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| ACADEMIC YEAR       | 2022-20223                               |

## **DECLARATION**

I, SHUKURU NICOLAUS DIMOSO, hereby declare that the work titled “Smart Invigilation System” has been carried out by me in the department of Computer Science and Engineering at Mbeya University of Science and Technology.

.....

Shukuru N. Dimoso (A STUDENT).

.....

Date

## **CERTIFICATION**

The undersigned certify that, he has read and hereby recommend for acceptance by MBEYA UNIVERSITY OF SCIENCE AND TECHNOLOGY(MUST) a project titled ‘SMART INVIGILATION SYSTEM in the fulfillment for the Bachelor of Computer Engineering at Mbeya University of Science and Technology (MUST).

.....  
Lihendime Madembwe (A SUPERVISOR).

.....  
Date

## **ACKNOWLEDGEMENT**

I would like to thank my ALMIGHTY GOD for his life grace which enabled me to have time for project study and presentation. I would like also to thank my project coordinator, SHADRACK NJUGUNYA for his advices and allowance to work on this project.

I would also thank my project supervisor 'LIHENDIME MADEMBWE for directing, advising me with this project. I would also want to thank to the department staffs of COMPUTER SCIENCE AND ENGINEERING for their help and advices on this project.

## **ABSTRACT**

Examination cheating is the situation which occurs when a student attempts to get academic credit in a way that is dishonest, disrespectful, irresponsible or unfair. Examination cheating activities like face movement, head movements, hand movements, or hand contact are extensively involved, and the rectitude and worthiness of fair and unbiased examination are prohibited by such cheating activities. The aim of this project is to develop a model to supervise or control unethical activities in real-time examinations. Exam supervision is fallible due to limited human abilities and capacity to handle students in examination rooms, and these errors can be reduced with the help of the Smart Invigilation System.

This work presents an automated system for exams invigilation using machine learning and computer vision approaches i.e., Dlib and Opencv . Dlib is an object detection algorithm that is implemented to detect the suspicious activities of students during examinations based on their face movements, and for starting capturing the video of students Opencv is used.

The model is fully efficient in detecting and monitoring students in one frame during examinations. Different real-time scenarios are considered to evaluate the performance of the Automatic Invigilation System. The proposed invigilation system can be implemented in colleges, universities, and schools to detect and alert student suspicious activities. Hopefully, through the implementation of the proposed invigilation system, we can prevent and solve the problem of cheating because it is unethical.

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## **LIST OF ABBREAVIATIONS**

|        |                                |
|--------|--------------------------------|
| OPENCV | Open Source Computer Vision.   |
| SSD    | Single Shot Detector.          |
| YOLO   | You Only Look Once.            |
| CNN    | Convolution Neural Networks.   |
| DLIB   | Digital Library.               |
| HOG    | Histogram of Oriented Gradient |



# CHAPTER ONE

## 1 Introduction

Smart Invigilator System is a project implemented to alert and detect unethical activities of students in a real time examinations. Unethical can be defined as a situation when a person does anything which is considered unacceptable.

So during exams, cheating is the among of the unethical activities because is the against the examination rule. Cheating occurs when a student attempts to get academic credit in a way that is dishonest, disrespectful, irresponsible or unfair.

During exams a student can cheat using eyes movement when student is copying or looking from another's sheet, movement of the head from one side to another (left, right, or upward), lip movement when a student is trying to talk with another student during exam, movement of the face from one side to another (left, right, or upward), when a student uses electronic gadgets such as mobile phone that can be used for malpractice, also motion of the students from one place to another.

### 1.1 Background information

In a traditional examination and formal examination, question papers are provided to students where student respond in the form of answers in a limited time period as we do now.

But in traditional and formal examination, the invigilators (examination supervisors) their job is to prevent any kind of cheating in a examination room such as gesture communications, movements of students during examinations and monitor students from cheating by observing the uses of notes or any cheating materials.

As a time goes on, now we have so many invigilation systems which have designed to detect, to monitor, to supervise and to alert cheating activities of students during exams.

Example some of universities now days use closed circuit television to monitor or detect cheating activities in a examination room with the aid of human invigilators who are checking student when conducting their exams through closed circuit television.

Examples of other systems which have been implemented for invigilation purpose are;

1. Realization of intelligent invigilation system based on adaptive threshold.
2. Multi-index examination cheating detection method based on neural network.
3. Real time automated invigilator in classroom monitoring using computer vision.

