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Research Article

Using embedded systems programming to develop an intelligent system for tracking public transport vehicles in Samawah city

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Abstract

With the development of software systems and their heavy reliance on them to help humans, especially imbedded systems, it was necessary to develop a smart system that would alleviate traffic congestion in the city of Samawah.

The high traffic congestion in the city of Samawah, especially during official working hours (beginning and end of work), has made employees, students, workers and citizens spend a lot of time waiting for the vehicle and thus delay reaching their workplace, which has led to the need to find a real solution to this problem. Perhaps the best solution is to create an application that makes citizens aware of the locations of public transport vehicles accurately and invest time until they approach their location. This application relies mainly on the radio navigation system to provide communication between the user and the vehicle, which is abbreviated as (GSM), which works by determining the latitude and longitude. The application has been programmed to receive accurate information about the location of the vehicle and notify the user of its location continuously via the Global Positioning System (GPS). The maximum benefit can be achieved from the application by linking it with the largest possible number of vehicles and using it by a larger number of users to save time and effort.

This application can be developed and expanded to include taxis, which further organizes the traffic process.

Keywords: *Mobile applications, embedded systems, Arduino, public transport vehicles, GSM, GPS.*

1. Introduction

To achieve the research objective in the different stages of work, we relied entirely on the working mechanisms of the Global System for Mobile Communications (GSM) and the Global Positioning System (GPS), as the process of tracking vehicles and knowing their locations is the main aim of the research. The application can be easily used by the user after connecting it to the device that we designed, programmed and placed in a group of vehicles. The GSM modem was programmed to achieve communication between the vehicle and the user's mobile device that contains the application [1]. By connecting the application to the Internet, the location of the vehicle is continuously determined, which makes it easy for the user to determine the times of vehicle availability and movement within the appropriate time. These technologies are widely used in Europe, the United States, Russia and many Asian countries, and have not been used in Iraq yet. Similar applications are also used to track children or the elderly and even track pets or wild and marine animals [2].

In this research, we proposed the appropriate solution to this problem in the city of Samawah, which is the center of Muthanna Governorate in southern Iraq. It is considered one of the small cities that has recently begun to suffer from traffic congestion, which facilitates the process of applying this technology in it and achieving tangible success [3]. The

city of Samawah contains a group of vital centers such as universities, government buildings and important markets, which constitute a large percentage of the population density and cause traffic congestion in their surroundings, as shown in figure (1).

