الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري

جامعة الدول العربية

كلية الذكاء الاصطناعي

Projects Overview

Spring 2024

1. Table of Contents

1. Agricultural Drone with Mobile Interface for Plant Disease Detection with Deep Learning (Green Drone)

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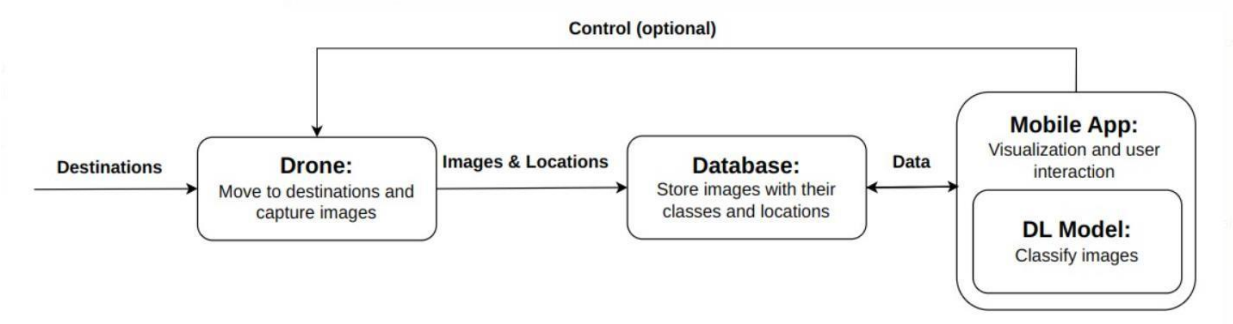
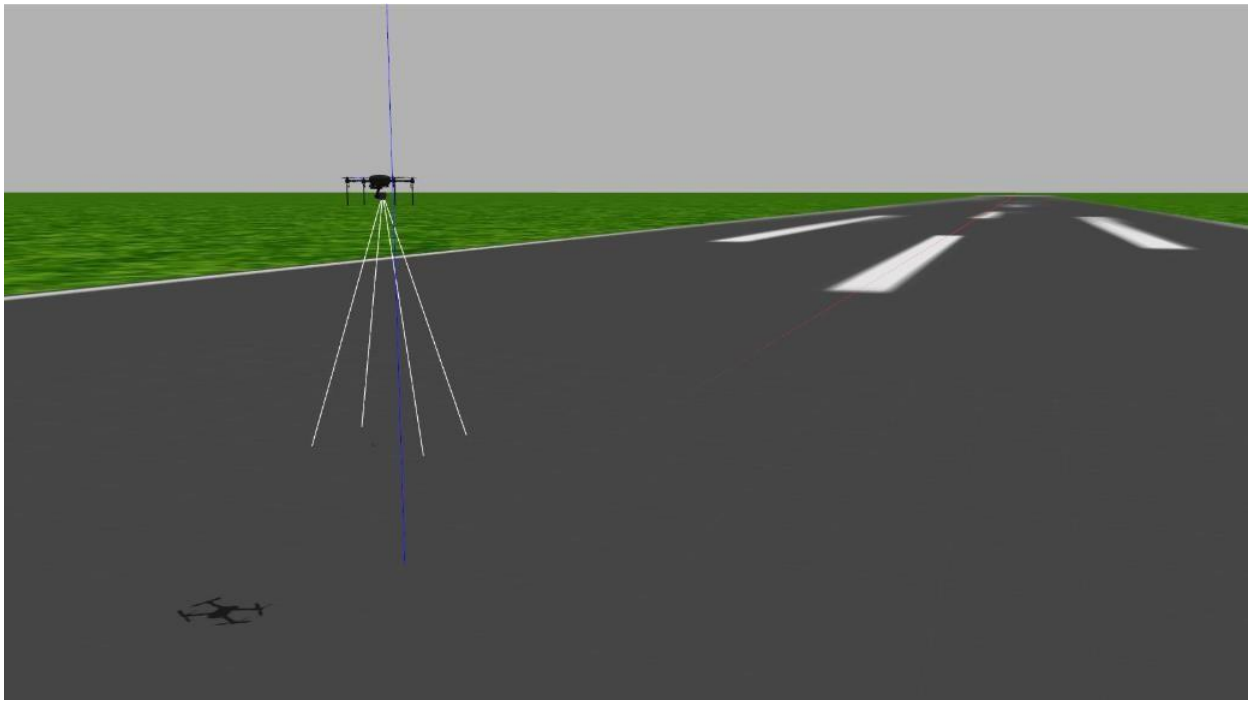
Abstract

This project presents an innovative mobile application that integrates deep learning for plant disease detection with drone control capabilities. The core of the system is a high-precision deep learning model, achieving up to 99.44% accuracy in identifying plant diseases. Deployed on a user-friendly mobile app, it enables real- time disease classification using the device's camera. Additionally, the app interfaces with agricultural drones, allowing users to control UAVs for aerial image capture. These images are then processed by the same deep learning model for large-scale crop monitoring. By combining mobile technology, drone automation, and artificial intelligence, this system offers a powerful, accessible tool for enhancing precision agriculture and addressing global food production challenges.

The project covers the following topics:

- ✓ Self-flying drone.
- ✓ Identify diseases in plants.
- ✓ Mobile App to display live stream.
- ✓ Database for drone data.
- ✓ Deep-Learning model to identify diseases.





