International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 05 | May - 2021 ISSN: 2582-3930

Privacy Preservation and Monitoring System for AAL using Deep Learning via Bodypix

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Abstract: **As the world is moving towards modernization, there are a plethora of threats regarding an individual's privacy. We have to move forward in every sector but with efficient security measures. Taking the health sector into account the factor of privacy cannot be neglected as there is persistent monitoring of patients through humans and hence there are chances of leakage of personal information. One of the most efficient ways to perform this action can de be done through continuous surveillance in a digitalized way through CCTV's.Mainly this project focuses on the elderly who cannot look after themselves and are kept at a secured place. This method will be cost-efficient because as a part of the hardware setup there will be a surveillance camera only with all the basic functionalities to monitor. This project aimsto keep the privacy of an individual unhampered and also letting the resource person know about any emergency caused during monitoring in the real-time environment. The task ofproviding the notification will be done through an intermediate module and necessary action will be taken. It intends to provide more options for the health organizations that take charge to look after people. The above methodology will be very much accurate and will be able to define real-time segmentation.**

Keywords: Ambient Assisted living, convolutional neural network , Surveillance, Segmentation.

I. INTRODUCTION

Ambient assisted living (AAL) can be well-defined as "the use of information and communication technologies (ICT) in a individual's daily living and working environment to allow them to stay active longer, remain communally associated and live independently into old stage"[1]. The Ambient Assisted Living is a sub-part of the Ambient Intelligence. Ambient assisted living is an emergent drift in which artificial intelligence allows the habit of new products, services, and processes that support to offer safe, high-quality, and autonomous survives for the delicate and elderly. Due to underlying provision day-to-day communication and be combined in the health care of older citizens, which are both vital to ensure their health and happiness. Surveillance is the main factor when dealing with looking after people but privacy preservation must not be compromised with it. The capturing frames through CCTV will be in a stable format as the mobility factor does not come into account [2]. The primary focus will be to segment the specimen from the surrounding environment and notify in case of any emergency. The segmentation process can be done using the body pix module of Tensor flow.js which can locate the mobility of the object while running in real-time. The approach follows the flow of convolutional neural networks adding more info in each step in the process of segmentation. Getting into the workflow the optimization with the above algorithms can result in a better output. The segmented frames now can be modulated in a structured way having the values in the form of graphs and tabular format. As a result of this, an emergency alert will be provided and necessary steps for it can be taken.

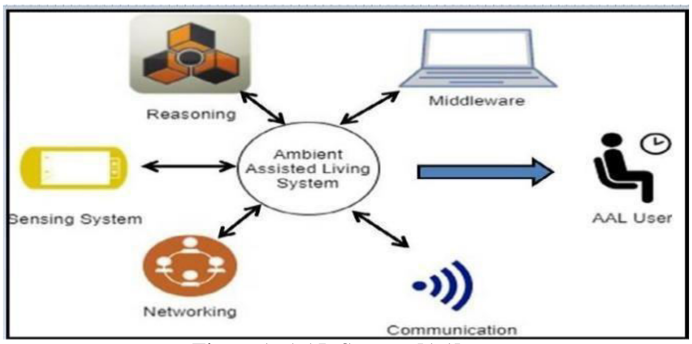

Figure 1: AAL System [1.1]

II. RELATED WORK

A. *Stage -1*

Segmentation and blurring:Bodypix 2.0 an open-source machine learning module provided by TensorFlow.js deals with the real-time biomechanics of the entity and accurately provides the coordinates for various body parts with multiperson support . The main aim is to get computationally efficient segmentation without compromising the accuracy factor. For this purpose, a webcam app made using ReactJs is modulated in which BodyPix is loaded which does the task of differentiation of the person and background using the drawBokehEffect function.[10]. Different layers of processing include collecting the frames and disintegrating them and finally segment the person from the background. It also performs the task of replacing the pixels that do not depict the person by which helps in the classification of the pixels the entity and -1 for the rest of the background by using the estimate Part Segmentation API for an image as well as video. Also, they can according to the used devices it can be MobileNetV1 or ResNet50 based on the GPUs. Although Resnet gives better results. The model is trained to capture 24 different body parts so for each image position there are different channels in the TensorFlow model from which optimal body id is picked [10].

