Rx – Comprehensive Digital Database of Indian Traditional Medicines

By

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To

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Major Project Report - Dissertation

DiabetesRx - Comprehensive Digital Database of Indian Traditional Medicines

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M.Sc. Bioinformatics (Semester IV)

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CERTIFICATE

This is to certify that the project report entitled **"DiabetesRx - Comprehensive Digital Database of Indian Traditional Medicines"** submitted by **OMAIMA SUBBOOH** to the Department of Computer Science, Jamia Millia Islamia, New Delhi, for the partial fulfilment of the requirements of the degree of M.Sc. (Bioinformatics), has been prepared under my guidance and supervision during January 2024 to May 2024. We hereby declare that the work presented in the report is the original work and that it has reached the required standards for submission.

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DECLARATION

I, **OMAIMA SUBBOOH**, student of **M.Sc. (Bioinformatics) 4th Semester** hereby declare that the project report entitled "**DiabetesRx - Comprehensive Digital Database of Indian Traditional Medicines**" which is submitted by me to the Department of Computer Science, Jamia Millia Islamia, New Delhi, in partial fulfillment of the requirements for the Degree **of M.Sc. (Bioinformatics)** has not previously formed the basis of any Degree, Diploma, Associateship, Fellowship or other similar title or recognition. I hereby declare that this work is an original contribution with existing knowledge and faithful record of research carried out by me.

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SUBBOOH

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CERTIFICATE

On the basis of declaration made by the student **OMAIMA SUBBOOH**, I hereby certify that the project report entitled **"DiabetesRx - Comprehensive Digital Database of Indian Traditional Medicines"** submitted by Omaima Subbooh to the Department of Computer Science, Jamia Millia Islamia, New Delhi, for the partial fulfillment of the requirements of the Major Project of **M.Sc. (Bioinformatics) 4th Semester** is carried out by her under my guidance and supervision. The report has reached the requisite standards for submission.

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We express gratitude to our educational institution for providing the necessary infrastructure, resources, and encouragement throughout the duration of the project. The institutional support has been instrumental in the successful completion of this database application.

Omaima Subbooh

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LIST OF ABBREVIATIONS

HTML: Hyper Text Markup Language

CSS: Cascading Style Sheet

JS: JavaScript

C#: C Sharp

MVC: Model View Controller

ASP.NET: Active Server Pages Network Enabled Technology

IMPPAT: Indian Medicinal Plants, Phytochemistry and Therapeutics

IMPLAD: Indian Medicinal Plants Database

BSI-MPDB: Botanical Survey of India- Medicinal Plants Database

DBMS: Database Management System

ER: Entity-Relationship

SQL: Structured Query Language

MPDB: Medicinal Plant Database

ABSTRACT

The traditional medicinal knowledge and practices of indigenous communities have been an integral part of healthcare systems for centuries. These traditional medicinal plants have played a significant role in the local population's wellbeing. However, there has been a lack of comprehensive databases that capture the rich diversity of traditional medicinal plants.

This thesis presents the development of DiabetesRx, a dedicated database for traditional medicinal plants of India. The primary objective of DiabetesRx is to preserve, document, and make accessible the traditional knowledge associated with these medicinal plants.

The research begins with a thorough literature review, highlighting the significance and potential of traditional medicinal plants in India for the cure of Diabetes. The gap analysis reveals the limitations of existing databases, paving the way for the development of DiabetesRx. The methodology encompasses data collection from various sources, including research papers and online resources, followed by database development using technologies such as ASP.NET MVC, C#, and HTML.

DIABETESRX offers a user-friendly interface that allows users to explore and retrieve information on traditional medicinal plants based on various search criteria. The database incorporates location data, enabling researchers to understand the distribution patterns of these plants in different types of practices such as Unani, Ayurveda, FDA Approved Drugs. Additionally, DiabetesRx includes comprehensive traditional information, including traditional uses, preparation methods, dosage recommendations, and historical significance.

The thesis also presents case studies that demonstrate the practical applications and impact of DiabetesRx in medicinal plant research for diabetes cure, preservation of traditional medicine, and conservation efforts. The database's performance and scalability are evaluated, highlighting its potential for further expansion and integration with other databases and resources.

Chapter 1 -Introduction

1.1. Research Problem and Motivation:

Diabetes is a chronic metabolic disorder characterized by elevated blood sugar levels due to either insufficient insulin production or the body's inability to use insulin effectively. This condition poses significant health risks and can lead to complications such as cardiovascular disease, kidney failure, and nerve damage if not managed properly. Traditional Indian medicine, with its rich history and diverse range of medicinal plants, offers promising avenues for managing diabetes.

Indian traditional medicine systems such as Ayurveda, Siddha, and Unani have long recognized diabetes as "Madhumeha" or "Prameha," describing it as a disorder resulting from an imbalance in bodily humors or doshas. These systems emphasize holistic approaches to diabetes management, focusing on diet, lifestyle modifications, and the use of medicinal plants.

Several Indian traditional medicinal plants have been identified for their potential anti-diabetic properties. For instance, bitter gourd (Momordica charantia), commonly known as "Karela," is known for its hypoglycemic effects and ability to improve insulin sensitivity. Similarly, fenugreek (Trigonella foenum-graecum), known as "Methi," contains soluble fiber and compounds like trigonelline, which help regulate blood sugar levels.

The management of diabetes with Indian traditional medicinal plants involves various approaches. Herbal remedies such as decoctions, powders, and teas made from medicinal plants are commonly used to regulate blood sugar levels. Additionally, lifestyle modifications such as regular exercise, stress management, and dietary changes complement the use of medicinal plants in managing diabetes.

In conclusion, traditional medicinal plants in India possess immense cultural, therapeutic, and scientific significance. Extensive research has been conducted to document their traditional uses, isolate bioactive compounds, and explore their potential for drug development. The creation of a database like DIABETES Rx can serve as a valuable tool for knowledge dissemination, research collaboration, and sustainable utilization of traditional medicinal plants.

1.2. Background and Significance of Traditional Medicinal Plants:

India is renowned for its rich tradition of medicinal plants, which have been an integral part of its cultural and healthcare heritage for thousands of years.

Historical Context: The use of medicinal plants in India dates back to ancient times, with references found in ancient texts such as the Rigveda and Atharvaveda. These texts contain detailed descriptions of various medicinal plants and their therapeutic uses. Over the centuries, traditional healers and practitioners in India have accumulated vast knowledge about the medicinal properties of plants through observation, experimentation, and transmission of knowledge from one generation to the next.

Diversity of Flora: India's diverse climate and geography have contributed to its rich biodiversity, making it home to a wide variety of medicinal plants. The country boasts a diverse range of ecosystems, from the Himalayan mountains to the tropical rainforests of the Western Ghats, each harbouring unique species of plants with medicinal properties. India's flora includes herbs, shrubs, trees, and climbers, many of which have been used for centuries in traditional medicine.

Therapeutic Properties: Indian traditional medicinal plants are known for their diverse therapeutic properties. They are used to treat a wide range of ailments, including digestive disorders, respiratory problems, skin diseases, and more. For example, neem (Azadirachta indica) is valued for its anti-inflammatory, antifungal, and antibacterial properties, while turmeric (Curcuma longa) is prized for its antioxidant and anti-inflammatory effects.

Scientific Interest and Research: In recent years, there has been a growing interest in Indian traditional medicinal plants among scientists, researchers, and pharmaceutical companies. Modern scientific studies have validated many of the traditional uses of medicinal plants and identified bioactive compounds responsible for their therapeutic effects. This intersection of traditional knowledge and modern research has led to the discovery of new drugs, formulations, and treatment approaches.

Significance in Healthcare: They offer sustainable and cost-effective alternatives to modern pharmaceuticals, especially in rural and underserved communities where access to healthcare is limited. Moreover, traditional medicine systems like Ayurveda emphasize preventive healthcare and holistic well-being, promoting a balanced lifestyle and dietary habits.

1.3. Research Objectives:

The research objectives of this study encompass several key aspects related to the DIABETESRx database and the primary objectives include:

To reduce the effect of Diabetes and Increase Awareness - It aims to address the dual challenge of mitigating the impact of diabetes and enhancing awareness about the disease and its management. Diabetes is a prevalent health issue in India, with a significant impact on individuals and the healthcare system. By focusing on this objective, the research seeks to explore how traditional medicinal plants can contribute to managing diabetes effectively. This includes identifying medicinal plants with potential anti-diabetic properties, documenting their traditional uses, and validating their efficacy through scientific research. Additionally, the objective involves raising awareness among healthcare professionals, patients, and the general public about the benefits of traditional medicinal plants in managing diabetes. Ultimately, the goal is to reduce the burden of diabetes-related complications and improve the quality of life for individuals affected by the disease.

To develop the DIABETESRx database: The main objective is to design and develop a comprehensive database specifically focused on traditional medicinal plants. This will involve the implementation of an efficient database architecture, data collection, and entry processes, and the integration of relevant information pertaining to the traditional medicinal plants.

To validate traditional knowledge and pra3ctices: The research aims to validate the traditional knowledge and practices associated with the medicinal plants included in the DIABETESRx database. This will involve collaboration with traditional healers, local communities, and experts in traditional medicine to verify and authenticate the information collected, ensuring accuracy and reliability.

To facilitate research and collaboration: Another objective is to provide a platform for researchers, practitioners, and policymakers to access reliable and up-to-date information on traditional medicinal plants. By facilitating research and collaboration, the DiabetesRx database can contribute to the advancement of scientific knowledge, the discovery of new bioactive compounds, and the development of alternative healthcare approaches.

1.4. Scope and Limitations:

The scope of this research encompasses the extraction and integration of data from **various** research papers conducted in various parts of India focusing on traditional medicinal plants. These studies provide valuable insights into the botanical details, traditional uses, preparation methods, and scientific evidence associated with the medicinal plants of the region. By incorporating data from these papers, the DiabetesRx database aims to consolidate and organize the information for over **200** traditional medicinal.

The database has been designed to accommodate **various** fields related to the plants, which include essential information such as scientific name, local name, plant family, parts used, therapeutic uses**, and available scientific studies**. The fields have been carefully selected to capture crucial aspects of traditional medicinal plants and facilitate efficient data retrieval and analysis.

The DiabetesRx database has been implemented using SQL Server Database for data storage, ASP.NET MVC for the frontend user interface, and C# and JavaScript for the backend development. This technology stack ensures a robust and scalable system that can handle the storage, retrieval, and presentation of the extensive dataset.

However, it is important to acknowledge the limitations of this study. Firstly, the scope is limited to the data extracted from the 10 research papers and may not encompass all traditional medicinal plants for the cure of diabetes. While efforts have been made to incorporate a wide range of species, there may be additional plants with valuable traditional knowledge that are not included in this dataset.

Secondly, the accuracy and completeness of the data heavily rely on the quality and reliability of the selected research papers. While rigorous efforts have been made to ensure data integrity, there may be inherent biases, inconsistencies, or omissions within the original research papers that could affect the quality of the information stored in the database.

Despite these limitations, the DiabetesRx database, with its integration of data from multiple research papers, its designed fields, and its implementation using SQL Server, ASP.NET MVC Framework, JavaScript offers a valuable resource for researchers, practitioners, and policymakers. It facilitates access to organized information on traditional medicinal plants from the India, contributing to the documentation, preservation, and utilization of traditional medicinal knowledge in the region.

Chapter 2 - Literature Review

2.1. Importance and Potential of the Research: Traditional Medicinal Plants

India is renowned for its rich biodiversity, diverse ethnic communities, and vibrant traditional cultures. Understanding the significance and characteristics of traditional medicinal plants in this region is essential for the preservation of indigenous knowledge, sustainable healthcare practices, and the development of evidence-based interventions.

