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Fog-Enabled Visual Assistance: Empowering the Blind with Artificial Vision

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ABSTRACT*:* The eyes are an essential tool for human observation and perception of the world, helping people to perform their tasks. Visual impairment causes many inconveniences in the lives of visually impaired people. This research project aims at helping blind people of all categories to achieve their day to day tasks easier through the use of a smart device. By using artificial intelligent and image processing, this smart device is able to detect faces, colors and deferent objects. The detection process is manifested by notifying the visually impaired person through either a sound alert or vibration. Additionally, this study presents a palpable survey that entails visually impaired people from the local community. There are modern technologies that help people to practice their activities easily. We focused on the special needs categories which are blinds people. The third blind eye is a stick that makes blind people life easier. It helps them to walk and carry out their daily activities in an easy way and safety by using Internet of Things (IOT) and Artificial Intelligence (AI).

The lighting affects a lot in the color images to find the face, so they found the property of chrome, which adds good properties in the image. They are tried to build face detection algorithm through face or skin color. The stick contain sensor that provide distance between blind people and the objects by use Ultrasonic sensor, infrared (IR), Light dependent resistor (LDR) Subsequently, the project uses both Open CV and Python for programming and implementation. The exertion of this project prototype investigates the algorithms which are used for detecting the objects. Also, it demonstrates how this smart device could detects certain physical object and how it could send a warning signal when faced by any obstacles. Overall, this research will be a positive addition in the world of health care sector by supporting blind people with the use of smart technology.

KEYWORDS *:* Artificial Intelligent, Open CV, Python, Face Recognition, Object Detection, Health Care Introduction.

I. INTRODUCTION

FOG COMPUTING

Fog computing, introduced by Cisco, extends the capabilities of cloud computing by decentralizing resources and bringing computation, storage, and networking services closer to the edge of the network where data is generated and consumed. This architectural approach aims to overcome the limitations of traditional cloud computing, particularly in scenarios requiring real-time processing, low latency, and bandwidth optimization.

In fog computing, a network of distributed devices known as fog nodes or edge devices collaborates to process data locally, reducing the reliance on distant cloud servers. This proximity to edge devices significantly reduces latency and improves response times for critical applications.

Furthermore, fog computing offers scalability, resource efficiency, and enhances data privacy and security by keeping sensitive data closer to its source.

These characteristics make fog computing an attractive solution for a wide range of applications across industries such as smart cities, healthcare, transportation, and manufacturing, enabling organizations to innovate and optimize operations in the era of the Internet of Things (IoT) and edge computing.

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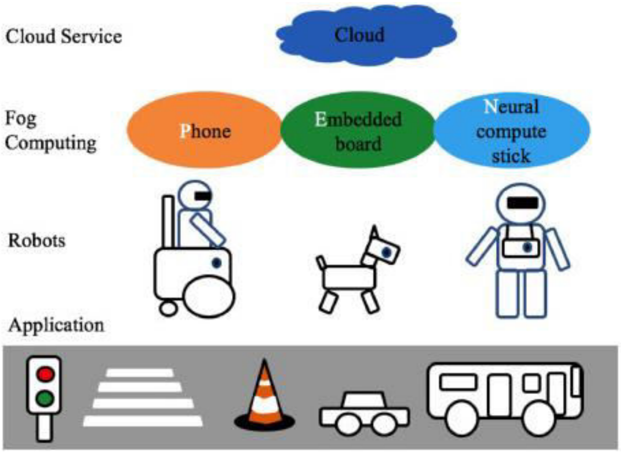
TECHNIQUES OF FOG COMPUTING



DISTRIBUTED COMPUTING:

Fog computing relies on distributing computing resources across a network of devices rather than centralizing them in remote data centers. This approach minimizes latency by processing data closer to where it's generated, enhancing the efficiency of resource utilization.

EDGE ANALYTICS:

Instead of transmitting raw data to a centralized cloud for processing, fog computing allows for performing analytics and deriving insights at the edge of the network. Edge analytics reduces the need for extensive data transmission, leading to lower bandwidth usage and faster response times for critical applications.

VIRTUALIZATION:

Fog environments often leverage virtualization technologies to create virtual instances of computing resources. Virtualization enables the efficient allocation and management of resources, facilitating scalability and flexibility in fog computing deployments.

CONTAINERIZATION:

Containerization technology, such as Docker or Kubernetes, is widely adopted in fog computing environments. Containers encapsulate applications and their dependencies, enabling rapid deployment and seamless migration of workloads across edge devices.