Generalized form:

body_id=max_probabliity(i)[(x,y)]

where i=[0 to 23] and x and y are the cordinates.

B. *Stage -2*

Notification:

The pace of the model can also be increased by using the mobileNetMultiplier which corresponds to the MobileNetArchitecture. The unwanted actions will then be detected and based on the confidence score using the {{ML model}} notification will be provided on the basis of the threat level.

III. System Architecture

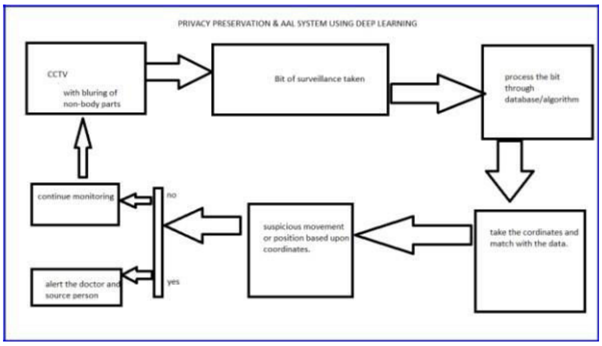

Figure 2: System Architecture.

A. *Use Case*

- Scenario for privacy :

If we consider a example like an patient who is isolated, old or a person who needs a medical attention is kept under CCTV surveillance at home. So CCTV captures everything around the patient and it reveals his/her privacy [2]. It is harmful because it gives many other unnecessary information to the doctor or third person. Now in this case our body pix model comes to use as it blurs the non-body parts and gives only proper footage of patient . It helps in privacy preservation and gives a focused view on patient.

- Scenario for alerting the care taker and doctor :

As we seen that surveillance helps on monitoring patient in previous section. So our next part is to alert doctor and care taker for unusual action of the patient. For this we have to train a model based on keypoints of body parts. Now, Keypoints Coordinates will be our input and it will determine the state of the patient. If the patient is having some trouble then the situation will be classified based upon the predetermined danger levels[10].

Danger levels will be categorized on the severity of the action. The levels will be as follows

- Level 0 : Healthy and normal behavioral state.
- Level 1 : Slight symptoms like headache, joint pain ,etc.
- Level 2 : Unusual actions from patient like having a heart pain or heart attack,etc.

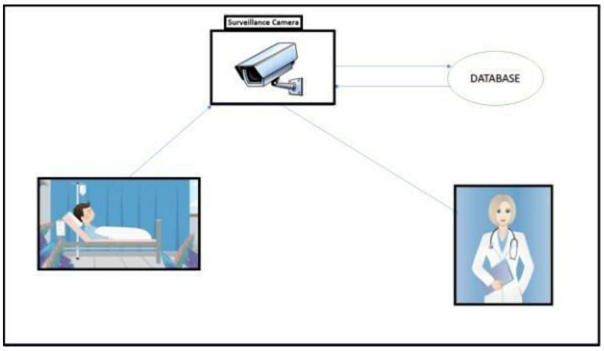

Figure 3: Purpose System

B. ALGORITHM USED:

a) Bodypix :-

As specified earlier, the proposed model makes use of BodyPix model,

- In BodyPIx we use the ResNet50 neural network model.
- Residual Network (ResNet50) consist of 48 Convolution layers along with 1 MaxPool and 1 Average Pool layer. So the results are more accurate.
- It will helps us to identify the coordinates of 24 body parts. So we could get more accurate results of body part coordinates with highest confidence score[10].

b) CNN:-

For alerting purpose, We need to classify the classes according to the threat levels.Here comes the use of CNN,
Input will be given from the output of bodypix model.

