Obstructive Sleep Apnea Detection Using
Machine Learning and GUI Techniques

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering

By

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Sabarish V(39117001) and Vishnu V(39111108)** who carried out the Project Phase-1 entitled **"Obstructive Sleep Apnea Detection Using Machine Learning and GUI Techniques"** under my supervision from January 2023 to April 2023.

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I, **Sabarish V (Reg.No- 39117001),** hereby declare that the Project Phase-1 Report entitled **Obstructive Sleep Apnea Detection Using Machine Learning and GUI Techniques** done by me under the guidance of **Dr. P. Asha, M.E., Ph.D** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.

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ACKNOWLEDGEMENT

ABSTRACT

Obstructive Sleep Apnea is a respiratory disorder that impairs sleep quality by causing respiratory arrest. An irregular breath delay or decrease of airflow during sleep is the hallmark of the apnea syndrome. According to the literature, approximately 2% of middle-aged women and 4% of middle-aged men are affected. The disease is diagnosed by the physician in two steps. In the first stage, the physician reviews the medical records obtained using the polysomnography system. The disease is diagnosed in two stages by the physician, who examines the patient records taken with the polysomnography system in the first stage. New diagnostic processes and equipment are required as a result of the negative aspects of this procedure. Sleep is a period of rest that is essential for functional learning ability, mental health, and even the performance of normal activities. Insomnia, sleep apnea, and restless legs are all examples of sleep-related issues that are growing more widespread. Obstructive Sleep Apnea is a respiratory disorder that impairs sleep quality by causing respiratory arrest. An irregular breath delay or decrease of airflow during sleep is the hallmark of the apnea syndrome. Sleep apnea is a sleep disorder that affects a large population. This disorder can cause or augment the exposure to cardiovascular dysfunction, stroke, diabetes, and poor productivity. Here, we use the machine learning algorithm are random forest and SVM as well as to create the web application of Django framework to predict the sleep apnea disease of the patient. Experimental results had shown the better performance of the system.

Keywords: Machine Learning, Web Application**,** Obstructive Sleep Apnea, Prediction, Django Framework.

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CHAPTER 1

INTRODUCTION

Obstructive sleep apnea (OSA) is a major type of sleep related breathing disorders. Poor sleep has a major impact on social and personal activities. Due to obstructions in the airway, it affects a person's ability to sleep well, causing loud snoring, choking, and gasping for breath while sleeping, as well as daytime sleepiness and headache. If not addressed, this could lead to health complications including hypertension, heart attacks, diabetes, depression, and early death. Obstructive sleep apnea (OSA) is a common chronic medical disease with an estimated prevalence rate of 5–14%. A recent study has suggested that the actual prevalence of OSA could be much higher, with estimates ranging from 24% to as high as 50% in the mean which would make it the most prevalent chronic medical condition. Besides high prevalence, OSA has a wide-ranging impact on health and has been shown to be associated with an increased risk of hypertension, cardiovascular disease, cerebrovascular disease, atrial fibrillation, impaired glycemic control, erectile dysfunction, and gastroesophageal reflux, as among other conditions. Moreover, sleep disruption caused by sleep apnea leads to significant daytime sleepiness with implications for risk for motor vehicle accidents, especially in high-risk employees such as truck drivers or those heavy operating machinery. It can also lead to significant changes in mood, including depression, and cause attention deficit and loss of memory. Traditionally the diagnosis of sleep apnea has been made by overnight polysomnography, which is done in a sleep laboratory. However, this requires significant investment in infrastructure, including hiring certified personnel, and hence became an impractical solution to diagnose sleep apnea efficiently. With the advent of home sleep testing, it became easier to screen more people for sleep apnea. Still, given the high disease prevalence, and relatively small numbers of home sleep testing equipment in use, especially among certified sleep providers, this approach is associated with significant barriers and diagnosis delays. Healthcare is one of the critical concerns for global nations. Irrespective of whether it's a developing nation or the super economic nations, in common one of the key areas of focus is the quality healthcare to the public. Alongside the increasing amenities and developments in the healthcare solutions, even the complexities too are on rise. For instance, some of the challenges that are impact the quality health for the individuals are the stress related health problems, obesity related

and the contemporary issues like the sleep apnea conditions that are adding up the complexities of quality health for public of the system.

Due to different sleep disorders, the death rate is increasing day by day. Not only India but the whole world is facing the wide spread of the infectious sleep disorders. The major reason for death is unawareness among people related to sleep disorders. Also, people are very careless regarding their lifestyle and eating habits which causes a sleep disorder to grow at a fast rate in their body and finally leads to the end of a human life. Computer science is growing at a surprising rate, giving new arenas and progress interfaces to tackle the disastrous situations that can be a great source of assistance for an ordinary human being to diagnose and further get to know about the deadly sleep disorders with which they are suffering. As per the survey, 93% population in India is suffering from sleep-related issues, however just 2% Indians talk about their sleep-related issues with physicians. Further, sleep loss and sleep disorders have critical commercial effects. Along with this, sleep disorders have also a significant economic impact. These economic, socio and personal consequences which the people with sleep disorders face are much higher than the cost involved in the treatment. An enormous amount of money for every year is spent on direct medical cost related to doctor's visits, service charges, medicinal cost etc. In comparison to healthy people, who experience the effects of sleep loss, sleep disorders, or both are less productive and are more inclined to accidents. Out of the total population, 20% of severe car crash accidents are related with driver's sleepiness rather than the consumption of alcohol. There are many short and long-term effects of sleep disorders. The short living impacts tend to less consideration, affect personal satisfaction, loss of potential and sometimes lead to mishappening. The long-term impacts of sleep disorders move towards inclination the morbidity and death rate from the expanding disasters, cardiovascular problems, hypertension, obesity and learning inability. A few sleep disorders are very serious to put great effects on physical, psychological, cognitive and motor functioning of a person. There are no reliable figures on how many are diagnosed and treated for the sleep disorders. According to a survey, total 40 million U.S. people have chronic sleep disorders, due to which $18 billion loss of productivity is estimated among them and 30% of all adults have insomnia problem Marcus. A large number of 1550 is estimated for car crashes/ major accidents due to falling asleep. By 2030, the number of older adults will be rise to 1.578 million, in which more than 260 million people probably facing sleep problems. Thus, the estimates

propose that sleep disorders may exhibit a powerful and obscure problem among older people in low-monetary comforts. Theses judgments further highlighted the global height of sleep problems as a developing public health issue.

●   In our article, we use the web application based Django framework are implemented to predict the sleep apnea disease based on present and absent condition of the patient of the system.

●   The Existing system uses same techniques, but different algorithms to predict the Obstructive Sleep Apnea (OSA) .

