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***Research paper***

# ABTAS: An Automated Baggage Tracking and Alert System using RF Technology

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**Abstract**

Radio Frequency (RF) is a challenging technology that has been used for providing accurate solutions for many kinds of societal issues. This paper focuses on developing an automated device named "ABTAS" to identify and track the location of passengers' luggage during their travel or any theft by applying RF technology. The proposed system analyzes the use of an interactive RF transmitter and receiver that communicates with each other in tracking objects. The proposed system also deals with the tracking of missed luggage by sending a SMS alert to the passenger by using GSM.

***Keywords***: *ABTAS; Luggage Tracking; RF Transmitter; RF Receiver; Microcontroller; GSM; SMS Alert.*

## 1. Introduction

Many initiatives have been taken to provide customers' satisfaction during journey. With this, many devices has been introduced to track the luggage during the travelling of passengers. If any theft occurs, the system has to intimate the passengers using any communication mode. RFID, Wireless Sensors and Zigbee are some of the technologies used for providing solutions to this kind of issue in tracking objects. This paper includes the implementation of RF based luggage tracking and alert system. An efficient luggage handling system helps to reduce the waiting time of passengers in crowded places and also useful for identifying the mishandled luggage.

Radio frequency technology is a wireless system in which radio waves are used for the transmission of data between the transmitter and receiver. Mainly this technology is applied for automatic object tracking and identification. Now RF has emerged everywhere and it is applicable for developing systems for people tracking, document tracking, health care etc.

Currently, there are multiple types of RFID tags and readers are available in the market and are easily purchasable. The tags are the major components of the system because they contain unique identification numbers. The tag can be active with an internal power supply, or passive, which draws power directly from a reader by electromagnetic induction. Active RFID tags are used for transmitting information over longer range than passive tags.

Advantages of RFID

- Cost effective
- Fast transmission of signals
- No line of sight requirement.
- Long distance coverage
- Usage of Portable database
- Tracking people, items, files and equipment in real-time

This paper is organized as follows: Section II analyzes the different technologies and devices used for tracking luggage in different countries. In Section III, the design of ABTAS system was described with all the components used and also the interaction between these components was discussed. Section IV presents the working of ABTAS system and Section V focuses on the hardware implementation of the proposed system with the experimental results.

## 2. Related Work

Radio Frequency Identification (RFID) is a promising technology that has been implemented for various real time applications. RFID tags are used to identify and track the location of passengers' luggage. Sennou et al. investigates the usage of an interactive bracelet in airport that communicates with the RFID system with the help of a database application [1]. The database system interacts with the bracelet in the form of messages which will inform the passenger about his luggage status.

Traceable Air Baggage Handling System [2] focuses on tracking luggage in airports using RFID tags. The RFID tags are feasible for object identification and considered as a significant tool to provide traceable visibility along different stages of the aviation supply chain and improve user satisfaction. This paper introduces the IATA RP1740c protocol used for the standard to recognize the baggage tags. One distributed aviation baggage traceable application is designed based on the RFID networks.

Radio frequency identification (RFID) technology became most popular in market because of its efficiency and cost-effectiveness. Medeiros et al. presents the state of RFID adoption planning, architecture and implementation at a major airline, with a special focus on improved services due to improved baggage handling, on increased airport/airline security and on frequent flier program services. This is accomplished by integrating RFID technology together with networking and database technologies [3].

Paper [4] gives a brief overview of the current state of radio frequency identification (RFID) technology. Also the authors provided the principles, working, applications and limitations of RF technology. This paper documents the usage of RFID in biometric for providing security along with its different types.

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The problems of barcode scanner system at airports were discussed in the paper [5]. An improved system for baggage processes at airports was introduced based on RFID technology. Performance analysis of barcode and RFID technology was made using various parameters. The RFID tag was implemented into a watch/bracelet which will act as a device fixed to the baggage and supports safe journey with user satisfaction.

Ghazal et al. [6] introduces a smart system for real-time tracking of airport luggage using mobile applications and smart watches. This work focuses on Kalman-filtered Wi-Fi fingerprints collected by active tags. Information about the flights and association with different luggage pieces is inputted pre-flight using QR codes. The system uses a smart power management scheme fusing multi-sensor and flight data and assesses the risk of a battery drain to warn the user about the need for recharging. A mobile phone application is used to track the arrival of the luggage allowing passengers to rest after a long flight.

