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ROBO CASE-THE SMART SUITCASE

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Abstract: The integration of Internet of Things (IoT) technology and Android-predicated mobile applications has enabled the development of innovative solutions for sundry authentic-world scenarios. This abstract introduces a novel application of this technology stack in the form of a “Human Following Robo-Case”. This research explores the technical aspects of the Human-Following Suitcase, including sensor protocols, integration, communication impediment avoidance, and utilizer interface design. The findings highlight the feasibility and potential benefits of this innovative solution, amending peregrinate comfort and enhancing utilizer experiences. The ESP32-CAM plays a crucial role in the development of an IoT-enabled smart suitcase designed to autonomously follow a human user. Its integration enables the system to leverage computer vision and connectivity features to achieve real-time object detection and tracking. As the IoT ecosystem and Android platform perpetuate to evolve, the Human-Following Robo-Case represents an exhilarating application of these technologies in the field of perspicacious peregrinate adjuncts. This research aims to engender a perspicacious suitcase that leverages IoT sensors and Android-predicated control mechanisms to autonomously follow its utilizer, providing a seamless and convenient peregrinate experience. The suitcase incorporates a range of sensors, including GPS, ultrasonic, and inertial quantification unit (IMU) sensors, to accurately detect and track the utilizer's position and forms of kineticism.

Keywords: Internet of things, android application, Arduino UNO, robo-case, travel partner, esp32-cam, real-time monitoring.

I. INTRODUCTION

A sensor-predicated robot utilizing the Internet of Things (IoT) is a robotic system that incorporates sundry sensors to amass data about its environment and employs IoT technology to transmit, process, and utilize this data for a wide range of applications. IoT-enabled robots leverage the connectivity and data-sharing capabilities of the IoT to enhance their autonomy, adaptability, and functionality.

This synergy between sensors and IoT enables robots to interact with their circumventions, make apprised decisions, and perform tasks more efficaciously. The ESP32-CAM captures live video feed, which serves as the primary input for detecting and tracking the user.

II. NEED OF THE STUDY

In the modern world of peregrinate and urban mobility, people often encounter challenges cognate to carrying their luggage, especially when navigating diligent airports, train stations, or city streets. Many peregrinators, concretely those with cumbersomely hefty or bulky luggage, face arduousness efficiently moving their bags from one location to another.

This quandary is compounded by the desideratum to monitor their luggage to obviate larceny or loss perpetually. This project aims to address these challenges by developing a "Human Following Robo-Case" utilizing Internet of Things (IoT) technology. The challenges considered in this project are:

3.1 Sensor Integration

Culling and integrating sensors such as cameras, ultrasonic sensors, proximity sensors, and GPS to accurately track the bag's owner and eschew collisions with obstacles.

3.2 Connectivity

Ascertaining reliable connectivity utilizing IoT protocols (e.g., Wi-Fi, Bluetooth, or cellular) for authentic-time communication between the bag and its owner's contrivance.

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3.3 Autonomous Navigation
Developing algorithms and control systems for the peregrinate bag to autonomously follow its owner, maintain a safe distance, and acclimate to different ambulating speeds and directions.

3.4 Obstruction Avoidance: Implementing obstruction detection and avoidance mechanisms to obviate collisions while navigating crowded environments.

3.5 Security: Incorporating anti-larceny measures, such as alarms, remote locking, or tracking capabilities, to bulwark the bag from larceny or loss.

3.6 Utilizer Interface: Designing a utilizer-convivial app or interface for peregrinators to control and interact with the keenly intellective peregrinate bag.

3.7 Battery Life: Optimizing power management to ascertain the bag has adequate battery life for an entire peregrinate day.

3.8 Robustness and Durability: Ascertaining the peregrinate bag can withstand the rigors of peregrinate, including rough handling, sundry weather conditions, and potential mechanical stress.

