EMPROVE - AN EMPLOYEE PRODUCTIVITY SYSTEM USING MACHINE LEARNING

A PROJECT REPORT (PHASE I)

by

ALEN GEORGE (VJC19CS018)
JOEL RAJU (VJC19CS079)
ROSHAN ROY (VJC19CS106)
SAN BABY FRANCIS (VJC19CS108)

in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY, VAZHAKULAM

DECEMBER 2022

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of

Mrs. Anju Markose

Assistant Professor, CSE Dept.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY, VAZHAKULAM

DECEMBER 2022

VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY, VAZHAKULAM

Department of Computer Science and Engineering

Vision

Moulding socially responsible and professionally competent Computer Engineers to adapt to the dynamic technological landscape

Mission

1. Foster the principles and practices of computer science to empower life-long learning and build careers in software and hardware development.
2. Impart value education to elevate students to be successful, ethical and effective problem-solvers to serve the needs of the industry, government, society and the scientific community.
3. Promote industry interaction to pursue new technologies in Computer Science and provide excellent infrastructure to engage faculty and students in scholarly research activities.

Program Educational Objectives

Our Graduates

1. Shall have creative aid critical reasoning skills to solve technical problems ethically and responsibly to serve the society.
2. Shall have competency to collaborate as a team member and team leader to address social, technical and engineering challenges.
3. Shall have ability to contribute to the development of the next generation of information technology either through innovative research or through practice in a corporate setting
4. Shall have potential to build start-up companies with the foundations, knowledge and experience they acquired from undergraduate education

Program Outcomes

1. **Engineering knowledge**:Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**:Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design / development of solutions**:Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**:Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**:Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:**Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:**Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and unread in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**:Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

1. Ability to integrate theory and practice to construct software systems of varying complexity
2. Able to Apply Computer Science skills, tools and mathematical techniques to analyse, design and model complex systems
3. Ability to design and manage small-scale projects to develop a career in a related industry.

VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY, VAZHAKULAM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the project report (phase I) entitled " **EMPROVE - AN EMPLOYEE PRODUCTIVITY SYSTEM USING MACHINE LEARNING** " is a bonafide record of the work done in collaboration by **ALEN GEORGE (VJC19CS018), JOEL RAJU (VJC19CS079), ROSHAN ROY (VJC19CS106), SAN BABY FRANCIS (VJC19CS108)** in partial fulfillment of the requirements for the award of the **Degree of Bachelor of Technology** in **Computer Science and Engineering** of APJ Abdul Kalam Technological University.

Mr. Amel Austine
Head Of Department
Dept. of CSE
VJCET

Mr. Joe Mathew Jacob
Project Coordinator
Asst. Professor
Dept. of CSE
VJCET

Mrs. Anju Markose
Project Supervisor
Asst. Professor
Dept. of CSE
VJCET

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DECLARATION

We undersigned hereby declare that the project report "EMPROVE - AN EMPLOYEE PRODUCTIVITY SYSTEM USING MACHINE LEARNING", submitted for partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology of the APJ Abdul Kalam Technological University is a bonafide work done by us under the supervision of Mrs. Anju Markose. This submission represents ideas in our own words and where ideas or words of others have been included, We have adequately and accurately cited and referenced the original sources. We also declare that We have adhered to the ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or formed the basis for the award of any degree, diploma or similar title of any other University.

Place: Vazhakulam

Date:

Alen George

Joel Raju

Roshan Roy

San Baby Francis

ABSTRACT

Studies show that increase in employee productivity can contribute to greater profits for the company as well as increased employee satisfaction. Efficient productivity techniques would help the employees to perform well without burning out or compromising the quality of the software product. Traditionally, workforce productivity relies on various managerial decisions taken by the company. However, since the software industry is constantly evolving and as more and more companies are going remote, there is a need for an alternative. Here we propose a novel software system that would maximize the productivity of the employees by including features such as setting tasks, providing timely short breaks during working hours, etc. The system would also detect if the person is active or drowsy using machine learning techniques. A detailed report is then sent to the manager. The system would also suggest changes to the employee to maximize his productivity.

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List of Abbreviations

SDDD	State Farm Distracted Driver Datasets
FPN	Feature Pyramid Network
ROI	Region Of Interest
AI	Artificial Intelligence
ASR	Artefact Subspace Reconstruction
EDA	Electrodermal Activity
SVM	Support Vector Machine
EEG	Electroencephalography
ASM	Active Shape Models
AAM	Active Appearance Models
ICA	Inverse Compositional Algorithm

NIR	Near Infrared
ROI	Return of interface
CLAHE	Contrast Limited Adaptive Histogram Equalization
HOG	Histogram of Oriented Gradients
FAR	Face Aspect Ratio
MAR	Mouth Aspect Ratio
EAR	Eye Aspect Ratio

Chapter 1

INTRODUCTION

An employee productivity system is a system that will help employees to increase their productivity and perform well without compromising the quality of the software product that they work on. It helps employees to manage their time more efficiently and track and prioritise important tasks. To address this need for employee productivity, we propose a web-based system called ”Emprove”. Emprove is a feature-rich, intuitive productivity management system that helps employees to be more productive and organised. It has been designed to assist employees to manage their tasks, schedules and overall workload in a more efficient manner, thereby reducing stress and increasing job satisfaction. The system provides an array of features such as Pomodoro Timer, Concentration Music, Drowsiness Detection and Productivity Reports, all aimed at promoting a productive work environment. With Emprove, managers can also view tasks and progress of their team members, and assign tasks and deadlines to them.

1.1 Problem Statement

As the software industry is constantly evolving and as more and more companies are going remote, there is a need for a modern and reliable system that ensures the productivity of the employees.

1.2 Objective

To create a software system that would maximize the productivity of the employees by incoorperating features like Pomodoro Timer, Concentration Music, Drowsiness Detection, etc. The goal of this system is to help both employees and managers to work more efficiently and effectively, resulting in increased productivity and satisfaction.

1.3 Scope

Our system is an employee productivity system that maximizes the productivity of employees by setting short-term goals and providing timely short breaks during working hours. It follows the Pomodoro technique, a time-management method that involves breaking work into focused intervals with frequent short breaks. This technique ensures that the employee takes timely breaks during work to help maintain focus and productivity. It includes a feature that detects the level of alertness of the employee during working hours using real-time detection of facial features. This feature helps the employees and managers to identify patterns and take appropriate measures to improve their productivity. The system generates a detailed report that highlights the employee's productivity level, time management skills, and areas that need improvement. It also allows users to set a concentration music of their choice. This feature aims to enhance employee focus and create a positive work environment. Additionally, the system provides a manager dashboard that enables managers to efficiently manage his employees.

Chapter 2

LITERATURE SURVEY

2.1 Driver Drowsiness Identification by means of Passive Techniques for Eye Detection and Tracking

This paper describes a prototype of web camera-based system aimed at detecting and tracking the eye of a driver. The final goal is to extract parameters (e.g. eye blinks duration) which are useful to identify drowsiness and alert the pilot in order to prevent potentially dangerous situations.

To check the potential sleepiness state of the driver it is necessary to analyze his or her eyes, to assess their openness degree. In most cases, eye detection is preceded by a face identification stage, in which the acquired frames are examined to find the user's face.

2.1.1 Face Detection Methods

Main passive methods for face detection include color segmentation, image differencing and machine learning. Color segmentation looks for skin-like areas in the image, but is likely to fail in presence of complex backgrounds. Similarly, image differencing methods, which try to locate the face on the basis of head movements, are hardly applicable with dynamic backgrounds or when there are frequent changes in illumination. Machine learning algorithms are usually a better choice, due to both their robustness and precision in different background and illumination conditions. Among these methods, the Viola-Jones technique is certainly one of the most exploited.

2.1.2 Eye Detection Methods

Once the face region has been localized, it is necessary to identify eye areas within it.Like for face detection, the difference between consecutive frames in a video stream can be used to find the eyes through their movements, mainly blinks . While simple, this technique cannot however produce reliable results in our context, because correct eye detection may be misled by large head shifts or sudden changes in lighting. Anthropometric methods , which exploit “rules” about positions and proportions of facial traits to infer the most probable eye area in the face region, can be of some help as well (although they usually tolerate only small head rotations).

Different other methods for eye detection are given below:

Edge detection

Edge detection is another possible approach to eye recognition in digital videos. However, the potential noise introduced by eye elements such as folds in the skin, eyelashes and wrinkles, along with the need for fine tuning of some thresholds, make this technique little suitable for our application context.

Projections of intensity distributions

A further method for eye detection considers projections of intensity distributions within face images. A vertical or horizontal integral projection is calculated by summing the intensities of pixels on each column or row of the image (usually after an edge detection process). Since eye regions correspond to areas of high spatial frequency, the peak positions in the projections identify the eye zones in the face image.

Deformable parametric models

Deformable parametric models are another category of eye detection techniques. Essentially, a model is used to describe the eye and its features, allowing to discriminate among different candidates. Examples of simple models include shapes such as circles, ellipses and parabolas. While generally computationally challenging, the main advantage of deformable models is that they can adapt to the specific size and position of the eye.

Other techniques under deformable parametric model are given below:

1. Snakes (also called Active Contours) : It uses deformable splines to model shapes.

2. Active Shape Models (ASM) : It can be considered as an evolution of snakes and exploit a priori information (obtained from sample images) about the shape to be searched for.

3. Active Appearance Models (AAM) : It considers both the geometric shape and the appearance (texture) of the elements to be recognized. These models are built through statistical analyses of sets of samples, and can be also applied in real-time (the Inverse Compositional Algorithm , or ICA, is one of the most effective methods to this purpose). Statistical models are usually created using the Principal Component Analysis (PCA) technique, a powerful tool for data examination and compression. In general, the geometrical shape of an object is

represented by the coordinates of landmark points placed on it, while the texture is typically given by the intensity of pixels within the shape.