●   The algorithms used in the existing systems are Support Vector Machine (SVM) and KNN

Sleep Apnea

Sleep Apnea is a common phenomenon of sleep disorder, which is faced by millions of people across the countries. The condition is about how a person stops breathing during the sleep, in periodical instances. The cessations of breathing might take place regularly and the intensity and frequency of cessations decide the categorization as mild or medium or high levels of sleep apnea problem. The impact of the problem is about the brain are not allowed to deeper stages of sleep to prevent choking for breathing in the patient. When there are frequent interruptions, the quality of sleep gets affected, thus leading to more health complications. While there are many who are familiar with the distinct forms of sleep apnea conditions, OSA (Obstructive Sleep Apnea) is the major challenge that goes often unrecognized. Figure 1 shows side effects of sleep Apnea.
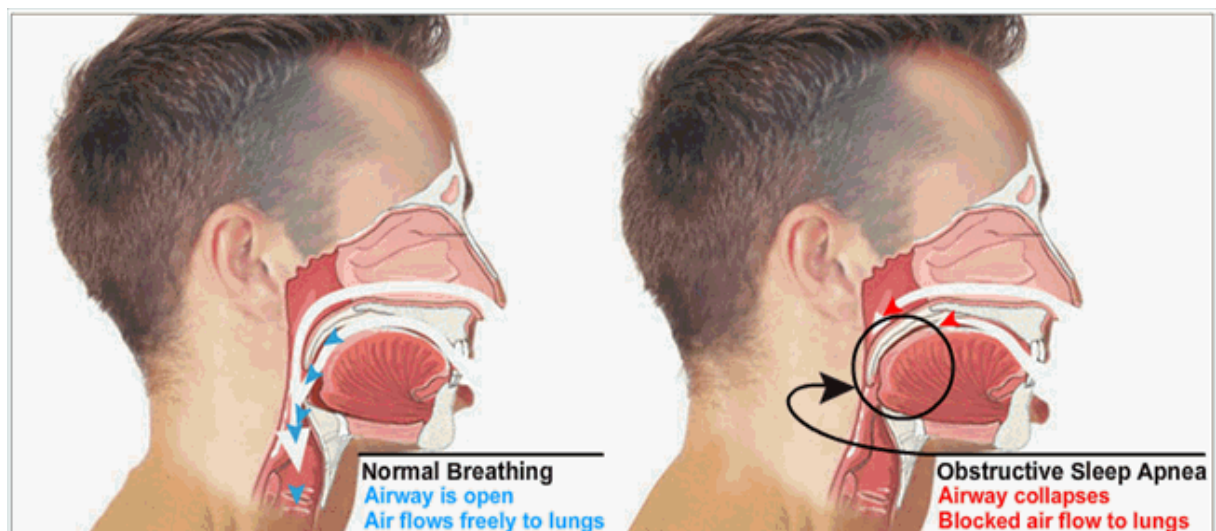

Normal Breathing
Airway is open
Air flows freely to lungs

Obstructive Sleep Apnea
Airway collapses
Blocked air flow to lungs

SLEEP AND ITS TYPES

Sleep is a naturally occurring state identified by decreasing or missing awareness of surrounding and suspension of sensational activities. In this state, all muscles are in the relaxed state. It is an increased anabolic state which helps in the development of strong immune, nerve, muscles and skeletal system. It is found in all well-evolved creatures, birds and numerous reptiles, creatures of land and water and fish. Sometimes, sleep is supposed to aid preserve energy.

Types:

Basically, sleep has been categorized into two forms

➢   Rapid eye movement (REM)

➢   Non-rapid eye movement (NREM)

Every form has a set of identified physiological and neurological features. As per the American Academy of Sleep Medicine, NREM has been divided into three parts: N1, N2, and N3 as explained below. One does not go straight from deep sleep to REM sleep, however. Rather, a sleep cycle progress through the stages of non-REM sleep from light to deep sleep, then reverse back from deep sleep to light sleep, ending with time in REM sleep before starting over in light sleep again. After REM sleep, the individual returns to stage 1 of light sleep and begins a new cycle.

NREM stage 1: This is a stage between sleep and wakefulness. It is a light sleep (alpha activity) and a person can wake up easily at this stage. Eyes move very gradually while muscles activities slow down and people mostly remember the visual images after awakening from this stage.

NREM stage 2: Also known as theta activity. It gradually becomes harder to awaken the sleeper in this stage. The eye movement and brain activities become slow due to the sleep spindles and K-complexes which intercede the alpha waves of stage 1. Out of the total sleep time, 50% time is spent in this stage.

 NREM stage 3: It is also called as slow-wave sleep (SWS) and delta waves begin to appear with high amplitude at less than 3.5 Hz. The sleeper is less responsive to the environment. When stage 4 arrives, then almost exclusively delta waves are generated by the brain. During stages 3 and 4, t is very difficult to wake someone, which

collectively known as deep sleep. Eye movements or muscle activities are stopped at this stage. People can't adjust themselves after awakening from this stage and feel dizzy and unbalanced for a few minutes. A few minors encounter bedwetting, night fear or sleepwalking in deep sleep.

Types of Sleep Disorders

Sleep Apnea: It is a sort of sleep disorder defined by stops in breathing or infrequent breathing amid sleep. Every stop in breathing known as apnea that can retain from no less than ten seconds to minutes and may happen 5 to 30 times or increasingly 60 minutes. Fundamentally, sleep apnea is a sleep-related breathing disorder. The below Figure 4 demonstrates the consequences of sleep apnea.
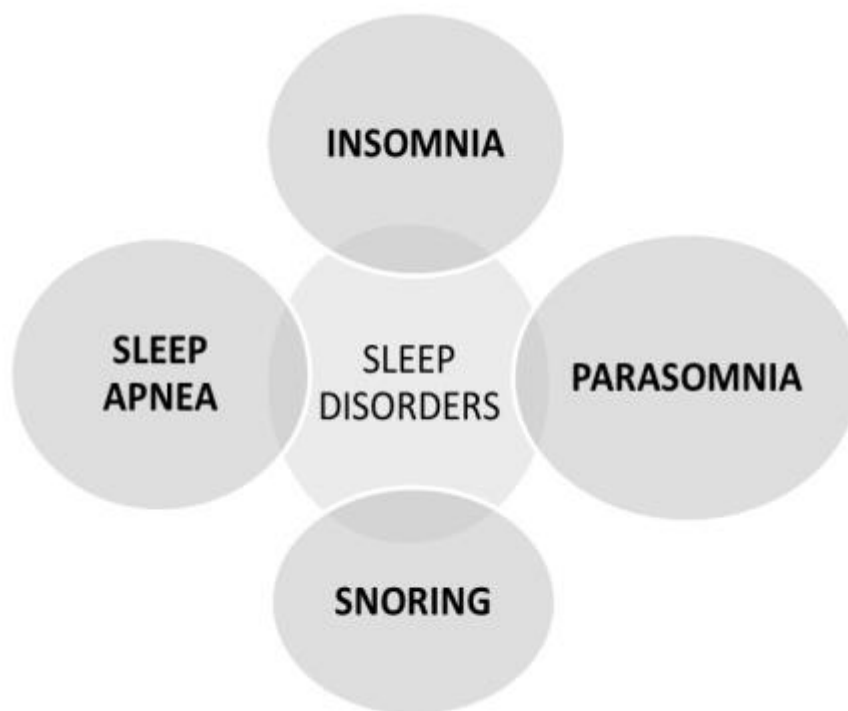
Fig 1 Types of Sleep Disorders

It is treatable; still, around 90% of patients are unknown and consequently untreated. They encounter daytime lethargy and tiredness that leads to car crashes, sadness, and memory loss. Moreover, it is viewed as a hazard factor for morbidity and mortality because of its long-haul consequences on the cardiovascular system. This impact is identified with various physiological components like hypertension that in a long haul compromises the well-working of the heart. It is related to heart failure which is 12-16% more pervasive in apnea patients. It has additionally been watched that roughly

60-70% of rest apnea patients are obese. Patients in danger for sleep apnea should be distinguished for symptomatic testing and treatment .