Botanical Diversity: India is blessed with a remarkable botanical diversity, comprising a wide array of traditional medicinal plant species. The region's diverse ecosystems, including tropical rainforests, subtropical forests, and alpine meadows, provide ideal habitats for a vast range of plant species. This botanical diversity encompasses a wide variety of families, genera, and species, each possessing unique medicinal properties and therapeutic potential.

Traditional Knowledge and Practices: The traditional medicinal knowledge in India has been passed down through generations within indigenous communities. Traditional healers, often referred to as "vaidyas" or "bon," possess deep knowledge of the medicinal properties of various plant species and the intricate practices associated with their preparation and administration.

Ethnobotanical Surveys: Ethnobotanical surveys conducted have played a pivotal role in documenting and preserving traditional medicinal knowledge. These surveys involve engaging with local communities, traditional healers, and knowledgeable individuals to gather information about traditional medicinal plants. The data collected during ethnobotanical surveys provide insights into the botanical details, traditional uses, preparation methods, dosage, and safety considerations associated with the plants

Conservation Challenges: Despite the cultural and ecological importance of traditional medicinal plants, several challenges threaten their conservation. Factors such as habitat loss, deforestation, climate change, unsustainable harvesting practices, and the erosion of traditional knowledge pose significant threats to the availability and sustainability of these plants.

Past Studies on Traditional Medicinal Plants: The documentation of traditional medicinal plants in India has been a subject of interest for researchers, botanists, ethnobotanists, and traditional medicine practitioners for several decades. Numerous studies have been conducted across different regions of India to identify, document, and validate the traditional knowledge associated with medicinal plants. These studies have played a crucial role in

cataloguing the botanical details, traditional uses, preparation methods, and scientific evidence of various plant species, enriching our understanding of traditional medicine.

Regional Variations and Traditional Knowledge: The past studies have highlighted the regional variations in the traditional medicinal plant practices across India. Each region possesses its unique traditional knowledge, plant species, and healing systems. The traditional medicinal practices are deeply intertwined with the cultural heritage of indigenous communities. The past studies have documented the diverse plant species used by these communities, capturing the nuances of their traditional knowledge, healing rituals, and healthcare practices.

Scientific Validation and Research Gaps: While the documentation of traditional medicinal plants in India has made significant strides, there are still notable research gaps that need to be addressed. Many traditional uses and practices associated with medicinal plants have not undergone rigorous scientific validation. While traditional knowledge is valuable, the scientific community recognizes the importance of conducting scientific studies to validate the safety, efficacy, and mechanisms of action of traditional remedies.

Information Accessibility and Integration: While past studies have generated a wealth of data on traditional medicinal plants, this information is often dispersed across various publications and databases, making it challenging to access and utilize comprehensively. Efforts should be made to collate, standardize, and integrate the existing knowledge into easily accessible platforms, such as the DiabetesRx database developed as part of this research. Sustainable harvesting practices and conservation of medicinal plant species are crucial for the long-term availability of these valuable resources. Understanding the ecological requirements, population dynamics, and sustainable harvesting thresholds of medicinal plant species is vital for their conservation and ensuring their availability for future generations.

Integration of Traditional Medicine and Modern Healthcare Systems: Past studies have highlighted the potential benefits and challenges associated with this integration. More research is needed to identify strategies for effectively incorporating traditional medicinal plant-based therapies into mainstream healthcare, ensuring patient safety, promoting interdisciplinary collaborations, and bridging the gap between traditional healers and modern healthcare providers.

2.2. Existing Databases and Resources on Traditional Medicinal Plants:

Traditional medicinal plants and resources in India have played a vital role in the country's healthcare system for centuries. India has a rich heritage of traditional medicine, with a diverse range of medicinal plants that have been used in various traditional healing practices like Ayurveda, Siddha, and Unani. In India, there are quite a number of Medicinal Plants Databases. few of them are mentioned here:

1- **IMPPAT:** Indian Medicinal Plants, Phytochemistry, and Therapeutics or IMPPAT is a manually curated database that has 4010 Indian medicinal plants, 17967 phytochemicals, and 1095 therapeutic uses. Its first version was released on June 17, 2022, whereas, the second one was released on January 25, 2018. Now, it is the largest database on phytochemicals of Indian medicinal plants to date.

2- **NEI –MPDB:** It is an integrated database of an extensive list of medicinal plants used in the North Eastern part of India. The database comprises more than 550 plants and 9000+ phytochemicals. It was published on July 2022 and has the state-wise distribution of medicinal Plants in North East Region.

3- **UMPDB:** UMPDB provides extensive information on botanical names, common name, taxonomy, genomic taxonomy id, habit, habitat, location in Uttarakhand, part use, medicinal use, genomic information (including a number of nucleotides, proteins, ESTs), chemical information, and scientific literature. The current version of UMPDB contains 1127 records of medicinal plants which belong to 153 plant families distributed across 13 districts of Uttarakhand. It was published on 26 Jan 2018.

4- **MPDB-BSI:** MPDB-BSI provides information on scientific names, family, vernacular names, medicinal uses, location of species, and images of herbarium specimens. It has a total of 1,915 species are enlisted.

5- **IMPLAD:** Indian Medicinal Plant Database incorporates 7263 botanical names, more than 1,50,000 vernacular names in ten different Indian languages & more than 5000 authentic images of Indian medicinal plants. The medicinal plants are arranged under the six Indian Systems of Medicine namely Ayurveda(2559 names/ 1540 species), Siddha (2267 names/1149 species), Unani (1049 names/493 species), Homeopathy (460 names/372 species), Sowa-Rigpa(671 names/250 species) and Folk (6403 names/5376 species).

2.3. Gap Identification and Research Opportunities:

In the previous section, we discussed several existing plant databases in India. However, despite their presence, there are significant gaps that create an opportunity for the development of a dedicated traditional medicinal plant database like DIABETESRX. This section highlights some of the major gaps identified in the existing databases and the research opportunities they present.

UI Enhancements: One of the key gaps observed in the existing plant databases is the lack of user-friendly interfaces. Many of these databases suffer from typography issues, inadequate graphics, and spacing problems, which ultimately diminish the user experience. With DIABETESRX, our primary aim is to address these UI shortcomings and create a database with an engaging and interactive user interface.

Location of the Plants: Another prominent gap found in existing databases is the limited availability of information regarding the specific locations where the plants are found or from where the plant samples were collected. DIABETESRX aims to overcome this limitation by including comprehensive location data for each plant species. By providing precise geographical information, researchers and users can better understand the distribution patterns of traditional medicinal plants in different regions of India. This information can be invaluable for ecological studies, conservation efforts, and targeted exploration of specific plant species in their natural habitats.

Lack of Traditional Information: One of the fundamental aspects behind the development of DIABETESRX is to address the lack of traditional information in existing databases. Many databases primarily focus on botanical details, chemical composition, and pharmacological properties of the plants, while overlooking the rich traditional knowledge associated with their usage. DIABETESRX aims to bridge this gap by incorporating comprehensive traditional information for each plant species. This includes details on traditional uses, preparation methods, dosage recommendations, and historical significance. By including this traditional knowledge, DIABETESRX can serve as a valuable resource for researchers, practitioners, and enthusiasts interested in understanding and preserving the cultural heritage of traditional medicinal plants. In summary, the identified gaps in existing plant databases in India provide an excellent opportunity for the development of DIABETESRX. By addressing the issues related to user interface, location information, and traditional knowledge.

2.4. Future Expansion for Database:

The database also contributes to conservation efforts of medicinal plant species in India. By providing comprehensive information on the distribution, habitats, and traditional uses of these plants, and the IUCN status of each plant, the database aids in identifying endangered species and areas of high conservation priority. This information can guide conservation strategies, including the establishment of protected areas, cultivation programs, and sustainable harvesting practices, ensuring the preservation of medicinal plant biodiversity.

Expansion to Include Additional Diseases: While the current focus of the DIABETESRX database is on the Diabetes Management, there is potential for future expansion to include other major Diseases. By expanding the database to cover additional Diseases, a more comprehensive resource can be developed, fostering collaboration and knowledge-sharing among researchers, traditional healers, and healthcare professionals across the country.

Collaborations and Partnerships: The DIABETESRX database can serve as a platform for collaborations and partnerships among various stakeholders. Researchers, traditional healers, botanists, ethnobotanists, and policymakers can come together to contribute their knowledge, expertise, and resources to enrich the database further.

User Feedback and Continuous Improvement: Regular feedback collection and analysis can help identify areas for enhancement, identify new features or functionalities that would benefit users, and address any technical or usability issues. User feedback can be obtained through surveys, user testing, and engagement with the user community, ensuring that the database remains user-centric and aligned with the needs of its users.

Future Research and Funding: The development of the DIABETESRX database opens avenues for future research and funding opportunities. The database can serve as a foundation for further research on traditional medicinal plants, including studies on their pharmacological properties, mechanisms of action, and therapeutic potential. Additionally, the availability of a comprehensive database can attract funding for research projects, conservation initiatives, and technology advancements, contributing to the growth and sustainability of the database.

The integration of the DIABETESRX database with traditional medicine practices, conservation efforts, and its potential expansion to include additional Diseases demonstrates the versatility and future scope of the database.

Chapter 3 - Methodology

3.1. Research Design and Approach:

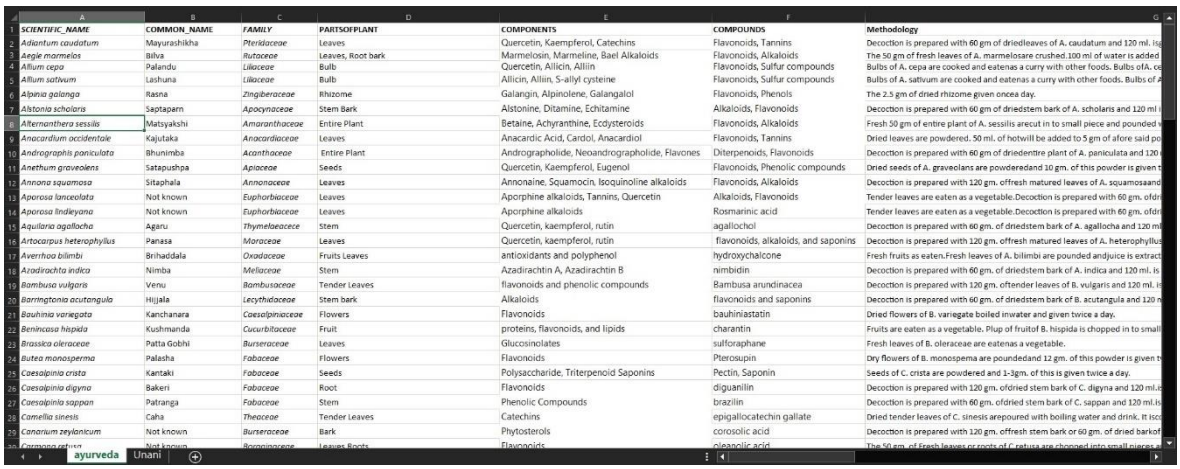
The research design and approach for the development of the DIABETESRX database involved a systematic and multidisciplinary approach to ensure the collection, organization, data analysis and presentation of accurate and reliable data on traditional medicinal plants of India.

Data Collection: The data collection process involved the selection and extraction of relevant information from research papers and ethnobotanical surveys. Specific criteria, such as geographic focus, relevance to traditional medicinal plants, and credibility of the sources, were applied to ensure the inclusion of reliable and pertinent data. The collected data encompassed botanical details, traditional uses, preparation methods, dosage, safety considerations, and therapeutic properties of the medicinal plants.

