

## SAKARYA UNIVERSITY TRAFFIC EMERGENCY SYSTEM(SAUTES) PROJECT USING EMBEDDED SYSTEM NAMED E-BOX4300

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**Abstract:** The traffic jam that is growing with the developing technology has become one of the biggest problems of the world. According to results of researches, for example a ambulance arrives to the place of accident about in 10 minutes. This time is very long for situations that need the emergency response such as brain trauma, heart attack and spinal cord concussion. With increasing number of people and developing technology, traffic accidents, heart attacks and seriously injuring increase. In this case, arriving to the accident place on time can save life of hundreds people only in one country. We prepared a project which is handled this problem in the Imagine Cup2009[1] competition by Microsoft Corporation in Egypt. The solution that we offer is to open the way through the knowledge given by the embedded systems in the specific points of the sides of the roads for emergency vehicle before it arrives this way. So the system helps the emergency vehicle to arrive to the place on time. In our project, firstly we send data to web server as XML info with transmitter program. Our embedded system which scans properly with GPRS, if it is in the list which we create from XML, it makes itself active. Thus systems which are on the way of ambulance become active and ambulance way is started to become empty.

**Keywords:** e-box4300, embedded system, Imagine Cup2009, emergency, Windows CE

## E-BOX 4300 GÖMÜLÜ SİSTEM PLATFORMU İLE SAKARYA ÜNİVERSİTESİ TRAFİK ACİL DURUM SİSTEMİ(SAUTES)

**Özet:** Trafik yoğunluğu gelişen teknolojiye bağlı olarak dünyanın büyük problemleri arasında yer almaktadır. Araştırma sonuçlarına göre, bir ambulansın kaza yerine varma süresi ortalama 10 dakikayı bulmaktadır. Bu zaman özellikle beyin travmaları ve kalp krizi gibi acil durumlarda oldukça uzun bir süredir. Dünya nüfusunun artışı ve gelişen teknoloji ile beraber yukarıda bahsedilen acil durumların sayısında bir artış yaşanmaktadır. Bu durumda kaza yerine zamanında varma insanların hayatını kurtarma açısından önem taşımaktadır. Microsoft tarafından 2009 yılında Mısır'da düzenlenen Imagine Cup yarışması için bahsi geçen durumu ele alan bir proje hazırlandı. Bu projede araç güzergahlarında tespit edilen özel noktalara konulacak gömülü sistemlerden gelen bilgiyi değerlendirip acil durum aracının olay mahalline kadar güzergah üzerinde yolun müsait duruma getirilmesi ve dolayısıyla zamanında ulaşması hedeflenmektedir. Bu projede öncelikle transmitter programı ile XML bilgisi Web sunucusuna ulaştırılır. Sistem daha sonra GPRS kullanılarak XML listesinde yer alan gömülü sistem noktalarını aktif etmektedir. Aktif olan sistem o güzergah üzerinde araçlara yayın yaparak acil durum aracının geçmesi planlanan güzergahını açmasını hedeflemektedir.

**Anahtar Kelimeler:** e-box 4300, gömülü sistem, Imagine Cup 2009, acil durum, Windows CE platform

### 1. Introduction

The traffic jam that is growing with the developing technology has become one of the biggest problems of the world. This problem affects emergency vehicles deeply. Minutes even seconds are so important for emergency vehicles. Firstly, we handle the ambulance in the emergency vehicles throughout the problem[2]. The time is the significant element for first aid. If the ambulance does not arrive the place on time and first aid does not apply on injured people, these people would die or permanent apoplectic would occur on that injured people. According to results of researches, the ambulance arrives to the place of accident about in 10 minutes.

This time is very long for situations that need the emergency response such as brain trauma, heart attack and spinal cord concussion. With increasing number of people and developing technology, traffic accidents, heart attacks and seriously injuring increase. In this case, arriving to the accident place on time can save life of hundreds people only in one country. Another emergency vehicle is fire-fighting. The fire is a situation that needs both fire-fighting and ambulance. If the fire does not extinguish on time, the damage would be high. In traffic, most vehicles cannot let ambulances move quickly because the ambulance driver does not turn on its siren until realizing the traffic jam. In the world, the system, that directs the ambulance to the scene of accident and then from this place to the nearest hospital, is available but this system cannot solve the trouble of the traffic so the ambulance is generally late while arriving the places where it has to go to. The solution that we offer is to open the way through the knowledge given by the systems embedded in the specific points of the sides of the roads for emergency vehicle before it arrives this way. So the system helps the emergency vehicle to arrive to the place on time. In many country, municipalities have own routing services and by the help of these systems the way of ambulance can be known earlier. In our project, firstly we send data to web server as XML info with transmitter program. Our embedded system which scans properly with GPRS, if it is in the list which we create from XML, it makes itself active. Thus systems which are on the way of ambulance become active and ambulance way is started to become empty. If there isn't central guidance service, we can use a map which is like "Microsoft Virtual Earth" to create these services. We can summarize that working method of our system;

