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An Overview of Emergency Call Systems Used in Highway Vehicles

Atilla Ergüzen[1], Ahmet Özcan[2]

[1]Associate Professor, Department of Computer Engineering, Kırıkkale University, Kırıkkale, Turkey
[2]Instructor, Department of Computer Engineering, Kırıkkale University, Kırıkkale, Turkey

ABSTRACT

The number of vehicles participating in road transport worldwide is increasing every year. It is estimated that there are currently 1,400 billion vehicles on the road around the world. Since new vehicles are added to traffic every day around the world, an exact figure cannot be given. In Turkey, hundreds of thousands of vehicles participate in traffic every year. As the number of vehicles increases, the number of traffic accidents also increases. In 2020, there were about 150 thousand traffic accidents with deaths and injuries in Turkey.

It is important to provide first aid to the injured persons as soon as possible after a traffic accident occurred. The location of the accident site has a great impact on the survival rate of the injured persons. In the case of road accidents that occur in the settlement, the intervention of people in the area and calling the emergency services will ensure that first aid accurately is provided in a short time. However, when road accidents occur outside residential areas or in unpopulated areas, the number of fatalities increases. For this reason, emergency call systems in road vehicles are important for the timely provision of first aid. In European Union countries, emergency call systems have been deployed in new vehicles with eCall application since 2007. However, it is known that a large number of older design vehicles are still in use in the European Union, Eastern European countries, Turkey. In this study, the emergency call systems (eCall) actively used in Turkey and Europe are investigated and the situation is determined.

KEYWORDS: *Embedded system, Accident, First aid, Emergency, Gsm, Gprs, eCall*

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I. INTRODUCTION

Accidents that result in property damage, injury, or death on highways are called traffic accidents. Traffic accidents cause loss of life or economic damage worldwide. According to the data of the Turkish Statistical Institute for the year 2020, a total of 983,808 traffic accidents occurred on the Turkish road network. Of these accidents, 833,533 were road accidents with property damage and 150,275 with deaths and injuries [1].

Today, with the increasing number of satellites and the spread of GSM network, vehicles traveling on the road can be monitored and even controlled through satellite systems. By installing emergency response systems in new vehicles of luxury vehicle companies, accidents are detected by the system and the necessary actions can be taken immediately. Similar applications are used by vehicle fleets and rental companies for commercial purposes. However, there are many older model vehicles on the road today that do not have an emergency call system. Hiring or obtaining monitoring services for these systems involves high costs for private individuals or institutions.

Emergency call systems in vehicles have been used in the European Union since 2007. In Turkey, efforts are being made to harmonize new vehicles to be produced with this system with a regulation issued in 2018. The emergency call system used in vehicles informs the emergency call center about the location of the vehicle in case of a call or an accident by estimating the damage in the vehicle through sensors. In emergencies other than an accident, it is possible to

reach the eCall operators through a button in the system that is easily accessible to the driver.

II. METHOD

This section explains the components and operation of the emergency call system in vehicles. Emergency call systems in vehicles are activated in two ways. When the sensors in the vehicle detect a collision, the emergency call system (eCall) is automatically activated. The control unit in the vehicle calls the emergency numbers 112 in Europe and Turkey. In emergency situations that are not the result of an accident, a call is made at the touch of a button [2]. In North America, the OnStar service provides in-vehicle safety, emergency, navigation and remote diagnostic services. OnStar-equipped vehicles have also a stolen vehicle tracking feature that reports information about the vehicle's location, speed, and direction to the poliçe [3]. In Japan, the HELPNET system is used, which is similar to the eCall system. This system, whose work began in 1996, has been used since 1999. The car manufacturers Toyota and Honda have been using this system in their vehicles since 2000 [4].

By establishing a telephone connection with the emergency call center, a telephone call is made between the accident victim and the operator. At the same time, the eCall system transmits the time of the accident, the coordinates of GPS and the chassis number of the vehicle (VIN) to the system. After the call, the operator sends the first aid teams to the region [5].