Database Development: The collected data were organized and structured to develop the DIABETESRX database. The database was designed using SQL SERVER, with appropriate tables and relationships established to store and manage the data efficiently. The development process followed best practices in database design, ensuring data integrity, security, and ease of use.

Data Analysis Techniques: The data analysis techniques utilized in this study included descriptive analysis, content analysis, and data visualization. Descriptive analysis involved summarizing and presenting the collected data in a structured manner, allowing for easy interpretation and understanding. Content analysis was conducted to identify patterns, trends, and relationships among medicinal plants, their traditional uses, and therapeutic properties. Data visualization techniques, such as charts, graphs, and maps, were employed to present the data in a visually appealing and informative manner.

The research design and approach employed in this study ensured a systematic and rigorous process for the development of the DIABETESRX database. By conducting a comprehensive literature review, carefully selecting and extracting data, and employing robust data analysis techniques, the database was built on a strong foundation of reliable and validated information. The use of appropriate methodologies and technologies in the development of the database contributed to its usability, accuracy, and potential impact in the field of traditional medicine.



SCIENTIFIC_NAME	COMMON_NAME	FAMILY	PARTSOFPLANT	COMPONENTS	COMPOUNDS	Methodology
Adiantum caudatum	Mayurashikha	*Pteridaceae*	Leaves	Quercetin, Kaempferol, Catechins	Flavonoids, Tannins	Decoction is prepared with 60 gm of driedleaves of A. caudatum and 120 ml. is
Aegle marmelos	Bilva	*Rutaceae*	Leaves, Root bark	Marmelosin, Marmeline, Bael Alkaloids	Flavonoids, Alkaloids	The 50 gm of fresh leaves of A. marmelosare crushed.100 ml of water is added
Allium cepa	Palandu	*Liliaceae*	Bulb	Quercetin, Allicin, Alliin	Flavonoids, Sulfur compounds	Bulbs of A. cepa are cooked and eatenas a curry with other foods. Bulbs ofA. ce
Allium sativum	Lashuna	*Liliaceae*	Bulb	Allicin, Alliin, S-allyl cysteine	Flavonoids, Sulfur compounds	Bulbs of A. sativum are cooked and eatenas a curry with other foods. Bulbs of A
Alpinia galanga	Rasna	*Zingiberaceae*	Rhizome	Galangin, Alpinolene, Galangalol	Flavonoids, Phenols	The 2.5 gm of dried rhizome given oncea day.
Alstonia scholaris	Saptaparn	*Apocynaceae*	Stem Bark	Alstonine, Ditamine, Echitamine	Alkaloids, Flavonoids	Decoction is prepared with 60 gm of driedstem bark of A. scholaris and 120 ml i
Alternanthera sessilis	Matsyakshi	*Amaranthaceae*	Entire Plant	Betaine, Achyranthine, Ecdysteroids	Flavonoids, Alkaloids	Fresh 50 gm of entire plant of A. sessilis arecut in to small piece and pounded w
Anacardium occidentale	Kajutaka	*Anacardiaceae*	Leaves	Anacardic Acid, Cardol, Anacardiol	Flavonoids, Tannins	Dried leaves are powdered. 50 ml. of hotwill be added to 5 gm of afore said po
Andrographis paniculata	Bhunimba	*Acanthaceae*	Entire Plant	Andrographolide, Neoandrographolide, Flavones	Diterpenoids, Flavonoids	Decoction is prepared with 60 gm of driedentire plant of A. paniculata and 120
Anethum graveolens	Satapushpa	*Apiaceae*	Seeds	Quercetin, Kaempferol, Eugenol	Flavonoids, Phenolic compounds	Dried seeds of A. graveolans are powderedand 10 gm. of this powder is given t
Annona squamosa	Sitaphala	*Annonaceae*	Leaves	Annonaine, Squamocin, Isoquinoline alkaloids	Flavonoids, Alkaloids	Decoction is prepared with 120 gm. offresh matured leaves of A. squamosaand
Aporosa lanceolata	Not known	*Euphorbiaceae*	Leaves	Aporphine alkaloids, Tannins, Quercetin	Alkaloids, Flavonoids	Tender leaves are eaten as a vegetable.Decoction is prepared with 60 gm. ofdri
Aporosa lindleyana	Not known	*Euphorbiaceae*	Leaves	Aporphine alkaloids	Rosmarinic acid	Tender leaves are eaten as a vegetable.Decoction is prepared with 60 gm. ofdri
Aquilaria agallocha	Agaru	*Thymelaeaceae*	Stem	Quercetin, kaempferol, rutin	agallochol	Decoction is prepared with 60 gm. of driedstem bark of A. agallocha and 120 ml
Artocarpus heterophyllus	Panasa	*Moraceae*	Leaves	Quercetin, kaempferol, rutin	flavonoids, alkaloids, and saponins	Decoction is prepared with 120 gm. offresh matured leaves of A. heterophyllus
Averrhoa bilimbi	Brihaddala	*Oxalidaceae*	Fruits Leaves	antioxidants and polyphenol	hydroxychalcone	Fresh fruits as eaten.Fresh leaves of A. bilimbi are pounded andjuice is extract
Azadirachta indica	Nimba	*Meliaceae*	Stem	Azadirachtin A, Azadirachtin B	nimbidin	Decoction is prepared with 60 gm. of driedstem bark of A. indica and 120 ml. is
Bambusa vulgaris	Venu	*Bambusaceae*	Tender Leaves	flavonoids and phenolic compounds	Bambusa arundinacea	Decoction is prepared with 120 gm. oftender leaves of B. vulgaris and 120 ml. is
Barringtonia acutangula	Hijjala	*Lecythidaceae*	Stem bark	Alkaloids	flavonoids and saponins	Decoction is prepared with 60 gm. of driedstem bark of B. acutangula and 120 m
Bauhinia variegata	Kanchanara	*Caesalpiniaceae*	Flowers	Flavonoids	bauhiniastatin	Dried flowers of B. variegata boiled inwater and given twice a day.
Benincasa hispida	Kushmanda	*Cucurbitaceae*	Fruit	proteins, flavonoids, and lipids	charantin	Fruits are eaten as a vegetable. Plup of fruitof B. hispida is chopped in to small
Brassica oleraceae	Patta Gobhi	*Burseraceae*	Leaves	Glucosinolates	sulforaphane	Fresh leaves of B. oleraceae are eatenas a vegetable.
Butea monosperma	Palasha	*Fabaceae*	Flowers	Flavonoids	Pterosupin	Dry flowers of B. monosperma are poundedand 12 gm. of this powder is given t
Caesalpinia crista	Kantaki	*Fabaceae*	Seeds	Polysaccharide, Triterpenoid Saponins	Pectin, Saponin	Seeds of C. crista are powdered and 1-3gm. of this is given twice a day.
Caesalpinia digyna	Bakeri	*Fabaceae*	Root	Flavonoids	diguanilin	Decoction is prepared with 120 gm. ofdried stem bark of C. digyna and 120 ml.is
Caesalpinia sappan	Patranga	*Fabaceae*	Stem	Phenolic Compounds	brazilin	Decoction is prepared with 60 gm. ofdried stem bark of C. sappan and 120 ml.is
Camellia sinesis	Caha	*Theaceae*	Tender Leaves	Catechins	epigallocatechin gallate	Dried tender leaves of C. sinesis arepoured with boiling water and drink. It isc
Canarium zeylanicum	Not known	*Burseraceae*	Bark	Phytosterols	corosolic acid	Decoction is prepared with 120 gm. offresh stem bark or 60 gm. of dried barkof
Carmona retusa	Not known	*Boraginaceae*	Leaves, Roots	Flavonoids	oleanolic acid	The 50 gm. of Fresh leaves or roots of C.retusa are chopped into small pieces a

REFERENCES	ImagePath	Category
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Liyanaarchchi, S.K., 1986, Gruhaushadha Chinthamani, Gunasekara & Co, Anuradhapura, Sri Lanka p. 43	C:\Users\amanS\Images_Scientific\Averrhoa bilimbi.jpg	Ayurveda
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https://www.researchgate.net/publication/285706172	C:\Users\amanS\Images_Scientific\Bauhinia variegata.jpg	Ayurveda
Gunarathna, L., 1954, Pavula ath Veda Potha, Ratna printers, Colombo, Sri Lanka p. 11	C:\Users\amanS\Images_Scientific\Benincasa hispida.jpg	Ayurveda
Tissera, H. M. A & Thabrew, M. I., 2001, Medicinal plants and Ayurvedic preparations used in Sri Lanka f	C:\Users\amanS\Images_Scientific\Brassica oleracea.jpg	Ayurveda
Jayasekara, D.C.,1950, Arka Prakaranaya, Siriwardhana printers, Colombo, Sri Lanka p. 111.	C:\Users\amanS\Images_Scientific\Butea monosperma.jpg	Ayurveda

Fig 1. Snapshots of the prepared database in MS-Excel Sheet

After Gathering of all the data from various resources. I consolidated into various Excel Sheets. After that a thorough preparation and cleaning of data is done, so that there wont be any data discrepancy and errors while filling the data in the database using python selenium automation code. As this data has to go for certain validations before insertion in actual tables, it should not have any empty values and must not go beyond certain length.

3.2. Data Sources and Sampling Strategy:

This section provides an overview of the data sources and the sampling strategy employed to gather a diverse and representative dataset.

Research Papers: A wide range of research papers published in scientific journals, conference proceedings, and other scholarly sources were considered primary data sources. These research papers covered studies related to traditional medicinal plants, ethnobotanical research, phytochemical analysis, and traditional healing practices in India. The selection of research papers was based on their relevance to traditional medicinal plants, geographic focus, and scientific rigor.

Ethnobotanical Surveys: Ethnobotanical surveys conducted by researchers, institutions, and local communities were also considered valuable data sources. These surveys involved field visits, interviews with traditional healers and local communities, and documentation of traditional knowledge related to medicinal plants. They provide valuable insights into the traditional uses, preparation methods, and cultural significance of medicinal plants.

Sampling Strategy:

1. Inclusion Criteria: The inclusion criteria were defined to ensure the selection of relevant and reliable data sources. Research papers and ethnobotanical surveys that focused specifically on traditional medicinal plants, their traditional uses, and their therapeutic properties were included. The credibility and scientific rigor of the data sources were assessed based on factors such as the reputation of the authors, preview processes, and adherence to recognized research methodologies.
2. Exclusion Criteria: Certain data sources were excluded from the sampling process. These included duplicate publications, studies with insufficient or unreliable information, and studies that did not meet the predefined inclusion criteria. By applying exclusion criteria, the database aimed to maintain a high standard of data quality and reliability.

Sample Size: The sample size was determined based on the availability of research papers and ethnobotanical surveys meeting the inclusion criteria. Efforts were made to include a substantial number of data sources to ensure the representativeness of the dataset while considering practical constraints and available resources. The sample size aimed to capture a diverse range of traditional medicinal plants and their associated knowledge.

3.3. Database Development and Architecture:

This section provides an overview of the database development process and the architecture employed to ensure the storage, retrieval, and management of the extensive traditional medicinal plant data.

Database Design:

1. **Relational Database Model:** The DIABETESRX database was designed based on the relational database model. This model allows for the organization of data into structured tables, with defined relationships between them. The use of a relational database model facilitates data integrity, consistency, and efficient querying capabilities.
2. **Entity-Relationship Diagram:** An entity-relationship (ER) diagram was developed to visualize the structure and relationships of the database entities. Relationships, such as one-to-many and many-to-many, were established between the entities to represent the associations and connections between them.