2. Intelligent Hydroponic Farming

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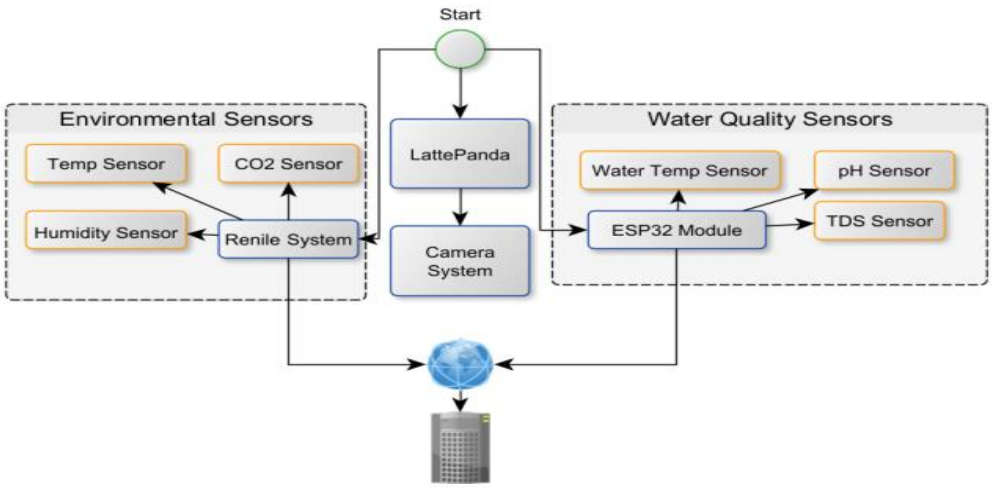
Abstract

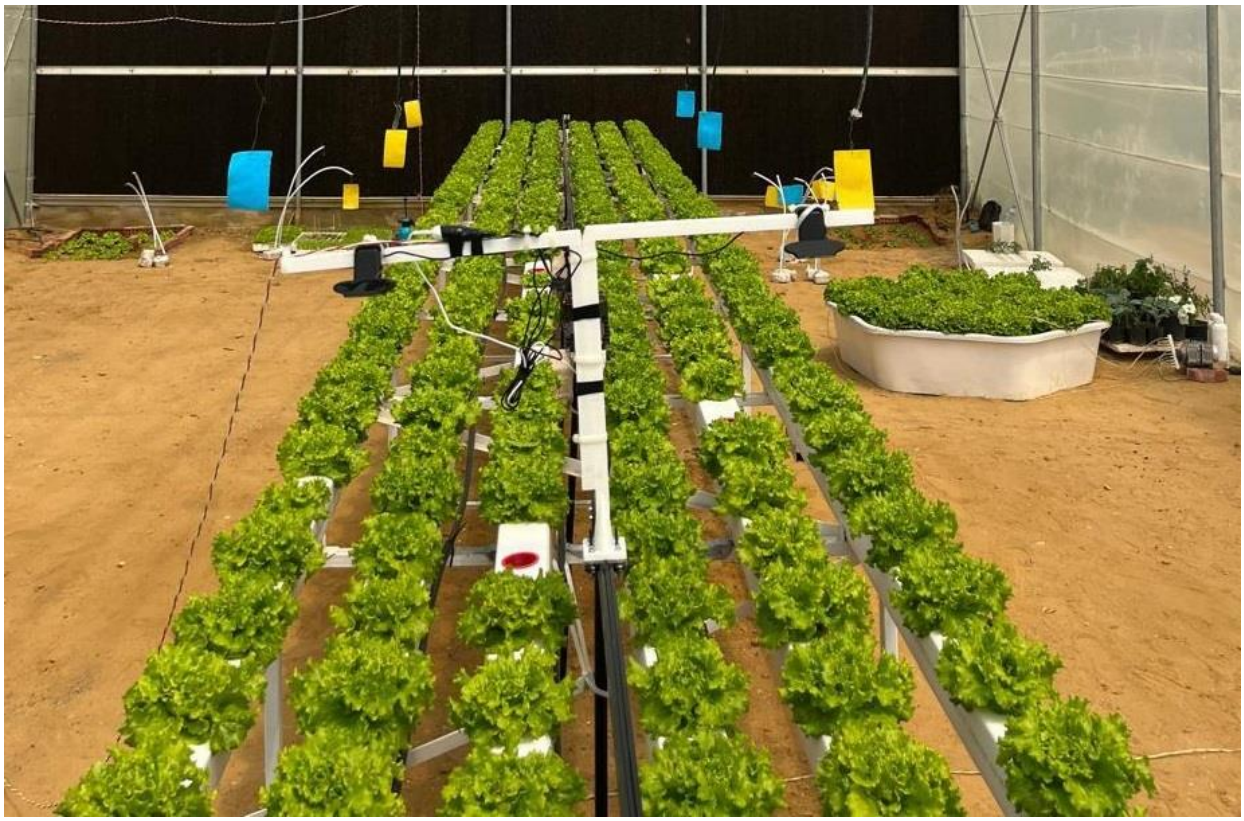
Hydroponic farming is revolutionizing modern agriculture by enabling efficient and sustainable crop production without the need for traditional soil-based methods. Among the various hydroponic techniques, the Nutrient Film Technique (NFT) has emerged as a standout method, particularly effective for cultivating leafy greens. This study delves into the numerous advantages of NFT hydroponics, emphasizing its precision in nutrient delivery, optimal resource utilization, and efficient space management. To comprehensively evaluate these benefits, we conducted three separate experiments over a three-month period, meticulously collecting data on key performance indicators.

A key innovation in this study is the integration of machine learning and computer vision technologies to further enhance precision agriculture within the NFT hydroponics framework. By leveraging these advanced technologies, we aim to improve the monitoring and management of nutrient levels, plant health, and growth conditions. The application of machine learning algorithms allows for the analysis of large datasets, leading to more accurate predictions and informed decision-making, while computer vision provides real-time insights into plant growth and development.

Our findings reveal significant improvements in crop yield, resource efficiency, and overall system performance when using NFT hydroponics combined with these technological enhancements. The results underscore the potential of NFT hydroponics as a sustainable and scalable solution for modern agriculture, capable of addressing the challenges of food security and environmental sustainability. This research contributes to the growing body of knowledge in precision agriculture and highlights the transformative impact of integrating
advanced technologies with innovative farming techniques, advancing sustainable agricultural practices.

