Algorithm for Security in Autonomous Cars

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Abstract: *An autonomous vehicle is capable of sensing its environment and navigating without human input. Imbibing intelligence to these devices is through a system called embedded systems. Embedded Systems are combinations of hardware and software that are mounted on compact electronic circuit boards integrated into devices. Autonomous vehicles sense their surroundings with such techniques as radar, GPS, and computer vision. These systems are more intelligent and autonomous.*

The challenge faced by this system is that; there are many possible ways for hacking the GPS. This system also contains alternate way for moving the car even if still the GPS is blocked. But the alternative ways are still focused on connection with the satellite. Now there needs to be a total security for preventing hackers from hacking the satellite. This is going to be done by encrypting the signal sent from car to the satellite. There are many ways of encrypting, among which we are going to use the concept of Secret key Encryption method. We use One-Time-Pad concept where the data is converted to cipher text and then it is going to be decrypted by the satellite. By this way, we could create a high level security where only that particular car and the satellite will have a common code and each time the car moves to a location, there is going to be a random key generated.

The current topic which we had chosen is one of a major problem in autonomous cars, which needs to be focused on. Our objective is to bring a complete security for the car and its owner.

General-Terms: *Autonomous cars, embedded systems, Security, Total security, resolutions for problems faced by autonomous cars.*

1. INTRODUCTION

Embedded system is a combination of hardware and software that forms the component of a larger system; this in turn is programmed to perform a range of dedicated functions usually with a minimal operator intervention. In embedded systems the hardware is normally unique to a given application; computer chips are embedded into the control electronics to manage the products functionality.

Autonomous Cars: These cars have the ability to control it. The car, which is embedded, can simulate the human driver completely and direct the vehicle on the road. Autonomous vehicle is the drastic change in technical brilliance and developments in different fields with EMBEDDED SYSTEM as pioneer. A fully computerized car capable of doing almost everything a car lover would want to. Almost all automobiles will interact with computer on dashboards. From ordering food materials to booking tickets at the nearest theatre, things would be as easy as giving orders to your servant. As a matter of fact, vehicles all over the world is now fitted with intelligent devices that makes the vehicles to respond to various factors like - climate control, sudden accelerations or braking or even self-repair of modules.

The finger print technologies have been introduced to enter and start your car with the touch of a finger. The fingerprint, which is acting as a key, would trigger a check of the mirrors, steering wheel, radio and temperature to ensure that they're the way you like

them. The convenience of fingerprint recognition technology comes with heightened security. Unlike personal identification numbers, passwords and keys, each person's unique fingerprints can't be duplicated, lost or forgotten.

2. Illustration

As mentioned above, this car system runs on it won through the embedded system concept. For this purpose Global Positioning System (G.P.S) using satellites can provide positioning information. For still higher accuracy wide area differential GPS is used, which offers a robust system that readily deals with selective availability errors and satellite clock errors.


The models for GPS also include aiding sensors, e.g. dead reckoning, radar and camera. A computer is simply required to feed destination into a dashboard computer. Highly sensitive actuators simulate a human driver completely and direct the vehicle on the road. The vehicle transmitter broadcasts its position and velocity to other immediate participants for collision-avoidance and lane changing man oeuvres. Forward and reverse motions and U-turns are precisely achieved as per route guidance requirements. Furthermore, an accurate steering control is obtained using Pulse Code Modulation technique and acceleration/braking control is successfully implemented using learning adaptive system The reliability, efficiency and cost effectiveness of an autonomous vehicle depend mainly on how judiciously its navigation sensors, perception unit and computer control is incorporated. The driver's activity is influenced by several factors that depend on driver itself and is environment such as traffic density, traffic status, time of travel and weather. Thus the driving activity deals with a combined driver vehicle-environment system shown in figure. The vehicle is required to blend its environmental perception capabilities with its intelligent controls in order to affect optimal path-planning strategies that not only avoid obstacles but also minimize criteria such as time of travel, fuel consumption, exposure to pollution/danger, etc. however basic driving functions consists of lane-keeping, safe distance maintenance, timely lane changing and overtaking. The key to all these driving tasks is collision avoidance.