2.1.3 Algorithm Description

Viola-Jones Technique

Initially, the driver's face is identified within the acquired frames by means of the Viola-Jones algorithm. False positives are avoided by selecting, among possible multiple face candidates, the one whose size and position match the typical location and dimension of the driver's head.

Once the rectangular area containing the driver's face has been identified, it becomes the region of interest in which to look for the eyes. Because of the position of the webcam and to reduce the algorithm computational load, only the right eye is tracked.

Like for the face, the eye area is initially broadly identified using the Viola-Jones technique. The result of this process is a rectangular region enclosing the eye.

Human morphology is also exploited, as the eyes are usually located, vertically, in a region occupying one third of the face and placed slightly below the upper limit of the head. To precisely identify the eye and its features within the found rectangular region, in a first implementation of the project we employed an AAM eye detection method. After creating a suitable training set of face images to build the model, each picture was manually annotated by placing proper points on the eye and eyebrow .

The ICA algorithm was then used to build the best- fitting active appearance model , after an initialization of the model parameters according to the position and size of the just found eye region.

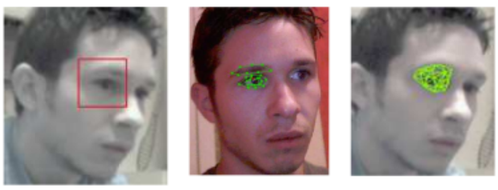


Figure 2.1: Identification of the eye region through the Viola-Jones technique

Viola-Jones Technique and Template Matching Approach

While effective, however, Viola-Jones technique turned out to be little efficient for our purposes - on average, only seven frames per second could be processed, a rate which is unacceptable for reliable eye-blink detection.

Therefore, a simpler and faster algorithm, which is practically a combination of the Viola-Jones technique and a template matching approach (a normalized squared difference matching method) was opted. To reduce the computational load, the algorithm is applied to an area A centered on the eye position found in the previous frame and double-size with respect to the eye rectangle.

The algorithm can be briefly summarized as follows:

1. The eye is precisely searched using the Viola-Jones technique.
2. If the eye is found, a copy of it is saved as a template.
3. If the eye is not found, the last valid template saved is used in a template-matching procedure.
4. After a certain number of consecutive template- matching procedures (i.e. successive failures of the Viola-Jones method), a re-initialization process (face detection, etc.) is carried out, to avoid a potential general failure of the tracking due to a sequence of wrong matchings.

The analysis of the eye status should be carried out only if the driver's head is about still and directed forward, since a moving or turned head are usually, as such, signs of a wakefulness state. The eye test is thus performed only if the face is detected in a ”rest” position. To identify such posture, the average eye location over the last n frames is calculated. This position becomes the center of an area used to test both the eye status and the inclination of the head: the vertical position of the eye within such area indicates how much the driver's head is vertically tilted, thus allowing the identification of potentially danger situations.

If the eye is within the rest area, the blink test can be carried out. To this purpose, the eye image is first converted to grayscale and then thresholded to obtain a binary picture.

Since the binary picture is often characterized by reflections on the pupil, which may compromise the study of the openness degree, a further processing is necessary. After an edge detection procedure, the closed boundary with maximum area is selected and filled, in order to eliminate the gaps generated by pupil reflections. Through this process, also the noise due to shadows and/or portions of eyebrows can be usually reduced.

Subsequently, the vertical projection histogram of the binary image is obtained. To remove micro peaks generated by eyelash edges, a histogram smoothing is performed. The peak in the obtained histogram corresponds to the position of the pupil. The eye openness level can then be assessed by calculating the average value over all the columns and comparing it with that relative to the ”fully-open eye” case. Moreover, the peak position provides also a broad indication about the driver's horizontal gaze direction.

When the eye remains totally or partially closed for more than a defined timeout, the driver may have fallen asleep, and proper actions must be taken.

Figure 2.2: Identification of the eye region through the Viola-Jones and Template Matching technique

2.1.4 Advantages

The peculiarity of this algorithm is that it exploits the good qualities of both the Viola-Jones and template- matching techniques, to reduce the error rate: when, for any reason, the Viola-Jones technique fails, the tracking continues with the template matching method, which can rely on a constantly updated template. Also this algorithm can robustly deal with different driving conditions.

2.1.5 Disadvantages

The following are the primary types of mistakes that could occur while the system is being tested:

1. Tracking miss: It occurs when in successive frames, the tracking does not occur correctly.
2. Detection miss: It occurs when the user's face or eye are not detected because of shadows.
3. Blink miss: It occurs when the eye blink is not detected (especially with rapid blinks).
4. Blink fail: It occurs when a blink is erroneously detected (usually because of particular head positions).

2.2 An Efficient Deep Learning Framework for Distracted Driver Detection

Road accidents are increasing day by day. One of the major cause of accidents is distracted driving.The main aim of this paper is to detect the distracted drivers thereby reducing the number of road accidents. The dataset used in this study for measuring distracted driving includes eight classes: calling, texting, everyday driving, operating on radio, inactiveness, talking to a passenger, looking behind, and drinking. In order to train computers to recognise items in photos or videos, a tool called EfficientDet is used to identify distracted driving. It is a guide to State-of-the-art Object Detection model. For an object detection test, EfficientDet (D0-D4) already outperforms Mask RCNN, RetinaNet, and Yolo-V3. On evaluating EfficientDet on the COCO dataset, it achieved MAP (mean average precision) of 52.2 with 9.4x less computation and exceed current State of the art (SOTA) models by 1.5 points. This model can be effective in identifying distracted drivers and determining the ROI of body parts to decrease serious mishaps. The proposed model contains two steps. In the first step, preprocessing on the data is performed. In the second step, objects involved in these distracting activities are detected and the ROI of the body parts from the dataset's images.

2.2.1 Data Pre-processing

In April 2016, State Farm started the competition on the website named Kaggle. The purpose of this competition is to generate images related to distracted driver behavior. The State Farm Distracted Driver Dataset (SDDD) is used to train the proposed algorithm. State Farm has collected the 2D images by placing the camera into the vehicle's dashboard. The purpose of these images is to generate the results on this data that will directly or indirectly help improve the stats of causalities due to distracted driver behavior.

The original SDDD has two folders containing 22400 training images and 79727 testing images. The image has a resolution of 640 * 480 pixels. The training folder includes a total of 10 categories, which are as follows; calling (left hand), calling (right hand), texting (left hand), texting (right hand), everyday driving, operating on radio, in activeness, talking to a passenger, looking behind, and drinking. Each category contains different images. Therefore, the data in the testing folder is unlabeled.The data in the training folder is used to evaluate our method. Ten original SDDD are converted into eight categories by combining calling (left/right) hands together, same as texting (left/right) hands. By cleaning the dataset, 1000 images are put in each dataset. Every image from each class is annotated using the annotation tool labeling, and the annotated image is stored in an xml file. Annotation is done to highlight the specific part of the images that include distracted objects and the region of interest of the body parts. There are 1000 annotated files in each class. So, this becomes 8000 RGB images and 8000 annotated files. The dataset for each category is split into 80% train data and 20% validation data. The training set is split so that the validation set is not related to the training set.

Table 2.1: Summary details of original SDDD

SDDD classes	Description	Data (Frames)
c0	normal driving	2489
c1	texting (right hand)	2267
c2	calling (right hand)	2317
c3	texting (left hand)	2346
c4	calling (left hand)	2326
c5	operating on radio	2312
c6	drinking	2325
c7	looking behind	2592
c8	inactiveness	1911
c9	talking to passenger	2129

Table 2.2: Summary details of modified SDDD

Dataset classes	Images (Frames)	Annotated files
Normal driving	1000	1000
Texting (left/right hand)	1000	1000
Calling (left/right hand)	1000	1000
Operating on radio	1000	1000
Drinking	1000	1000
Looking behind	1000	1000
Inactiveness	1000	10001
Talking to passenger	1000	1000

Figure 2.3: Samples of dataset to represent classes

2.2.2 EfficientDet

The preprocessed and annotated data is used to train the EfficientDet model. After training the model, the video frame is input to predict whether the driver is distracted or not. The image is then converted into the textual label related to the defined image classification and detection categories. For image classification, the transfer values of EfficientNet is used. Efficientdet model is used to detect the objects and the region of interest of body parts involved in these distracting activities to make accurate predictions and achieve state-of-the-art results. These steps are described as; extracting the convolution features of the input image, classifying the image, detecting the objects, and the ROI of the body parts, predicting by combining the label of classification and detection. The flow diagram of the methodology is shown in Figure 2.4. The proposed deep learning framework gets frames from the video streaming where the camera is placed on the vehicle's dashboard. These input images are passed through a pre-processing phase where each class image is annotated after image cleaning. Then fine-tune a pretrained ImageNet model EfficientNet for image classification. After that, objects are detected along with the region of interest of the body parts involved in these distracting activities using EfficientDet and gives the final result to detect distracted activities of the driver.

