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Safety cum Automated Luggage Bag Using Arduino UNO Microcontroller Board

Prashik Chavan¹, Kartikesh Ambavade², Yash Tembhurnikar³, Shubham Jagdale⁴,

Dr. Sanjeevani S Sonar⁵

F.Y. Student, Department of Information Technology, Pimpri Chinchwad College of Engineering College, Pune, Maharashtra, India^{1,2,3,4}

Associate Professor, Department of Applied Sciences and Humanities, Pimpri Chinchwad Engineering College, Pune, Maharashtra, India⁵

ABSTRACT: The history of luggage bags can be traced far back when the simple camel handbags were invented. After lots of new inventions and modifications rectangular steel bags with simple lock and key came into existence. Later these were converted to fabric bags. Perhaps, one of the greatest inventions in luggage bags in 20th century was by Bernard Shadow who first patent wheeled suitcase in 1972. After many years of that, wheeled suitcase with handles were introduced.

In the age of fast growing world where the people are travelling all over the world, the need of safety features in luggage bags has the same importance as the need of advanced features. In most of the luggage bags, zip runners with password system are used for security. But, this chain style is less secured as anyone can damage the zip runner with sharp weapon. So there is a need to improve the safety which can be achieved by completely eliminating the chain or zip i.e., by introducing Zipless Luggage Bags.

The zipless bag is an oval shaped bag with old suitcase style locking system with password modified lock. To enhance more security the bag has GPS and GSM Module to provide location updates about the bag. It uses Ultrasound Sensors for object detection and path tracking. It also has inbuilt powerbank which can be charged by electrical as well as solar energy. The DC motors help with the movement of the bag. The most unique feature of this bag are the LED lights which can be put on for better vision at night.

KEYWORDS: Zipless Luggage Bag, Automated Luggage Bag, TSA Approved Lock, GPS, GSM, Alarm(Wi-Fi Module), Alert(Cloud Database), Fingerprint & RFID, Ultrasound sensor, Arduino UNO, Inbuilt Powerbank with electrical / solar system, DC Motors, LED Lights, Polycarbonate, Light Weight, Water Resistance.

I. INTRODUCTION

As the name of the bag is Safety cum Automated Luggage Bag, safety and automation both have topmost preference. Safety means that the locking system and the design of the bag has the highest priority. Also Automated means the human intervention in the functioning of the bag is less. The chain is completely eliminated and is replaced by Zipless Case cover. The bag works on both automation as well as the manual mode. For anti-thief reasons GPS and GSM module is there. The Alarm and Alert system is guided by the Wi-Fi module and the Cloud Database respectively. The bag can be locked and unlocked by the mobile application. The inbuilt power bank which charges on electrical as well as solar energy can be used to charge electronic gadgets like mobiles, laptops, tabs, etc. DC motors help to throttle the movement of the bag.

The bag is made up with Polycarbonate material which lightweight, hard and durable. The bag is an oval shaped which gives it a modern look and is also water resistant. Perhaps the most unique feature of the bag are the LED lights which are fixed in the interior of the bag for clear vision in the dark.

II. HARDWARE DESCRIPTION

- a) **Lock:** The regular chain system of the luggage is eliminated and replaced by the zipless polycarbonate case cover which can be closed and opened. The bag has TSA approved lock. The lock (Fig. 1) can be unlocked by either setting the password or by fingerprint sensor at the centre. We have to just pull the system upwards to unlock. To lock again we simply have to pull the system back to the initial position. Transportation Security Administration(TSA) can unlock the bag by Master RFID Card.

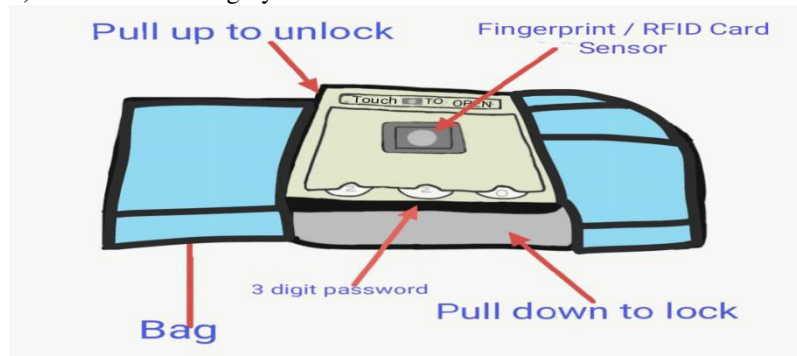


Fig. 1 Locking Mechanism

- b) **GPS:** GPS stands for Global Positioning System. It is a spacebased radionavigation system made up of at least 24 satellites that provides geolocation and the time information to a GPS receiver anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites. The bag can be easily navigated by the assistance of GPS technology. It is one of the anti-theft features as the bag if lost can be easily found through the location updated on the database.



Fig. 2 GPS

- c) **GSM:** GSM modem or GSM module is Global System for Mobile Communication. It uses mobile telephone technology to provide a data link to a remote network. It is a TDMA (Time Division Multiple Access) based network technology. It is used along with the GPS as it can send text messages over a mobile data network to user's SIM card. Therefore in case if GPS fails to send the data, it communicates the user through GSM.

