IOT-BASED SMART BAG
An IOT-based Smart Bag for disabled and solo travelers using Arduino

Submitted in partial fulfillment of the requirements of the degree of

Third Year Bachelor of Technology

By

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Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

CERTIFICATE

This is to certify that the project entitled **IOT-based Smart Bag** is a bonafide work of **Shazia Talib, Tanvi Save and Arwa Ujjainwala** (60003190049, 60003190059 and 60003200121) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of “Third Year Bachelor of Technology” in “InformationTechnology”.

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Project Report Approval for T.Y. BTech

This project report entitled ***IOT-based Smart Bag*** by **Shazia Talib, Tanvi Save and Arwa Ujjainwala** (60003190049, 60003190059 and 60003200121) is approved for the degree of Information Technology.

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We declare that this written submission represents our ideas in our words and that where other's ideas or words are incorporated, the original sources have been properly cited and referenced. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data source in our submission. We understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources who were not properly referenced or from whom sufficient permission was not obtained when required.

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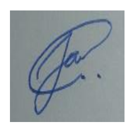

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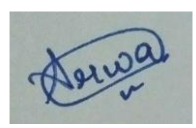

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Acknowledgement

We are extremely grateful for being given the opportunity to make an IOT-based project in our IT department which is mostly software based. We are really thankful to our guide, Prof. Arjun Jaiswal for providing us guidance in this domain. We are also grateful to Prof. Priyanca Gonsalves for helping us throughout the project.

We would also like to express gratitude for all the resources(components, labs) that were provided to us by our department during the project. We learned a complete new domain through this project and learned different tools/technologies as well. The exposure to IOT helped us understand the hardware side of different projects.
Hence we are really happy for this amazing opportunity.
Thank you.

Shazia Talib

Tanvi Save

Arwa Ujjainwala

Abstract

Did you know, about $1.25 billion worth of baggage was potentially lost or stolen in 2018 77% of mishandled bags are delayed, 18% damaged or pilfered, with 5% completely lost or stolen. Baggage being lost, mishandled and stolen is a very common problem faced by a lot of us. It becomes especially hard for solo travelers and disabled people. Traveling is such an important aspect of everybody's lives. We travel every single day to different locations. The world is being taken by a technological revolution, then why are our bags not a part of it as well?

Hence, to help the travelers and make journeys comfortable and safe, we have developed the concept of an intelligent suitcase. The features and components of the system will be discussed further. Our project comes under the domain of IOT.

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Chapter 1: Introduction

1.1 Motivation and Objective

Why should we build a smart bag?

In our everyday life, traveling is one of the important aspects for human beings. Generally, for traveling purposes people use normal luggage bags or suitcases but in today's tech savvy world, there are tech-savvy thieves as well! Missing pieces of baggage and damage to customers' belongings and carrying around huge loads of luggage everywhere are the common problems faced by passengers around the world.

Smart Bag is based on a simple fact that people always suffer from all these issues when they go traveling or on a business trip, and there will always be some circumstances that people forget to bring some important items during their trip, maybe changes of clothes, charging cables, and even their passports which is extremely crucial for traveling. However, no one will forget to bring their phones and suitcases on the trip.

We develop our system using Arduino Uno which is cost effective and simple to work with. Our system has multiple functionalities which can help users to manage their personal trips and let their luggages automatically follow them. The luggage can be tracked remotely using GPS. It is as IOT application integrated into the luggage

We use a motor and a motion detection sensor to drive the suitcase.

On doing a lot of literature review we found out that many of the similar systems that have been built have different faults. Some of them are not as cost effective(for example, they use raspberry pi) and some use less reliable technology(like RFID).

1.2 Major Challenges

The major setbacks we faced during this project were:

1. Diving deep into a completely new domain
2. Acquiring all the components together
3. Soldering the wires to motors multiple times since they tend to break often
4. The GPS and GSM module works well only in open space areas limiting our work spaces.
5. The motors only work with specific batteries.
6. The hardware needed to be replaced a few times.

Although these were our setbacks, we managed to develop and achieve what our objective was. Our model can be built on a large scale with stronger and more efficient machines

1.3 Report Overview

The purpose of this document is to define and explain all the functionalities of our project. This project is a prototype product for IOT-based Intelligent bags. This report lays down the scope and project resources necessary for the implementation of the project. We also list down the system design which includes information architecture, circuit diagrams, sequence diagrams, activity diagrams etc. for software modeling. System architecture and Implementation details are thoroughly mentioned in the subsequent sections. In the end, we discussed the testing of our project and the future scope.

Chapter 2: Literature Review

2.1 Existing work

2.1.1 Literature Related to Existing Systems

1. **LUGGAGE TRACKING SYSTEM USING IOT [1]:**

   This project has a GPS module along with arduino and an alarm sensor. We can track the location of the bag at all times. The alarm sensor in the system is integrated so as to prevent theft or losing the bag. The users get notifications as the bag moves out of a particular range like 10m, 20m and 30m. The alarm gets triggered if the bag goes out of a certain range.

2. **SMART LUGGAGE TRACKER [2]:**

   This system implements a luggage tracking handling system using RFID.

   This algorithm is used for generating tags that are attached to printed luggage labels. The details of passengers and airline are stored in it. A prototype at the two locations of check-in and check-out is to be developed. RFID readers in the check-out have step by step tracking of luggage. Location is also tracked. Each boarding passenger has a unique RFID code which has to be entered on the website to know the exact location and status of their luggage. Details include the exact time of arrival of luggage, location, net weight before and after loading. This information lets the passenger take necessary action if the luggage has been misplaced, stolen or tampered.

3. **SMART LUGGAGE TRACKING AND ALERT SYSTEM USING ARDUINO [3]**

   This system is a lightweight device with an advanced security system made for human traveling where people lose their luggage in public areas like airports, railway stations. The android software provides the location status of luggage. It also has a Fingerprint Sensor to keep their important things safe and secure. In addition, it also stores the unauthorized and authorized location details in the cloud.

2.1.2 Literature Related to Methodology/Approaches

The existing systems use arduino or raspberry pi as a microcontroller. They usually have a gsm-gps integrated module to track and send the location to the user. They also have a wifi module attached to send the messages over the wifi. They also have protection against theft and security. They have an alarm sensor that gets triggered as soon as the bag is stolen. They have a fingerprint module integrated to protect the bags from being opened by an unauthorized user.

2.1.3 Literature Related to Technology / Tools /Frameworks

RFID:

Radio Frequency Identification – or RFID do the two of the following things:

1. Automatically identify an object
2. Capture data about that object that has been stored in a small microchip tag and attached to the object.

The RFID tag has a built-in antenna that communicates to a scanning device that reads the data remotely.

RFID uses radio frequency waves to transfer data. They are wireless. RFID tags help the users to uniquely separate their luggage apart from other passengers. The RFID tags are attached to the passenger luggage and are scanned by RFID Readers at various locations. Passengers can check this information through a website. The RFID reader has antennas. The scanning antenna in the RFID puts out the radio-frequency signals in a relatively short range.

RFID radiation does two things:

I. helps communicating with RFID tag

II. It is assigned to provide the RFID tag with energy to communicate. An RFID tag does not contain batteries, and can, therefore, remain usable for very long periods of time (maybe decades). RFID tags get the activation signal from the antenna and this gives energy to the RFID chip.

Once the RFID tags detect the activation signal from the antenna, it energizes the RFID chip, and its pieces of information are transmitted to its microchip which is to be picked up by the scanning antenna. The RFID tags are of two types, Active and Passive. Active RFID tags are better because the reader can be much farther away and still get the signal. They do have limited lifespans though.

Passive RFID tags, however, are battery-less, and are much smaller and have a virtually unlimited life span.

Raspberry pi:

The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins, allowing you to control electronic components for physical computing and explore the Internet of Things (IoT). Raspberry Pi 3 is used as a microprocessor in many of the iot based projects.

In smart bag tracker projects, raspberry pi is integrated with anti theft sensors, motor drivers, GPS-GSM sensors, etc..

2.2 Observations on Existing Work

We observed the existing works and decided not to include the following technology in ours:

Why not RFID?