Block Diagram





3. IntelliLearn

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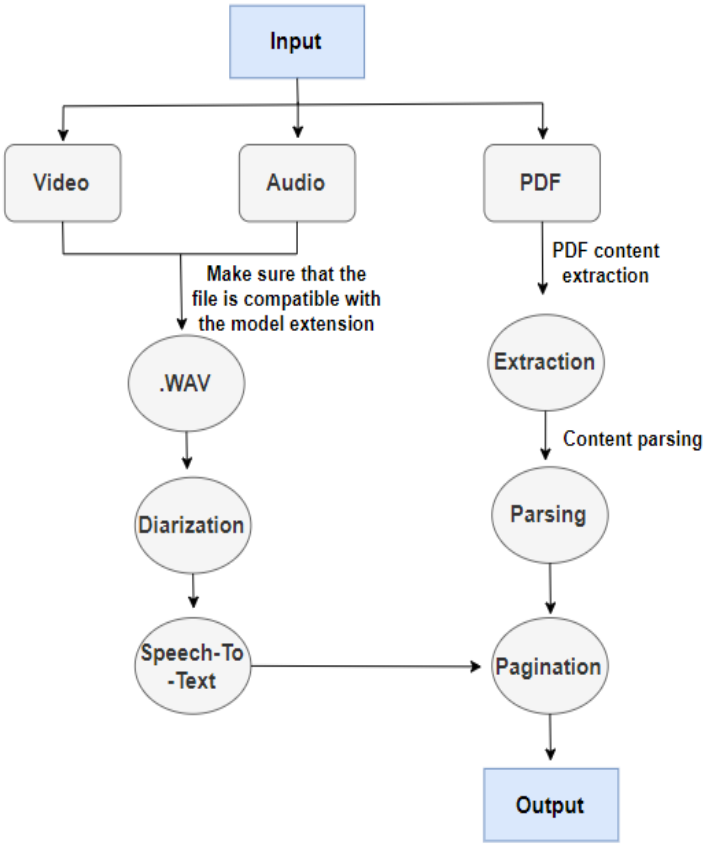
Abstract

In the digital age, the transformation of educational tools and resources is crucial to enhancing learning experiences and accessibility. This project, "IntelliLearn," leverages advanced AI technologies, including OpenAI's Whisper and xAI's Grok, to develop a comprehensive system for text analysis, summarization, and generation. The system allows users to upload a PDF, audio recording, or video. If the uploaded file is an audio recording or video, it undergoes speech-to-text (STT) processing to extract the text, which is then fed into a large language model (LLM). For PDFs, the text is directly processed by the LLM. The extracted or uploaded text is then utilized for various tasks such as text generation, code generation, summarization, and question answering. By integrating robust speech recognition capabilities with deep learning insights, IntelliLearn provides efficient content processing and user-friendly interaction, making it an invaluable tool for students, educators, and professionals. The system aims to bridge the gap between vast information sources and users, facilitating better understanding and retention of complex information. This project not only enhances the accessibility of educational content but also streamlines the process of information extraction and utilization, thereby significantly contributing to the field of educational technology.

Preprocessing Scheme



4. Media AI

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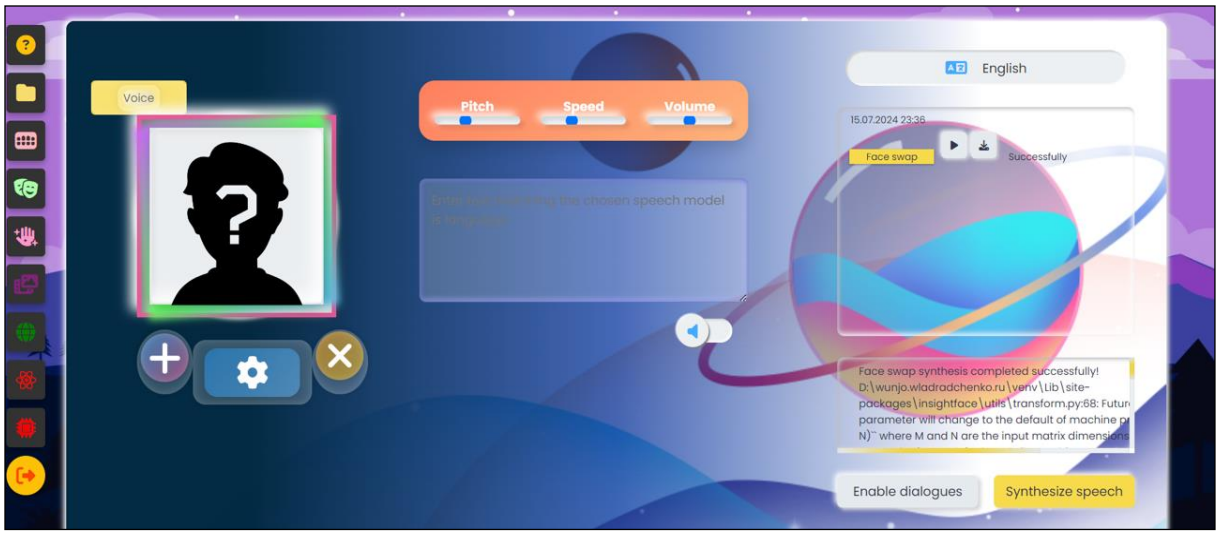
Abstract

The convergence of Artificial Intelligence (AI) and digital platforms is ushering in a new era of innovation, with profound implications for various industries and aspects of daily life. The integration of multiple AI models presents an unprecedented opportunity to create transformative applications that can revolutionize how we interact with technology and media.

Our project aims to capitalize on this potential by developing a cutting-edge web application that seamlessly blends advanced AI capabilities into a cohesive and user-centric platform. By combining the power of Mouth Animation, Face Swap, Text-to-Speech, and Video/Image Retouching, we seek to create a versatile tool capable of enhancing creativity, communication, and entertainment experiences in unprecedented ways.

The project covers the following topics:

- ✓ **AI Integration and Web Application Platform:** This core component focuses on building a robust and scalable foundation for integrating diverse AI models into a user-friendly web application interface. By leveraging cutting-edge technologies and design principles, a seamless and intuitive user experience is created.
- ✓ **Image Animation:** This topic aims to push the boundaries of image animation by developing advanced techniques that bring static images to life with realistic and engaging movement. The goal was to create lifelike animations that captivate audiences and inspire creativity.
- ✓ **Face Swapping:** A high-precision face swapping technology that enables users to seamlessly swap faces between different images or videos has been developed. By leveraging advanced AI algorithms, highly realistic and undetectable face swaps have been achieved.
- ✓ **Voice Cloning:** The used voice cloning technology focuses on replicating individual voices with exceptional accuracy, allowing users to create highly authentic and personalized audio experiences. It is aimed to develop a system that can capture the nuances and subtleties of human speech, resulting in lifelike voice clones.


