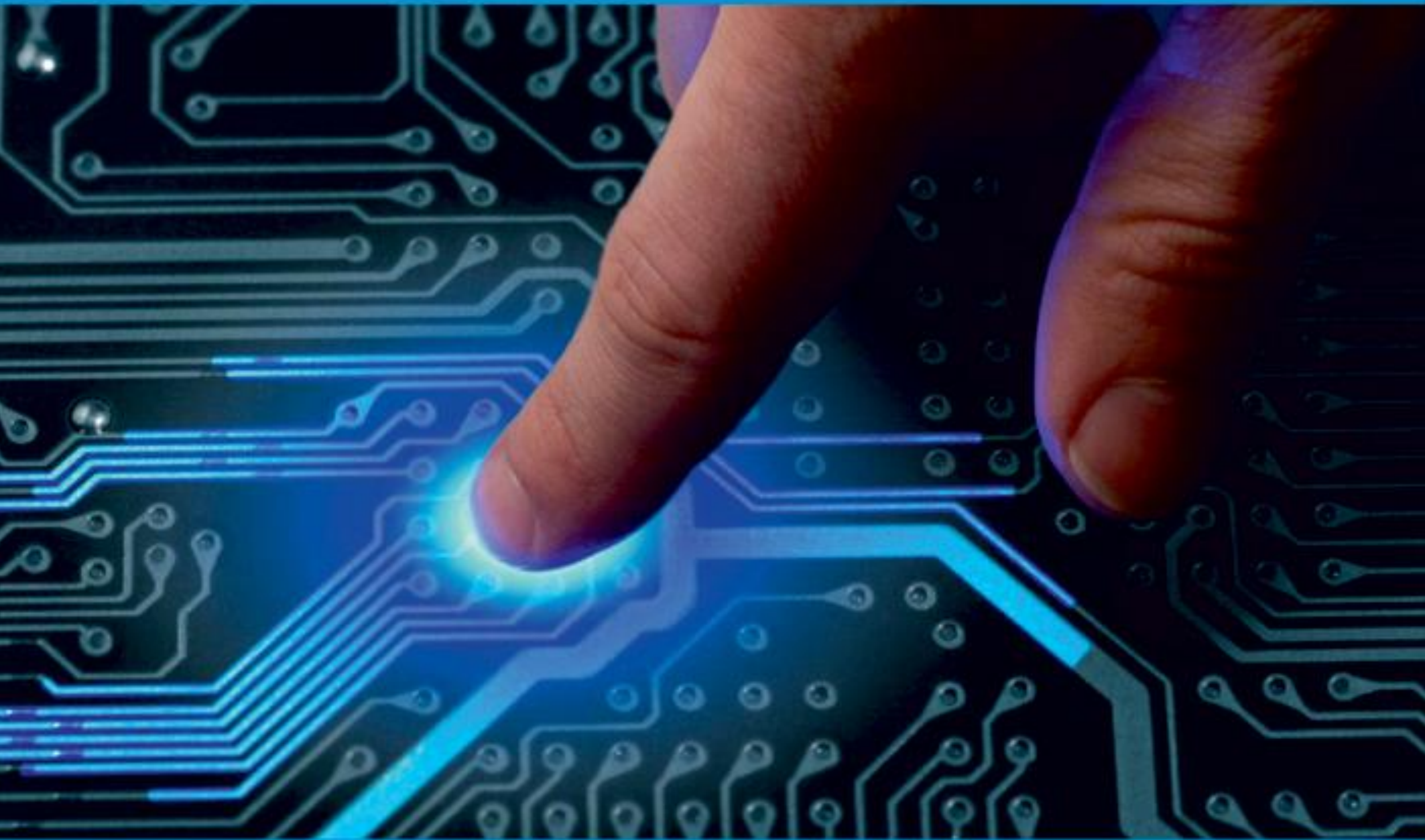
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

## IN COMPUTER & COMMUNICATION ENGINEERING

**Volume 12, Issue 2, April 2024**

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

**Impact Factor: 8.379**

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

# Bionic Eye Model to Provide Vision or Restore Sight for Blindness Using Vision Transformer

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**ABSTRACT**: The advancement of medical technology has led to the development of innovative solutions for addressing visual impairments, particularly blindness. In recent years, the convergence of artificial intelligence (AI) and biotechnology has paved the way for groundbreaking approaches in this domain. This abstract proposes a novel bionic eye model employing a Vision Transformer (ViT) architecture to provide vision or restore sight for individuals affected by blindness.

