

# ACCIDENT CONTROL USING MUSIC PSYCHOLOGY OF DRIVER THROUGH AUTO- TUNED FM CHANNEL IN VEHICLE ON HIGHWAYS

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**Abstract :** The research in now a day's examined the effect of loud music on driving performance, and mental effort on driver psychology. It is found that loudness and tempo of music increases driving risks, leading to increased number of highway accidents. This paper proposes a solution over this problem by introducing an electronic system which makes use of a simple RFID based Switching circuit in a vehicle music system. A dedicated Radio station is proposed in this paper, which transmits only slow tempo and soothing music. Switching circuit implemented in music system of vehicle enables and auto tunes this station and leaves no choice for the driver of choosing other kind of music.

## I. Introduction

As per the reports from Ministry of road transport and Highways transport research wing [1], Govt. of India, analysed Road Accidents - a leading cause of Injuries, Deaths & Disabilities. Following statistics for Calendar year 2016 shows 4,80,652 Accidents caused 1,50,785 Deaths and 4,94,624 persons injured. It shows that every day 1,317 Accidents take place and 413 Persons killed on Indian Roads and every hour 55 Accidents take place and 17 Persons killed on Indian Roads. Numbers of casualties are much more than war casualties.

Parameter	2015	2016
Total Accidents	5,01,423	4,80,652
Killed	1,46,133	1,50,785
Injured	5,00,279	4,94,624
Accident Severity*	29.1	31.4

\*: Number of persons killed per 100 accidents

**Table 1. Accidents on Highways report from Ministry of RT&HT Research Wing [1].**

Driving is a complex task, which if not carried out adequately can have serious safety consequences Main cause of accidents and crashes are due to human errors. Some of the common behaviour of humans which results in accident are

1. Over Speeding
2. Drunken Driving
3. Distractions to Driver
4. Red Light Jumping
5. Avoiding Safety Gears like Seat belts and Helmets
6. Non-obedience to lane driving and overtaking in a wrong manner

There are various causes that lead to distraction from driving, one of them is loud and high tempo music, leads to over speeding which causes accidents [2]. This paper mainly focus on a psychological cum technical solution on over speeding caused by distractions to driver with loud and high tempo music. Many Psychology researchers [3] found that loud and high tempo music affects driving performance. It is observed that, in everyday environment, background music tempo modifies human motor behaviour. Studies on music psychology states that supermarket shoppers move around in shop with fast paced music, restaurant customers eat quickly and drinks in pub consumed quickly with in presence of fast music. It all shows that tempo of fast and slow music has high impact on human motion behaviour. Following table [4] shows effect of music elements on affective mood states.

The Effects of Music Elements on Affective Mood States.

Emotional State	Music Elements						
	Instrument Range	Tone Frequency	Arrangement	Voicing Texture	Tempo	Intensity	Rhythmic Activity
Positive (Happy)	Wide	High	Heavy Busy	Dense	Fast	Low	Not Constant
Negative (Sad)	Narrow	Low	Light Simple	Transparent	Slow	Low	Constant
Aroused	Wide	Changing	Heavy Busy	Transparent	Medium Fast	Changing	Changing
Optimal For Driving	Balanced	Balanced	Balanced	Balanced	Balanced	Balanced	Balanced
	Medium	Medium	Medium	Medium	Medium	Medium	Medium

**Table 2. Effects of Music Elements on Affective Mood States.**

To avoid over speeding due to loud and high tempo music, if a music system enforced and operated with desired tempo by playing a particular radio station on accidental prone highways then it would avoid possibility of occurrence of an accident. The suggested radio station played here will transmit only slow tempo and soothing music that leads to controlled driving performance.

This Paper suggests an electronic system mounted with the music system of a vehicle that turns off vehicles in build music system and operates an externally mounted radio receiver which is tuned for only one carrier frequency, enforced by highway authorities. System design comprises of following components.

- 1) Radio transmission centre (FM)
- 2) Repeaters on highways
- 3) RF tags
- 4) FM radio receivers
- 5) Switching circuit

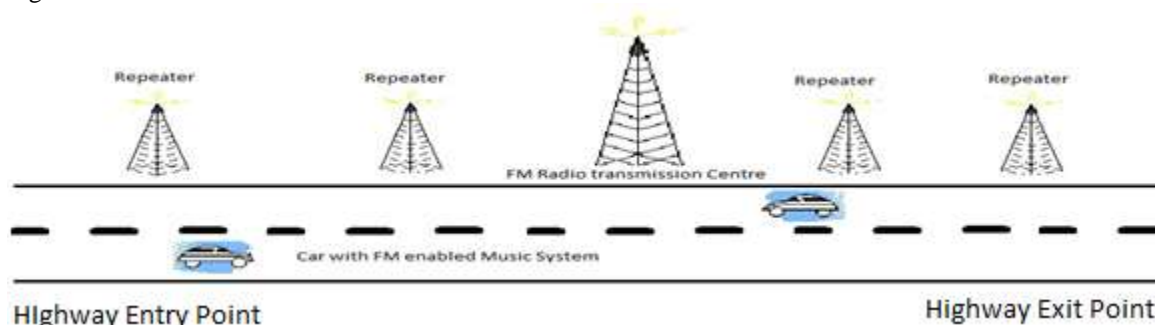


Fig. 01. FM transmission scenario on Highways with Entry and Exit point [5].