- i) At the beginning, our system interferes the radio frequency and it changes the broadcast into our emergency voice message.
- ii) The necessary messages are sent to signboards on the road so that directions are given to drivers.

## 2. The Developed Embedded System

In our Project, through the specified computer technology we establish a bridge that is between the computer systems that defines the roads and the electronic hardware that opens the road. The reasons of using embedded system in this level;

- 1-) Specified computer responses to our needs and it can be economic. We will set many of systems up especially in cities so cost becomes an important figure economically.
- 2-) Each country or city has its own identical Routing Standards of Emergency Vehicles so as a result for an embedded system to be easily updatable and programmable is significant.

The connecton diagram and hardware platform of the traffic emergency system we have designed is seen Figure 1, Figure 2, respectively.

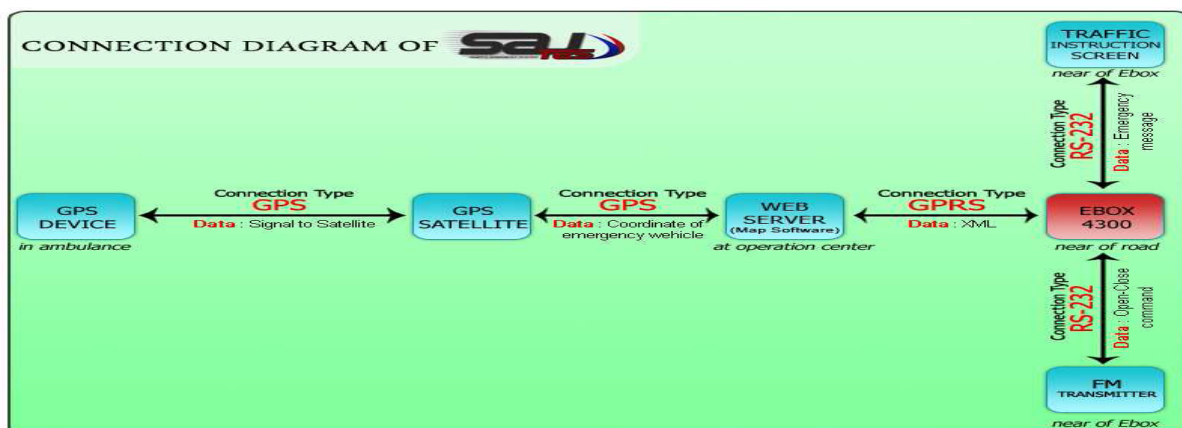


Figure 1. Connection diagram of SAUTES



Figure 2. Hardware Platform of SAUTES

### 2.1 Overall Embedded System Architecture

Obtaining a perfect compatibility between Ebox4300 and Windows CE 6.0 was quite pleasant and interesting. We recognized the system in a short time and began to intervene. As a result, a pleasant architecture came to light. It is seen in Figure 2 our embedded system architecture we established.