3.9 Proposed Solution:
Design and develop an IoT-predicated peregrinate bag that autonomously follows its owner, providing accommodation and tranquility of mind to peregrinators. The system should incorporate a range of sensors and connectivity options to enable the peregrinate bag to track its owner's forms of kineticism and maintain a safe distance while eschewing obstacles. It should additionally offer adscititious features such as security measures to deter larceny and loss of the bag. The solution should be utilizer-amicable, robust, and adaptable to sundry peregrinate scenarios, such as airports, train stations, or urban environments. The prosperous development of a Human Following Peregrinate Bag utilizing IoT technology can significantly ameliorate the peregrinate experience by offering accommodation, security, and placidity of mind to peregrinators, ultimately addressing the prevalent challenges associated with luggage conveyance in today's expeditious-paced and crowded world. The ESP32-CAM is integral to the smart human-following suitcase project, combining its camera and Wi-Fi capabilities to deliver a robust solution for autonomous tracking and IoT connectivity. Its ability to process visual data and communicate over the internet makes it an ideal choice for developing intelligent, connected devices that enhance user convenience and safety in travel scenarios.

III. RESEARCH METHODOLOGY

(D et al. 1), the concept about this project is to eradicate the traditional billing methodology and abbreviate human efforts. Through IOT we can monitor contrivances and circumventions wirelessly, which initiates the utilization of tags electronically, when these tags approach in the span of the reader it reads the information stored in the RFID tag with the avail of RFID technology. Unlike barcode scanners, RFID is the fundamental mechanism feature of our exploration. Where in RFID tags are utilized for the apperception of items, an RFID reader is pre-owned for scanning of goods, and a robotic arm places products in the trolley this avails incapacitated people who are unable to pick and scan of products, and details are exhibited on the LCD, and the customer can do the payment in their hand itself without waiting in the long queue. The proposed archetype infers expeditiously paying one's bill and dispenses standing in a queue, customers can make online payments which plenarily obviates burglary.

(Padma et al. 2), the objective of the work was to solve a major quandary of subsisting shopping carts: they rely on manual labor to move. The cart utilizes the principles of image processing to map itself to one particular utilizer utilizing a patterned tag and follows the utilizer predicated on single object tracking and the distance sensed by ultrasonic sensors interfaced with a Raspberry Pi.

(Vetal et al. 3), the human-following robot is an automobile system that has the faculty to agnize obstacles, move, and transmute the robot's position toward the subject in the best way to remain on its track. This project uses Arduino, motors, and variants of sensors to achieve its goal. This project challenged the group to cooperate, communicate, and expand their construal of electronics, mechanical systems, and their integration with programming.

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This project challenged the group to cooperate, communicate, and expand their construal of electronics, mechanical systems, and their integration with programming. utilizer is too far away, the suitcase will expedite to maintain the distance between the users to evade of losing connection with the utilizer. For image processing, we utilize Convolutional Neural Networks (CNN) as our algorithm and OpenCV for implementation to achieve object apperception and tracking. The Wi-Fi module is installed on the suitcase, it accommodates detecting whether the target is missing by connecting to the utilizer's mobile phone. When the detected Wi-Fi signal is too low, the mobile phone will issue an admonition to remind the utilizer that the luggage distance is too far. In terms of control, we utilize fuzzy control and machine learning to control the motor to make tracking of the utilizer more stable.

(Redmon et al. 8) on the YOLO (You Only Look Once) algorithm demonstrates real-time object detection capabilities that can be adapted for use with the ESP32-CAM. This algorithm can be optimized to detect and track a human user, allowing the suitcase to follow the designated individual accurately. Studies on lightweight machine learning models, such as MobileNet and TensorFlow Lite, indicate their compatibility with the ESP32 architecture. (Howard et al. 9) showed that these models could efficiently run on microcontrollers, enabling real-time user detection and tracking with minimal computational resources.

