Connected Cars – The Future Cars Driven by Data

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Abstract— The aim of this project is to provide the road users a digital driving experience by creating a individual database to each and every car thereby connecting each and every automobile to the internet. The digital information is shared among nodes helping avoid accidents and improve traffic flow. The infrastructure needed for this new driving experience is to provide seamless Wi-Fi connectivity throughout the road which is possible by Volte technology based on IP Multimedia Subsystem. The accident detection is implemented by using ultrasonic sensor connected to ESP8266EX.The wireless sensor nodes on the roads gives earlier warning system to the dashboard and the speed can be controlled even in the invisible road signs. The Toll payment system is incorporated with a "Wi-Fi connected system" and payment is done automatically. An alerting system is connected hereby giving emergency information to the nearby medical rescue team.

Keywords—Car to Car Communication; Emergency Button; Road Sign Early Detection; Wi-Fi based Toll Payment.

Abbreviations—Blind Spot Warning (BSW); Cooperative Collision Warning (CCW); Cooperative Forward Collision Warning (CFCW); Software Development Kit (SDK); Lane Change Warning (LCW).

I. INTRODUCTION

INTELLIGENT Transportation System (ITS) uses wireless technologies that enable vehicles to communicate with other vehicles as well as with infrastructure in order to improve road safety, traffic efficiency, and fuel efficiency. There are quite a number of different types of applications in that ESP8266EX which has been designed for mobile, wearable electronics and Internet of Things applications with the aim of achieving the lowest power consumption with a combination of several proprietary techniques. The power saving architecture operates mainly in 3 modes: active mode, sleep mode and deep sleep mode. By using advance power management techniques and logic to power-down functions not required and to control switching between sleep and active modes, ESP8266EX consumes about than 60uA in deep sleep mode (with RTC clock still running) and less than 1.0mA (DTIM=3) or less than 0.5mA (DTIM=10) to stay connected to the access point. When in sleep mode, only the calibrated real-time clock and watchdog remains active. The real-time clock can be programmed to wake up the ESP8266EX at any required interval. The ESP8266EX can be programmed to wake up when a specified condition is detected. This minimal wake-up time feature of the ESP8266EX can be utilized by mobile device SOCs, allowing them to remain in the low-power standby mode until Wi-Fi is needed. It provides more convenient and safer driving conditions on the road at overall lower costs.ESP8266EX provides several wireless communication technologies such as Bluetooth, NFC, Wi-Fi, and 4G. It is possible that various solutions based on these technologies of mobile devices can replace DSRC/WAVE devices (OBUs) in safety-critical applications. Among them, there is no doubt that a cellular technology (including 3G, 4G, and 5G) is the best candidate for V2X communication. It provides wide coverage and reliable connectivity with low latency and high data rate. These properties enable a cellular technology to support some safety applications such as Blind Spot Warning (BSW), Cooperative Collision Warning (CCW). A cellular technology is based on a centralized communication approach using a base station providing certain transmission coverage. Some applications such as BSW and Lane Change Warning (LCW), Cooperative Forward Collision Warning (CFCW) do not need to be performed by centralized communication through cellular infrastructure.. In addition, not all safety applications can be supported in 3G and 4G due to strict requirements for end-to-end latency (e.g., a Pre-Crash Sensing). It allows Wi-Fi-enabled devices to make ad-hoc networks without infrastructure. In this paper, we focus only on road safety to all automobiles using the simple In

Section II, we describe the architecture of the ESP8266EX micro controller. In Section III, we present our approach which complements the more expensive infrastructure WAVE used in hybrid cars and our system provides basic safety levels in low end cars and this system does not require any infrastructure to form a network. Finally, we discuss and conclude our work in Section IV [Daiheng Ni et al., 1; Camps-Mur et al., 2].

II. Architecture of ESP8266EX

The Espressif Systems' Smart Connectivity Platform (ESCP), is a set of high performance, high integration wireless SOCs, for various automobile applications which includes Car to X communication, Car to Car communication, Car to Infrastructure communication. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated Wi-Fi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the Wi-Fi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; sample codes for such applications are provided in the software development kit (SDK) [Miucic et al., 3].