Insomnia: The presence of this disorder happened regularly in OSA patients and consistently related with poor sleep quality yet had no impact on long-haul 7 inconveniences and as indicated the half patients experienced insomnia which goes from moderate to serious.

Parasomnia: It refers to physical disturbance during sleep that involves the skeletal, motor and autonomic nervous systems. Adults with parasomnia often report the behavioral, perceptual, emotional, and dreamlike disturbances that may erroneously suggest a psychiatric disorder

Snoring: It is a sound delivered because of obscured air movement amid breathing during sleep. Sometimes, this sound might be delicate, however in different cases; it can be heavy and undesired. It is a syndrome and an indication of sleep-related upper aviation route deterrent and is exceptionally normal, influencing over 9% to half of the grown-up population. It alludes to an issue of bed-partner. Numerous do not view snoring alone to be a morbidity. Only with other disorder is snoring considered pathologic. It has been reported as a risk factor for the growth of more problems such as brain infraction, hypertension, and sleep disturbances etc.

IMPACT OF SLEEP APNEA

It is a sort of sleep disorder defined by stops in breathing or infrequent breathing amid sleep. Due to this disorders, many bad impacts put on our various body parts as shown in the below Figure 1.4

Fig 1 Impact of Sleep Apnea

The below is the brief description of the few impacts which put bad effects on various parts of the body.

Impaired Moral Judgement:- Bad sleep always put an adverse effect on physical well being and passionate prosperity of an individual. A sleep-deprived patient always takes more time to give the answers of questions than a normal one.

Heart Rate Variability:- Heart rate changes during various sleep stages. If an individual suffers from any sleep disorders like in sleep apnea where pauses occur during breathing then these pauses affect the heart. Similarly, in snoring, heart rate varies due to the air obstruction. **Risk of Heart Diseases:-** The person suffering from sleep apnea and snoring is more likely to be suffering from cardiovascular diseases.

Decreased Accuracy:- A sleep disorder patient are more tend to be a tired person. Due to this tiredness, an individual is not able to give the best efforts and the overall performance or growth would be degraded.

Increased Reaction Time:- A sleep-deprived patient always takes more time to give a response as per the assigned task than the normal human being. Hence, the effectiveness of the task would be less.

Impaired Immune System:- An individual suffered from sleep loss will suffer from cold, flu and other ailments and when it is not functioning properly, the person will fail to do the job.

Hallucinations:- Due to sleep apnea, sometimes a person feels hallucination or sleep paralysis in which a person is not able to move for some minutes/seconds.

Severe Yawning:- Due to tiredness, drowsiness and sleep loss, a person moves towards severe yawning.

Memory Loss:- Sleep apnea occurs when a blocked airway repeatedly halts the sleeper's breathing, resulting in loud bursts of snoring and chronic daytime fatigue. Memory loss and difficulty focusing are the common complaints in sleep apnea patients.

Irritation:- The Individuals having sleep loss and sleep deprivation tend to be more irritated. Due to this, they are not able to give the best efforts towards their tasks.

Diabetes:- It has shown to be associated with higher incidence of sleep disorders, which may be due to the disease itself or because of secondary complications or associated comorbidities associated with diabetes.

Obesity:- Decreased sleep duration and quality is associated with an increase in body weight.

Tremors:- People with sleep apnea experience a range of symptoms, including tremor (shaking), rigidity (stiffness), slowness of movement, and problems with balance and coordination. They may also have memory problems, depression, and sleep complaints.

Aches:- Sleep disorders such as sleep apnea or insomnia also can trigger bouts of muscle pain that make sleeping difficult.

Growth Suspension:- The sleep breathing disorder also influences the growth hormone secretion in adults as well as in children.

Decreased Temperature:- In this sleep occurs when the core temperature is dropping. Sleep usually begins when the rate of temperature change and body heat loss is maximal.

Risk Factors

Rapidly increasing prevalence of OSA is a concern of paramount importance worldwide which demands the identification the risk factors responsible for the onset of OSA in order to ensure effective management OSA and associated consequences like cardiovascular disorders (CVD). Figure 6 depicts various risk factors associated with OSA.
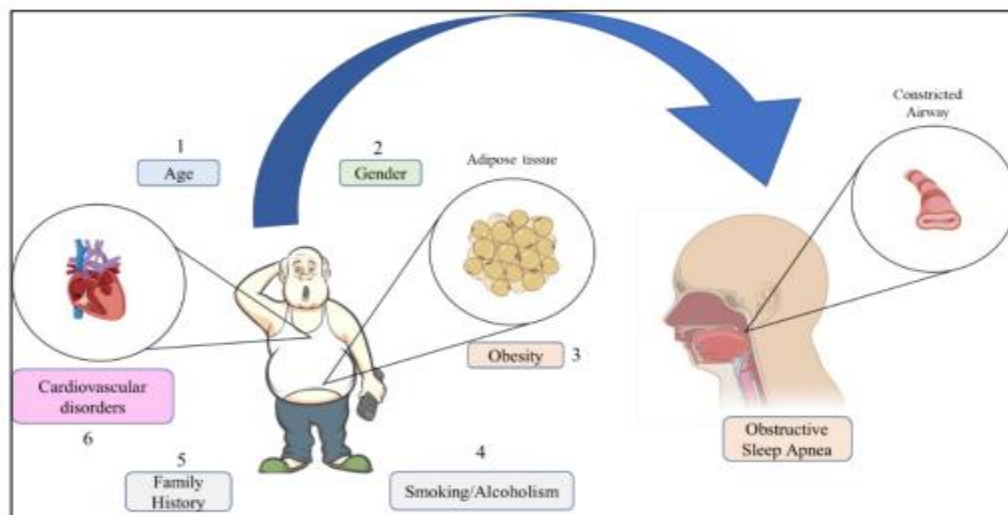

Fig 1 Risk factors for OSA

1.1 ARTIFICIAL INTELLINGENCE:

Artificial intelligence (AI) is the ability of a computer program or a machine to think and learn. It is also a field of study which tries to make computers "smart". As machines become increasingly capable, mental facilities once thought to require intelligence are

removed from the definition. AI is an area of computer sciences that emphasizes the creation of intelligent machines that work and reacts like humans. Some of the activities computers with artificial intelligence are designed for include: Face recognition, Learning, Planning, Decision making etc. Artificial intelligence is the use of computer science programming to imitate human thought and action by analysing data and surroundings, solving or anticipating problems and learning or self-teaching to adapt to a variety of tasks

