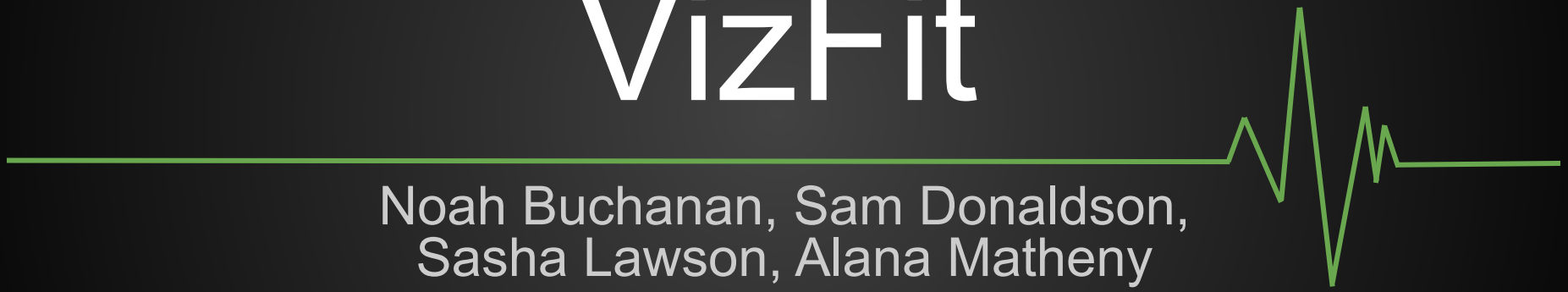
VizFit



Noah Buchanan, Sam Donaldson,
Sasha Lawson, Alana Matheny

Introduction

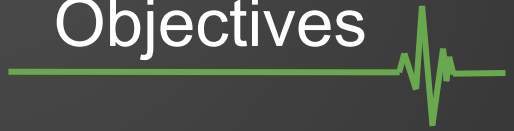
Team Members

- Alana Matheny
  - Background
    - Artificial Intelligence
    - Computer Graphics
    - Information Retrieval
- Noah Buchanan
  - Background
    - Artificial Intelligence
    - Machine Learning
    - Deep Learning
    - Information Retrieval
    - IoT
- Sam Donaldson
  - Background
    - Artificial Intelligence
    - Computer Graphics
    - Deep Learning
  - ArcBest Developer Intern
- Sasha Lawson
  - Background
    - Artificial Intelligence
    - Computer Graphics
    - Machine Learning
  - ArcBest Developer Intern

Problems Facing Fitness

- Lack of Insight
  - Cannot aim fitness routines toward personal or medical goals
- Failure to be Consistent
  - Can’t go to the gym
  - Not convenient
- Proper Fitness is Difficult
  - Could over exercise
  - Incur injury from improper technique

Objectives



- Provide insightful fitness data
  - Keep variety of statistics on each user
  - Make highly personalized
- Improve fitness routine consistency
  - Don’t have to go to the gym
  - More convenient
- Decrease the difficulty of properly exercising
  - Monitor exercise and ensure correctness
  - Track live progress & rest times

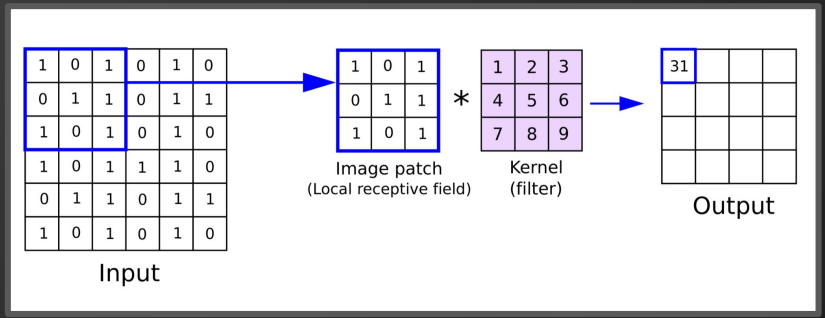
Background

Convolutional Neural Networks

- Reduce the number of input nodes and parameters
- Tolerate small shifts in where the pixels in images are
- Take advantage of the correlations that are observed in complex images

