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Human Following Robot using Husky Lens and Arduino

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Abstract
This research presents the development of an autonomous human-following robot using HuskyLens, an AI-powered vision sensor, and Arduino Uno, a microcontroller platform. The robot detects and tracks a human target by processing real-time visual data from HuskyLens, then adjusts its movement using a differential drive system controlled by four DC motors. The system employs threshold-based logic to interpret the target's position (x-axis, y-axis) and distance (derived from bounding box height) to execute forward, backward, left, right, or stop motions. Experimental results demonstrate robust tracking within a 0.8–1.1-meter range under controlled lighting, with a response time of <500ms. The project highlights the feasibility of integrating low-cost machine vision sensors into robotics for real-world applications. Autonomous robots capable of following humans have applications in assistive technologies, logistics, and security. Traditional systems rely on expensive LiDAR or complex neural networks, limiting accessibility. This project addresses these challenges by leveraging HuskyLens, an affordable vision sensor with built-in object recognition, and Arduino, a low-cost microcontroller.The Arduino-based intelligent cart for human following is a modern solution designed to enhance the efficiency and convenience of shopping. The system integrates an Arduino microcontroller with ultrasonic sensors and motors to ensure a smooth and personalized experience. The cart uses ultrasonic sensors to detect the shopper's movement and maintain a set distance, following them through the store without requiring manual control. This design not only enhances user convenience but also reduces physical effort and helps store staff focus on other tasks, improving overall store efficiency and providing a novel solution for modern retail environments.

Keywords: *Human-Following Robot, Huskylens, Arduino Uno, Object Tracking, Motor Control, Threshold Algorithm.*

1. Introduction

This project focuses on developing an automated, human-following shopping trolley equipped with a billing system to enhance the shopping experience. The trolley follows the customer autonomously, scans items added using barcode technology, calculates the total bill, and prints a receipt through a thermal printer. An Arduino microcontroller integrates the system's sensors and modulesAutonomous robots capable of following humans have applications in assistive technologies, logistics, and security. Traditional systems rely on expensive LiDAR or complex neural networks, limiting accessibility. This project addresses these challenges by leveraging HuskyLens, an affordable vision sensor with built-in object recognition, and Arduino, a low-cost microcontroller. The Arduino-Based Intelligent Cart for Human Following is an innovative solution designed to enhance the shopping experience by automating the movement of the shopping cart. The system integrates various hardware components and software algorithms to achieve the following key functionalities [1]. In today's fast-paced world, there is an increasing need for automation in various sectors, including retail and shopping environments. One of the challenges faced by consumers in large stores or shopping malls is the difficulty in managing carts, especially when they

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need to follow the customer around. The physical effort of pushing and maneuvering a cart can become burdensome, especially in crowded or expansive spaces. In this context, an Arduino- Based Intelligent Cart for Human Following can provide a solution by combining automation, sensor technology, and real-time tracking to enhance the shopping experience, reduce physical strain, and improve overall convenience in busy retail environments [2].

2. Literature Survey

2.1 Introduction to Human-Following Robots

Human-following robots are a growing area of research, primarily used in logistics, healthcare, security, and retail automation. These robots utilize sensor-based tracking, machine vision, and navigation algorithms to autonomously follow a target while avoiding obstacles. Traditional systems rely on expensive technologies like LiDAR (Light Detection and Ranging) or advanced neural networks, making them inaccessible for low-cost applications. This study aims to develop an affordable human-following cart by integrating HuskyLens, an AI-powered vision sensor, with Arduino and ultrasonic sensors [3].

2.2 Human-Following Mechanisms

Human-following robots typically rely on one or more of the following tracking methods:

2.2.1 Ultrasonic and Infrared Sensor-Based Tracking

Ultrasonic and infrared (IR) sensors are widely used in human-following robots due to their simplicity and low cost.

- Ultrasonic Sensors (HC-SR04, SRF05) measure the distance to a human by emitting sound waves and detecting their reflections [4]. They can effectively detect obstacles and maintain an optimal following distance.
- Infrared Sensors (IR modules, PIR sensors) detect human motion by sensing changes in infrared radiation. Passive Infrared (PIR) sensors are commonly used to identify movement, while active IR sensors help in proximity detection [5].