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1.2 MACHINE LEARNING

Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for **building mathematical models and making predictions using historical data or information**. Currently, it is being used for various tasks such as **image recognition**, **speech recognition**, **email filtering**, **Facebook auto-tagging**, **recommender system**, and many more. Machine Learning is said as a subset of **artificial intelligence** that is mainly concerned with the development of algorithms which allow a computer to learn from the data and past experiences on their own. The term machine learning was first introduced by **Arthur Samuel** in **1959**. We can define it in a summarized way as: "Machine learning enables a machine to automatically learn from data, improve performance from experiences, and predict things without being explicitly programmed". A Machine Learning system **learns from historical data, builds the prediction models, and whenever it receives new data, predicts the output for it**. The accuracy of predicted output depends upon the amount of data, as the huge amount of data helps to build a better model which predicts the output more accurately. Suppose we have a complex problem, where we need to perform some predictions, so instead of writing a code for it, we just need to feed the data to generic algorithms, and with the help of these algorithms, machine builds the logic as per the data and predict the output. Machine learning has changed our way of thinking about the problem. The below block diagram explains the working of Machine Learning algorithm:
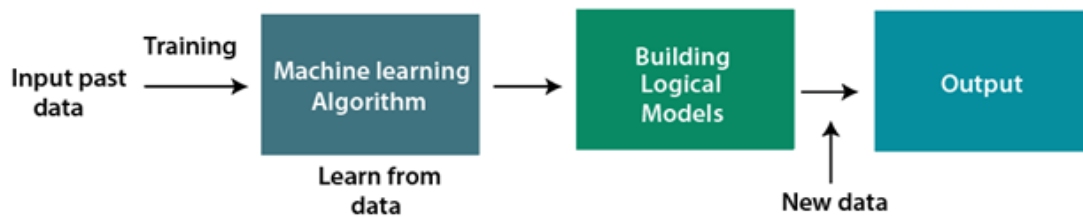
Fig 1.2 Machine Learning

Features of Machine Learning:

● Machine learning uses data to detect various patterns in a given dataset.

● It can learn from past data and improve automatically.

● It is a data-driven technology.

● Machine learning is much similar to data mining as it also deals with the huge amount of the data.

Classification of Machine Learning

At a broad level, machine learning can be classified into three types:

1. Supervised learning

2. Unsupervised learning

3. Reinforcement learning

Fig 1.2 Machine Learning Classification

1.2.1 Supervised Learning

Supervised learning is a type of machine learning method in which we provide sample labeled data to the machine learning system in order to train it, and on that basis, it predicts the output. The system creates a model using labeled data to understand the datasets and learn about each data, once the training and processing are done then we test the model by pro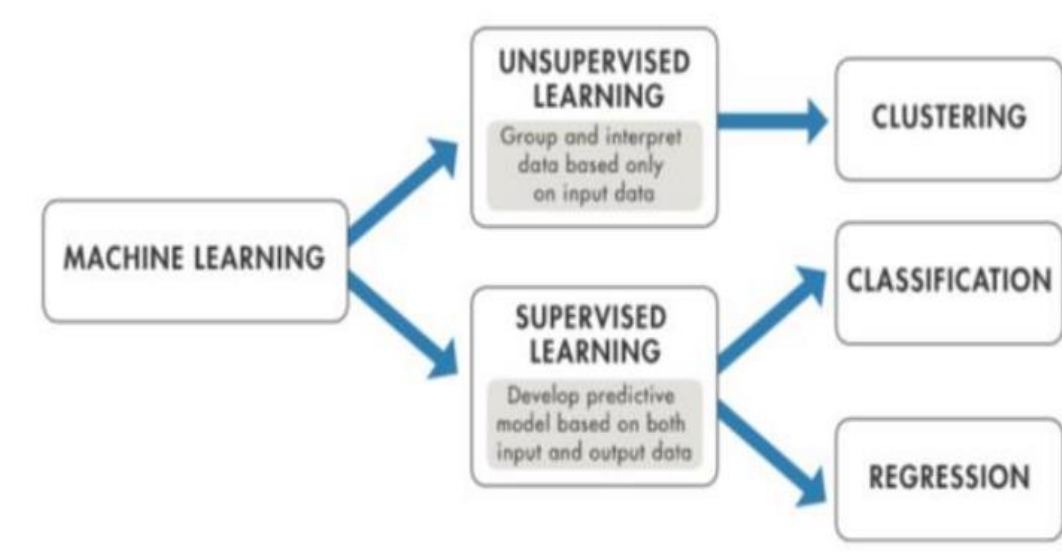viding a sample data to check whether it is predicting the exact output or not. The goal of supervised learning is to map input data with the output data. The supervised learning is based on supervision, and it is the same as when a student learns things in the supervision of the teacher. The example of supervised learning is **spam filtering.**

Supervised learning can be grouped further in two categories of algorithms:

- **Classification**
- **Regression**

1.2.2 Unsupervised Learning

Unsupervised learning is a learning method in which a machine learns without any supervision. The training is provided to the machine with the set of data that has not been labeled, classified, or categorized, and the algorithm needs to act on that data without any supervision. The goal of unsupervised learning is to restructure the input data into new features or a group of objects with similar patterns. In unsupervised learning, we don't have a predetermined result. The machine tries to find useful insights from the huge amount of data. It can be further classifieds into two categories of algorithms:

- **Clustering**
- **Association**

1.3 SQL:

SQL is Structured Query Language, which is a computer language for storing, manipulating and retrieving data stored in a relational database.

SQL is the standard language for Relational Database System. All the Relational Database Management Systems (RDMS) like MySQL, MS Access, Oracle, Sybase, Informix, Postgres and SQL Server use SQL as their standard database language.

Also, they are using different dialects, such as −

- MS SQL Server using T-SQL,
- Oracle using PL/SQL,
- MS Access version of SQL is called JET SQL (native format) etc.

Why SQL?

SQL is widely popular because it offers the following advantages −

- Allows users to access data in the relational database management systems.
- Allows users to describe the data.
- Allows users to define the data in a database and manipulate that data.
- Allows to embed within other languages using SQL modules, libraries & pre-compilers.
- Allows users to create and drop databases and tables.

SQL Process

When you are executing an SQL command for any RDBMS, the system determines the best way to carry out your request and SQL engine figures out how to interpret the task.

There are various components included in this process.

These components are :
- Query Dispatcher
- Optimization Engines
- Classic Query Engine
- SQL Query Engine, etc.

A classic query engine handles all the non-SQL queries, but a SQL query engine won't handle logical files.

Mysql: A database is a separate application that stores a collection of data. Each database has one or more distinct APIs for creating, accessing, managing, searching

and replicating the data it holds. Other kinds of data stores can also be used, such as files on the file system or large hash tables in memory but data fetching and writing would not be so fast and easy with those type of systems. Nowadays, we use relational database management systems (RDBMS) to store and manage huge volume of data. This is called relational database because all the data is stored into different tables and relations are established using primary keys or other keys known as Foreign Keys.

A **Relational Database Management System (RDBMS)** is a software that −

- Enables you to implement a database with tables, columns and indexes.
- Guarantees the Referential Integrity between rows of various tables.
- Updates the indexes automatically.
- Interprets an SQL query and combines information from various tables.

