Salat Error Detecting System

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**Salat Error Detecting System**", submitted by Tahmid Ahmad Khan, ID: 173-15-10379 and Rubai Rahman, ID: 173-15-10327 and MD. Hamim Hasan, ID: 173-15-10351 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 6 January 2022.

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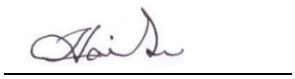

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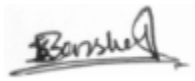

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mr. Md. Azizul Hakim, Senior Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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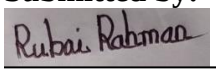

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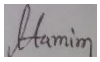

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ABSTRACT

Research has become one in every of the foremost talked buzzwords the epoch thanks to knowledge development and practical improvement obtained by research papers. However, choosing the precise research topic from the vast ocean of knowledge fields for an unaware individual person is sort of hard. Sometimes a beginner researcher /students cannot specify the research interest, or they're unknown with trending topic and technology, which are most impactful within the near future. Therefore, we think computer vision is such a very important thing that already helps the individual in a various way and it'll help us in the future.

In the Muslim community Salat is the second pillar of Islam and it is the most significant and fundamental worshiping activity that believers have to perform five times every day. From a gesture's perspective, there are predefined human postures that must be performed in a precise manner. However, for several people these postures are not correctly performed, because of being new to Salat or maybe learned prayers in an incorrect manner.

The process of identifying salat errors from a real time salat is one of the promising applications of visual object recognition in computer vision. However, detection of salat error from real time salat is a particularly challenging work due the characteristic of their complex movements. For this we use open cv NumPy matplotlib libraries. For detecting real time movement, we first take image and using function we draw landmarks. Later we compare this image and its angle with the real time detection to compare and get the correct movement.

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CHAPTER 1

Introduction

1.1 Introduction

According to adherents 2020 the current Muslim population around the world is 1.91 billon which is the 24.9% of total population of earth, and in Bangladesh the current Muslim population is 148.61 million and in 4 out of 177 countries. As we saw this number, we can say that the number is huge. Salat is the one of main pillar in Islam and is the important prayer activity that is done five times a day by Muslim. As it consists of a series of fixed postures that have to executed in a fixed sequence as instructed by the Prophet Mohamed, peace be upon him. In the corvid19 pandemic in 2020 we knew that all the mosque was locked down, due to that reason people had to pray their daily prayer in their home. So, they may sometimes forget to perform the right postures. There can be many reasons for this to occur like, for example the lack of proper knowledge about those movements', or being careless, Besides, another thing is that in Salat every pose should be done in a fixed amount of time while making those movement.

When we look at an image where some people are in picture, if any known person in there, we can easily recognize him or her. We can also tell some phenomenon about the person but if same thing happens with computer just like if computer sees the same picture, it can't tell anything either we do it with machine vision or computer vision. So, in short machine vision means if computer or machine has sight Computer Vision plays a significant role by achieving best ability in manufactured things, curtail costs. Cameras and image processing software help machine vision for better inspections. That's why, we are going to use computer vision for detecting error in salat.

1.2 Motivation

Human Activity Recognition has been extensively investigated mistreatment totally different techniques as well as sensing technologies. Computer visions and a lot of recently mis treatment deep learning. The process of identifying real time movement form salat is quite interesting. As we know the Muslim community in number is huge and salat is one of major pillar in Islam and it is performed five times in a day. The ultimate goal of our research is to develop a system that will help Muslim community. We chose this appropriate human motion with special concern to the Muslim community. As the posture in salat is fixed and must be executed in a certain time to complete the prayer, anything out of the fixed posture will hinder the prayer. Mostly the people who is new to Islam(reverted), children who are still learning the salat sometimes make certain mistake. Our project main focus is here to help them to understand where they are making those mistake or not. If they are making any mistake with the output, they will be able to correct the mistake. So, we believe that this research project is going to help to solve these kinds of problem. As we live in an age where works are going on with the help of electronic device, or mechanical device that operate electrically, make every work easy and clear, but we found absence of this automated system in this topic.

1.3 Rationale of the Study

[1]We mainly work on the basis of posture of salat. [2] In this paper the writher used smartphone to detect salat pose. In [3] the authors detect activities of salat using electromyographic alarm. And there are some works used deep learning system to address the problem of human posture detect in different system such as sports healthcare and many more sector. In this paper, we introduce a unique solution to detecting motion of salat using computer vision.