Voice
Pitch
Speed
Volume
English
15.07.2024 23:36
Face swap
Successfully
Face swap synthesis completed successfully!
Enable dialogues
Synthesize speech

5. Mobile Application for Psychotherapy using Artificial Intelligence (AICO)

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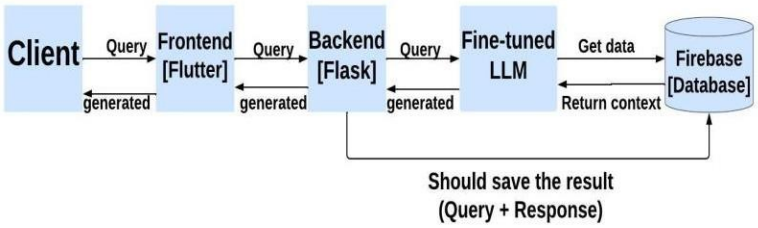
Abstract

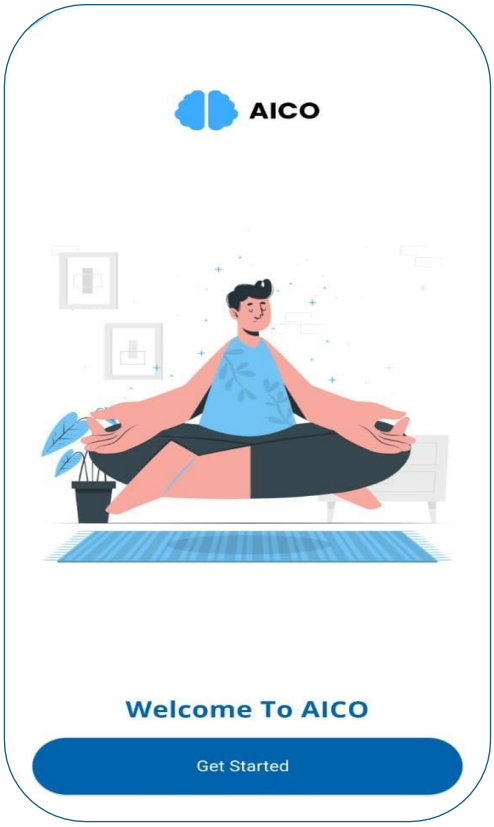
This project investigates the feasibility of utilizing a large language model (LLM) to create a mobile application with an AI chatbot psychotherapist. The LLM was fine-tuned on a psychotherapy dataset to enable it to engage in therapeutic conversations with users. The project explored various challenges, including the selection of a suitable LLM and the creation of a question-and-answer psychotherapy dataset. Through an innovative approach involving LLM-generated data, a training dataset was constructed for fine-tuning. While the project successfully developed a functional prototype, limitations in time and resources necessitated the postponement of deploying the model on a high-performance server and integrating it into a native Android application. The results demonstrate the potential of LLMs for developing AI-powered therapeutic tools, paving the way for further exploration and refinement in future iterations.

The project covers the following topics:

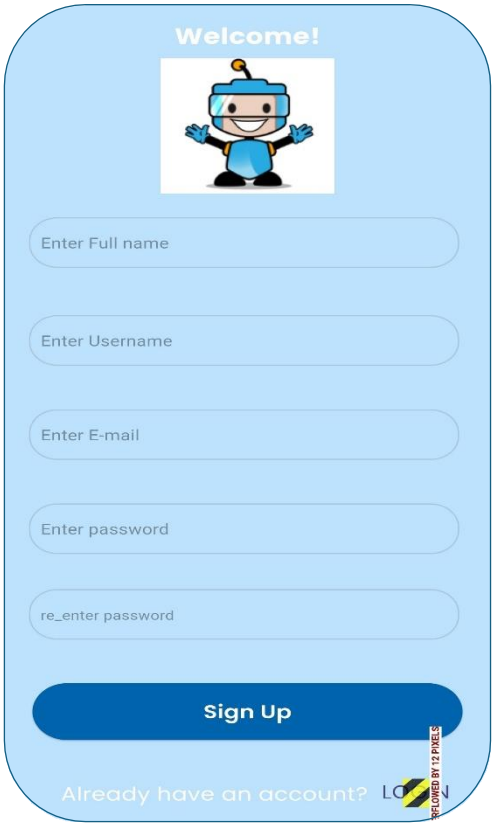
- ✓ Fine tuning Falcon 7-b Large Language Model
- ✓ Utilizing cloud services (Firebase)
- ✓ Using a local server as a global server (Flask framework & ngrok)

Keywords: Falcon 7-b; Fine tuning; LLM; Firebase; Flask; decoder-only model



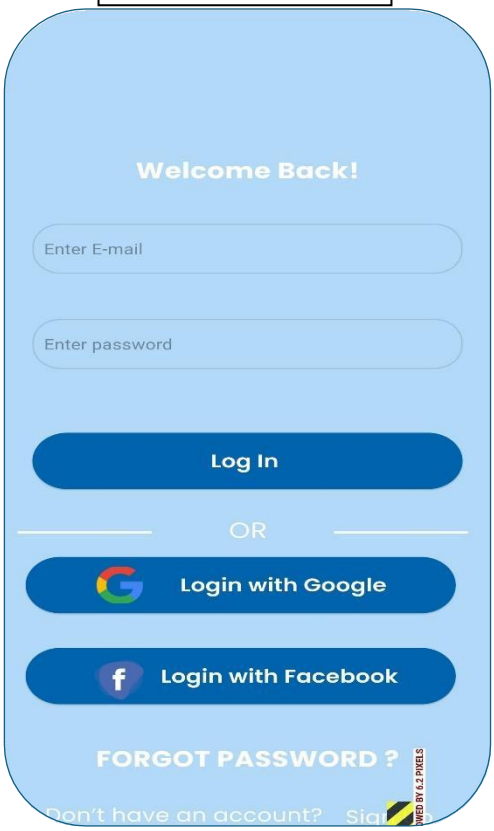


Welcome screen



Sign up screen

Sign in screen



Chat screen

6. Personal Care Robot using Language Grounding Approaches

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Abstract

This project explores the development of a personal care robot utilizing advanced language grounding approaches to enhance human-robot interaction. The motivation for this project arises from the increasing demand for assistive technologies capable of understanding and executing tasks based on natural language inputs, facilitating their seamless integration into both domestic and medical environments. The primary problem addressed is the significant challenge of enabling robots to autonomously comprehend and perform complex tasks in dynamic, real-world settings, which is essential for providing effective and reliable assistance to individuals in need.