RFID is not a very reliable technology as the materials like metal and liquid can very well impact signals. It is difficult for an RFID reader to read the information in case the tags are installed in liquid or metal products. The problem here is that liquid and metal surfaces tend to reflect radio waves, which makes the tags unreadable. It is also not very accurate as barcode scanners. These are really expensive. Implementation of RFID is very time consuming and not efficient. RFID tags are also larger than barcode scanners. Interference has been observed to take place in RFID systems, when devices such as forklifts and walkies-talkies are in the vicinity. The presence of mobile phone towers too has been found to interfere with these radio waves. RFID signal frequencies across the world are non standardized.

Why not Raspberry Pi?

It does not replace the computer, and the processor is not as fast. It is time consuming to download and install software i.e.; unable to do any complex multitasking.

Not compatible with the other operating systems such as Windows. Raspberry Pi is good for developing software applications using Python, while Arduino is good for interfacing Sensors and controlling LEDs and Motors. If your system is a single-purpose system like ours then arduino is a better cost effective way than raspberry pi

Why not an Alarm sensor?

The alarm sensor getting triggered after the bag goes out of a certain range is really ambiguous. Technically it should get triggered on it's own since the owner might be in absolute distress with their bag being stolen and have no sense to trigger the alarm, but, if it does then triggered on it's own then how can we make sure that the bag is actually being stolen or just getting away from the radius simple because of something else? The alarm sensor also causes a lot of noise pollution and can be harmful to the elderly and small children.

Chapter 3: Proposed Methodology and Approach

3.1 Problem Definition

To build a device that makes normal suitcases smart. The device can track the suitcase, and can move the suitcase on its own. This is done by integrating the IR sensors with the bluetooth module and the motor drivers as well.

We have 2 functionalities in the system i.e.

1. Tracking of the suitcases at all times(even if the user has no wi-fi in his phone)
2. Making the suitcase move by giving it command through your phone.

The main objective of our system is to help the lone travelers and also disabled people who cannot lift heavy bags.

3.2 Scope

- The main scope of the Smart Bag using IoT is to develop a device integrated into your luggage that could be user-friendly.
- We can get the location coordinates of the bag so if our bag gets lost we can find it using the location of the bag.
- Users can handle the motion of the bag using the app.
- This will improve passenger satisfaction by reducing delays caused by mishandled luggage.
- The application should be more dynamic and it should show the movement of the luggage which gives updates of the luggage(when asked) in movement.
- It comes with a GSM module which helps us to triangulate its location using GPS to retrieve the data.

3.2.1. Assumptions and Constraints

The current implementation assumptions and constraints we have encountered are:

Assumptions:

A. We assume that the users know how to work a basic phone app. We also assume they know how to message someone through the app

B. We assume that users know how google maps work and can click on the link to find the location of their bag.

C. We assume that the user knows a little bit about bluetooth.

D. We assume the user has cell service in his phone at all times. We do not need the user to have wi-fi but we need their sim-card to be working and sending/receiving messages efficiently.

E. We assume that the bag is controlled by the user but only within a certain circle of range(i.e the bluetooth module's range).

Constraints:

F. If the bag is moving and detects the person or some obstacle, it will stop. It will not go around the obstacle or identify the obstacle as well.

G. The user will not receive any coordinates unless they get cell service on their phone.

H. The main constraint is if the bag will go out of the range of bluetooth we won't be able to control its motion.

I. There is no full-proof way of actually protecting the bag against theft. We can only hope the authorities retrieve the bag as long as we provide the bag's location.

3.3 Proposed approach to build Smart Bag

3.3.1 Features of Proposed System

a. **Motion Detection**

- Motion Detection is to be done with the help of IR motion detector.
- Should follow a user manually by using an app.
- The user should have bluetooth connected to the app.
- The Carrier follows the user based on the motor which is connected to the app through bluetooth.

b. **Speed Control**

- Based on the motor driver we can control the speed of the motor.
- By using the motor driver it will control the speed and also give the high voltage to the motor.
- Using a motor bag can move.

c. **Obstacle Avoiding**

- Has to be done with the help of the IR sensors.
- The carrier detects the value of closeness of an object with the help of IR sensors.
- When it will detect anyone so it will stop.

d. **Tracking the Location**

- The carrier is built with smart features that allow the user to get the location of the luggage wirelessly on the mobile phone.
- Users will get the notification of the bag that was its location.

3.4 Benefits of Proposed Solution

The following are the benefits of the proposed system:

1. The proposed system is cost-effective as compared to other systems.
2. The system is easy-to-use and implemented.
3. Location is obtained in the form of a google map link that can be easily opened.
4. No specialized software needed.
5. User friendly.
6. Whole system integration is controlled through Application installed in Android where controlling the device will get very easy to the user.
7. The luggage moves on its own by using motorized wheels hence no hassle of carrying around heavy loads while traveling.

3.5 Project Resources

3.5.1 Hardware Requirements

- **Arduino -**

  It is a microcontroller board which is based on the ATmega328. Arduino is the heart of our project. USB cable is connected to Arduino and laptop. We program in the arduino IDE (Language: C). Arduino Uno contains a set of analog and digital I/O data pins which is used to connect all the other electronic components. It consists of 14 digital I/O pins and 6 analog I/O pins. Arduino Uno has a USB port from which we can connect to our laptop and upload the program. This port can also be used to power the board by connecting it to a laptop, PC, etc. Also with the USB port, it also has a DC power jack. An external battery or adaptor of 9V or 12V can also be used to power Arduino boards. It can take in voltages between 7 and 20 V

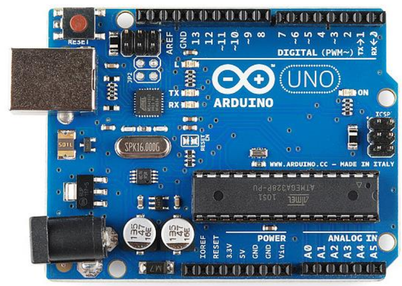

Figure 3.5.1.a Arduino

- **Motor Driver(L298N) -** The wheels in our project are powered by motors that are implemented by the motor driver. Motors require a high measure of current while the controller circuit takes low current signals. So the motor driver takes the low input from the arduino and converts it into high voltage so that our motor can work accordingly. So the job of motor drivers is to take a low-current control signal and transform it into a higher- current control signal that can drive a motor accordingly. Motor driver also requires the external battery. We can connect two motors to one motor driver. One motor goes into the terminal labeled OUT1 and OUT2 and the second goes to the terminal labeled OUT3 and OUT4. By using a motor driver we can control the speed of the motor and change the direction of the motor as well. The row of pins on the bottom right of the L298N control the speed and direction of the motors. IN1 and IN2 control the direction of the motor connected to OUT1 and OUT2. IN3 and IN4 control the direction of the motor connected to OUT3 and OUT4. You can power the L298N with up to 12V by plugging your power source into the pin on the L298N labeled "12V".

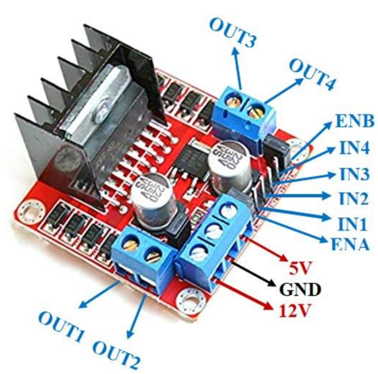

Figure 3.5.1.b Motor Driver

Pin Name	Description
IN1 & IN2	It is used to control the spinning direction of motor A
IN3 & IN4	It is used to control the spinning direction of motor B
ENA	It enables PWM signal for motor A
ENB	It enables PWM signal for motor B
OUT1 & OUT2	This pins is the output pins for motor A
OUT3 & OUT4	This pins is the output pins for motor B
12V	In this pin external battery is connect like 9V
5V	This pins used for switching the logic circuitry inside L298N IC
GND	Ground pin which connected to the ground of arduino

Table 1 - L298N Module Pinout Configuration

- **Motor -** As we have discussed above in the motor driver, we are using a motor to move our bag. We are using the two motors so that we can start and stop the motion of the bag using the bluetooth app.

Figure 3.5.1.c Motor with wheels

- **IR sensor -** It is an electronic type of instrument which is used to sense certain characteristics of its surroundings using Infrared radiation. We are using an IR sensor to detect whether an obstacle is present in front of our bag. IR sensor is used to detect proximity of the obstacle. This sensor is very popular amongst beginners as it consumes low power and is cost efficient. Working of this sensor is very simple, it mainly consists of two main components: the first is an IR transmitter and second is IR receiver. In the transmitter, IR led is used and in the receiver, a photodiode is used to receive infrared signal and after some signal processing and conditioning, you will get the output.