The Master Control Station (MCS) receives the positioning information from the satellite by employing WADGPS concept. The MCS is linked to GPS instrumented position location systems (PLS) installed on the autonomous vehicles through a data link sub system (DLS). The DLS can either use VHF or UHF or L-band, incorporating time division multiple access protocol to handle on the roads. A

block forward error correction code is employed to protect and maintain the message integrity. The desired destination and starting position of the vehicle together with the time of travel, manifest an optimal route on the road network. Once the vehicle commences the journey the sensors continuously keep track of the direction and displacement of the vehicle initial calibration is a little crucial for dead reckoning performance; however a feedback calibration indicated in fig suggested obtaining distance accuracy better than 99.9 percent.
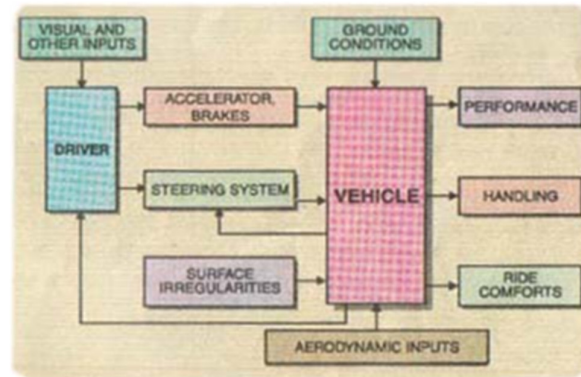
GPS navigation guides you through the traffic. The GPS interface in the car pinpoints your exact location on a map. In case the GPS signal can't be received due to high density of tall buildings or other magnetic interface, the 'dead reckoning ' technique, which works for short durations guides you effectively. The system is also loaded with GSM/CDMA protocol standards further modified on the CANBUS standard to give uninterrupted information.

3. Challenge Faced

Now-a-days computers are more and more prone to hacking and vulnerabilities. In our concept of embedded system in car automation, we utilize the GPS technology for effective guidance of the vehicles. Hackers today are able to crack the security features present in the satellites. Few software's in net helps these hackers. If such software's goes to the hands of evil doers and anti-social elements, car automation could become a nightmare.
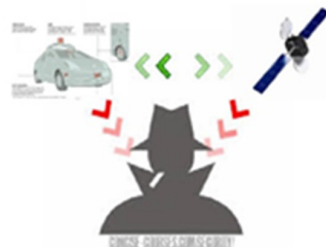
Let us consider that a VIP is using the autonomous car to visit a place. A person who could perform a MITM (man in the middle) attack can drive away or change the destination of the car. This is the major weak spot or vulnerability that a hacker could use to kidnap the individual.

The only solution to prevent a MITM or any hack attack would be implementing strong security feature such as encryption.

What is Encryption?

Encryption is a technique for transforming information on a computer in such a way that it becomes unreadable. So, even if someone is able to gain access to a computer with personal data on it, they likely won't be able to do anything with the data unless they have complicated, expensive software or the original data key.

The basic function of encryption is essentially to translate normal text into cipher text. Encryption can help ensure that data doesn't get read by the wrong people, but can also ensure that data isn't altered in transit, and verify the identity of the sender.

There are three different basic encryption methods, each with their own advantages. We are choosing Secret key encryption method.

The encryption key is same as the decryption key.

Implementation of One-Time-Pad Method: The One time pad method has a common key between the sender and receiver. The message which is sent from the sender is going to be converted as cypher text by using the common key and this encrypted code is sent to the receiver. The receiver further with the same code, decrypts the data.
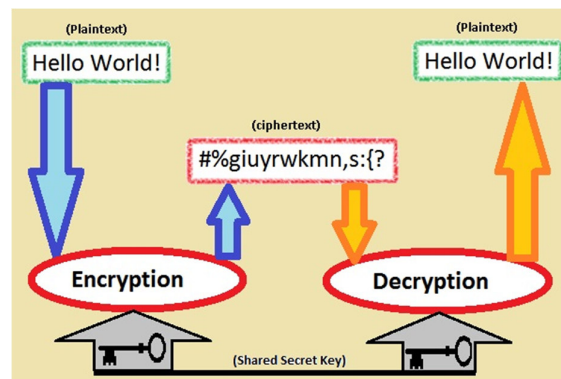
The secret key which is going to be given for each car are unique. We are going to implement this like a normal bank system (where we get an ATM pin which only we know and we access). The key given is going to be 15 digits key. The key is going to be alphabets. The first four places are going to be the starting four alphabets found in number plate. The remaining 11 places in the key are going to be assigned by the central database. Each time an autonomous car is registered, the unique 15 digit key is going to be given to the owner. Example: (TNAH***********).

