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Smart Trolley: Lose your track of Losing Things

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Abstract : Automation for advanced sustainability in the upcoming years has been a growing think tank and in such an era, aiming at inclusivity is of paramount need. Smart Trolley, is a hands-free luggage and cart control & movement mechanism, that is the prime focus of this work. In this article, we aim to encapsulate the key processes towards architecting the Smart Trolley, using Arduino Uno and external motors, interfaced with a Bluetooth module as controller, to usher in the next age revolution, inclusivity-centered automation in India, especially driven for the citizens of age or PWD.

Keywords *Smart trolley; External motor; Arduino Uno; Physically impaired; Senior citizen; Automation*

I. INTRODUCTION

Air travel and retail industries are considered by far, one of the leading, national and international fronts rising higher every single day. In India alone, passenger traffic amounted over 327 million at airports over the fiscal year 2023[1]. As per the Railway Board, the number of elderly passengers in 2020-21 was 1,86,16,972, while in 2021-22 it was 5,44,48,061 and in 2022-23, it rose to a 7,95,88,393[5]. Also, there are a total of 62,691 retail and grocery supermarkets as of June 15, 2024 that are operating all across India [2]. Additionally, as per reports, there were 149 million persons aged 60 years and above in 2022, comprising around 10.5% of the country's population, and by 2050, this population will double to 20.8% with the absolute number at a staggering 347 million[3]. Additionally, around 5,67,633 people in India are locomotive-impaired [4] . Therefore, as a country that houses one of the highest number of senior citizenship and people with disabilities that make it challenging for them to be part of these growing industries, they need to be represented and stood up for, considering travel and groceries would be included in primary commodities of necessity. It is due to these barriers of old age and physical or neurological obstacles, they are struggling in their mundane, day-to-day activities, especially in areas of carrying something as heavy and bulky as luggage trolleys or supermarket carts. This paper, therefore aims to consider the challenges and problem statement and devise a solution centric approach to the world of automation. Using this assistive technology, the working, daily activities and long term sustainability of these people can be achieved. The smart trolley is a simple luggage prototype with external motors at its rotary wheels, connected to Arduino board, that by extension controls the movement via a bluetooth module interfaced and accessible on a smartphone. The trolley can, thereby move in tandem with the Bluetooth signals and without any physical strain or effort. It is important to note the extensive security check-ins at an airport or long distances between aisles of a supermarket, that makes it difficult for aged people and physically impaired people to keep up. Also, in densely crowded areas, these challenges amplify, including the vulnerability to potential loss or damage. This sense of inferiority can create a sense of abandonment from society and affect personal confidence to engage or simply live life normally. It is this problem that can be solved by seeking out thorough analysis and effective implementations.

Combining these numbers of aged and/or disabled people, the population would suffice to be called the third most populated country in the world. Hence it is more important to talk about them and address their issue that we think. While the field of technology gallops into the turn of the century, it is vital to reach the end goals together and remember that the world is one, thereby every single habitant would hold rights to experiencing the fruits of science and engineering, pioneering a society where, technology is for 'everyone'.

Fig. 2 shows a schematic representation of the function segregation units for a smooth, effective control flow. The motor driver controls the external motors on the trolley and facilitates the movements in a linear (forward and backwards) as well as clockwise or counterclockwise.

The unique perceived benefits are:

- Arduino Uno can be configured for individual-specific requirements or additional improvisation.
- Cost efficient and simple architecture than other contemporaries.

• Easy to access for the elderly and physically challenged.

In the recent times, a few wheeled trolleys have been raised as solution possibilities to provide mobility aid for the disabled and the elderly, most of them with trays for carriage of things. However, these trolleys are not practical for long-distance travel or carriage of heavy loads. On top of that, these trolleys generated at a high cost production, are mostly inaccessible to the vast bracket of middle-class citizen that caters to the broader section of the Indian population. To overcome the above-mentioned shortcomings, this experimental prototype experiments to create a simple, straightforward and efficient alternative to the elderly and the disabled to aid in luggage mobility. The enterprise of the proposed system is that, it simplifies the use of an interfaced motor system with an Arduino board and Bluetooth module that assembles to provide hands-free automated movement of heavy carriage. Therefore this paper proposes to design such Smart Trolleys that can be automated with simple machinery and consumer friendly technology and can be recreated with ease at a very cost-effective level.