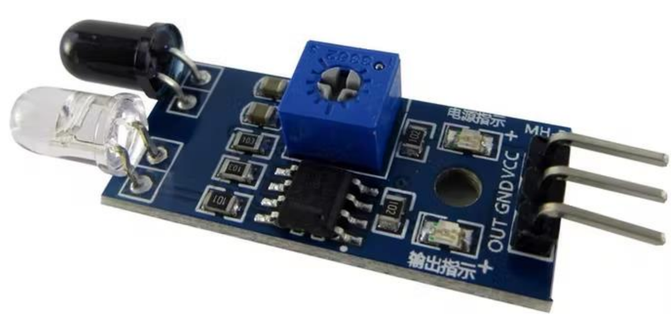

Figure 3.5.1.d IR sensor

Pin Name	Description
IR Emitter LED	This LED use to emits infrared light
IR Receiver	A photodiode with resistance depending on the amount of IR light falling on it
Vcc Pin	3–5 V input voltage
Gnd Pin	Connected to the ground
Out Pin	This pin tramits the output signal from the sensor to Arduino.
Obstacle LED	If the light falls on the IR Receiver it gets turned on.
Power LED	When it is connected to the voltage source the LED will turned on
IR Emitter LED	It emits infrared light

Table 2 - IR sensor Pinout

- **Wires -** Wires are of different types. There are male-to-male, female-to-female and male-to-female wires. They are used to connect different sensors with our arduino uno.

Figure 3.5.1.e Jumper Wires

- **GPS -** Global positioning system (GPS) is a sensor by means of which the location of the device can be ascertained. GPS navigation is based on a satellite system.. It gives latitude and longitude by which we can track and be informed of the position of the bag. GPS works by receiving unique signal and orbital parameters transmitted by the satellite that is then decoded by the GPS device to compute the precise location of the satellite and thereby calculate the exact location of users. The GPS receiver bases it distance calculation by the amount of time it takes to receive a transmitted signal from each satellite. With distance measurements from a few more satellites, the receiver can triangulate a user's position and display it. A minimum of three satellites are required to be locked on to calculate your 2-D position (latitude and longitude) and track movement,. As soon as the GPS sensor finds the satellites, a blue light starts blinking continuously. This is an indication that GPS is working correctly

Figure 3.5.1.f GPS Module

Pin Name	Description
GND	Connected to the GND pin on the Arduino.
TxD	TxD (Transmitter) pin is used for serial communication.
RxD	RxD (Receiver) pin is used for serial communication.
VCC	It supplies the power to the module. It can be directly connected to the Arduino 5V pin.

Table 3 - GPS Pinout

- **GSM -**To send and receive messages, a GSM - Global System for Mobile Communication (GSM) SIM card is put into the mobile handset. The number of the GSM SIM card is stored in the system. Data is sent from the control unit to the base unit through GSM. It is used for long-distance data transmission using GSM technology in areas where there is no access to the internet. This makes it handy in projects that require data transfer over long distances. This module can be used to create a variety of applications, such as call or text message-based triggers that can be used in our daily lives. The GSM module communicates wirelessly with another device using GSM and GPS technology. It connects to the internet via a 2G network and supports Quad-band (EGSM 900, GSM 850, DCS 1800, PCS1900). Because of this, one can send or receive messages from this. The versatility of this module is very high due to its ability to read and send messages without any hassle. Because of the use of AT Commands, it is very easy to configure. because of the presence of an external antenna, the module can also be used in areas with low signal areas.

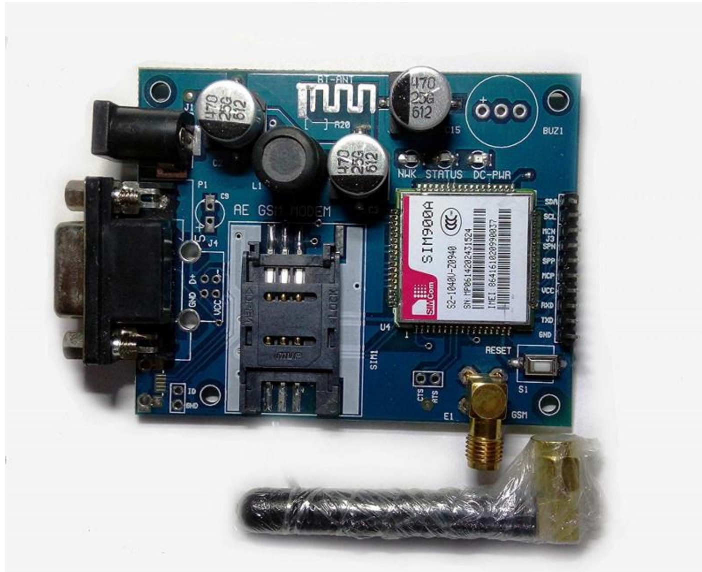

Figure 3.5.1.g GSM Module

- **Bluetooth -** It helps in establishing wireless connection between devices. In our project, the bluetooth module helps us connect our app to the arduino. The bluetooth connected app in turn helps us to move the wheels. It has a range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It uses serial communication to communicate with devices. It communicates with a microcontroller using a serial port (USART). HC-05 is the Bluetooth module we use in our project. This module can be used in a master or slave configuration.

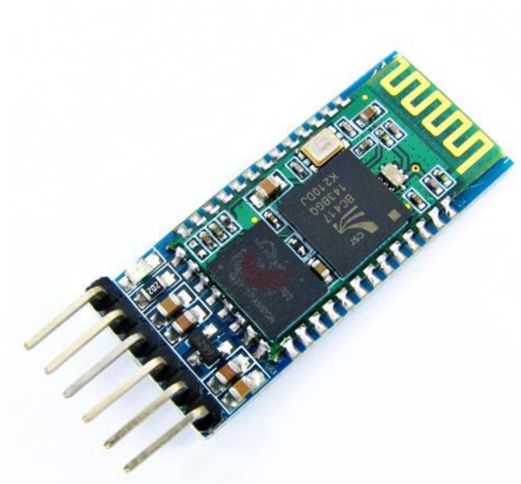

Figure 3.5.1.h.1 Bluetooth Module

Fig 33.5.1.h.2 Pin Description of Bluetooth Module

Pin Name	Description
VCC	Connect 5 V or 3.3 V to this Pin.
GND	Ground Pin of module.
TXD	Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
RXD:	Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

Table - 4 Bluetooth Pinout

3.5.2 Software Requirements

Arduino IDE: Arduino IDE (Integrated Development Environment) is a software platform used to write programs to operate Arduino or any other ATmega controller. The user can write code to program the Arduino in C language but the backend is developed using JAVA. It is an interface that acts like a bridge to upload code to the Arduino and hardware and communicate with them.

1. **void setup ():** This space is used to initialize any variables required for the programme and include libraries of various sensors. This function is used to set up an Arduino before adding functionality for the circuit.
2. **pinMode:** In this function it is used to declare pins of Arduino as input or output.
3. **serial.begin:** This function initiates the Arduino’s communication with other sensors or devices. It allows a specific baud rate to be set for the purpose of communication.
4. **void loop ():** Any code written in this section will loop again and again unless Arduino is interrupted either by issuing an interrupt or disconnecting the USB cable from the port.
5. **digitalWrite:** This function is used to make a specific pin on Arduino logically HIGH or LOW.
6. **digitalRead:** This function has two uses: reading digital data from sensors and controlling something using a switch.

Android mobile application: This project requires the user to install an android application on their smartphones.

3.5.3 Operating Requirements

a) Usability: The user should need no training to operate with the system.
b) Reliability: The system should be reliable enough to not fail or crash at all.
c) Accuracy: The coordinates and the movement of the bag should happen flawlessly with high accuracy of coordinates.

Chapter 4: System Design

4.1 Design Diagrams

4.1.1 UML Diagrams

Activity Diagram: Activity diagram is essentially a flowchart to depict the flow from one activity to another activity. An activity can be defined as a system operation. The control flow is drawn from one operation to another.

