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Research Article

# Intelligent System Of Duo Functional Bagpack

**H. Imran**[1]
Faculty of Technical And Vocational Education
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,Malaysia

**Ridhwan Rani**[2]
Faculty of Technical And Vocational Education
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,Malaysia;

**S.M. Zulfadhli**[3]
Faculty of Technical And Vocational Education
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,Malaysia

**Munirah Ahmad Azraai**[4]
Faculty of Technical And Vocational Education
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,Malaysia

**Raja Mariatul Qibtiah**[5]
Department of Electrical Engineering
German Malaysia Institute, Jln Ilmiah, Tmn University, 43000 Kajang Selangor, Malaysia

**Abstract**

In today's world, numerous technological innovations have been introduced to improve the performance of human intelligence. While some tasks can be accomplished conventionally, many tasks become easier when technology is integrated. The internet of things is a critical component of intelligent technologies nowadays. One of these innovations is the 'smart bagpack' that will be useful for travelers. This study aims to develop an android application to track the location of a backpack. The structure integrates a GPS receiver that records the bag's longitude and latitude. This position is accessible via an SMS message sent to another user. Together with assistance of coordinates information, provided by GPS, the user will able to locate the bag using Google Map. Once the device is in standby mode, the authorized user will get a notification message when the Bluetooth has been disconnected, and the user will sound the buzzer to locate the bag. Furthermore, this product will make it easier for users to answer phone calls while on the move. A button on the backpack will be connected to the phone by Bluetooth to make sure the user can access an android application to answer the call. The backpack will send alerts on incoming calls, and the user can answer with the push of a button without ever taking out the phone. This could help solve problems faced by commuters when trying to receive voice calls during peak travel hours. This project consists of two main features, which are tracking and call pick up.

**Keywords**

Smart bagpack, Arduino Nano, Internet of Things, Autonomous System.

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# Introduction

In 2014, according to Chen et al. [1], the Internet of Things (IoT) is a "smart technology that connects all computers to the Cloud for the ability to access information and communicating with mobility system via agreed-upon protocols." Consequently, they imagined IoT as a means of improving established interactions for both implementations and human beings, depending on a naive view of "Things" as communications technology. However, IoT is related to the real world application and surrounding human being. This is proved by Yan et al. [2], article that The Internet of Things (IoT) is "a paradigm in which existing networked devices are connected to physical objects such as household appliances, equipment, and human services." Here, objects are intelligent objects able to detect and communicating with other objects via the Internet.

Several scholars have endeavoured to describe several frameworks for implementing IoT, with particular being applied to specific application areas. Castellani et al. [3] have contributed architectural design, focusing on cloud based applications in particular. This model aims to establish a web service connection between a wireless sensor network and a propulsion network. These systems, which include access control and the authorization of authenticated individuals, require a stable network and selected form of classification technology, for instance RFID. Their framework is composed of three distinct types of nodes which are Base Station Node (BSN), Mobile Node (MN), and Specialized Node (SN). Each type has distinct characteristics that are determined by its mobility, operating range, and specialization. MN is a remote node, for instance, a wireless dongle. It emphasizes the importance of protocol and specification interoperability. The SN is the third and most critical component of the complete architecture [4]. This is a dedicated node for the delivery of specific services, including tracking misplaced items for human mistakes.

There are numerous technologies invented to assist humans. Technology can reduce labor by assisting in replacing manual labor. As humans still make mistakes that can cause works to be delayed, technology can solve many work-related concerns. For instance, one issue faced by travelers is packing and carrying their luggage [5]. In many cases, the lack of storage forced them to leave some of their belongings behind. A backpack is a large bag used for carrying things, especially when traveling or walking. This study introduces the "Duo Functional Backpack" that could ease travelers. In this regard, the most common concerns for travelers are the possibility of their belongings being stolen by a pickpocket and the risk of misplacing their baggage. In most public areas, there hasn't been much literature recommended or applied to increase the quality of baggage loss prevention. Many studies have focused on intelligence classification or the characteristics of various mathematical models to better analytical products. However, due to the limitations of empirical studies in the baggage security sector, the remaining research has not yet been completed and therefore does not address the electronic information model [6], resulting in ineffective intelligence products [7].