Convolutional Neural Networks

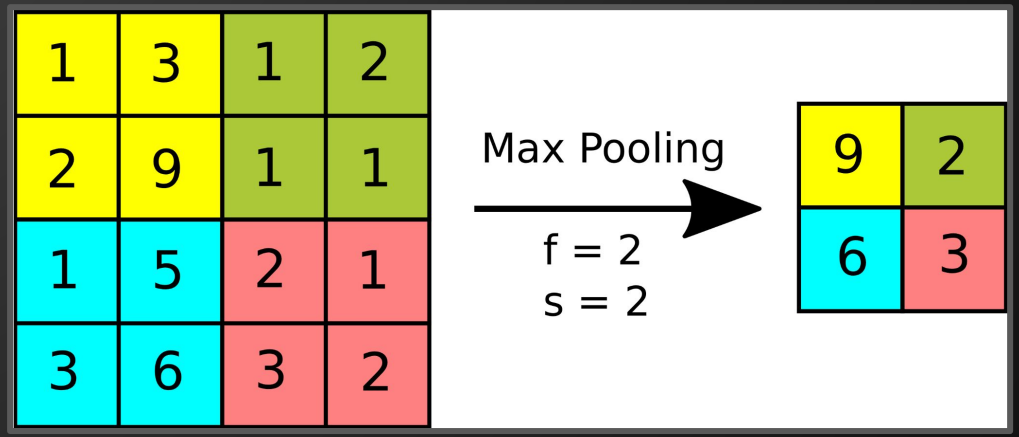
- Kernel/filter is used to create a feature map
- Dot product of a kernel sized portion of the image and the kernel itself is put into the feature map



- Values of the kernel are determined by random initially and adjusted through backpropagation

Convolutional Neural Networks

- When the feature map is full, we run it through an activation function and the resulting map is pooled to further reduce the size
- Max pooling selects the spots where the filter did the best job matching the image



- The pooled layer is converted into an n x 1 input layer and fed into a traditional neural network from here

Technology

- MySQL
  - Relational database management system
- Java & Spring
  - Create back-end RESTful API built on Java
- Python
  - Implement various packages to create a computer vision based machine learning model
    - OpenCV - access webcam
    - TensorFlow - access various datasets and create neural networks
    - Matplotlib - displaying images for testing purposes

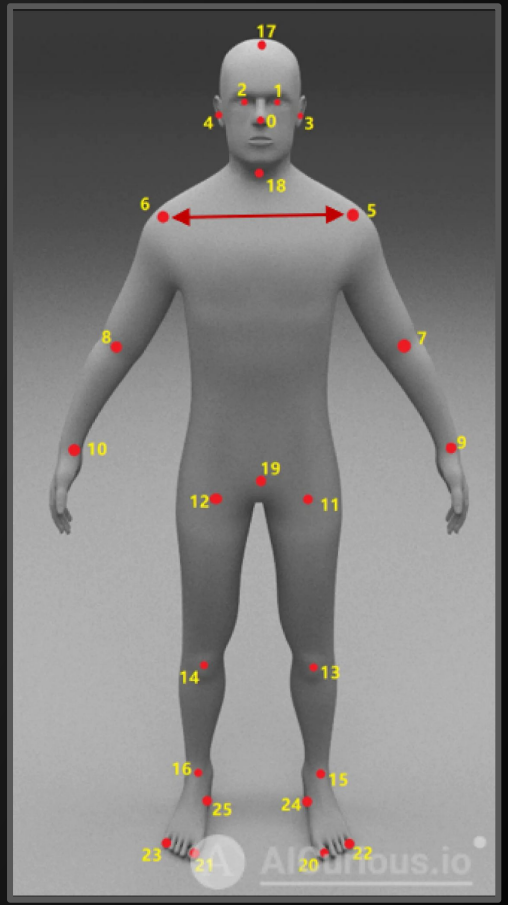
Technology

- Vue.js
  - Framework for constructing user interfaces and front-ends
  - Uses components to simplify complex pages
    - Components can contain data and logic

- Vuetify
  - User interface framework built to complement Vue.js
  - “Pre-built” components allowing easy implementation of commonly used interfaces

Related Work

- Nguyen, 2021
  - Keypoint detection
    - y - ŷ must be within a specified threshold to be considered correct
  - Exercise Recognition model
    - Identifies only push-ups
    - Cannot identify incorrect pose for push-ups
  - Signal processing from keypoints to count repetitions
  - MPII Human Pose Dataset as training