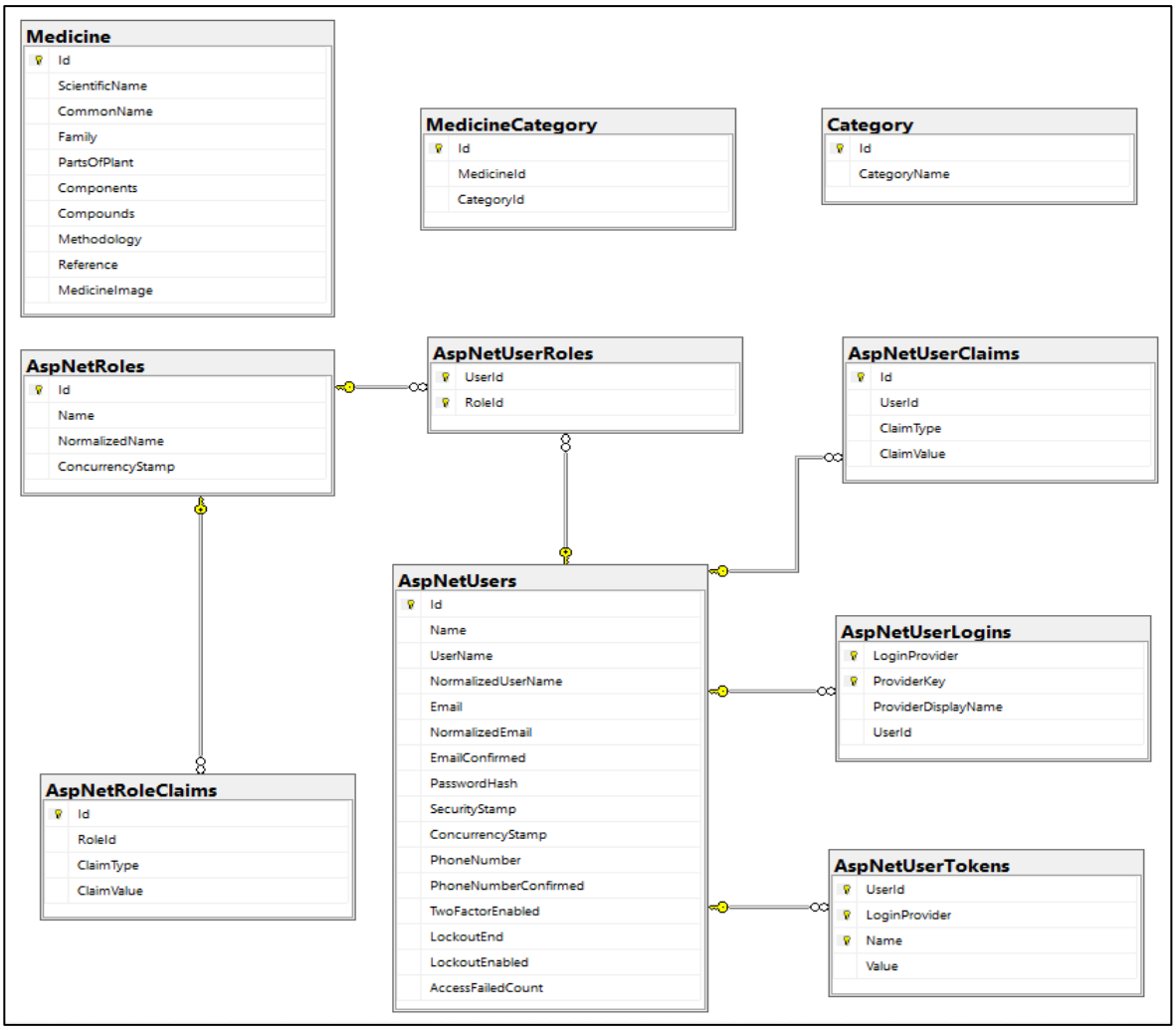

Fig 2. ER Diagram of DiabetesRX

Database Management

1. **SQL SERVER:** The DIABETESRX database was implemented using the SQL SERVER relational database management system (RDBMS). SQL SERVER is a widely adopted and robust database system known for its performance, scalability, and reliability. It provides comprehensive features for data management, including efficient indexing, query optimization, and transaction support.

Database Architecture:

1. **Tables and Fields:** The database architecture consisted of multiple tables, each representing a specific entity in the traditional medicinal plant domain. For example, there were tables for plants, traditional uses, therapeutic properties, geographic information, and references.
2. **Primary and Foreign Keys:** Primary and foreign keys were utilized to establish relationships between the tables and maintain data integrity. Primary keys uniquely identified each record within a table, while foreign keys established associations between tables by referencing the primary keys of related entities.
3. **Indexing and Query Optimization:** To enhance the performance of data retrieval, appropriate indexing techniques were employed. Indexes were created on frequently queried fields to speed up the search process.

Data Entry and Validation:

1. **Data Entry Interface:** A user-friendly data entry interface was developed to facilitate the input of traditional medicinal plant data into the database. The interface allowed for the systematic entry of information into the respective tables and fields.
2. **Data Validation:** To maintain data accuracy and consistency, validation mechanisms were implemented. Data validation rules were applied to ensure that the entered information adhered to predefined standards and constraints. This included checking for data completeness, data format, and allowable value ranges.
3. **User Authentication and Access Control:** User authentication mechanisms were implemented to control access to the database. User roles and permissions were defined to ensure that only authorized individuals could access and modify the data.
4. **Data Backup and Recovery:** Regular data backups were performed to safeguard against potential data loss. Backup strategies included periodic backups external storage devices. In case of any unforeseen circumstances, data recovery mechanisms were in place to restore the database to a previous state.

The Architectures for various important tables are as follows:

3.3.1 Medicinal Plant Table – It consists of all the attributes relevant to medicinal plant database.

Column Name	Data Type	Allow Nulls
Id	int	☐
ScientificName	nvarchar(MAX)	☑
CommonName	nvarchar(MAX)	☑
Family	nvarchar(MAX)	☑
PartsOfPlant	nvarchar(MAX)	☑
Components	nvarchar(MAX)	☑
Compounds	nvarchar(MAX)	☑
Methodology	nvarchar(MAX)	☑
Reference	nvarchar(MAX)	☑
MedicineImage	nvarchar(MAX)	☑

3.3.2 Category Table – Every Medicines lies in one of the categories defined inside the category table.

Column Name	Data Type	Allow Nulls
Id	int	☐
CategoryName	nvarchar(MAX)	☐
		☐

3.3.3 Medicine Category Table – This table maps the Medicine Plant table with the Category Table. Each Medicine can belong to multiple Categories.

Column Name	Data Type	Allow Nulls
Id	int	☐
MedicineId	int	☐
CategoryId	int	☐

There are some other important tables which are included due to Identity framework for carrying out different user management tasks.

3.4. Technologies Used:

The development of the Web Application involves a range of technologies, frameworks, and tools that collectively contribute to the functionality, security, and user experience. Here is a detailed overview of the key technologies used in the project:

1. ASP.NET 6

ASP.NET 6 serves as the foundational framework for building the web application. It is a cross-platform, high-performance framework for building modern, cloud-based, and internet-connected applications. Key features and components of ASP.NET 6 utilized in the project include:

- MVC Architecture: The Model-View-Controller architectural pattern is employed for a structured and modular development approach.
- Identity Framework: Identity is used for user authentication and authorization, providing a secure and customizable solution for managing user accounts.
- Razor Pages: Razor Pages are used for creating dynamic and interactive web pages, allowing for seamless integration with backend logic.
- Routing: ASP.NET routing is utilized for defining URL patterns and handling navigation between different views and controllers.
- Middleware: Middleware components are used to handle requests and responses, enabling various features such as authentication, logging, and error handling.
- Dependency Injection: ASP.NET's built-in dependency injection container is used for managing and injecting dependencies, promoting a loosely coupled architecture.

2. Entity Framework Core

Entity Framework Core is employed as the Object-Relational Mapping (ORM) framework for interacting with the underlying SQL Server database. Key aspects of its usage include:

- Code-First Approach: Entity Framework Core follows a code-first approach, allowing developers to define the data model using C# classes, and the database schema is automatically generated from these classes
- Migrations: Migrations are used to evolve the database schema over time as the application's data model changes.
- LINQ (Language-Integrated Query): LINQ is utilized for querying the database using C# syntax, providing a type-safe and intuitive way to interact with the database.

- DbContext: The DbContext class is employed to represent the database context, providing a high-level abstraction for interacting with the database.

3. SQL Server

SQL Server is chosen as the relational database management system (RDBMS) for storing and managing data. Key aspects of its usage include:

- Database Design: The database is designed to include tables for user management, bioinformatics categories, Python scripts, and other relevant entities.
- Security Measures: SQL Server security features are implemented to protect sensitive data and ensure data integrity.

4. Python

Python is utilized for automating the process of data Insertion into the Database. Using UI of the Web Application and basic Knowledge of Selenium and BeautifulSoup, Data automatically gets inserted from Excel Files to Database via Application UI. It seamlessly integrates with the ASP.NET application, allowing for the launch of Data Insertion Page in browser and saving the data.

5. Other Relevant Technologies and Tools

- C# Programming Language: The primary language for developing the backend logic of the ASP.NET application.
- HTML, CSS, JavaScript: Frontend technologies used for creating the user interface and enhancing the user experience.
- Git: Version control system for tracking changes and collaborating on the project.
- Visual Studio: Integrated development environment (IDE) used for coding, debugging, and deploying the ASP.NET application.

This stack of technologies ensures a robust, scalable, and user-friendly web application, seamlessly integrating ASP.NET, Entity Framework Core, SQL Server, and Python.

Chapter 4 - Database Implementation and Features

4.1. User Interface Design and Functionality:

The user interface (UI) of the DIABETESRX database was carefully designed to provide users with an intuitive and efficient platform for accessing and interacting with the traditional medicinal plant data. This section outlines the key aspects of the UI design and the functionality implemented to enhance user experience.

User-Centric Design: The design elements, such as layout, navigation, and visual aesthetics, were tailored to ensure a user-friendly and visually appealing interface. Responsive and Accessible Design: The DIABETESRX database UI was designed to be responsive, meaning it could adapt to different devices and screen sizes. Whether accessed from desktop computers, laptops, tablets, or mobile devices, the UI provided a consistent and optimized experience

Intuitive Navigation: Effort was made to create a clear and intuitive navigation system within the DIABETESRX database. Users could easily browse through different sections, search for specific plants or information, and access related data seamlessly. Logical categorization, hierarchical menus, and contextual links were implemented to guide users and facilitate their exploration of the database. Search and Filtering Capabilities: The DIABETESRX database offered robust search and filtering functionalities to help users quickly locate specific plants or information of interest. A comprehensive search feature allowed users to input keywords, plant names, or any relevant criteria to retrieve relevant results. Advanced filtering options enabled users to refine their search based on specific attributes, such as therapeutic properties, geographical location, or traditional uses.

Interactive Data Visualization: To enhance the understanding and analysis of traditional medicinal plant data, interactive data visualization tools were integrated into the DiabetesRx database. This facilitated data-driven decision-making and provided a more engaging and insightful user experience.

By focusing on user-centric design principles, responsive and accessible interfaces, intuitive navigation, powerful search capabilities, interactive data visualization, and user support mechanisms, the DIABETESRX database aimed to provide users with a seamless and enriching experience. The UI design and functionality were optimized to enable efficient data exploration, analysis, and knowledge discovery in the field of traditional medicinal plants.

4.2.Database Features and Functionality:

This section highlights the key features and functionalities implemented in the database.

Data Storage and Organization: The DIABETESRX database utilizes a robust data storage system to efficiently store and organize the vast amount of traditional medicinal plant data. The database employs MySQL as the backend database management system, providing a reliable and scalable platform. The data is structured and organized using appropriate tables, fields, and relationships to ensure data integrity and optimal performance.

