

# An innovative wireless design for a car infotainment system

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**Abstract**—The rapid development of automotive industry system has promoted a brand new revolution of vehicle design. In recent years, in-vehicle-infotainment(IVI) systems have quickly become one of the most valuable features auto makers have used to promote their flagship models as an advanced competitive marketing weapon. Owing to this, an innovative idea for a infotainment system is proposed in this paper. The aim of this design is to eliminate the head unit in the current systems and reduce the overall cost of the system considerably. Instead of a touch screen display or buttons to control the functionalities, an android smartphone is used which can control volume, bass, treble, fade and balance. The objectives of this system is to reduce cost, size and to provide comfort and luxury to the passengers.

**Index Terms**—IVI, Infotainment, CD, Bluetooth, WiFi, tone parameters

## I. INTRODUCTION

Car infotainment system is a embedded system (hardware and software) designed for entertainment. [5] Back in 1920, IVI was nothing more than the AM radio. However gradually the system changed from magnetic tapes to CDs (Compact Disk) and today we have the infotainment systems which are not only meant for entertainment but also provide parking assistant, emergency calling, road navigation etc. Every day some new ideas are introduced and made available to the customers. Compelled by the demand for more connected vehicles, IVI is getting more and more refined. Car makers, application developers and chip manufacturers are working in unison to come up with infotainment systems that are user-friendly and safe to use. A worldwide development partnership called as AUTOSAR (AUTomotive Open System ARchitecture) is developed as a standard for all the auto makers.[6] It is a worldwide accepted standard for the manufacture of car ECUs and other body parts. This helps to maintain uniformity and a standard procedure for any auto maker. The idea proposed in this paper is inspired from the fact that most of the people nowadays use smartphone. So the idea aims at developing an infotainment system which is completely controllable by smartphone. It uses bluetooth technology to communicate with the system. An android application can control the entire music system.

The flow of this paper includes basic and existing infotainment system in section II and III, related work in Section IV and the details of the proposed idea in Section V. Section VI gives the aims and objectives of the proposed system and implementation is given in section VII.

## II. BASIC INFOTAINMENT SYSTEM

A basic infotainment system consists of a head unit, amplifier and speakers. The head unit is the one that controls the audio source, volume level and other variables of music. It has control knobs or touch screen interface for each function. Now a days number of audio sources are available such as pen drive, Internet radio, SD card, radio etc. Listener can choose any of the audio sources and start playing the music. So we can say that head unit acts as a central entity for controlling the entire system. Amplifier may be a part of head unit or a separate system. The head unit usually contains a low power amplifier. The OEM amplifiers can be separately installed which amplify the audio signal and feed it to the speakers. Speakers are of different types. The ones used for reproducing low frequency audio are called as woofers and are usually large in size. Tweeters are used to generate the high frequency sounds and are smaller in size.[7] In a usual car design two speakers are placed in front side and two in the rear side of the car. Low and high frequencies are divided and fed to the appropriate speakers. The basic block diagram of a infotainment system is shown in the figure 1:

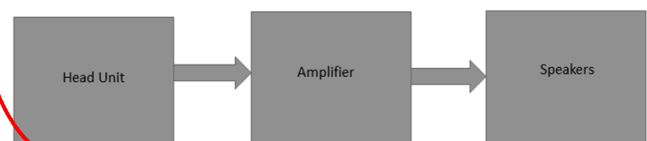


Fig. 1. Basic block diagram of an infotainment system

Equalizers and digital sound processors are two kinds of devices that are used in vehicle audio systems. Car audio is inherently more complicated than home audio due to the irregular nature of car interiors, so even great automotive sound systems can end up sounding bad. The interior of car is

full of materials that absorb or reflect sound, which can result in some frequencies getting attenuated completely while others interfering with each other to create high frequency noise.[8]

### III. EXISTING INFOTAINMENT SYSTEM

Nowadays infotainment systems are getting adapted more to smartphone apps and Internet of Things (IoT). Car makers have started to incorporate touchscreen interfaces to their infotainment systems by introducing menu driven screens and apps. This has given rise to the todays intelligent in-car entertainment paving a way for new challenges and opportunities for the auto makers. Multiple number of audio inputs are available such as radio, pen drive, Bluetooth, internet etc. Infotainment systems are becoming smarter which not only play music but have features such as GPS, voice control for smartphones, internet radio, parking assistance with touch-screen interface and sensors.