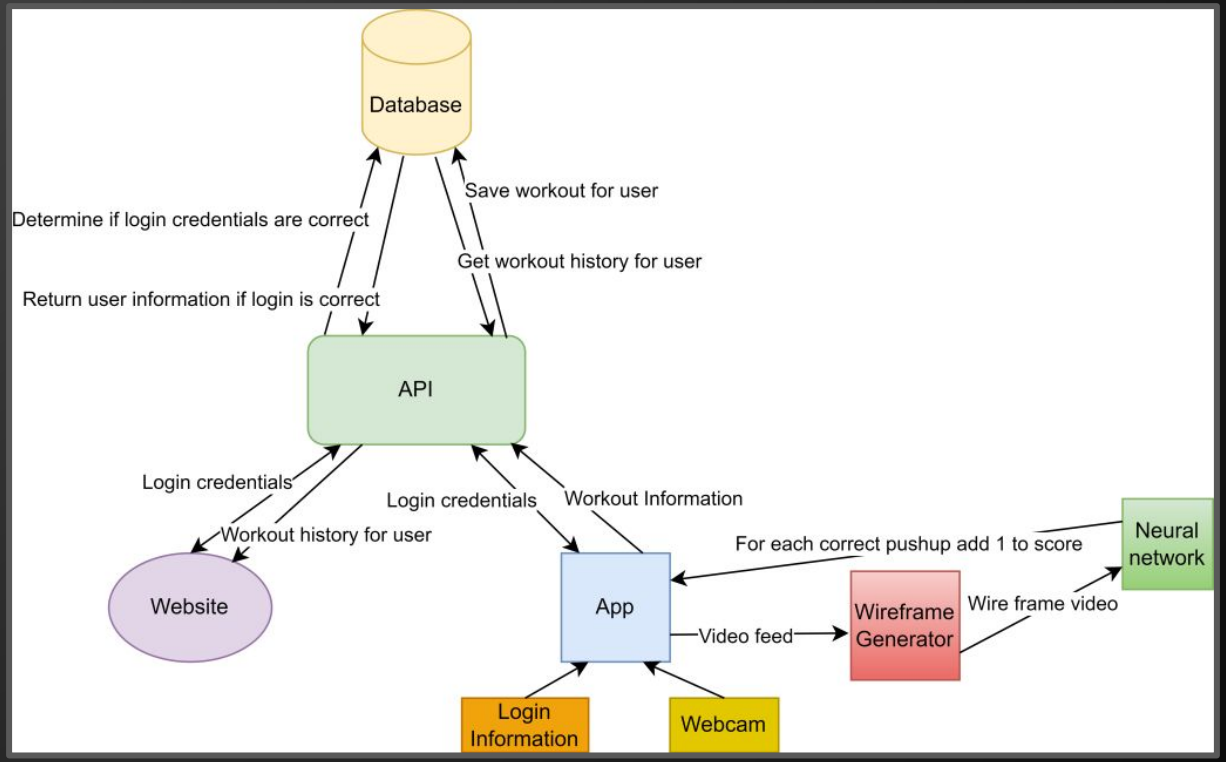
Related Work

- Alatiah & Chen, 2020
  - Keypoint detection
  - Exercise recognition model
    - Traditional neural network used
    - Final prediction is based off the formula below
    - Recognizes push-ups, pull-ups, and squats
  - Each exercise has pre-selected parameters to count repetitions
    - Usually some sort of distance or angle between two keypoints
      - Range of motion
      - Major joint
      - Motion (push or pull)