1.4 Research Questions

There are some phenomenon that help to bring some questions those are related to our work. From these questions we can improve our search and anybody can get clear concept

- Can we able to detect real time posture of slat?
- Is there only white background which we will use far taking pictures of salat? Can we change background?
- Can we detect if there is more than on person?
- If we take pictures of salt posture at different angles, will those pictures be detected perfectly?
- If the dimension of image is different with the real time posture, how can it will be recognized?

1.5 Expected Outcome

From this analysis, universities and analysis establishments will discover the papers utmost related to their research plans or thesis. Hence, in search of the proper papers to browse flip out to be associate degree vastly essential phase of their academic lives and introducing with trending and upcoming research topic impacts on their though. In addition, it can explore more talked buzzed, used the topic in recent times, which motivates them to work with new problems, finding new solutions, and help the students who are confused about their field of interest. In computer vision, there are number of techniques and algorithms used to extract the choice to extract information from a huge amount of data. Expected outcome of our project is to detect the error from real time salat and generate an output that will show the person where he/she is mistaken the salat.

1.6 Report Layout

The report will be described as follows:

Chapter 1 provides substance of our project. Firstly, we introduce all thing about our project as well in this chapter. Afterwards there is a content that is based on what motivated us to do this project. Hereafter why this study is helpful for us that will be described in rationale of study very well. Then some content name as research questions and expected output are also written in the last part of this chapter 1.

Chapter 2 involves the discussions of what types of works done in this field before. Moreover, this second chapter provides the summary of those related works and the problems that were the limitations of these area. And lastly it explains the challenges that could not be overcome.

Chapter 3 represents theoretical description of this research project. This chapter expands the procedure that will encourage using statistical method. And very last it explains data collection processes and instrumental objects that grant us by taking raw pictures of salat. In this chapter, we will discuss our procedure for this work and also give some figure. Hereafter implementation requirements will be required in third chapter.

Chapter 4 utters experimental outcomes and discuss the results properly. In this forth chapter we attach some experimental tables and pictures that display the procedure and how we finalize our project.

Chapter 5 is based on conclusions of our research. Finally, this chapter includes our final work limitations and challenges. And if anyone wants to research elaborately in this field this research is a big scope for them to assist.

CHAPTER 2
Background

2.1 Introduction

We Have Used Mediapipe framework to detect humans poses in videos by localizing the key body joints (also referred as landmarks), these are elbows, shoulders, and knees, etc.

Mediapipe provides 33 landmarks on human body. It has the capability to detect human poses in real time. Its gives us high accuracy in CPU. By utilizing a two-step machine learning pipeline. By using a detector, it firstly localizes a person. It uses a frame to localize a person. Then it uses the pose of landmarks detector. Then it detects the landmarks within the region.

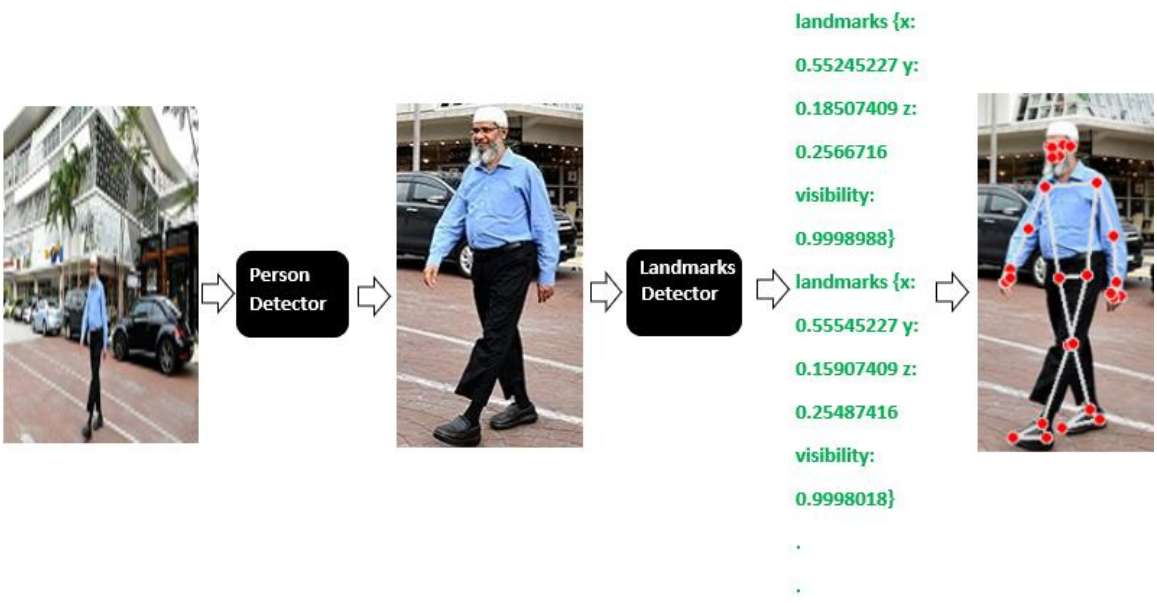

Figure2.1: Two-Step Machine Learning Pipeline

For the real time videos, the detector uses the very first frame. Then the ROI is derived from the previous frame. Then the ROI is derived, by using pervious

frame's pose landmarks using a tracking method. Also, when the tracker loses track of the identify body pose presence in a frame, the detector is invoked again for the next frame which reduces the computation and latency. Below the image shows 33pose landmarks along with their indexes. Please see the appendix B