A wearable antenna for a Global Positioning System–Global System for Mobile communication (GPS–GSM)-based anti-theft tracking system is introduced in the paper [7] which is useful to track the location of high-cost clothing and luggage accessories in crowded areas. An IoT based system to trace passenger's baggage in real time using RFID tag based on RTLS (Real-Time Locating System) is proposed in paper [8]. This model is more cost effective, decreases missing baggage and improves customer convenience. The papers [9-11] focuses on different RFID based airport baggage handling systems.

## 3. ABTAS: Proposed System Design

Nowadays, RF technology is widely used for long range applications since the RF signals can travel through larger distances without any failures. The proposed system ABTAS was implemented by using RF technology and consists of the following components.

1) RF Transmitter
2) RF Receiver
3) 8051 Microcontroller
4) Liquid Crystal Display(LCD)
5) GSM
6) Mobile Phone with SIM
7) Buzzer

a) RF Transmitter and Receiver

In RF system, the digital data is represented as variations in the amplitude of carrier waves.

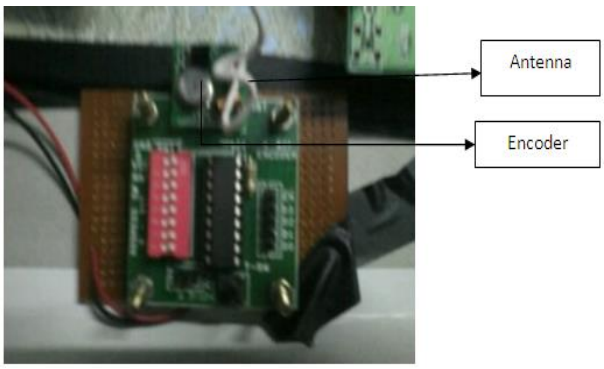



**Fig. 1:** RF Transmitter.

The RF module operates at Radio Frequency and the frequency range varies between 30 KHz & 300 GHz. RF signals can be transmitted even when there is an obstacle between transmitter and receiver. Also the signals transmitted through RF waves are more reliable and strong. So, this RF technology is most suited for signal transmission rather than other technologies like IR (Infra Red), Wireless sensors, etc.

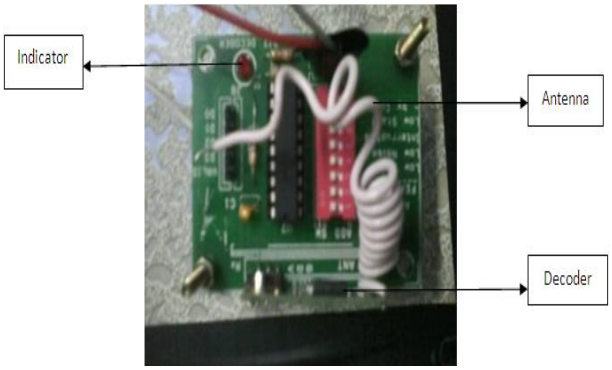



**Fig. 2:** RF Receiver.

Figure 1 and 2 depict the RF Transmitter and Receiver used for implementing the proposed system. An RF transmitter receives serial data and transmits it wirelessly through its antenna. Transmission occurs at the rate of 1Kbps to 10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used along with a pair of encoder and decoder. The encoder is used for encoding parallel data for transmission feed while at the receiver side the data is decoded by a decoder.

b) GSM

GSM (Global System for Mobile Communications), is a digital cellular radio network used for data communication over different networks. Figure 3 shows the GSM device used for the ABTAS system. GSM is a wireless device used to send the message to the passenger's mobile about the location of the luggage. A SIM is inserted into the GSM and the message about luggage missing was sent to the passenger using this SIM. It has one antenna which is used for network communication. GSM has indicator light that is used to indicate the net connection in the surrounding area. If the net connection is available in the area then the light is in on state otherwise off.

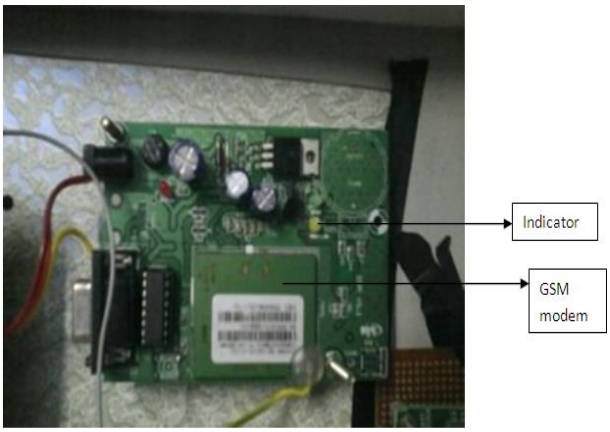



**Fig. 3:** GSM.

c) 8051 Microcontroller

A Microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontrollers are used in automatically controlled products and devices. For ABTAS system, the 8-bit microcontroller, MC 8051 is used which can Read, Write and Process 8 bit data. This is most commonly used microcontroller in the robotics, home appliances etc.