$$\text{performed exercise}(f) = most\_common(y(f-9), y(f-8), ..., y(f))$$

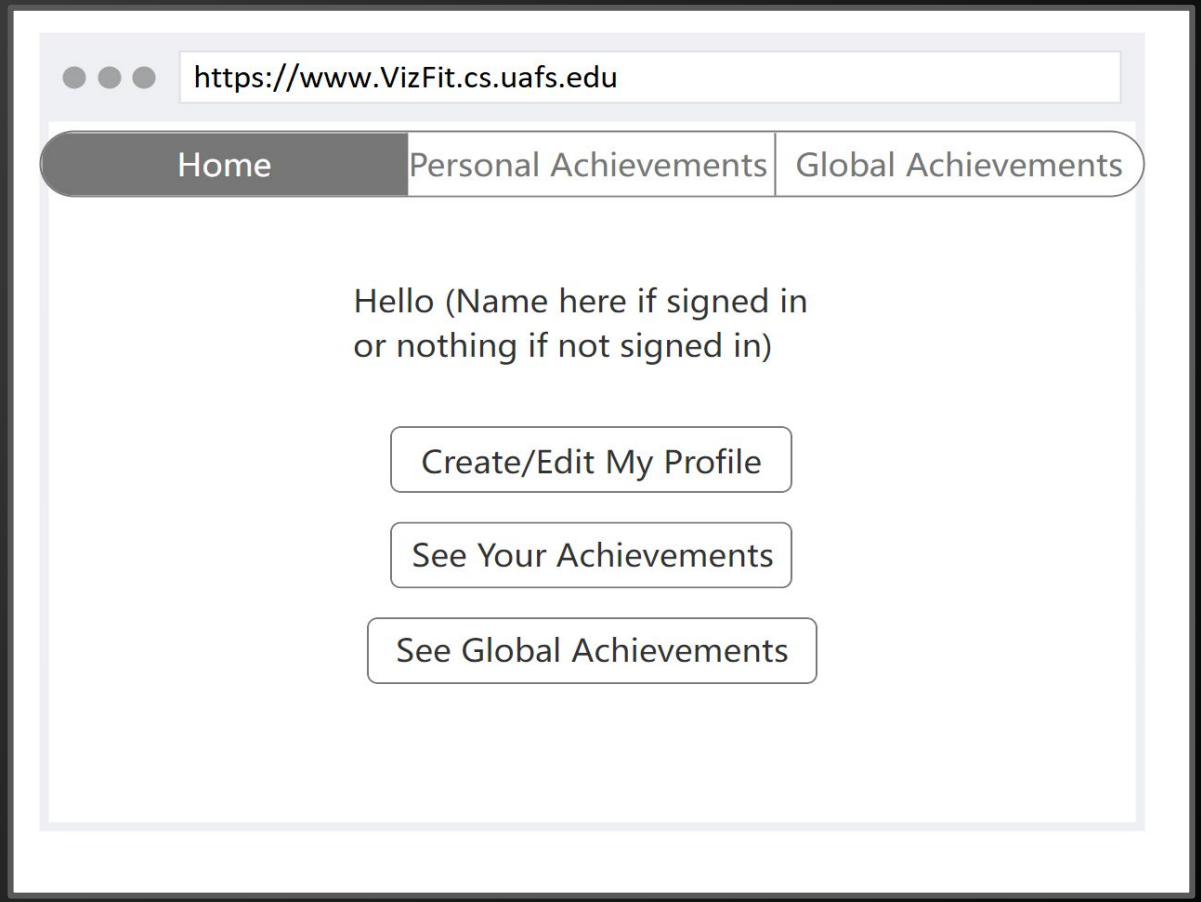
Design

Architecture



Mockups

- Website



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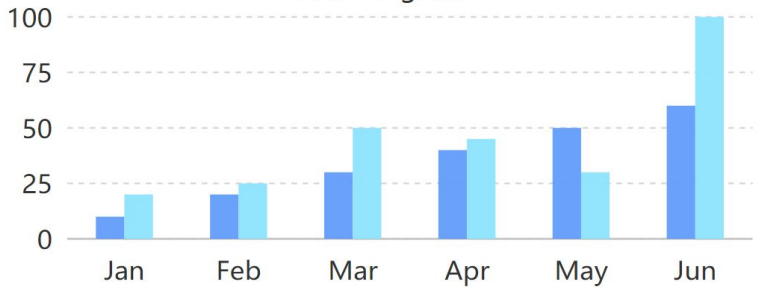
Home | Personal Achievements | Global Achievements

Your Scores

	Exercise 1	Exercise 2	Exercise 3	Exercise 4
Try1				
Try2				
Try3				
Try4				

Your Progress



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Home | Personal Achievements | Global Achievements