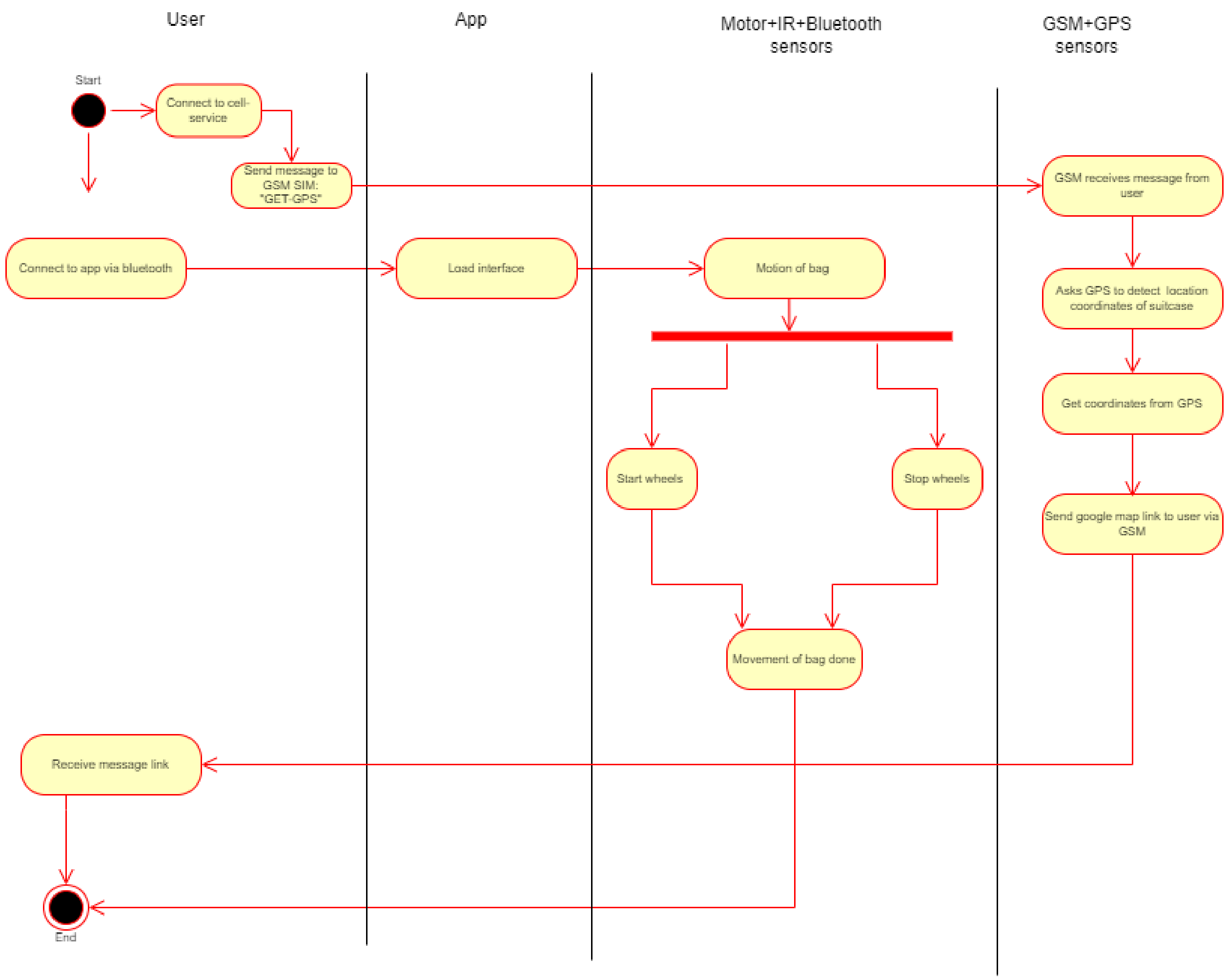

Figure 4.1.1.a Activity Diagram

Sequence Diagram: UML Sequence Diagrams are interaction diagrams that elaborate how operations are performed. The sequence diagram's main purpose is to portray the interactions between objects in the sequence in which they occur.

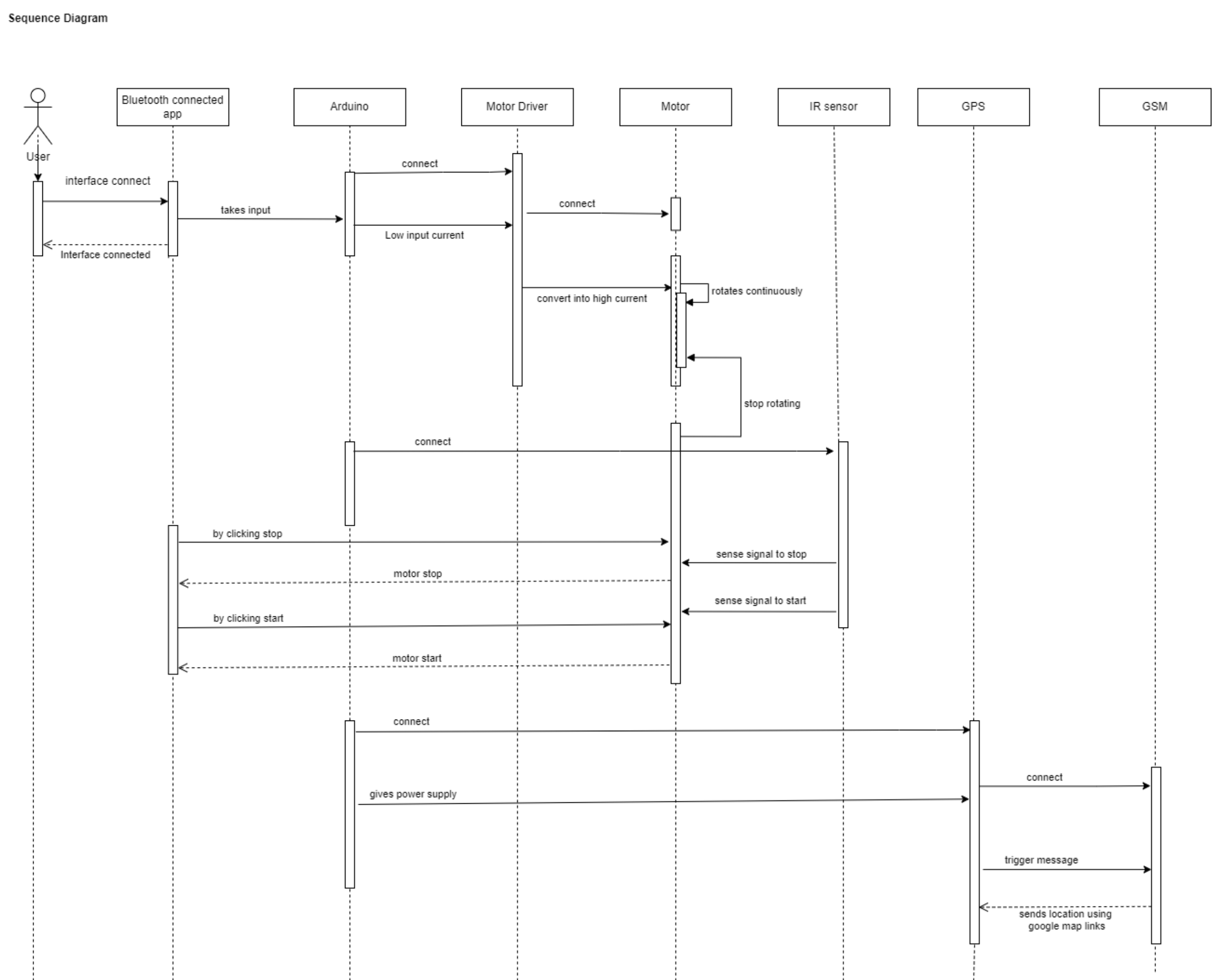

Figure 4.1.1.b Sequence Diagram

Use Case Diagram:

A use case diagram is used to represent the dynamic behavior of a system. It has use cases, actors, and their relationships. It models the tasks, services, and functions required by a system/subsystem of an application. It shows the high-level functionality of a system and also tells how the user handles a system. It understands the system's needs and depicts the external view of the system. It also helps in recognizing the internal as well as external factors that influence the system. It shows the interaction between the actors