This study aims to produce a new methodology tracking a bag's location using GPS to overcome the problem of missing or misplaced luggage in real-time. GPS, or Global Positioning System, is a wireless communication process that monitors the coordinates of a GPS receiver device connected to the backpack wherever it should be in the universe. The user can also access the application via their phone to view the bag's location and activate a buzzer instantly via a voice call.

## Related Work

### A Noble Approach to Develop Smart Travel Bag

The article introduces a mobile, voice-activated, and gesture-activated technology useful for everyday life and travel. The smart travel bag has several capabilities include carrying a substantial amount of weight and moving autonomously without the assistance of another person. The system consists of robotics and micro controller-programmed sensors. The smart bag will move according to the user's instructions. Simultaneously, the bag provides security and will alert users if it is overweight. The system was established based on practical experience and user feedback. The system's overall performance analysis demonstrates its feasibility, reliability, affordability, and uniqueness. The device is a must-have for travelers and anyone carrying multiple bags or luggage at any given time. It will save users both time and money. This paper discusses additional research opportunities as a daily life tool for humans. However, this study was limited to the movement of users' free handling. Hence, it is recommended that

the bag should be used in a safe area [8].

## Design of a Smart Bag Using the Apriori Algorithm

Using a preceding heuristic and RFID sensing devices to test the smart bag, it could be ascertained that the RFID device functions as a reader or detects objects with RFID tags that were located inside of the smart bag [9]. By utilizing the priori algorithm, it is possible to deduce the algorithm's performance by determining the integration of required functions for the production of many bought products in the smart bag. With the help of a rule created based on the results of the priori algorithm, the smart bag can provide notifications when some items in the back are stolen or misplaced. The device will notify the user of items left apart not whether the luggage is fully functional after analyzing the information sent to the fire base smart bag. This project's findings have shown the need to improve the smart bag prototype in subsequent studies. Possible improvements including substituting the existing systems with almost comparable algorithms such as FP-Growth and CBL to improve time efficiency in determining the rules for luggage combination. Additionally, baggage combinations can be varied, and many more users can use the smart bags if the luggage data processing is embedded in the microcontroller [10].

## Smart Backpack

The smart backpack is a novel concept with a multitude of interesting features. The auto-traveling bag is equipped with an obstacle detection system that travels autonomously using an object counter to cover a specified distance set by the user. It features an integrated charging system for mobile phones. Moreover, it features an integrated led safety system that safeguards users traveling in low-light areas. The bag aims to meet all of a person's basic human needs. It comprises a combination of various systems within a bag that contribute to users' safety to make it more user-friendly.
Nevertheless, this smart backpack concept can be advanced by enabling solar energy to be captured to power mobile devices and automatic lighting systems, resulting in significant energy savings. In addition, digital weighing machines can remain interfaced to determine the backpack's exact weight, and high-precision ultrasonic sensors can be incorporated to enhance the auto-traveling system [11].

## Proposed System Design

The system was designed in a straightforward manner, similar to that of a bag pack. It was customized to include distinct compartments within the bag. The circuit board and battery are located in the bag's bottom layer. The middle layer offers space for storing clothing and other materials. The sub-space sections can be used to store laptops and other electronic devices. Meanwhile, the circuit is located at the bottom layer's middle. The battery is a Li-polymer battery that is located in one corner of the bottom layer. The bag contains a GPS module, a Parallax PMB-688 SRIF GPS EXT ATENNA with TTL Asynchronous Serial (UART) communication and an optional I2C interface. The bag is equipped with a single on/off switch, which powers the device when pressed.


**Fig. 1.** Backpack View Drawing

Figure 1 shows the product design that allows the phone application to map the bagpack's location and hands-free calling feature. As a result, the user can answer phone calls with the push of a button without ever taking out the phone. The phone application can also be used to pair the phone with the button and check the remaining battery life on the device.