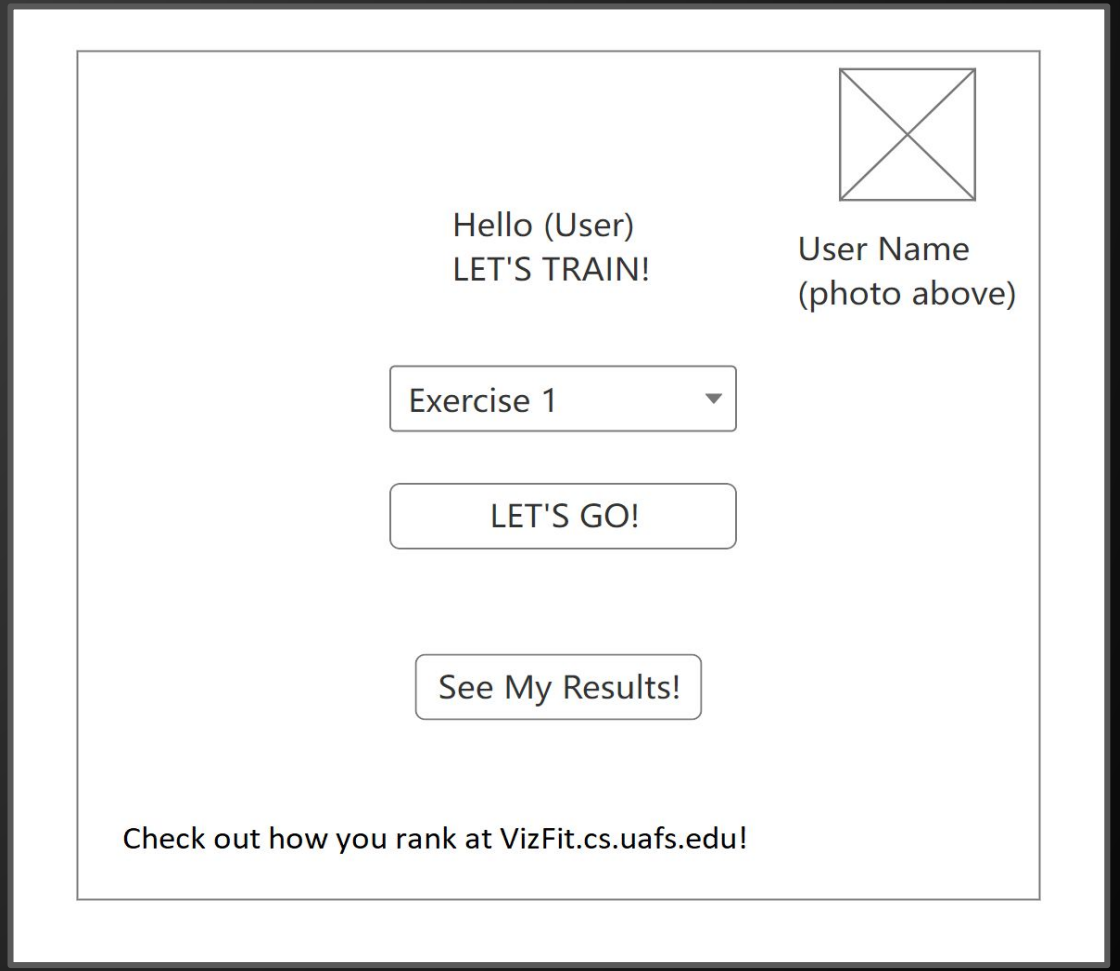
Best Scores

	Exercise 1	Exercise 2	Exercise 3	Exercise 4
1st				
2nd				
3rd				
4th				

The Highest Scorer Is
(Highest scorer/user
given all exercises)

Mockups

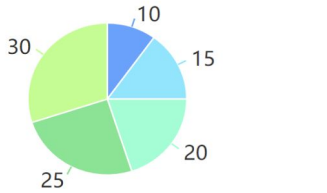
- Application



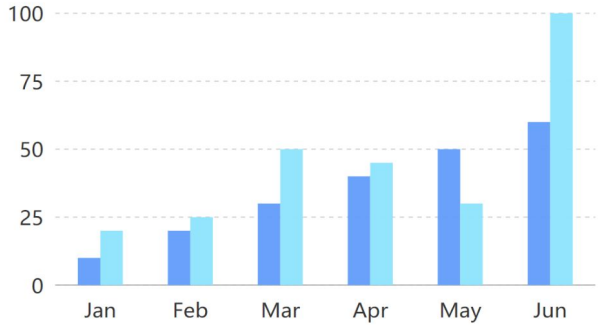
Go Train

User Name
(photo above)

You are doing great (User)!