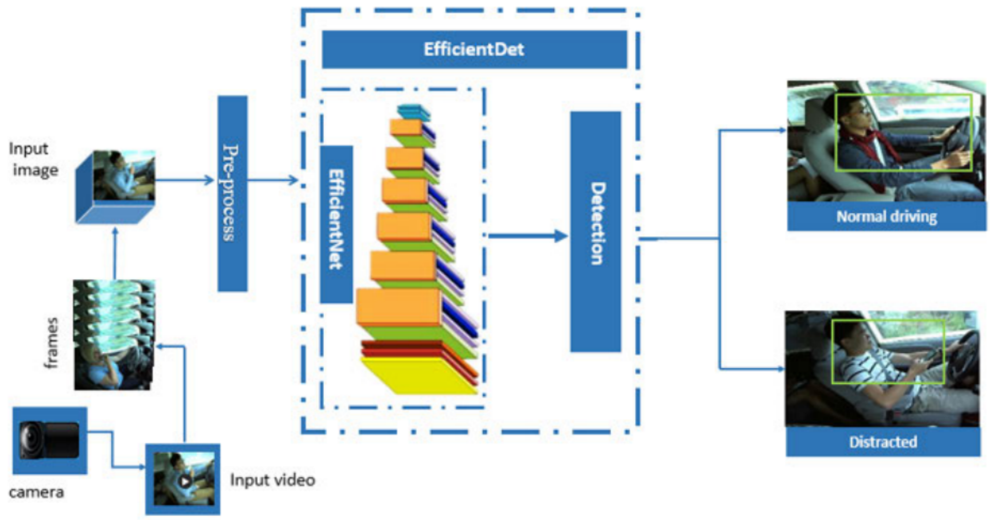


Figure 2.4: Flow diagram of EfficientDet

2.2.3 EfficientDet Architecture

The Google Mind group developed the EfficientDet model. Improving the different dimensions includes combination construction of Feature Pyramid Networks (FPN) and acquiring thoughts from scaling technique of EfficientNet model, it is a model that can adapt recognition calculation. EfficientDet comprises three sections. The initial segment is prepared as ImageNet uses EfficientNet as the backbone network. The subsequent section is a Bidirectional Feature Pyramid Network

(BiFPN), which performs the hierarchical and bottom-up, including various occasions for the yield normal for Levels 3 -7 in EfficientNet. The third component is the characterization and location box prediction network used to group and identify the diverted driver. Parts two and three modules can be rehashed repeatedly depending on hardware situations. EfficientNet is used as the backbone model; with feature extraction of image contributions to the network and few feature map boundaries, rich data can be separated, partly guaranteeing location speed and precision. Input P3-P7 to BiFPN for include combination at that point. To acquire semantic data of various sizes, BiFPN receives weighted element combinations. Because EfficientDet is the objective recognition of anchor-based, the underlying anchor estimation should be changed appropriately to achieve better results. BiFPN performs the function of a featured network. This takes features from the backbone network's levels 3 - 7 and applies the BiFPN repeatedly. The combined features are fed into a class and box network to detect the object's class and bounding boxes.

2.2.4 Bidirectional Feature Pyramid Network (BiFPN)

Conventional FPN accumulates multiscale attributes from time to time. After convolution of the information highlight guide of layer 7, the yield highlight guide of layer seven is obtained. Convolving the combination highlight map obtained by up-testing the yield include a guide of layer seven and adding the information have a guide of layer six yields the yield highlight guide of layer six., convolving the combination highlight map obtained by upexamining the yield include a guide of layer four and adding the information highlight guide of layer three yields the yield highlight guide of layer 3.

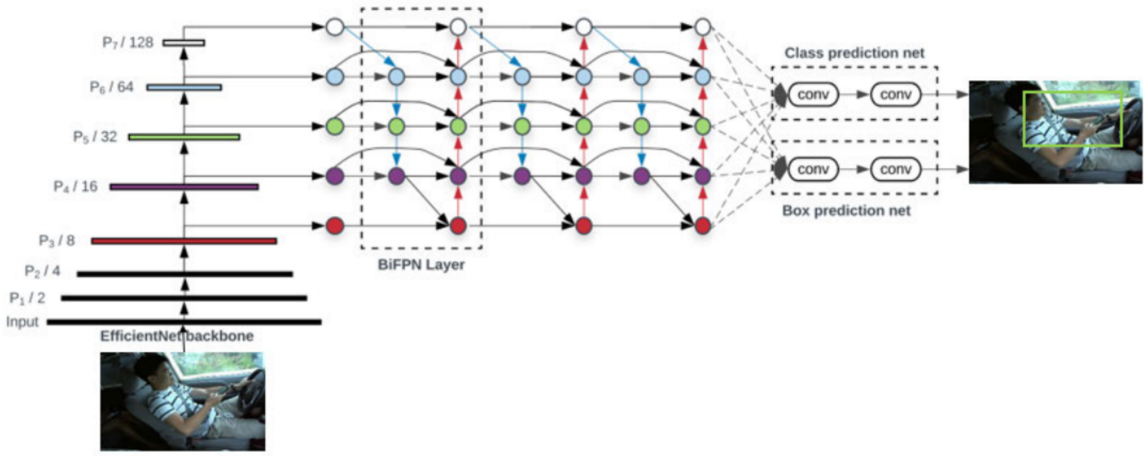


Figure 2.5: EfficientDet with BiFPN

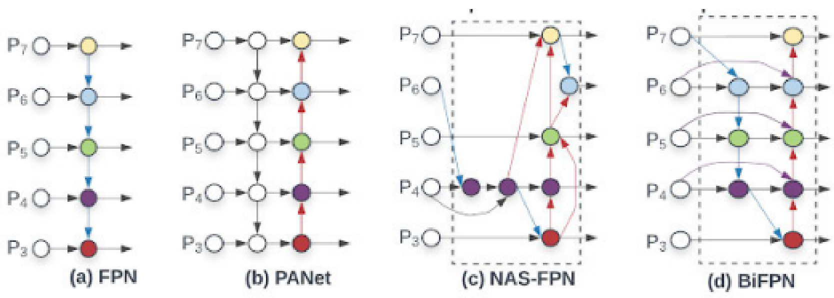


Figure 2.6: Feature network design

PANet improves FPN's performance element combination strategy, receiving the hierarchical technique and the base up strategy. An unpredictable trademark network geography, NAS-FPN, is discovered using the neural engineering search (NAS) technique. A significant amount of GPU processing time is required to achieve this result. The BiFPN showed is improved in three ways:

1. If a feature map only contains one piece of information, its commitment to feature combination is little, and it could be erased.
2. At each level, associations are set up to allow users to join other features at a low cost.
3. This is recommended that each BiFPN joins as a module and that the output of the previous BiFPN is used as the contribution of the following BiFPN. The circumstances determine the number of such structures required.

2.2.5 Advantages

This system is capable of detecting distracted drivers and the ROI of the body parts to reduce serious incidents. It also has a faster running speed and a higher success rate.

2.2.6 Disadvantages

The major disadvantage of the system is the complex architecture of EfficientDet, which makes it difficult to implement.

2.3 Framework for Preventing Procrastination and Increasing Productivity

Productivity is a measure of how efficiently a person, typically an employee, works during a specific period of time. Procrastination, the act of delaying or postponing tasks, can be a major obstacle to productivity. There have been many studies on ways to increase productivity, and there are professional tools that are used to monitor it. One example is the use of Sprints in the software industry, which involves dividing work into modules and focusing on one at a time. However, this method may not be flexible enough or simple enough for general use. Other techniques that are sometimes used include the Pomodoro technique and gamification.

In order to address the problem of procrastination, a simple, generic tool that combines the Pomodoro technique, gamification, and a leaderboard is proposed. The Pomodoro technique involves breaking up a large task into smaller sessions, with breaks in between. The tool, called ProScore, uses a points system and shows users how their productivity compares to that of their peers in order to encourage productivity. Gamification is used by penalizing users who leave tasks unfinished by reducing their points. The leaderboard is based on the points that the users have earned, providing them with an incentive to be more productive in order to top the leaderboard. The productivity of the users is also tracked over time.

2.3.1 ProScore

ProScore is a mobile application framework meant to increase the productivity of an individual which is lagging due to procrastination. The Pomodoro Timer technique helps overcome this by allocating a session of 25-minutes followed by a 5-minute break. This alone won't help. We also need some kind of peer influence that forces us to be productive. ProScore tries to influence users to work productively by showing their peers aka other users' productive session details. When we see that others are doing something productive, we feel the compulsion to do productive work ourselves. Furthermore, ProScore incentivizes Productivity through the Point System. The name of the application is derived from "Productivity Score". This ensures that the more productive you are, the more points you will earn. Leaving the app midway during a session penalizes the user by reducing their points. This leads us to the next productivity enhancing technique - Gamification.

A leaderboard is shown based on the points the user have scored. This provides users an incentive to top the leaderboard and hence be more productive while doing so. Finally, the productive sessions of the users are tracked so that a user can revisit how they have performed over a course of time.

2.3.2 The Pomodoro Technique

By good time control, the Pomodoro Technique aims to promote focus, consciousness, and independence of mind . A pomodoro is 25 minutes of uninterrupted, concentrated work on one task followed by 5 minutes of rest and recovery. Based on scientific evidence, the inventor says, “20 to 45- minute time intervals can maximize our attention and mental activity, if followed by a short break”. The 5-minute break is designed to help team members build and sustain an optimum focus curve when working on project tasks. A longer pause of 15 minutes is suggested for every four consecutive pomodoros to maximise the influence of this result. An individual’s efficiency can be improved with this method. Increased optimism leads to increased efficiency, and the approach has also proven useful in assisting in the handling of complex scenarios. These advantages can be obtained by using the Pomodoro Technique’s two interconnected features: time-boxing and length estimates.

Time-boxing is one of the key inspirations for the Pomodoro Technique . When a set of events is delegated to a certain time interval, time-boxing means that the delivery deadline for such activities can never change. Unfinished operations may be reassigned to the next time cycle if desired.

The Pomodoro Technique, when used as an effort estimation method, will help optimise an effort estimation mechanism by requiring constant reflection of team activities . The Pomodoro Technique was originally developed as a personal time control method for individual jobs. However, the technique’s inventor and proponents have built and perfected it over time in the form of coordination. Several XP teams use the methodology as a team time management tool. They say that using the Pomodoro Technique to help teams find their ”normal” rhythm in everyday work is both stress-free and effective.