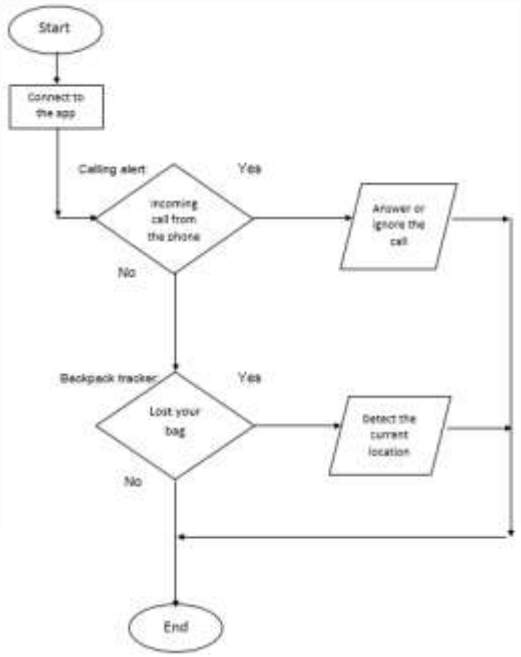


**Fig. 2.** Flow chart of the backpack system process

As shown in figure 2, the application will activate the system when the user is ready to use it. The application will connect via Bluetooth to alert the user by triggering the buzzer. The application will send messages to provide information on the bag's current location by GPS module.

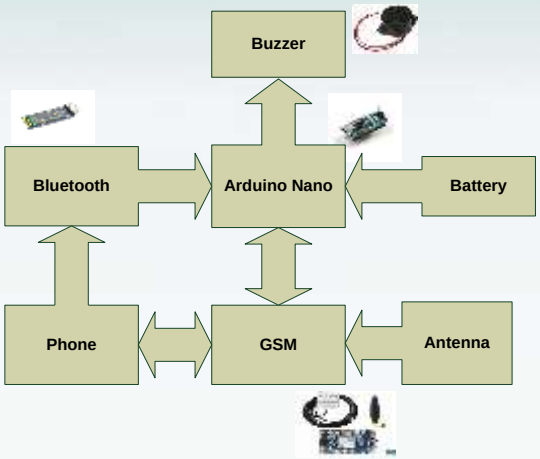


**Fig. 3.** Block Diagram

The main function of this system is the Arduino Nano, which operates as the system's microcontroller. The microcontroller's structure is embedded with multiple electronic devices, making it more compact and easier to program.

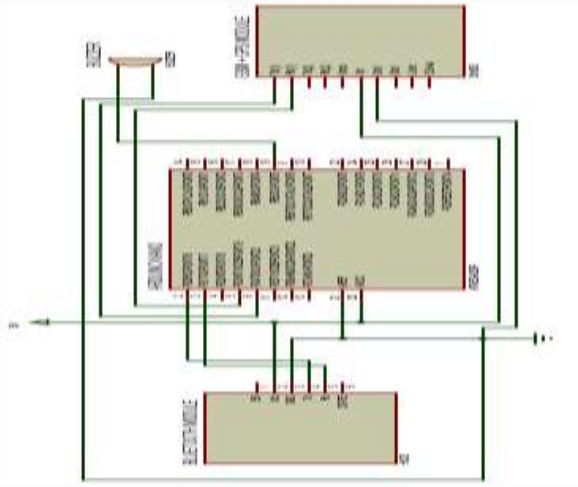

**Fig. 4.** Circuit Diagram

The circuit diagram shown in figure 4 represents the overall connection of three modules: Bluetooth module, GSM/GPS module, and the Arduino nano.


**Fig.5.** Software Built-in system

In terms of software specifications, this project focused on Arduino IDE to program the Arduino microcontroller. Furthermore, the system used Android Studio as the graphic user interface. Meanwhile, Proteus 8 is software for schematic capture, simulation and PCB layout design, as shown in figure 5.

