International Conference on Innovative Trends in Electronics Communication and Applications 2015 [ICIECA 2015]

ISBN	978-81-929742-6-2
Website	icieca.in
Received	02 - April - 2015
Article ID	ICIECA005

VOL	01
eMail	icieca@asdf.res.in
Accepted	15 - November - 2015
eAID	ICIECA.2015.005

Virtual Speed Breakers Using Radio Frequency

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Abstract: *The objective of this presentation is to reduce the number of accidents caused by the conventional speed breakers on the road by slowing the vehicle automatically. This can be achieved by using radio frequency (RF) receiver modules in the future vehicles and use of RF transmitter modules in areas where the speed limitation is required. When the vehicles move into the radiation range of the transmitter the receiver system gets activated and it warns the driver to reduce the speed of the vehicle. This is done unconditionally by limiting the flow of the fuel using ferromagnetic shape memory alloys(FSMA). These alloys come to a different shape upon applying a magnetic field. This technology will prove to be cost effective as it reduces the design cost for the vehicles according to the prevailing road conditions in our country as well as reduce the cost of laying the speed breakers. Above all it prevents the frequent accidents due to the sudden presence of speed breakers. Further this system improves the driving comfort.*

Keywords: Speed Breakers, Radio Frequency, FSMA, Magnet.

INTRODUCTION

Today we are in the Age of Technology. The introduction of wireless communication has transcended all barriers and has resulted in making the communication to be almost instant. This phenomenonal achievement has its roots in Radio Frequency. Many applications now use radio frequency to transmit and receive data, provide wireless connectivity among various devices etc. Many new applications can be derived from the existing technology if it is combined and used in a novel method. In this paper, an antenna which makes use of the radio frequency is used as a controlling module to reduce the speed of the four wheeled vehicle. This idea is mainly concentrated for school zones, hairpin bends and U turns where the speed limit is 20km.

DIRECTIONAL ANTENNAE:

Omni directional antennas are employed for this setup. It is a system which radiates power uniformly in one plane and the direction is perpendicular to it. Omni directional antennas have a similar radiation pattern to the dipole antenna. These are used when coverage is required in all directions (horizontally) from the antenna with varying degrees of vertical coverage. Polarization is the physical orientation of the element on the antenna that actually emits the RF energy. This antenna focuses the RF energy in a particular direction. As the gain of aomni directional antenna increases, the coverage distance increases. For directional antennas, the radiation lobes are pushed in a certain direction and little energy is there on the back side of the antenna. Another important aspect of the antenna is the front-to-back ratio. It measures the directivity of the antenna. It is a ratio of energy which antenna is directing in a particular direction, which depends on its radiation pattern to the energy which is left behind the antenna or wasted. The higher the gain of the antenna, the higher the front-to-back ratio is. For this application we require an antenna with a moderate gain. Hence we propose to use the antenna which has a gain of 15 dBi, a front-to-back ratio of 17 dB. This means the gain in the backward direction is 1 dBi. This way the gain is reduced in the opposite direction. Selecting the appropriate gain we could have the antenna set to different range depending upon the width and length of the road.

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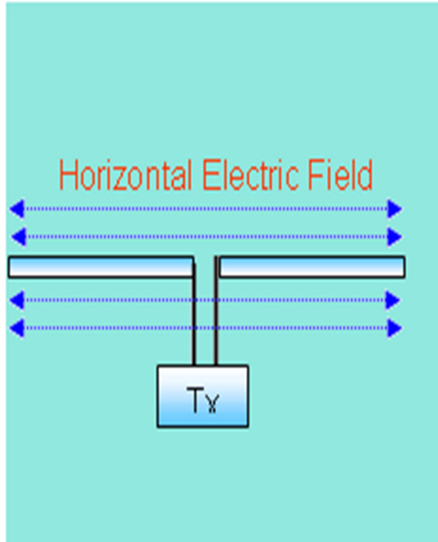

Figure 1. 1 Horizontal Electric field Effect

Figure 1. 2 Omni directional antenna

FERROMAGNETIC SHAPE MEMORY ALLOYS

Ferromagnetic shape-memory (FSM) alloys are materials that exhibit large changes in shape and size in an applied magnetic field. In FSM materials, the magnetic moments of the twin variants play a crucial role in the deformation process: when a sample is exposed to an external magnetic field in the martensitic phase, the magnetic field tends to realign the magnetic moments along the field and, simultaneously, the variant in a favorable orientation with respect to the field grows at the expense of other variants (see Figure 2). The resulting deformation can be as large as 10 %.