2.3.3 Pomodoro Technique in ProScore

Each job will have its own work time in the ProScore application, and the entire slot will be split into a number of pomodoros, each of which will specify a timeslot and unit of work. We use a timer to keep track of the pomodoros, and for each one, there is a mandatory break period. Rewards will be granted in the form of points based on the completion of pomodoros. For each good completion, points will be awarded, and in the event of any deviation, the points will be deducted by 5. As a result, if the user fails, the likelihood of falling through bad points is very high, motivating the user to be more aware of points and, as a result, increasing productivity. The user’s task time will be taken as input, and each task time will be split into pomodoros, with the following calculation:

$$N = t/120 \tag{2.1}$$

$$T = t \; mod \; 120 \tag{2.2}$$

Where, ‘N’ represents the number of cycles, ‘T’ represents the total time and ‘t’ represents the input time. The explanation for the division and modulo by 120 is that the traditional pomodoro technique uses a 25-minute pomodoro followed by a 5-minute pause, for a total of four pomodoros in one cycle and a 15-minute break will be provided at the end of each loop . Since not every task in in the programme is supposed to take 120 minutes, the number of cycles and the time are measured and further pomodoro estimates are calculated.

Table 2.3: Pomodoro time estimation

Time (T)	**Pomodoro(s)**	**Pomodoro Time (t)**	**Break Time (b)**
0 < T <= 30	1	T	Nil
30 < T<= 60	2	T/2 - 5	5
60 < T<= 90	3	T/3 – 5	5
90<T<= 120	4	T/4 – 5	5

2.3.4 Game Elements in ProScore

Points: The reward scheme includes points. Users are rewarded with points for acts that we believe are essential to the platform or application. Points are real-time reviews provided to users for their activities in order to help them appreciate the connection between effort and rewards. As a result, in our case, points are awarded for completing assigned tasks.

- Leaderboards : These are similar to game leaderboards in that they enable users to compare their rank to that of other members of the group. The fundamental premise behind this aspect is that people want to be the best, to be at the top of the leaderboard.
- Badges : A study states that badges are awarded to users in order to provide them with something to brag about. It works on the same basis as sporting trophies or awards. Badges can be earned permanently or just for a temporary time.
- Avatar : The way in which users chose to connect with other members of the network. In the game, this is a graphical representation of themselves. An avatar may be an icon, picture or a photo of the users themselves.
- Process bar : Process bar shows the completion and progression of a user in a game. In our application, the timer is to be regarded as a process bar as the time worked and the time left

can be inferred easily from it.

Table 2.4: Point system in ProScore

Task	Points
SUCCESSFUL	+10
FAILURE	-5

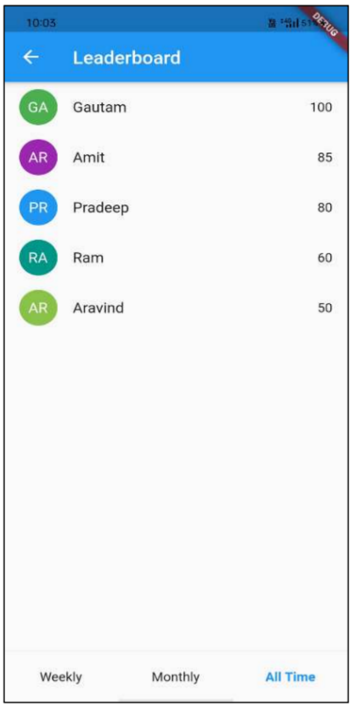


Figure 2.7: Leaderboard in ProScore

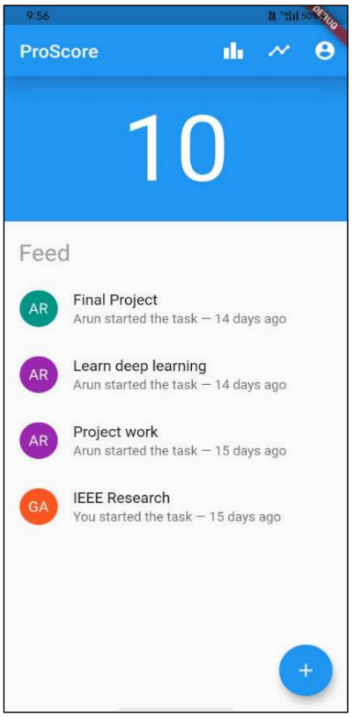


Figure 2.8: Activity feed in ProScore

2.3.5 Advantages

1. Improved efficiency: By helping individuals to avoid procrastination, the framework could potentially lead to increased efficiency and productivity.
2. Increased motivation: Gamification elements, such as leaderboards and points systems, may serve as incentives and increase motivation to work productively.
3. Better time management: The Pomodoro technique, which involves breaking work into smaller sessions with breaks in between, can help individuals to manage their time more effectively.
4. Increased focus: By reducing distractions and helping individuals to stay on track, the framework may help to improve focus and concentration.
5. Enhanced performance: By helping individuals to be more productive and efficient, the framework may ultimately lead to improved performance.
6. Greater accountability: The framework may help to increase accountability by providing individuals with a way to track their progress and measure their productivity over time.

2.3.6 Disadvantages

1. Initial investment: Implementing such a framework may require an initial investment of time and resources to set up and train individuals on its use.
2. Resistance to change: Some individuals may resist using a new framework or tool, particularly if they are used to working in a certain way.
3. Overreliance on the tool: If individuals become too reliant on the framework or tool, they may struggle to be productive without it.
4. Pressure to perform: The use of a points system or leaderboard may create pressure to perform, which could lead to increased stress and burnout.
5. Inability to account for individual differences: The framework may not be suitable for all individuals, as everyone has different work styles and preferences.
6. Potential for misuse: The framework could be misused by individuals who try to game the system or artificially inflate their productivity scores.

2.4 Feature Based Statistical Model of Employee Productivity with Real-time Checked Data

The COVID-19 pandemic has caused many industries to decentralize their workforce, with many employees working from home due to stay-at-home orders. While some companies have been able to adapt to this new way of working using modern technology, others have struggled to effectively manage and accommodate their remote employees. This research shows that the challenges that organizations are currently facing in managing their human capital are similar to those caused by demographic changes in the workplace. This study aims to analyze these challenges and explore how human competencies can be unlocked and developed to support sustainable autonomous working in different locations, including the office, at home, or while traveling. It investigates the challenges faced by both organizations and employees and proposes a new business model that helps to sustainably use human resources and improve employee efficiency.

2.4.1 Weibull Distribution

The Weibull distribution is a continuous probability distribution that is often used to model the distribution of failure times or other times to events in reliability engineering and other fields. It is defined by two parameters, shape and scale, and is often used to model data that is skewed or has a long tail.

The Weibull distribution is often used in reliability engineering to model the distribution of failure times of components or systems. It is also used in other fields, such as economics, engineering, and biology, to model the distribution of various types of events or data.

One advantage of the Weibull distribution is that it can take on a wide range of shapes, including exponential, uniform, and normal, depending on the values of the shape and scale parameters. It is also relatively easy to fit to data, making it a popular choice for modeling real-world data. However, it is important to carefully consider the appropriateness of the Weibull distribution for a particular dataset, as it may not always be the best choice for modeling all types of data.

2.4.2 Case Study

A tracker program was developed by Enigma Design Solutions in Python and installed on company computers to track user activity. Time spent on a specific project is recorded every second, and data is saved into a MySQL/SQLAlchemy database. Collected data has the following attributes:

- The type of program

- KEevents: It tracks when there is a keyboard event such as typing
- MEvents: It tracks the mouse usage (such as left and right clicks)
- SEvents: It tracks every time the user scrolls

The above attributes are utilized in data collection to avoid idle time. For example, if there is a document open on the computer and nothing is being done on it, then the program would not record the time. Once the events are recorded individually, the total time spent on any project can be calculated in seconds by tallying the event count. This can then be utilized to calculate the time taken for each component of the project using a time-weighted average method, which can then be fed into a statistical model. The figure below shows the workflow of this process.

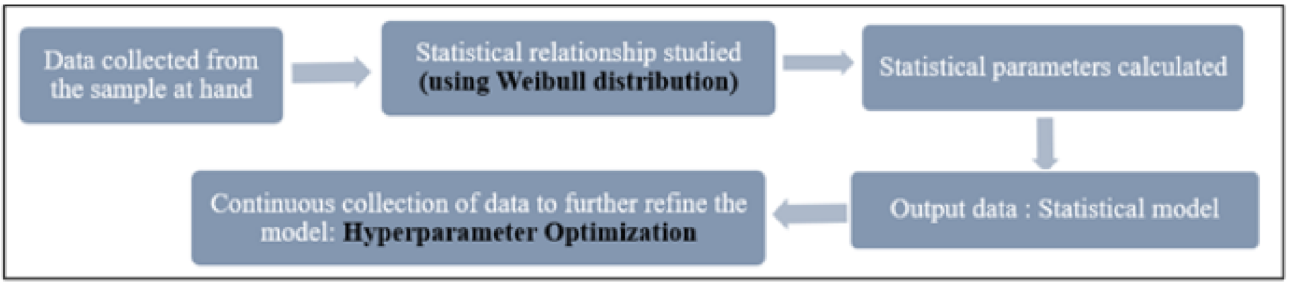


Figure 2.9: Workflow diagram

Data for the hyperparameter (time) by which the learning process is controlled is continuously collected, and the model is dynamically updated to refine the parameter values.

2.4.3 Data Sorting and Statistical Modelling

As mentioned earlier, the data collected is based on time spent on a specific project. For example, the time spent on a project that involves Solidworks modeling and analysis. This can be sorted further to study the time spent by the user on individual components of the larger task.

