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Design and Implementation of Smart Trolley System

Anuja Pakidde[1], Ritik Ramteke[2], Pratham Godselwar[3], Nishant Meshram[4], Khan Mohammad Abusad[5], Kanchan Khobragade[6], Prof. Dr.Sayyed Naimuddin[7].

Anjuman College of Engineering and Technology[1,2,3,4,5,6,7]

[1]anujapakidde@gmail.com,[2] ritikramteke78@gmail.com, [3]prathamgodselwar454@gmail.com, [4]nishantmeshram1998@gmail.com, [5]khan.mrabusaad@gmail.com, [6]kkhobragade002@gmail.com

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ABSTRACT

We are now using the rapidly growing artificial intelligence in our day-to-This project aims to develop a Smart Trolley System using Bluetooth and Arduino technology to enhance shopping experiences in retail environments. Traditional shopping carts lack interactive features to assist shoppers during their shopping journey. Our proposed Smart Trolley System addresses this gap by integrating Bluetooth communication with Arduino microcontrollers to create an intelligent and interactive shopping companion. The system consists of two main components: the Smart Trolley Unit and the Shopper Application. The Smart Trolley Unit is equipped with sensors for detecting items placed within the cart, an Arduino microcontroller for processing data, and Bluetooth modules for communication. The Shopper Application is a mobile app installed on the shopper's smart phone, serving as the interface for interacting with the Smart Trolley System.

Introduction:

People of today enjoy traveling to new places. There are usually always throngs of people traveling through airports. One of the main travel inconveniences is the large luggage they are carrying. Airports must provide luggage trolleys in order to lessen this burden. Most places you'll see these luggage carts are airports, sizable bus terminals, lodging facilities, or rail stations. It does, however, take more work to traverse, particularly for elderly or disabled people. Thus, a remote-controlled luggage cart was suggested by the researchers. This study's primary goal is to design a luggage cart that the owner may operate with a remote control. Its specific goals are as follows: The objectives are as follows: (1) build a baggage cart that can support less weight; (2) wirelessly operate the luggage cart with two Arduino Microcontrollers, wireless modules, and a direction/tilt sensor; and (3) use a relay and dc motor to move the luggage cart's wheels. This baggage cart has restricted turning as well as limited stopping, forward, left, and right movement. It follows its owner on a dedicated frequency all its own [1].

An airport is among the world's busiest locations. When going on a business trip, taking a family holiday, or studying abroad, the plane is typically the main mode of transportation. Therefore, in order to lessen the strain of moving through the airport and from one terminal to another, luggage carts must be provided for tourists.

Travelers manually maneuver miniature vehicles known as luggage carts, luggage trolleys, or trolleys. Two main sizes are available: one for large luggage and another for little luggage. Typically, carts consist of two sections for carrying luggage: a lowered large area for suitcases and a small or large bag, and a small section (basket) for carry-on luggage at the same level as the handle.

Airports of days have also been significantly impacted by technology. New remote-controlled luggage carts, such as the NUA Robotics, are being introduced. These carts are mostly operated by connecting to the owner's smartphone. Proximity sensors are employed to avoid collisions with objects. The researchers suggested a layout in which no human labor is required for the luggage cart. Using Arduino and Zigbee technologies, the owner operates this luggage cart remotely. The owner will receive a remote control to operate this type of luggage cart. When the owner moves the remote control in a certain direction, the luggage cart will automatically follow suit.

This design's primary goal is to produce a luggage cart that the owner may operate with a remote control. Its specific goals are as follows: The objectives are as follows: (1) build a luggage cart that can support up to 5.6 kg of luggage; (2) control the luggage cart wirelessly with two Arduino Microcontrollers, two Zigbee modules, and a direction/tilt sensor; and (3) operate the luggage cart's wheels with a relay, dc motor, and servo motor.

Related Work:

A literature survey for the design and implementation of a Smart Trolley System using Bluetooth and Arduino technology would involve reviewing existing research, publications, and projects related to similar topics. Here's a structured approach you can follow:

1.Introduction to Smart Trolley Systems:
Review academic papers, books, and industry reports discussing the evolution of shopping carts and the need for smart solutions in retail environments. Explore how technology integration, such as Bluetooth and Arduino, can enhance traditional shopping carts to create smarter, more interactive systems.

2.Bluetooth and Arduino Integration:
Investigate studies and tutorials on integrating Bluetooth modules with Arduino microcontrollers. Understand the communication protocols, data transmission rates, and power consumption considerations when using Bluetooth in embedded systems.

3.Sensors and Object Detection:
Examine research papers and projects focusing on sensor technologies for object detection and recognition. Explore different sensor types such as ultrasonic sensors, RFID readers, or computer vision systems and their applications in smart trolley systems.

4. Mobile Application Development:
Study literature on mobile application development for retail and consumer interaction. Explore frameworks and libraries for developing cross-platform mobile applications compatible with both Android and iOS devices.