But both of those systems are not more efficiently for offline examinations, aim was for online examination which can monitor and detect one student at a time and each student must have his or her camera.

So to overcome the problem of offline examinations monitoring and to reduce a load to a invigilation staffs, the proposed model Smart Invigilation System based on computer vision that can detect and alert suspicious activities of students in a real time examinations is implemented.

This project is time constraints, so it focuses on the analysis of the face movement of each student during exams.

By analyzing the movement or orientation of the face, a cheating label is considered for the following face movements left, right, or upward and no cheating is considered only for down movement of the face when student is doing his/her exam.

## 1.2 Problem Statement

Academic dishonesty and cheating have constantly been worrying factors for the educational institutes in the education system worldwide. The fact is that the students adopt different cheating approaches during the examination. There are psychological and social reasons why students opt to cheat in exams, such as parent's pressure, feeling of incompetency, want better grades, time constraints, fear of failure, and take a risk with less fear of being caught. So invigilation process becomes a problem during exams due limited human ability and capacity to handle students in examination room.

A good invigilation system must detect and alert cheating activities in a real time and checks must be promptly, accurately and automatically.

In the past few years, the process of detecting cheating activities of students during online and offline exams have been detected multiple times by using various techniques. Some of the related works developed for detecting cheating activities of students are;

### 1.2.1 Automated Invigilation System for detection of suspicious activities during examination

Implemented a system using spatial-temporal features to detect students abnormal behavior, this model based on the movements of the students like turning around, movements of the head, movements of hands and other part of the body.

#### ➤ Strength of the system

- ▢ The system helps to detect cheating in a real time examinations.
- ▢ It was used for both online and offline examinations.

#### ➤ Weaknesses of the system

- ▢ The problem with this system was overlapping of detection boxes when students sitting arrangement is conducted or when students sitting arrangement is very close or during the collection of the papers.

### 1.2.2 Real Time Automated invigilator in Classroom Monitoring using Computer Vision

Also detecting the cheating of students using the openpose module in which the poses of the students were extracted by fetching the multiple joints of the body, and then cheating label drawn on the faces of the students who are trying to make movements during exams.

#### ➤ Strength of the system

- The system helps to detect cheating in a real time examinations.

#### ➤ Weaknesses of the system

- Due to this, increase the computation of the model and hence not suitable for real time.

### 1.2.3 Closed circuit Television and manual systems

Globally even also in Tanzania, some of universities use human invigilators and some of the universities use closed circuit television camera to monitor students during examinations.

#### ➤ Strength of the system

- The system helps to detect cheating in a examination rooms.

#### ➤ Weaknesses of the system

- Both of those systems do not alert suspicious activities automatically instead use human being to detect suspicious activities.

### 1.2.4 Expected solution

Therefore the proposed model which is smart invigilation system is focused to come up with a smart invigilation system which will monitor and alert cheating activities in a real time during exams.

## 1.3 Project objectives

### 1.3.1 Main objective

The main objective is to design a Smart Invigilation System.

### 1.3.2 Specific objectives

1. To create invigilator interface for capturing live video.
2. To create an algorithm that will extract facial images from the webcam.
3. To create an algorithm that will check the angle of face orientation to determine whether exceeding or not.
4. To link a software part with hardware part.

## 1.4 Scope of the project

Prototyping, the system will use webcam or mobile phone camera for capturing video.

## 1.5 Significance

1. To reduce dishonesty and cheating among the students during examinations.
2. To reduce the burden on the invigilation staff members.
3. To improve fairness and integrity of examinations.

## 1.6 Limitation

The process of detecting cheating activities of students will be done only if the camera is in front of the student face and not behind him/her.

## CHAPTER TWO

### 2. Literature Review

#### 2.1 Introduction

This part focuses on the looking of different solutions implemented by researches to remove or reduce the problem of cheating of students during exams.

The review is comprised of works that have been done to find the solution to the problem, the systems that were closely related to the proposed model are reviewed and noted the strengths and weaknesses of the solutions.

By studying these systems, we were able to find the deficiency and stated ways in which the solutions can be implemented.

#### 2.2 Related work

The following are common systems (related works) as elaborated below; -

##### 2.2.1 Realization of intelligent invigilation system based on adaptive threshold.

Adil, (2022) created a model that will help schools and universities to monitor cheating activities such as whispering, hand contact in the classroom during examinations. The model based on certain threshold levels, in which a box is drawn around the student and whenever a student moves his hand beyond this level, it will be detected. They used the Viola Jones algorithm which used to recognize face and Adaboost for their proposed model

Drawback: The drawback of this algorithm is that, the overlapping may occur when there is less space in students sitting arrangement.