Data Entry and Editing: The database offers user-friendly interfaces for data entry and editing. Authorized users can access dedicated forms to input or modify information related to traditional medicinal plants. The forms provide structured fields, dropdown menus, and validation checks to ensure consistent and accurate data entry. The ability to edit and update existing records allows for the inclusion of new research findings and emerging information.

Search and Retrieval: A powerful search and retrieval system is integrated into the DIABETESRX database, enabling users to quickly locate specific plant data based on various search criteria. Users can conduct keyword searches, search by plant name, to narrow down the search results. The search functionality retrieves relevant records based on the specified parameters, facilitating efficient data exploration and retrieval.

User Access Control: Different user roles and permissions are defined to regulate access to specific functionalities and data. Administrators have full control over the database, while other users, such as researchers or contributors, have role based restricted access. This system prevents unauthorized access and safeguards sensitive data.

Data Backup and Recovery: Regular data backup procedures are implemented in the DIABETESRX database to prevent data loss and ensure data recovery in case of any unforeseen incidents.

By incorporating features and functionalities such as efficient data storage and organization, user-friendly data entry and editing interfaces, powerful search and retrieval capabilities, cross-referencing and linking of data, reporting and exporting options, user access control, and data backup and recovery mechanisms, the DiabetesRx database aims to provide a comprehensive and user-centric platform for managing and utilizing traditional medicinal plant data.

4.3. Data Entry and Management Processes:

The DIABETESRX database follows well-defined data entry and management processes to ensure the accuracy, consistency, and reliability of the traditional medicinal plant data. This section outlines the key processes involved in data entry, validation, and ongoing management.

Data Extraction and Conversion: To populate the DIABETESRX database, data extraction techniques were employed to retrieve relevant information from the selected research papers and other sources. PDFs of the research papers were obtained, and data was extracted using various tools and techniques, such as manual extraction, text mining, and natural language processing. The extracted data was then converted into a structured format, typically Excel, to facilitate further processing and database entry.

Data Entry and Validation: The extracted and converted data was entered into the DIABETESRX database using the dedicated data entry interfaces. Authorized personnel carefully entered the information into the appropriate fields, ensuring accuracy and consistency. The data entry forms included validation checks to enforce data integrity and prevent the inclusion of invalid or inconsistent data. Mandatory fields, dropdown menus, and predefined formats were implemented to standardize the data entry process.

Data Quality Assurance: To maintain data quality, Data cleaning techniques, such as duplicate detection and resolution, were applied to ensure the uniqueness and reliability of the data. An iterative process of data verification, correction, and validation was employed to enhance data accuracy and completeness.

Data Documentation: Comprehensive documentation of the data entry and management processes is maintained in the DIABETESRX database. This includes details on data sources, extraction methods, data entry protocols, validation procedures, and any modifications made to the data. Documentation ensures transparency, reproducibility, and traceability of the data management processes, enabling future researchers or database administrators to understand and validate the data.

By following systematic data collection, extraction, entry, validation, the DIABETESRX database ensures the accuracy, reliability, and relevance of the traditional medicinal plant data. These processes enable the database to serve as a valuable resource for researchers, practitioners, and policymakers in the field of traditional medicine.

```
[15]: from selenium import webdriver
from selenium.webdriver.common.keys import Keys
from selenium.webdriver.common.by import By
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.support import expected_conditions as EC
from selenium.webdriver.support.ui import Select
import openpyxl
import time

# Load Excel file
workbook = openpyxl.load_workbook('ayurveda.xlsx')
sheet = workbook.active

# Initialize Chrome web browser
driver = webdriver.Chrome()

# Open the login page
login_url = "https://localhost:44330/UserAuthentication/Login"
driver.get(login_url)

# Find the username and password fields and fill them in
username = WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Username"]')))
username.send_keys("Admin")

password = WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Password"]')))
password.send_keys("Admin@123")

# Find and click the login button
login_button = WebDriverWait(driver, 10).until(EC.element_to_be_clickable((By.CSS_SELECTOR, 'button[type="submit"]')))
login_button.click()

# Wait for the login process to complete
time.sleep(2)

# Now you should be logged in, navigate to the desired URL
desired_url = "https://localhost:44330/Medicine/Add"

driver.get(desired_url)

# Iterate through rows in Excel file
for row in sheet.iter_rows(min_row=2, max_row=sheet.max_row, values_only=True):
    # Extract data from Excel
    scientific_name, common_name, family, parts_of_plant, components, compounds, methodology, reference, image_path, category = row

    # Fill the form
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="ScientificName"]'))).send_keys(scientific_name)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="CommonName"]'))).send_keys(common_name)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Family"]'))).send_keys(family)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="PartsOfPlant"]'))).send_keys(parts_of_plant)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Components"]'))).send_keys(components)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Compounds"]'))).send_keys(compounds)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Methodology"]'))).send_keys(methodology)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="Reference"]'))).send_keys(reference)
    WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'input[name="ImageFile"]'))).send_keys(image_path)

    categories = category.split(',')
    select = Select(WebDriverWait(driver, 10).until(EC.presence_of_element_located((By.CSS_SELECTOR, 'select[name="Categories"]'))))
    for cat in categories:
        select.select_by_visible_text(cat.strip())

    # Click on the Save button
    WebDriverWait(driver, 10).until(EC.element_to_be_clickable((By.CSS_SELECTOR, 'button[type="submit"]'))).click()

    # Wait for the form to be submitted and the next page to load
    time.sleep(2)

# Close the browser
driver.quit()
```

Fig 3. Snapshot of the Python Code

This is the automation code to add data to the Database. Selenium with Python is used to carry out automated test cases for browsers or web applications. We can easily use it to simulate tests such as tapping on a button, entering content to the structures, skimming the entire site, etc. With the help of this code data from the excel sheet is fetched and put in the respective fields of the Add medicine page of the Web application and then click on the Save button. Using this we saved a lot of time and effort of manually entering and saving the dats to database.

4.4. Database Performance and Scalability:

This section discusses the key considerations and measures taken to enhance the performance and scalability of the database.

Data Indexing and Optimization: To improve data retrieval speed and query performance, the DiabetesRx database utilizes indexing techniques. Indexes are created on frequently queried fields, such as plant names, categories and medicinal uses. This enables faster searching and retrieval of data, minimizing the response time for user queries.

Database Caching: Caching mechanisms are employed in the DIABETESRX database to reduce the load on the database server and improve response times. Frequently accessed data, such as plant details, common search results, and user preferences, are cached in memory. This allows for faster retrieval of data, as it eliminates the need to access the disk for every request.

Vertical and Horizontal Scaling: The DiabetesRx database is designed to accommodate both vertical and horizontal scaling to address increasing data storage and processing requirements. Vertical scaling involves upgrading hardware resources, such as increasing server memory, storage capacity, or processing power, to handle larger data volumes and improve performance. Horizontal scaling involves adding more database servers to distribute the workload and improve throughput. The database architecture and infrastructure are designed to facilitate seamless scaling as the database grows.

By implementing data indexing and optimization, database caching, vertical and horizontal scaling and performance monitoring and optimization, the DIABETESRX database ensures high performance, scalability, and availability. These measures enable the database to handle increasing data volumes, user traffic, and future growth, providing a robust and responsive platform for managing traditional medicinal plant data.

5. Web Application Implementation and Features

5.1. ASP.NET 6 MVC Application

The ASP.NET 6 MVC application serves as the core of the system, responsible for user authentication, authorization, and overall application flow. It follows the Model-View-Controller (MVC) architectural pattern, ensuring a modular and organized structure.

Components and Interaction:

- Controllers: Controllers handle user requests, interact with the database through Entity Framework Core, and coordinate the flow of data between the models and views.
- Views: Views are responsible for presenting the user interface, generated based on the data provided by the controllers. Razor Pages are used for dynamic page generation.
- Models: Models represent the application's data structures and business logic. These models are used by controllers to interact with the database.

5.2. SQL Server Database

SQL Server is employed as the relational database management system (RDBMS) for storing and managing data related to user accounts, medicine categories, and Medicinal Plants.

Components and Interaction:

- Entity Framework Core: The ASP.NET application interacts with the SQL Server database using Entity Framework Core. Code-first migrations are used to evolve the database schema over time.
- Data Entities: C# classes representing data entities are defined, and Entity Framework Core translates these into tables in the SQL Server database.

5.3. User Authentication and Authorization

- The user authentication and authorization mechanism in the Web Application is implemented using ASP.NET Identity Framework, providing a robust and customizable solution for managing user-related functionalities.

A. User Registration:

New users can register for an account, providing essential details such as username, email, and password.

Implementation:

- Registration Page: A dedicated registration page presents users with a form to input their registration details.
- Input Validation: Client-side and server-side validation ensure the correctness and security of user-provided information.

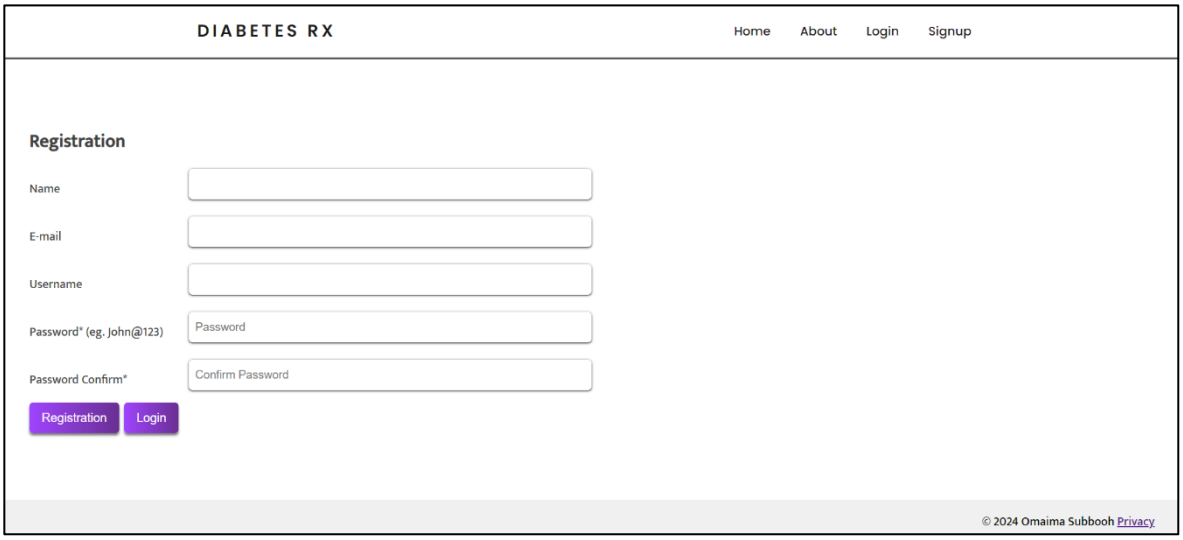

Fig 4. Registration Page

- Registration page has validations and shows warning on following conditions.
  1. Password won't contain an upper and a lowercase letter, a special character and a digit.
  2. Password is less than 8 characters.
  3. Email is not valid.
  4. Username is not Unique.
  5. Any of the field is empty.

After successful registration user can click on Login button to redirect to login page.

B. User Login:

Registered users can log in using their credentials to access the application's features and bioinformatics tools.

Implementation:

Login Page: The login page prompts users to enter their username/email and password.

- Authentication: ASP.NET Identity verifies user credentials, and upon successful authentication, a session is created for the user.
- Session Management: User sessions are managed to maintain authentication state across requests.