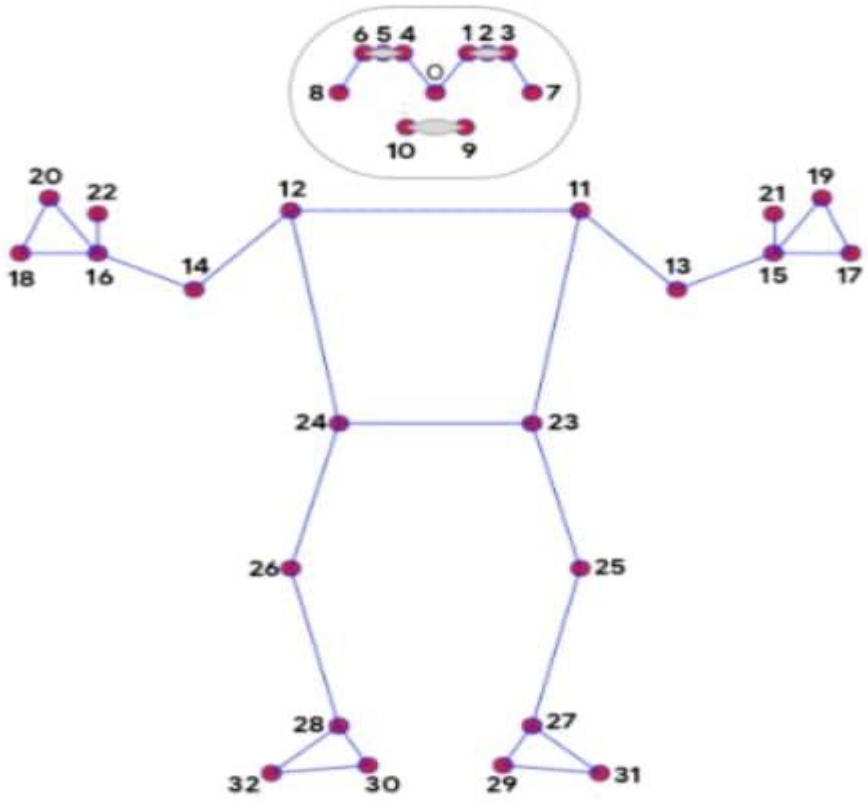

Figure 2.2: Thirty-three pose landmarks along with their indexes

2.2 Related Works

The very first work that targets the task of automatic recognition of prayer motion is that the paper published in 2009 by El-Hoseiny et al. [13]. They used a camera to capture the facet view of the prayer. Then, they used morphological operations to find the polygon comparable to the contour of the prayer body. The polygon knowledge is used to calculate the backbone axis angle and find the main four key-points of the shape of human. The backbone axis angle is that the angle between the axis and so the back-axis of the detected body. The four key functions determined from the polygon unit of measurement the center purpose of the polygon, the diarthrosis purpose, the highest purpose, and so the rear purpose. supported the coordinates of the key-points and so the value of the backbone axis angle, the prayer postures and movements are determined using a collection of given inequations. the tactic is completely supported camp-made options with none use of machine learning classifiers. This work is that the entirely work that used normal camera detector for this task. the alternative works leveraged the use of measuring instrument and Kinect sensors. Al Ghannam et al. [2] used a collection of classifiers for prayer activity observance and recognition supported measuring system knowledge collected from a mobile. They used 3 machine learning classifiers: J48 call Trees, IB1 (Instance-Based Learning) algorithmic program, and Naive Bayes. The accuracy of those algorithms exceeded ninety percent. Eskaf et al. [14] introduce a framework for lifestyle activities (sitting, standing, etc) from measuring instrument info. Then, they mixture these straightforward activities for recognition of prayer victimization supervised machine learning classifiers. Ali et al. bestowed equally a system for automatic detection and observance of prayer postures supported triaxial measuring system knowledge collected from a smartphone. They found associate with degree analysis of cluster prayer activities victimization dynamic time corrupt. In [16], the authors planned an individual's activity detection technique supported a deep learning model designed for low power devices. Alobaid et al.[1] conjointly studied the utilization of mobile measuring system knowledge for prayer activity detection . They created a performance comparison of 3 feature extraction system and eight machine learning classifiers. They terminated that random forest is that the foremost useable for this task, with associate degree accuracy of ninety