**FM transmitter**

Basically there are two methods of FM transmission. In the first method the audio input signal is varies directly with the carrier signal therefore it is called as direct FM. Second method is known as Armstrong indirect method. In this method PM (Phase modulation) is used instead of direct FM, the PM indirectly changes the frequency of the signal, resulting in the increased frequency stability of the carrier oscillator which is affected by inherent variations in values of L and C due to temperature changes and component aging. So indirect transmission method is preferred over direct FM.

Name	Frequency Range	Applications
Low Frequency(LF)	30 to 300 KHz	Navigation, Time Standards
Medium Frequency(MF)	300 KHz to 3 MHz	Marine/Aircraft Navigation, AM Broadcast
High Frequency(HF)	3 to 30 MHz	AM Broadcast, Mobile radio, Amateur radio, Shortwave Broadcasting
Very high Frequency(VHF)	30 to 300 MHz	Land mobile, FM/TV broadcast, Amateur radio
Ultra High Frequency(UHF)	300 MHz to 3 GHz	Cellular Phones, Mobile radio, Wireless LAN, PAN
Super High Frequency(SHF)	3 to 30 GHz	Satellite, radar, backhaul, TV, WLAN, 5G cellular
Extremely High Frequency(EHF)	30 to 300 GHz	Satellite, radar, backhaul, Experimental, 5G cellular
Terahertz, Tremendously High Frequency(THF) or Far Infrared	300 GHz to IR	R & D, Experimental

Table 3. Radio spectrum segments for communication [6].

The FM transmitter consists of Pre-amplifier, Fm modulator, Oscillator, frequency multiplier and power amplifier. Since the audio signals have very low amplitude, it is first applied to Pre-amplifier, where it is boosted to a level that is enough for feeding to the modulator. The oscillator generates the carrier signal which is modulated by the modulator with the input signal generated by preamplifier stage. The generated frequency modulated output is not enough for the transmission in free space, so FM output signal is passed through several multiplier stages to increase the frequency. At the final stage this system the multiplied frequency is applied to the power amplifier which maintains the strength of signal at desired level.

**FM repeater**

An FM repeater is used to repeat or retransmit radio signal. It works as a radio station that has been designed or situated at a particular location for the purpose of retransmitting the signal as it is received. Typically, an FM repeater station will be located at a high position location, an advantage of repeater station is, it may also retransmit the signal with higher power than an operator. As a result, the FM repeater’s carry FM signal over a much broader area than a transmission station alone. So as a vehicle is travelling, the FM signals will cover the complete highway.

**RFID**

Here RF ID tags are used for radio frequency identification of a vehicle and to turn on/off the FM radio system mounted in a vehicle. These tags are constructed in a very small package containing a small electronic circuit and antenna to transmit radio frequency waves. Basically there are three types of RF tags.

- 1) Passive
- 2) Semi-passive
- 3) Active

Band	Regulations	Range	Data Speed	Remarks
120-150 KHz (LF)	Unregulated	10 cm	Low	Animal Identification, Factory data collection
13.56 MHz (HF)	ISM Band Worldwide	10cm – 1 m	Low to Moderate	SMART Cards, Memory cards/ Microprocessor ISO compatible cards
433 MHz (UHF)	Short Range Devices	1 – 100 m	Moderate	Defence application with active tags
865-868 MHz (Europe) 902-928 MHz (North America) UHF	ISM Band	1 – 12 m	Moderate to High	EAN various standard
2450-5800 MHz (microwave)	ISM Band	1 – 2 m	High	802.11 WLAN Bluetooth standard
3.1 – 10 GHz (microwave)	Ultra wide band	Upto 200 m	High	Requires semi-active or active tags

**Table 4. RFID Frequency bands [7].**

Passive tags does not require any power for its operation, it receives the power from RFID reader where as semi-passive tags performs their internal operation by using battery power and relies on RF reader for the power required for transmission of the signal. Active tags are used in an application where long distance communication is necessary between Tag and Reader, so these tags require battery power for their operation.

A very important function of a RFID is how it handles the information storage and processing. So depending on RFID’s abilities, it is classified in to three types.

- 1) One bit EAS(Electronic Article Surveillance)RFID tag
- 2) RFID smart labels
- 3) SAW RFID tags(Surface Acoustic Wave)
- 4) Smart Card Tags

For the proposed system in this paper, one bit EAS tags are preferred, because these tags are commonly known as 1 bit tags i.e. they are designed in such a way to communicate one bit of information i.e. their presence. So if a tag is present at an entry point of highway, then it is detected by the RF reader mounted on the car.