MySQL is a fast, easy-to-use RDBMS being used for many small and big businesses. MySQL is developed, marketed and supported by MySQL AB, which is a Swedish company. MySQL is becoming so popular because of many good reasons:

- MySQL is released under an open-source license. So you have nothing to pay to use it.
- MySQL is a very powerful program in its own right. It handles a large subset of the functionality of the most expensive and powerful database packages.
- MySQL uses a standard form of the well-known SQL data language.
- MySQL works on many operating systems and with many languages including PHP, PERL, C, C++, JAVA, etc.
- MySQL works very quickly and works well even with large data sets.

1.4 Django Frame work

Django is a web application framework written in Python programming language. It is based on MVT (Model View Template) design pattern. The Django is very demanding due to its rapid development feature. It takes less time to build application after collecting client requirement. This framework uses a famous tag line: The web framework for perfectionists with deadlines. By using Django, we can build web applications in very less time. Django is designed in such a manner that it handles much of configure things automatically, so we can focus on application development only.

Django is an MVT web framework that is used to build web applications. The huge Django web-framework comes with so many "batteries included" that developers often get amazed as to how everything manages to work together. The principle behind adding so many batteries is to have common web functionalities in the framework itself instead of adding latter as a separate library. One of the main reasons behind the popularity of Django framework is the huge Django community. The community is so huge that a separate website was devoted to it where developers from all corners developed third-party packages including authentication, authorization, full-fledged Django powered CMS systems, e-commerce add-ons and so on. There is a high probability that what you are trying to develop is already developed by somebody and you just need to pull that into your project. Python is arguably one of the easiest programming languages to learn because of its simple language constructs, flow structure and easy syntax. It is versatile and runs websites, desktop applications and mobile applications embedded in many devices and is used in other applications as a popular scripting language.

CHAPTER 2
LITERATURE SURVEY

We present HealthGear, a real-time wearable system for monitoring, visualizing and analyzing physiological signals. HealthGear consists of a set of non-invasive physiological sensors wirelessly connected via Bluetooth to a cell phone which stores, transmits and analyzes the physiological data, and presents it to the user in an intelligible way. In this paper, we focus on an implementation of HealthGear using a blood oximeter to monitor the user's blood oxygen level and pulse while sleeping. We also describe two different algorithms for automatically detecting sleep apnea events, and illustrate the performance of the overall system in a sleep study with 20 volunteers

Presents a new automated method to diagnose and quantify obstructive sleep apnea from single-lead electrocardiograms based on the detection of the periodic oscillations in cardiac interbeat intervals that are often associated with prolonged cycles of sleep apnea. This technique employs the Hilbert transformation of the sinus interbeat interval time series to derive the instantaneous amplitudes and frequencies of the series and calculates their averages and standard deviations over a moving 5-minute window. The authors then apply a thresholding technique and

detect continuous sequences of those windows that lie within threshold limits. When applied to the Computers in Cardiology sleep apnea test data, the authors' algorithm correctly classified 28 out of 30 cases (93.3%) of both sleep apnea and normal subjects, and correctly identified the presence or absence of sleep apnea in 14,591 out of a total of 17,268 minutes (84.5%) of the data from the test set.

Obstructive Sleep Apnea (OSA) is one of the main under-diagnosed sleep disorders. It is an aggravating factor for several serious cardiovascular diseases, including stroke. There is, however, a lack of medical devices for long-term ambulatory monitoring of OSA since current systems are rather bulky, expensive, intrusive, and cannot be used for long-term monitoring in ambulatory settings. In this paper, we propose a wearable, accurate, and energy efficient system for monitoring obstructive sleep apnea on a long-term basis. As an embedded system for Internet of Things, it reduces the gap between home health-care and professional supervision. Our approach is based on monitoring the patient using a single-channel electrocardiogram signal. We develop an efficient time-domain analysis to meet the stringent resources constraints of embedded systems to compute the sleep apnea score. Our system, for a publicly available database (PhysioNet Apnea-ECG), has a classification accuracy of up to 88.2% for our new online and patient-specific analysis, which takes the distinct profile of each patient into account. While accurate, our approach is also energy efficient and can achieve a battery lifetime of 46 days for continuous screening of OSA.

Detection of sleep apnea using electrocardiographic (ECG) parameters is noninvasive and inexpensive. Our approach is based on the hypothesis that the patient's sleep-wake cycle during episodes of sleep apnea modulates heart rate (HR) oscillations. These HR oscillations appear as low-frequency fluctuations of instantaneous HR (IHR) and can be detected using HR variability analysis in the frequency domain. The purpose of this study was to evaluate the efficacy of our ECG-based algorithm for sleep apnea detection and quantification. The algorithm first detects normal QRS complexes and R-R intervals used to derive IHR and to estimate its spectral power in several frequency ranges. A quadratic classifier, trained on the learning set, uses 2 parameters to classify the 1-minute epoch in the middle of each 6-minute window as either apneic or normal. The windows are advanced by 1-minute steps, and the classification process is repeated. As a measure of quantification, the algorithm correctly classified 84.7% of all the 1-minute epochs in the evaluation database; and as a measure of the accuracy of apnea classification, the algorithm

correctly classified all 30 test recordings in the evaluation database either as apneic or normal. Our sleep apnea detection algorithm based on analysis of a single-lead ECG provides accurate apnea detection and quantification. Because of its noninvasive and low-cost nature, this algorithm has the potential for numerous applications in sleep medicine.

Repetitive respiratory disturbance during sleep is called Sleep Apnea Hypopnea Syndrome and causes various diseases. Different features and classifiers have been used by different researchers to detect sleep apnea. This study is undertaken to identify the better performing blood oxygen saturation features subset using an Artificial Neural Network classifier for sleep Apnea detection. A database of 8 subjects with one-minute annotation is used to test the proposed system. The optimized system has seven features chosen from a total set of sixty-one features presenting a high accuracy rate using a genetic algorithm. Artificial Neural Network was able to achieve 97.7 percentage of accuracy with only seven features chosen by the Genetic algorithm

2.1 INFERENCES FROM LITREATURE SURVEY
• Mehmet Recep recommended artificial intelligence for based automatic awake detection based on K-Nearest Neighbour algorithm have used to test the model classification accuracy reached to 88% .

• Hemant Sharma and kk sharma used VMD – KNN algorithm performs better than others

• Taneja Abhishek used the most effective model to predict patients with the sleep apena appears to be a VMD - KNN classifier implemented on the selected attributes with a classification accuracy of 95.56%

2.2 OPEN PROBLEMS IN EXISTING SYSTEM

• Mainly focused on accuracy as the performance metrics

• Depends on polysomnography for detecting apnea which is costly

• No UI (web page) is available for knowing state of persons apnea

• Depends on physical body characteristics for classifying apnea which is cheaper

• A UI (web page) was created for classifying the state of apnea

CHAPTER 3
REQUIREMENT ANALYSIS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

● This Existing paper focuses on an automated classification algorithm which processes short duration epochs of the electrocardiogram (ECG) data.