- We will select parameters, apply filters with strides, padding if requires & do convolution on the input to apply on ReLU activation to the matrix.
- We will consider pooling to reduce dimensionality size in CNN.
- We will add classes layers until the results are satisfied.
- Flatten the output from the layers and feed into a fully connected layer
- Output will be in one of the given classes i.e. one of the threat level(0,1,2) [5].

IV. DATA FLOW DIAGRAM

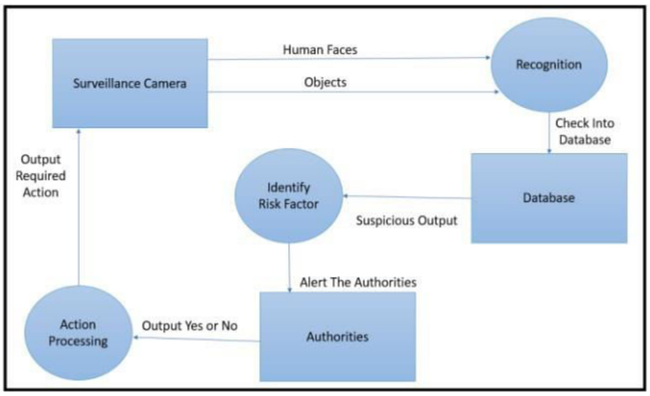

Figure 4: Data Flow Diagram.

The DFD deals with the basic functionalities of the designed module a simple architecture of input and output operation. As there is continuous monitoring of the patients with the help of the surveillance camera the bit frames of the video are treated as the input to the model and the risk level is detected as per the situation. The model is trained with all the functional information previously and the desired output is obtained.

Individual components & working: -

- Surveillance camera - A stationary hardware device used for capturing the environment and recognition of the human faces and separating it out from the rest of the substances.
- Recognition - The procedure of identification of the threat levels based on the posture of the individual.
- Database - The dataset or container of the previously processed images which helps in comparison of the current posture of the individual.
- Risk factor - The type of risk based on the threat level and its notification to the responsible individual.
- Authorities - Resource person who is connected with the target element virtually.
- Action processing - Necessary steps for the notification received to the resource person.

V. USE CASE DIAGRAM

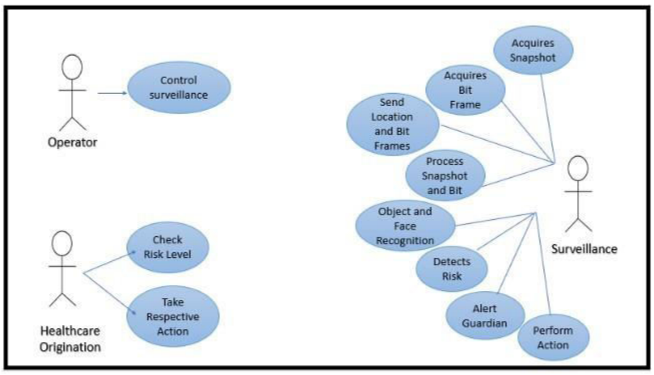

Figure 5: Use Case Diagram.

In the above diagram, there are two actors and Various use cases are present.

- First Actor is Surveillance which will monitor all the activity. The role of surveillance is to snap each bit by considering only a patient body and blur the rest of the part to acquire the security. For eg, if a patient is under surveillance then the surveillance will capture only the patient body and ignore or blur all the objects present near the patient. The Surveillance or CCTV will snap each bit and send it to the database where all the datasets are present for processing. Once the processing is done, it will generate a report.
- Second Actor is Health Organization who can be a doctor or any resource person. The role of 2nd actor is to monitor the patient's health by seeing the reports generated by 1st actor. If the resource person finds any risk factor in the report then the resource person will take necessary actions.