three percentage. They planned a 2-level classifier to unravel the confusion between 2 similar prayer stages and to max up the accuracy to ninety three percentage. They offered a short study on the result of private characteristics like height and age on the achievement of the classifier. Jaafer et al. [17] used another detector, kinect rgb depth camera. 2 kinect sensors square measure place in an exceedingly mounted position on the body, and therefore the skeleton info is extracted mistreatment kinect code development kit. They used the hidden markov model because the machine learning classifier for learning the prayer movements from the skeleton info.

2.3 Research Summary

For this project, we have studied serval conference paper articles, research paper, and books. In computer vision, many analyses used same algorithms on the same dataset. Sometimes the same dataset and same algorithms can accord diverse types of result.

Many researcher did not add info about their procedure on which algorithm they used. It generates tricky position for implementing the algorithm. Also, different operation are used in the same procedure that might result different result. Also a slight change landmarks, procedure, or user input predictability make a big change in the result of the approaches. So, Finding the best approaches is an humongous task.

2.4 Scope of the problem

When we were doing our analysis, we tend to found that selecting the precise analysis field from the huge ocean of data fields for an unaware particular person is kind of hard. There are many fields when a researcher wants to do research. However, he/she could not choose

most of the time. In addition, in research in academy, colleges and universities, professors, graduate students, and other analyst need to discover the papers utmost related to their research plans. In their educational lives, finding for the correct papers to read turn out to be an immensely essential segment. This research paper will advantage these individuals in serving the best related papers and preserving their valuable time. There is a many of related work. However, no works have taken sufficient significant info about research papers into the proposition. In addition, most of the researcher research on the same landmarks.

2.5 Challenges

Salat Error Detecting System from real time videos is an exciting challenge for Computer Vision researchers. It is a branch of human pose estimation. In our paper we address the study of salat error detecting from the view point of Computer Vision. It is a challenging task with high irregularity.

Numerous salat postures are gathered through the internet have generally a low resolution and have been processed by operators with creative and improvement filters. The big challenge is to collect the raw images from internet which suits with our project. There would be many unusable images. After collecting the images, the main Challenge is processing the images.

CHAPTER 3

Research Methodology

3.1 Introduction

This chapter mainly handles all the theoretical information of our research. Anyone will get clear impression thought about our thesis. Making it more commodious to understand we assembled some important knowledge shortly. To learning computer vision image is very important. So, we discuss image processing very briefly we will give clear concept about our method for recognition the salat posture. For recognize the correct posture of salat we use certain technique in addition, the chapter elaborates the statistical analysis. Research subject and instrumentation are also included in this chapter. The working procedure of the two models is shown with simple block diagrams.

3.2 Research Instrumentation

This experimentation is based on the person /pose detection model (balzepose detector) pose landmark model (blazepose ghum 3d).

Computer vision has some advantages-

- Simple and faster process
- Reliable
- Higher accuracy
- A wide range of use
- Reduction of costs

Efficiency and scalability of computer vision models

They are-

- insanely small
- insanely fast
- remarkably accurate
- easy to tune for resources vs accuracy

Tools or instrument that we use –

Up to now, we have explained the theoretical notions and procedures. Now a list of requirements of instrument are given below

- Hardware and software instruments-
- 2.5GHz Intel i5processor
- 4GB memory
- 16000MSzDDR3
- 64-bit operating system
- Web camera

Developing tools-

- Python 3
- NumPy
- OS
- Python OpenCV
- media pipe
- matplotlib
- Math

3.3 Step of Working Flow

Work flow refers to how to preprocess data and how to arrange them step by step very well to understand all the methods very quickly and having the scope for analyzing data to draw some limitations. In Shown fig: 3.1, we are going to discuss step by step what method we used for our work**.** We use person /ose detection model (blazepose detector) pose land mark model (blazepose ghum 3d)