Many car manufacturers have incorporated car play in their infotainment system. Apple car play is an apple standard that allows user to use their iPhone in the car. It connects iPhone directly to the cars infotainment display and has features such as GPS, making call, reading messages, music player and so on. The reason behind popularity of Car Play is that it can be added to the current design with an aftermarket system. A similar standard for Android OS is developed by Google known as Android Auto. When an Android device is connected to the compatible head unit using Android auto then the user can broadcast apps such as GPS, SMS, web search etc. on the systems display. Internet radio like Pandora, Sticher, iHeartRadio, Spotify are common these days. The other noticeable features include customizable menu layout, 3G and 4G, LTE WiFi, wireless smartphone charging, remote vehicle control. From security and safety point of view, features like teen driver settings, talk-to-text, automatic post-collision 911 calling (via your phone), car-finding app are available. Some unique features like maintenance reminders and online manuals are also provided by Honda.

### IV. RELATED WORK

Advanced technology such as Hand Recognition can be used in the infotainment system [1]. Different hand gestures are captured and stored in the memory. Each of these gestures is meant for a particular action. For example, and fist may be used for changing the audio source or play the music. In hand gesture, object recognition is the main part which decides the accuracy of the system. A neural network is used in [1] to detect the hand gestures.

Speech recognition is also used in infotainment systems.[2] explains the use of speech recognition in the music system. It uses offline speech recognition. Major advantage of off line system is that it can be used in rural areas where there is no internet connection. Jasper algorithm and Raspberry pi is used for the processing

Safety of the passenger is the utmost important aspect in automotive design. Many ideas have been proposed till date from the safety point of view. One such idea is proposed in

[3], which introduces different method of speech so that the driver is not distracted due to highly interactive system.

### V. PROPOSED SYSTEM

The proposed system is a wireless infotainment system which is controlled using a smartphone. A basic block diagram is shown in the Fig.2.



Fig. 2. Basic block diagram of proposed system

Mobile application UI is as shown in the Fig.3. There are sliders available to change the settings. The system is bluetooth and WiFi enabled so that the passenger can connect his smartphone to the system. Once the smartphone is connected, the system is ready to use. The inspiration for this idea is the fact that most of the people own a smartphone. So instead of using a head unit (usually having a touch screen interface) a smartphone is used to control the system. So the passengers in the rear seat can easily operate the system.

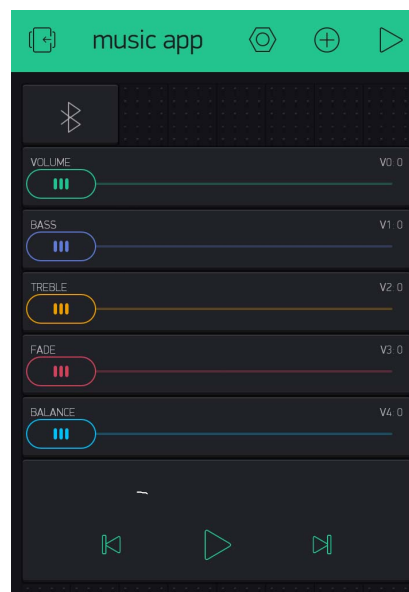


Fig. 3. Mobile Application

Auto makers can include it as a default part of their car design. This way the customer need not install a separate music system in their car. The requirement of a head unit is completely eliminated in this system thereby drastically reducing the size of a classical infotainment system.

