Design System Detection Magnetic Mine Which Is Hidden Under The Cars By Using Hall Effect Sensors

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Abstract:

This work study design system detection to detect magnetic mine or magnetic material which is hidden in any place under the car or vehicle using hall effect sensors . Hall effect sensors could be entirely integrated on a single silicon chip a several sensors might be used in a modern devices as switches, latches or linear sensors. Hall effect sensor is a small sheet of semiconductor material represented connect with DC-voltage source and will force a constant current flow in the semiconductor sheet if it is placed in a magnetic field with flux lines perpendicular to the sheet .This sensors are sensitivity to magnetic field the output voltage ,(Hall effect voltage) will be directly proportional to the strength of magnetic field . This concept might be used to detection a magnetic mine or materials which is hidden under the car by using numbers of bipolar sensors placed in special manner's under the car to sensitive any magnetic field and give warning as light or sound.
Keywords: DSDM / Hall effect . New Application.

تصميم نظام كشف القنابل المغناطيسية التي توضع تحت العجلات باستخدام متحسسات هول

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الخلاصة :

يدرس هذا البحث تصميم بعض أنظمة كشف القنابل المغناطيسية او اللاصقة التي تضع في أماكن محدودة تحت العجلات باستخدام متحسسات هول .التي تصنع على شكل دوائر متكاملة تحتوي على قطعة من أشباه الموصلات ومضخمات (DC) . هذه المتحسسات تستخدم في الوسائل الحديثة كمتحسسات خطية أو منزلقات أو مفاتيح عالية الكفاءة .متحسسات هول تمثل قطعة صغيرة من اشباة الموصلات التي تربط مع مصدر فولتية ثابت عندها يمر تيار مستمر فى شبة الموصل إذا وضعت في مكان فيه مجال مغناطيسي كثافته عمودية على سطح المتحسس.
تعمل هذه المتحسسات على مبدأ التحسس لشدة المجال المغناطيسي حيث تقوم بتوليد فولتية (هول فولت) التي تتناسب قيمتها مع شدة المجال المغناطيسي هذا المفهوم او الفكرة يمكن استخدامه لكشف القنابل التي تضع على مواد مغناطيسية لاصقة . عندما توضع هذه المتحسسات بطرق معينة تحت السيارة او العجلة تقوم بإعطاء أشارة تحذير على شكل ضوء أو صوت .

1. Introduction:

The Hall effect was discovered by Dr. Edwin Hall in 1879 [1] .He found when a magnetic was placed so that its field was perpendicular to one face of a thin rectangle of gold through which current was flowing a different in potential appeared at the opposite edges and this voltage proportional to current flowing through the conducted and flux density or magnetic induction perpendicular to the conductor .

With the advent of semiconductor materials in the 1950 the Hall effect found its first applications micro switch sensing and control sensor development engineers[2] .Teamed up to final a practical low cost solid state sensor .Hall effect could be entirely integrated on a single silicon chip several sensors might be used in a modern automobile ignition systems .Security systems mechanical limit switches computer printer . Disk drivers keyboards, machines tools , position detectors and brushless DC. Motorcommutators .

Hall effect sensors are immune to environmental contaminants and operate reliably under oily and dirty hot or could bright or Dark and wet or dry conditions[6] .

2. Principals of operation:

When we used a sample of rectangle semiconductor (p.- type or n -.type) silicon or germanium materials in **figure (1)** .[5]

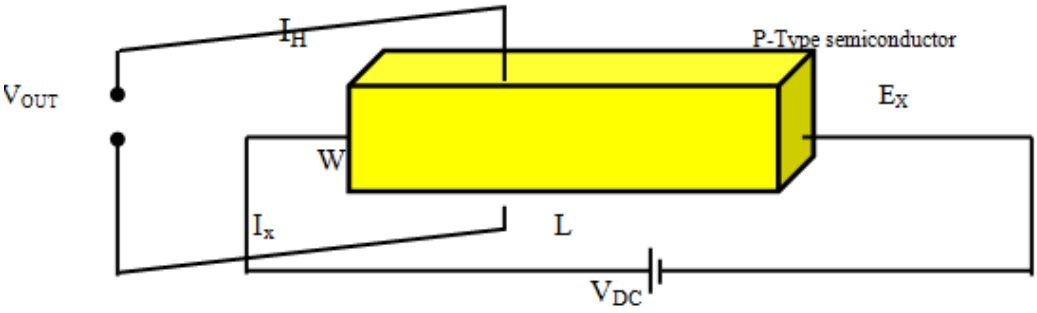

Fig.(1) system circuit of semiconductor

A source voltage (bias voltage) will cause a constant bias current to flow through the semiconductor and electric field applied along x – axis . When a magnetic field applied perpendicular to electric field the Lorentz force will exert to pulling and accumulation of holes at the top surface and the other side the electrons .