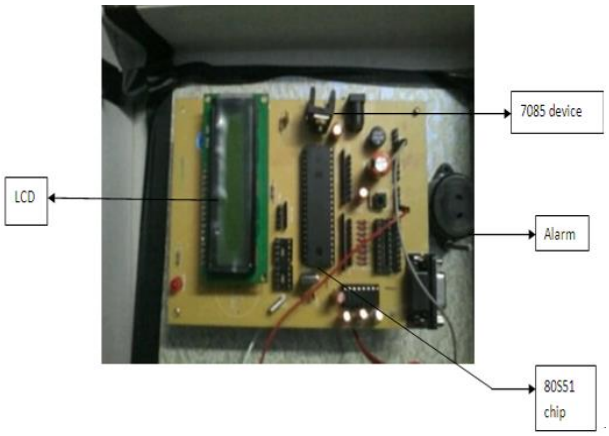



**Fig. 4:** 8051 Microcontroller.

Figure 4 clearly depicts the 8051 Microcontroller connected to RF receiver, GSM, Alarm, Power supply and LCD display. It has 40 pins. There are 4 ports. The 20$^{th}$ pin is connected to ground. The 40$^{th}$ pin is connected to Vcc (power supply). RF receiver is connected to P0 (port 0). The 7085 device is used to convert 12V into 5V. The frequency range of this microcontroller is 12MHz. There is one bridge which is used to convert AC to DC.

d) LCD

The LCD display is used to display the current status of the ABTAS system. There are 16 pins, in which 5 pins are used for display settings, 8 pins are used for data representation and remaining 3 pins are used for RS (Register selection), R/W (Read/ write), E (Enable).

## 4. Working of ABTAS System

The ABTAS system was implemented by using RF transmitter and RF receiver. The RF transmitter transmits the signal to the RF receiver. RF receiver receives the frequency and processes it on the microcontroller. If the signal is not received by the RF receiver then Microcontroller enables the GSM module and buzzer device.

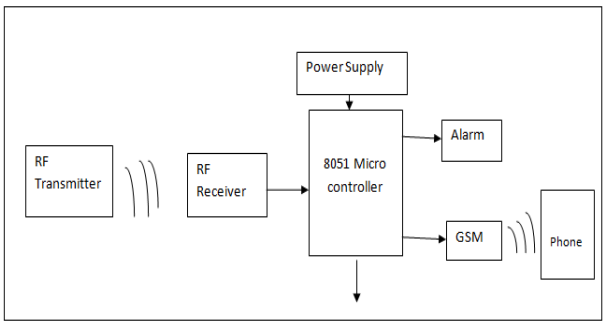



**Fig. 5:** System Architecture.

The architecture of ABTAS system is shown in Figure 5. It consists of an integrated part with both AT89S52 Micro controller and RF receiver. LCD was internally connected with Microcontroller. The output devices like GSM and alarm were externally connected with Microcontroller.

Modules:

The proposed system is divided into three modules;

1) Signal Identification by RF receiver
2) Processing of data on Microcontroller
3) Alert System

a) Signal Identification by RF Receiver

The RF transmitter is given to the passenger by the request of the passenger. RF receiver generates the electromagnetic field. The transmitter when comes in contact with the electromagnetic field, it is detected by the receiver with the unique code given to every RF transmitter and receiver. Initially the luggages are provided with RF receiver which is pre-programmed in the micro controller and is processed once the receiver recognized the transmitter. The detection of transmitter is done in a way that the receiver is with the luggage and it has an antenna to transmit and receive the signals. The receiver generates the electromagnetic field, the transmitter also has an antenna to transmit and receive the signals. This makes the receiver to detect the transmitter.

RF transmitter transmits radio frequency signals, that signals are encoded by encoder. Then it is send to the RF receiver through antenna. The RF receiver receives the signals from RF transmitter through antenna and that signals are decoded through decoder.

b) Processing of Data in Microcontroller

Once the transmitter is recognized by the receiver, the Microcontroller matches the unique code of RF transmitter which is pre programmed in it. The receiver decodes the data in the transmitter and the data is passed to the host computer (Microcontroller) for processing.