The NiMgAl which has Nickel 50%, Magnesium 25%, Aluminium 25% is used as the shape memory alloy. The specialty of this alloy is that it offers immediate response even in the presence of a very small magnetic field. This has the capacity to change shape even in the presence of field of 1 Tesla. This alloy is used in the fuel injection system of the engines. The NiMgAl alloy is casted as a tube and is attached to the common point of the fuel entry into the engine. The alloy is enclosed with a coil to produce a magnetic field on reception of the radiowaves from the antenna. The diameter of the tube is reduced with the increase in magnetic field. This reduces the supply to the engine thus improving the efficiency while saving the fuel during slowing of the vehicle. The FSMA proves to be an efficient system. The property of this alloy is under research and so the alloy may take a few years to come into market for domestic use. Thisalloy can considerably reduce the fuel consumption and also result in efficient fuel management.

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Ferromagnetic shape-memory (FSM) alloys are materials that exhibit large changes in shape and size in an applied magnetic field. The key factor behind this phenomenon is martensitic transformation of the crystal lattice below a certain temperature. Regions having typically a tetragonal crystal structure start to form within the parent austenitic, cubic phase, and the resulting strain is accommodated by the formation of strained twin variants (the words "austenitic" and "martensitic" are normally used to describe the different steel variants but they can be also associated with different crystal structures). This behavior is illustrated in Figure 1. The redistribution of these variants, the twin-boundary motion, leads to the macroscopic deformation of the whole element. What differentiates FSM materials from conventional, shape-memory (SM) alloys is that the shape change takes place solely in the martensitic phase. In the case of traditional temperature-driven SM materials, a sample is first cooled, and then deformed to modify the dimensions and shape of the studied sample, and the initial state is retained when the sample is again heated above the martensitic transformation temperature. Some shape-memory alloys exhibit super elasticity, i. e. , an applied stress leads to the martensitic transformation and a large shape change above the transformation temperature. In FSM materials, the magnetic moments of the twin variants play a crucial role in the deformation process: when a sample is exposed to an external magnetic field in the martensitic phase, the magnetic field tends to realign the magnetic moments along the field and, simultaneously, the variant in a favorable orientation with respect to the field grows at the expense of other variants (see Figure 2). The resulting deformation can be as large as 10 times.

For applications, an FSM element has to be biased in a single-variant state in zero field, e. g. , by applying stress. The magnetic field is applied orthogonal to the biasing direction, which leads to the above-mentioned behavior when B > 200-300 mT (at lower fields the magnetic moments just rotate without any structural change taking place). The FSM effect is a reversible process just like the normal SM effect: When the field direction is reversed, the material returns to its original shape.

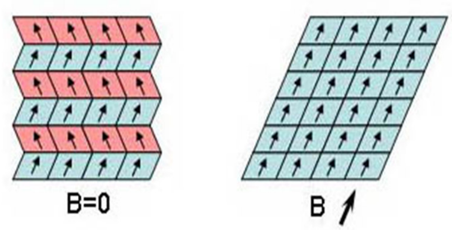

Figure 2. 1 Formation of martensitic regions within the parent austenitic phase.

SYSTEM PRINCIPLE AND WORKING

SYSTEM OVERVIEW

The speed of the vehicle can be controlled by applying clutch, break. To avoid wastage of fuel ferromagnetic shape memory alloys can be used near the place, from which fuel is being injected into the engine. All these actions are performed upon the reception of electromagnetic waves in radio frequency range transmitted by a transmitter installed in the places where speed reduction is required.