SECURITY MECHANISMS:

Fog computing introduces unique security challenges due to the distributed nature of resources and the heterogeneity of edge devices. Techniques like encryption, access control, and authentication are essential for safeguarding data and ensuring the integrity of fog computing environments.

RESOURCE MANAGEMENT:

Effective resource management is critical in fog computing to optimize performance and ensure efficient utilization of available resources. Techniques such as dynamic resource allocation, load balancing, and task scheduling play a vital role in maximizing the utilization of edge resources.

EDGE AI AND MACHINE LEARNING:

Integrating AI and machine learning algorithms at the edge enables intelligent decision-making and real-time data processing. Edge AI techniques like federated learning and model compression allow for efficient utilization of computational resources while preserving data privacy and reducing communication overhead.

FAULT TOLERANCE AND RESILIENCE:

Fog computing systems must be resilient to failures and disruptions in edge environments. Techniques such as redundancy, replication, and fault tolerance mechanisms help maintain system availability and reliability in the face of failures or network outages.

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RESOURCE VIRTUALIZATION:

Virtualization techniques are used to create isolated environments for applications and services on edge devices. This allows hardware resources to be shared efficiently among multiple workloads.

RESOURCE ORCHESTRATION:

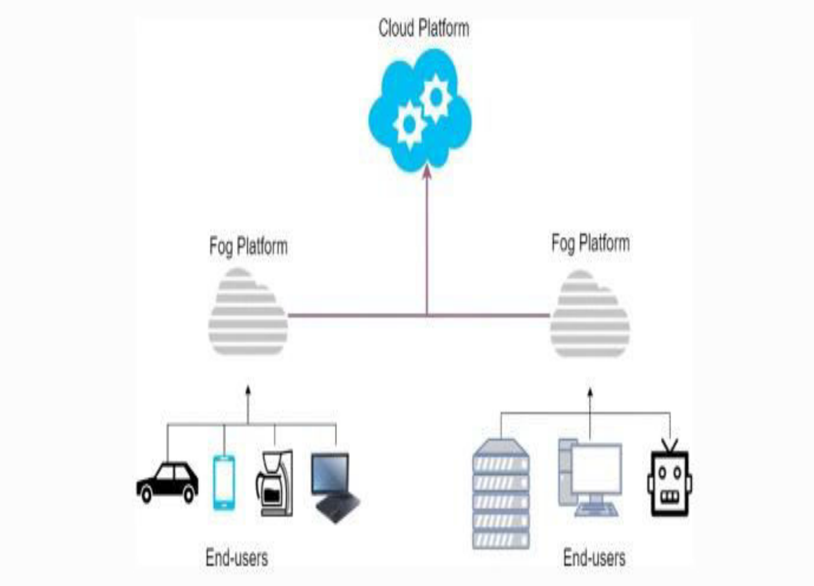
Orchestration mechanisms coordinate the use of computing, storage, and network resources on edge devices and in the cloud, ensuring that workloads are executed efficiently and with low latency.

COLLABORATIVE FOG COMPUTING:

Edge devices close to each other collaborate to perform data processing tasks. This may involve sharing computing resources, direct communication between devices, and coordination of distributed tasks.

FOG MACHINE LEARNING:

Machine learning algorithms are run on edge devices for real-time data analysis and local decision-making. This is especially useful in scenarios where latency is critical or cloud connectivity is intermittent.



II. LITERATURE SURVEY

Title : Data mining on parallel database systems
Author : Mauro sousa marta mattoso nelson ebecken

Recent years have shown the need of an automated process to discover in- teresting and hidden patterns in real-world databases, handling large volumes of data. This sort of process implies a lot of com- putational power, memory and disk I/O, which can only be provided by parallel com- puters. Our work contributes with a solu- tion that integrates a machine learning algo- rithm, parallelism and a tightly-coupled use of a DBMS system, addressing performance problems with parallel processing and data fragmentation.

Title : **Ant colony system for graph coloring problem**
Author : Malika bessedik, rafik laib, aissa boulmerka et habiba drias

In this paper, we present a first ACO approach, namely Ant Colony System (ACS) for the graph colouring problem (GCP). We implemented two strategies of ACS for the GCP; construction strategy and improvement strategy. In construction strategy, the algorithm iterativelly constructs feasible solutions. The phase of construction is carried out by a specific constructive method for the problem, that is: Recursive Largest First (RLF) or DSATUR.