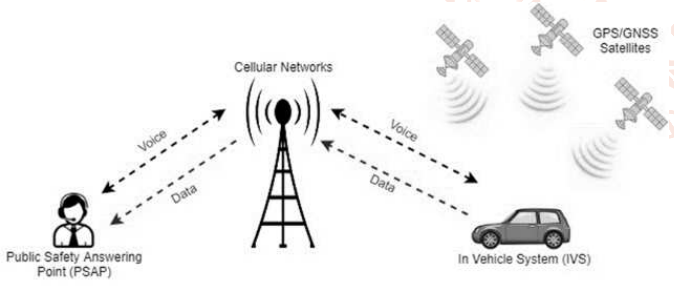

Figure 1 Emergency Call System (eCall)

The GNSS (Global Navigation Sattellite System), which plays an important role in the eCall system, also is known by different names depending on the continent. This system is known as GPS (Global Positioning System) in America, GALILEO in Europe, GLONASS in Russia and BEIDOU in China. This system provides navigation services [6]. The eCall system consists of a GNSS receiver, a telematics control unit and a gateway module. The GNSS receiver provides the vehicle with the location at the time of the accident. The telematics control unit establishes the connection between the eCall system and the network and acts as a GNSS receiver. It also acts as a telephone with a SIM card. The gateway ensures communication between the modules.

III. RELATED WORKS

Much work has been done in this area. Virtanen et al. studied the impact of the automatic in-vehicle emergency call (eCall) service developed in the European Union on accident outcomes [7]. Sihvola et al. evaluated the impact of the automatic emergency call system on the number of traffic fatalities [8]. On the other hand, Lego et al. investigated the economic value of the emergency call system (eCall) [9]. Weinlich et al. argued that emergency response would be accelerated by the use of a global emergency call system [10]. Aygen et al. developed an SMS-based vehicle tracking system [11]. In the study conducted in 2010, a vehicle was controlled by messages using a mobile phone and a pic controller [12].

In another study conducted by Türker et al. in 2016, a mobile phone was used to access the vehicle's can-bus system and control the speed remotely. At the same time, the vehicle's location information could be accessed via GPS [13]. Raduca et al. developed an ATMEGA 2560 microcontroller to remotely control a web server [14]. Balcılar, in the study of a computerized vehicle tracking system using GSM [15], developed a real-time vehicle tracking system that determines the location using the GSM system in closed areas and in cases where the information from GPS is interrupted. Kaya and his partner developed a GSM-GPS and camera based vehicle tracking and guidance system. They proposed the use of cameras for real-time monitoring and reduction of crimes related to vehicles using geographic information system (GIS) [16].

In a 2013 study by Demircan et al. developed a system that is triggered by the explosion of the airbags of the vehicles involved in an accident. In the study, information such as the number of exploded airbags, the license plate number of the vehicle, its age, and its location were sent as short messages to the emergency response teams using the GSM module [17]. Oorni et al. concluded in their study of the eCall system that the 911 and 112 frameworks used so far are a building block for the next generation of eCall and will help to establish common standards [18]. In contrast, Bonyar et al. studied eCall solutions for accidents involving autonomous vehicles. Their studies compared existing eCall solutions, technical applications and services offered.

The eCall solutions available today can be divided into three categories. Embedded eCall solutions use the sensor, location and communication services of the new vehicles. Blackbox solutions, on the other hand, include semi-autonomous or fully autonomous

devices with their own hardware. The last solution is the eCall software installed on the smartphones used in the vehicle.

European automotive companies often use smartphone software solutions that are triggered by the deployment of airbags. Black box solutions are used in older vehicle models. This solution is often used in Eastern European countries. As in Europe, smartphone solutions are also used in new generation vehicles in Turkey. The black box method is preferred over the rental method in old vehicle models and in company vehicles. However, the black box method is known to be prone to false alarms. Damage to mobile phones in case of an accident affects the operation of the system. The installation of wireless transmitting and receiving devices in vehicles is fraught with concerns. The possibility of unauthorized listening to the surroundings with the microphone in the vehicle worries the users. There is also a risk that wireless access to vehicles will render vehicle management systems ineffective.

IV. CONCLUSION

New vehicles manufactured in Europe and Turkey are now compatible with the eCall system. These systems comply with European Union standards. There are many black box solutions for older models. Some automotive companies in North America and Europe use their own emergency call systems. There is a large market for black box solutions as there are many vehicles without eCall systems. There is a need for the studies conducted on different continents for solutions to have a common standard in the world. With a common standard that can be accepted throughout the world, the loss of life and property will be prevented.

Developing solutions for disabled people with orientation difficulties and language barriers will improve emergency response. Using GPS instead of Wi-Fi in emergency call systems will lead to more successful results in location tracking.

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