Abstract

Nowadays, the rapid evolution in transportation technologies makes the necessity for avoiding and reducing traffic accidents to increase road safety and save lives. A smart onboard GPS/GPRS based wireless controlling system proposed to be implemented and attached to vehicles, thus will provide the capability for monitoring and controlling the speed of vehicles. When there is a traffic speed violation, a GPRS message contains information about the vehicle such as location, maximum speed is sent to a hosting server located in an authorized office, and therefore, the violated vehicle is ticketed. Issuing penalties makes the driver always feels under control, this will help in decreasing the chances of drivers’ fraudulence. An additional feature, is tracking by plotting the vehicle current location in terms of longitude and latitude coordinates on a Google earth map. This would be useful for public transportation when vehicles are not allowed to go everywhere, and a specific route should be followed instead. Tracking may consider a great advantage in case of robbery. Moreover, geo-casting will be a major role for this model. In addition, some sensors are attached to the microcontroller, such as shock/vibration sensor which is usually attached to the air-bags in vehicles; in case there is an accident, the system will send notifications to the nearest hospital, police station and civil defense. This would be useful in saving people and avoiding traffic jam. Our proposed model can be implemented and utilized in many areas for different applications; either public or private sectors, for example, in public transportation, renting company, social tracking, etc. To be the first model in Palestine that supports both ticketing and tracking and accidents notifications system, while similar existing models considered as tracking systems only.

Keywords: GPS; GPRS; Transportation; Ticketing; Tracking

1. Introduction

Recent studies show that the worlds, including Palestine, have been exhibiting a rapid increase in vehicle numbers. The latest statistics show that there are approximately 140,000 licensed vehicles in West Bank in 2011. About 17,000 of them are newly registered [1]. As a result, traffic crashes increases in past few years in West-Bank. It was investigated that the lack of proper infrastructure for roads, is one of the reasons for these crashes. Moreover people by nature are not willing to deter something. Unless they are obliged by laws and threatened to pay large fines or to get penalty, the resulting costs of damages adding to that an extra burden to the society. So we find it convenient to study this issue. Figure 1 depicts the number of traffic accidents distributed among all West Bank cities.

A transportation management system is developed for enhancing public transportation services based on GSM and GPS integration.

1.1. GSM Technology

Global System for Mobile Communications, originally (GroupeSpécial Mobile), is the world’s most popular mobile telephone system. 80 percentages of mobile operators use this standard, providing services to over 1.5 billion people across more than 212 countries. This is because GSM is the first mobile generation which provides services and ability to roam and switch carriers without replacing phones, and also to network operators. General Packet Radio Service GPRS represents an evolution of the GSM standard, allowing data transmission in packet mode and providing higher throughputs compared with the circuit switched mode.

1.2. GPS Technology

Global Positioning System (GPS) is a worldwide
radio navigation system formed from the constellation of 24 satellites and their ground stations. The Global Positioning System is mainly funded and controlled by the U.S Department of Defense (DOD). The system was initially created and designed for the U.S. military use. But nowadays, it is available for civilian, without any kind of charge or restrictions. Global Positioning System tracking is a method of working out exactly the position of GPS sensor’s holder based on a simple mathematical principle called trilateration or triangulation. Trilateration falls into two categories: 2-D Trilateration and 3-D Trilateration. It requires having at least four satellites transmitting coded signals from known positions. Three satellites are required to provide the three distance measurements, and the fourth to remove receiver clock error [3].

A GPS tracking system can work in various ways. Active and passive tracking. In Passive tracking the position is usually stored in internal memory or on a memory card along the ride, while in the active tracking, also refers to a real time tracker, data is to be transmitted to central database via a modem within the GPS unit [4].

The paper is organized as follows: the first chapter gives an overview about the problem. Related works are discussed in the second chapter. The model components are introduced in chapter three. System requirements are described in chapter four. The project description is proposed in the fifth chapter, the sixth chapter describes the ongoing work, while conclusions are introduced in the final chapter.

2. Related Work
Several GPS and GPRS based models have been designed for managing and organizing transportation systems. Patinge and Kolhare developed a GPS based urban transportation management system in which the fleet tracking using GPS and GSM/GPRS technology and public information system unit mounted at bus [2]. Kumar and Prasad attempted to enhance public transportation management services based on GPS and GSM [3]. Optimizing the traffic and passenger flows and improving system management, integrated real-time information on the traffic situation in the urban area (e.g. concerning parking spaces, congestion, and public transport) can be provided by CIVITAS II [5]. Goud and Padmaja proposed a useful approach in detecting accidents precisely by means of both vibration sensor and Micro electro Mechanical system (MEMS) or accelerometer [6].