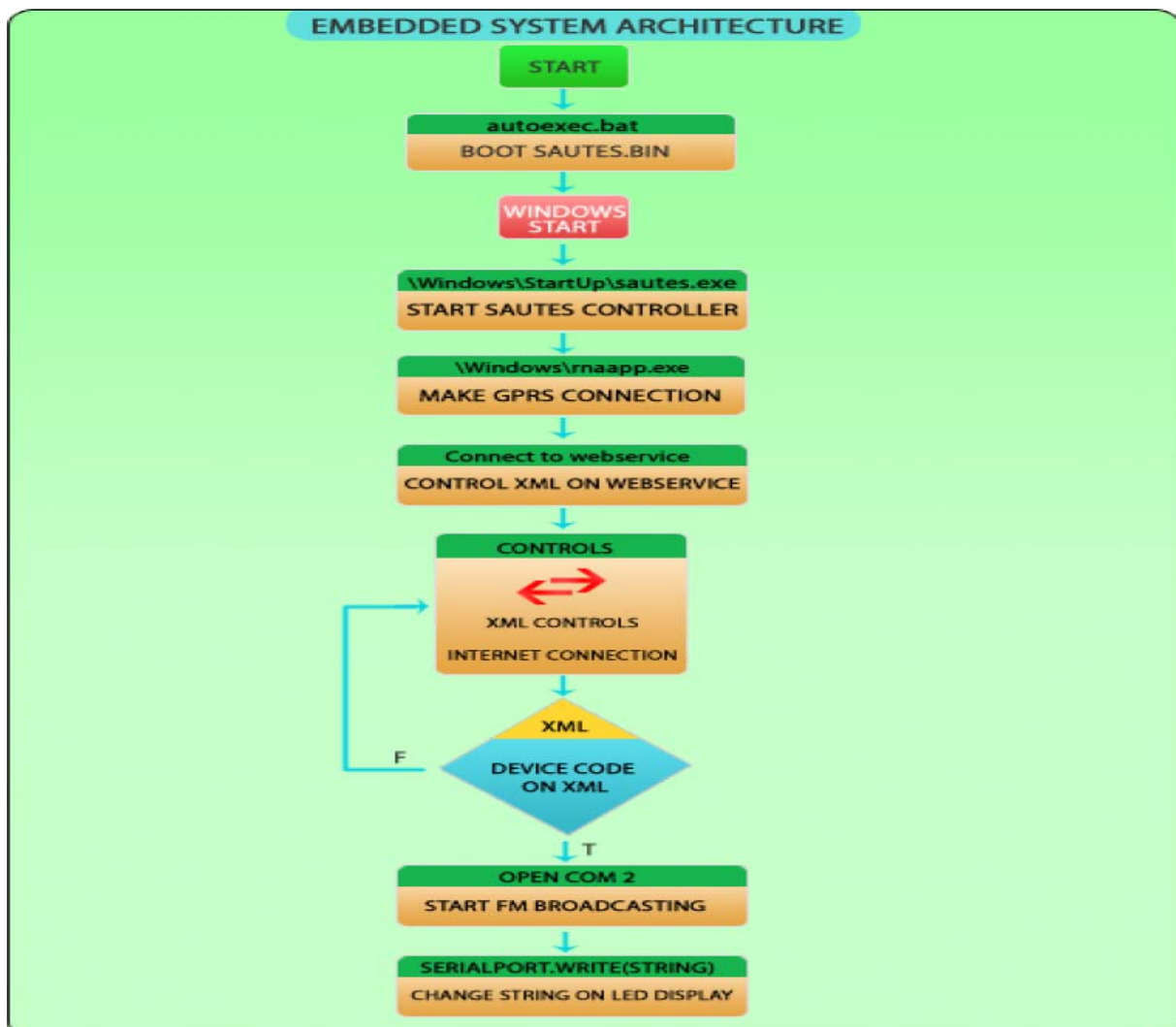


Figure 2. Embedded System Architecture of SAUTES  
2.2 FM Transmitter

We used the fm transmitter at check points on the way that our emergency case vehicle goes as stated in our project’s first report. Before the emergency case vehicle arrives ( 1 or 2 minutes) our system becomes active and provides us broadcast fm by cutting in fm transmitter. When fm broadcasting begins, on the radios where our vehicles are for example, when Power FM is broadcasting with our system that becomes active it provides us to listen emergency case message in the Ebox4300. Our system’s working logic is as follows;  
 In order to cut in our Fm transmitter we take advantage of Rs232 i protocol. When we take a glance at Rs232 cable that is connected to Led Plaque that is a part of our system;  
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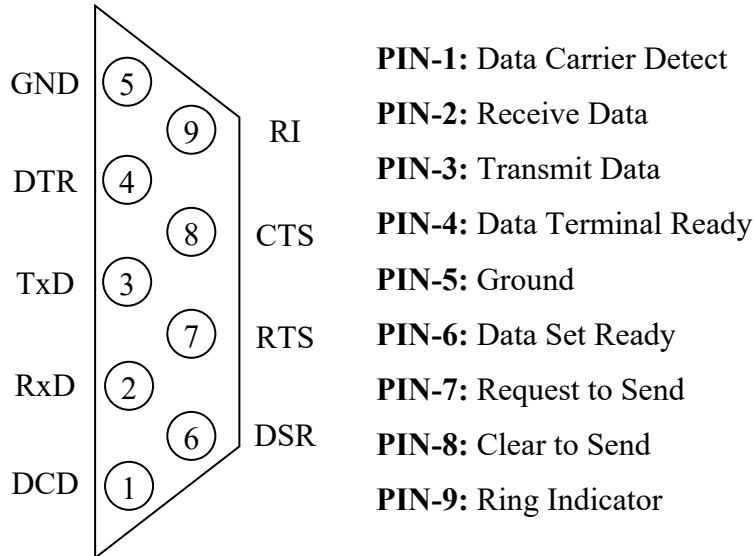