IV. METHODOLOGY

The working of a human-following suitcase utilizing IoT involves an amalgamation of sensors, microcontrollers, communication modules, and motor control. Human-following suitcases leverage computer vision and IoT technologies to autonomously track and follow a user, providing a hands-free travel experience. These systems typically incorporate sensors, microcontrollers, and wireless communication to achieve real-time object detection, user tracking, and remote monitoring. Here's a step-by-step explication of how such a system typically operates:

Sensors for Person Tracking via ESP Cam Module:
The suitcase is equipped with ESP32-Cam for tracking human, sensors, which could include ultrasonic sensors or infrared sensors. These sensors are responsible for detecting and tracking the person the suitcase is supposed to follow.

Data Processing:
The sensor data is processed by a microcontroller (such as Arduino or Raspberry Pi) that is embedded in the suitcase. The microcontroller interprets the sensor inputs to understand the position and kineticism of the person.

Decision Making:
Predicated on the processed data, the microcontroller makes decisions about the kineticism of the suitcase. It determines the direction and speed the suitcase should move in order to follow the person efficaciously.

Motor Control:
The microcontroller sends signals to motor drivers that control the kineticism of the suitcase's wheels or motors. This sanctions the suitcase to move autonomously in the desired direction.

Obstruction Detection:
Adscititious sensors, such as ultrasonic sensors or infrared sensors, are habituated to detect obstacles in the path of the suitcase. If an impediment is detected, the microcontroller adjusts the suitcase's path to eschew collisions.

Communication with IoT Platform:
The suitcase is equipped with communication modules (such as Wi-Fi or Bluetooth) that enable it to connect to an IoT platform. This connection sanctions for remote control, status monitoring, and potential updates to the suitcase's software.

IoT Platform Interaction:
Users can interact with the suitcase through a mobile app or a remote control contrivance connected to the IoT platform. Commands from the utilizer are sent to the IoT platform, which then relays them to the suitcase.

Power Management:
The suitcase is powered by a battery, and power management systems ascertain efficient utilization of energy. This includes features such as slumber modes when the suitcase is stationary to conserve battery life.

Engendering a human-following suitcase utilizing IoT (Internet of Things) and mobile technology involves an amalgamation of hardware and software components to enable the suitcase to autonomously follow its owner. Below is the hardware requirement specification for building such a system:

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- Ardino UNO
- Ultrasonic sensor
- Motor Driver
- DC motor 12 volt 150Rpm
- DC motor wheel
- Node MCU 8266 wifi model
- Connecting Wire jumper
- ESP32 – Cam

