Bus tracking system using Radio Frequency Identification (RFID)

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Abstract — In this fast-paced world, people are often in a rush to get where they need to go. Students who rely on buses as their mode of transportation are most concerned about knowing the real-time location of their buses. Bus tracking system concepts provide us with efficient ways to solve the above problem. The current system consists of RFID readers in the buses and tags in bus stops which aid in checking if the bus has crossed a particular stop, IR sensors to detect the number of people in the bus, and GPS and GSM technology to know the current location and send location in the form of messages. This project consists of individual RFID cards for each and every student to detect the identity of the students. When students board the bus, a GSM network is utilized to send text messages to parents, updating them on their child's whereabouts. Through this method, the location of the buses along with the safety of the students is ensured.

Keywords— RFID reader and tags, GPS, GSM, SMS, and IR Sensors.

I. INTRODUCTION

Today's world is driven by technology's continuous advancements. Innovation and advancements in technology worldwide have contributed towards improving people's daily lives, making them more convenient and efficient. Transportation plays a major role in people's lives. Thus, knowing the real-time position of their buses is of the utmost importance for those who utilize buses as their primary source of transportation. Concepts for bus tracking systems give us effective solutions to this issue. This project is designed for students who depend on buses for their mode of transportation and are in need of knowing the real-time location of the buses. The tracking system is developed using RFID and GPS technology which provides promising results. Radio Frequency Identification (RFID) is a wireless technology that operates through the use of electromagnetic fields which identify objects that are attached to the tags automatically. The Radio Frequency Identification (RFID) system comprises two primary components - tags and readers. The reader is equipped with one or more antennas that emit radio waves and receive signals in response from the tags. Similarly, the Global Positioning System (GPS) is a satellite-based radio-navigation system. It is the most widely used and versatile method for tracking any object. Through the system developed from the above technologies, students will be able to resolve problems pertaining to the current location, the bus timings, and the routes that the bus will travel. It would help students to be on time for their desired destinations.

II. LITERATURE SURVEY

Previous studies have utilized various techniques for tracking bus locations, including IoT-enabled real-time bus tracking systems that employ ultra-high frequency RFID (tags and readers) for real-time location tracking. Users could access bus status in real-time via a mobile application[1]. GPS technology integrated with IoT was also employed to track bus movements, with the bus's current location updated via Google Map API. The system was designed to emit an alarm signal to the driver when users were near a bus stop[2]. Automating the system's services resulted in a real-time bus tracking experience for public transport. Buses were equipped with RFID tags, and RFID readers were placed at every bus stop, with the Arduino acting as the central controller for the system[3]. An adaptive location estimation method and GPS approach-based bus tracking system, called Bus Tracking System, was proposed for location estimation[4]. Another IoT-based bus tracking system employs RFID technology and ThingSpeak web server to track buses and display bus locations and seat availability via an Android application[5]. The Autonomous Informative Service for Bus Route Maps (AISFBRM) was also developed, utilizing GPS to obtain bus location with the assistance of Google Maps, and RFID for bus identification and fuel-related transactions. The entire information for a particular bus was stored in a database on the server side[6].

III. SYSTEM REQUIREMENTS

Hardware Requirements:

- Arduino Mega
- RFID reader
- RFID tag
- Global Positioning System (GPS)
- Global System for Mobile communication (GSM)
- Infra-Red (IR) Sensors
- Liquid Crystal Display (LCD)

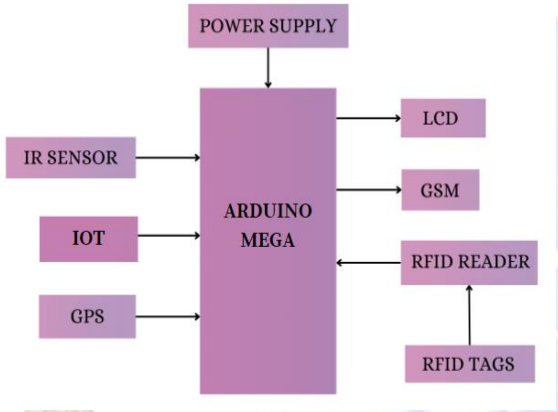
Software Requirements:

- Embedded C
- Arduino IDE

IV. PROPOSED SYSTEM

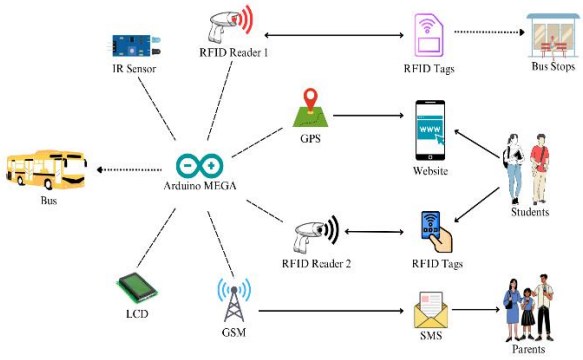
The complete system is monitored and controlled using the Arduino Mega micro controller. The setup consists of multiple components such as an RFID reader that emits radio waves and receives signals from RFID tags, a GPS module from which the location of the bus is obtained, an IR sensor that is attached to the front and back doors of the bus to detect the ENTRY and EXIT of students and a website that gives the current location of the bus on request from the student.