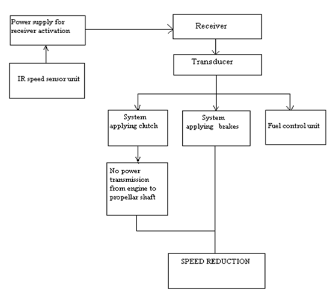

Figure 3. 1 Block diagram of the entire system operation

APPLYING CLUTCH:

The first step in stopping the vehicle is to apply the clutch. This could be done by using a dc motor which is directly connected using a clutch cable to the clutch. The current produced
upon reception of the electromagnetic wave is used to run the motor in a manner that the clutch would automatically be applied so that power transmission from the engine to the propeller shaft is stopped. This system is designed in such a way that the driver has control over the clutch even though the clutch is being applied automatically. This control would enable the driver to start the vehicle even if the engine goes off in the region where electromagnetic wave is being received. For four wheelers the system already present in the automobile is to be used used for applying clutch upon reception of rf waves.

APPLYING BRAKES:

Upon applying clutch the transmission of power from engine to propeller shaft is stopped. The brakes are then applied using a separate breaking system which would be operating along with the breaking system already present in automobiles; the system uses a coil to produce a strong magnetic field. Upon production of magnetic field the system is designed in such a way that the brakes are applied. The production of magnetic depends on the intensity of reception of rf waves which in turn depends on the speed of the vehicle. This magnetic brake system is to be used for four wheelers. For two wheelers a stepper motor is to be used for applying brakes. These stepper motors are supplied with power upon reception of rf waves. The rotation of these motors in steps provides braking through the cables used along with the cables which are used in automobiles for applying brakes. The driver of the vehicle is given control over the brake system so that the driver may stop the vehicle under accidental situations. These actions would retard the speed of the vehicle considerably moving at design speed in the road. The vehicle which is moving at considerably would further be slowed down if the above actions of applying clutch and brake are performed. To overcome this, power required to activate the receiving antenna is supplied from a dynamo which is directly in contact with the rotating wheels of the vehicle. This makes the receiving antenna to be activated only when the vehicle is moving with a speed for which speed retardation is required.

The system which applies brake is to be designed in such a way that the force it would produce upon supplying minimum current is sufficient to reduce the speed of the vehicle which is moving at a design speed in the road.

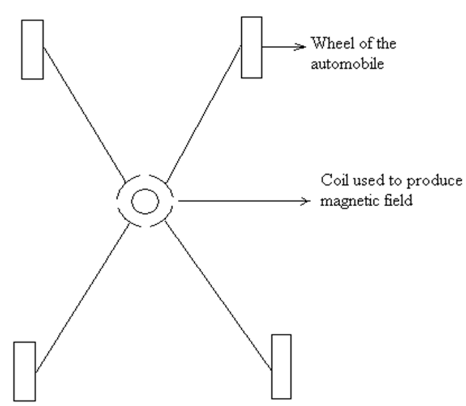

Figure 3. 2 Brake system before applying brake

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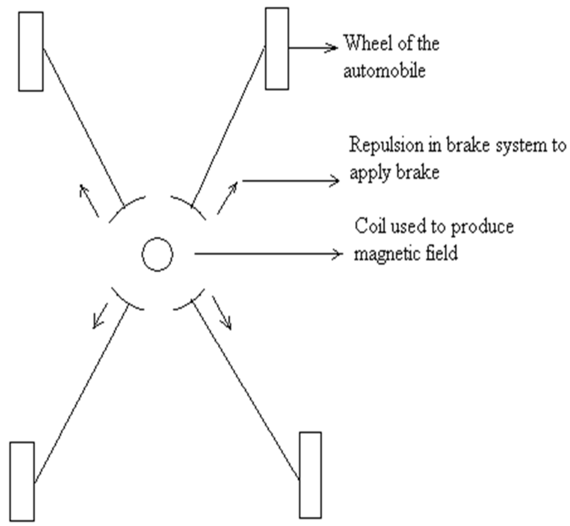

Figure 3. 3 Brake system before applying brake

FUEL CONTROL:

By above actions the speed of the vehicle would be reduced but the fuel supplied to the engine would not be controlled. As power transmission from engine the engine to the propeller shaft has been stopped there is no need that the fuel should continuously be injected into the engine. The fuel supply is to be controlled by using a ferromagnetic shape memory alloy.

The fuel supply can be controlled by reducing the diameter of the pipes from which fuel is being injected into the engine. This is done by using a ferromagnetic shape memory alloy near the point from which fuel is injected into the engine. The current produced upon the reception of a radio waves is supplied to a coil to produce a magnetic field of about 1 tesla at which the diameter of the alloy is reduced .This action would reduce the fuel being supplied to the engine. Ultimately the consumption of fuel upon speed reduction is reduced.