● The presented classification technique is based on support vector machines (SVM) and has been trained and tested on sleep apnea recordings from subjects with and without OSA. which is tested through polysomnography (PSG) at sleep labs.

● PSG is both expensive and inconvenient as an expert human observer is required to work over night. New sleep apnea classification techniques are nowadays being developed by bioengineers for most comfortable and timely detection.

● This paper focuses on an automated classification algorithm which processes short duration epochs of the electrocardiogram (ECG) data. The presented classification technique is based on support vector machines (SVM) and has been trained and tested on sleep apnea recordings from subjects with and without OSA.

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

● Python language is used.
● Operating System : Windows
● Simulation Tool : Anaconda (Jupyter)

CHAPTER 4
DESCRIPTION OF PROPOSED SYSTEM

Sleep apnea is a sleep-related breathing disorder that causes respiratory problems

and arousals due to a reduction or rise in airflow during sleep. Obstructive sleep apnea (OSA) is the most common form of sleep apnea. In our Proposed method, to predict the sleep apnea disease by using Django Framework as well as machine learning model of the system. With the explosive growth of machine learning (ML) and artificial intelligence and its increasing use in healthcare, recently, the focus has turned to applications of ML in developing predictive models to improve the screening strategy for OSA and increase its accuracy of the system. In the Web Application part, user can enter the symptoms of the patient detail. Finally, to predict the disease based on sleep apnea present or sleep apnea absent of the system.

ADVANTAGES

- Web Application used
- Prediction proper
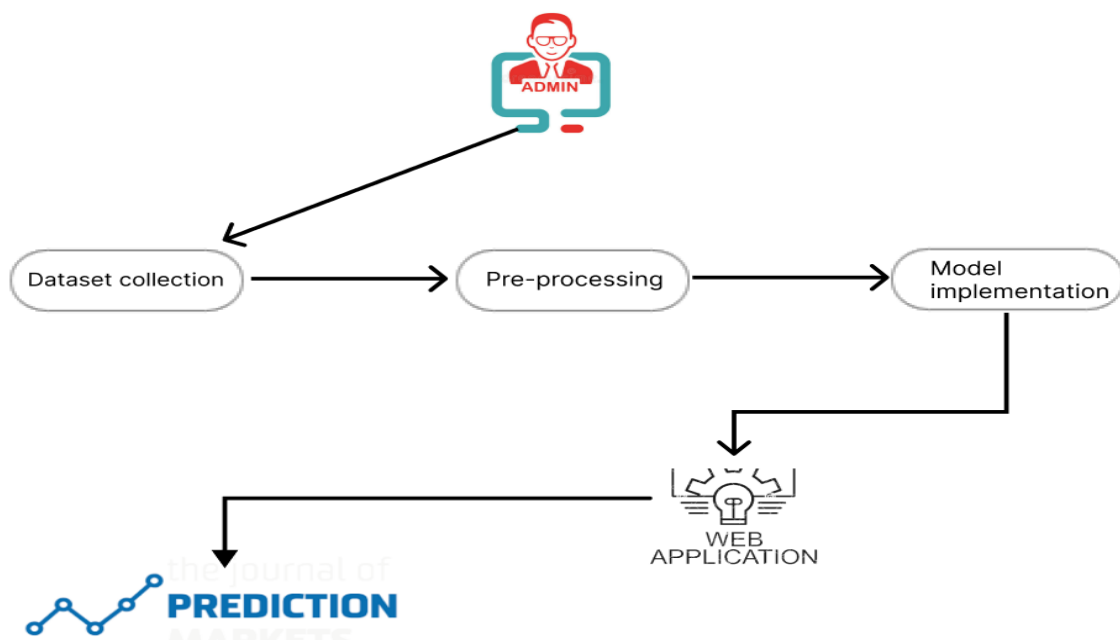- Better accuracy

*Fig 4 **Use case Diagram***

4.1 . EXISTING SYSTEM

- This Existing paper focuses on an automated classification algorithm which processes short duration epochs of the electrocardiogram (ECG) data.
- The presented classification technique is based on support vector machines (SVM)

and has been trained and tested on sleep apnea recordings from subjects with and without OSA. which is tested through polysomnography (PSG) at sleep labs.

● PSG is both expensive and inconvenient as an expert human observer is required to work over night. New sleep apnea classification techniques are nowadays being developed by bioengineers for most comfortable and timely detection.

● This paper focuses on an automated classification algorithm which processes short duration epochs of the electrocardiogram (ECG) data. The presented classification technique is based on support vector machines (SVM) and has been trained and tested on sleep apnea recordings from subjects with and without OSA.

● The Existing system uses same techniques, but different algorithms to predict the Obstructive Sleep Apnea (OSA) .

● The algorithms used in the existing systems are Decision Tree and KNN.

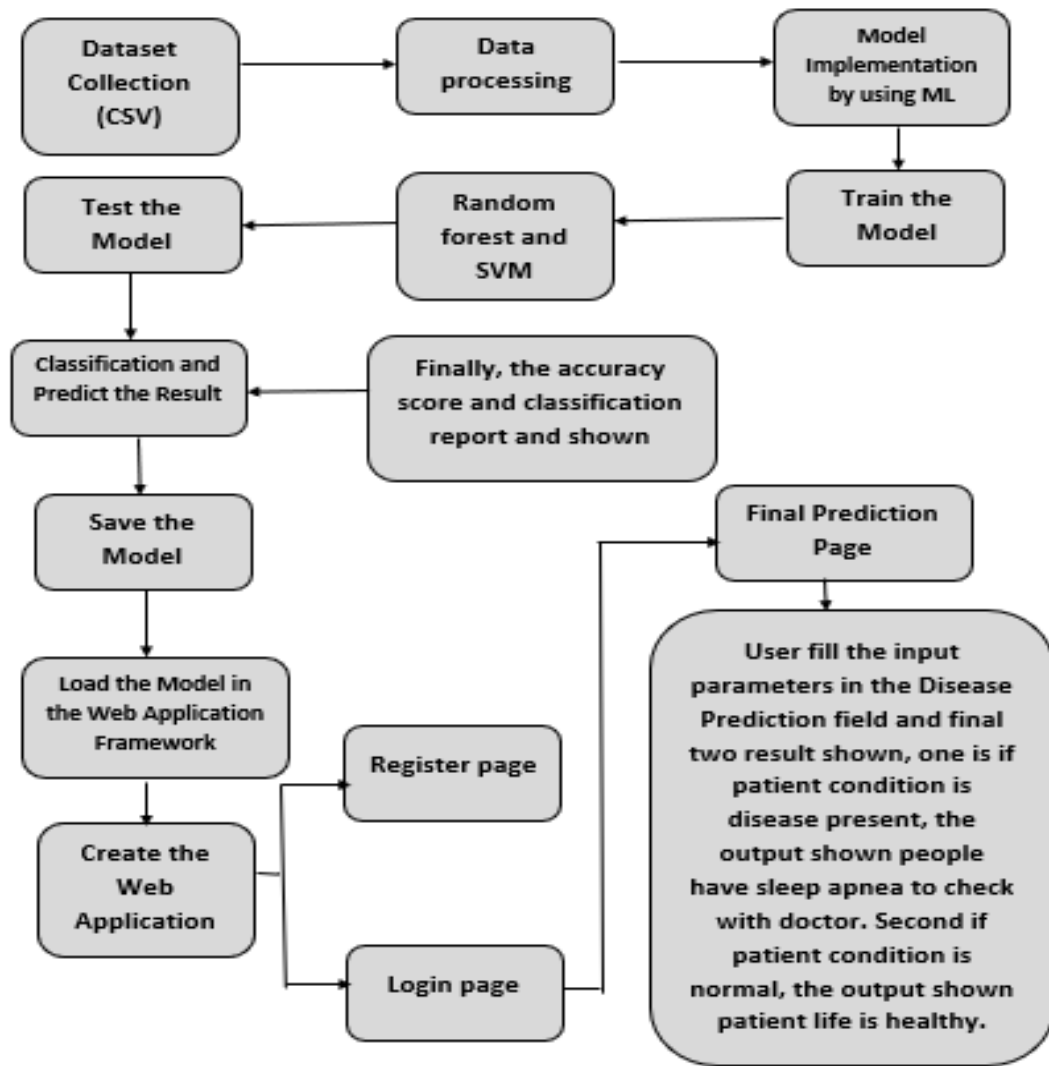## 4.2 ARCHITECTURE / OVERALL DESIGN OF PROPOSED SYSTEM