##### 2.2.2 Automation of traditional exam invigilation using closed circuit television and bio-metric.

Ketab, (2022) created an invigilation system with the authentication process of students. The proposed model was used for both offline and online examination.

It uses the technique of multi-model bio-metrics for the student's identification along with a 3D facial recognition method. But to monitor students during examinations, the model used eye movement and speech recognition module is implemented to detect any improper voice

Drawback: The drawback of this algorithm is that, it requires multiple cameras to capture students.

### **2.2.3 Automatic invigilation using computer vision.**

Zhenhong and wan, (2022) created a deep learning module for the identification of cheating during exams, also another algorithm which is YOLO (You Only Look Once) algorithm is implemented to detect the boundary box for each student along with Openpose algorithm which used to identify and recognize student correct posture and position and label them as suspected or non-suspected.

YOLO is an algorithm that uses neural networks to provide real time object detection. This means that prediction in the entire image is done in a single algorithm run. The CNN is used to predict class probabilities and bounding boxes simultaneously.

The Yolo algorithm consists of various classes. Some of the common ones include tiny YOLO and YOLOV3.

Drawback: This system works fine for online examinations and not suitable for offline examinations, because there is overlapping of detection boxes.

### **2.2.4 Application of a single- shot Multi-core detection algorithm in intelligent visual monitoring of examination room.**

Xiao, (2022) created an automatic real time based invigilation system by using a single- shot Multi-box (ssd) detector and then comparing the accuracy of the model with Yolo and other object detection deep learning modules.

SSD is designed for object detection in real-time . Faster R-CNN uses a region proposal network to create boundary boxes and utilizes those boxes to classify objects.

This model used to detect and identify cheating activities of students during the exam with an accuracy of 88%, so it has been adapted to the education sector.

Drawback: Requires multiple cameras to supervise and monitor each student.

### **2.1.5 Real time automatic invigilator using inception V3 CNN algorithm.**

Kulkarni, Rutuja, (2022) created a method which used V3CNN for the classification of body movements into legal and illegal activities during examination.

In their model, the automatic invigilation system was proposed in which students are being monitored and supervised. The backbone of this architecture was the inception V3CNN model.

The inception V3 model used several techniques for optimizing the network for better model adaptation. This is a deep learning model based on Convolution Neural Networks, which is used for image classification

Drawback: But the problem with this invigilation system is that, it is not enables the capture of more than 15 students during the examination while live stream.

### 2.3 Literature review summary

| S/NO | AUTHOR                   | SYSTEM   | DRAWBACKS   |
|------|--------------------------|--|---|
| 1    | Adil, (2022)             | Realization of intelligent invigilation system based on adaptive threshold                       | Drawback of this algorithm is that, the overlapping may occur when there is less space in students sitting arrangement.                   |
| 2    | Ketab, (2022)            | Automation of traditional exam invigilation using closed circuit television and bio-metric       | Drawback of this algorithm is that, it requires multiple cameras to capture students  |
| 3    | Zhenhong and wan, (2022) | Automatic invigilation using computer vision   | This system works fine for online examinations and not suitable for offline examinations, because there is overlapping of detection boxes |
| 4    | Xiao, (2022)             | Application of ssd core detection algorithm in intelligent visual monitoring of examination room | Requires multiple cameras to supervise and monitor each student   |

|   |                          |  |   |
|---|--------------------------|--|---|
| 6 | Kulkarni, Rutuja, (2022) | Real time automatic invigilator using inception V3 CNN algorithm | The problem with this invigilation system is that, it is not enables the capture of more than 15 students during the examination while live streaming |
|---|--------------------------|--|---|

## 2.4 Proposed system

So a proposed model which is Smart Invigilation System is focused to come up with simple solution to detect and alert cheating activities of students in a real time examinations.