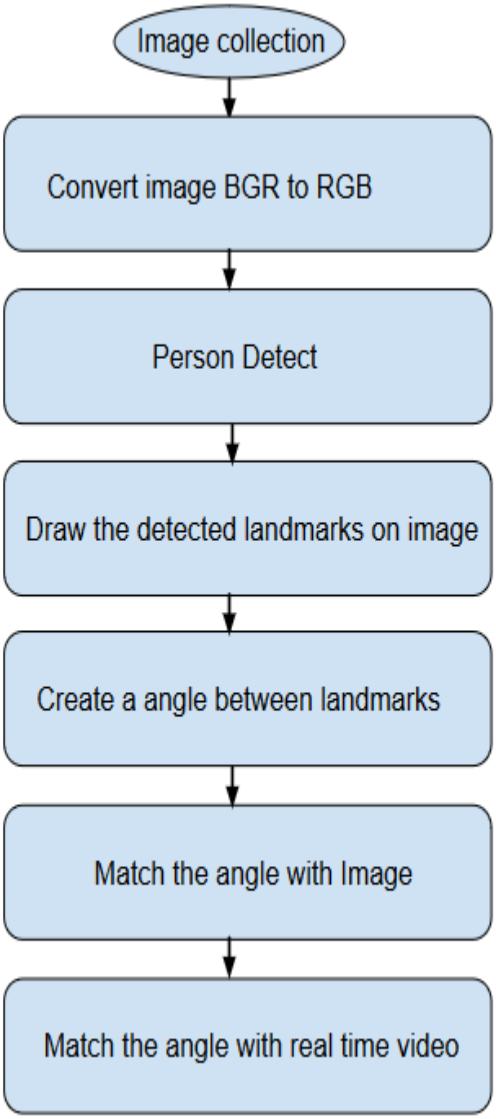

Figure 3.1: Flowchart of the proposed model

3.3.1 Image of Salat Posture

At first, we take all the picture of all the posture required in salat. When taking pictures some conditions should be remembered. Footage is captured by exploitation any angle and any dimension. Pixels and resolutions do not matter for making the pictures more clear. As we know salat is consist of some fixed posture they are known as Takbir, Qiyam, Ruku, Sajdah,Tashahhud, Peace of the right, Peace of the left.

Figure 3.3.1: Posture of Salat

Takbir: It is the step in standing and this pose is associated to when salat is starting. In Figure 3.3.1 first image shows an example of Takbir posture.

Qiyam: It is the step of standing, and this pose is associated to when recite the Quran, or after rising from ruku. It is generally take over one or two minutes. Figure 3.3.1 second image shows a case of a man in qiyam posture.

Ruku: It means yielding, and this pose appear after Qiyam to make next act. It generally take over a few seconds. In Figure 3.3.1 third image shows a case of a man in ruku posture.

Sajdah: It is the collapse and done after raising from yielding for also making next act It take over several seconds. In Figure 3.3.1 fourth image shows a case of a man in Sajdah posture.

Tashahhud: It is the posture when the tashahud is reciting in salat. In Figure 3.3.1 fourth image is shows a case of a man in this posture.

Peace upon Left and Right: It is the point of sitting after doing tashahudd for making next act and finishing Salat at its end. In Figure 3.3.1 last two image shows a case of a man in this posture.

3.3.2 Image Color Conversion

Now we will pass the image to the pose detection machine learning pipeline by using the function mp.solutions.pose.Pose().process(). however, the pipeline expects the input pictures in RGB color format thus initial we'll need to convert the sample image from BGR to RGB format victimization the operate cv2.cvtColor() as OpenCV reads pictures in BGR format (instead of RGB). [9]

3.3.3 Person Detect

The best part of contemporary object identifying result have confidence Non Maximum Suppression algorithmic program for his or her last post-clarification step. This works well for adamant objects with short degrees of freedom. But, this formula used for eventualities that embody very choral posture like those of humans, example. of us waving or foreplay. this may be as a results of multiple, ambiguous boxes satisfy the inter- section over union (IoU) brink for the NMS algorithmic program. to beat this limitation, we have

a tendency to concentrate on sleuthing the bounding box of a comparatively rigid part just like the face or body.

Figure 3.3.2: Person Detect

3.3.4 Image Processing

The pose evaluation factor of our system anticipated the part of all 33-person key points, and uses the person adjustment proposal given by the primary stage of the pipeline we have a tendency to adopt associated heatmap, offset, and regression approach. We have an inclination to use the heatmap and offset fall entirely inside the coaching stage and subtract the corresponding output layers from the model before starting the illation. Thus, we've got an inclination to effectively use the heatmap to manage the light-weight embedding, that's then tested by the regression encoder network. This path is an element affected by Stacked timepiece path of Newell et al. [5] , but in our example, we have an inclination to heap a touch encoder-decoder heatmap-based network and a future regression encoder network. we have a tendency to actively utilize skip-connections between all the moment of the network to reach a balance between high and low-level appearance. But, the acclivity from the regression encoder are not raised back to the heatmap competent appearance We have establish this to not only to better the heatmap predictions, but also considerably raise the coordinate regression accuracy.