Making an engineering model in Solidworks takes several steps. A VBA macro has been developed and implemented to extract the details on those steps and model and store those details in an excel file. The following images show an example of data extracted via the above method. This can be done for every part that is modeled in Solidworks for a specific project.

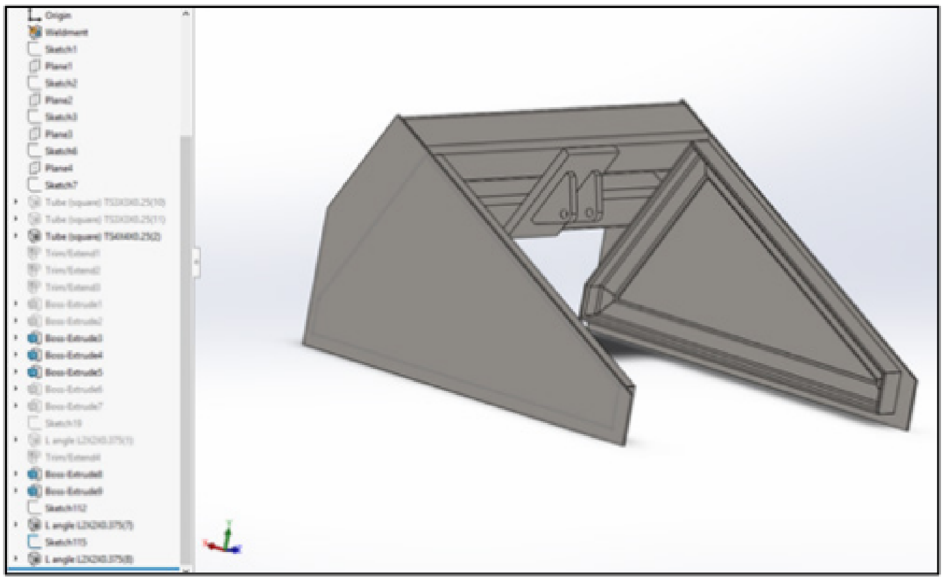
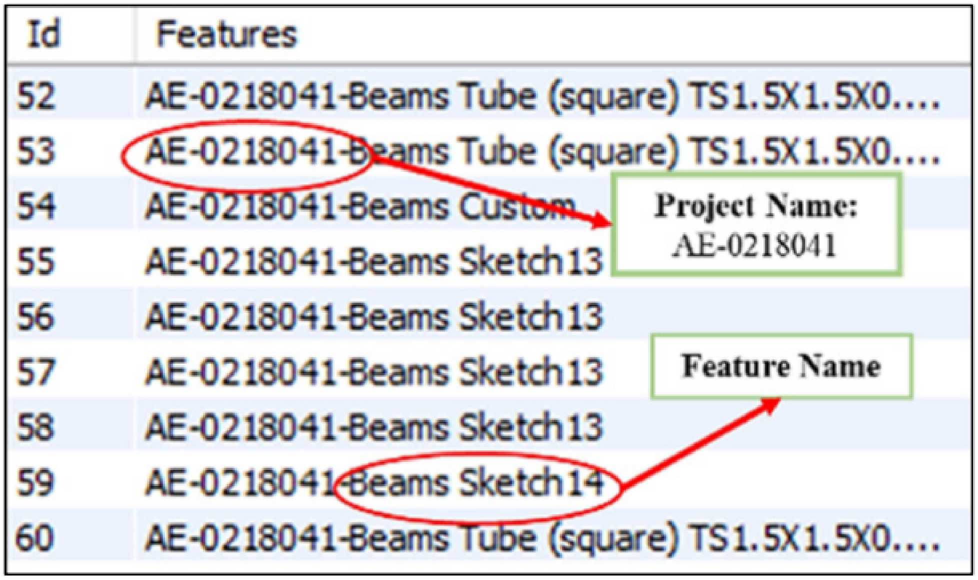


Figure 2.10: VBA Macro for Solidworks Model

Table 2.5: Extracted Data

List of Features		
Comments	Front Plane	Design Binder
Favorites	Cut-Extrude3	Annotations
Equations	Cut-Extrude 1	Surface Bodies
Selection Sets	Sketch 2	Material



Id	Features
52	AE-0218041-Beams Tube (square) TS1.5X1.5X0....
53	AE-0218041-Beams Tube (square) TS1.5X1.5X0....
54	AE-0218041-Beams Custom
55	AE-0218041-Beams Sketch13
56	AE-0218041-Beams Sketch13
57	AE-0218041-Beams Sketch13
58	AE-0218041-Beams Sketch13
59	AE-0218041-Beams Sketch14
60	AE-0218041-Beams Tube (square) TS1.5X1.5X0....

Figure 2.11: Transferred Data

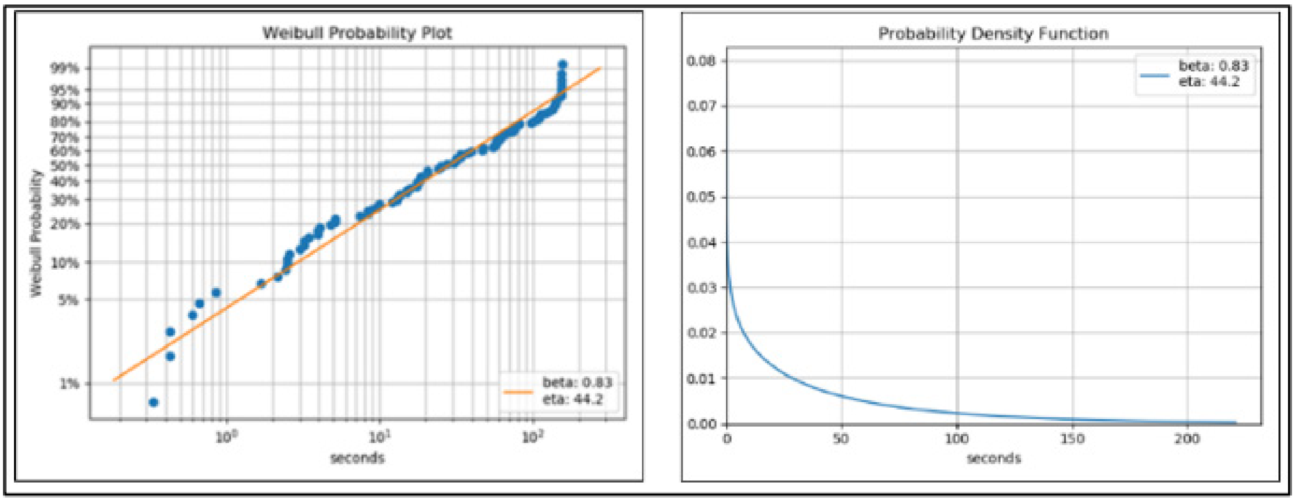


Figure 2.12: First Weibull Probability Plot and Probability Density Function for Feature Sketch

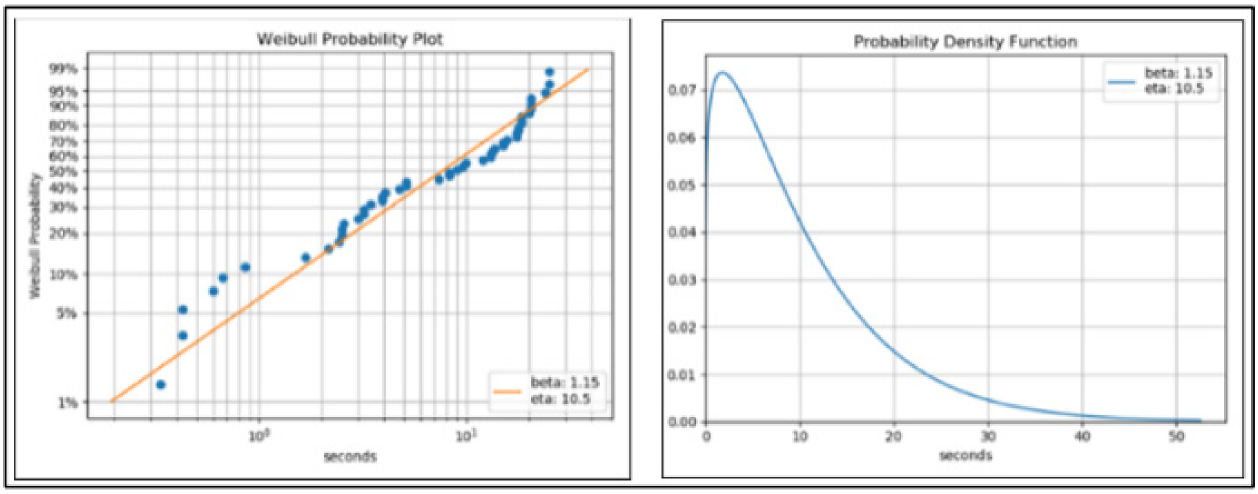


Figure 2.13: Second Weibull Probability Plot and Probability Density Function for Feature Sketch