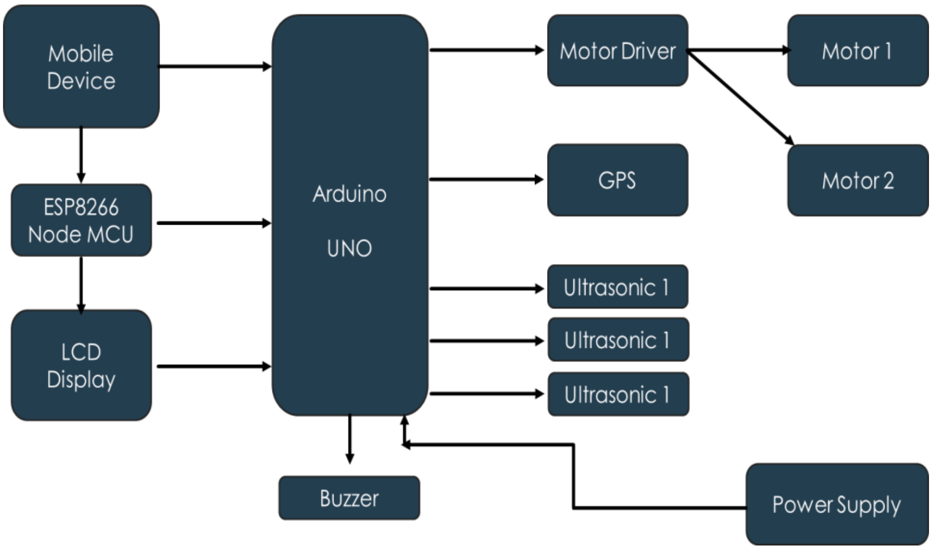

Fig. 3.1 Block Diagram

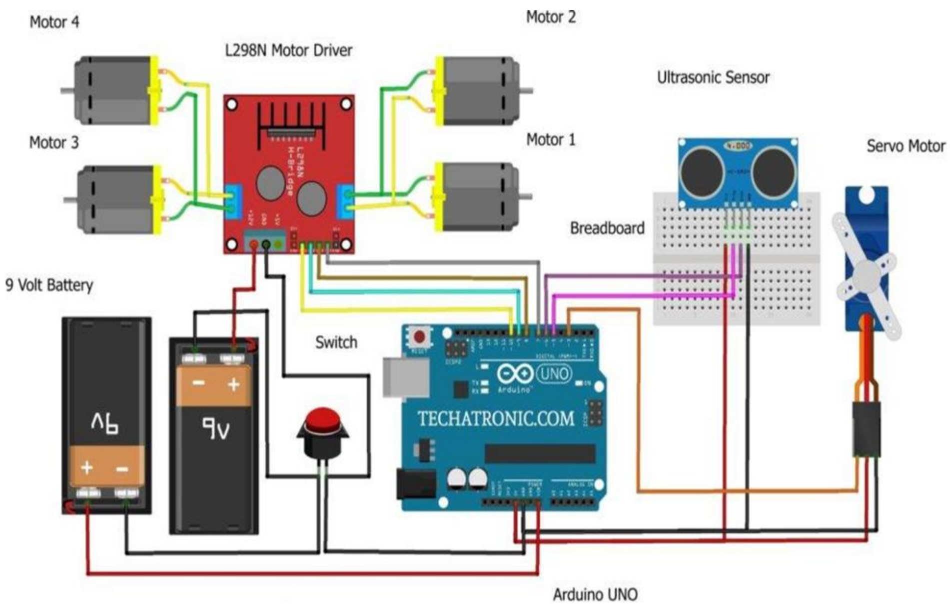

Fig. 3.2 Circuit Diagram

The proposed system aims to provide a cost-effective and user-friendly solution for frequent travellers by introducing an automated suitcase. This suitcase utilizes various components such as an Arduino microcontroller board with the suitcase through based on the user's commands. To ensure accuracy and efficiency, the smartphone utilizes accelerometer and magnetometer sensors to compute the user's movements and speed.

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This eliminates the need for expensive GPS systems or image processing, which may not always be reliable, especially in indoor environments. The proposed system has been tested and validated for various real-life scenarios. And also discusses the growing demand for comfort and convenience in the current technologically advanced era. It highlights the impact of technological advancements in the travel industry and the need for automated suitcases to assist physically challenged, children, and elderly individuals who travel alone. These automated suitcases can alleviate the dependency on human assistance and enhance traveler's self-esteem.