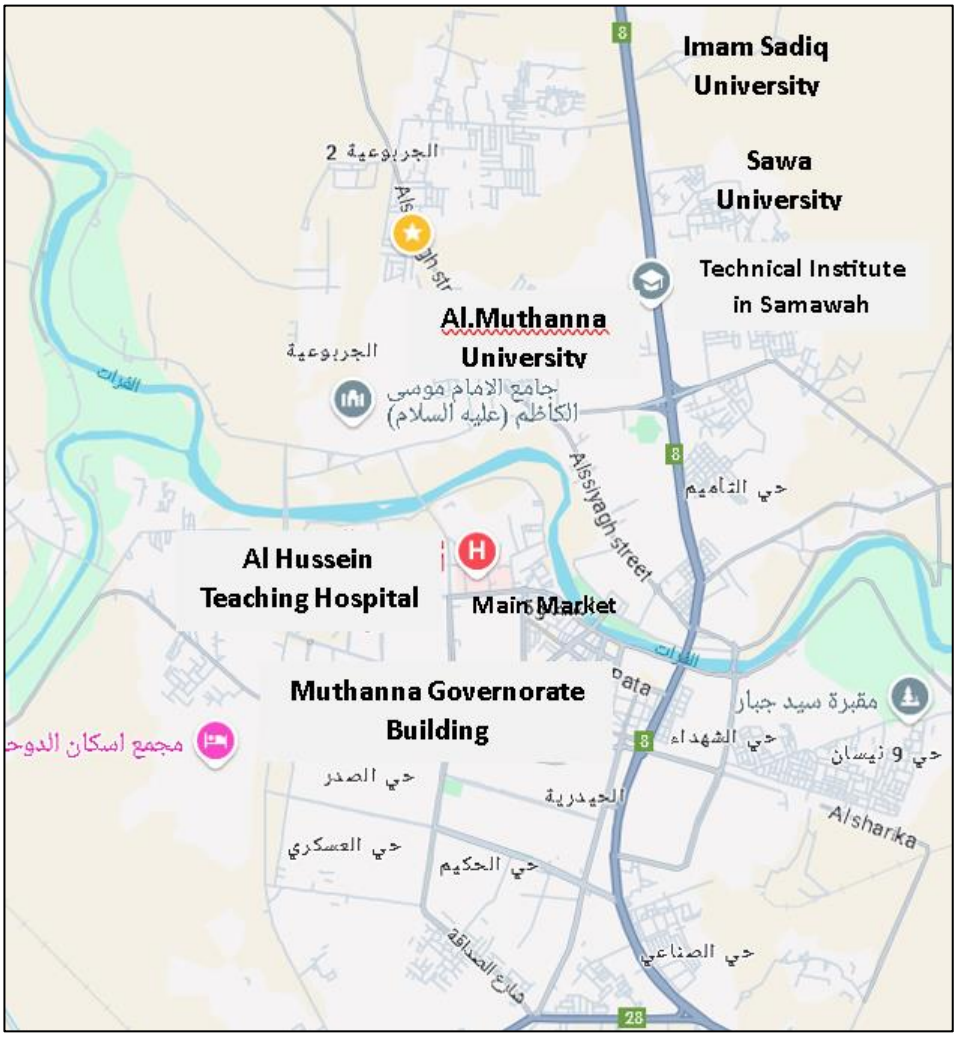

Figure (1) most important vital centers in the city of Samawah

Determining the arrival time of public transport vehicles is one of the problems that affect the citizen, who sometimes has to wait for a long time and sometimes misses the vehicle and waits for a longer time. This study simulates the solution to this problem by installing a GPS device on a group of vehicles that sends notifications of the vehicle's location to the user via the application, which helps the user determine the location of the vehicle and the time required for it to arrive at the station [4-5].

Related Work

Many GSM technologies have been used to track different objects. Some systems are used to track children, others are used to track wild or marine animals or birds, and others track taxis [6]. Some researchers have used the Internet of Things to track vehicles and obtain the most accurate and best results [7]. Others have used GSM to track wild animals [8]. Later some authors have developed methods to monitor their children in or out of schools to protect them [9]. Perhaps the most prominent applications are the widespread taxi tracking applications in the world.

Some have dealt with their studies with complete professionalism in building tracking systems based on Arduino, GPS and GSM, which ensure sending and receiving data that includes the locations of vehicles accurately [10]. As for SeokJu Lee, Girma Tewolde and Jaerock Kwon, they relied on (GSM / GPRS) in addition to (GPS) in building their systems that track vehicles at any time and any place [11].

A group of researchers such as Saw Nang Paing, May Zin Oo, Mazliza Othman, and Nobuo Funabiki have developed systems that detect the locations of stolen cars by relying on the same elements that send and receive signals that include the locations of cars [12-13].

In a previous study, we used an application to track school children, which achieved good success rates and reduced the percentage of children lost or delayed [14].

2. Project Methodology

The model we made is a miniature model of a large project. We relied on a set of easily available tools to design this system, which are a GPS antenna, a GPS receiver, and an Arduino Mobile modem. Here we will use (Arduino pro mini) and GSM in addition to a mobile device. So, this system will consist of two main parts: the transmitter part and the receiver part [15].

Arduino is an opensource electronic platform that relies on easy-to-use hardware and software. It is a microcontroller interface built around the Atmel ATmega processor in addition to a programming language and environment to create the application on the chip [16].