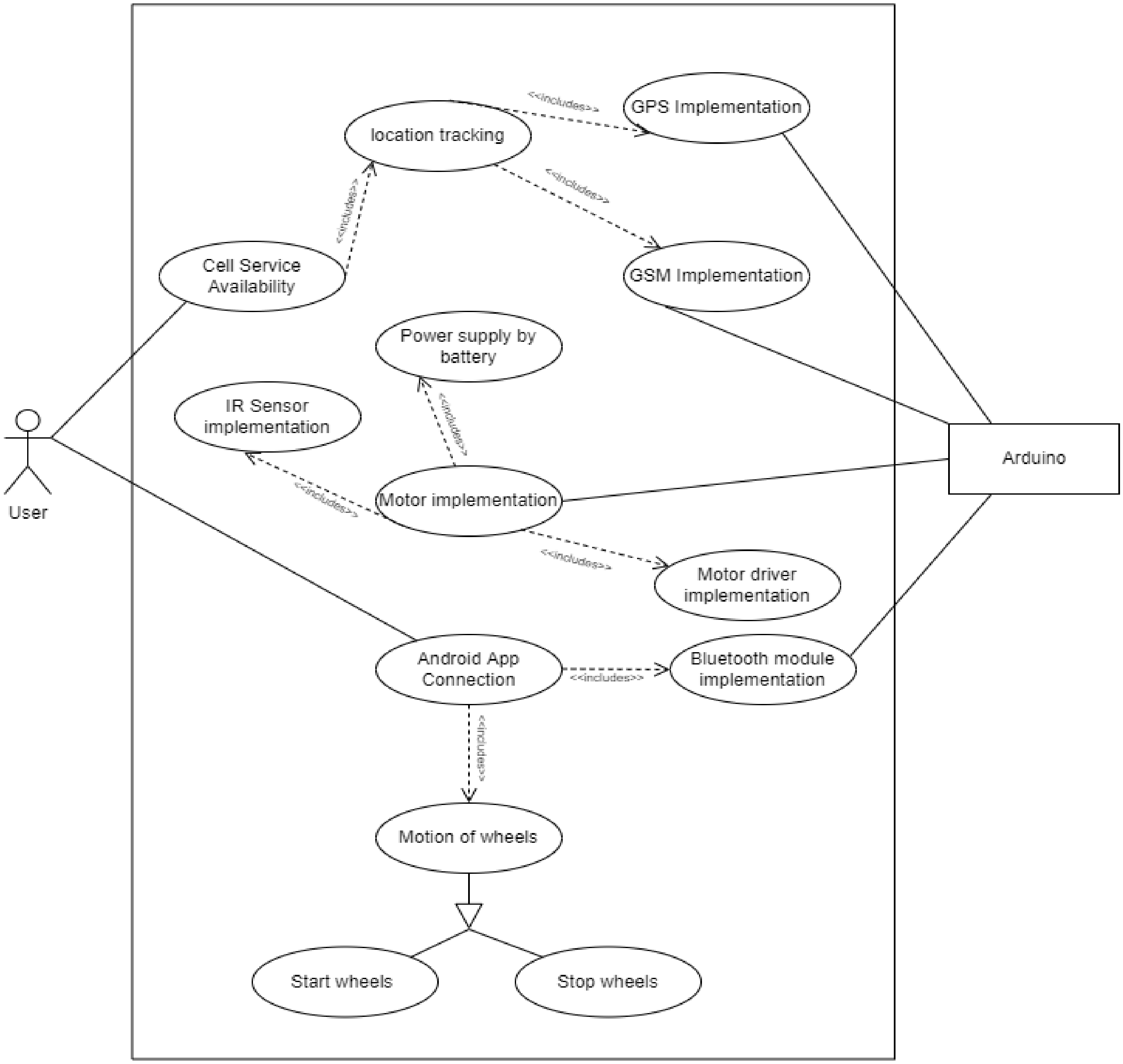

Figure 4.1.1.c Use case

4.2. Proposed System Architecture

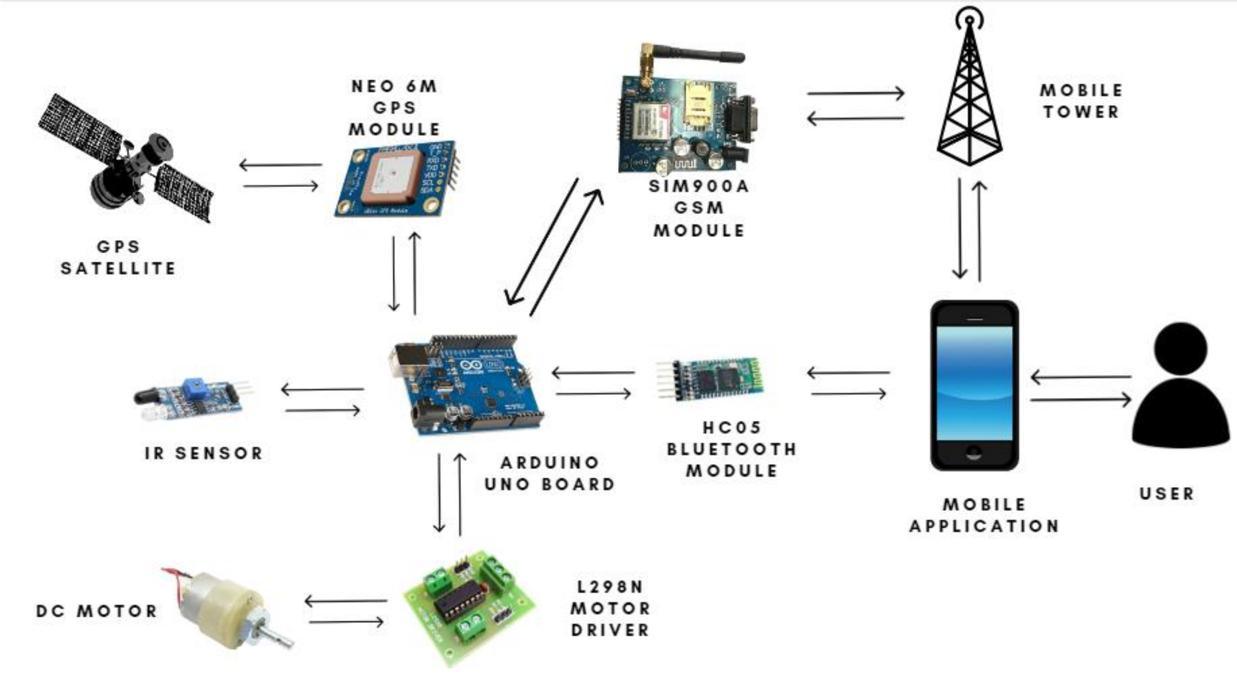

Figure 4.2 System Architecture

Our project has 2 main functionalities: Location Tracking and Automated Motion.

1. **Location Tracking**

   This module is used for obtaining the geographical location of the bag in the form of latitude and longitude coordinates using the NEO 6M GPS module and the SIM900A GSM module. The user can send a trigger message from their smartphone to obtain the location of the system. The trigger used is “GET-GPS". Coordinates will only be sent after the system receives this particular trigger message and for any other message. After the system receives the trigger message via the GSM module, it activates the GPS modules which connect with GPS satellites and obtain latitude and longitude coordinates. The system then creates a google map link and appends these coordinates to the url as parameters. This link is sent to the phone number registered by the user via SMS. The user can click the link received and will be redirected to the google maps page which will display the location of the system

We have used the Tiny GPS library to get cleaned data from the GPS module and Software Serial library for creating multiple serial ports on the arduino board. Standard AT commands are used to communicate with the GSM module.

2. **Automated Motion**

This functionality enables the bag to move automatically. The system is capable of detecting obstacles and stopping motion when it encounters a barrier. We use DC motors attached to a L298N Motor driver to control the motor. The motor driver helps control voltage provided to the motor and provides speed control facilities. It enables the motor to be connected to and controlled by the arduino.

We use an IR sensor to detect obstacles in the path of the system. It is connected to a digital pin of the arduino board and provides a continuous stream of high or low output to the pin. A HIGH output means no obstacle is present and a LOW output means an obstacle is detected.

A HC 05 bluetooth sensor is used to connect the system to the user's smartphone application. The application has functionalities to connect to the bluetooth sensor and buttons to give commands to start and stop the motors. The application is developed for android devices for this version of the project.

Once the user connects to the system using bluetooth via the app, they have the option to start or stop motion of the motors. On pressing the ON button, the motors begin forward motion. If an obstacle is detected, motion stops. Once the obstacle is removed motion resumes. Motion is stopped when the user clicks OFF.

The Simple Timer library has been used to simulate parallel execution of IR and bluetooth loops as well as Software Serial library to add serial port.