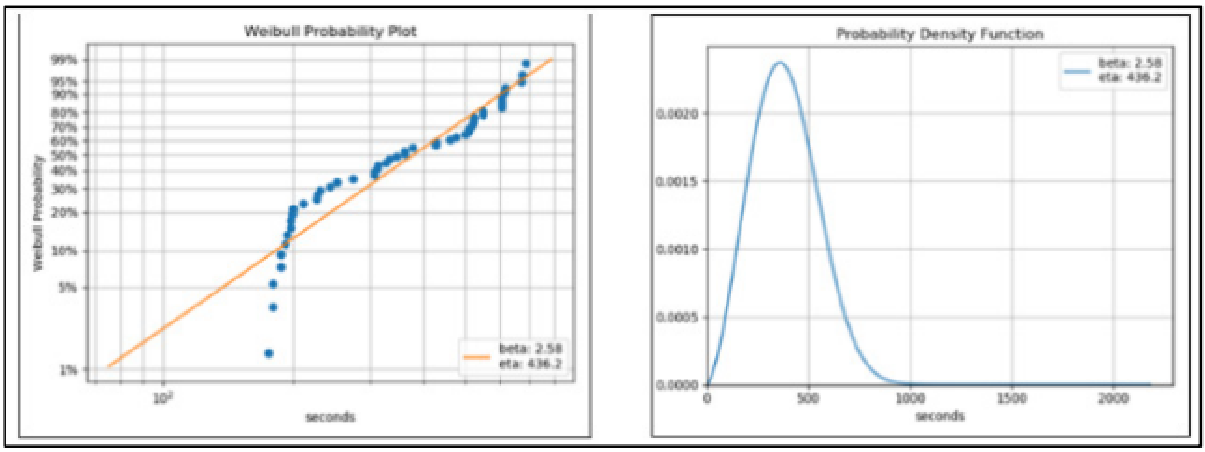


Figure 2.14: Third Weibull Probability Plot and Probability Density Function for Feature Sketch

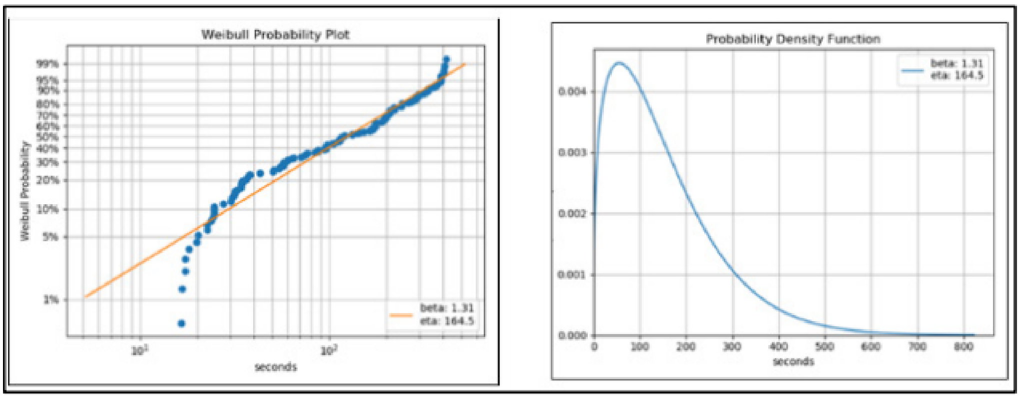


Figure 2.15: First Weibull Probability Plot and Probability Density Function for Feature Extrude

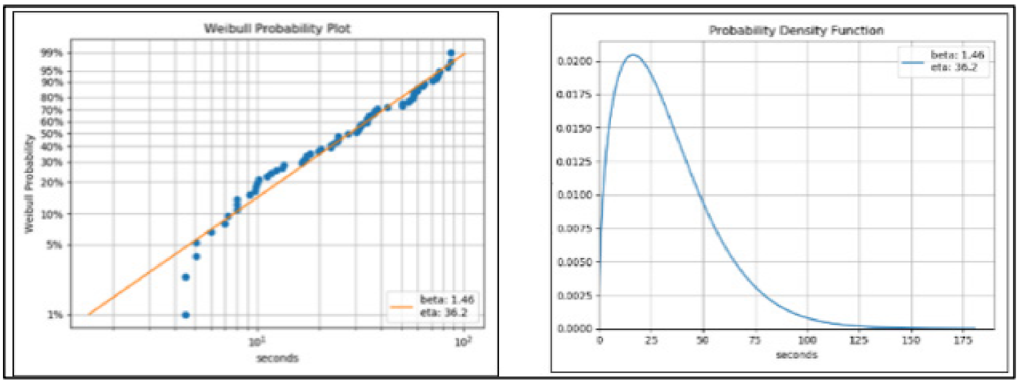


Figure 2.16: Second Weibull Probability Plot and Probability Density Function for Feature Extrude

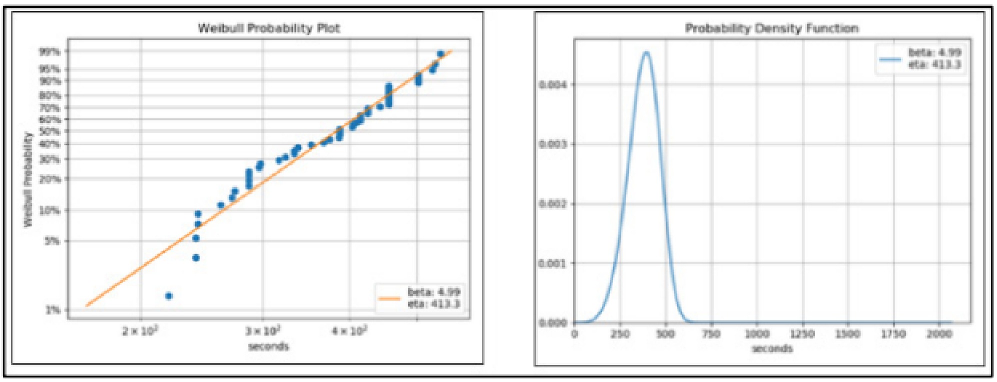


Figure 2.17: Third Weibull Probability Plot and Probability Density Function for Feature Extrude

The dynamic data model discussed in this study has the potential to bring a variety of benefits to companies and workers across different fields. In today's world, a company's ability to effectively manage its human capital can be crucial to its productivity and success. Each component of this model plays a role in promoting more sustainable and productive business practices. The ability to collect consistent, dynamic, and precise data and cross-reference it in various ways allows work processes to be analyzed from different angles, which is important for companies in the 21st century to develop plans for handling decentralization. The use of the Weibull statistical analysis curve and its two-parameter system adds an extra level of confidence to the data analysis process.

2.4.4 Advantages

1. Improved accuracy: By using real-time data, the model may be able to more accurately predict employee productivity.

2. Enhanced efficiency: The model may be able to quickly analyze data and provide insights into employee productivity, helping organizations to be more efficient in their decision-making.

3. Greater flexibility: A feature-based model may be able to handle a variety of data types, allowing organizations to incorporate a wide range of factors in their analysis.

4. Increased transparency: By using real-time data, the model may provide a more transparent view of employee productivity, allowing organizations to identify any potential issues or areas for improvement.

5. Better performance: By providing insights into employee productivity, the model may help organizations to identify and address any factors that may be impacting performance.

6. Greater accountability: By using real-time data, the model may help organizations to hold employees accountable for their productivity.

2.4.5 Disadvantages

1. Initial investment: Setting up and implementing such a model may require an initial investment of time and resources.

2. Complexity: Depending on the complexity of the model, it may be difficult for individuals without a statistical or technical background to understand and interpret the results.

3. Potential for errors: There is a risk of errors in the data that is fed into the model, which could impact the accuracy of the results.

4. Dependence on technology: The model relies on technology to function, and if there are technical issues, it may not be able to provide accurate results.

5. Limited perspective: The model may only consider certain factors, potentially leading to a limited perspective on employee productivity.

6. Privacy concerns: There may be concerns about the use of real-time data and the potential for employee privacy to be violated.

Chapter 3

PROPOSED SYSTEM

In today's fast-paced and competitive business world, productivity is key. Companies are constantly looking for ways to improve the efficiency and effectiveness of their employees, and new technologies and techniques are being developed to help achieve this goal. One such system is our proposed **Emprove**, the intelligent productivity tracker, which combines various existing systems and techniques to provide a comprehensive tool for improving employee productivity.

The Pomodoro technique is a well-known method for improving productivity by taking regular breaks during work hours. The technique involves dividing work into 25-minute intervals, followed by a short break, and repeating this process several times throughout the day. By breaking up work into smaller chunks, employees are able to maintain focus and avoid burnout. Our system incorporates the Pomodoro technique by allowing employees to set their own break intervals and providing notifications when it is time to take a break.

In addition to the Pomodoro technique, our system also utilizes machine learning to detect fatigue and drowsiness in real-time. This is achieved through the use of facial recognition software, which is able to detect changes in a person's facial expression and movements that may indicate they are becoming tired or drowsy. This information is then used to provide personalized recommendations for improving productivity, such as taking a break or adjusting the lighting in the workspace.

To help managers track the productivity of their team, our system also includes an employee productivity leaderboard. This feature allows managers to see how each employee is performing in terms of productivity, and to identify any areas where improvements can be made. By providing this information in real-time, managers are able to quickly identify and address any issues that may be impacting employee productivity.

Overall, our proposed system aims to provide a comprehensive tool for improving employee productivity by combining the Pomodoro technique, machine learning, and employee productivity tracking. By providing timely breaks, detecting fatigue and drowsiness, and tracking employee productivity, our system helps employees to work more efficiently and effectively, and helps managers to optimize the performance of their team.

There are several benefits to using our proposed system. First, by providing regular breaks, employees are able to maintain focus and avoid burnout, which can lead to increased productivity and job satisfaction. Second, by using machine learning to detect fatigue and drowsiness, our system is able to provide personalized recommendations for improving productivity, which can help to increase efficiency and effectiveness. Finally, the employee productivity leaderboard allows managers to track the performance of their team in real-time, which can help to identify and address any issues that may be impacting productivity.

Of course, there are also some potential challenges to implementing our proposed system. One potential challenge is the cost of implementing the system, as it may require the purchase of new software and hardware. Additionally, there may be some concerns about privacy, as the facial recognition software used to detect fatigue and drowsiness may be perceived as intrusive by some employees. To address these concerns, it will be important to clearly communicate the benefits of the system and to ensure that employee privacy is protected.