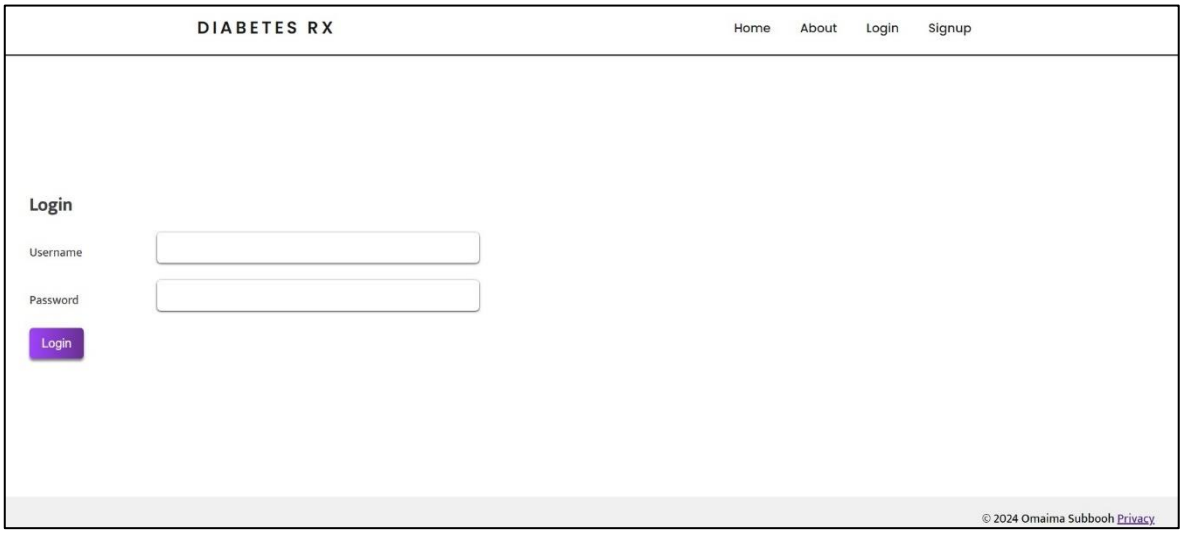

Fig 5. Login Page

Login page has validations; therefore, it shows error on following two cases.

1. UserName and Password does not match.
2. Any one of the field is empty.

After Successful login user can land on Dashboard page of the application. If the user is new, On clicking the hyper link below login button (Not a user? Signup) user can register.

C. Password Change:

Authenticated users have the ability to change their passwords for improved security.

Implementation:

- Change Password Page: A dedicated page allows users to enter their current and new passwords.
- Security Checks: Users are typically required to confirm their current password to prevent unauthorized password changes.
- Password Policy: The application may enforce password policies such as complexity requirements.

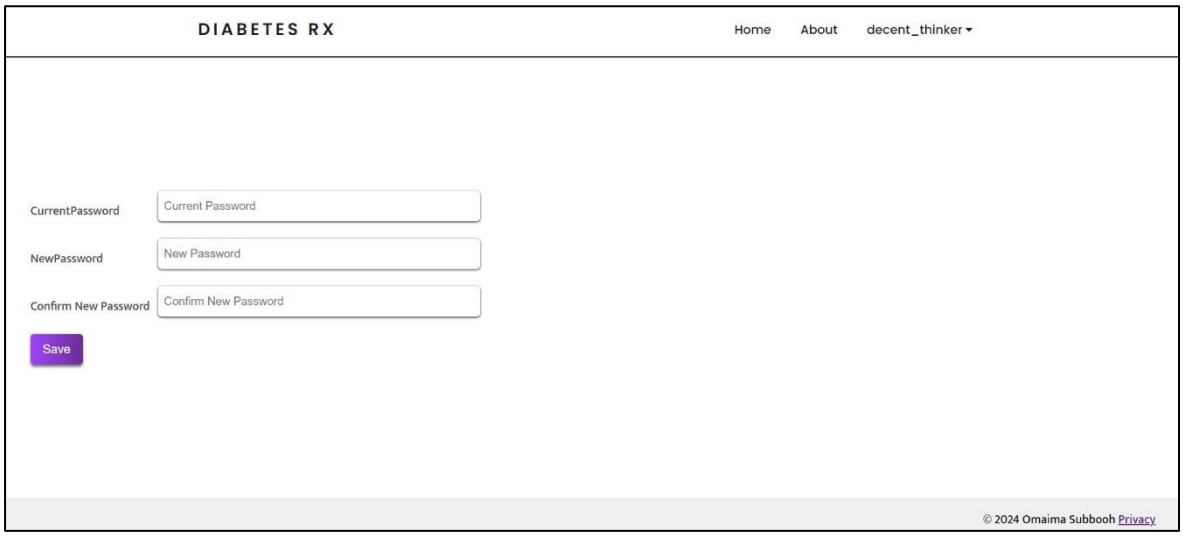

Fig 6. Password Change Page

- Password change has certain validation as follows.

  1. Current Password should match with the database.

  2. New password should follow the password guidelines.

  3. No fields should be empty.

D. Role-Based Authorization:

Authorization is implemented based on user roles, allowing different levels of access to resources.

Implementation:

- Roles: Roles such as "Admin" and "User" are defined to categorize users.
- Access Control: Certain pages or functionalities are restricted based on user roles.
- Role Assignment: Admin users have the authority to assign roles to other users.

5.4. Logout and Session Management:

Users can log out of their accounts, terminating the session and ensuring the security of their data.

Implementation:

- Logout Functionality: A logout button or link triggers the termination of the user session.
- Session Expiry: After logout, attempts to access protected resources require reauthentication.

5.5 – Home and Detail Page

The dashboard serves as the central hub for users, presenting a user-friendly interface with access to all the medicinal plant and their details in one click.

Components:

- Medicinal Plant Tile: Each Plant in the Database present as a tile with Image and some basic information like its name, category, etc.
- Upon Clicking on any of the Title user can see all the details of the medicinal plant Attributes in the DiabetesRx Database.

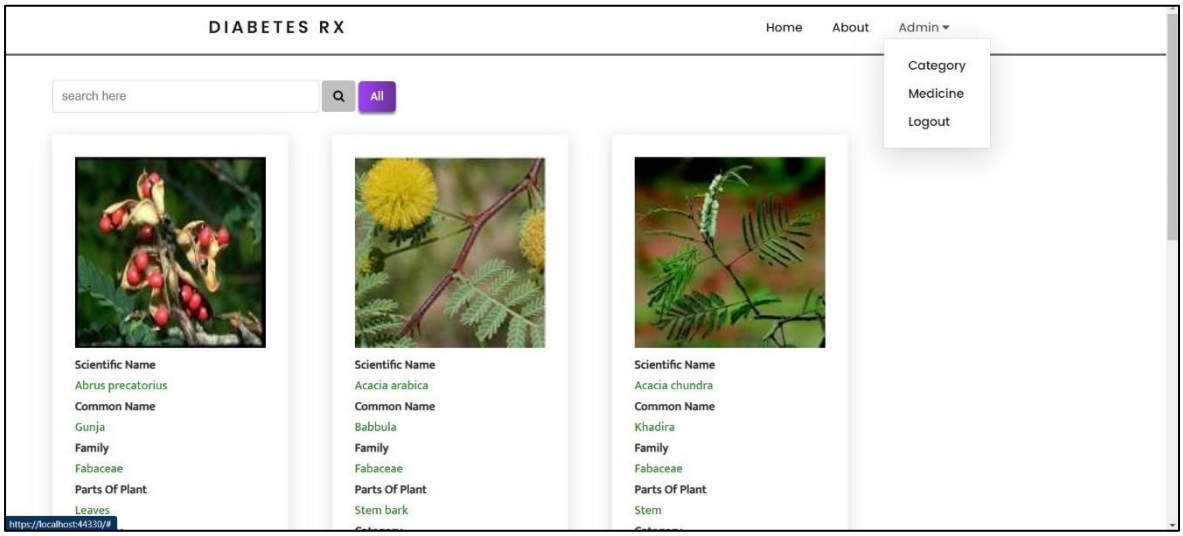

Fig 7. Application Home Page

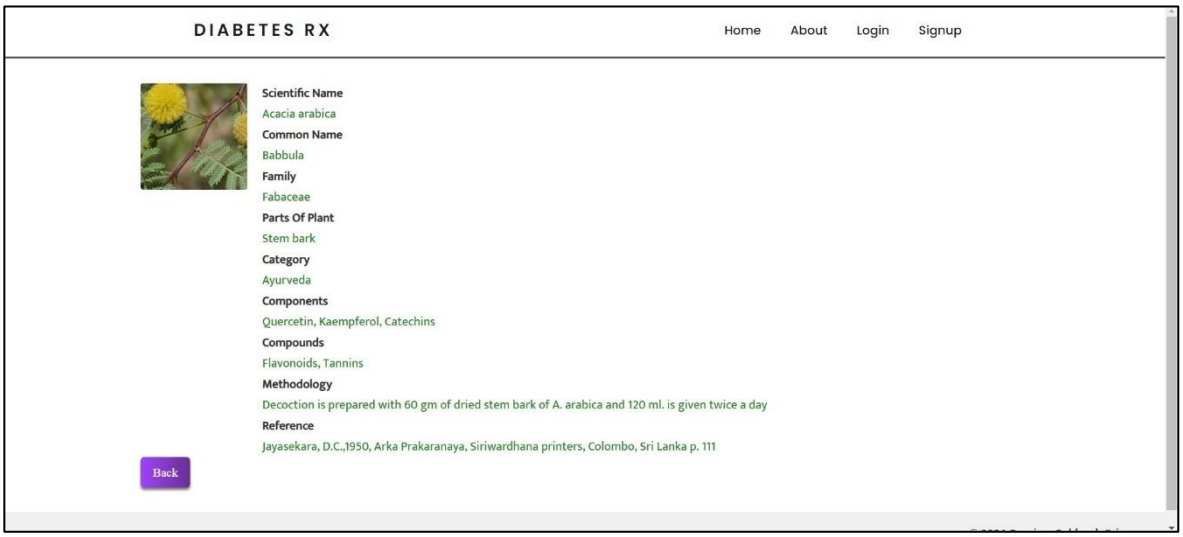

Fig 8. Detail Page

5.6. Admin Pages

When the logged in User is an Admin. Then he can access following functionality of Website.

- All the details of each Medicinal plant in the DiabetesRx Database Along with its Image in a Tabular Format.
- Admin has the authority to Edit and Delete the Medicinal Plant data from the Website's U.I itself.
- Not only Admin can Add new Categories to the Database but also Edit and Delete them.

Fig 9. Add Category Page

- Here, Admin can Add new Category to the DiabetesRx Database and when click on All records, below page can be seen where Admin can view, edit and delete Categories.