Vision Transformer, a state-of-the-art deep learning model primarily applied in computer vision tasks, demonstrates remarkable capabilities in understanding visual content through self-attention mechanisms. Leveraging its potential, this bionic eye model aims to emulate the functionality of the human visual system, enabling the perception and interpretation of visual stimuli.

The proposed bionic eye system comprises multiple components, including a camera module for capturing visual input, a processing unit equipped with ViT for image understanding, and an output interface for transmitting interpreted visual data to the brain or optic nerves. Through a series of neural processing stages, the model extracts meaningful features from the captured images, reconstructs them into perceptible representations, and delivers them to the user's visual processing centers.

## I. INTRODUCTION

### I.I. Background

The intricate, multifaceted process of seeing provides the feeling of sight. The act of seeing does not occur in the eyes. Instead, processing reflected light from the environment around us is the result of the brain, retinas, optic nerves, and eyes working together. Sustaining vision can have a significant impact on one's health and standard of living. Visual impairment, also referred to as low vision, is the loss of vision that cannot betreated with glasses, medication, or surgery. Daily activities like reading, shopping, identifying faces, and even crossing the street can be challenging for those who are vision impaired.

### I.I.I ThreeVarious FormsofVisualImpairment

Low visual acuity, blindness, and legal blindness (which differs per nation) are the three categories of visual impairments: Insufficient optical acuity.

## II. OBJECTIVE

Key features of the bionic eye model include adaptability to various environmental conditions, real-time processing capabilities, and potential for customization based on individual needs and preferences. Additionally, the incorporation

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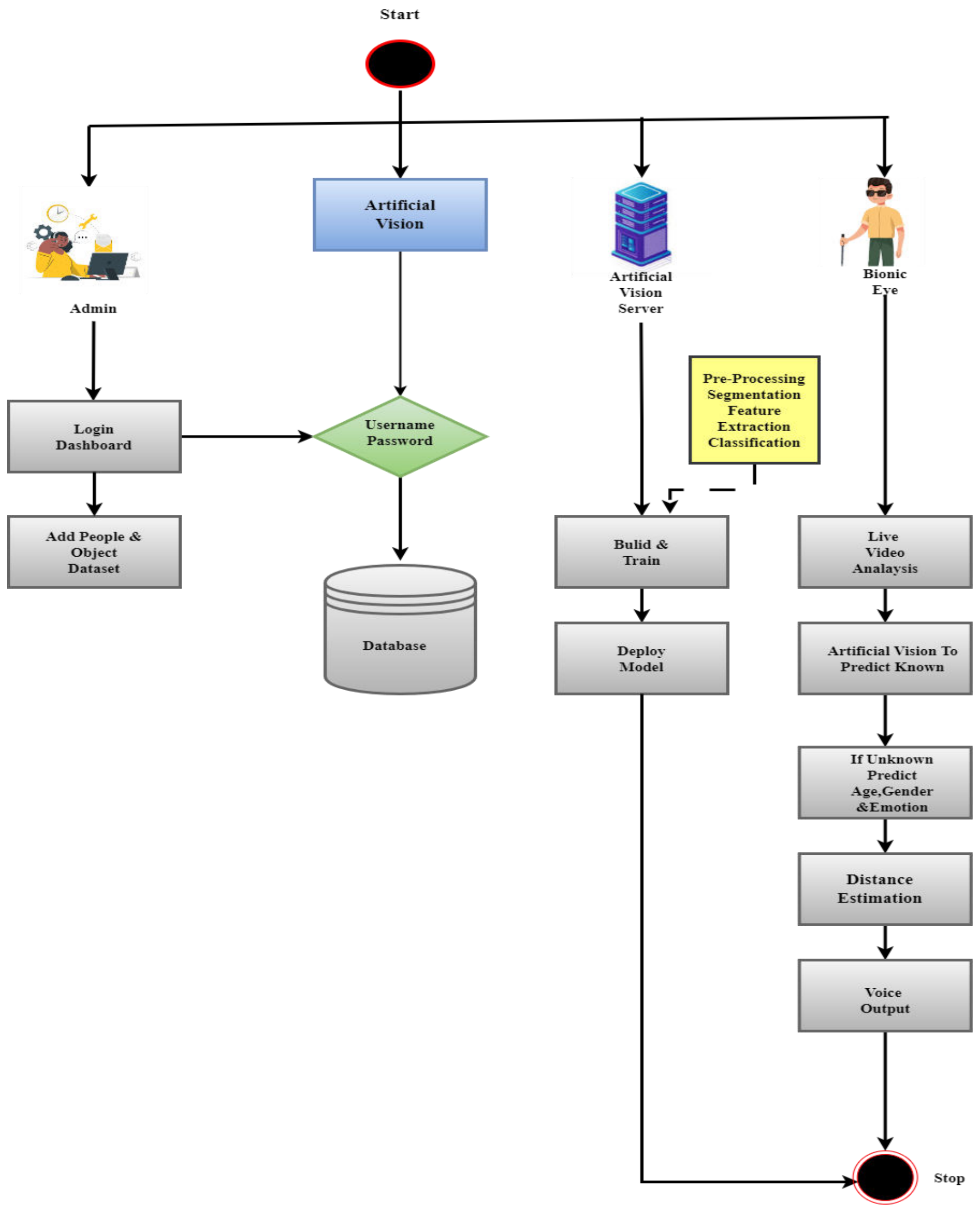
of ViT facilitates efficient learning from large-scale visual datasets, enhancing the system's ability to recognize and interpret diverse visual stimuli.