Despite these challenges, we believe that our proposed system has the potential to significantly improve employee productivity and help companies to stay competitive in today's business environment. By combining the Pomodoro technique, machine learning, and employee productivity tracking, our system provides a comprehensive tool for improving efficiency and effectiveness, and helps managers to optimize the performance of their team.

3.1 Process Overview

The productivity improvement software consists of several key processes that help employees manage their tasks and time effectively. These processes include:

1. **Task Tracking :** Employees can create, prioritize, and mark tasks as complete through our task management interface. The interface includes features such as the ability to add new tasks, edit existing tasks, and mark tasks as complete. Employees can also view their task list and filter the tasks by status (e.g., pending, complete, or overdue).

2. **Pomodoro Timer :** Employees can track their work sessions using the Pomodoro timer, which helps them stay focused and take breaks at regular intervals. The Pomodoro timer is based on the Pomodoro Technique, which recommends working for 25 minutes and then taking a 5-minute break. After four Pomodoros (or 100 minutes of work), the employee

takes a longer break of 15-20 minutes. The Pomodoro timer helps employees stay on track and avoid burnout by encouraging regular breaks.

3. **Concentration Music :** During working hours or breaks, employees can choose to listen to concentration music to help them relax and refocus. The concentration music feature includes a selection of instrumental tracks designed to promote relaxation and focus. Employees can choose the track they want to listen to and adjust the volume as needed.

4. **Drowsiness Detection :** In the background, the system uses machine learning techniques to determine if the employee is drowsy or alert based on facial features. If the system detects that the employee is drowsy, it will alert the employee and suggest that they take a break. This feature can help employees stay alert and avoid or mistakes caused by fatigue. The system also provides detailed analysis in the productivity report.

5. **Productivity Reports :** Employees and Managers can view reports on employee productivity to help them identify areas for improvement and track progress over time. The reports include metrics such as the number of tasks completed, the amount of time spent on each task, and the employee's overall productivity over a given time period.