Each time the car moves to different locations, the data is sent to satellite in a randomize manner. The randomly produced code is going to be cypher texted using the 15 digit unique key. This text is going to be sent to the satellite along with the signals from the GPS. The satellite will further decrypt this cypher text and send back the information of location and timing to the GPS. The hacker

will have a probability of choosing one out of a quadrillion or one thousand billion. This will give a high security to the autonomous car. Also the satellite coding is done in such a way that, if the hacker accidently finds the correct key, and tries to access our car, the secret key will be blocked. The blocking is done if two signals from same key number are received. Now the person's car will stop, and he will be alerted by the incoming problem and he can inform the police or alert his security guards. He then has to reset his pin by going to the control database.

Added Feature (using TOR Project)

Using Tor protects you against a common form of Internet surveillance known as "traffic analysis." Traffic analysis can be used to infer who is going where over a public network. Knowing the source and destination of your Internet traffic allows others to track your behavior and interests. It can even threaten your job and physical safety by revealing who and where you are.

Staying Anonymous

Tor can't solve all anonymity problems. It focuses only on protecting the transport of data. You need to use protocol-specific support software if you don't want others to see your identifying information. This is where encryption kicks in.

Working of TOR Project
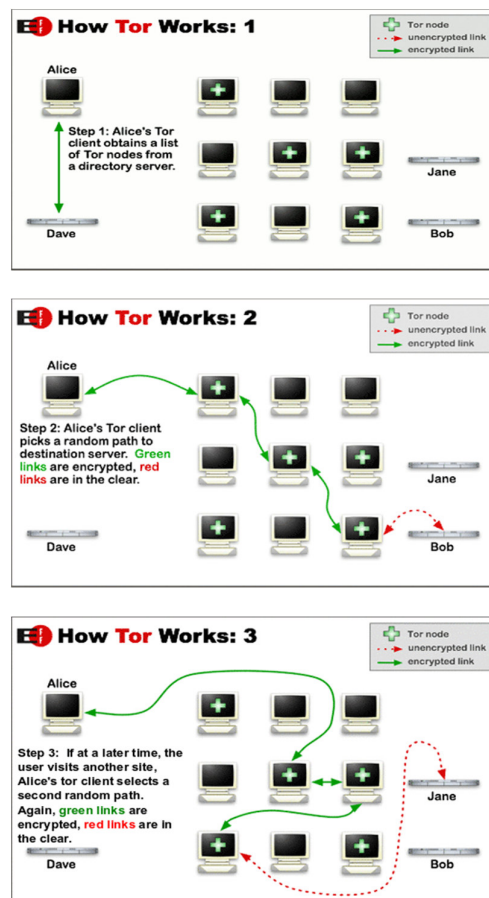
Result

As we encrypt our data it is not easy for hackers to penetrate into the data exchange between the car and the satellite. The probability of a computer and the human, to guess the randomize code is going to be one quadrillion which is seriously unimaginable. Also, if the evil doer tries to crack the encryption, it would take at least a couple weeks for him. Even though if it's a long journey, the passenger will each time go to a different zone of the satellite control which would make the hacker get delayed each time, and by the time he finds the next address of the location, the passenger would have reached his destination.

4. Conclusion

Autonomous car had been implemented in reality and being tested in various countries. In this fast advancing world, security acts as most important feature.

We would like to present that there must be further developments in this technology to make autonomous car more common all over the world with a high security level system. This can be happened by making the autonomous easy to operate for the user and the designers should concentrate more in producing autonomous cars, which should not cost a lot.. With this type of vehicles there will be great advantages in the coming future. Speed control technique and tracking system based cars would reduce amount of accidents. In the near future, autonomous car become more common all over the world. Indian efforts in the embedded technology can assure that these autonomous cars will become cheaper and may evolve with many more advantages. By this way we could find ourselves using these autonomous cars in the near feature in a totally secured way.

Thus the complexity to track a person will multiply exponentially depending upon the number of people using this service.
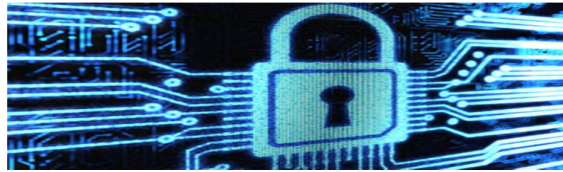
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