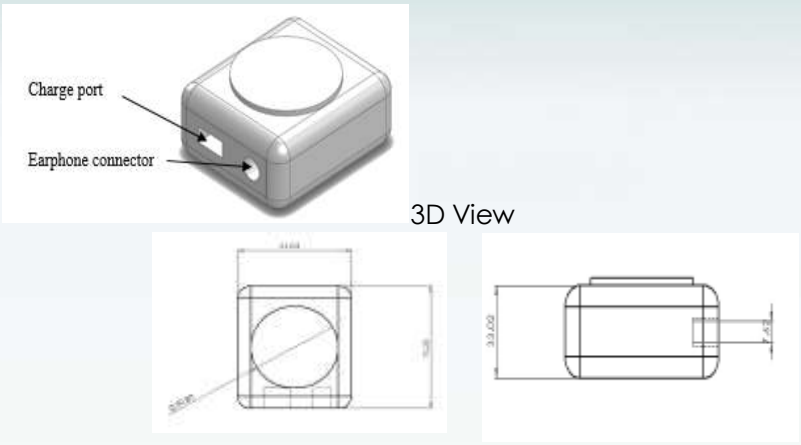


**Fig.6.** Software Built-in system

The button on the bagpack allows users to pick up calls hands-free when traveling. The user will press the button to connect to the phone via Bluetooth to ensure that the user can access the android application to answer a call. In addition, the backpack will notify the user when there are incoming calls, allowing the user to respond with the push of a button without having to take out the phone from the back.

## Components Description

There are three major modules in the overall system. The microcontroller, transmitter and receiver and communication. The Arduino module will function as both a communication device and a control circuit.

## Arduino Nano

**Fig. 7.** Arduino Nano Module

The Arduino Nano can indeed be operated through the Mini-B USB cable, an unrestricted auxiliary power supply ranging from 6 to 20V (pin 30), or a regulatory external device ranging from 5 to 5V (pin 27). The power supply is automatically turned to the supplier with the required intensity. The ATmega328 does have a 32 KB RAM (plus an additional 2 KB for the operating system); it has 2 KB of SRAM and 1 KB of EEPROM. When using pin Mode (), digital Write (), and digital Read () operations, each of the Nano's 14 digital pins could be used as an output device. They execute at a voltage of 5 volts. Every pin can supply or obtain a total of 40 mA and includes a 20-50 KOhm internal pull-up resistor. Likewise, some pins have particular function, as listed below.

- 0 (RX) and 1 (Serial) (TX). TTL serial data is obtained (RX) and transmitted (TX) using this interface.
- 2 and 3 External Interrupts such pins may be designed to initiate an interrupt in response to a minimal value, a high or low advantage, or a value change. PWM: three, five, six, nine, ten, and eleven. The analogWrite () step creates an 8-bit PWM signal.
- SPI: ten (SS), eleven (MOSI), twelve (MISO), thirteen (MISO) (SCK). Assist with demonstration purpose.
- Integrated LED integrated to digital port 13.

The Arduino Nano includes a variety of communication interfaces for connecting to a processor, some other Arduino, or any other embedded systems. The ATmega328 supports UART TTL (5V) serial

communication via input pin 0 (RX) and 1 (TX) (TX). The board includes an FTDI FT232RL that channels serial connection over USB, and the FTDI drivers include a virtual com port to software programs. The Arduino software contains a following command that enables the transmission and reception of basic text mining from and to the Arduino microcontroller. Once data is transferred through the FTDI chip and USB cable to the processor, the RX and TX LEDs on the panel will flash.

**Bluetooth**

**Fig. 8.** Bluetooth HC-05 Module

Bluetooth technology connects a sensor to a phone via radio waves rather than cables or wires. Bluetooth systems operate via short-range mobile ad - hoc networks called piconets. A piconet is a platform of Bluetooth-enabled devices. When a program is developed, each device is designated as the master, as well as other devices are designated as slaves. Piconets are interactively and instantly identified as Bluetooth devices come and go from radio proximity. A Bluetooth component's distribute power, and thus its spectrum, could be categorized only by power class. As illustrated below, there are three distinct categories of power.