This state establishment of electric field is called Hall field and Hall voltage with the equation;- .

$$V_H = \frac{I.B_Z.W}{e.P.A} \quad \text{.....(1)}$$

$V_H \alpha I_{X\times} B_Z$.....(2)

$V_H = E_Y .W (\mu v)$ .....(3)

V_H =Hall voltage (μ v)
I = current flow through semiconductor (m A)
B_Z = Density of magnetic field (W_b/ m^2) .
E = charge of electron (C)
W = Width of semiconductor (cm)
A = Cross – section area (m^2)
P = Concentration of holes (m^{-3}) .

Equation (1) shows that Hall voltage at the output increase proportionally with increase the strength of magnetic field or current flow throw semiconductor other components are constant [5].
Equation (2) and (3) show that Hall voltage depend at width of semiconductor and Hall electric field [6]
The output voltage (Hall voltage) is small (in micro-voltage (μv) or (m v)) . using DC amplifier to amplified this voltage to must be useful for applications.

3. Types of Hall effect sensors dependent to structure .

3.1 Introduction.

To effectively apply Hall effect technology .It is necessary to understand the sensor .Its input And its output analog and digital. Analog sensors provide an analog output voltage which is Proportional to intensity of the magnetic field . The output of digital sensor is two discrete Level (1 or 0) (ON or OFF) never in between [9]

A. Analog output sensors.

Analogue sensors provide an output voltage that is proportional to magnetic field to which it is exposed although this is a complete device as in figure (2) additional circuit functions were added to simplify the application .

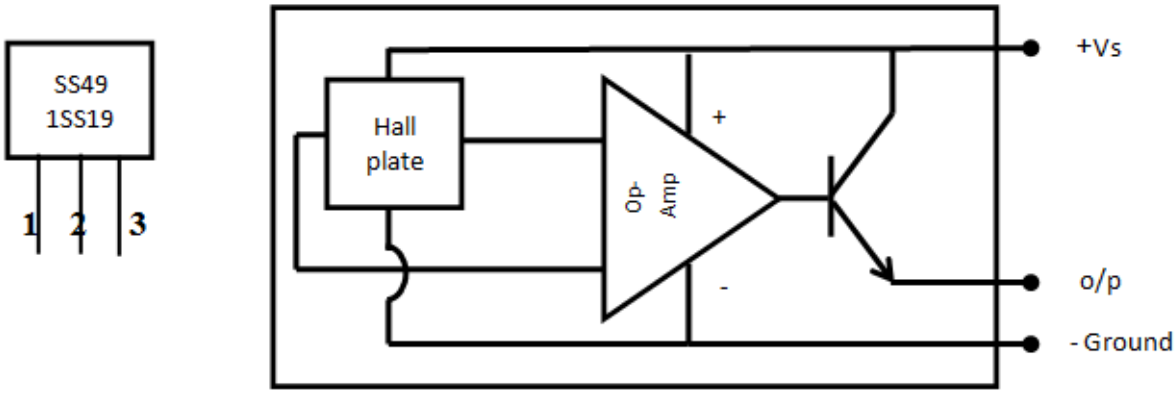

Fig.(2) Simple analog sensor ([C-chip)

The sensed magnetic can be either positive or negative, as a result the output of the amplifier will be driven either positive or negative .Thus requiring both plus and minus power supplies .to avoid the requirements for two power supplies[4] .

A fixed offset or bias is introduce in to the differential amplifier. The bias value appears on the output when no magnetic field is present and is referred to as a null voltage when a positive magnetic field is sensed the out increase above null voltage .

Conversely, when a negative magnetic field is sensed the output decrease below the null voltage but remains positive .This concept is illustrated in **Figure(3)**[8].