Title : A definition of peer-to-peer networking for the classification of peer-to-peer architectures and applications
Author : Riidiger schollmeier

The main contribution ojthe poster, which is shortly outlined in the following, is to ofer a definition for Peerto-Peer networking and to make the differences to common so called Client/Server-architectures clear. With this definition

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we are able to classrjji currently existing networking concepts in the Internet either as "Pure" Peer-to-Peer, or "Hybrid" Peer-to-Peer or Client/Server architecture,

Title : Review of mobile banking and its evolvingtrend in india
Author : Hamia khan

With the advent of technology, banking industry has also evolved. The industry has been making judicious use of technology. Technology has aided the banking industry for ease of rendering services. Internet has also proved to pave way for different industries leading them to introduce new product line and has demonstrated to be helpful for banking industry. In today's digital age, mobile devices are the primary mode of accessing the internet. Increased affordability and accessibility of smart phone and the emergence of fusion feature phones has led to widespread internet usage.

Banks serve customers efficiently using various channels and branches like Automated Teller Machines (ATM), internet banking, telephone banking, and mobile banking. Mobile banking has itself evolved from Short Message Service (SMS) banking; mobile applications to secured biometric applications M-Banking let users to avail banking services 24*7. It has moved forward and has proved to be advantageous to users and has been beneficial for the banking industry as well. Though there are challenges especially on the part of security reason which banking sector need to curb to advance.

Title : Ip-based virtual privatenetwork implementations in future cellular networks
Author : Madhusanka liyanage, mika ylianttila, andrei gurtov

Virtual Private Network (VPN) services are widely used in the present corporate world to securely interconnect geographically distributed private network segments through unsecure public networks. Among various VPN techniques, Internet Protocol (IP)-based VPN services are dominating due to the ubiquitous use of IP-based provider networks and the Internet. Over last few decades, the usage of cellular/mobile networks has increased enormously due to the rapid increment of the number of mobile subscribers and the evolvement of telecommunication technologies. Furthermore, cellular network-based broadband services are able to provide the same set of network services as wired Internet services.

Thus, mobile broadband services are also becoming popular among corporate customers. Hence, the usage of mobile broadband services in corporate networks demands to implement various broadband services on top of mobile networks, including VPN services. This chapter is focused on identifying high-level use cases and scenarios where IP-based VPN services can be implemented on top of cellular networks. Furthermore, the authors predict the future involvement of IP-based VPNs in beyond-LTE cellular networks

III. MODULES

- Fog Nodes Module
- Fog Orchestrator Module.
- Communication Protocols Module
- Security Framework Module
- Monitoring and Management Module.

MODULES DESCRIPTION
FOG NODES MODULE

These are computing nodes located at the edge of the network, closer to the edge devices. Fog nodes can range from small servers to powerful edge computing devices. They provide computing, storage, and networking capabilities to process data locally. Fog nodes are strategically positioned to reduce latency and bandwidth usage by processing data closer to its source, enabling faster response times and more efficient use of network resources.

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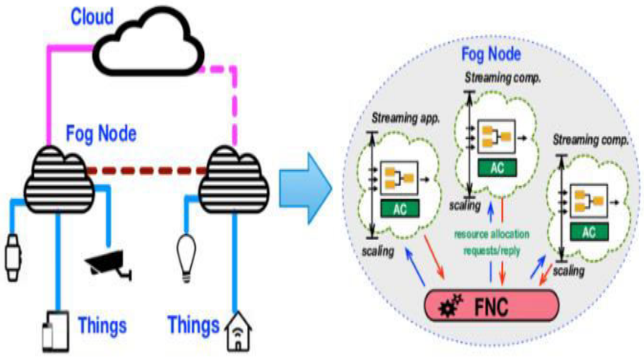
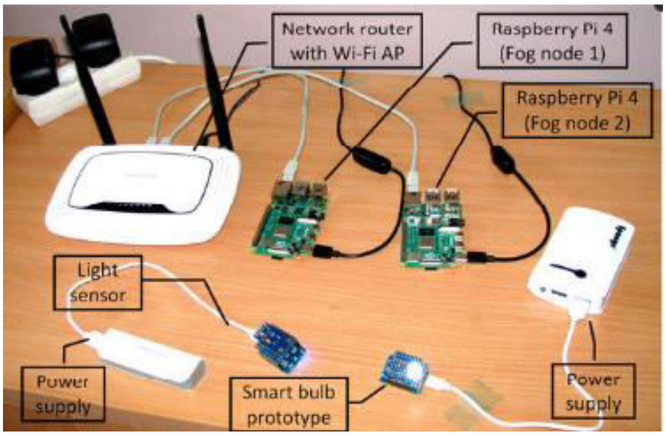