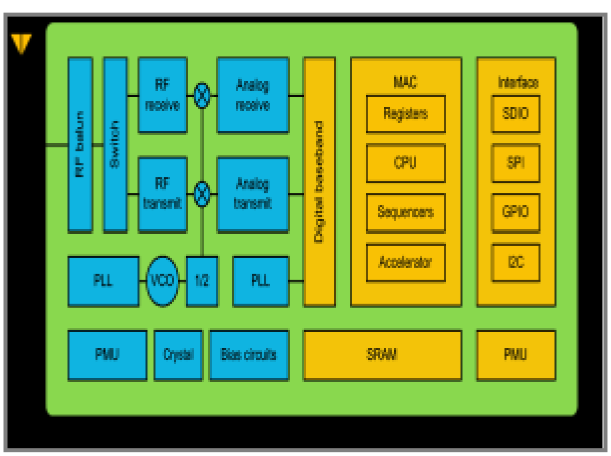

Figure 1: ESP8266EX Block Diagram

III. Implementation

Here, we have used the ESP8266EX for the entire system which is used as access points for sharing digital information to the neighboring cars, the infrastructure and also the centralized servers. The server updates the real time information to the dash board of the cars in early which avoids accidents in highways. The block diagram of the concept is given below as follows [Hsu et al., 4].

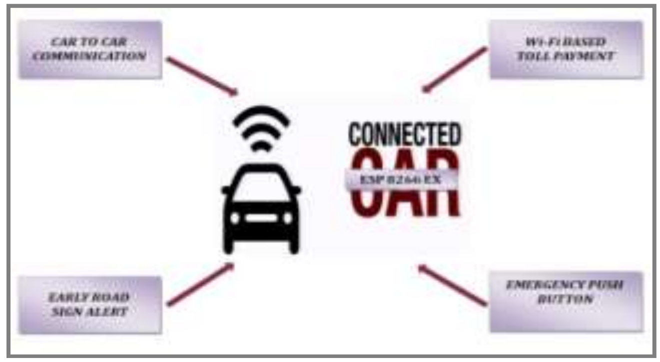

Figure 2: Implementation of the Concept

3.1. *Car to Car Communication*

Here, ESP8266EX is installed in the two cars Car A & Car B.A ultrasonic sensor is interfaced to the car A and it acts as Server and certain condition is pre programmed in the car A. A OLED is interfaced to the car B and it acts as Client. These cars as a ad-hoc network and it shares digital information such as distance of the obstacle and early warnings to the neighboring cars or vehicles in a blind spot. The ultrasonic sensor is set some condition. If the threshold value read by the ultrasonic sensor "ok" message will be transmitted to the connected vehicles in the network. If the threshold value exceeds, "danger" signal will be shown in the own vehicle as well as to the connected cars. By this method the drivers will get early alert on the motionless vehicles, obstacles [Ratasuk et al., 5].

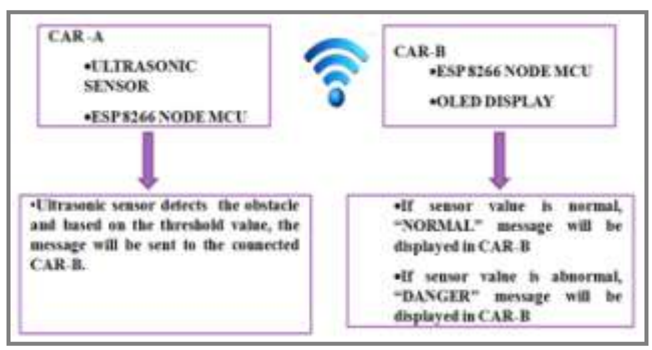

Figure 3: Car to Car Communication

3.2. *Wi-Fi based Toll Payment*

The digital highway consists of the digitally connected infrastructure and the existing electronic toll collection (ETC) uses RFID based smart card system. In our system, the car's Wi-Fi will be connected to the automatically to the access point of Toll-gate. The proximity sensor is placed at the toll lane counts the vehicle number. At the server end the MAC address of the connecting vehicle will be registered and it will be redirected to the Car's database where the payment will be made from wallet of the car. The amount can be refilled through net banking. If the amount is insufficient in the wallet, payment status will be pending in the database and once the amount is sufficient the payment can be made. The above system may have some difficulties in implementation and it will be rectified in the further research [Tarik Taleb & Adlen Ksentini, 6].