Limitations:

- Ultrasonic sensors struggle with detecting transparent or highly absorbent surfaces.
- IR sensors may fail in brightly lit environments due to interference from ambient infrared radiation.

2.2.2 Camera-Based Object Detection (Husky Lens & OpenCV)

Vision-based tracking systems provide a more accurate approach by identifying and following a specific human target [6].

- HuskyLens, an AI-powered vision sensor, integrates facial recognition and object tracking capabilities. It provides real-time x-y position data of the target, allowing the robot to adjust its movement accordingly.
- **OpenCV-Based Human Tracking:** Some studies employ OpenCV's Haar cascades and deep-learning models like YOLO (You Only Look Once) to detect and track humans. However, OpenCV requires additional processing power, making it unsuitable for low-cost microcontroller-based systems.

3. Related Work

3.1 Human Following and Navigation

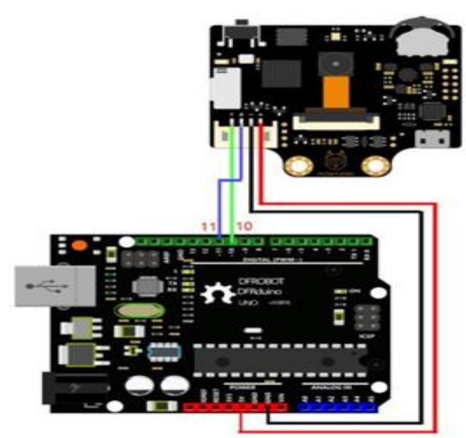

Figure 1 Ultrasonic, Infrared Sensors

The Ultrasonic, infrared sensors, and motor drivers to track and follow the shopper (Figure 1). The Arduino microcontroller processes sensor data in real time, adjusting the cart's speed and direction based on the position of the customer. Human Following Mechanism: The cart is equipped with sensors to detect and track the user's movements in real-time, allowing it to follow the shopper automatically. This eliminates the need for the shopper to manually push or carry the cart, offering convenience and reducing physical strain, especially in large stores or crowded environments.

3.2 Seamless Shopping Experience

The cart autonomously adjusts its speed and direction to stay at an optimal distance from the shopper. This ensures a smooth and personalized shopping experience, allowing the customer to focus on selecting items while the cart follows them through the store without requiring manual effort.

3.3 Advanced Navigation and Object Detection

Using technologies like ultrasonic sensors or computer vision, the cart is capable of avoiding obstacles, navigating crowded aisles, and adjusting its path based on the shopper's movement, ensuring both safety and ease of movement in a dynamic retail environment

3.4 Future Integration

The cart's design is flexible for future integration with various advanced technologies (Figure 2), such as AI for enhanced human tracking and interaction, voice command systems, or even autonomous routing to specific store sections, further improving convenience and efficiency for shoppers.

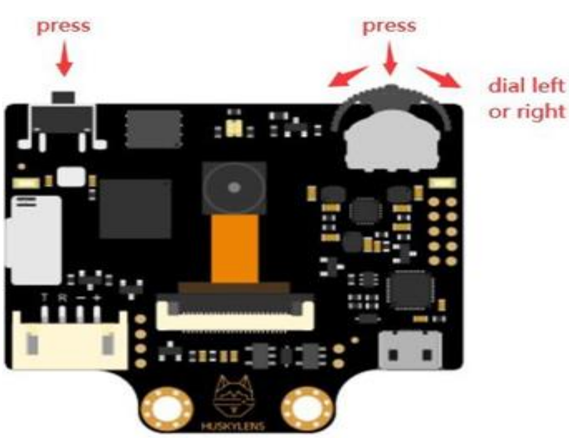

Figure 2 Cart's Design

Test Steps:

- **Hardware Setup Test:** Power on and check connections (Arduino, sensors, motors, barcode scanner, thermal printer, and display). Verify sensor functionality (distance measurement, barcode scanning, printing).
- **Human Following Test:** Move a person in front of the cart and check if it adjusts speed to maintain a set distance. Test obstacle detection and avoidance. 24
- **Barcode Scanning Test:** Scan items and verify correct price addition to the total bill. Test with multiple items and handle unreadable barcodes.
- **Bill Calculation Test:** Ensure the total bill updates correctly with each scanned item. Test for price adjustments (e.g., removing an item).
- **Receipt Generation Test:** After completing shopping, check if the receipt is printed with correct item details and total.
- **Cart Stop Test:** Verify that the cart stops following after the shopping is done and waits for further instructions.
- **Power and Battery Test:** Test system's power duration and ability to recover after power loss.
- **User Interface Test**: Ensure display is clear, readable, and updates with item info, prices, and total bill.
- **End-to-End Test:** Simulate full shopping (following, scanning, billing, and receipt printing) to check system performance under normal conditions. detection.
- **Initialization:** Initialize the Arduino board. Set up and calibrate all sensors (ultrasonic sensors, IR sensors for human tracking, barcode scanner, thermal printer). Initialize the variables for total bill and scanned items.
- **SHuman Following:** Continuously track the customer's position using the IR or ultrasonic sensors. Calculate the distance between the cart and the customer. Adjust the cart's direction and speed accordingly to maintain a set

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distance behind the customer.

- **Barcode Scanning:** Wait for the customer to scan an item using the barcode scanner. On detecting a barcode, retrieve the product details (e.g., price) from a database (could be pre-programmed or from an SD card). Add the product price to the total bill.
- **Billing System:** 25 Continuously update the total bill as items are scanned. Display the updated total on a display (e.g., LCD screen).
- **Handle Emergency Scenarios:** If an obstacle is detected on the track, immediately send an emergency alert to the station personnel and loco pilot.
- **Receipt Generation:** Once the customer finishes shopping and the cart has completed the task of scanning all items, print the total bill using a thermal printer. Display a confirmation message on the display.
- **End of Process:** Stop the cart from following once the customer is done. Optionally, send a signal to notify the customer that they are ready for checkout.

4. Methodology

This methodology outlines the design and development approach for an Arduino-based intelligent car capable of following a human. The project involves a series of steps, including hardware selection, sensor integration, software programming, and testing. The methodology follows a systematic approach to create a reliable, responsive, and cost-effective solution for human-following robots.

4.1 System Design and Requirements

The objective of the project is to build an Arduino-based intelligent car that can autonomously follow a person. The system will consist of the following components:

- **Hardware:** The Arduino microcontroller, sensors for human detection, motors for movement, and a power supply.
- **Software:** Control algorithms for processing sensor data and directing the car's movements.
- **Testing:** Evaluate the system's ability to follow a person accurately and respond to obstacles in the environment.

4.1.1 Hardware Requirements

Arduino Board: Arduino Uno or Arduino Mega, which will serve as the central controller.

Motors and Motor Driver: DC motors with a motor driver (e.g., L298N) for movement control.

Sensors:

- **Ultrasonic Sensors:** For distance measurement to detect the human's position and avoid obstacles (e.g., HC- SR04).
- **Infrared Sensors:** For proximity detection to assist in determining the presence of the human.
- **Bluetooth Module (optional):** For additional tracking and communication in real-time if needed.
- **Gyroscope/Accelerometer (optional):** For orientation and stability control.

Chassis: A simple robotic car chassis with wheels and frame.

Power Supply: A battery (e.g., Li-ion or NiMH) to power the system.

4.1.2 Software Requirements

Arduino IDE: To program the microcontroller.

Libraries: Libraries for sensor integration (e.g., NewPing for ultrasonic sensors, Servo library for motor control).

Algorithms: Motion control and human-following algorithms (PID, fuzzy logic, or machine learning).