To address this challenge, a combination of state-of-the-art artificial intelligence and machine learning techniques has been examined. The research focused on overcoming key technical obstacles such as obstacle detection and avoidance, autonomous grasping, and visual environment understanding. The methodology involved designing a robust system architecture that integrates sophisticated hardware and software components. This architecture was subjected to rigorous testing through simulations and real-world performance assessments to ensure its reliability and efficiency.

The system architecture of the personal care robot comprises several core modules: a language processing unit for understanding and generating natural language commands, a perception module for interpreting visual and sensory data, and a control system for executing tasks based on the interpreted commands. Each module was developed with a focus on modularity and scalability, allowing for future enhancements and adaptations to various application scenarios.

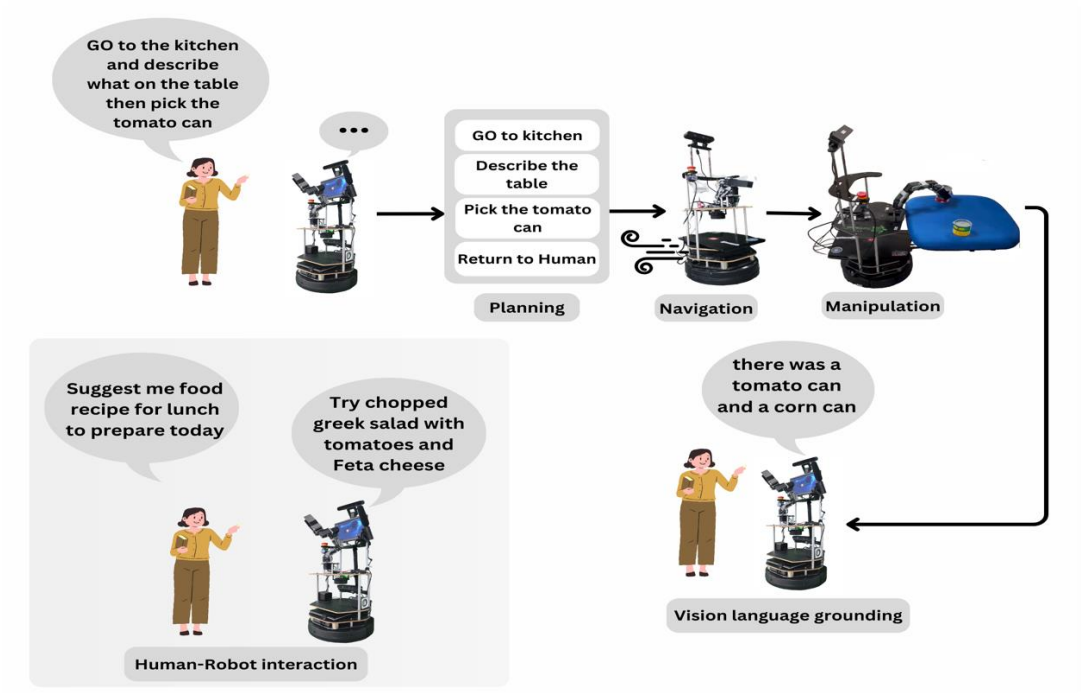
The results demonstrate the robot's ability to accurately interpret and execute a wide range of verbal commands, perform precise autonomous grasping of objects, and navigate complex environments while avoiding obstacles. The implementation was evaluated in various simulated and real-world environments, showcasing the robot's capability to recognize objects, navigate autonomously, and interact with users naturally and intuitively. The system's performance metrics indicated high accuracy and robustness in task execution, highlighting its potential for real-world applications.

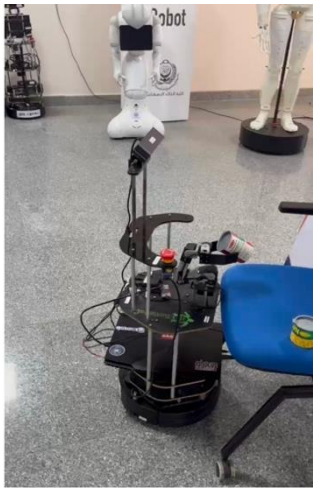
The implications of this work are substantial, as it provides a foundation for future advancements in personal care robotics. This project not only contributes to the broader field of intelligent systems but also underscores the potential for robots to significantly enhance human well-being and promote independence. By addressing the critical aspects of human-robot interaction, this research paves the way for more sophisticated and practical applications of personal care robots in everyday life. The findings suggest that with continued development, personal care robots could become invaluable assistants in homes, healthcare facilities, and other environments, providing support and improving the quality of life for a wide range of individuals.

The project covers the following topics:

- ✓ Robot Manipulation.
- ✓ Robot Navigation.
- ✓ Task and Motion Planning.
- ✓ Visual Language Understanding for Robot Environment
- ✓ Human-Robot Interactions
- ✓ Object identification and finding the 6D pose of various household objects by using description of that object.

Keywords: Robot Manipulation; Robot Navigation; Task and Motion Planning; Visual Language Understanding for Robot Environment; Human-Robot Interactions.