V. RESULTS

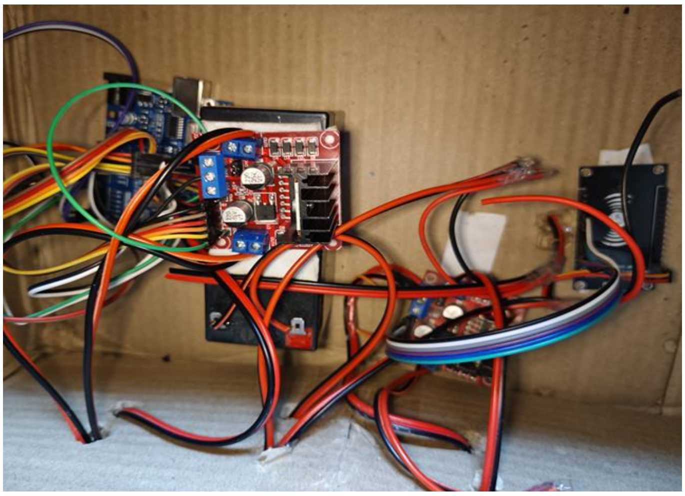

Fig. 4.1 Motor Driver Circuit Implementation

Fig. 4.2 Suitcase Wheels Setup

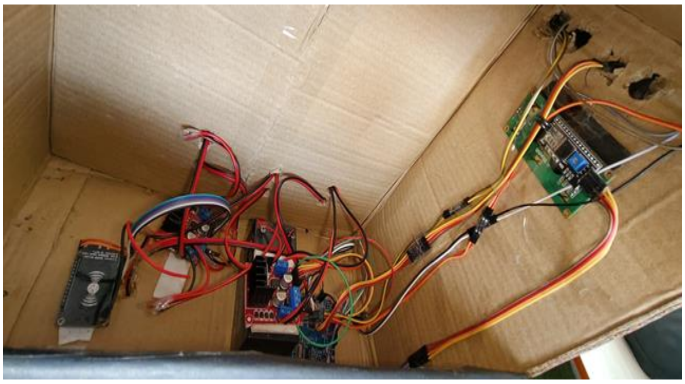

Fig. 4.3 Sensor Setup

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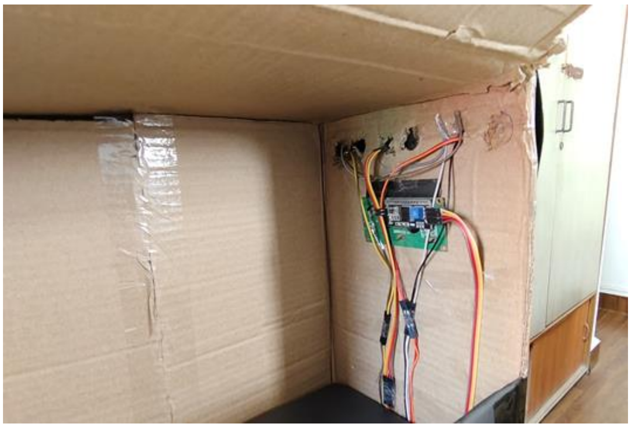

Fig. 4.4 LCD Display Setup

Fig. 4.5 Power Supply Unit

Fig. 4.6 Final Hardware Model Implementation

VI. CONCLUSION

The human-following suitcase utilizing IoT relies on a coalescence of sensors, data processing, motor control, and communication to autonomously follow a person while eschewing obstacles. The integration of IoT capabilities enables remote control and monitoring, integrating into the accommodation and functionality of the suitcase. In conclusion, the ESP32-CAM is a pivotal component in the development of IoT-enabled human-following suitcases, offering a practical and efficient solution for enhancing user convenience in travel. The ESP32-CAM's combination of low cost, compact size, and powerful processing capabilities makes it an ideal choice for implementing real-time computer vision and connectivity in smart luggage.

VII. FUTURE SCOPE

The future scope of a human-following suitcase utilizing IoT is promising, and several advancements and applications can be anticipated. Future iterations may incorporate advanced sensing technologies such as amended computer vision, LiDAR, or radar for more precise person tracking and impediment avoidance. Integration of machine learning algorithms could enhance the suitcase's faculty to acclimate to different environments, learn from utilizer predilections, and amend its overall performance over time. Integration with mapping and navigation systems could enable the suitcase to navigate involute environments, including airports, shopping malls, and crowded city streets, with more preponderant efficiency and autonomy. Future versions may incorporate multi-modal interaction, sanctioning users to control the suitcase through voice commands, gestures, or other intuitive interfaces for a more utilizer-cordial experience.

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