Our proposed system combines all the useful features of existing systems into a single system for benefit of the students. RFID tags and RFID readers are used in every possible way to make tracking easier and more efficient. In addition, individual RFID cards for every student to detect the identity of the students who are embarking on the bus. GSM sends text messages to parents to inform them if the student has boarded the bus.



Working:

The major components of this are RFID readers and tags that are placed on the busses and bus stops respectively. An Arduino Mega board is placed on the bus to which the working components namely RFID readers, GPS, GSM, IR Sensors, and LCD are attached. If the bus crosses a particular bus stop, it will receive the signals from the tags present at the bus stops, using the RFID reader present in the bus. Thus, the bus stop is identified and the data will be updated on the website using IoT. Students will be able to obtain the details regarding the bus stops crossed by the bus from the website. The students can find the details regarding the bus, which are updated on the website by the GPS module present on the bus, such as checking whether the bus has crossed a particular stop. An IR sensor is affixed to the bus doors, which enables the tracking of students ' enter and exits from the bus. The LCD displays the name of the bus stop on the bus. In addition to this, individual RFID cards with a unique 12-digit number will be given to every student to detect the identity of the pupils who are embarking on the bus. Text messages are dispatched to parents, providing them with updates regarding their child's entry and exit from the bus.



Modules:

1. Location Identification

The central focus of this initiative is to determine the precise location of the bus through the utilization of the Global Positioning System (GPS) installed within it. Students can access the bus's location through a website and also check whether the bus has crossed a particular stop.

2. IoT storing process

All information about the stops crossed by the bus is collected from the Arduino Mega controller using IoT. Then all the information is displayed on the website.

3. Student identification

To verify the boarding status of the students, individual RFID tags with a unique 12-digit number will be provided. The radio signal emitted by the tags will be received by the reader on the bus. Two IR sensors are attached to the bus doors, which are used to count the entry and exit of students from the bus. Thus, detailed information regarding the boarding status of the student can be obtained. The LCD displays the name of the bus stop on the bus.

4. SMS Module

With the assistance of the provided information, a GSM network will be utilized to send a Short Message Service (SMS) to the mobile number of the parents obtained from the RFID tags to inform them about the entry and exit of the student from the bus.

V. CODE

E1200-1_EUNO_STUDENT.ino

File Edit View

```
#include "global.h"
#include "ss.h"
#include "set_up.h"
#include "lcd.h"
#include "bus_count.h"
#include "rfid.h"
#include "rfid2.h"
#include "gsm.h"
#include "gps.h"
#include "iot.h"

void setup() {
  // put your setup code here, to run once:
  set_up();
}

void loop() {
  // put your main code here, to run repeatedly:

  if (count_flag == true) {
    count_C++;
    bus_count();
    lcd.setCursor(1, 1);
    lcd.print(count_C);
  }
  if (count_C > 0) {
```

E1200-1_EUNO_STUDENT.ino

File Edit View

```
if (count_C > 0) {
  if (ir_in == 0) {
    ss1.begin(9600);
    if ((rfid_S() == 1) || (rfid_S() == 2) || (rfid_S() == 3)) {
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("STUDENT " + String(rfid_S()) + " PICK");
      lcd.setCursor(0, 1);
      lcd.print(0, 1);
      lcd.print("    THE BUS    ");
    }
  }
  if (count_C >= 60) {
    if (flag_S1 == false) {
      GSM_SEND("9363447400", "STUDENT 1 DIDN'T PICK THE BUS");
    }
    if (flag_S2 == false) {
      GSM_SEND("6385112364", "STUDENT 2 DIDN'T PICK THE BUS");
    }
    if (flag_S3 == false) {
      GSM_SEND("6379760451", "STUDENT 3 DIDN'T PICK THE BUS");
    }
    if (flag_S1 == true && flag_S2 == true && flag_S3 == true) {
    }
    count_C = 0;
    count_flag = false;
    ss.begin(9600);
```

E1200-1_EUNO_STUDENT.ino

File Edit View

```
if (rfid() == 1) {
  rfidno = 0;
  rf_no = 1;
  lcd.clear();
  lcd.setCursor(0, 1);
  lcd.print("   BUS @ GUNDY  ");
  digitalWrite(APR_GUNDY, LOW);
  delay(1000);
  digitalWrite(APR_GUNDY, HIGH);
  IOT_SEND("*BUS @ GUNDY#");
}

if (rfid() == 2) {
  rfidno = 0;
  rf_no = 2;
  lcd.clear();
  lcd.setCursor(0, 1);
  lcd.print(" BUS @ SAIDAPET ");
  digitalWrite(APR_SAIDAPET, LOW);
  delay(1000);
  digitalWrite(APR_SAIDAPET, HIGH);
  IOT_SEND("*BUS @ SAIDAPET#");
}

if (rfid() == 3) {
  rfidno = 0;
  rf_no = 3;
```