4.2 System Architecture and Integration

The system is built by integrating the hardware components and developing control algorithms that enable the robot to follow a human while avoiding obstacles. The architecture consists of four primary blocks:

- **Sensor Input:** The ultrasonic and infrared sensors will provide real-time distance measurements. These sensors will detect the person's position and help the robot adjust its movements accordingly.

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- **Control Unit:** The Arduino board will receive sensor data and make decisions based on the pre- programmed algorithms. It will process the sensor inputs to determine the distance from the human and the environment (e.g., obstacles).
- **Motion Control:** The motion control system, driven by the motors and controlled via a motor driver, will move the robot based on instructions from the Arduino. The control system will ensure that the robot moves towards or away from the human as necessary and avoids obstacles.
- **Feedback Loop**: A closed-loop control system using sensors to provide feedback to the Arduino will continuously monitor the robot's position relative to the human and the environment. The system will adjust motor speeds to maintain the desired position and orientation.

4.3 Ultrasonic Sensors for Distance Measurement

Positioning: Two ultrasonic sensors will be mounted at the front and rear of the robot to measure the distance between the human and the robot.

Calibration: Each ultrasonic sensor will be calibrated to ensure accurate distance measurements. This includes determining the optimal range and ensuring the sensors detect the human at an appropriate distance.

Algorithm: The Arduino will continuously monitor the distance readings and decide whether the robot should move forward, stop, or adjust its direction.

4.4 Infrared Sensors for Proximity Detection

Positioning: The infrared sensors will be placed on the sides or front of the robot to detect the proximity of the human. These sensors will assist in detecting the human's position even if the ultrasonic sensors fail due to obstructions or environmental factors.

Calibration: Infrared sensors will be calibrated to detect a predefined range of proximity that is safe and optimal for following a human without collision.

4.5 Bluetooth Module (Optional)

Tracking: If Bluetooth tracking is used, the Bluetooth module will pair with a smartphone or a Bluetooth beacon carried by the human. The Arduino will track the signal strength to maintain the human’s position relative to the robot.

Testing: Bluetooth-based tracking will be tested to check the range and accuracy of the following behavior.

Conclusion

The Arduino-based intelligent cart for human following and automatic billing presents a significant step forward in improving the shopping experience. By integrating an autonomous navigation system and a barcode-based billing mechanism, this project demonstrates how technology can enhance convenience and efficiency in retail environments. The cart’s ability to autonomously follow the customer ensures a handsfree shopping experience, reducing the burden of pushing a cart while enabling the user to focus on their shopping. The incorporation of sensors like ultrasonic and infrared modules allows the cart to navigate 27 and avoid obstacles, ensuring a smooth and safe movement. The automatic billing system, using barcode scanning and real- time calculation of the total bill, streamlines the checkout process. The integration of a thermal printer ensures that customers receive a receipt immediately, enhancing customer satisfaction by minimizing waiting times. This project also showcases the potential of Arduino in developing cost-effective, practical, and scalable solutions for smart shopping experiences. Future improvements could include features like payment integration, more advanced navigation algorithms, and the ability to handle a wider variety of products and payment methods. In conclusion, this intelligent cart not only optimizes the shopping process but also paves the way for more sophisticated automation in retail environments, aligning with the growing demand for smart technologies in everyday life

References

[1]. HuskyLens Official Documentation The

official documentation for HuskyLens provides detailed information on how to interface the device with various platforms, including Arduino.

[2]. Link: HuskyLens Documentation Arduino Official Website The Arduino website offers resources, libraries, and code examples for working with microcontrollers and interfacing with sensors like HuskyLens.

[3]. Link: Arduino Official Website Arduino Motor Control Guide A comprehensive guide on controlling motors with Arduino, covering motor drivers, wiring, and coding.

[4]. Link: Arduino Motor Control TutorialsPoint - Object Tracking Using HuskyLens A beginner-friendly guide to using HuskyLens for object tracking, ideal for integrating it into robotics projects.

[5]. Link: Object Tracking Tutorial Instructables - Arduino Robot Projects A platform with step-by-step guides for building robot projects with Arduino, including human-following robots.

[6]. Link: Instructables - Arduino Robots