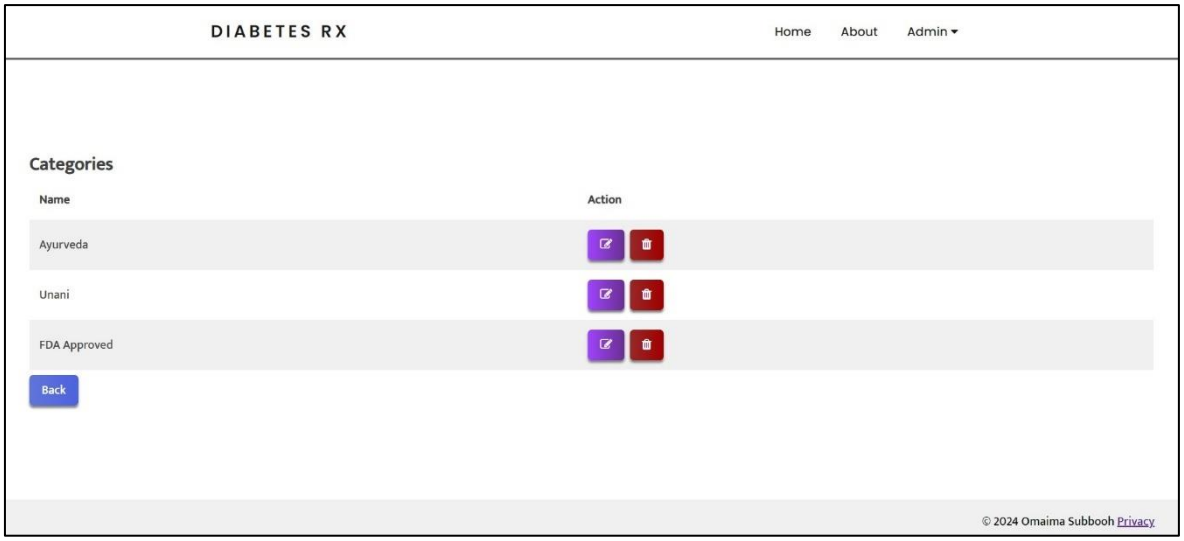

Fig 10. All Categories Page

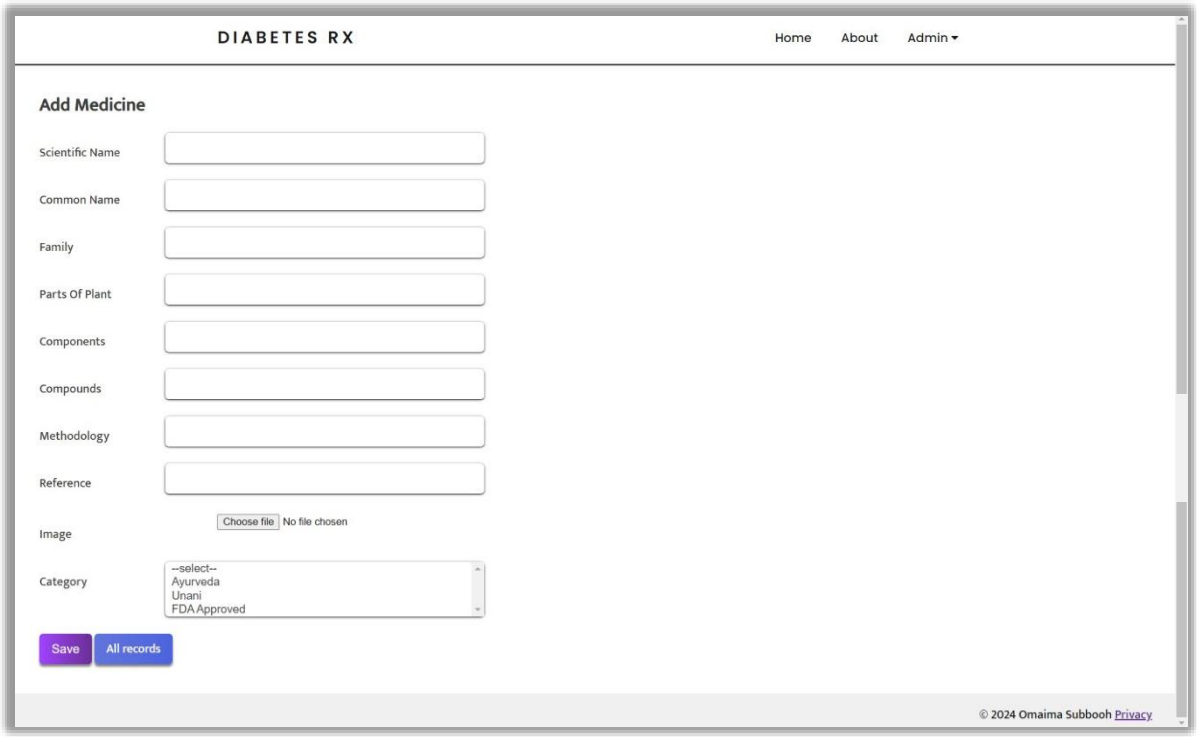

Fig 11. Add Medicine Page

- Here, Admin can add a new medicinal plant in DiabetesRx Database after filling all fields along with Image and click on save button. The data will be entered in the database. When click on All records button following page will come.

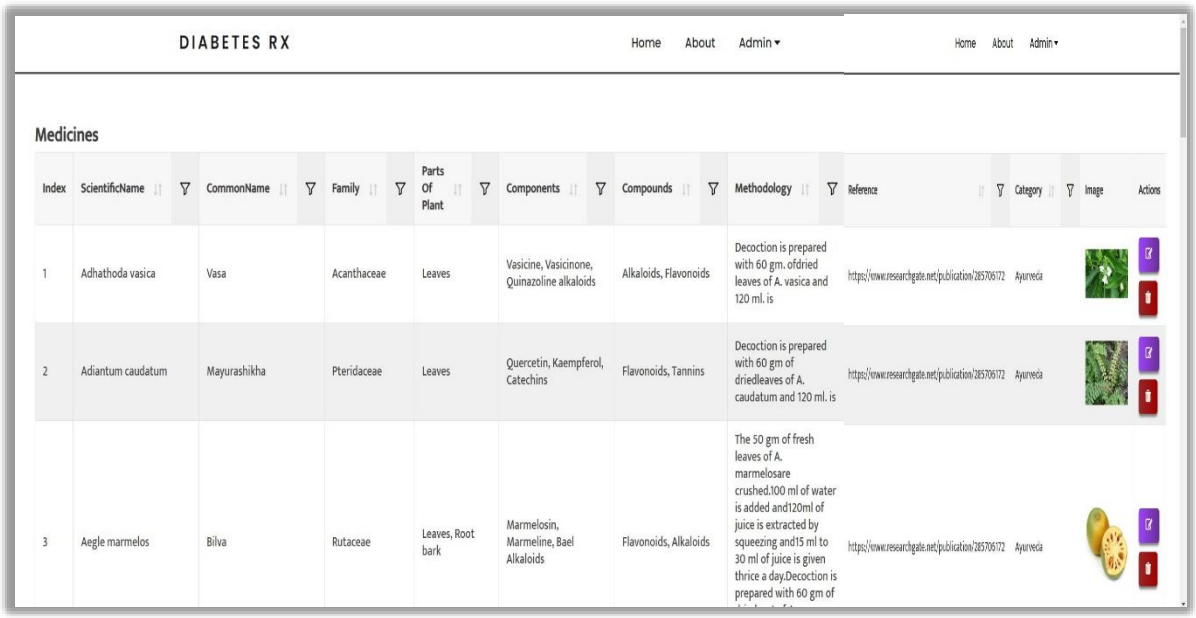

Fig 12. All Medicines Page

- Here Admin can sort and filter the Database on the basis of Attributes of the Table.
- Admin can also Edit and Delete the Data of Each Medicinal Plant

5.7. Security Measures:

Additional security measures are implemented to safeguard user accounts and sensitive information.

Implementation:

- Account Lockout: After a certain number of failed login attempts, the account may be temporarily locked for security.
- Two-Factor Authentication (Optional): Users may opt for an additional layer of security using two-factor authentication.
- Security Logging: Logging mechanisms are in place to track security-related events for auditing.

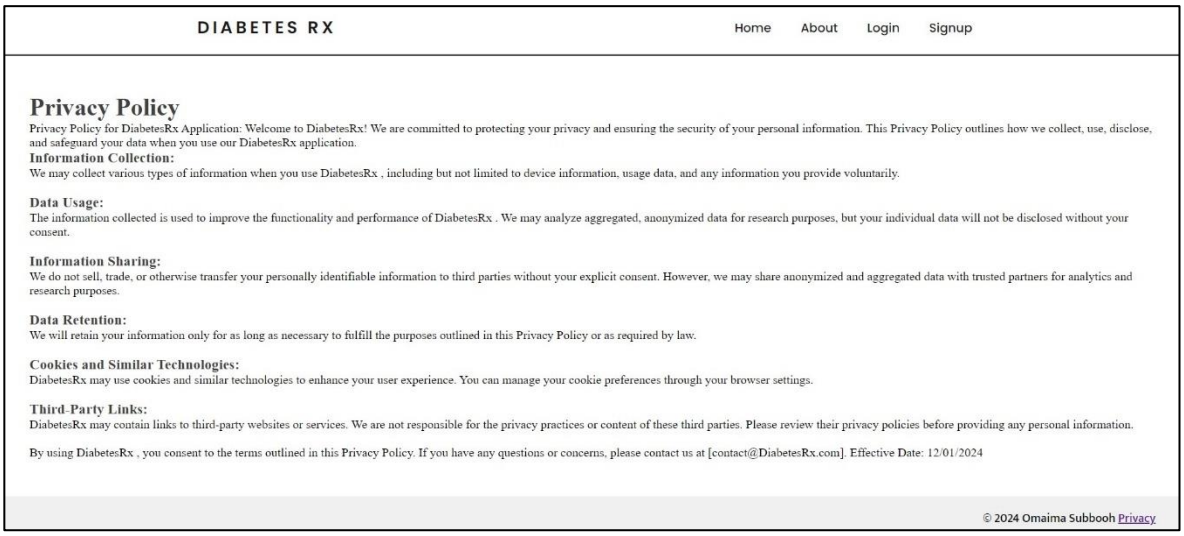

Fig 13. Privacy Policy Page

- On this page a user can read the website's privacy policy.

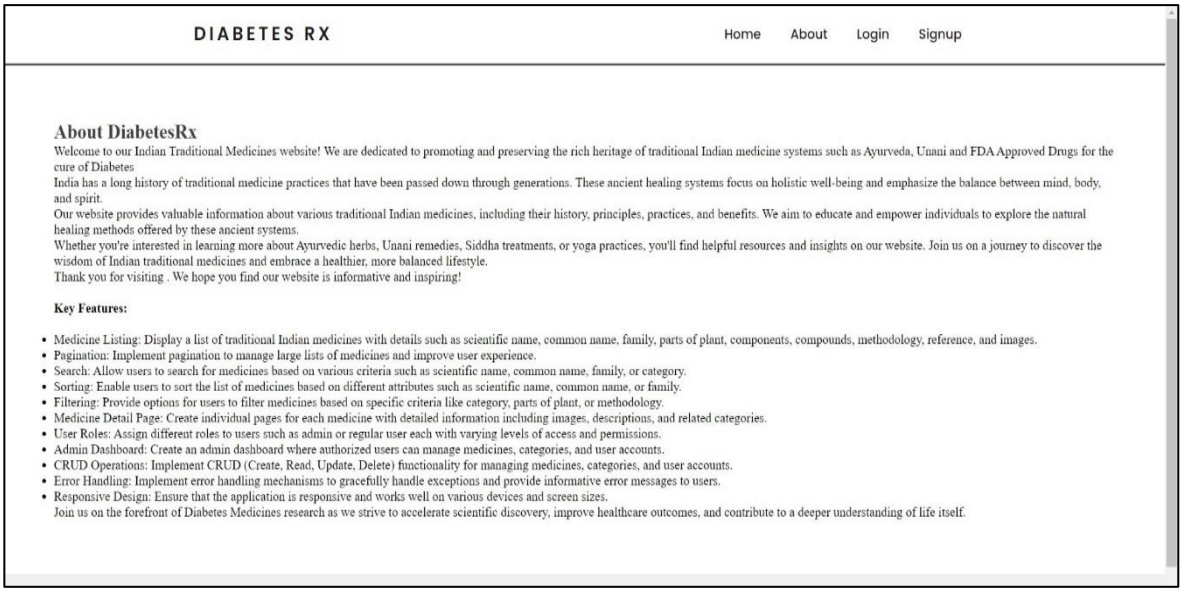

Fig 14. About Page

- On this page a user can read the about the purpose and features of the website.

This architecture ensures a separation of concerns, with the ASP.NET application handling user management and high-level control and Python script providing automation for Data handling like insertion from prepared Excel Sheet.