Because the project is a miniature model, we used Arduino mini. To facilitate the programming process, we used Arduino IDE, which is somewhat easy to use, so it is preferable to use it to program Arduino boards. The process of writing the code necessary to implement the required commands is done, then it is connected to the Arduino board, which is stored on it in a special memory. The code for the system program is written, which includes commands that allow Arduino to communicate with GSM and GPS and accept data from GPS and send it via mail using GSM [17]. As shown in the flowchart in figure (2):

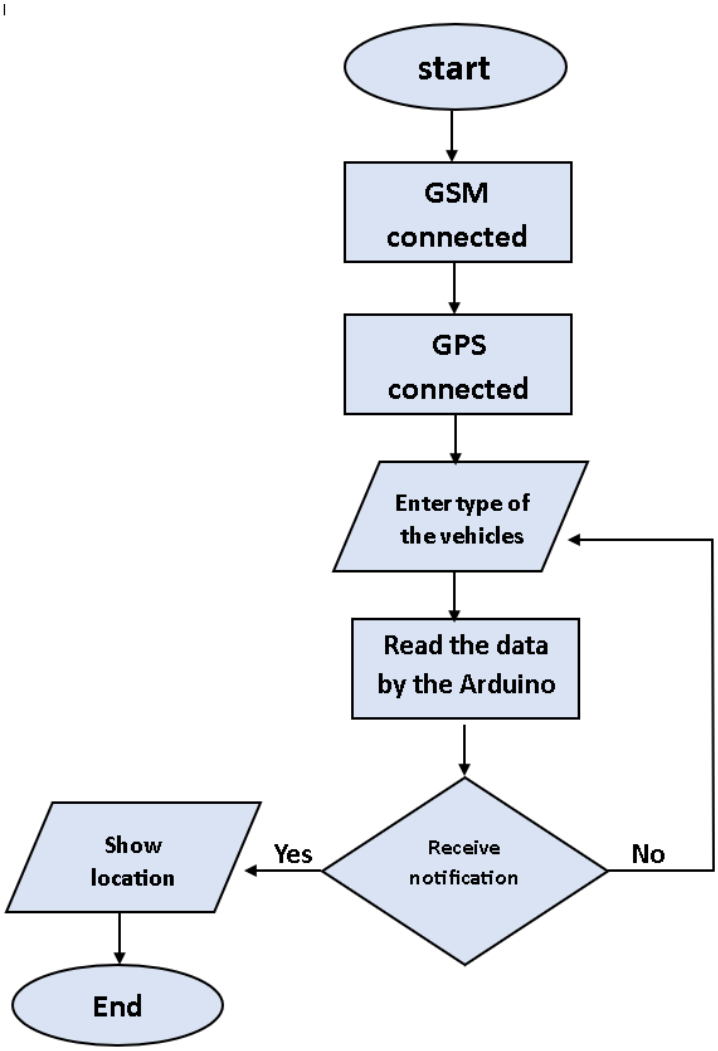

Figure (2) Stages of building a tracking system

3. System parameters

4.1 Ublox NEO-6M GPS Module with EEPROM and Antenna:

It is a GPS module used to determine location using satellites and can work with Raspberry Pi, Arduino and PIC. It can be connected directly to controllers via the Serial Port protocol and is handled directly through libraries dedicated to it [18].

4.2 Arduino Mini

It is considered one of the most important and popular elements of embedded systems because it is low cost, small in size and flexible in use. There are two versions of the board: one that operates at 5V (like most Arduino boards), and one that operates at 3.3V. It is programmed using Arduino software (IDE), which is an integrated development environment that brings together all our boards and the work is organized online [19]. The components of the system can be illustrated as shown in the diagram in Figure (3).