5.User Experience and Human-Computer Interaction (HCI): Review HCI literature focusing on user interaction with smart devices in retail environments. Understand principles of usability, accessibility, and user-centered design to ensure the Smart Trolley System provides an intuitive and seamless shopping experience.

6. Indoor Navigation and Localization:
Investigate research on indoor positioning systems (IPS) and navigation algorithms for guiding users within indoor environments. Explore techniques such as Bluetooth Low Energy (BLE) beacons, Wi-Fi fingerprinting, or inertial navigation systems for indoor localization.

7. Data Security and Privacy:
Review literature on data security and privacy considerations in smart retail systems. Understand best practices for securing Bluetooth communication, protecting user data, and complying with regulations such as GDPR or CCPA.

8. Case Studies and Implementations:
Examine existing projects, prototypes, or commercial implementations of smart trolley systems. Analyze their design choices, technical architectures, and user feedback to identify successful strategies and potential improvements. By conducting a comprehensive literature survey across these domains, you can gain valuable insights, identify existing solutions and challenges, and inform the design and implementation of your Smart Trolley System using Bluetooth and Arduino technology.

3. Materials and Methods

3.1. Materials Used in the Research Study

The Arduino microcontroller and its corresponding shields, sensors, and modules are used in the suggested remote-controlled airport luggage cart, as shown Arduino controller, DC Motor 100 rpm, Wireless module, Relay 12 V Battery Connector wire Trolley

Motor driver IC L923D Wheels

Arduino uno
A microcontroller board based on the ATmega is called the ATMega. It contains four hardware serial ports (UARTs), sixteen analog inputs, sixteen digital input/output pins (of which fifteen can be used as PWM outputs), a sixteen MHz crystal oscillator, a USB connector, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; all you need to do is power it with a battery or an AC-to-DC adapter or connect it to a computer via a USB cable to get going. The majority of shields made for the Uno are compatible with the Mega 2560 board.

Relay
An electrical device that functions as a switch is called a relay. Circuits can be opened or closed electronically or electromechanically. It opens and closes a circuit in order to control another electrical circuit. When the relay is not activated, there is an open contact when the contact is ordinarily open (NO). The same holds true for a normally closed (NC) relay contact. However, if an electrical current is supplied to the contacts, their state will alter [14].

3.2. Methods and Design

displays the design's system flowchart. The owner carries a directional/tilt sensor, which detects movement on their part. The Arduino Mega will be used to process the data collected from the tilt sensor. A zigbee module will be used to communicate the processed data, and another zigbee module will be used by the luggage cart to receive it. The one that was obtained

An additional Arduino Mega will be used to process data once more. The DC motor will advance if the x-axis data is larger than the user-specified threshold; if not, it will stop. The servo motor will move to the right or left depending on whether the user-specified threshold for the y-axis data is exceeded.

Battery

When you need power, the Mighty Max ML4-6 6 Volt 4.5 AH delivers it. Makes use of a cutting-edge, heavy-duty calcium alloy grid that offers remarkable performance and long service life in cycle and float applications. With its valve-regulated architecture, the ML4-6 Absorbent Glass Mat (AGM) technology offers outstanding performance for hundreds of models and may be utilized in enclosed and indoor locations without leaking or requiring maintenance. Applications for Mighty Max A batteries are numerous and include consumer electronics, electric cars, golf carts, hunting, tools for the lawn and garden, motorcycles, power sports, portable tools, solar energy, toys and hobbies, access control devices, emergency lighting, security, and more. Details: Six volts of voltage4.5 AH of amperage Chemistry: A, AGM Terminal: F1Quantity: 15 Batteries Battery Dimensions: 2.76 in x 1.85 in x 4.17 in Weight: 1.83 Lbs. Genuine Mighty Max battery Product.

A brushless synchronous motor that splits a complete rotation into many steps is called a step motor. A step motor rotates in discrete step angles as opposed to a brushless DC motor, which rotates continuously when a set DC voltage is provided to it. As a result, the Motors are produced with 12, 24, 72, 144, 180, and 200 steps each revolution, giving rise to stepping angles of 30, 15, 5, 2.5, 2, and 1.8 degrees per step. The motor can be operated with or without feedback, allowing them to produce the same output at the same level of quality and upholding consistency.

4. Design Implementation

The luggage cart can only move in a horizontal direction. The wheels can only turn left and right at a 90-degree angle. At the very least, there is a space large enough to rotate the gadget. It is incapable of doing any vertical movements or stair climbing. It can only move in the following directions: forward, stop, left, and right. It cannot withstand severe stress or be watertight. Its maximum weight capacity is equivalent to or less than that of luggage. The luggage cart operates on a predetermined schedule.

Conclusion:

The electronics design prototype is functional, it is concluded. All of the goals were achieved. They succeeded in building a luggage cart with two servo motor-driven wheels up front and two DC motor-driven wheels in the back. The two Arduino microcontrollers and the two Wireless modules were both correctly configured and capable of providing data.

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