Both the modules work together in parallel but are independent of each other. The location tracking has a wide range of operations. It can work in the entire geographical area that the sim network provider operates in. The motion detection functionality will work only in the range of bluetooth connectivity.

Chapter 5: Implementation

5.1 Working of System

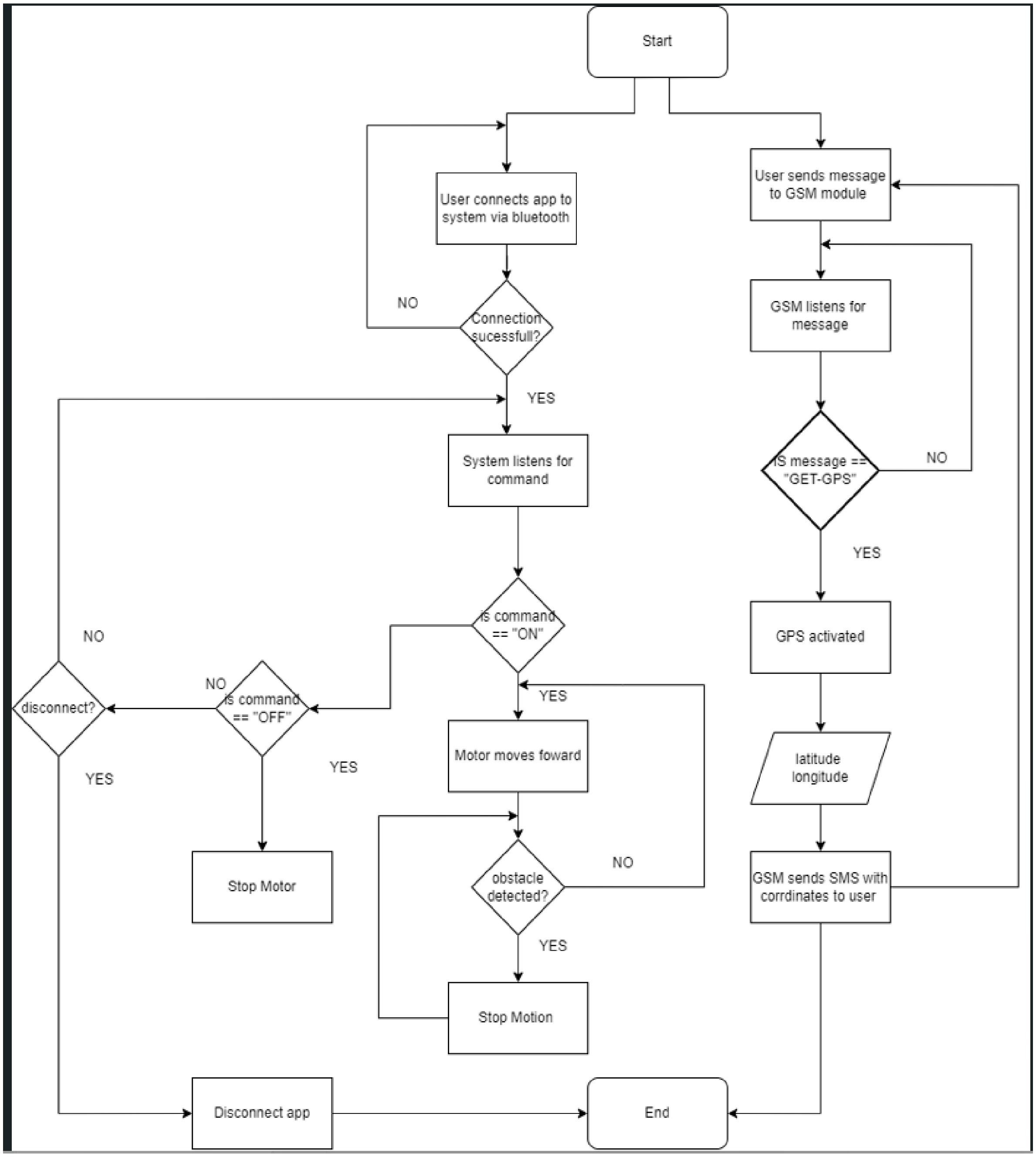

Figure 5.1.a Flow of System

Location tracking:

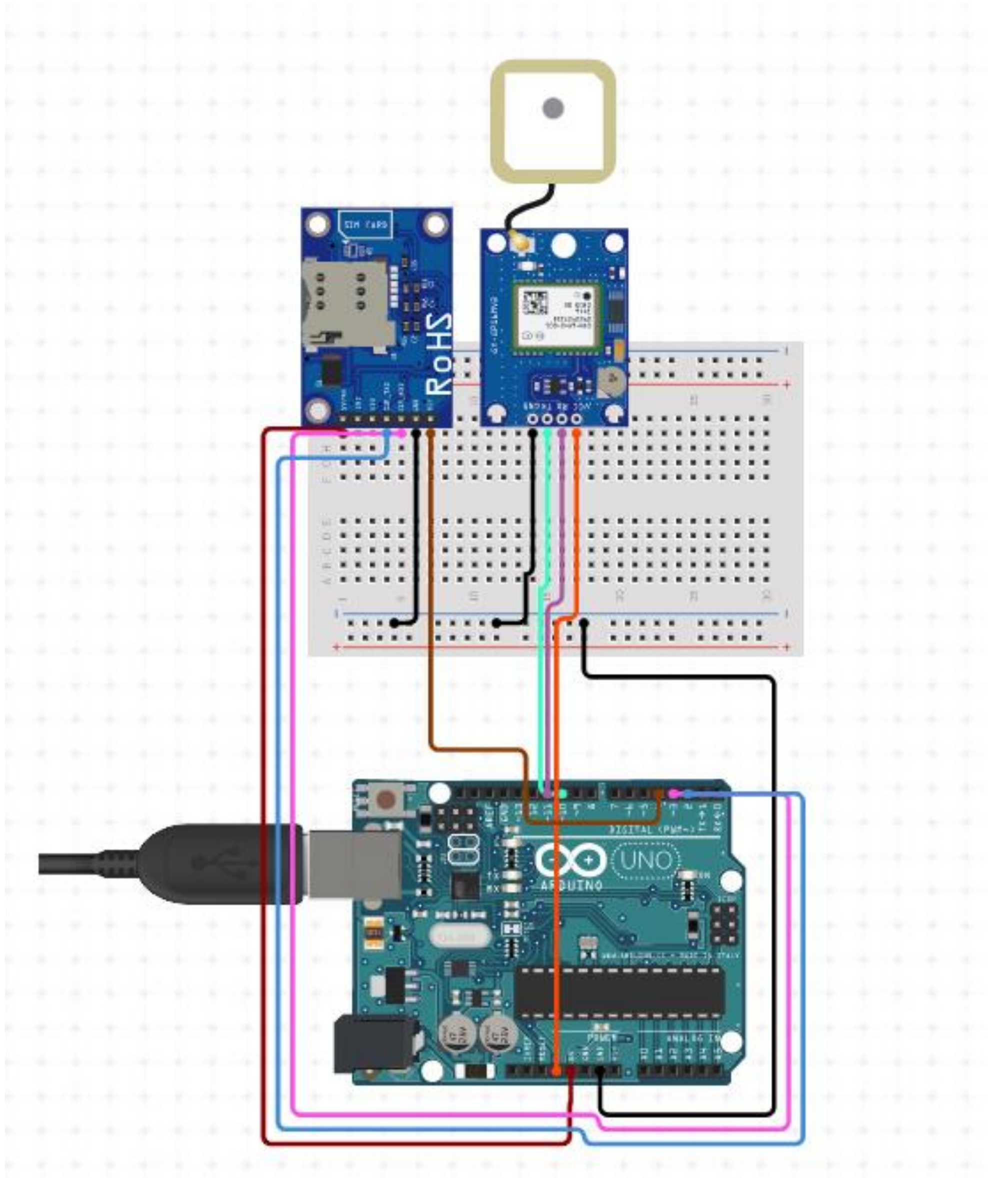

Figure 5.1.b. Location Tracking

The GPS and GSM modules are connected with the arduino as portrayed in the above circuit diagram. Using the Software Serial library, we create two sets of serial ports using which each of the two modules can communicate with the arduino uno board.

The GSM modules operate on a 5V input supplied from the arduino board and it has a ground connection as well. Arduino pins 2 and 3 are converted to RX and TX pins respectively using the software serial library. The TX pin of the GSM is connected to pin 2 and RX pin to arduino pin 3.