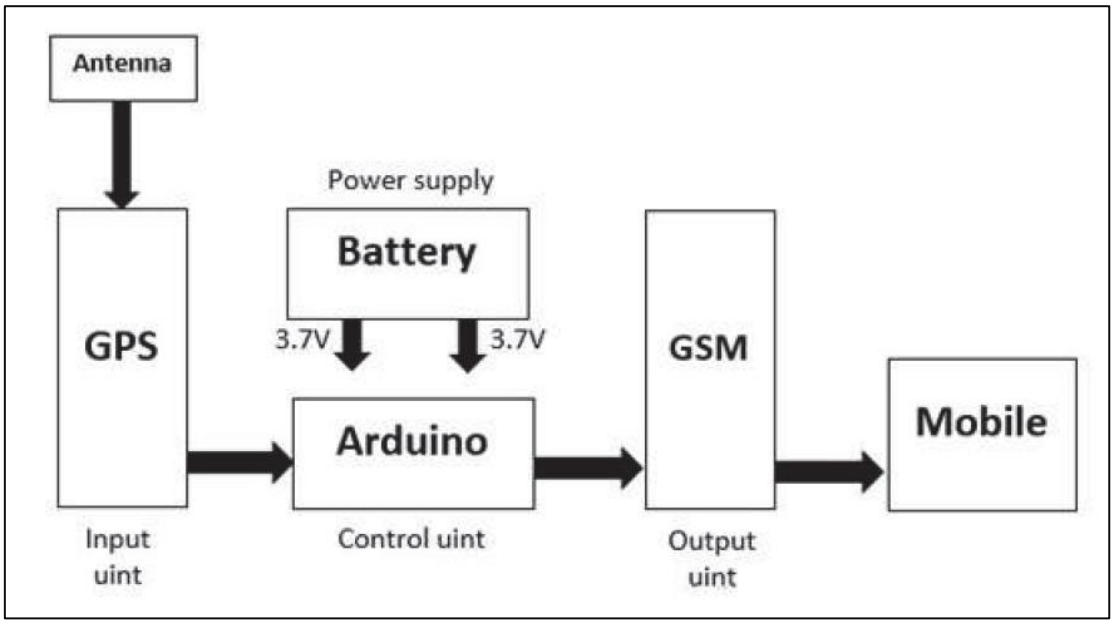

Figure (3) System Component Flowchart

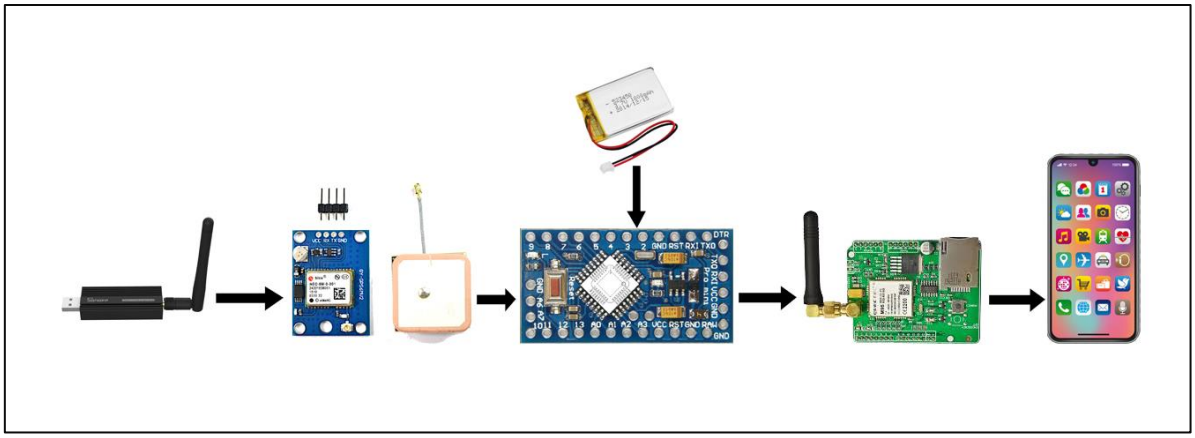

Figure (4) System structure

4. Results

The GPS and GSM systems that we used in our vehicle tracking system showed good and accurate results for the models we adopted in the system in terms of determining the locations of vehicles at the required time, thus saving effort and time for the user, as the user follows the movement of the vehicle from the starting point to his location through continuous notifications of the vehicle's location.

The system was tested on 30 people from different areas of the city and at different times, and the devices were connected to 10 vehicles whose starting point was at different times and locations. The results were positive for the users as they monitored the targeted vehicles and synchronized their exit with the time of their arrival to their areas, as well as tracking vehicles that precede peak traffic congestion times, which helped them solve the problem of being late for work [19].

5. Conclusion

The application is used to accurately and continuously locate the vehicle using GSM based on longitude and latitude lines by tracking the vehicle in a specific area and sending notifications to the user via his mobile phone using a GSM modem. The results were good in determining the location of the vehicle from the starting point to the user's location along the way, which saved effort and time for the user and contributed to solving the problems of being late for work and getting rid of traffic congestion [20].

This system can be developed to be available to all people in the city and cover various public transport vehicles.

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