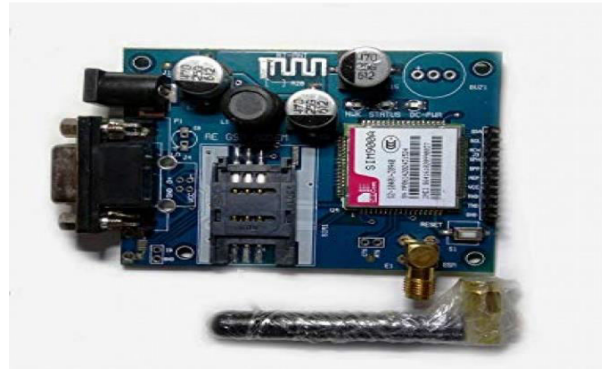


Fig.3 GSM Module

- d) **Alarm & Alert:** The Alarm and Alert system of the bag are supported by the Wi-Fi Module and Cloud Database respectively. Wi-Fi module has a limitation in the range, the bag beeps an alarm when the authorized person is away from the bag. IOT cloud stores all the data which is detected by the bag and display it to user's app. User can determine the bag's live location anytime and anywhere. IOT cloud stores the location in case of loss or theft and beeps an alarm. It has an integrated Wi-fi module with Arduino Uno board. The ESP8266 Wi-Fi Module is a self contained SoC with integrated TCP/IP protocol stack that can give access to your Wi-Fi network. One useful feature of Uno Wi-Fi is support for OTA (Over The Air) programming, either for transfer of Arduino sketches or Wi-Fi firmware.

- e) **Fingerprint & RFID:** Another anti-theft features of the bag which highlights the safety side of the bag are the fingerprint sensor and the RFID (Radio Frequency Identification) card. It is used to keep the bag protected. If the finger print is not matched repeatedly the bag rings an alert alarm and sends the location to the user. To unlock the bag the fingerprint should matched with the authorized person. RFID tag is also used to provide unique id to the bag which stores all the data to cloud database. RFID tag is verified by showing valid RFID tag to valid RFID reader. RFID reads the magnetic stored information and on matching it unlocks the bag. The RFID reader can also be used by the TSA at the airport to unlock the bag by using master RFID card.

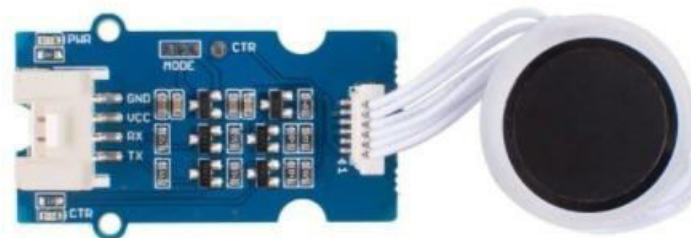


Fig. 4Fingerprint & RFID Card Sensor

- f) **Ultrasound Sensor:** The ultrasound sensor is a Transceiver Module(Transmitter + Receiver) which measures the distance using ultrasound waves. It transmits high frequency ultrasonic waves of frequency greater than 20Khz which is above human audible frequency range. There are two main part in the sensor, one is transmitter part which helps to transmit the sound waves and other is receiver part which receives the echo. The work of transmitter is to converts electrical energy into sound energy & that of the receiver part is to receive the reflected waves from the obstacle and turn the received sound waves into electrical signal. It measures the distance of the obstacle by estimating the time between the emission ultrasound waves and reception ultrasound waves. The strength of the received sound/signal decides the movement of the bag. Supply voltage required is +5V DC and working current of 15mA which will get through power bank. In autonomous mode when Arduino decides a route this checks whether there is any obstacle in the route and helps Arduino in changing the route.

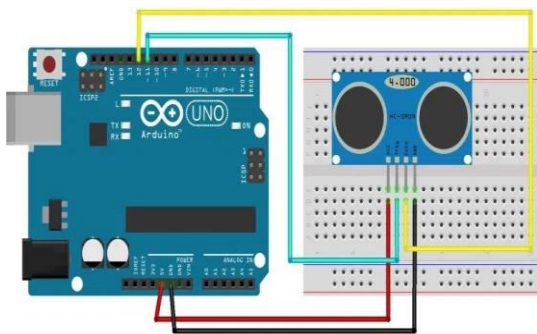


Fig. 5 Pin Connections of Ultrasound Sensors

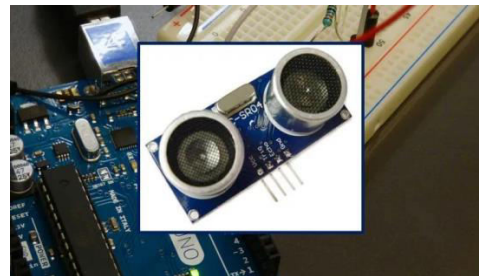


Fig. 6 Ultrasound Sensor

- g) **Arduino Uno:** The input or output working of the components (like RFID tags, fingerprint sensors, etc..) is controlled by Arduino Uno micro-controller. It is capable of sensing and controlling the objects in physical world. It can interact with large array of outputs (LEDs,motors, etc..). Arduino boards are relatively less expensive compared to other microcontrollers. The least expensive version of the Arduino module can be assembled by hand. The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. It is easy to use for beginners, yet flexible enough for advanced users as well. The Arduino boards are published under a Creative Commons license, so the circuit designers can make their own version of the module, extending it and also improving it.