7. Preliminary Prototype: AI-Facilitated App for EGY Governmental Services (Easy Egypt)

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Abstract

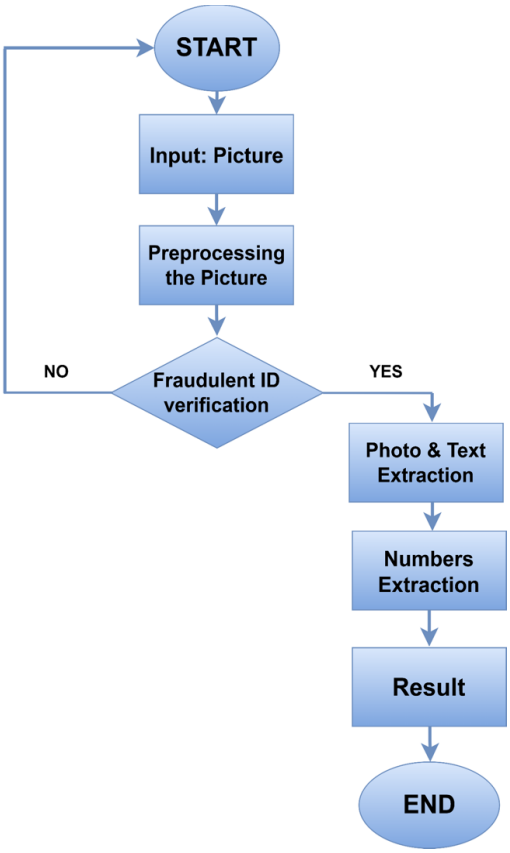
Global e-government initiatives are becoming increasingly interested in improving the accessibility, efficiency, and transparency of public services worldwide. However, with the country's strongly increasing population, broad smartphone use, and assistance from the government, several barriers continue to exist, most notably the use of papers and the complexities of bureaucracy. In this paper, we present a novel approach that utilizes generative AI models to address these challenges. Inspired by previous research, it aims to revolutionize administrative procedures. Our system facilitates remote interaction between citizens and government entities. Through the digitization of personal documents and integration with official systems, the system ensures a seamless user experience. Upon application, users can effortlessly submit their IDs, facilitating the extraction of digitally written Arabic information (e.g., name, address, and date of birth) and identity photos. Furthermore, despite the effectiveness of PyTesseract and EasyOCR for Arabic text extraction achieving an accuracy exceeding 81.5%, their results were not satisfactory for Arabic numbers. Due to this, we developed and customized a deep learning model from scratch to extract Arabic numbers (i.e., national ID numbers), achieving an accuracy exceeding 99.5%. Furthermore, we employed the SUGAN model for the data augmentation of Arabic numbers, thus enhancing the diversity of the training dataset. In addition, the DCGAN model is utilized to generate synthetic data for fraud detection and document verification. However, the initial results are suboptimal. Subsequently, we explored the effectiveness of StyleGAN2, which yielded better outcomes, particularly after augmenting the training data by injecting Gaussian and Salt&Pepper noise and adjusting the lighting variations. Later on, the synthetic data will serve as a separate class for our CNN classifier, aiming to tell the difference from the real IDs, in order to improve the automation of document verification process by detecting fraudulent documents.

The project covers the following topics:

- ✓ E-Government Initiatives
- ✓ Challenges in E-Government
- ✓ Remote Interaction System
- ✓ Generative AI Models
- ✓ Arabic Text and Number Extraction
- ✓ Data Augmentation with SUGAN
- ✓ Synthetic Data for Fraud Detection with StyleGAN2-ADA
- ✓ CNN Classifier for Document Verification

Keywords: Arabic text extraction; Arabic numbers extraction; SUGAN model; Data augmentation; DCGAN model; Fraud detection; StyleGAN2-ADA; Generative AI models; Deep learning; CNN

Block Diagram



Feature Graphic/Poster

8. RAFEQI Robot

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Abstract

RAFEQI is a cutting-edge humanoid robot designed to serve as a versatile companion and assistant. Equipped with a mobile base featuring four wheels for effortless navigation, RAFEQI possesses a comprehensive suite of advanced capabilities.

Central to RAFEQI's functionality is its robust computer vision system, enabling it to accurately detect and recognize objects, determine age, and gender, and interpret sign language. Moreover, in order to facilitate seamless interaction

with its surrounding environment, the robot incorporates advanced localization technologies, allowing it to build and maintain a detailed map of its surroundings.

Furthermore, RAFEQI is capable of engaging in natural and informative conversations with user, thanks to its integration with the ChatGPT database. This powerful language model empowers the robot to provide comprehensive and relevant responses to a wide range of queries.

To enhance user experience and accessibility, RAFEQI features a user-friendly Graphical User Interface (GUI) and a dedicated website. These platforms provide intuitive control over the robot's functionalities, allowing users to explore its capabilities and customize its behavior. RAFEQI's versatility extends to various professional settings, where it can excel as a dynamic front desk receptionist or a dedicated personal assistant in companies, schools, and colleges.

With a strong commercialized focus, this project aims to develop RAFEQI into a market-ready product that delivers exceptional value and utility to users across diverse sectors.

The project covers the following topics:

- ✓ Personal Assistant Robots
- ✓ Computer Vision
- ✓ Natural Language Processing (NLP)
- ✓ Localization Robotics
- ✓ GUI
- ✓ Front Desk Robots

9. Robotics Swarm-Based Nuclear Waste Management System (HIVE-5)

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Abstract

The Hive5 project addresses the critical challenge of managing nuclear waste and mitigating associated risks by reducing human interaction with hazardous materials.

The primary objective of Hive5 is to develop a swarm of autonomous robots capable of efficiently collecting nuclear waste from power plants. Utilizing advanced swarm algorithms, the robots operate collaboratively to enhance efficiency and coverage. Each robot in the swarm is equipped with an array of sensors and cameras to acquire real-time data from the environment, ensuring precise navigation and effective waste collection.