Figure 3. RS232 DB-9 Male Pinouts[3]

The coloured bits are used for data transaction at our led screen. We decided to benefit from the bits that were free. PIN-4, Data Terminal Ready (DTR), bit shows a one-way data flow. It shows us that it is ready to get data by using computer DTR signal. In our researches e made the DTRbit active with System.IO.Ports that is on Visual C# and the *SerialPort1.DTREnable=True* that we made from SerialPort that contains NET atheneum. At the same time, when the Port is off the DTR bit is measured at “-5V” ( Figure 4-a) rate voltage; when we open Port u it begins to give “+5V” ( Figure 4-c ) rate voltage.

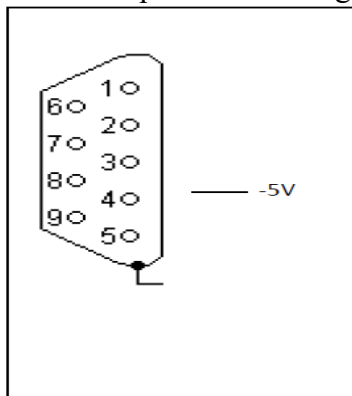


Figure 4.a When the port is off

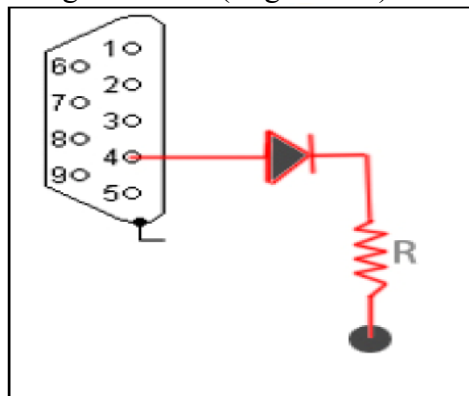


Figure4.b Voltage Selection Circuit

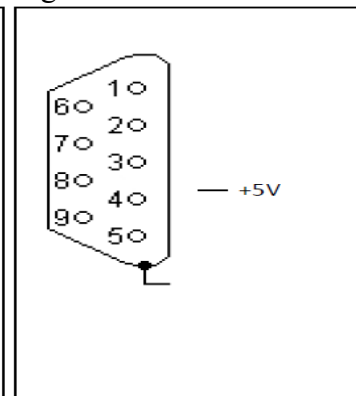


Figure 4.c When the port is on

In this case we impose as follows;

With the diode ( Figure 5) that we connect it on PIN-4 we prevent the negative voltage (-5V) that becomes normal and in such a case;

The relay did not get active that was connected to diode that we see above circuit; because in order to get the relay active and complete the circuit at least +1,5 V voltage is needed.

When we open “COM2” port that is connected to Rs232 cable (Serialport.Open ) positive voltage (+5V ) appears on 4 numbered bit and the diode transmits this voltage and makes the relay become active and completes the circuit.

When the circuit is completed, the power adapter that is connected to Fm transmitter transmits electricity and it broadcasts as radio wave on “ EMERGENCY CASE SOUND BROADCAST “ that it gets from Ebox’s sound outflow.

As a result, “ EMERGENCY CASE SOUND BROADCASTING” is obtained by supressing the required radio frequencies on the vehicles that are at that area.



**Figure 5. The diode connected on PIN-4**

### **2.3 Led Display**

One of the our hardware equipment is the Led screen that is used in order to warn drivers in traffic jam or rush hours and that mechanism warns putting down in writing.we carried out that if driver’s fm receiver (radio) is closed and if we are not able to warn them through frequency , driver of our system will be warned in order to write that message ( “URGENT SITUATION MESSAGE”) on the Led Screen in visual feature.