VI. SEQUENCE DIAGRAM

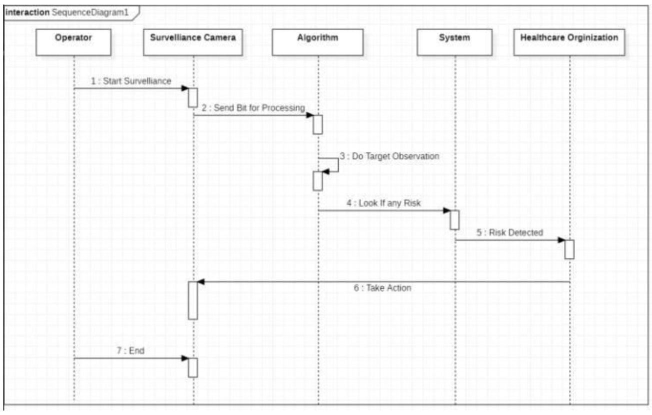

Figure 6: Sequence Diagram.

A sequence diagram displays object interactions set in time sequence. It portrays the objects intricate in the situation and the sequence of messages exchanged among the objects needed to carry out the functionality of the situation. Sequence diagrams are typically related with use case recognitions in the logical view of the system under development. Sequence diagrams are occasionally named event diagrams or event scenarios. A sequence diagram shows, as parallel vertical lines, unlike methods or objects that living concurrently, and, as horizontal arrows, the messages switched between them, in the order in which they occur. This allows the specification of simple runtime situations in a graphical way.

In the above Sequence Diagram, there are Five Objects. They are Derived as Operator, Surveillance Camera, Algorithm, System, Healthcare Organization.

As Derived

- First Object is Operator. Operator is use to Start Surveillance to start the operation.
- Second Object is Surveillance Camera. Surveillance Camera is used to take the bits required which will be further send for processing.
- Third Object is Algorithm. Main part as Heart plays in body Algorithm does the same it is used for Observation and look for any risk, Suspicious Movement or Position Based Upon Coordinates.
- Fourth Object is System. System helps to detect the risk if found and to Alert the Doctor and Source Person in HealthCare Organizations.
- Fifth Object is HealthCare Organization. Healthcare organization is used to take the action based on the system input. Here the Doctors and Source Person comes in action. As they are the person to treat the patient.

VII. RESULT

Step 1:

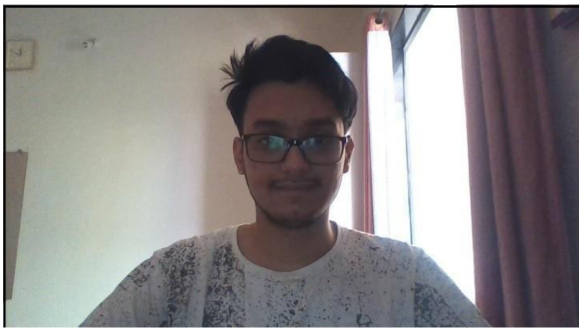

Figure 7.1: Original Image

Figure 7.2: Processed Image

- As our aim is to preserve the data of patient. And we have mentioned about the blurring part of the area expect the patient.
- Above image shows image after the bits and frames are been processed and the objects beside the patient are been preserved. Comparing Figure 7.1 and Figure 7.2 shows us the data after it's been processed.

Step 2:

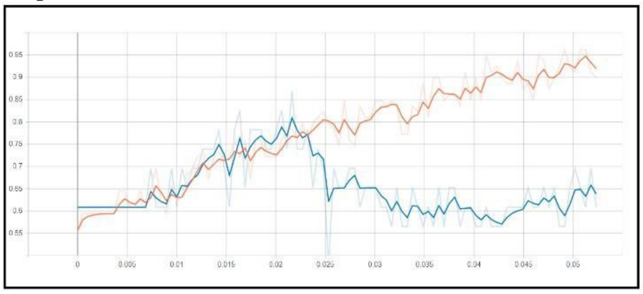

Figure 7.3: Graph of Reading

Graph Explanation:

After the creating the CNN model, we ran the model by giving our training dataset to model and ran through 100 epochs to get the best results. Our dataset was having fewer images. We were having imbalanced data, data quantity and data quality. Though we had dataset problems our model was trained good as per the conditions. We got epoch accuracy of 91.93%. We can improve the model results by giving proper dataset with good quality and equal quantity.