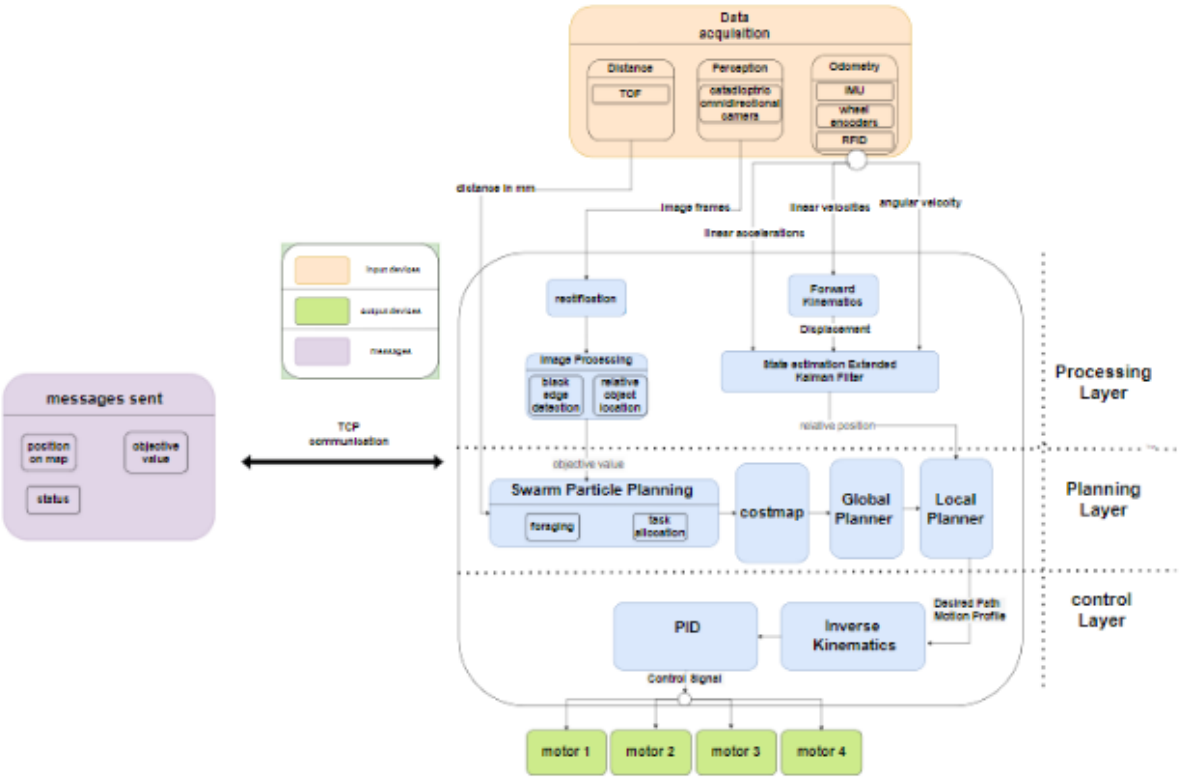
The methodology involves deploying swarm intelligence principles to coordinate the robots, leveraging their collective capabilities to perform complex tasks in hazardous environments.

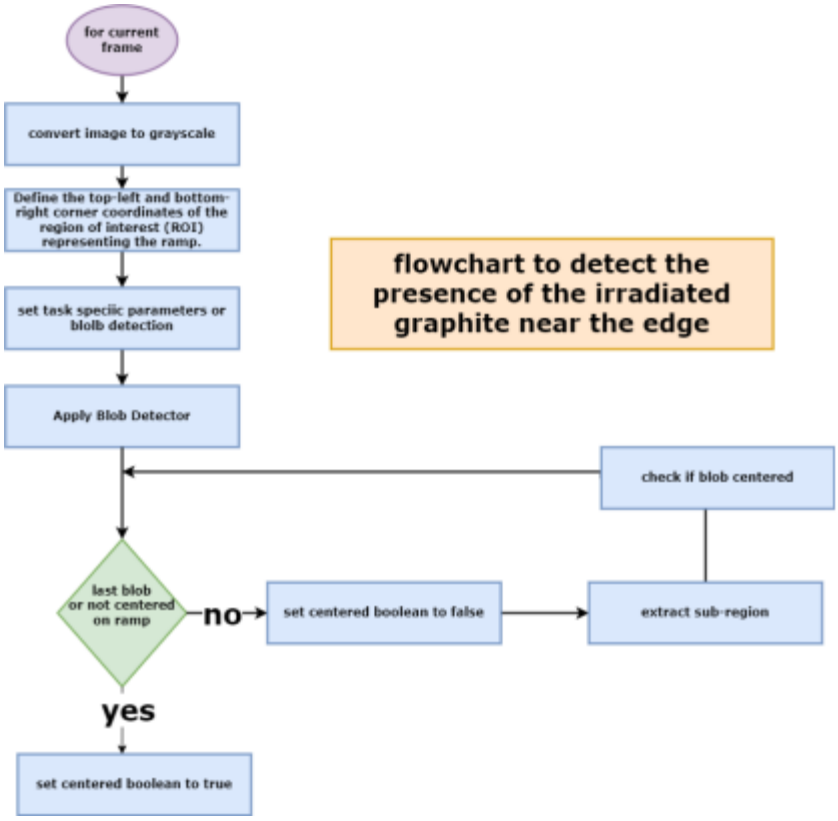
Preliminary results demonstrate the efficacy of the swarm approach in optimizing waste collection processes and minimizing human exposure to radioactive materials. Acknowledging the potential challenge of malfunctioning robots becoming additional nuclear waste, future work will focus on developing strategies for the safe recovery and disposal of inoperative units. The findings highlight the potential of autonomous robotic systems in transforming nuclear waste management practices, offering a safer and more efficient solution.

The project covers the following topics:

- ✓ Holonomic Robot Control
- ✓ Robotics Operating System (ROS)
- ✓ Localization and Path Planning
- ✓ Blob and Black Edge Detection
- ✓ Catadioptric Omnidirectional Vision
- ✓ Swarm Optimization (PSO, ACO, etc.)

Keywords: PSO, ACO, GWO, TEB local planner, inverse kinematics, odometry, extended Kalman filter





flowchart to detect the presence of the irradiated graphite near the edge

10. Safety Features Design and Implementation for a Smart Electric Scooter (SCOOTECH)

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Abstract

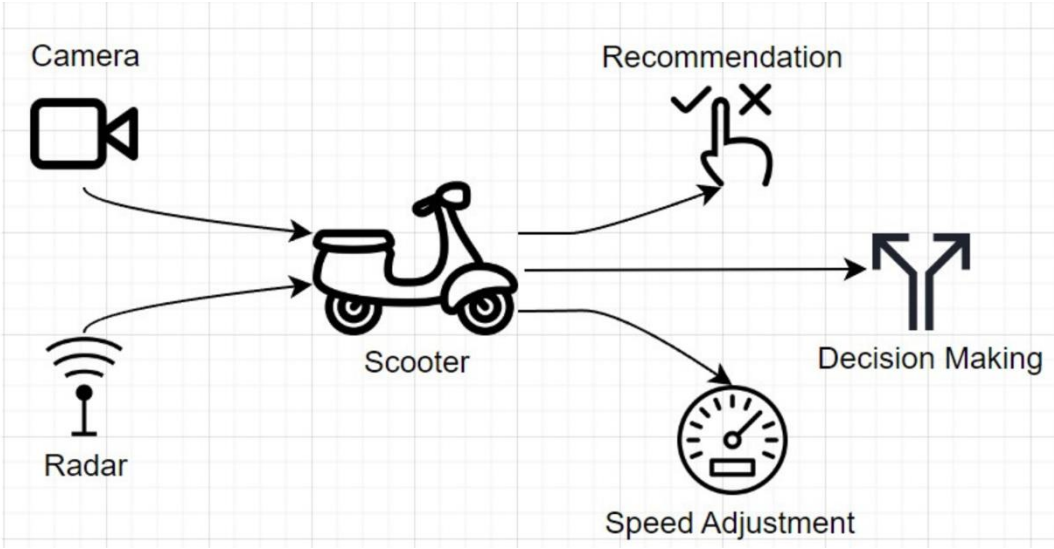
Titled "Safety Features Design and Implementation for a Smart Electric Scooter," explores the integration of advanced safety technologies into electric scooters to address the growing need for efficient and safe urban transportation. aims to enhance scooter safety through the implementation of Blind Spot Detection (BSD), Collision Warning Systems (CWS), and Adaptive Cruise Control (ACC).