FOG ORCHESTRATOR MODULE

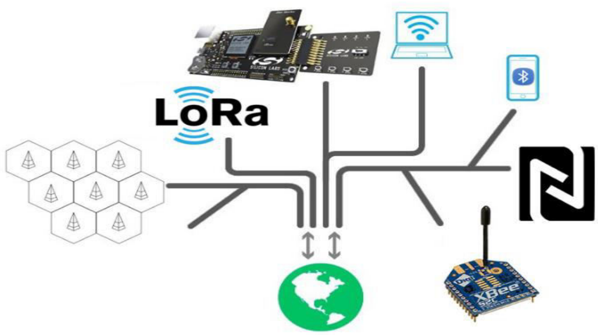
This module is responsible for managing and coordinating resources across fog nodes and edge devices. It ensures efficient resource utilization and workload distribution, as well as dynamic scaling based on demand. The fog orchestrator plays a critical role in optimizing the allocation of computational resources, ensuring that tasks are executed in the most efficient manner possible while maintaining reliability and scalability.



Orchestrator Model for Fog Computing

COMMUNICATION PROTOCOLS MODULE

Fog Computing relies on various communication protocols to enable seamless communication between edge devices, fog nodes, and the cloud. These protocols include MQTT, CoAP, AMQP, and others, optimized for low latency and resource-constrained environments. Communication protocols facilitate the exchange of data and commands between different components of the fog computing architecture, enabling efficient and reliable communication in distributed environments.



SECURITY FRAMEWORK MODULE

Security is a critical aspect of fog computing. This module encompasses authentication, encryption, access control, and other security measures to protect data and resources from unauthorized access, tampering, and cyber

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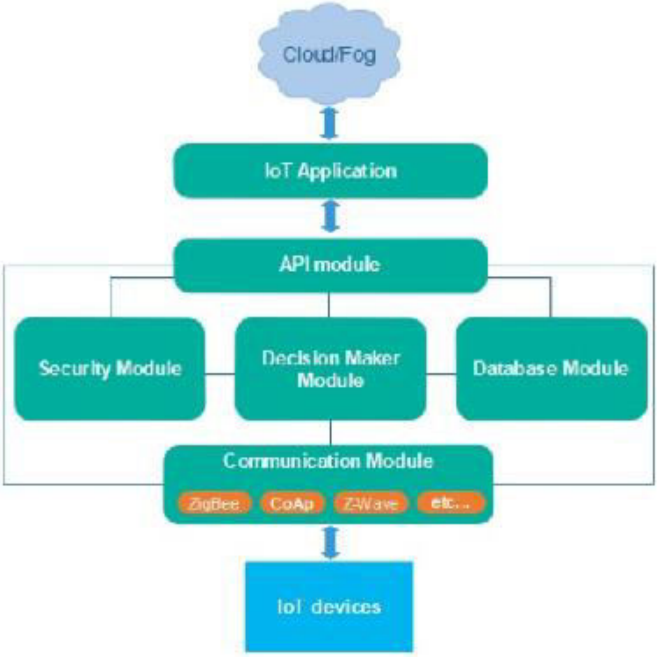
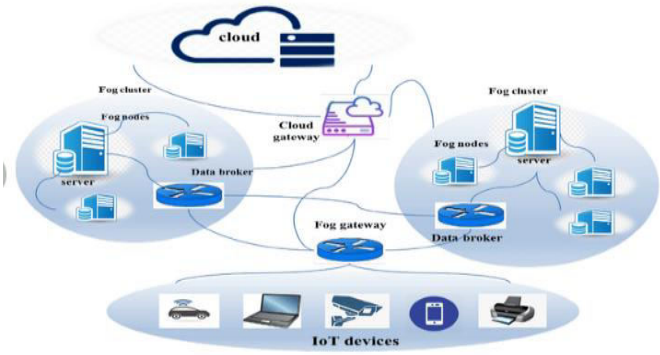
threats. The security framework is designed to safeguard sensitive information and ensure the integrity and confidentiality of data transmitted and processed within the fog computing environment..



MONITORING AND MANAGEMENT MODULE

This module provides tools and interfaces for monitoring the health, performance, and utilization of fog computing resources. It enables administrators to troubleshoot issues, optimize resource allocation, and ensure the smooth operation of the fog environment. Monitoring and management capabilities are essential for maintaining the reliability, availability, and performance of fog computing infrastructure, ensuring that it meets the needs and expectations of users and stakeholders..