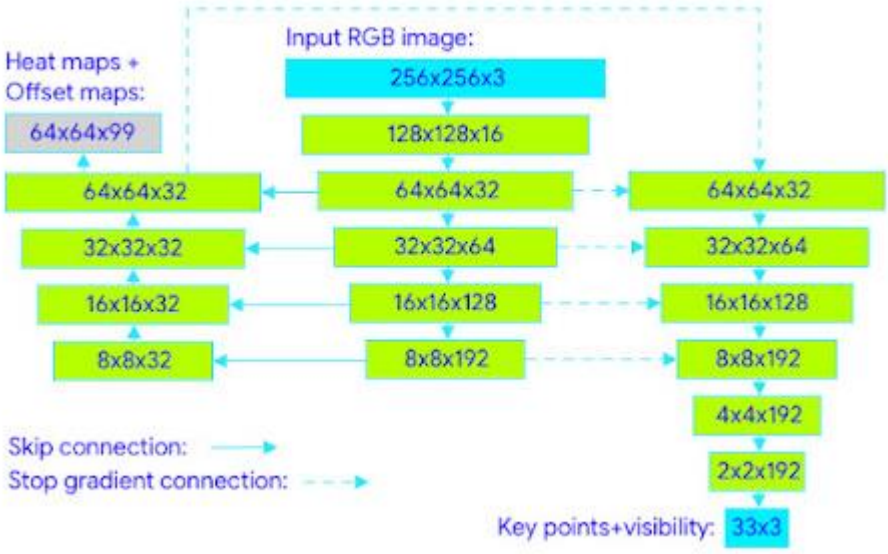

Figure 3.3.3: Find 3 key points and visibility of landmark

After performing the process on the sample image above, (Figure 3.3.3) we will display the first two landmarks from the list, so that you get a better idea of the output of the model.

Figure 3.3.4: Drawing Landmarks

The value we get are shown below:

NOSE:

x: 0.4521198570728302

y: 0.4892975687980652

z: -0.20324353873729706

visibility: 0.999996542930603

LEFT_EYE_INNER:

x: 0.4567885994911194

y: 0.47847145795822144

z: -0.19917456805706024

visibility: 0.9999940395355225

3.3.5 Angel Create Between Landmarks

We have learned to perform pose detection, now classifying different Salat posture using the calculated angles of various joints. We'll 1st notice the cause landmarks then use them to reckon angles between joints and relying upon those angles we'll acknowledge the yoga cause of the distinguished person in a picture.

But this approach will have a disadvantage that limits its use to a controlled atmosphere, the calculated angles vary with the angle between the person and therefore the camera. So, the person needs to be facing the camera straight to get the best results.

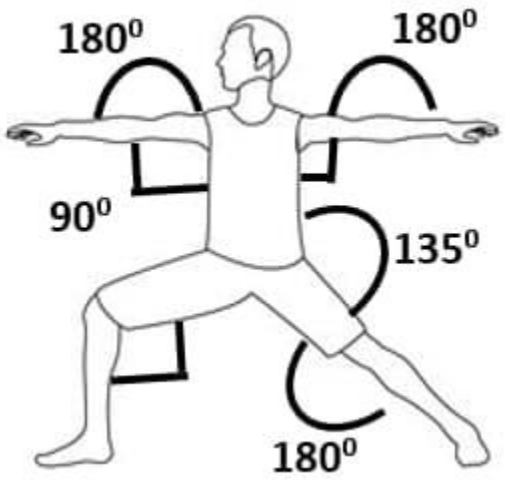

Figure 3.3.5: Human body angle between landmarks

Now we will create a function that will be capable of calculating angles between three landmarks. The angle between landmarks? Don't get confused, as this can be an equivalent as calculative the angle between 2 lines.

The first point (landmark) is considered as the beginning point of the first line, the second point (landmark) is considered as the last point of the first line and the starting point of the second line as well, and the third point (landmark) is considered as the last point of the 2nd line.