The GPS module operates on a 3.3V input supplied by the arduino and is provided with a ground connection. Arduino pins 10 and 11 are converted to RX and TX pins respectively. The TX pin of the GPS module is connected to pin 10 and RX pin to pin 11 or the arduino.

The system initializes the GPS module to get the current coordinates of the bag. These are parsed through the Tiny GPS Plus library to get latitude and longitude coordinates from raw GPS NMEA data. These coordinates are stored as global variables.

Next, the serial ports of the GSM are activated. The GSM is set to listen mode using AT + CMGF =1 and AT + CNMI = 2,2,00 commands wherein it listens for any text messages sent to it. Once the module receives a text message, it checks to see if it matches the trigger message which has been set as “GET-GPS". Only if the text message received matches the trigger message, the system calls the sendSMS() function

Once the sendSMS() function is called, the GSM is set to send mode using the AT + CMGS command and the recipient (in this case the user’s) mobile number is provided. The body of the messages is a google map api link to which the latitude and longitude values, retrieved from the global variables, are passed as arguments. The google map api URL is as follows: “https://maps.google.com/maps?q=" and latitude and longitude values are concatenated as comma separated values at the end of the URL.

This URL is then sent to the user following which the GSM is again set to listen mode to wait for future messages.

Automated Motion with obstacle detection:

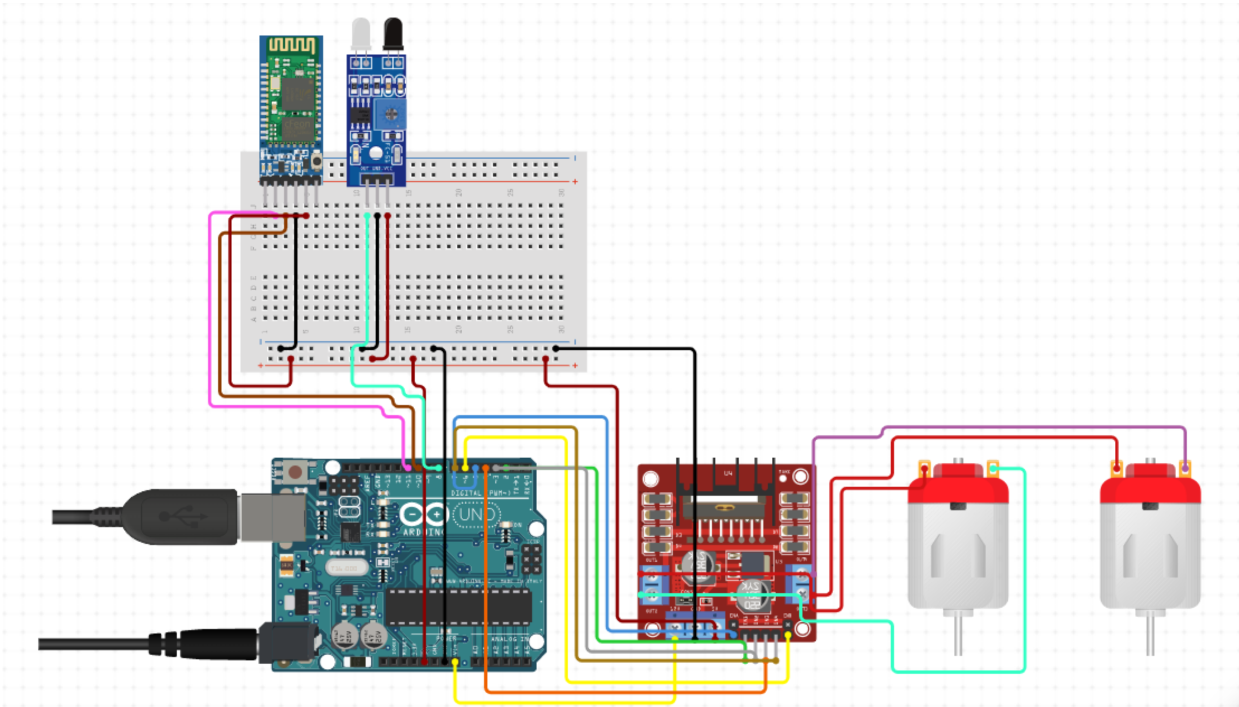

Figure 5.1.c. Automated Motion with obstacle detection

This subsystem consists of three components, the motors and motor driver, an IR sensor to detect obstacles and a bluetooth sensor to connect to the android application.

The two DC motors are connected to a motor driver which is an essential interface between the arduino and the motors. The motor driver enables us to start and stop the motors on command. It also regulates voltage going to the motors. It makes speed control possible by controlling voltage supplied and is also capable of changing the direction of motors. It has two types of pins, EN and IN pins. The EN pins are used for speed control and IN pins for start, stop and direction control. A maximum of two motors can be connected to one motor driver.

The ENA and ENB are connected to arduino pins 5 and 6 respectively while the IN1, IN2, IN3 and IN4 pins are connected to pins 2,3,4 and 7 respectively.

The bluetooth sensor requires a serial port to be setup which has been set as 10 and 11 along with a 5V power connection and a ground connection. The android application connects to the bluetooth sensor. Upon successful connection the user can press buttons on the app which will send specific commands to the arduino via the sensor. On pressing the “ON” button, integer value 78 is sent and on pressing “OFF” the value of 70 is sent. Based on these values, a loop has been setup in the system with an if-else condition. If the value received is 78, the motor pins are set to combination of HIGH and LOW to enable clockwise or forward motion and they start moving and if the vale is 70, the motor pins are set to LOW to stop motion

The IR sensor only requires one digital pin connection apart from 5V power and a ground. Arduino pin 8 is dedicated to receiving the output stream from the sensor. And has been defined as an input pin in the code. If the sensor provides an output of HIGH it means it detects no obstacles and if it sends an output of LOW it means obstacles are detected. A separate loop is setup to analyze the input provided by the IR sensor. It has an if statement with a dual condition which states that the digital pin input should be HIGH and at the same time the command received from the bluetooth sensor should be 78 and only then the motors may move. If the digital pin receives LOW input the motor stops irrespective of the bluetooth command.

These two loops are run in a pseudo-parallel environment using the Simple Timer library by calling each loop every one second to provide the effect that they run in parallel. This causes a maximum delay of one second but this latency is tolerable for our system given the range of the IR sensor.

5.2 Tools Used

After comparing different systems and extensive literature review, this system has been developed using multiple selected technologies that function the best and most accurately for our problem definition. The technologies cater to multiple functionalities for creating serial ports, cleaning GPS data and setting auto timers. The tools and technologies are as follows:

1) Software Serial Library: This library uses software to change the functionality of digital pins on the arduino board and convert them to serial pins to allow serial communication between the arduino and the sensors.
2) Tiny GPS ++ : It parses NMEA data streams provided by GPS modules to extract data like position, date, time, altitude, speed and course. Its interface is simpler than its predecessor Tiny GPS. To use, an instance of TinyGPSPlus is created and it is repeatedly fed characters from the GPS device from which one can query for desired information.
3) Simple Timer: A simple Arduino library for work with time.