Furthermore, the bionic eye model holds promise for enhancing the quality of life for individuals affected by blindness, offering the prospect of regaining autonomy, independence, and participation in daily activities. Moreover, the integration of AI-driven technologies opens avenues for continuous improvement and refinement, ensuring the scalability and sustainability of the proposed solution.

## III. FLOW CHART



## IV. EXISTINGSYSTEM

Thenavigationsystemoutlinedusesasealedleadacid12V/7AbatterytopoweraKinectsensor, makingitportablefortheuser.ADC-to-DCconverterisusedtoprovideconsistentpoweroutput. Using depth cameras and SLAM processing servers,smart canes include Simultaneous Locating andMapping(SLAM)technology,suchasGoogle'sProjectTangoorIntelRealSense,toprovide precise indoor placement and obstacle detection. The Virtual Haptic Radar system, which is derived from Haptic Radar, uses an ultrasonic motion capture device in place of an IR sensor to provide vibration alerts in close proximity to objects.
While BlindSquare provides visually impaired users with speech-based location information, Moovit provides advise on public transportation. Lazzus serves visually impaired users by providing them with intuitive indications about nearby Points of Interest (POIs) through the use of motion capture sensors and GPS.

## V. PROPOSEDSYSTEM

The goal of the suggested system is to transform artificial vision by incorporating a Vision Transformer-basedstrategycreatedespeciallyfornext-generationvisualimplants.Constructand Teach Artificial Vision : The Artificial Vision Build and Train project's first phase is devoted to putting together a varied dataset and collecting photos that are pertinent to face identification, gender prediction, age estimation, and emotion prediction.

Through pre-processing procedures, such as scaling, noise filtering, binarization, and grayscale conversion,guaranteestandardisedinput conditionsforthebestpossiblemodeltraining afterthe datasetiscollected.Then,usingsophisticatedsegmentationmethodssuchastheRegionProposal Network (RPN), facial areas are identified and extracted, laying the groundwork for further analysis.UsingtechniquessuchasLocalBinaryPatterns(LBP),featureextractionextractsunique features that are essential for complex tasks. The last phase is to put the plan into action.