E1200-1_EUNO_STUDENT.ino

File Edit View

```
  rf_no = 3;
  lcd.clear();
  lcd.setCursor(0, 1);
  lcd.print(" BUS @ MAMBALAM ");
  digitalWrite(APR_MAMBALAM, LOW);
  delay(1000);
  digitalWrite(APR_MAMBALAM, HIGH);
  IOT_SEND("*BUS @ MAMBALAM#");
}

if (rfid() == 4) {
  rfidno = 0;
  lcd.setCursor(0, 1);
  lcd.print(" BUS @ COLLEGE ");
  digitalWrite(APR_COLLEGE, LOW);
  delay(1000);
  digitalWrite(APR_COLLEGE, HIGH);
  GSM_SEND("9363447400", "STUDENTS REACHED COLLEGE");
  delay(2000);
  GSM_SEND("6385112364", "STUDENTS REACHED COLLEGE");
  delay(2000);
  GSM_SEND("6379760451", "STUDENTS REACHED COLLEGE");
  delay(2000);
  IOT_SEND("*STUDENTS REACHED COLLEGE#");
}
```

E1200-1_EUNO_STUDENT.ino

File Edit View

```
if (loc_track == true) {
  loc_track = false;
  ss2.begin(9600);
  if (rf_no == 1) {
    if (sms_from == 'A') {
      GSM_SEND("9363447400", "STUDENT LOCATION");
    }
    if (sms_from == 'B') {
      GSM_SEND("6385112364", "STUDENT LOCATION");
    }
    if (sms_from == 'C') {
      GSM_SEND("6379760451", "STUDENT LOCATION");
    }
  }
  if (rf_no == 2) {
    if (sms_from == 'A') {
      GSM_SEND("9363447400", "14.00,15.00");
    }
    if (sms_from == 'B') {
      GSM_SEND("6385112364", "14.00,15.00");
    }
    if (sms_from == 'C') {
      GSM_SEND("6379760451", "14.00,15.00");
    }
    ss.begin(9600);
  }
```

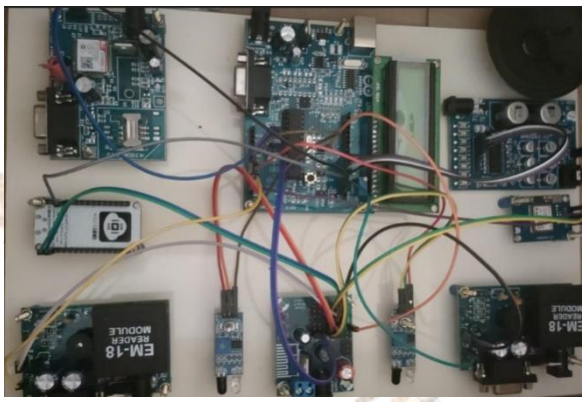
E1200-1_EUNO_STUDENT.ino

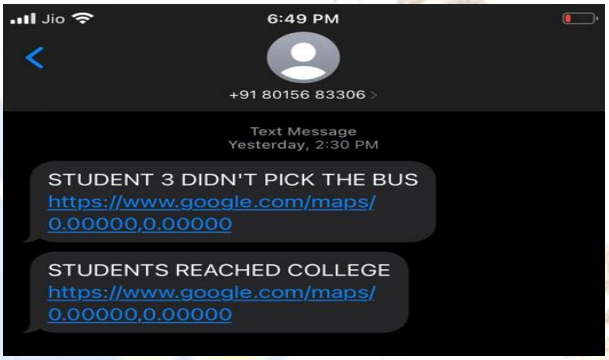
File Edit View

```
    if (sms_from == 'B') {
      GSM_SEND("6385112364", "16.00,17.00");
    }
    if (sms_from == 'C') {
      GSM_SEND("6379760451", "16.00,17.00");
    }
  }
 }
 delay(1000);
}

void serialEvent() {

 while (Serial.available() > 0) {
  gsm_req = Serial.read();
  if (gsm_req == 'A') {
    loc_track = true;
    sms_from = 'A';
  }
  if (gsm_req == 'B') {
    loc_track = true;
    sms_from = 'B';
  }
  if (gsm_req == 'C') {
    loc_track = true;
    sms_from = 'C';
  }
```

VI. RESULTS

The tags are read by the RFID reader on the bus, and the stop details are then displayed on the website. The parents are notified via text messages regarding the boarding status of the students.





VII. CONCLUSION

By using this efficient bus tracking system, the students who use the buses as their mode of transportation can accurately determine the location of the bus, as well as obtain information regarding the various stops that have been passed. The safety of the students can also be ensured with the help of individual RFID tags which provide essential boarding status (IN/OUT) messages to their parents. Thus, by implementing this effective bus tracking system students, parents, as well as the organization, will be benefited greatly.

VIII. REFERENCES

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