The integration of ASP.NET Identity Framework provides a standardized and secure solution for user authentication and authorization. This mechanism ensures that only authenticated users with the appropriate permissions can access the web application. The implementation of security measures enhances the overall robustness of the user authentication and authorization system.

Chapter 6 - Discussion

6.1. Analysis and Interpretation of Database Implementation:

In this section, we present an analysis and interpretation of the implementation of the DIABETESRX database. We evaluate its design, functionality, and overall performance to assess its effectiveness in achieving the research objectives and addressing the needs of users.

Database Design Evaluation: The database design of DIABETESRX was carefully planned and executed to ensure efficient data storage, retrieval, and management. The schema and entity relationship diagrams (ERDs) provided a clear structure for organizing the data, including information on plant taxonomy, medicinal uses, geographic distribution, and active compounds. The relationships between different entities were well-defined, facilitating the establishment of connections and retrieval of related data. The use of MySQL as the database management system (DBMS) ensured data integrity, scalability, and reliability. The database design incorporated normalization principles to eliminate redundancy and ensure efficient storage and retrieval of data. The schema design was optimized to support the search and analysis functionalities, allowing users to navigate and explore the data seamlessly.

Functionality Evaluation: DIABETESRX offers a range of functionalities to users, enhancing their experience and enabling effective utilization of the database. The user interface (UI) design provides an intuitive and user-friendly platform for accessing and interacting with the database. The search functionality allows users to perform keyword-based searches, enabling them to quickly retrieve information on specific plants, medicinal uses, category. The cross-referencing capabilities of DIABETESRX enable users to explore the connections between different entities, such as linking specific plant species to their medicinal uses and active compounds. This feature facilitates comprehensive research and analysis, supporting users in identifying potential relationships and correlations.

Performance Evaluation: The performance of the DIABETESRX database was evaluated in terms of response time, scalability, and reliability. The database demonstrated efficient query processing and retrieval speed, ensuring a seamless user experience. Indexing techniques were applied to optimize query performance, allowing users to obtain search results promptly. The database architecture and infrastructure were designed to support scalability, accommodating growing data volumes and user traffic. Vertical scaling measures, such as hardware upgrades and optimization, were implemented to handle

increasing workloads. Horizontal scaling strategies, such as load balancing and database replication, were employed to distribute the workload and ensure high availability. Data backups and disaster recovery mechanisms were also in place to maintain the integrity and reliability of the database. Regular performance monitoring and optimization practices were performed to identify and address any potential bottlenecks or performance issues.

6.2. Contributions and Advancements of DIABETESRX:

In this section, we discuss the contributions and advancements made by the DIABETESRX database in the field of traditional medicinal plant research.

Centralized and Accessible Repository: DIABETESRX serves as a centralized repository for traditional medicinal plant data for the cure of Diabetes. By consolidating information from various sources and research papers, DIABETESRX provides researchers with a single platform to access a wide range of data on traditional medicinal plants. This centralized approach eliminates the need for researchers to search through multiple resources, saving time and effort. The accessibility of DIABETESRX further contributes to its value. The user-friendly interface and intuitive navigation enable researchers, practitioners, and enthusiasts to easily explore and retrieve information from the database. The search functionality and filtering options make it convenient to find relevant data and make meaningful connections between different aspects of traditional medicinal plants.

Promotion of Traditional Knowledge Preservation: One of the significant contributions of DIABETESRX is its role in promoting the preservation of traditional knowledge associated with medicinal plants. Traditional medicine practices have been passed down through generations, often in oral or written form. DIABETESRX captures and documents this valuable traditional knowledge, ensuring its preservation and dissemination to a wider audience. By providing detailed information on the traditional uses, preparation methods, and cultural significance of medicinal plants, DIABETESRX helps to safeguard and promote traditional knowledge. Researchers and practitioners can access this information and gain a deeper understanding of the traditional healing practices from India.

Support for Evidence-Based Research: DIABETESRX contributes to evidence-based research in the field of traditional medicine. The database incorporates information on the chemical constituents, pharmacological properties, and medicinal uses of traditional medicinal plants. This data serves as a valuable resource for researchers to explore the therapeutic potential of these plants and their active compounds. Researchers can utilize the comprehensive information in DIABETESRX to conduct studies on the efficacy, safety, and

mechanisms of action of traditional medicinal plants. The database supports evidence-based decision-making, enabling researchers to identify promising plant species for further investigation and potential development of new therapeutic agents. Empowering

Collaborative Research: DIABETESRX fosters collaboration among researchers, institutions, and communities interested in traditional medicinal plants. The database provides a platform for sharing research findings, contributing additional data, and exchanging insights and knowledge. This collaborative approach promotes cross-disciplinary research and encourages a broader understanding of traditional medicine. Researchers can leverage the database to initiate collaborative projects, compare findings, and validate traditional knowledge through scientific investigations. The integration of geographic information in DIABETESRX also facilitates collaboration among researchers studying traditional medicinal plants in specific regions, allowing them to identify regional trends, variations, and unique plant species.

Effective management of Diabetes: Effective management of diabetes with the help of traditional medicinal plants in India involves the utilization of natural remedies derived from indigenous flora to regulate blood sugar levels and alleviate symptoms associated with the condition. Traditional medicinal plants such as bitter melon, Indian gooseberry (amla), fenugreek, and neem have been extensively studied for their anti-diabetic properties. These plants contain bioactive compounds that help enhance insulin sensitivity, promote glucose uptake by cells, and inhibit glucose absorption in the intestine. Additionally, traditional herbal formulations and decoctions are often used to support overall health, boost immunity, and reduce the risk of complications associated with diabetes. Integrating these traditional remedies into modern healthcare practices offers a holistic approach to diabetes management, providing safe, effective, and accessible treatment options for individuals living with the condition.

6.3. Future Enhancements and Expansion of DIABETESRX:

In this section, we discuss potential areas for improvement and development of DIABETESRX.

Enriching Data Coverage: To enhance the comprehensiveness of DIABETESRX, efforts should be made to expand the database's coverage of traditional medicinal plants. This can be achieved by conducting additional field studies, engaging with local communities, and collaborating with researchers across the region. By including data from a wider range of sources, DIABETESRX can provide a more holistic and representative view of traditional medicinal plants in India.

Furthermore, the inclusion of additional data fields related to plant characteristics, traditional preparation methods, and dosage information can enrich the database and provide more comprehensive information to users

Integration of Multi-lingual Support: To overcome the language barrier and increase accessibility, the integration of multi-lingual support within DIABETESRX is crucial. Providing translations of the database content in local languages spoken in the across Indian states can facilitate wider participation and understanding of traditional medicinal plants.

Advanced Search and Analysis Tools: To facilitate efficient data retrieval and analysis, DIABETESRX can benefit from the implementation of advanced search and analysis tools. These tools can include features such as advanced keyword search, filters based on plant properties and medicinal uses, and data visualization capabilities.

By incorporating these tools, researchers and practitioners can quickly identify specific plant species, explore relationships between plant characteristics and medicinal properties, and conduct data-driven analyses. This can aid in identifying potential new leads for drug discovery, understanding regional variations in traditional medicine practices, and supporting evidence-based decision-making.

Collaboration and Data Sharing: Encouraging collaboration and data sharing within the research community can further enhance the value of DIABETESRX. By establishing partnerships with research institutions, organizations, and traditional healers, DIABETESRX can serve as a platform for sharing research findings, data contributions, and insights.

Promoting data sharing can lead to the growth of the database, with contributions from diverse sources and regions. Collaboration can also foster the exchange of knowledge and

expertise, leading to new research opportunities and cross-disciplinary studies. Implementing mechanisms for data citation and acknowledgment can incentivize researchers to contribute their findings to DIABETESRX, further enriching the database.

Integration of User Feedback and Continuous Improvement: To ensure the ongoing improvement and relevance of DIABETESRX, it is important to actively seek and integrate user feedback. Providing avenues for users to provide suggestions, report errors, and share their experiences can help identify areas for improvement and address any concerns.

Regular updates and maintenance of the database, including bug fixes and security enhancements, should be carried out to ensure its smooth functioning. Additionally, incorporating user feedback in the development roadmap can guide the prioritization of new features and functionalities, ensuring that DIABETESRX remains aligned with the needs of its users.

In conclusion, the future enhancements and expansion of DIABETESRX should focus on enriching data coverage, integrating multi-lingual support, implementing advanced search and analysis tools, fostering collaboration and data sharing, and actively incorporating user feedback. By continuously improving and expanding the database, DIABETESRX can serve as a valuable resource for researchers, practitioners, and communities engaged in the study and utilization of traditional medicinal plants, contributing to the preservation and advancement of traditional medicine in India.

Conclusion

In this study, we have developed the DIABETESRX database, a comprehensive repository of traditional medicinal plants in India. The study aimed to address the need for a centralized and accessible platform that consolidates information on traditional medicinal plants, promoting their preservation, utilization, and further research. Through an extensive literature review, we established the background and significance of traditional medicinal plants in India. The research problem and motivation were identified, highlighting the gaps in existing databases and the potential for DIABETESRX to contribute to the field. The research objectives were formulated to guide the development and evaluation of the database. The scope of the study encompassed the extraction of data from research papers conducted in various parts India.

The database was developed using ASP.NET MVC Framework and SQL Server Database, ensuring a user-friendly interface and efficient data management. We discussed the research design and approach, emphasizing the collection of data from diverse sources, including online resources and research papers. The data collection methods involved extracting information from PDFs and organizing it in Excel and other suitable formats. Data sources and sampling strategies were outlined, highlighting the importance of collaboration with researchers and local communities to gather reliable and representative data. The database development and architecture were described, emphasizing the use of modern technologies to ensure scalability and flexibility. The database structure and schema design were presented, illustrating the organization of data fields related to traditional medicinal plants. Data validation and quality assurance procedures were implemented to maintain data accuracy and reliability.

Ethical considerations were addressed, emphasizing the respect for traditional knowledge, the need for informed consent, and the protection of intellectual property rights. User interface design and functionality were discussed, focusing on creating an intuitive and accessible platform for users to interact with the database. Database features and functionality were presented, showcasing the various search options, filters, and data visualization tools available to users. Data entry and management processes were outlined, emphasizing the importance of ongoing updates and data maintenance, The integration of traditional medicinal plant data was described, showcasing the linkage between traditional knowledge, scientific research, and conservation efforts. The performance and scalability of

the database were discussed, highlighting the optimization measures implemented to ensure efficient data retrieval and processing.

The comparison with existing databases and resources emphasized the unique contributions of DIABETESRX in terms of its regional focus, comprehensive data coverage, and user-friendly interface. The contributions and advancements of DIABETESRX were outlined, emphasizing its potential to promote traditional medicinal practices, facilitate research collaborations, and support evidence-based decision-making. Limitations and challenges encountered during the study were acknowledged, including data availability, language barriers, data validation, and sustainability.

Future enhancements and expansion opportunities were proposed, such as enriching data coverage, implementing multi-lingual support, and fostering collaboration and data sharing.

In conclusion, the DIABETESRX database serves as a valuable resource for researchers, practitioners, and communities interested in traditional medicinal plants in India. It contributes to the preservation and utilization of traditional knowledge, promoting sustainable healthcare practices and supporting the development of evidence-based traditional medicine. Recommendations for further development and collaboration were provided, emphasizing the need for ongoing support, maintenance, and user engagement to ensure the continued success and impact of DIABETESRX.

In summary, the research objectives have been successfully achieved through the development of the DIABETESRX database. It provides a valuable resource for accessing and utilizing information on traditional medicinal plants in India, promotes research collaborations, and supports evidence-based traditional medicine practices. The achievements of this study lay the foundation for further development, collaboration, and utilization of DIABETESRX in the future.

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Major project DiabetesRx

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