## VI. SYSTEM MODULES

TheVisualImplantFirmware,tailoredtoenhancetheexperienceofvisuallyimpairedindividuals, integrates cutting-edge technology into a user-friendly interface. Crafted with HTML templates andFlask-Bootstrap,thefrontendensuresaccessibility,whilethePythonandFlask-poweredback endorchestratesessentialmoduleslikeimageprocessing,objectdetection,facialrecognition,and distance estimation. With MySQL serving as the database, storing critical data such as user credentials and preferences, the system conducts real-time scene analysis, distinguishing known and unknown individuals, identifying gender, estimating ages, recognizing facial emotions, and determining approximate distances. The Admin Interface comprises a secure Login Module and a Dataset Training Module, empowering administrators to manage datasets dynamically. For visually challenged users, the interface includes a Live Video Module for real-time video streaming,aninsightfulPredictedResultModuleutilizingobjectdetectionandfacialrecognition, and an Audio Output Module converting predictions into spoken information for enhanced accessibility. The Artificial Vision Build and Train process begins with comprehensive dataset collection encompassing various tasks like face recognition, gender prediction, age estimation, andemotionprediction. Techniquessuchaspre-processing,segmentation,andfeatureextraction ensuredatasetoptimizationandmodelaccuracy.Objectdetectionandclassificationareintegrated into a unified Convolutional Neural Network architecture, trained iteratively to capture intricate relationships within the data. The Vision Prediction System further enhances user understanding through live video analysis, prediction of known or unknown individuals, estimation of demographicsandfacialexpressions,distanceestimationusingtheMiDaSalgorithm,andobject detection.Finally,anAudioOutputcomponentconvertspredictionsintoauditorycues,providing real-time feedback for a seamless user experience.

## VII. SOFTWARETESTING

System testing, which assesses the functionality, quality, and performance of software applications,isanessentialstageinthesoftwaredevelopmentlifecycle.Findingandfixingbugs or problems is the goal,

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along with making sure the programme satisfies requirements and performsasintended.Enhancingthesoftware'sperformance,dependability,andqualityisanother goaloftesting.Therearetwoprimaryformsoftesting:automatedtesting,whichusesautomation technologies, and manual testing, which involves testers carrying out test cases by hand. While whiteboxtestinglooksatthesoftware'scorelogic,structure,andcode,blackboxtestingfocuses on inputs and outputs whiletesting theprogrammewithout knowing about its internal workings. The steps included in the testing life cycle are test design, test planning, test execution, defect reporting, and test.

## VIII. FUTURE ENHANCEMENT

Inthefuture,theprojectenvisionssignificantadvancementstoenhancetheartificialvisionsystem forvisuallyimpairedindividuals.Thedevelopmentofreal-timescenedescriptionalgorithmsaims to provide detailed and instant information about the user's surroundings, improving overall situational awareness. Additionally, the integration of gesture-based interaction will empower users to control and customize the system's functionalities through intuitive gestures, enhancing user experience and accessibility. Another key focus is on public spaces navigation assistance, withspecificfeaturestailoredtoaidvisuallyimpairedusersinnavigatingcomplexenvironments like transportation hubs, malls, and recreational areas. These enhancements collectively aim to further elevate the system's capabilities, fostering greater independence and convenience for visually impaired individuals in various aspects of their daily lives.

## IX. CONCLUSION

Insummary,theproject'sgoalistocompletelytransformtheartificialvisionexperienceforthose with visual impairments by combining cutting-edge technologies and creative solutions. By utilisingVisionTransformertechnology,real-timeimageprocessingalgorithms,andinformation extraction methodologies, the project aims to improve visually impaired individuals' overall quality of life, independence, and accessibility. Through tackling major issues such restricted informationavailability,difficultieswithnavigation,restrictedsocialinteractions,andbarriersto educationandwork,theprojectaimstoenablevisuallyimpairedpeopletolivemorefulfilledand independentlives.Accessiblefeedbackisensuredbytheintegrationofaudiooutputwithtext-to- speech conversion, and the project's potential impact is further reinforced by validation using a simulated prosthetic vision and a feasibility study for daily use.

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