Led screen with its included leds and pictures written particularly shows string structures with RS232 protocol from the COM port. Message will be written on the led screen with accepted form of string format(our custom string) and also SerialPort.Write(our custom string) method , that functions was written in Ebox4300

### **2.4 Gprs Modem**

GSM/GPRS 1218 model of Enfora was used and that was included in our Project by platform Builder which described model in ” IMGENFORA=1” enviroment, and also this model uses Standart RS232 Protocol that is compatible with Windows CE 6.0. Consequently we performed dial-up connection by means of using Turkcell GPRS infrastructure in Turkey and so we got prosperous internet connection.



**Figure 6. The GPRS modem used in Project.**

## 2.5 SaMSy-SauTes Mapping System

In our project we assumed that there was a program on the operators hands that would define the vehicle's route that guides the emergency case vehicles. In order to carry out the project we improved a program that converts mapping system to XML and loads it to the webserver as prototype.

Our program starts with a sample map that we formed that has SauTes emblem on it and control points. These points are the roads where our devices are. After choosing the systems that are on the ambulance's route, the program forms an object named "Road.cs" class at the background and sends them to the list that we formed ( List <RoadList> routeList). When we click on the control points that are SauTesPictureBox class from PictureBox class, the elements on the list sends it to RoadControl ( routeControl ) method. Method first checks whether the control point is open or not.If it is open it closes the "deactivate" method. If it is closed , it opens the activate method. By this way, it is prevented to choose randomly and provides us to choose only one route.

When the activate method starts to work it carries out three processes.

- 1-) It adds new elements to the lists
- 2-) It changes the screen on the map and countdown starts
- 3-) It starts upload process to the webserver by sending the list from streaming class update.

The control points are closed in two ways that we opened on the program.

- 1-) When we click on it again and cancel it
- 2-) When its time is finished

## 2.6 Data Flow

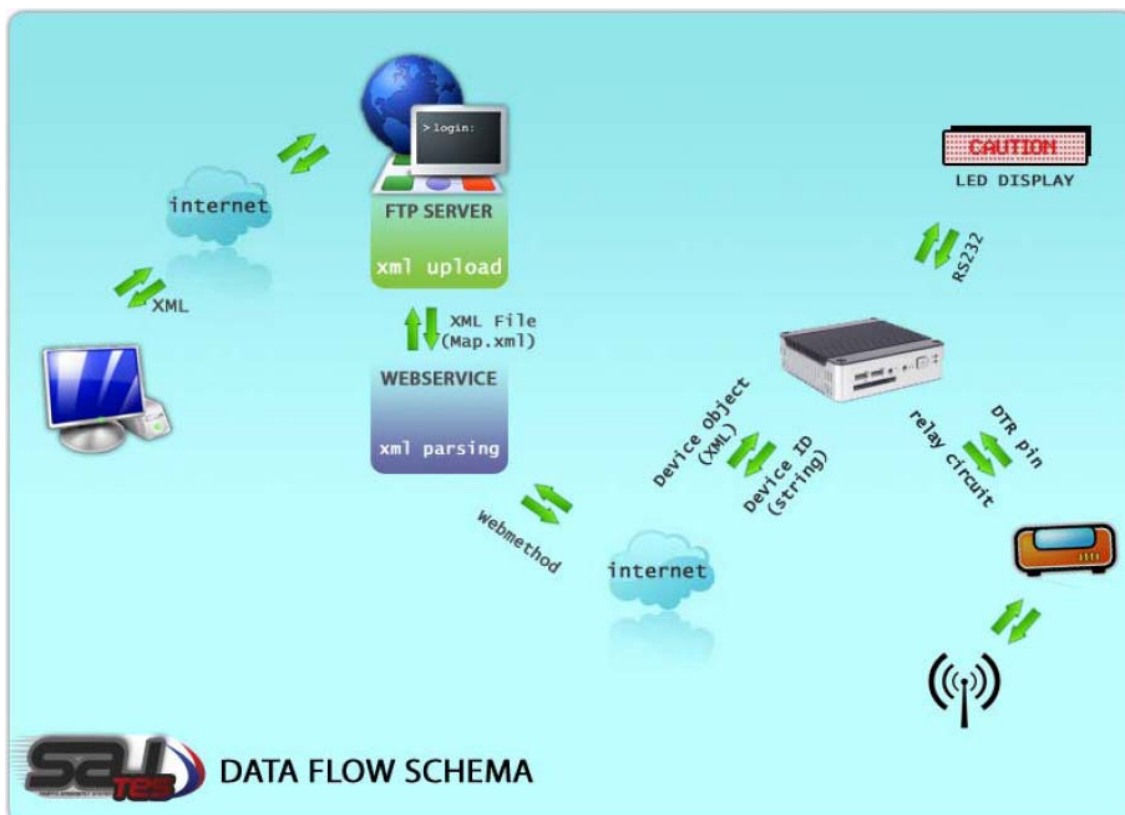


Figure 7. Data Flow of SAUTES

a-) Between Operation Center And WebServer

The map application that is working over operation center loads the emergency vehicle route data as XML to the webserver