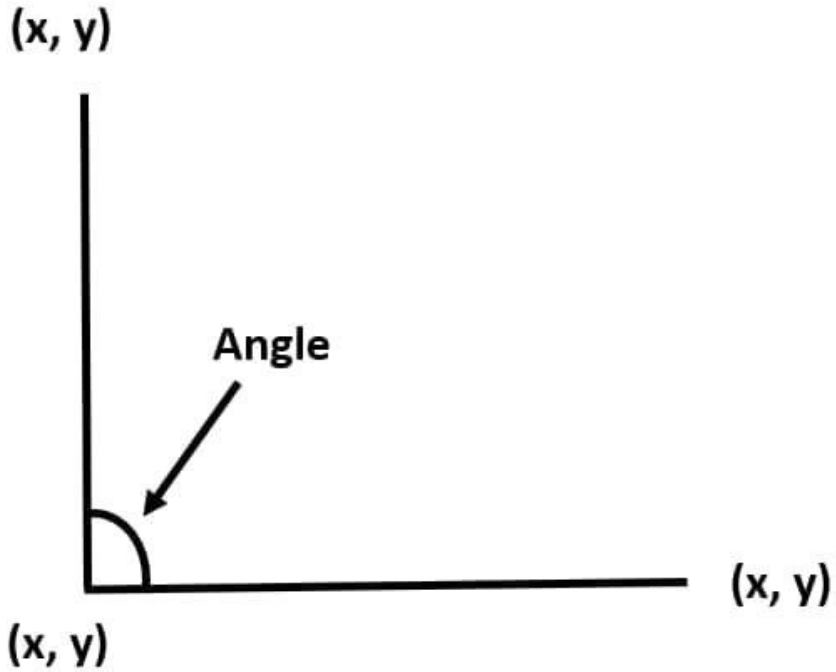

Figure 3.3.6: Angle Between 3 point of body joints

CHAPTER 4

Research Experiment and Result Discussion

4.1 Introduction

We applied an efficient Salat posture detection model spending a slight training time and get a greater precision. This chapter is mainly focus how we implement and brief analysis of data that used in our project. In this chapter, we also discuss about the experimental results of our research briefly.

4.2 Experimental Result

In this project we have used several libraries such as NumPy OS OpenCV media pipe matplotlib Math. First, we have collected all the images of posture used in salat. As we know the posture used in salat is fixed. So, we have to take the image with very carefully. After collecting the image, we had to first convert those images from BGR to RGB. Because media pipe does not support BGR image. For converting image we have used open cv and the function we used is results = (pose.prose.process(cv2 .cvtColor (sample img , cv2 color BGR2RGB))

After that using media pipeline we landmark all those images. As shown in Figure 4.2.1. As we saw these images all the point has been put for landmark point and test the posture with salat posture.

Figure 4.2.1: Landmark points of Salat Different Posture

After that our main focus was to detect the posture from real time movement of salat and detect the posture of salat. For that first load the web camera and detect the person for this we use Non-Maximum Suppression (NMS) algorithm. After that we calculate angle of human body parts and then we use the condition required for salat posture then compare the detected image with the calculated angle. After that if the image is match then we can saw posture name in display otherwise in display we saw unknown posture as result. The code and output of the project is shown below:

For Takbir

```
#Sajdah
elif left_hip_angle > 60 and left_hip_angle < 80 or right_hip_angle > 280 and right_hip_angle < 310:
    if left_knee_angle > 150 and left_knee_angle < 190 or right_knee_angle > 60 and right_knee_angle < 90:
        if left_elbow_angle > 150 and left_elbow_angle < 200 or right_elbow_angle > 290 and right_elbow_angle < 310:
            if left_salam> 75 and left_salam < 80:
                label = 'SAJDAH'
```

Figure 4.2.2: Takbir

For Qiyam

```
# Qiyam
elif left_elbow_angle > 120 and left_elbow_angle < 300 and right_elbow_angle > 40 and right_elbow_angle < 120:
    if left_shoulder_angle > 10 and left_shoulder_angle < 40 and right_shoulder_angle > 10 and right_shoulder_angle < 40:
        if left_knee_angle > 170 and left_knee_angle < 190 and right_knee_angle > 170 and right_knee_angle < 190:
            if left_salam> 80 and left_salam < 120:
                label = 'Qiyam'
```

Figure 4.2.3: Qiyam

For Ruku

```
#Ruku
elif left_hip_angle > 50 and left_hip_angle < 130 or right_hip_angle > 250 and right_hip_angle < 280:
    if left_knee_angle > 150 and left_knee_angle < 190 or right_knee_angle > 150 and right_knee_angle < 190:
        if left_shoulder_angle > 10 and left_shoulder_angle < 50 or right_shoulder_angle > 10 and right_shoulder_angle < 50:
            if left_elbow_angle > 150 and left_elbow_angle < 200 or right_elbow_angle > 150 and right_elbow_angle < 200:
                if left_salam> 90 and left_salam < 110:
                    label = 'RUKU'
```