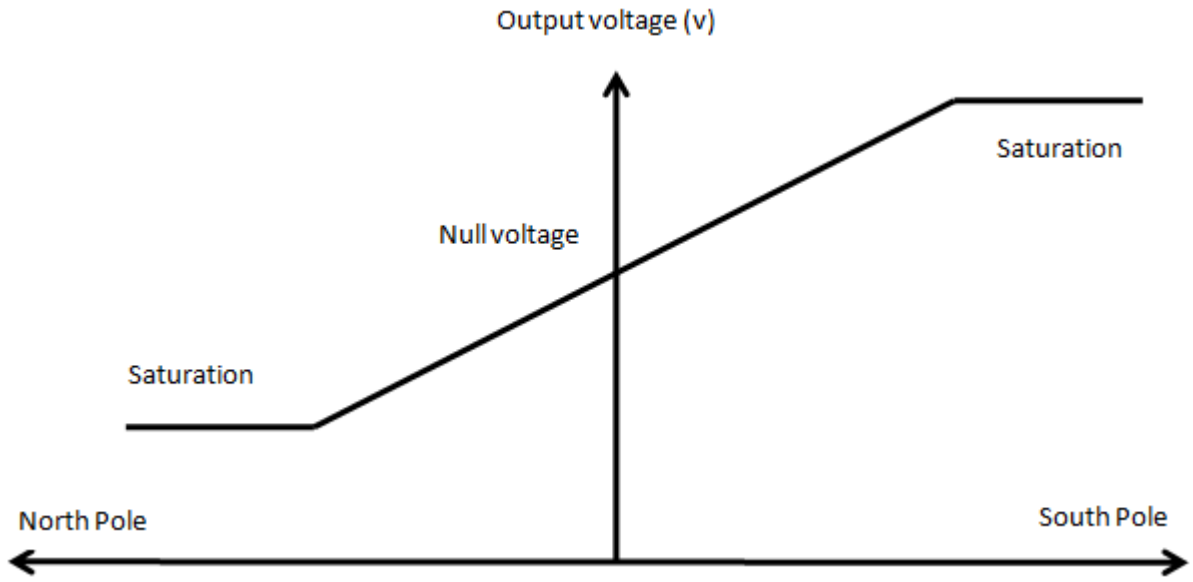

Fig.(3) Input magnetic field (gauss)

After operational amplifier (Differential) stage connect the open emitter or open collector or push – pull transistor to increase flexibility of device ,

B. Digital output sensors :

This sensors has an output that is just one of two state : ON of OFF .

The difference between analog sensor and digital sensors that added a Schmitt trigger stage after differential amplifier as in **Figure (4)** .

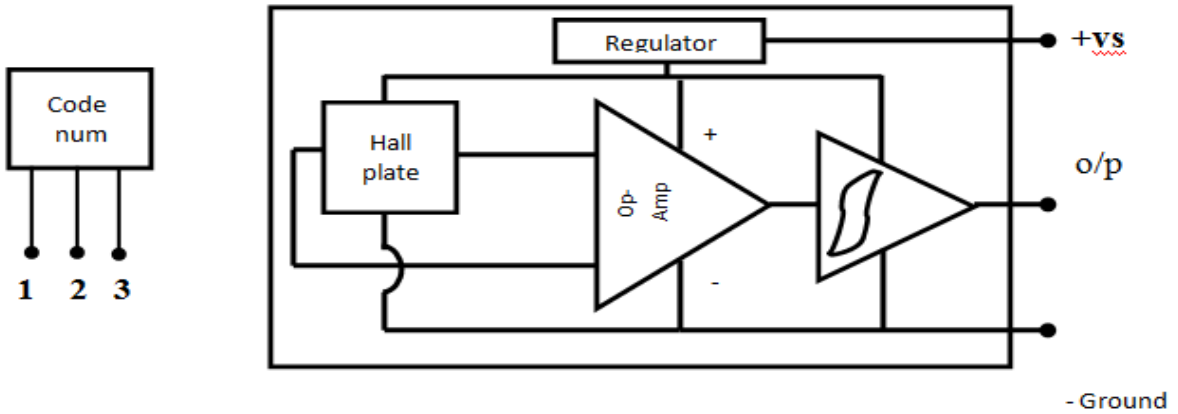

Fig. (4) Inside of digital sensor

The principle input / output characteristics are the operate point , release point and the differences between the two or differential.