The processes that take place in the micro controller are as follows

- Every transmitter contains a unique data, once the receiver reads the data in transmitter, it decodes the data.
- The decoded data is checked with preprogrammed data in the microcontroller.

The data transmitted by the transmitter may provide identification or information about the location once the microcontroller ends up with the processing of data. When the transmitter moves over the frequency range, the microcontroller gets into the next module i.e Intimation to the user.

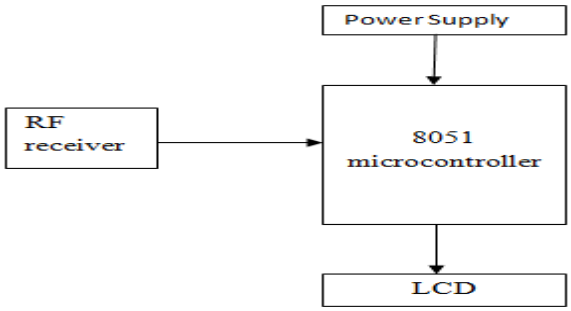



**Fig. 6:** Processing In Microcontroller.

c) Alert System

Intimation to the passenger about the luggage missing can be done by two ways.

- SMS Notification
- Alarm

When the transmitter moves over a frequency range, RF receiver cannot receive the signal from the transmitter.

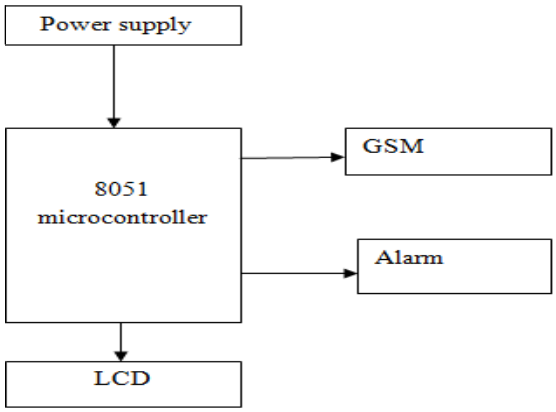



**Fig. 7:** Structure of Alert System.

Once the transmitter goes out of frequency range, the port 0 of microcontroller is set to 0 and enables the GSM modem to send the message to the passenger and enables the buzzer which will

make high volume alarm and is used to find out the location of the luggage. SMS is delivered to the passenger about the luggage missing by using the GSM modem. The structure of alert system is depicted in Figure 7.

## 5. Results and Discussions

The hardware part of the ABTAS system was developed by using the components described in section III of this paper. The software part of the system was implemented by using the language 'Embedded C' and the developed code is tested using Keil Compiler. The results are tested by changing the location of the luggage and the outputs shown in LCD are recorded. Also when the luggage goes out of range, the system was tested for alarm sound and SMS intimation to the passenger's mobile phone.

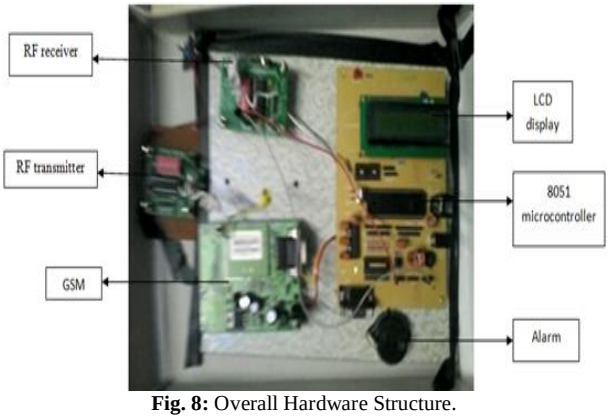



**Fig. 8:** Overall Hardware Structure.

The proposed system was tested for various input conditions in tracking the luggage and the SMS delivery was checked by using a mobile phone. The SMS was delivered successfully to the passenger's mobile phone. Figure 8 clearly depicts the overall hardware structure of the ABTAS system.

## 6. Conclusion

In this ABTAS system, RF technology is applied for tracking luggage of an individual in their travel. In order to provide safe transportation, this device can be implemented in airports, railway stations, bus stands in cities etc. for tracking the location of luggage. The proposed work is best suited for persons who frequently have business trips or long travels. They could apply this tracking device for their luggage which has been packed with the valuable objects or other important documents. The location of the luggage could be tracked accurately at every moment and if the luggage goes out of fixed range, then the alert message will be sent by GSM module to the passenger's mobile which is more helpful in tracking the luggage. This system would improve user satisfaction and reduce mishandling of luggage at crowded areas.

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