The basic design for this system is developed by studying various models of current infotainment systems available in cars.[4] deals with similar kind of a system which has helped the authors to design their system. As shown in the Fig.2

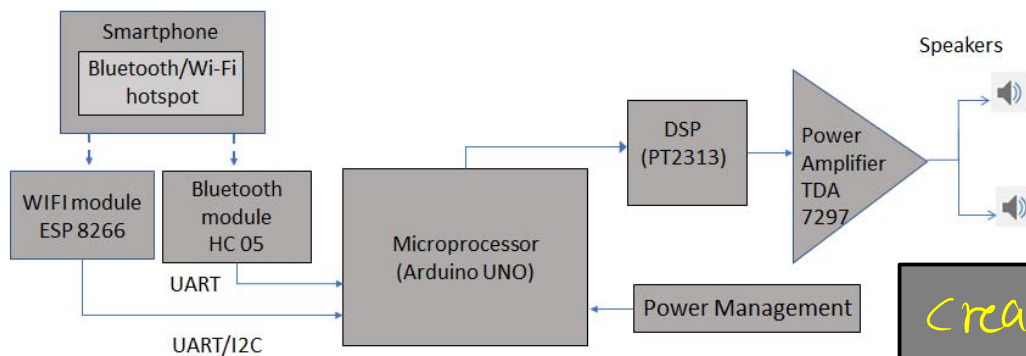
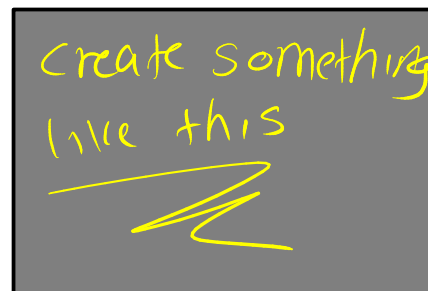


Fig. 4. Detailed block diagram of proposed design



the proposed system has replaced the traditional amplifiers in current systems and the head unit is replaced by a smartphone. The detailed implementation of idea is explained in section VII.

## VI. AIMS AND OBJECTIVES

The idea aims at introducing a music system at the low prices than the existing infotainment system. Low price is the major objective behind this idea along with advanced features. Other objectives of this system is to reduce the size of the overall system and provide comfort and luxury to the passengers. Reduction in the size of the system will open up new opportunities and challenges for auto makers. Luxury and comfort enhances the experience of the passengers and gives product an edge over other products available in the market.

## VII. IMPLEMENTATION

In the proposed design a mobile application is developed, as shown in Fig 3, which can control the tone parameters such as volume, bass, treble, fade and balance of the audio signal. All these changes are done wirelessly.

Bluetooth [9] and Wifi [10] technology is used to make the system wireless. The wifi (esp 8266) and Bluetooth chips (HC 05) are used to receive the signals wirelessly from the mobile. ESP 8266 connects to the smartphone using mobile's hotspot. It is programmed so as to receive control signals accordingly. Atmel AVR (8 bit) controller controls the entire system. It connects to the Wifi and Bluetooth chip using UART (Universal Asynchronous Receiver Transmitter). 9600 bps is the transmission speed used for this communication.

The wifi/bluetooth chip receives the control signal, for example, increasing the volume. Using UART [11] this control signal is transferred to the controller. The controller sends them to the DSP. DSP is a software controller processor (PT2313) which uses I2C [12] for communication. Software controlled processor means there are pre-defined bit streams for carrying out each function. When this exact stream is sent to the

processor then that function is carried out. For example, the volume of -37.5dB is given by 00011110.

The controller, through I2C sends appropriate bit stream to the DSP. DSP does all the processing for the volume parameter. Finally, the processed audio stream is fed to the speakers through a power amplifier. The power amplifier used in this design is TDA 7297. The detailed block diagram is shown in figure 4.

## VIII. CONCLUSION

The infotainment systems are developing at a very fast rate. Wireless systems are more popular these days compared to wired connectivity. The manufacturers strive continuously to make their product best in the market. This paper proposes the wireless infotainment system incorporating Bluetooth and wifi. It uses a smartphone application to control the system. It removes the requirement of a head unit whose space can be utilized to incorporate new features in the car design. It aims at reducing the costs and size. It is very user friendly and easy to use. This system is used for changing the tone parameters of the audio signal.

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