As the magnetic field is increased no change in the sensor output until the operate point is reached the sensor change state from " Off " to " on " state [7].

If magnetic field is decreased to below the operate point the output stay in state " on " until the release point is reached the sensor will return to state " off" [3] as in **Figure(5) .**

Most digital Hall effect sensors are regulated and can be used with power supplies in range (3, 8 V, to 24V)V_{DC} unregulated sensors require power supply of (4.5 to 5.5) V .

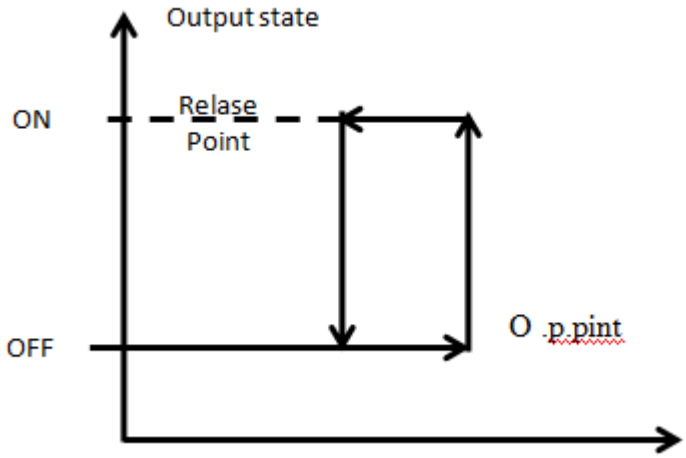

Fig.(5) Input magnetic field (gauss)

4. Basic affective magnetic design consideration

The flux density produced by a magnet at aparticular point in space is affected by numerous. Factors among these are magnet length cross section area shape and material as well as other, Substances in the path of the flux[2].

The magnetic field is reach at the face of sensor proportional to the inverse square of the Distance between a magnet and sensor ($B\alpha 1/d^2$)[4]

This means that magnetic sensing is effective dependent at two factors one is strength of Magnetic field a second is distance and long of magnet from increase the effective distance With strength and type of magnet. All Hall effect devices are activated by a magnetic field .A absence of any magnetic field .Most Hall effect digital switches are designed To be (OFF) open circuit at output. They will turn (ON) only if subjected to A magnetic field that has both sufficient density and correct orientation[1][2].

5. Some systems detection magnetic material(mine)

1. Row system arrangement.

In this system or manner Hall effect sensors put in line at the every edge under the car in four

Direction. For example when magnetic mine put under the driver stool of car .Hall effect sensors sensing a magnetic field and given the. warning indicator as light or sound(Buzzer).This manner can be arrangement as in **Figure (6)** below[5].

Need(DC. battery 3.5V to 6V).(n) number of bipolar hall sensors and .system warning.

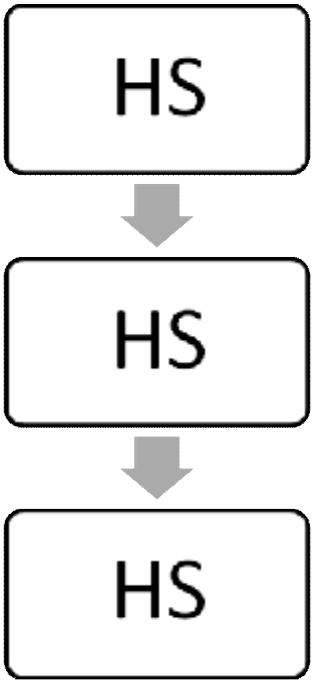

Fig.(6) Row system arrangement

2. A square manner(system) arrangement.

This system choose in the center of position under the vehicleas in **Figure (7)** for detection magnetic mine need..

a. DC Battery (3V to 6V) I_{DC}= 100mA

b. Four bipolar sensors devices (as switch) **.**

This manner dependent of types of sensors and position of magnet (density of magnetic field.