Fig 4.2 System Architecture

The block diagram of the Our proposed system is a Sleep apnea is a sleep-related breathing disorder that causes respiratory problems and arousals due to a reduction or rise in airflow during sleep. Obstructive sleep apnea (OSA) is the most common form of sleep apnea. In our Proposed method, to predict the sleep apnea disease by using Django Framework as well as machine learning model of the system. With the explosive growth of machine learning (ML) and artificial intelligence and its increasing use in healthcare, recently, the focus has turned to applications of ML in developing predictive models to improve the screening strategy for OSA and increase its accuracy of the system. In the Web Application part, user can enter the symptoms of the patient detail. Finally, to predict the disease based on sleep apnea present or sleep apnea absent of the system.

ADVANTAGES

- Web Application used

- Prediction proper

- Better accuracy

4.3 SOFTWARE ENVIRONMENT

PYTHON:

Python is a dynamic, high level, free open source and interpreted programming language. It supports object-oriented programming as well as procedural oriented programming. In Python, we don't need to declare the type of variable because it is a dynamically typed language.

For example, x=10.Here, x can be anything such as String, int, etc.

Python is an interpreted, object-oriented programming language similar to PERL that has gained popularity because of its clear syntax and readability. Python is said to be relatively easy to learn and portable, meaning its statements can be interpreted in a number of operating systems, including UNIX-based systems, Mac OS, MS-DOS, OS/2, and various versions of Microsoft Windows 98. Python was created by Guido van Rossum, a former resident of the Netherlands, whose favourite comedy group at the time was Monty Python's Flying Circus. The source code is freely available and open for modification and reuse. Python has a significant number of users.

Features in Python

There are many features in Python, some of which are discussed below

- Easy to code

- Free and Open Source

- Object-Oriented Language

- GUI Programming Support

- High-Level Language

- Extensible feature

- Python is Portable language

- Python is Integrated language

- Interpreted Language

ANACONDA

Anaconda distribution comes with over 250 packages automatically installed, and over 7,500 additional open-source packages can be installed from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI).

The big difference between conda and the pip package manager is in how package dependencies are managed, which is a significant challenge for Python data science and the reason conda exists.

When pip installs a package, it automatically installs any dependent Python packages without checking if these conflict with previously installed packages. It will install a package and any of its dependencies regardless of the state of the existing installation. Because of this, a user with a working installation of, for example, Google Tensorflow, can find that it stops working having used pip to install a different package that requires a different version of the dependent numpy library than the one used by Tensorflow. In some cases, the package may appear to work but produce different results in detail.

In contrast, conda analyses the current environment including everything currently installed, and, together with any version limitations specified (e.g., the user may wish to have Tensorflow version 2,0 or higher), works out how to install a compatible set of dependencies, and shows a warning if this cannot be done.

Opensource packages can be individually installed from the Anaconda repository, Anaconda Cloud (anaconda.org), or the user's own private repository or mirror, using the conda install command. Anaconda, Inc. compiles and builds the packages available in the Anaconda repository itself, and provides binaries for Windows 32/64 bit, Linux 64 bit and MacOS 64-bit. Anything available on PyPI may be installed into a conda environment using pip, and conda will keep track of what it has installed itself and what pip has installed.

Custom packages can be made using the conda build command, and can be shared with others by uploading them to Anaconda Cloud, PyPI or other repositories.

The default installation of Anaconda2 includes Python 2.7 and Anaconda3 includes Python 3.7. However, it is possible to create new environments that include any version of Python packaged with conda.

Anaconda Navigator

Anaconda Navigator is a desktop graphical user interface (GUI) included in Anaconda distribution that allows users to launch applications and manage conda packages, environments and channels without using command-line commands. Navigator can search for packages on Anaconda Cloud or in a local Anaconda Repository, install them in an environment, run the packages and update them. It is available for Windows, macOS and Linux.

The following applications are available by default in Navigator:

- JupyterLab

- Jupyter Notebook

- QtConsole

- Spyder

- Glue

- Orange

- RStudio

- Visual Studio Code

JUPYTER NOTEBOOK

Jupyter Notebook (formerly python Notebooks) is a web-based interactive computational environment for creating Jupyter notebook documents. The "notebook" term can colloquially make reference to many different entities, mainly the Jupyter web application, Jupyter Python web server, or Jupyter document format depending on context. A Jupyter Notebook document is a JSON document, following a versioned schema, containing an ordered list of input/output cells which can contain code, text (using Markdown), mathematics, plots and rich media, usually ending with the ".ipynb" extension. Jupyter Notebook can connect to many kernels to allow programming in different languages. By default, Jupyter Notebook ships with the IPython kernel. As of the 2.3 release (October 2014), there are currently 49 Jupyter-compatible kernels for many programming languages, including Python, R, Julia and Haskell. The Notebook interface was added to IPython in the 0.12 release (December 2011), renamed to Jupyter notebook in 2015 (IPython 4.0 – Jupyter 1.0). Jupyter Notebook is similar to the notebook interface of other programs such as Maple, Mathematica, and SageMath, a computational interface style that originated with Mathematica in the 1980s. According to The Atlantic, Jupyter interest overtook the popularity of the

Mathematica notebook interface in early 2018.