5.3 Interface Design

Figure 5.3.a Interface Design

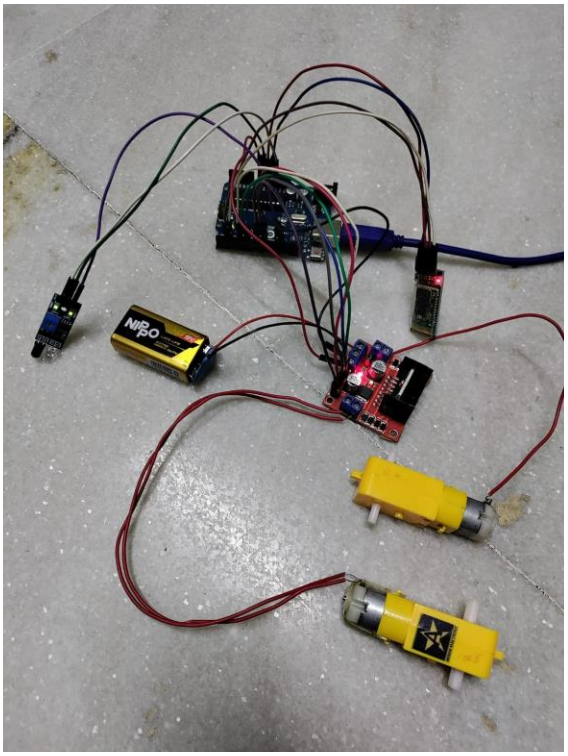

Figure 5.3.b Automated Motion Circuit

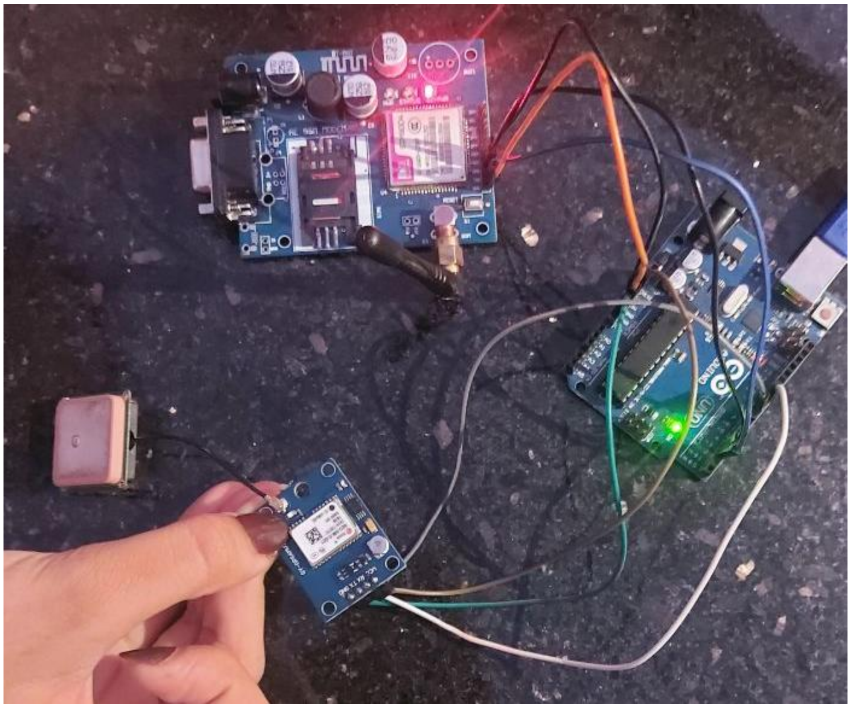

Figure 5.3.c Location Tracking Circuit

The app has an easy-to-use interface.

- A Conect button that is a bluetooth client, which enables user to connect to nearby bluetooth devices.
- ON button which gives command for starting motion
- OFF button which gives command to stop motion

Chapter 6: Testing and Results

6.1. Test Plan

We first outline the features of our system that need to be tested:

a. Motion Detection: We need to detect if our motor driver is connected to the arduino properly or not and with the external battery. Also need to check whether the motors are connected to the motor driver or not. Connection of motor driver and arduino should be correct in proper order with their suitable pin number. After doing so we need to check when the motor driver receives the input voltage and external voltage then the motor should work accordingly.

b. Tracking the Location: GPS and GSM are connected to the arduino and when they receive the input voltage the LED should be turned on. GPS should double link after every 6 seconds. GSM's nwk signal should blink after every 3 seconds. When the message is triggered the GPS should give the exact location of the bag.

c. Obstacle Avoidance: IR sensor used to detect if the obstacle is there or not. It should detect the obstacle and stop the bag from moving. When it receives the signal of some obstacle nearby it should react to our system.

d. User Control: By using the mobile app we can start and stop the motor. So by using the bluetooth module which is connected to the arduino when it gets the supply it should be turned on and should be connected to our bluetooth app. For this it is necessary that the user who is using this product must have bluetooth in their phone. So when the user clicks on stop the bag should stop moving and when we click on start the bag should start moving.

Features not to be tested: These features will not be tested because these are included in the requirements specification section of the report.

a. Hardware Components: This includes study of all the hardware required for the working of the system in depth. We assume that they work correctly.

6.2. Test Cases

Unit Testing				
Sr No.	**Test Case**	**Expected o/p**	**Actual o/p**	**Remark**
1	Arduino with USB	Sensors should activate and code should get uploaded	Sensors activated and code uploaded “ON” LED stable TX pin blinking. Once code is uploaded TX is stable.	Pass
2	Bluetooth, powered on but not connected	Commands from mobile app not sent	Commands from mobile app not sent. Continuous blinking of LED (red)	Pass
3	Bluetooth, powered on and connected	Send commands from mobile app	Send commands from mobile app Double blink every 6 seconds	Pass
4	IR sensor power on	Detecting obstacles	Detecting obstacles VCC LED stable OUT LED: on when obstacle detected OUT LED: off when no obstacle	Pass
5	GSM power on, with sim: network detection	Sending and receiving SMS messages	Sending and receiving SMS messages. DC-PWR led: stable NWK: blink every 3 seconds when network detected	Pass
6	GSM power on without SIM	Should not send and receive SMS messages	Should not send and receive SMS messages DC-PWR led: stable NWK: blinks continuously	Pass

7	GPS in confined space	Detection of satellite	Satellite not detected Blue LED does not blink / blinks occasionally	Fail
8	GPS in open skies	Detection of satellite	Satellite Detected Blue LED blinks continuously at regular intervals	Pass
9	Motor without driver with 9V battery	Spinning of Motors	Motors Spin Motor wheels move very fast at fixed speed and can be stopped and started only by removing / connecting battery	Pass
10	Motor with driver	Spinning of Motors	Motors Spin Motor works with speed control. Can be started and stopped using code.	Pass

Table 5 - Test Cases

Location Tracking				
Sr No.	**Test Cases**	**Expected o/p**	**Actual o/p**	**Remark**
1.	Getting response in confined space	Receive location link	No response	Fail
2.	Getting response in open skies	Receive location link	Receive location link	Pass
3.	Receiving location link with GET_GPS trigger	Receive location link	Receive location link	Pass

Table 6 - Test case of Location Tracking

Automated Motion				
Sr No.	**Test Cases**	**Expected o/p**	**Actual o/p**	**Remark**
1.	Press start button on app	Forward motion of motor	Forward motion of motor	Pass

2.	Press start button on app	Motor stops moving	Motor stops moving	Pass
3.	Pressing ON button while obstacle present	No movement of motor	No movement of motor	Pass

Table 7 - Test case of Automated Motion

6.3. Testing methods used

The testing strategies used for testing our system are:

1. **Unit Testing:** As per software engineering the unit testing is the process that examines the smallest components of an application, known as unit, individual or independent for an specific operation. So in our product we have come across various components so firstly we have researched about each and every component. Then we have implemented one by one components to see whether it's working independently or not. So like this we have tested each and every sensor and module independently.

2. **Integration Testing:** So after doing the unit testing we have done the integration testing. We have integrated the components using the bottom up approach. Taking one component, integrating with another and then integrating another module and so on. Like we have integrated the Bluetooth module with ir sensor then we have integrated motor with them and so on.

3. **System Testing:** Once we have integrated the module then we have tested each module whether they are giving the accurate results or not. Oresle, we need to make some changes to our product. So after integration we have checked our System.

6.4. Experimental Results

1. The inference we get from motion detection is the motor is connected to the motor driver properly and connection is done properly so our motor is working.
2. In low voltage power supply to motor driver then only one motor works and another does not because it is not able to supply the low voltage to both the motor while high power supply to motor driver then both the motor is working respectively.
3. GPS will work when there is open space so when we tested using it in a confined place it was not working as expected and when we tested the GPS in the open it works well.
4. GSM works in a confined place but it takes time to get a range, it will blink continuously if it does not detect the range, once it will detect the range it will work accordingly as expected.
5. When we trigger the message through SMS “GET POST” to the sim which is inserted in it then we get the output of the location as a link of google map.
6. When we click on start the bag starts moving and when we click on stop bag stops moving. The app should be connected to the bluetooth with its specific name once it detects its range then we can control our bag accordingly.
7. The inference we get from obstacle avoidance is when the obstacle is detected our bag stops and when there is no obstacle then our bag starts moving.

Conclusion

It is an innovative carry bag which makes our life easier and smoother. The main aim of the project is to carry the heavy bag and this difficulty is faced by every passenger. So from this project we are trying to solve the problem of dragging luggage and also providing some security. So we have developed this new innovative project at low cost and user friendly. We can also get the location of the system and can stop and start the bag.

Future Scope:

Implementing security and anti-theft features to the bag.

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