Image key points values:

pose: Object { score: 0.7708595234024174, keypoints: (17) […] }

keypoints: Array(17) [{…}, {…}, {…}, …]

0: Object { score: 0.9986851811408997, part: "nose", position: {…} }

part: "nose"

position: Object { x: 286.03819933264424, y: 118.97195871440206 }

score: 0.9986851811408997

<prototype>: Object { … }

1: Object { score: 0.9961485862731934, part: "leftEye", position: {…} }

part: "leftEye"

position: Object { x: 298.95619710286456, y: 99.35244825371073 }

score: 0.9961485862731934

<prototype>: Object { … }

2: Object { score: 0.9995331764221191, part: "rightEye", position: {…} }

part: "rightEye"

position: Object { x: 264.009738815165, y: 105.31115108505819 }

score: 0.9995331764221191

<prototype>: Object { … }

3: Object { score: 0.8459264636039734, part: "leftEar", position: {…} }

part: "leftEar"

position: Object { x: 317.17635585511584, y: 102.54068224261906 }

score: 0.8459264636039734

<prototype>: Object { … }

4: Object { score: 0.9727745056152344, part: "rightEar", position: {…} }

part: "rightEar"

position: Object { x: 240.74778999494987, y: 112.28436861790068 }

score: 0.9727745056152344

<prototype>: Object { … }

5: Object { score: 0.9962173104286194, part: "leftShoulder", position: {…} }

part: "leftShoulder"

position: Object { x: 342.5902768904546, y: 179.99506147075985 }

score: 0.9962173104286194

<prototype>: Object { … }

6: Object { score: 0.9976186752319336, part: "rightShoulder", position: {…} }

part: "rightShoulder"

position: Object { x: 203.80470252111323, y: 192.62964747258738 }

score: 0.9976186752319336
<prototype>: Object { … }

7: Object { score: 0.9840573072433472, part: "leftElbow", position: {…} }

part: "leftElbow"

position: Object { x: 348.03439987040014, y: 320.6723225067265 }

score: 0.9840573072433472

<prototype>: Object { … }

8: Object { score: 0.9936718940734863, part: "rightElbow", position: {…} }

part: "rightElbow"

position: Object { x: 190.99507406121845, y: 321.79255331205627 }

score: 0.9936718940734863

<prototype>: Object { … }

9: Object { score: 0.9827354550361633, part: "leftWrist", position: {…} }

part: "leftWrist"

position: Object { x: 326.87560322128724, y: 430.0933423180798 }

score: 0.9827354550361633

<prototype>: Object { … }

10: Object { score: 0.9504222869873047, part: "rightWrist", position: {…} }

part: "rightWrist"

position: Object { x: 221.9436796431972, y: 431.8007219876491 }

score: 0.9504222869873047

<prototype>: Object { … }

11: Object { score: 0.9447975754737854, part: "leftHip", position: {…} }

part: "leftHip"

position: Object { x: 300.01111942659657, y: 373.788271069032 }

score: 0.9447975754737854

<prototype>: Object { … }

12: Object { score: 0.9584265947341919, part: "rightHip", position: {…} }

part: "right Hip"

position: Object { x: 239.82815846475856, y: 408.7631711524552 } score: 0.9584265947341919