*b-) Between WebServer And E-Box*

The data that are loaded to the webserver from operation center is downloaded to ebox4300 through Dial Up that is formed by using GPRS Modem

*c-) Sound Flow Between E-box And Fm Transmitter*

“EMERGENCY CASE SOUND RECORD” is transferred to Fm transmitter’s Audio input with a stereo cable that is connected to ebox4300’s sound card where FM transmitter is broadcasting

*d-) Voltage Control Between E-box And Relay Circuit*

The voltage that is obtained from the cable that is connected to 4 numbered pin of rs232 cable connected to COM2 port is used to obtain relay’s triggering

*e-) Between Led Board And Ebox*

The string that is prepared on the program that is working over ebox4300 is transferred to the led board from COM2 port and the led board updates the printing by annotating it.

## **2.7 Data Processing**

### **2.7.1 Operation Center**

The route that is chosen for emergency case vehicle on SaMSy main screen converts it to XML streaming and the XML data device code that is organized as below contains the message that will be written and how long the route will be lasted by second type rate. The XML data is loaded to the webserver with XML2FTP class and XMLDocument object ftp protocol.

```
<?xml version="1.0" encoding="utf-8" ?>
<root>
<device>
<id>BN10</id>
<time>24</time>
```

While there is no existing program for using it at operation center we improved SaMSy. Our system can work easily with any map program that load this XML printout.

### **2.7.2 WebServer**

We prepared a web method that is parsing the map data coming as XML format by using ASP.NET web service on Webserver. This web method first gets e-box’s id as string and then the parsing process starts. If the coupling result is found, it produces an object as device class and loads the chosen xminode’s content to this object and sends the data to e-box by this object.

### **2.7.3 E-Box**

By opening the E-box 4300[4] the application that is starting automatically checks the active internet connection, board and FM transmitter devices. While this application is improved multi-threading programming technique is used. By this way, it carries out without hampering

hardware and software processes. The application's life cycle is to use the web service and controlling the necessary devices according to the data that are turning back. Before using the web service it is checked whether it has active internet connection or not. If there is no connection, connection will be obtained by triggering gprs modem. During gprs modem internet connection the processing thread related with application is waited. Then another query sending testing is done. If connection is obtained, the Device that comes from web service is explicated. If there is an input that is coupling with the e-box identity data, an operative Device object is obtained. So the message that comes to board is transferred. Fm transmitter is set to active position. Processing thread waits as time rate. In this phase the channel that is querying is waiting. After a time duration passed the supposed message is transferred, Fm transmitter is set to passive state and by this way the system is progressing periodic web queries. The application character is kept as XML format in a Config.xml file. When the application is opened a stream connects to this file and it keeps it as readonly. By this way, this application's changings and deletings are prevented. Config.xml file can only be changed with a management panel that is saved with a code by the program. In order to prevent reverse engineering, management panel password is obtained by using one way MD5 ( System.Security.Cryptography) coding algorithm.

The application has 2 GUI(graphical user interface) data and management purpose. The first screen is for data purpose and the error that occurred on the system sends warning and information messages. Also, it contains connection state with operation center, connection state with board and connection state with FM transmitter device. Device ID data can be seen on this data screen. Settings can be made for the related application from management panel interface. This field is kept with a password. The application's visual interface is on the other applications. By this way, when the application is active the intervenes that will occur on application system will be reduced to minimal rate. The Core class that carries out the main processes and Error class that contains error checking mechanism should be reach to the main Form object of visual components. The problems between cross threads channels are removed and they thread-safe is obtained.

### **3. Results and Conclusion**

This project presents that the system helps the emergency vehicle to arrive to the place on time. In this Project, we build a bridge between computer systems and the electronic equipment gives that the status of roads using embedded technology named E-box4300. The reasons of using embedded system in this level brings specified computer responses to our needs and it can be economic. This situation will contribute in terms of cost economically. especially in bigcities. Also, each country or city has its own identical Routing Standards of Emergency Vehicles so as a result for an embedded system to be easily updatable and programmable is significant.

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