3. Model Main Components
3.1. GSM-GPRS Module
A GSM module is a wireless transmission module that works with a GSM wireless network. It behaves like a dialup modem. The main difference between GSM module and dialup modem, is that a dialup modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The module can be connected to a computer through a serial cable or a USB cable. In our project we use the SM5100B Cellular Shield, since it is easy to deal with and more flexible, also it supports AT Commands. It has unlimited transmission range and distance, so we can use it in any place. GSM can easily send and receive data across the mobile network, and it can transmit instructions, commands, SMS and receive them from microcontroller [7].
3.2. Arduino Microcontroller

The Arduino Uno is a microcontroller board, which has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC to DC adapter or battery to get started [7].

3.3. GPS-11058 Module

GPS-11058 is a development board that uses the smallest, most powerful, and most versatile GPS receiver. The module can be configured to an amazingly powerful 10Hz update rate, with 14 channel tracking. It has two serial ports, UART and SPI interfaces, 28 mA operating current and high sensitivity. It needs to connect it with an external battery or super capacitor to the board, to support very fast restarts after power is removed. There are even pads on the bottom of the board for the 0.2F super capacitor, which keeps the board hot start-able for up to 7 hours without power [7].

4. System Requirements

Our system is designed to run over windows server platform, with web services in addition to PHP and Mysql database.

5. The Proposed Ticketing and Tracking Model

Our proposed model performs online monitoring, ticketing, tracking, and geo-casting. If an accident occurs in a certain area, all the vehicles within a range of specific geographical coordinates will receive a message to choose another road trip. So, traffic jamming and unnecessary delays can be avoided and help in saving time and money. GPS receiver is used to determine the position and speed of vehicles. The location is used for tracking, while the measured speed is to be compared with a limited, predetermined value stored in the microcontroller, extracted from legal maps. When the vehicle’s speed is approaching the specified limit, alarm will go on to warn the driver. If the driver don’t slow down, and the speed is still increasing and exceeding the maximum allowed speed, GPRS packet containing the speed will be sent to the hosting server. The ticket will be registered at the server side. Moreover, SMS will invoice the driver about his ticket. Because, GPS signal requires Line Of Sight (LOS), in case, there is no valid GPS signal; accelerometer is used to measure the vehicle’s speed.

For accidents prevention and notification, we will use vibration sensor which is attached to the vehicle’s air-bags. When air-bags are launched, then an accident is detected. So the nearest hospital is informed to help and send paramedics to handle the situation and all other vehicles near the crash will
receive a message to configure another route. GSM/GPRS module and GPS sensor are being controlled using an Arduino microcontroller. Also, different programming languages will be used such as PHP, Java Scripts and HTML for the web design. AT commands are used for programming the GSM/GPRS module. Figure 5 illustrates the proposed model.

![Figure 5. The proposed model.](image)

5.1. Flowchart

Figure 6 depicts the flowchart of our project, starting with measuring the speed and location of a vehicle, as longitude and latitude points. These readings will be compared with standard specified value stored in the microcontroller. If the new measured speed is about to exceed a certain level, an alarm will be activated. If the driver is still speeding up and exceeding the maximum allowed speed or threshold for about 10 seconds, GPRS packet will be sent to a server. So the driver would be ticketed. If there is a need for tracking, coordinates will be transmitted to our web page, to be plotted over Google map. Tracks can be online, by sending the coordinate periodically or offline by storing location on the located memory.

6. Ongoing Work

We will keep working to achieve the proposed model, and consider additional features to the designed model. To add the vibration sensor and complete the geo-casting procedures, all the vehicles within a range of specific geographical coordinates will receive a message to choose another route, so traffic jamming and unnecessary delays can be avoided, help in saving time and money, leading to cutting in crashes expenses, decreasing the number of resulting casualties, all this in favor of human road safety.

![Figure 6. Model flowchart.](image)

7. Conclusions

Saving and protecting souls needs both government and Drivers Corporation and commitment. Much efforts and money will be essential to accomplish and maintain a very good level of road safety. Our target is to design a Low cost GPS/GPRS based wireless controlling model. Due to the wide spread of GSM network which increases the chance for applying this model in many areas around the world. The proposed model hope to be able to achieve what is meant for, reducing road traffics, leading to cut in crashes expenses, decreasing the number of resulting casualties. All these in favor of human road safety.
The economical study shows the feasibility of our project. After running our model for long enough period, we expect that tracking and ticketing system can be fed by authorized department which can be utilized to get clear view about infrastructure which can be used for developing and planning to improve the infrastructure on some field or apply some regulations which will aim to reduce traffic accidents.

REFERENCES