FOG CHARACTERISTICS

SUPPORT FOR IOT AND SENSOR NETWORKS:

Fog Computing is uniquely suited to handle the vast amounts of data generated by IoT devices and sensor networks. By processing data locally at the edge, Fog Computing alleviates network congestion and bandwidth constraints, enabling efficient and scalable IoT deployments.

INTEGRATION WITH MOBILE DEVICES:

Fog Computing seamlessly integrates with mobile devices and IoT endpoints, allowing for the efficient exchange of data and resources between edge devices, fog nodes, and cloud services. This integration enables mobile users to access and interact with edge services seamlessly, regardless of their location or network connectivity..

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EDGE INTELLIGENCE AND ANALYTICS

Fog Computing enables edge intelligence and analytics, allowing for real-time data processing, analysis, and decision-making at the network edge. By moving computation closer to the data source, Fog Computing enables faster insights and actions, empowering organizations to extract value from their data in real-time.

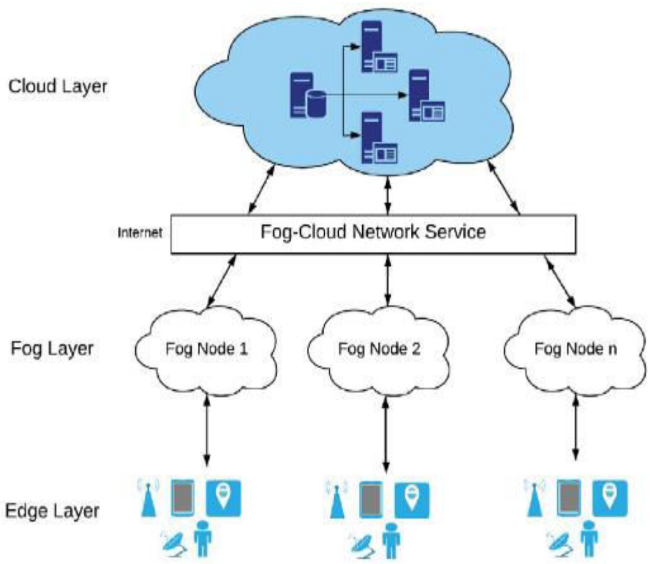
ALGORITHM

This project's goal is to develop the Fog-enabled visual assistance system for empowering the blind with artificial vision begins by capturing images using a camera-equipped wearable device worn by the visually impaired user. The captured images are then processed locally on the wearable device using computer vision algorithms to extract relevant visual information, such as object detection, scene recognition, and text extraction. Next, the processed data is transmitted to nearby fog nodes located at the network edge for further analysis and refinement. Throughout this process, the Fog Computing infrastructure optimizes resource utilization and minimizes latency by distributing computing tasks between the wearable device and nearby fog nodes, ultimately empowering the blind with enhanced artificial vision capabilities in real-world environments.

IMPLEMENTATION

The implementation of a Fog-enabled visual assistance system for empowering the blind with artificial vision begins with the setup of hardware and software components. Wearable devices equipped with cameras, such as smart glasses, are utilized by visually impaired users, while fog nodes, strategically placed in the environment, handle more complex computational tasks. Software architecture involves developing algorithms for the wearable device to perform basic image processing, including object detection and scene recognition. These algorithms transmit processed data to nearby fog nodes via wireless protocols, where more advanced computer vision algorithms are applied for tasks like image classification and object tracking.. Testing and validation are crucial, involving real-world trials with visually impaired individuals to refine algorithms and ensure usability. Once validated, the system can be deployed in various settings, with ongoing maintenance to ensure its reliability and effectiveness in enhancing the independence of the visually impaired.

IV. SYSTEM ARCHITECTURE



V. CONCLUSION

In conclusion, the development and implementation of a Fog-enabled visual assistance system hold immense promise in enhancing the independence and quality of life for the visually impaired. By leveraging the capabilities of wearable devices and fog computing infrastructure, this system empowers users with real-time access to visual information and assistance in navigating their surroundings. Through a combination of lightweight algorithms on wearable devices and more advanced processing at fog nodes, the system can efficiently analyze visual data and provide relevant feedback to users. Furthermore, the distributed nature of Fog Computing ensures low-latency processing and scalability, making the

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system adaptable to various environments and usage scenarios. As technology continues to evolve, further advancements in computer vision algorithms, hardware capabilities, and user interfaces promise to make Fog-enabled visual assistance systems even more effective and accessible. Ultimately, by harnessing the potential of Fog Computing, we can create inclusive solutions that enable individuals with visual impairments to live more independently and confidently in their daily lives.

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