Exercise 1 Exercise 2 Exercise 3
Exercise 4 Exercise 5



BMI:

40.2

No BMI? Take the test below! Or retest to stay up to date!

TEST ME!

Also, take the nutrition test to see if you should improve your eating habits!

TEST ME!

Information from your BMI, Nutrition, and Exercise Results!

You are doing well! Keep it up!

Possible Risks

- Data Security
  - Solution:
    - Encryption through API and database
    - User will own their data
- Issues With The System
  - Solution:
    - Proper testing
- Bias Datasets
  - Solution:
    - Well-tested, pre-trained datasets
    - Stick figure human representation

Timeline & Tasks

- Week 5
  - Implemented preliminary webpage & GUI designs
  - Start preliminary back-end API
  - Implemented wireframes and start on neural network model training
- Week 8
  - Have both front-end applications connected to back-end API
    - User authentication
  - Improved neural network model but continue training
- Week 11
  - Project bug review and fix phase
- Week 14
  - Final Project Review/Critique
    - Rework items as needed

References

“The physical activity guidelines for americans.” [Online]. Available: https://jamanetwork.com/journals/jama/article-abstract/2712935

“7 ways exercise can go wrong for your mind and body.” [Online]. Available: https://www.psychologytoday.com/us/blog/fulfillment-any-age/201409/7-ways-exercise -can-Go-wrong-your-mind-and-body

“National institutes of health,” Aug 2020. [Online]. Available: https://newsinhealth.nih.gov/2020/07/personalized-exercise/

J. M. Dickson, N. J. Moberly, D. Preece, A. Dodd, and C. D. Huntley, “Self-regulatory goal motivational processes in sustained new year resolution pursuit and mental wellbeing,” International Journal of Environmental Research and Public Health, vol. 18, no. 6, 2021. [Online]. Available: https://www.mdpi.com/1660-4601/18/6/3084/

“Gymtimidation is real: Half of americans afraid to work out around others,” Sep 2021. [Online]. Available: https://swnsdigital.com/us/2019/03/gymtimidation- is-real-half-of-americans-afraid-to-work-out-around-others

References

A. Malaythong, “Proper pushup form and technique: Nasm guide to push-ups.” [Online]. Available: https://blog.nasm.org/nasm-guide-to-push-ups/form-and-technique/

A. H. Reynolds, “Convolutional neural networks (cnns),” Oct 2017. [Online]. Available: https://anhreynolds.com/blogs/cnn.html/

T. Branson, “8 big advantages of using mysql,” May 2021. [Online]. Available: https://www.datamation.com/storage/8-major-advantages-of-using-mysql/

“Mysql.” [Online]. Available: https://www.mysql.com/

Vue.js, “Introduction - vue.js.” [Online]. Available: https://vuejs.org/v2/guide/

“Why you should be using vuetify.” [Online]. Available: https://vuetifyjs.com/en/introduction/why-vuetify/

R. A. S, “What is java api, its advantages & need for it: Simplilearn,” Nov 2021. [Online]. Available: https://www.simplilearn.com/tutorials/java-tutorial/java-api/

“Why developers like java.” [Online]. Available: https://stackshare.io/java/

References

“Building rest services with spring,” 2022. [Online]. Available: https://spring.io/guides/tutorials/rest/

“What is python? executive summary.” [Online]. Available: https://www.python.org/doc/essays/blurb/

B. Borisov, “Python has become the most popular language, according to tiobe,” Oct 2021. [Online]. Available: https://linuxiac.com/python-the-most-popular-programming-language/

“Opencv.” [Online]. Available: https://docs.opencv.org/4.x/d1/dfb/intro.html

“Tensorflow 2 quickstart for beginners : Tensorflow core.” [Online]. Available: https://www.tensorflow.org/tutorials/quickstart/beginner/

“Visualization with python.” [Online]. Available: https://matplotlib.org/

“Pillow.” [Online]. Available: https://pillow.readthedocs.io/en/stable/

References

“Numpy.” [Online]. Available: https://numpy.org/

V.-A. Nguyen, “Build a pushup counter app with opencv and deep learning,” Feb 2021. [Online]. Available: https://aicurious.io/posts/2021-02-15-build-a-pushup-counter/

T. Alatiah and C. Chen, “Recognizing exercises and counting repetitions in real time,” May 2020. [Online]. Available: https://arxiv.org/abs/2005.03194/