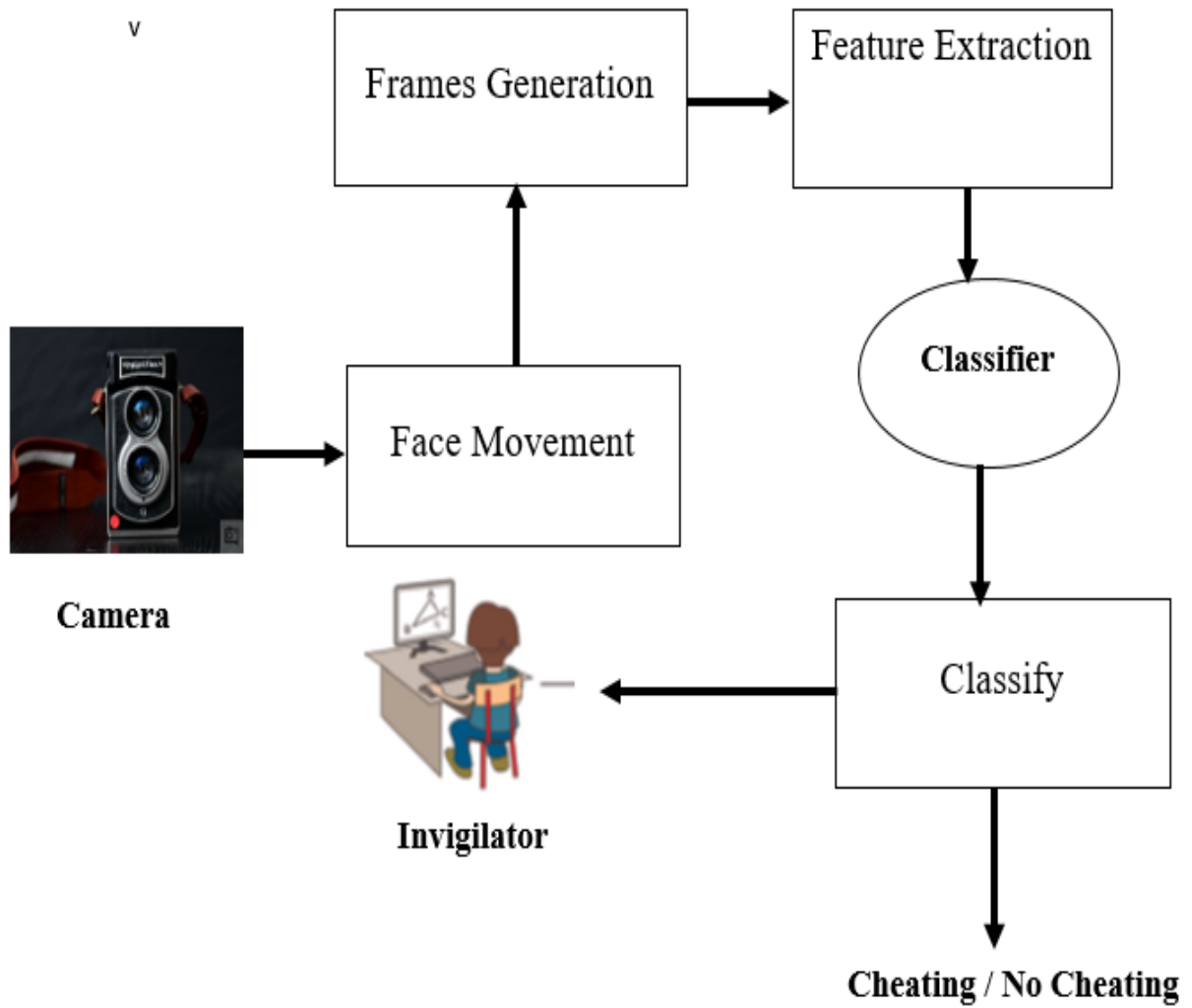
This model can be used in both offline and online examinations. This model uses two algorithms which are OpenCV and Dlib library which is more accurate for facial features extraction.

It has no limit for capturing number of students in examination room, but it depends on the device used to record live video. But to monitor students during examinations, the model used face movement with aid of boundary boxes and utilizes those boxes to classify students activities.

The model based on certain levels (angles), in which a box is drawn around the student and whenever a student moves his face beyond this level, it will be detected as a cheating.



#### 2.4.2 Block diagram of the proposed system



### 2.4.2 Working principle of the proposed model

In the proposed system two modules are implemented, the first is opencv and second is Dlib module. Opencv (open source computer vision library) is an open source computer vision and machine learning software library.

It is the huge library for the computer vision, machine learning and image processing. It plays a major role in real-time operation which is very important in today's systems. But in a proposed model opencv is used only to start the camera for capturing live video.