**Table 1.** Power Classes.

| | **Class Power (Max)** | | |
|---|---|---|---|
| **Class Number** | Output Power (dBm) | Output Power (mW) | Max Range |
| **Class 1** | 20 | 100 | 100m |
| **Class 2** | 4 | 2.5 | 10m |
| **Class 3** | 0 | 1 | 10cm |

The HC-05 Bluetooth module is a class 2 device that enables clear wifi communication protocol. It comes pre-configured only as Bluetooth slave device. When paired with a master Bluetooth connection as with a PC, mobile phone, or laptop, everything becomes completely functional. The HC-05 consists of two components of operation: instruction and information. The HC-05's task system is characterized through the on-board control panel. When the switch is activated, the HC-05 enters Command settings. In Command prompt, the user can modify parameter values (pin code, baud rate) via a sequential to TTL converter connected to the host device of a PC able to run terminal source code. Any recent changes to the system's variables would be maintained even when the power is turned off. The HC-05's power cycle will restore it to Data Mode. Even while being in Data Mode does transparent UART data transmission with an integrated remote device arise? The HC-05 can be configured also as master Bluetooth connection by the user using a series of AT instructions. When installed as master, it can instantly pair with either the HC-05 in its reset slave structure or with an HC-06 component, enabling point-to-point serial communication systems. The HC-05 operates between 3.6VDC and 6VDC. Fortunately, the RXD pin's logic level is 3.3V and is not 5V considerate. As a result, if connected directly to a 5V device, it may be harmed. A Circuit Converter is preferred in this system to protect the HC-05. Additionally, if the "EN" pin is attempted to pull to logic 0, energy to the HC-05 is reduced off. The characteristics are as follows:

- Bluetooth version 2 with enhanced data rate (EDR)
- The frequency of the 2.4GHz ISM band
- Baud rates of 9600, 19200, 38400 (default), 57600, 115200, 230400, and 460800 are represented.
- Asynchronous: 2.1 Mbps (maximum) / 160 kbps, Synchronous: 1 Mbps/1 Mbps.
- 3.6V to 6V Dc power source.

## Global Positioning System (GPS) Module

**Fig. 9.** GPS SIM808 Module

In Europe and other areas of the globe, the Global Navigation Satellite for Wireless communications is an extensively utilized electronic mobile phone platform. GPS is a variant of time - division access (TDMA) and has been the most broadly consumed types of communications innovation of the three currently available technologies (TDMA, GSM, and CDMA). GSM digitises and constricts data prior to transmitting it over a channel alongside two both these streams of metadata, within each time frame. It conducts whether at 900 MHz or 1800 MHz. A narrow spectral 30 kHz wide and 6.7 milliseconds lengthy is divided into three channels using TDMA. Due to the fact that narrowband relates to existing methods, each communication receives radio coverage perhaps one of the period. This is feasible since voice data is compacted after it has been transformed to digital information, requiring considerably less transmitting storage. As a result, TDMA has a threefold capacity increase over an analogue system with much the same range of systems.
SIM808 is a multiple module that includes GPS, GPRS, and GSM. It is focused on SIMCOM's latest GSM/GPS subsystem, the SIM808, and defends GSM/GPRS Quad-Band networks in addition to Gps devices for navigation systems. It has an extremely fast response time in closed position and an interconnected charging circuit for Li-Ion batteries, which results in an extremely long backup time and makes it perfect for processes that involve rechargeable Li-Ion adapters. This has a highly accurate GPS receiver with 22 monitoring and 66 acquiring platforms. The configuration is regulated via UART with an AT prompt and operates at 3.3V and 5V logical rates. The module communicates with Arduino via the TX and RX pins. This can be controlled either by a 5V battery or a lithium-ion battery. GPS employs a digital physical layer. Prior to transmission, analogue voice inputs are converted to electronic, and the GPS RF carrier can support up to 8 MS subscribers concurrently. The throughput is 270 Kbps. Digital signals can be transmitted using Gaussian minimum shift keying (GMSK). A phase in GMSK involves the transition from a digital "1" to a "0," which refers to a process. Eventually, the spectrum's addition of large modules is decreased. Additionally, the phase transition in GSMK is not consistent and is far more diffuse. The Features of the GPS module are listed below:

- Controlled by AT Command.
- Three power input interfaces: DC power supply interface and V_IN and a lithium battery interface.
- The logic level ranges from 3.0V to 5.0V.
- Power consumption is low, as low as 1mA in idle mode.
- GPS NMEA protocol support.
- Standard SIM-Card.
- LED status predictor for power source, connection, and control signals.

## System Layout

The BIOTRA application build-up for the system was developed via android [6]. It allows easier monitoring from cell phones and detection of the bagpack in any circumstances.


**Fig. 10.** Main page of GUI

When a user turns on the application, it will show the main page to begin the system run, as shown in Figure 10.


**Fig. 11.** Mode of the system display

After the consumer push the start key, the system provide an option to choose one out of two operating modes, standby mode or searching mode, as shown in the figure above.


**Fig. 12.** Searching mode system display

The search mode is activated when a user commands the application to search the location of the bagpack. It will initiate the auto searching function using GPS to detect either indoor or outdoor locations.


**Fig. 13.** Google maps display for searching mode

After completing the search with the Biotra application, Google maps will provide an exact location. The figure below shows the android source code that how the software runs the system efficiently.

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.user.biotra"
    android:versionCode="1"
    android:versionName="1.0">
    <application
    android:allowBackup="true"
    android:icon="@drawable/ic_stat_name"
    android:label="@string/Biotra"
    android:theme="@style/AppTheme">
    <activity
        android:name=".firstH"
        android:label="@string/Biotra"
        android:screenOrientation="portrait" />
    <activity
        android:name=".first"
        android:label="@string/Biotra"
        android:screenOrientation="portrait">
        <intent-filter>
            <action android:name="android.intent.action.MAIN" />
            <category android:name="android.intent.category.LAUNCHER" />
        </intent-filter>
    </activity>
    <activity android:name=".second" />
    <activity android:name=".empat"></activity>
  </application>
</manifest>
        }
```

**Fig. 14.** Coding of the Android application

## Conclusion

In terms of challenges, architecture for extremely large, dispersed, and heterogeneous environments is a significant one. Another difficulty it entails is the system's scalability, its flexibility, and its support for virtualization systems in all three dimensions, namely human density, innovations, and even intensity. Security and privacy are additional intriguing challenges to embrace from the perspective of both users and providers. Advanced technologies, such as sensors, actuators, and RFID, are the next domains that will present researchers with a challenge. Although luggage and backpacks are distinct domains, their close and interconnected relationship means that they overlap on the primary subject, i.e., personal belongings. Consequence, the next open challenge in both domains is to perform, customize, and analyze the extremely useful Duo Backpack.

This smart backpack eliminates every disadvantage associated with the use of conventional backpacks. By utilizing technology and innovations, humans have tried to make their life routines less

sophisticated. In this era of computerization, undoubtedly, a sufficiently large market will embrace this new generation of backpacks. Furthermore, the backpack will make outdoor activities, such as traveling, more convenient for users due to its ability to send notifications. The user only needs to click the button attached to it to answer to voice call from another person. It also sends alerts and prevents missing belongings by allowing users to track their backpacks using GPS if these bags are misplaced or missing.

### Future Work

Based on this final project's research findings, several recommendations have been made to enhance the concept of this intelligent bag in subsequent studies. First, we suggest using solar power to ensure that the device is constantly charged by the electricity generated by the solar panels and stored in the battery, allowing it to be used at any time. As a result, it can reduce its reliance on the grid and thus conserve energy. Apart from that, increase safety concerns by notifying users when devices are used in poor condition or running out of power.

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