3.1.1 Process Flow Diagram

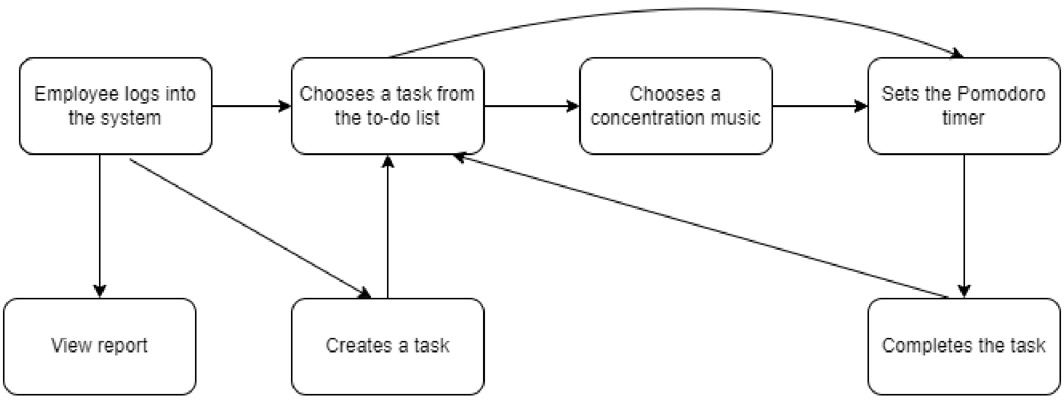


Figure 3.1: Process Flow Diagram of Employee

3.1.2 Process Flow Diagram

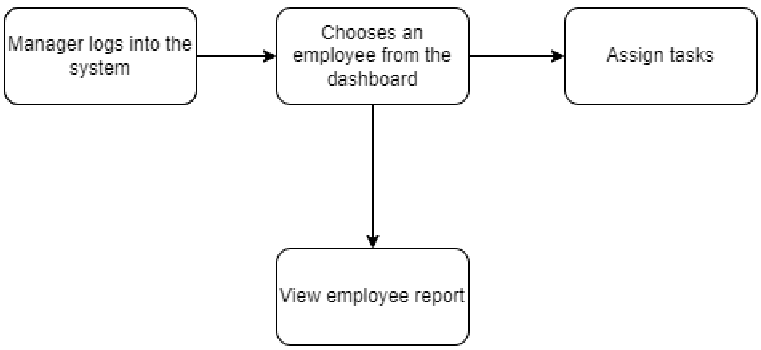


Figure 3.2: Process Flow Diagram of Manager

3.1.3 Architecture Diagram

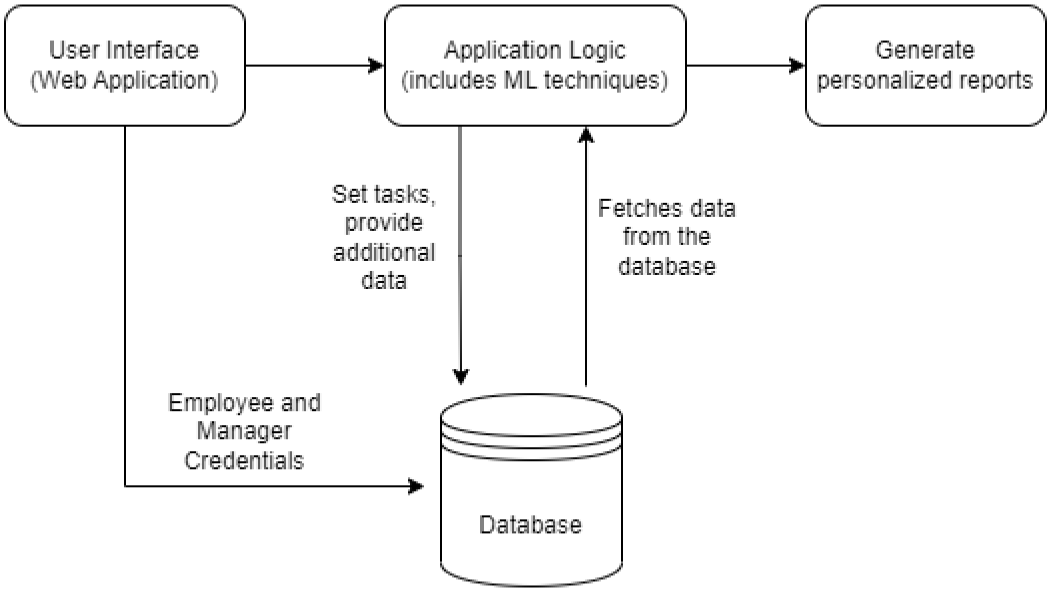


Figure 3.3: Architecture Diagram

3.1.4 Use case Diagram

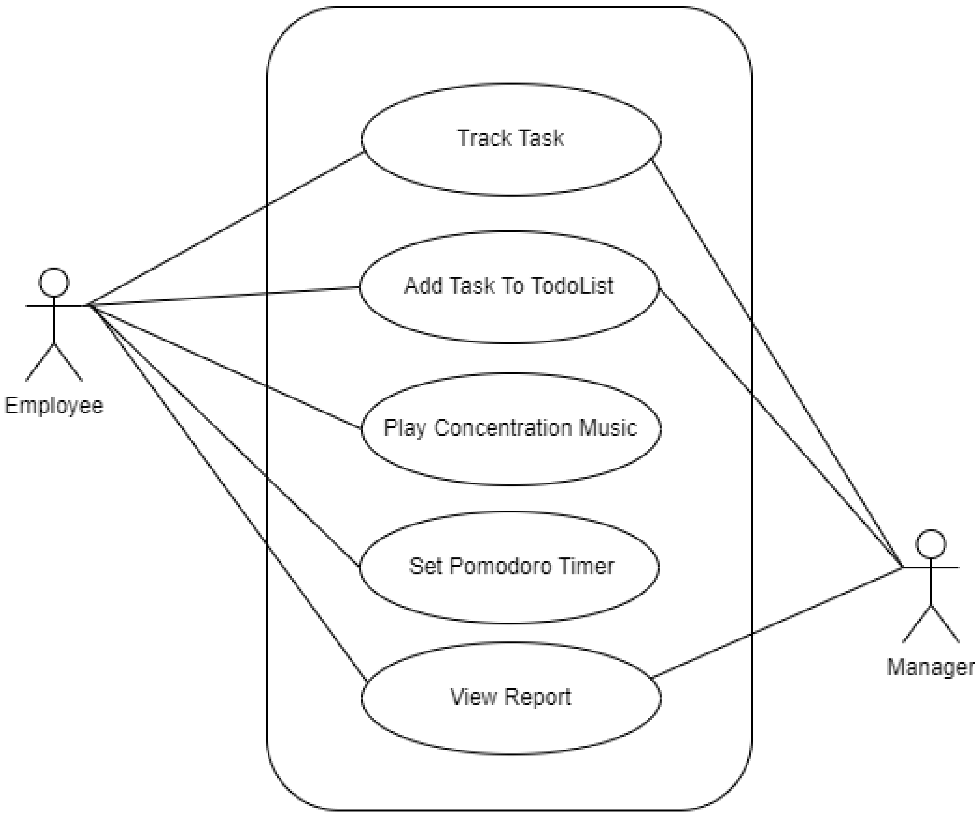


Figure 3.4: Use case diagram

3.1.5 Data Flow Diagram

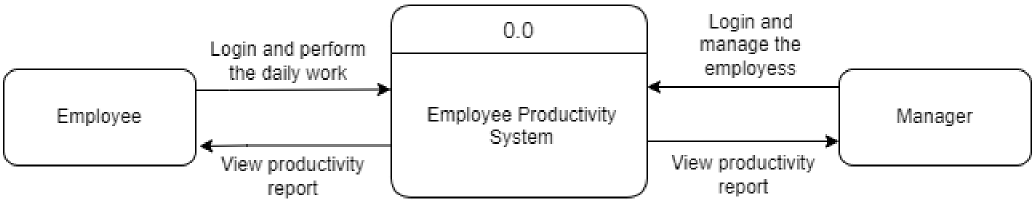


Figure 3.5: Data Flow Diagram Level 0

3.1.6 Data Flow Diagram

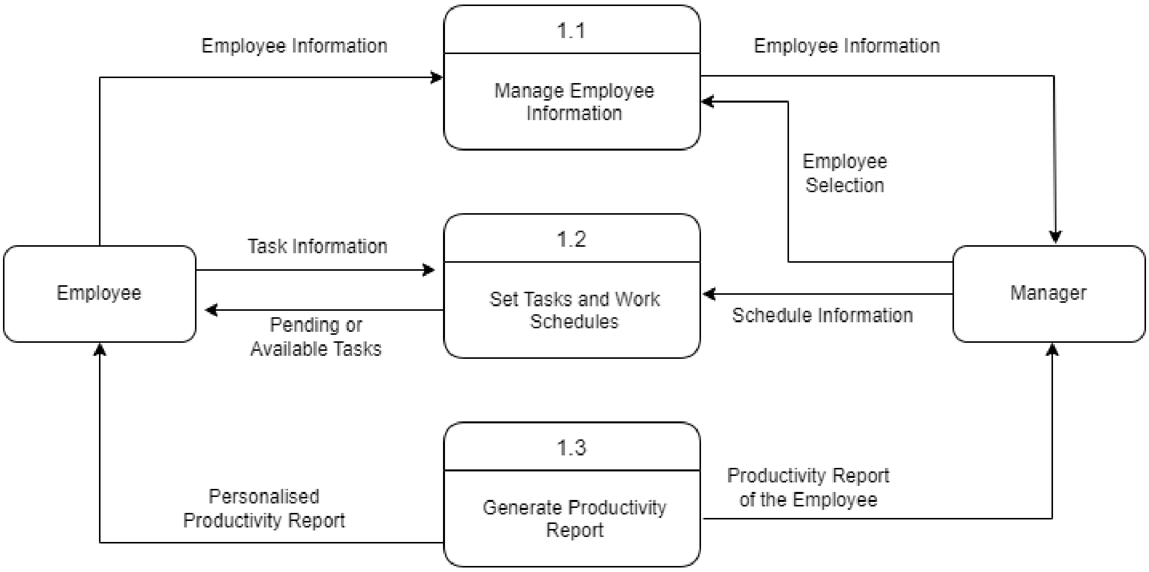


Figure 3.6: Data Flow Diagram Level 1

3.1.7 Data Flow Diagram

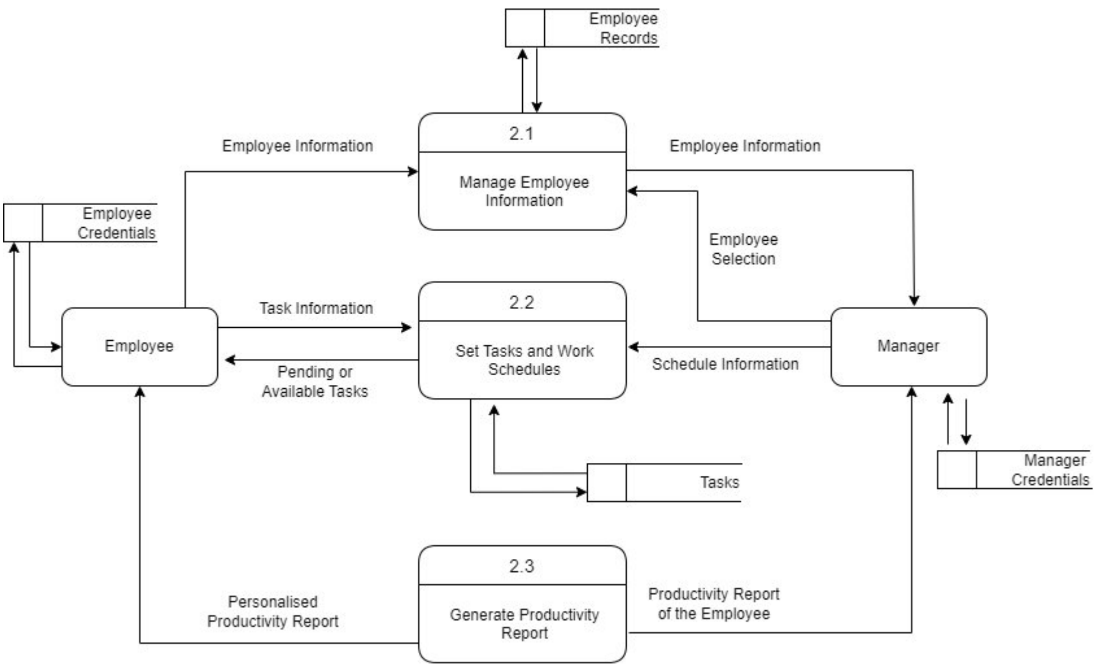


Figure 3.7: Data Flow Diagram Level 2

3.1.8 Class Diagram

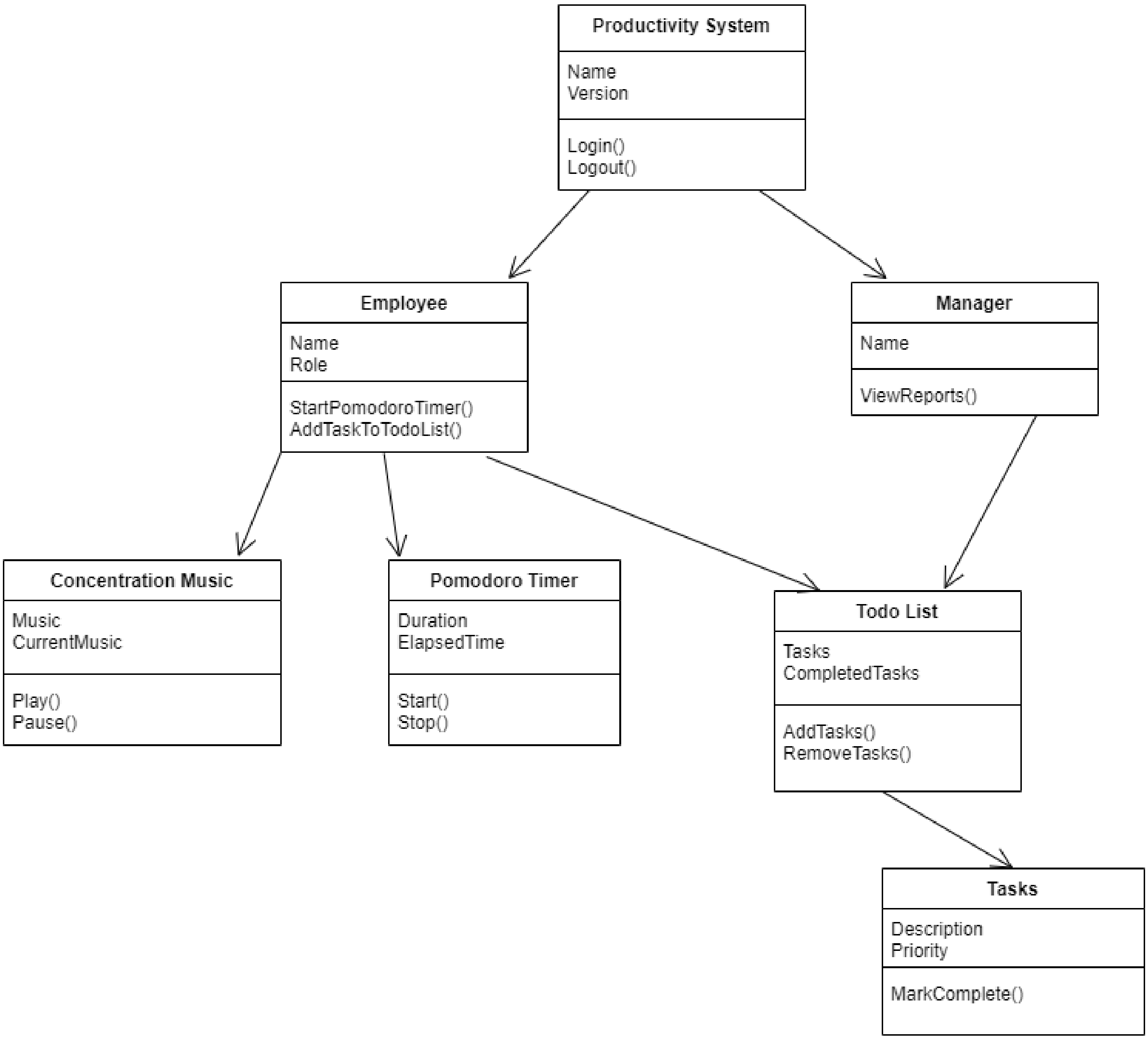


Figure 3.8: Class Diagram

Chapter 4

CONCLUSION

The productivity improvement software is a powerful tool for helping employees track their tasks, manage their time, and stay focused and productive throughout the workday. With features such as a Pomodoro timer, to-do list, concentration music, and drowsiness detection, the software offers a range of benefits for both employees and managers. For employees, the software helps them increase their productivity, manage their tasks more effectively, and achieve a better work-life balance. The Pomodoro timer and concentration music features help employees take breaks and relax, improving their overall well-being. The drowsiness detection feature can help employees stay alert and avoid accidents or mistakes caused by fatigue. For managers, the software provides valuable insights into employee productivity and areas for improvement. The reports feature allows managers to view metrics such as the number of tasks completed, the amount of time spent on each task, and the employee's overall productivity over a given time period. This data can help managers identify areas where employees may be struggling and provide support to help them improve.

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