<prototype>: Object { … }

13: Object { score: 0.09440715610980988, part: "leftKnee", position: {…} }

part: "leftKnee"

position: Object { x: 305.9654801508348, y: 512.099828443092 }

score: 0.09440715610980988

<prototype>: Object { … }

14: Object { score: 0.33361709117889404, part: "rightKnee", position: {…} }

part: "rightKnee"

position: Object { x: 226.16308574735933, y: 512.3427243054655 }

score: 0.33361709117889404

<prototype>: Object { … }

15: Object { score: 0.012358872219920158, part: "leftAnkle", position: {…} }

part: "leftAnkle"

position: Object { x: 312.12448500398534, y: 490.84665037289693 }

score: 0.012358872219920158

<prototype>: Object { … }

16: Object { score: 0.04321376606822014, part: "rightAnkle", position: {…} }

part: "rightAnkle"

position: Object { x: 222.2682092494311, y: 498.5054649258056 }

score: 0.04321376606822014

<prototype>: Object { … }

length: 17

<prototype>: Array []

score: 0.7708595234024174

VIII. Conclusion

From this experiment, we have covered the privacy part of AAL patients. We have also determining the threat level of the person. So that health care facilities will be provided to the customer as soon as possible.

IX. REFERENCE

[1] A Deep Learning Approach for Privacy Preservation in Assisted Living.Ismini Psychoula*, Erinc Merdivan, Deepika Singh 3, Liming Chen", Feng Chen", Sten Hanke, Johannes Kropft, Andreas Holzingers, Matthieu Geist *School of Computer Science and Informatics, De Montfort University, Leicester, UK

[2] Real-time gun detection in CCTV: An open problemJose Luis Salazar Gonz´aleza, Carlos Zaccaroa, Juan A. ´Alvarez-Garc´ıaa,⇤, Luis M. SoriaMorilloa, Fernando Sancho Caparrinib

[3] George Papandreou, Tyler Zhu, Liang-Chieh Chen, Spyros Gidaris, Jonathan Tompson, Kevin Murphy Google, Inc.arXiv:1803.08225v1 [cs.CV] 22 Mar 2018

[4] Angjoo Kanazawa1 , Michael J. Black2 , David W. Jacobs3 , Jitendra Malik1 1University of California, Berkeley 2MPI for Intelligent Systems, Tubingen, Germany, ¨ 3University of Maryland, College Park23 Jun 2018

[5] Rohit Girdhar1 ∗ Georgia Gkioxari2 Lorenzo Torresani2,3 ∗ Manohar Paluri2 Du Tran2 1The Robotics Institute, Carnegie Mellon University 2Facebook 3Dartmouth College 2 May 2018

[6] Georgios Pavlakos*1,2, Vasileios Choutas*1, Nima Ghorbani1 , Timo Bolkart1 , Ahmed A. A. Osman1 , Dimitrios Tzionas1 , and Michael J. Black1 11 Apr 2019

[7] Sheng Jin 1 ,2[0000 −0001 −5736 −7434], Lumin Xu 3 , 2 , Jin Xu 2 , Can Wang 2 , Wentao Liu 2 † , Chen Qian 2 , Wanli Ouyang 4 , and
Ping Luo 1 1 The University of Hong Kong 2 SenseTime Research 3 The Chinese University of Hong Kong 4 The University of Sydney 23 Jul 2020

[8] Quan Liu < Isabella M. Gaeta † Mengyang Zhao § Ruining Deng , Aadarsh Jha , Bryan A. Millis † Anita Mahadevan-Jansen ¶ Matthew
J. Tyska † Yuankai Huo , 2 Nov 2020

[9] Hari Prasanna Das,Ioannis C. Konstantakopoulos,Aummul Baneen Manasawala,Tanya Veeravalli,Huihan Liu,Costas J. Spanos 17 Jan 2019

[10] https://blog.tensorflow.org/2019/11/updated-bodypix-2.html

[11] https://www.researchgate.net/figure/Relationship-between- different-AAL-domain-and-AAL-user_fig4_326375130.