Figure 4.2.4: Ruku

For Sajdah

```
#Sajdah
elif left_hip_angle > 60 and left_hip_angle < 80 or right_hip_angle > 280 and right_hip_angle < 310:
    if left_knee_angle > 150 and left_knee_angle < 190 or right_knee_angle > 60 and right_knee_angle < 90:
        if left_elbow_angle > 150 and left_elbow_angle < 200 or right_elbow_angle > 290 and right_elbow_angle < 310:
            if left_salam> 75 and left_salam < 80:
                label = 'SAJDAH'
```

Figure 4.2.5: Sajdah

For Tashahhud

```
#Tashahhud
elif left_elbow_angle > 160 and left_elbow_angle < 240 and right_elbow_angle > 160 and right_elbow_angle < 240:
    if left_shoulder_angle > 10 and left_shoulder_angle < 50 and right_shoulder_angle > 10 and right_shoulder_angle < 50:
        if left_hip_angle > 130 and left_hip_angle < 190 or right_hip_angle > 130 and right_hip_angle < 190:
            if left_salam> 80 and left_salam < 120:
                label = 'Tashahhud'
```

Figure 4.2.6: Tashahhud

For Peach to the Left and Right

```
#Peace to the right or left
elif left_salam> 160 and left_salam < 200:
    if left_hip_angle > 130 and left_hip_angle < 190 or right_hip_angle > 130 and right_hip_angle < 190:
        if left_shoulder_angle > 10 and left_shoulder_angle < 50 and right_shoulder_angle > 10 and right_shoulder_angle < 50
            if left_elbow_angle > 160 and left_elbow_angle < 240 and right_elbow_angle > 160 and right_elbow_angle < 240:
                label = 'Peace to the left'

elif right_salam> 160 and right_salam < 200:
    if left_hip_angle > 130 and left_hip_angle < 190 or right_hip_angle > 130 and right_hip_angle < 190:
        if left_shoulder_angle > 10 and left_shoulder_angle < 50 and right_shoulder_angle > 10 and right_shoulder_angle < 50
            if left_elbow_angle > 160 and left_elbow_angle < 240 and right_elbow_angle > 160 and right_elbow_angle < 240:
                label = 'Peace to the right'
```

Figure 4.2.7: Peace to the right

For Unknown posture

Figure 4.2.8: Unknown posture

4.3 Summary

At the end of the test, we saw that if the posture is anything out of test images posture it shows unknown posture and if the posture match it show the posture name accurately and hopefully, this research paper will help the student and the researcher who wants to research more on this topic.

CHAPTER 5

Summary, Conclusion, Recommendation and Implication for Future Research

Summary of the Study

In our paper, we focused on classification models of computer vision used in data recognition. Different classification techniques of computer vision have merits and demerits for data classification and knowledge extraction. Furthermore, we use matplotlib library and MediaPipe framework which are helpful in classification.

In this section, we will like to describe the conclusion, recommendations and further improvement ideas of this research.

Recommendations

It is recommended:

- that acceptable model choice is a vital a part of any classification;
- that a contemporary and healthy image ought to be used;
- that a rise of knowledge diversity can facilitate to predict a lot of accurately;
- that the testing of project is vital.

Conclusions

We have demonstrated Salat Error Detecting System which is so far one of the very first work of its kind. As a one the very first research work on this domain, the result is absolutely suitable as well as encouraging. We also believe this work will affect researchers from various countries to work on their Prayer or Salat.

Implication for Further Study

Salat Error detecting system is a unique work. This work has been developed with future improvement possibilities. Hopefully, in the future, we could lengthen the work with more collection of images or more varieties of images. We will try to establish our work more efficient with android devices in the future. We also have the arranged to implement by using some other frameworks with to match the accuracy on the same landmarks on images.

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Appendix

Appendix A: Research Reflection

When we go through our research, it's not enough simple for us to solve all problematic features. At first we had to determine which methodological approach is better for our project. In addition there were not much related work based on our project in this field, that's a limitation for our work. Another problem was that computer vision was not understood by us. After continuing a long process with our hard working, finally we had finished our entire project

Appendix B: BlazePose key point names

0. Nose
1. Left eye inner
2. Left eye
3. Left eye outer
4. Right eye inner
5. Right eye
6. Right eye outer
7. Left ear
8. Right ear
9. Mouth left
10. Mouth right
11. Left shoulder
12. Right shoulder
13. Left elbow
14. Right elbow
15. Left wrist
16. Right wrist
17. Left pinky #1 knuckle

18. Right pinky #1 knuckle
19. Left index #1 knuckle
20. Right index #1 knuckle
21. Left thumb #2 knuckle
22. Right thumb #2 knuckle
23. Left hip
24. Right hip
25. Left knee
26. Right knee
27. Left ankle
28. Right ankle
29. Left heel
30. Right heel
31. Left foot index
32. Right foot index

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