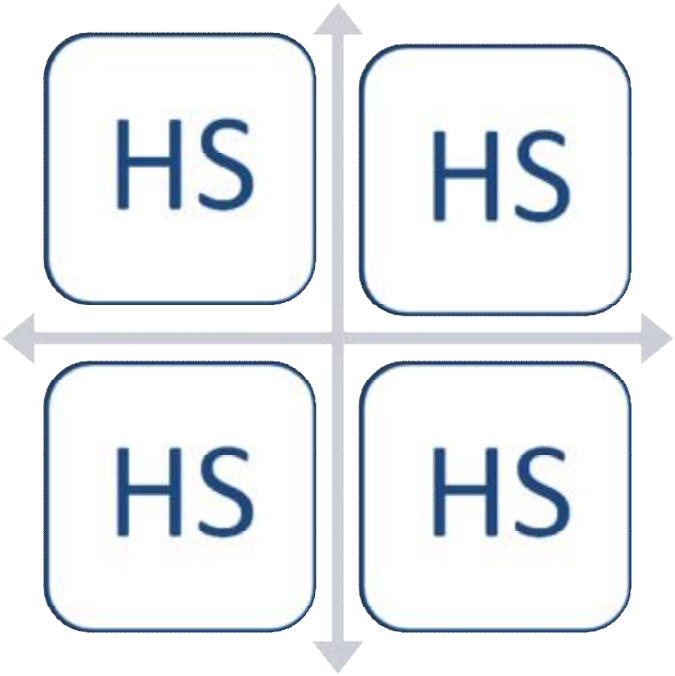

Fig. (7) square system arrangement

3. Ring arrangement system arrangement.

Putting hall effect sensors (as switch) in ring system to choose position under vehicle with.

Warning system. as in **Figure (8)**

To high possibility detection in this manner need.

a . Manufactured (n) numbers of sensors (bipolar) in ring manner

b. Using high quality battery for rang 3V to 6V Current=100mA

c . Detection dependent of choose position and density of magnetic material

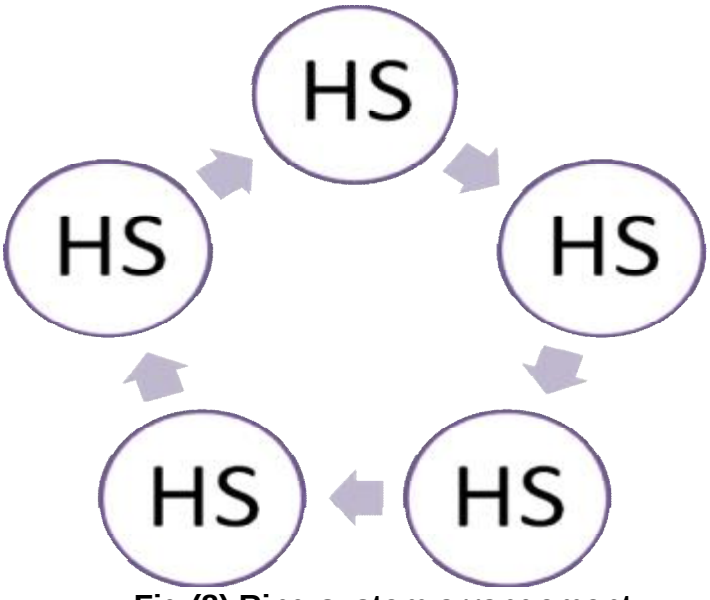

Fig.(8) Ring system arrangement

6. Conclusion

Laboratory experimental proof find that the best manner (system) for detection magnetic flux using Row system arrangement because the magnetic mine which put under car move near or above the Sensors .

Many types of Hall effect sensors using in applications resent sensing devices .Applying Hall effect Sensors involves selecting the magnetic system and choosing the Hall sensor with the appropriate And relate characteristics . The concept applications (I_C –Hall sensors) for detection magnetic mine Dependent of density of magnetic field and technique manufactured and applications sensors In this research by using systems (manners) .

1. Row system arrangement..
2. Square system arrangement .
3. Ring system arrangement .

Are useful for special application detection magnetic mine (material) but probability detection Dependent of ;

1. Types of (I_C –Hall sensors) .
2. Technique using Hall sensors (choosing position .designing system) .
3. Density of magnetic flux (field) .
4. Technique connection of electrical circuits with system warning .
5. Quality of DC-Source which feeding the electrical circuit .
6. system warning

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