4.4 SYSTEM REQUIRMENTS

4.4.1 SOFTWARE REQUIREMENTS:

Operating System	Windows 7or later
Simulation Tool	Anaconda (Jupyter notebook)
Documentation	Ms – Office

4.4.2 HARDWARE REQUIREMENTS:

CPU type	I5
Ram size	4GB
Hard disk capacity	80 GB
Keyboard type	Internet keyboard
Monitor type	15 Inch colour monitor
CD -drive type	52xmax

4.5 SYSTEM ARCHITECTURE
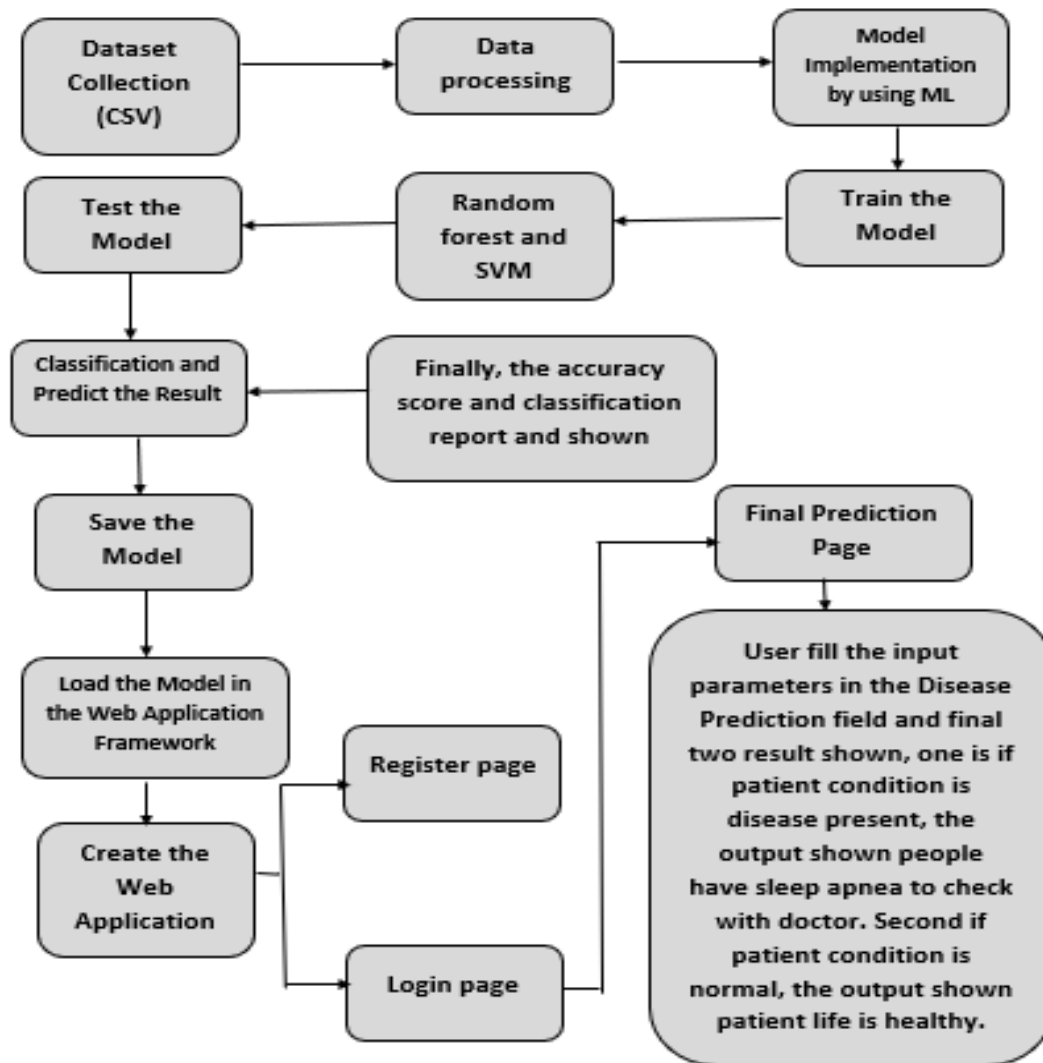
4.6 SYSTEM MODULES:

MODULES DESCRIPTION:

➢ Module 1: Dataset collection

➢ Module 2: Pre-processing

➢ Module 3: Model implementation

➢ Module 4: Web Application

➢ Module 5: Prediction

EXPLANATION

Module 1: data collection

● A dataset (or data set) is a collection of data, usually presented in tabular form. Each column represents a particular variable. Each row

corresponds to a given member of the dataset in question. It lists values for each of the variables, such as height and weight of an object. Each value is known as a datum.

● We have chosen to use a publicly-available patient's data which contains a relatively small number of inputs and cases. The data is arranged in such a way that will allow those trained in disciplines to easily draw parallels between familiar statistical and novel ML techniques. Here, we use the random forest and svm algorithm are used to predict the disease of the system.

Module 2: Pre-processing

● In this step, we use various types of pre-processing techniques to handle the missing, noisy and inconsistent data. There are a number of pre-processing techniques such as case folding dam character erase, tokenization, slang word handling, stop word removal, stemming and number handling. The sklearn.preprocessing package provides several common utility functions and transformer classes to change raw feature vectors into a representation that is more suitable for the downstream estimators of the system. Data preprocessing involves transforming raw data to well-formed data sets so that data mining analytics can be applied.

Module 3: Model Implementation

● Here, we use the machine learning model are random forest and svm algorithm are used to generate and save the model for further process of the system.

● The Machine Learning algorithm is used to train a model .

● The prediction result is then saved as a H5 model to predict the values for future.

Module 4: Web Application

A web framework is an architecture containing tools, libraries, and functionalities suitable to build and maintain massive web projects using a fast and efficient approach. They are designed to streamline programs and promote code reuse. To create the server-side of the web application, you need to use a server-side language. Python is home to numerous such frameworks, famous among which are Django and Flask.

Django:

Django is a high-level Python web framework that enables rapid development of secure

and maintainable websites. Built by experienced developers, Django takes care of much of the hassle of web development, so you can focus on writing your app without needing to reinvent the wheel.

Module 5: Prediction

● By using the saved model we are implementing the concept of web application using Django frame work.

● User, enter the values of symptom of sleep apnea patient as well as normal patient data. Next to click the enter button.

● Finally the result shown based on sleep apnea present or absent of the person.

4.7 SYSTEM DESIGN AND TESTING PLAN

TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub – assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

TYPES OF TESTS

UNIT TESTING

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

INTEGRATION TESTING

Integration tests are designed to test integrated software components to determine if

they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at   exposing the problems that arise from the combination of components.

FUNCTIONAL TEST

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input   : identified classes of valid input must be accepted.

Invalid Input   : identified classes of invalid input must be rejected.

Functions   : identified functions must be exercised.

Output   : identified classes of application outputs must be exercised

Procedures   : interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

SYSTEM TEST

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

WHITE BOX TESTING

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

BLACK BOX TESTING

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds

of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works.

UNIT TESTING:

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

CHAPTER 5
CONCLUSION

In this paper, we proposed the machine learning as well as web application based Django framework for predicting OSA based on present or absent of the patient . We are on the next wave of approaches to better detect sleep apnea in the general population, with the more widespread use of ML. The experimental results show that the Web application based Django model is more appropriate than the traditional neural network detection method. Our results showed promising findings with respect to recognition of apnea (Present or absent), which could be of significant interest to sleep

specialists of the system. Our method shows comparable performances to the state-of-the-art results in terms of getting prediction using end-to-end machine learning as well as Django Framework.

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