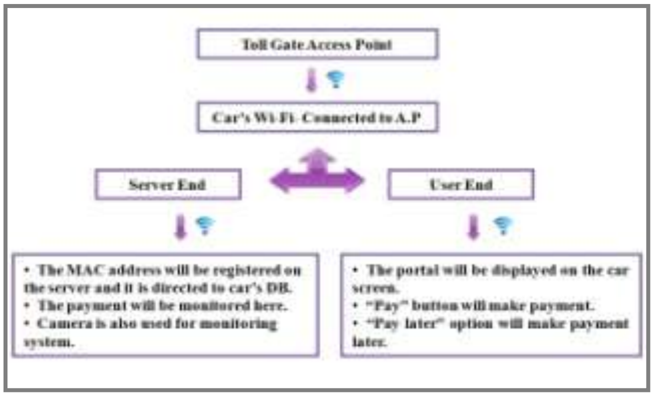

Figure 4: Wi-Fi based Toll Payment

3.3. Early Road Sign Alert

The road signs are created as access points and it is also used to save us from accidents in a minor level. Since the highway is a digital one the road signs and some traffic alerts are converted to access points and they form as Ad-hoc networks which send and receives data among each other.

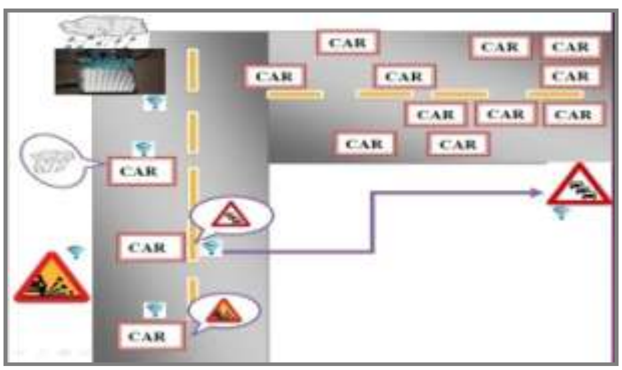

Figure 5: Early Road Sign Alert

3.4. Emergency Push Button

We can prevent the accidents by continuously monitoring the real time monitoring apart from that the vehicles can talk or communicate to each other and the occurrence of the accidents can be brought to minimum and there occurs the error of human and the autonomous cars are still in the testing and also there are some drawbacks in the autonomous cars. Since the vehicles are connected to a network, the location of the car or vehicle can be tracked easily. In case of disability or illness to the driver, a simple push button will send a "emergency signal" from the car data base to the centralized server of the nearby rescue team and the medical rescue team will be send to the place of the victim within the minimum amount of time [Gudymenko et al., 7].

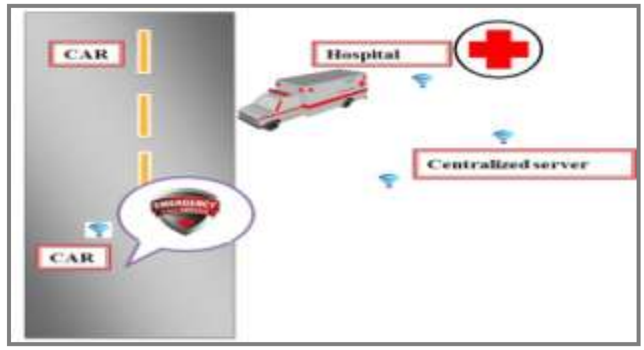

Figure 6: Emergency Push Button

IV. Conclusion

Reducing the number of accidents occurrence on the highway is a difficult one, as the safety standards are very poor in India. As we are very aware of the proverb "prevention is better than cure" leads the way for developing this project. The proposed model will be a part of the future digital highway system and digital infrastructure is essentially needed in the current situation because the no of vehicles on road is increasing by millions every year. The are several methods in Car to Car communication which are still in the development and testing stages. We have proposed this simple idea, which can be brought to existence since the 5G is evolved. The main requirement of this project is seamless internet connectivity and the security in the network.

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