Dlib is an open source C++ library implementing a variety of machine learning algorithms, including classification, regression, clustering, data transformation and structured prediction. In a proposed model Dlib used to estimate the location of 68 coordinates (x, y) that map the facial points on a person's face and then predict the orientation of the face from live video.

In a proposed model surveillance camera is used for live video recording of students in the examination room, video is then converted into frames by using python code.

Dlib used for facial features extraction with more than 90 % accuracy. In this project it is implemented to detect unethical or cheating activities in the examination room. The model is trained on two types one is labeled as cheating and the other one is labeled as no cheating.

## CHAPTER THREE

### 3. METHODOLOGY

#### 3.1. Introduction

In this article, data collection method, sampling techniques, methodology approach are elaborated. According to the project management institute (PMI), the methodology is defined as a system of practices, techniques, procedures and rules used by those who work in a discipline (zenkit.com, 2018).

#### 3.2 Data collection

Data collection Is a process of gathering and analyzing specific information to proffer solutions to relevant questions and evaluate the results. There are two types of data collection namely primary data collection and secondary data collection (www.formplus.us, 2020).

##### 3.2.1 Primary data collection

It is the gathering of raw data collected at the source. In this project, the primary data collection will not be conducted because of time and financial constraints

##### 3.2.2 Secondary data collection

Secondary data collection, on the other hand, is referred to as the gathering of second-hand data collected by an individual who is not the original user. It is the process of collecting data that is already existing, whether published books, journals, and/or online portals.

In terms of ease, it is much less expensive and easier to collect. Through it the data from internet, books and other journals will be gathered so that to be used whenever needed in this project.

#### 3.3 Design approach

The important concept of this project can be explained in two main phases: image acquisition, face detection and feature extraction.

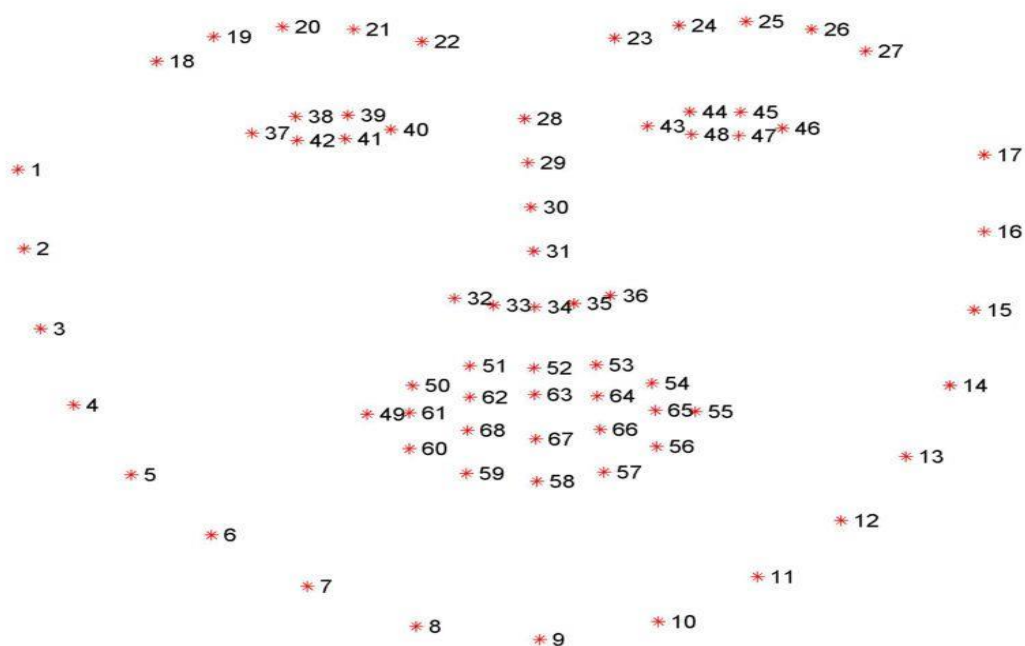
### 3.3.1 Image acquisition

In this part which is data acquisition; camera is used to capture the video of students, and then the video is converted in to multiple frames or images to detect the students.



### 3.3.2 Face detector

Dlib HOG (Histogram of Oriented Gradients) is implemented to detect students faces. The algorithm detects student faces along with 68 point facial landmarks.