Fig 1: Smart Blind Glass

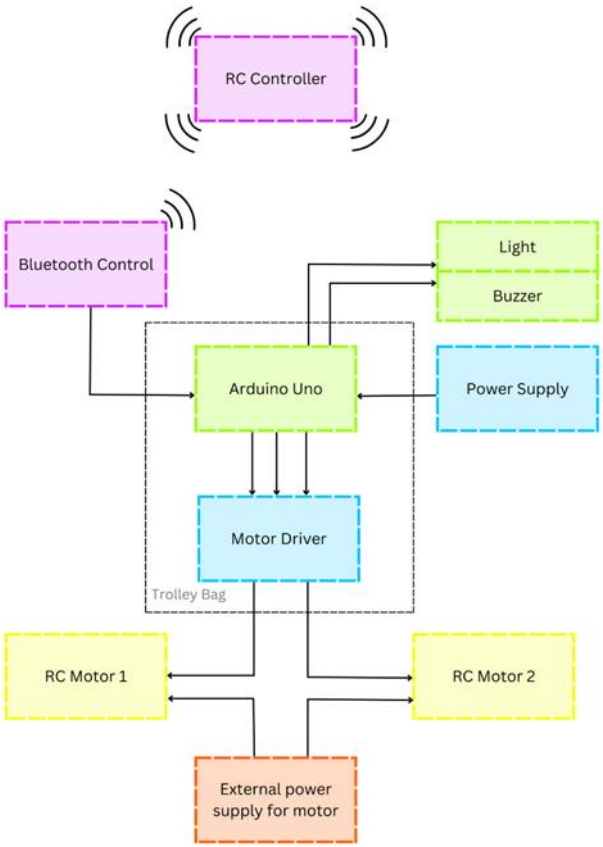


Fig. 2 Hardware architectural framework

DESIGN AND CONFIGURATION

The smart trolley is simply an automated assembly of the electronic and mechanical components, namely: a pair of external motors attached to the rotary wheels of the trolley to allow controlled and directed movement as per instruction, a Bluetooth module interfaced with RC Controller that works in tandem with a smartphone and is used via software to control and maneuver the movements, with the help of pre-programmed, manually hardwired and therefore, configurable code in Arduino Uno. The gestures controls at the RC Controller app sends control signals to the Arduino Uno through the interfaced Bluetooth module in a range of 10m. The Arduino Uno reads the aforementioned real-time commands and executes the desired movement by sending digital signals to the motor driver.

i) RC Controller:

An RC controller app with Bluetooth connectivity enables users to remotely steer and navigate motor vehicles using their smartphones or tablets. It offers virtual joysticks for precise directional control, customizable layouts, real-time telemetry feedback, and easy pairing via Bluetooth, providing a portable alternative to traditional RC transmitters.

ii) Bluetooth Module:

Is a source of facilitating wireless communication, in this instance, between the RC Controller and the Arduino Uno. It uses the frequency band: 2.45 GHz and has a workable range of 10m.

iii) Arduino Uno:

Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU). Multiple pairs of digital and analog input/output (I/O) pins are also available on this microcontroller board that may be interfaced to various expansion boards (shields) and other circuits, making it a resourceful and multidimensional electronic component. It is manually programmable and hence can be used to introduce modifications and improvisations as per need.

iv) Motor Driver:

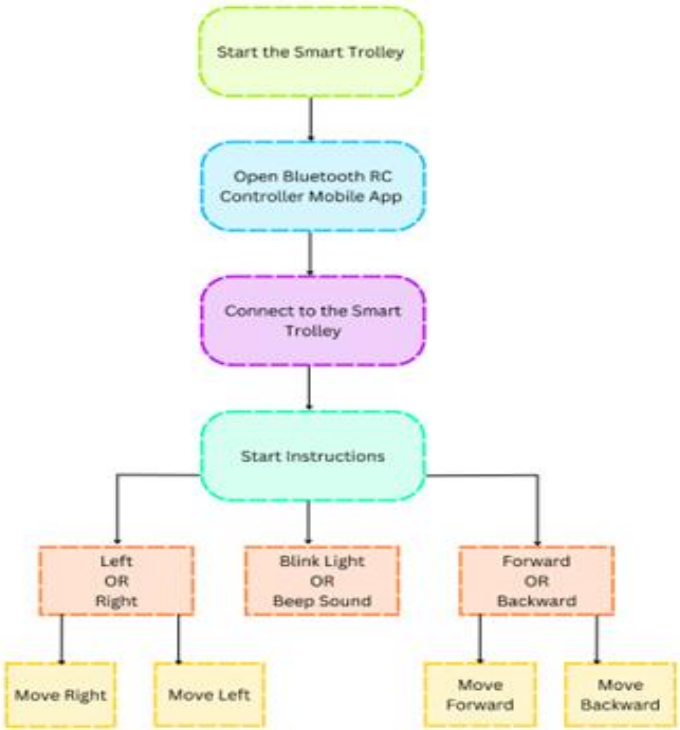
Motor Driver is the parent driver that is responsible for controlling the movement of other actuating components of a system, by providing the current, voltage, and directionality as per the command and requirement. It works in direct interface with the programmed Arduino Uno to provide system acceleration or deceleration to employ automated hardware movement.

Specifications:

- 12 volts
- 500 rpm
- Load capacity (weight lifting capacity) 20kg,
- Torque of the motor would be approximately 0.229 Nm.

The working mechanism behind the smart trolley can be easily divided into three header blocks of the input, controller and the output. The input includes the RC Controller and the Bluetooth module in the smartphone application that provides the directions for the desired movement. The Bluetooth module relays these commands up to a range of 10m. The controller unit is managed by the Arduino, that reads the received command and controls the movement by direction the motor controller. The output is given by the interfaced motor controller that directs the external motors to actuate, according to the commanding current, voltage and directionality in linear or sideways motions. On encountering an obstacle within a range of , a buzzer sound will be generated to alert the consumer and provide further aid in the carriage of luggage/commodities

FLOWCHART



The proposed prototype of the smart trolley, hence provides a simple, straightforward and affordable as well as configurable solution to help the marginalized and more often that not, ignored sections of the elderly and physically challenged bracket of citizens in living the same quality of life as the rest of us. It overcomes the challenges faced by them due to constraints of age, physical limitations and inabilities created out of helpless impairments by providing support for carrying heavy loads across travelling destinations or supermarkets and increases the inclusivity of civilization as a united society.

The smart trolley in compliance and adherence to human ergonomics, allows automation for these cohort of people and furthermore alerts them of impending collisions by beeping the buzzer when nearing an obstacle that will be priorly detected. Therefore, it elevates the quality of social interaction and restores wavering or lost confidence in them, allowing them support to become independent and make full use of the automation technology that is upon the horizon for further revolutions.

FUTURE WORK

The future of smart trolley bags holds exciting possibilities for integrating advanced technologies to enhance convenience, security, and functionality. Some potential future developments could include:

i. Integrated Tracking and Navigation: Incorporating GPS or RFID technology to track the location of the bag in real-time, providing peace of mind to travelers and enabling easy retrieval.

ii. Smart Sensors: Utilizing sensors for weight monitoring, ensuring the bag meets airline restrictions, and notifying users when it's overweight.

iii. Automated Lifting and Mobility: Implementing mechanisms for self-propulsion or assisted mobility, reducing the effort required to move the bag through airports or crowded areas.

iv. Smartphone Integration: Enhanced connectivity with smartphones for remote control, notifications about bag status (e.g., if it's opened or moved), and integration with travel apps for seamless itinerary management.

v. Security Features: Advanced locking mechanisms, biometric access controls, or alert systems to prevent theft and protect belongings.

vi. Power Management: Integrated power banks or solar panels to charge devices on the go, ensuring travelers stay connected without worrying about battery life.

vii. Environmental Sustainability: Materials and design considerations focused on reducing environmental impact, such as using recycled materials or implementing eco-friendly production processes.

viii. Augmented Reality (AR) Features: AR overlays for identifying contents within the bag, packing assistance, or providing information about local attractions and services.

ix. Personalization and Customization: Options for users to personalize their bags with interchangeable modules, colors, or digital displays for dynamic customization.

x. Collaborative Features: Integration with smart home devices or cloud services for seamless synchronization of travel plans, packing lists, and notifications across multiple platforms.

These advancements aim to transform smart trolley bags into intelligent travel companions that not only streamline the travel experience but also enhance security, sustainability, and user comfort.

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