The project's development process is divided into three main phases. The first phase involves creating a simulation environment for fully autonomous vehicles using tools like AUTOWARE. This simulation helps in understanding and refining the algorithms necessary for intelligent navigation and decision-making in dynamic environments.

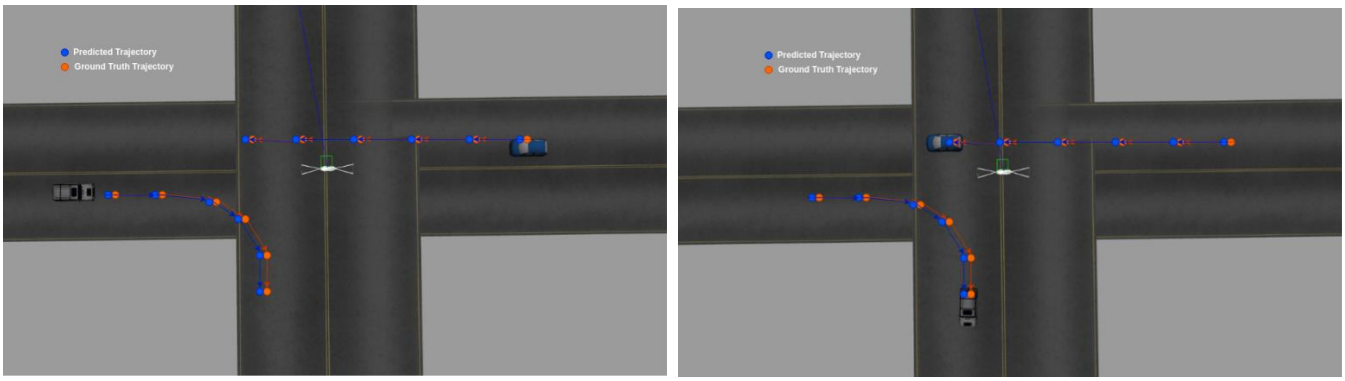
In the second phase, the project focuses on the practical implementation of safety features on a smart electric scooter. BSD technology is employed to alert riders of obstacles in their blind spots, thereby reducing the risk of collisions during lane changes. The CWS uses real-time data analysis and predictive modeling to warn riders of potential collisions, providing crucial reaction time to avoid accidents. ACC is integrated to automatically adjust the scooter's speed, maintaining a safe distance from other vehicles and enhancing overall traffic flow.

The final phase involves developing an augmented reality (AR) helmet. This helmet displays critical information such as navigation directions and hazard alerts directly in the rider's field of vision, thus improving situational awareness without distracting the rider from the road.

In conclusion, the successful design and implementation of these safety features on a smart electric scooter represents a significant step towards safer urban mobility. This project not only addresses current safety challenges but also paves the way for future advancements in autonomous transportation systems.



Project Block Diagram



Trajectory Prediction

AR Helmet View

11. Smart Delivery Car (AUCTUS)

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(5) Pavli Bahaa Tadros	20101169
(6) Amr Ashraf Fawzy	20102724

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Abstract

The AUCTUS project is all about making goods transport smarter. It aims to do this by using robots that move on their own, reducing the need for people to do the work and being good for the environment. The main goal is to create a robot that can carry goods safely, accurately, and easily, meeting the needs of today's logistics.

The AUCTUS prototype is designed to move goods by itself. Initially, it will be used indoors, carrying items from a central hub to different places as you request orders through the mobile application. Users can also interact with the robot using a built-in LCD touch screen. This screen makes it easy to give commands and get information. Additionally, the robot is equipped with a camera for computer vision tasks, allowing it to recognize and respond to its surroundings. In the future, we plan to use it outdoors, making it more versatile.

Equipped with top-notch technology, the AUCTUS prototype includes:

- ✓ Lidar Technology: This helps the robot know where it is and avoid obstacles
- ✓ Four Motors with Encoders: These helps control the robot's movement very precisely.
- ✓ User-Friendly Mobile Application: You can request your order via the app and track it by a simple interface
- ✓ LCD Touch screen: Users can interact with the robot using the touch screen, providing a seamless interface.
- ✓ Camera for Computer Vision Tasks: The integrated camera allows the robot to understand and respond to its environment, enhancing its capabilities.

Imagine a bustling business environment where goods need to be efficiently transported within an office complex. The AUCTUS prototype steps in to streamline this process. Here's how it operates:

- ✓ Order Placement: Users place orders through the mobile application, specifying the destination and items to be transported.
- ✓ Mobile App Interaction: Utilizing the user-friendly mobile app, orders are transmitted to the AUCTUS. Users can monitor the robot's location and status in real-time.
- ✓ Autonomous Navigation: The AUCTUS, equipped with LiDAR technology, autonomously navigates through the indoor environment, avoiding obstacles and following the optimal path.
- ✓ Touch Screen Interaction: Upon reaching the destination, the AUCTUS interacts with users through the built-in LCD touch screen. Users can scan a QR-Code generated by the mobile app to unlock the electronic latch and access the delivered items.
- ✓ Computer Vision Tasks: The integrated camera enables the AUCTUS to recognize its surroundings, ensuring precise positioning and enhancing its adaptation to dynamic environments.

- ✓ Efficient Operation: The AUCTUS, driven by four motors with encoders, operates with precision, ensuring the swift and accurate delivery of goods within the specified timeframe.

Block Diagram