Face detection is generally divided into 3 steps by using Dlib which are as follow:

1. **Face detection:** The step is to detect all the faces in the live video from the camera. This can be done using a face detector called HOG (Histogram of Oriented Gradients).
2. **Face alignment using facial landmarks:** Second step is to align or normalize the face using facial landmarks in order to improve the accuracy of the face orientation.



3. **Face encoding:** In this step the face images are passed to the model and extract the facial features.

### 3.4. Sampling technique.

Sampling technique is the selection of sample components that will provide a representative perspective of the entire sample. Simple random sampling, cluster sampling, stratified random sampling, and systematic sampling are some of the techniques used.

For this project the simple random sampling will be used. Simple random sampling is the one which individual is chosen entirely by chance and each member of the population has an equal chance of being included in the sample.

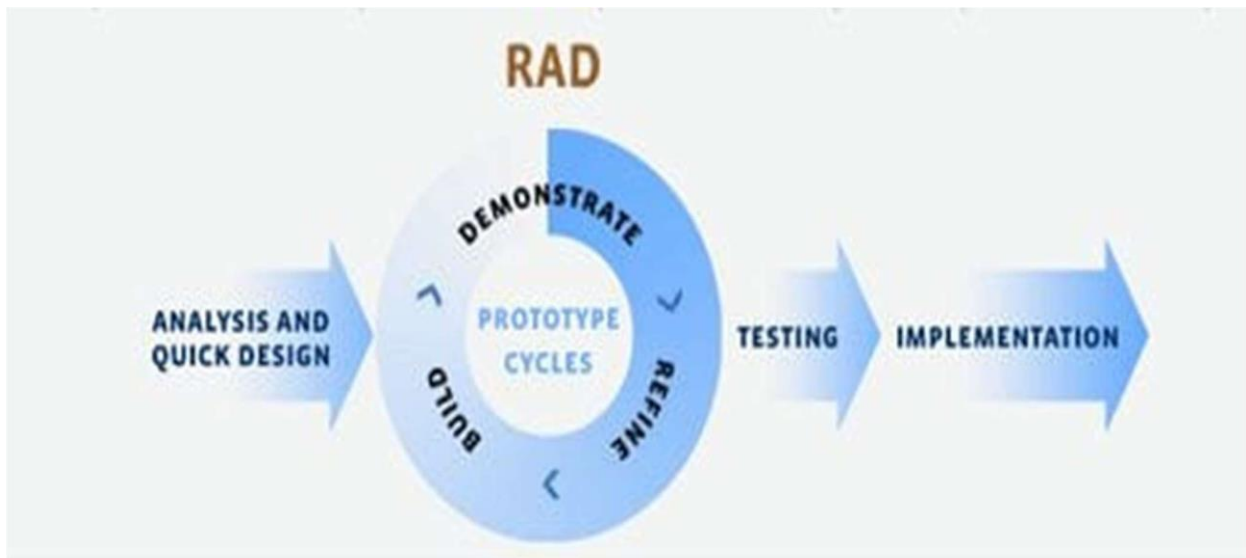
### 3.5. Data analysis tool

After collecting data I will use Statistical Package for Social Science (SPSS) to analyze those data.

### 3.6 Methodology approach

#### 3.6.1 RAD

Actually, in this project Rapid Application Development (RAD) as the type of prototyping model will be used. RAD is a development model prioritizes rapid prototyping and quick feedback over long drawn out development and testing cycles. With RAD, developers can make multiple iterations and updates to a software rapidly without needing to start a development schedule from scratch each time [kissflow.com](https://kissflow.com), (2021).



#### 3.6.2 Why RAD preferred

1. Enables face-to-face interactions.
2. Support, trust, and motivate the people involved.
3. It encourages Customer satisfaction through early and continuous software delivery.
4. Quicker customer feedback provides a better idea of customer needs.
5. Requirements can be changed at any time.
6. Encourages and priorities customer feedback.

7. Reviews are quick.
8. Development time is drastically reduced.
9. More productivity with fewer people.
10. Integration isn't a problem, since it integrates from project inception.
11. Time between prototypes and iterations is short.

### 3.7 Conclusion

This project proposed a model for students' invigilation in the examination using the Machine Learning and computer vision approach. In this work, implemented the Dlib with Opencv for automatic invigilation. The detection of the cheating was done on the base of the neck and face movement of the students. The data set was generated in a local environment for the experiments. The results show that proposed model achieved more accuracy as compared to other one. In future work, the system will also able to detect the other methods of cheating like exchanging sheet, head movement of the students, lip movement of the student and gesture detection.

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