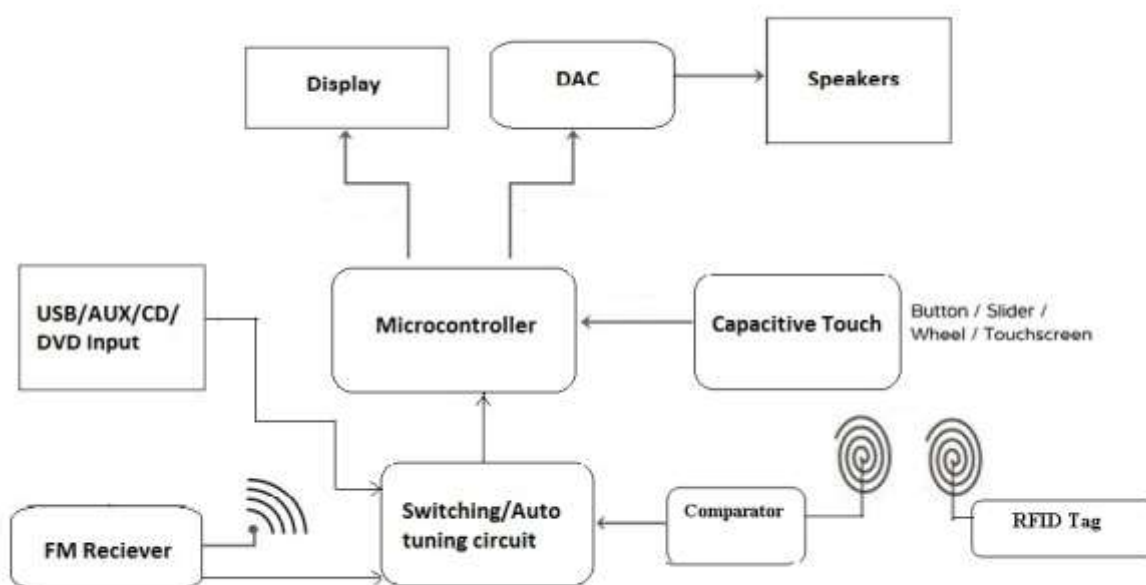
**FM Receiver**

The input signal to the FM receiver is FM carrier signal. And it is received from the Antenna and applied to the RF Amplifiers. The RF Amplifiers in the FM receiver are used to amplify signal. From the RF section the amplified received signal is applied to the mixer. One more locally generated signal by local oscillator is applied to mixer, As a result sum and difference frequencies will generate.

These sum and difference frequencies are applied to IF amplifier where the frequencies get amplified and filtered through band pass filter. So tuning of FM is accomplished by adjusting the frequency of local oscillator. Filtered signal is applied to FM demodulator circuit and finally it is applied to the AF amplifier used to drive the speakers.

For commercial FM radio broadcast, assigned frequencies are in between 88.0 MHz to 108.0 MHz and channel bandwidth of 200 KHz with maximum deviation of ±75KHz. Using one of these channels this paper proposes a dedicated music station to enforce vehicle music system to play proposed channel only. This dedicated channel plays a music which helps to avoid psychological disturbance of driver, which leads to accidents.

**II. Working mechanism of system**



**Fig. 02. Block diagram of proposed system for controlling Highway accidents through music psychology [8].**

Figure shows block diagram [8] of proposed system that controls the psychology of vehicle driver by playing a music that has transmitted through FM transmission station to reduce the number of accidents on accident prone highways. The core of a system is an automotive microcontroller and different devices interfaced with it. This microcontroller is responsible for all the functions related with music system. Following is the brief description of functioning of different block in diagram.

- 1) **RFID Tag:** RFID tag is used to detect entry of a vehicle on highway and to enable automated FM radio station on music system. If frequency transmitted by RFID tag situated at entry point matches with the tuned frequency of RFID reader mounted on Vehicle then switching circuit selects predefined FM radio station as an input and vehicle driver has no choice to listen other music.
- 2) **Comparator:** Comparator is used to compare RFID transmitted signal with tuned signal of RFID reader, if matching occurs comparator circuit enables switching action.
- 3) **Switching/Auto tuning circuit:** Decade counter IC 4017 is used for switching between customized music system and auto tuned FM station. This switching enables and disables auto tuned FM station at entry and exit point respectively. Output generated by comparator is used as clock input to IC 4017.
- 4) **Microcontroller:** microcontroller receives input from user to play music system through USB/AUX/CD/DVD and FM radio stations. This system is now monitored and controlled by a switching circuit which allows playing music system through USB/AUX/CD/DVD and FM radio stations or auto tuned FM stations.
- 5) **Display:** It is used to display the mode of music system operation, volume control in digital format and frequency of radio station tuned by user or enforced by proposed system.
- 6) **DAC (Digital to Analog Converter):** Digital data converted in to analog form by using DAC. Generally music played through USB/AUX/CD/DVD and FM radio stations is in digital form. To play this music in its original form it is applied to DAC. Output of DAC is applied to Preamplifier and then it is applied to power amplifier to drive speakers.

### III. Conclusion

Majority death and injuries on highways are due to accidents caused by driver's driving skills and performance. Music psychology proved that, it can change driving performance with music loudness and tempo. By enforcing proposed system, accidents can be reduced on highways due to drivers performance. There are other measures to be taken to reduce accidents on highways, as this is not the ultimate solution to avoid accidents but can reduce number of accidents and severity of injuries.

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