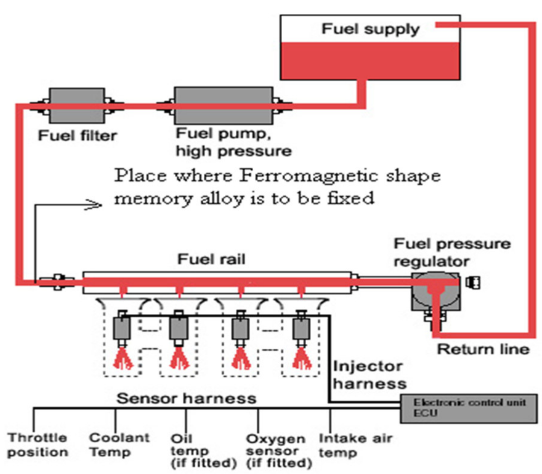

Figure 3. 4 Figure showing the position of ferromagnetic shape memory alloy

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SPEED SENSORS

In order to differentiate vehicles coming at a slower speed and those moving at a higher speed, we are going to use a sensor to gauge the speed. It consist of an arrangement of a perforated disc attached to the wheel and an IR light which sends light and the receiver receives it. When the vehicle is moving at a faster pace the light would be available to the sensor continuously. Upon continuous sensing of light the rf receiver would then be activated by supplying power from the unit that supplies power for rf receiver activation. If the vehicle is moving at slower pace the IR light would be available to the wheel speed sensor with continuous interruption. Upon sensing of interrupted IR light the rf receiver would not be activate and the speed will not be controlled by the system provided in the road. This speed sensor system would distinguish between the vehicles moving at slower speed and those moving at higher speed and would control the speed accordingly. The material to be used in the sensor would be chosen in such a way that the RF receiver would be activated if the vehicle is moving at a speed of about 25kmph to 45kmph. For vehicles which are moving at a speed of about 15kmph to 20kmph speed reduction is not necessary and activation of RF receiver would be avoided for vehicles moving at slower pace.

ULTRA LOW POWER RF

Now-a-days even Ultra Low Power RF can also be used by which power consumption can be reduced. ULP wireless connectivity can be added to any portable electronic product or equipment featuring embedded electronics, from tiny medical and fitness sensors, to cell phones, PCs, machine tools, cars and virtually everything in between. Tiny ULP transceivers can bestow the ability to communicate with thousands of other devices directly or as part of a network – dramatically increasing a product's usefulness.

ULP wireless technology differs from Bluetooth technology in that it requires significantly less power to operate. This dramatically increases the opportunity to add a wireless link to even the most compact portable electronic device.

SUGGESTIONS

The significance of the system lies in the use of ferromagnetic shape memory alloy NiMgAl which has a very high sensitivity. It is employed near the nozzle of the fuel injection system so even a slight change can decrease the fuel amount considerably. Also the use of speed breakers may cause congestion in traffic as the vehicles have to come to complete halt. If this system is implemented the vehicle would be moving at a constant rate thereby regulating traffic. Instead of laying big speed breakers near the railway gates, this system can act as an alternative. Nowadays the global trade is increasing though it got hit due to recession. Many cars are imported from foreign countries and our Indian roads are not suitable for those cars as they have a very low base. This system avoids speed breakers and thus suitable for all types of automobiles.

REFERENCES

- http://en.wikipedia.org/wiki/Directional_antenna
- http://www.authorstream.com/Presentation/Ahmedmalaa-92625-fundamental-types-antennas-antenna-electromagnetics-engineering-science-technology-ppt-powerpoint/
- http://www.cisco.com/en/US/tech/tk722/tk809/technologies_tech_note09186a00807f34d3.shtml#topic3
- http://ses.confex.com/ses/2004tm/techprogram/P1155. HTM
- http://depts.washington.edu/cims/publications/pdf/actuators2.pdf
- http://en.wikipedia. org/wiki/Transducer
- http://www.ezlan.net/antennae.html
- http://www.twminduction.com/faq/images/fuel_inj_system. jpg

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