Fig. 7 Arduino UNO Microcontroller Board

- h) **Inbuilt Powerbank:** Charging of devices like mobiles, laptops, tablets, etc can be done by both electrical and solar energy. In electrical system the charging is done by inbuilt power bank with external charging port. But in

absence of electricity, charging can be done by solar charging system. In this system solar energy is trapped in solar panel/plates which convert solar energy into electrical energy. Thus, charging can be done by both electrical and solar system. The powerbank is also used to provide electricity to the LED strips, ultrasound sensor and microcontroller. Power supply for all the devices is provided by using an inbuilt 12V rechargeable Li-ion battery.

- i) **DC Motors:** Motor is an electric or mechanic device used to create a motion. A DC motor converts DC electrical energy into mechanical energy. It is one of the parts of motor drive. A motor drive consists of controller, motor driver IC, motor and a power supply unit. The DC motors works on the principle of Lorentz Law and help in the movement of the bag. They work on comparatively high voltage power i.e., 12V supply. The motor driver IC converts the low current/voltage supply from the controller to high current/voltage supply and supplies it to the DC motor.

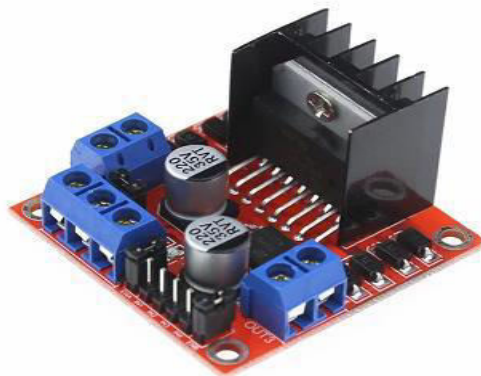


Fig. 8L298N Motor Driver

- j) **LED Lights:** Steady white LED light strips are installed along the inner edge lining of the bag for better vision in dark. The power source of these lights is the powerbank which is installed in the bag. The LED strip require 12V DC supply with a power consumption of 18W/ft.



Fig. 9 White Light LED Strip

III. WORKING

All the safety measures and the features in the bag rightly justifies the name of the bag – “Safety cum Automated Luggage bag”.



The bag can be switched between the manual and the automatic mode with the help of an app which has all the necessary controls of the bag. There is a TSA approved lock which can be opened in three ways: 1) 3-digit password, 2) Fingerprint, 3) RFID tag. The user can set a setting in the app such that each time to unlock a bag, a confirmation message will top up in his/her mobile asking whether to unlock the bag or not. This feature is an user controlled feature as the user can enable or disable it as per his/her needs. Once the bag is unlocked the we have to pull the lock in upward direction and lift the case of the bag. This Zipless bag also has the Alarm and Alert system which is controlled by the Wi-Fi Module and Cloud Database respectively. These features are very necessary considering the safety side of the bag. If any random person tries to unlock the bag using wrong password or fingerprint the user gets a continuous alert bell on his mobile.

There is also GPS and GSM Module which helps the user to track the bag in case of someone tries to steal the bag. The bag can be easily traced by GPS technology. All the geolocation and time information of the bag is updated on the cloud database. If the GPS fails to send the data, then the GSM Module communicates to the user's SIM card.

The Ultrasound Sensor helps in the automated mode of the bag which is very useful to move the bag especially when the bag becomes really heavy. It has a transmitter to transmit the ultrasound waves and the receiver which receives the echo of the waves and calculates the distance of the obstacle from the time required by the waves to reach the receiver. It also ordinates with the bell system and rings the alert bell if the distance between the user and bag exceeds increases beyond the safe distance.

Arduino Uno is the microcontroller where the whole programming code is embedded which helps in automation. It operates and balances the movement of the bag. Also, there is the inbuilt power bank with an external charging port which supports both electrical and solar charging. It can be used to charge various electronic gadgets.

DC motors works in coordination with the microcontroller and motor driver IC to help in movement of the bag. They help to throttle the movement of the bag. The most unique feature of this bag are the white LED light strips which can be put on for better vision at night.

IV. FUTURISTIC SCOPE

With the rate of growing technology, the bag has lots of futuristic opportunities that will make the bag more smart and powerful. The features like image detection and obstacle dodging can be added with the help of ROS (Robot Operating System). Also, the stair case climbing mechanism can be added. All these features will make the bag fully automated and safe.

V. CONCLUSION

The bag is especially designed by focusing on the safety and latest features to give safe and comfortable experience to the user. In the modern era automation makes life more easier and smoother. The problem of heavy luggage and safety is faced by most of the people. This bag solves these common problems by providing better security and advanced features. Specially designed by combining all the advanced features at a most affordable price in it's category.

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