

Smart Spirit level

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Abstract: Flatness measurement is always an emerging problem in broad area of Machines, automobile, construction etc. For any machine before its operation should have an accurate alignment. A simple spirit level is commonly employed in order to measure Flatness but the results are not so accurate. Although we have electronic devices such as inclinometer for those tasks but they are so much costly. Here comes our technology “A hybrid spirit level” through which measurement of inclination becomes more precise at very cheap cost. The apparatus consist of a spirit level integrated with electronic circuit to detect the inclination/ flatness of the required surface. Here the property of conductivity of liquid will be employed in the job of detecting the inclination of the surface. By using this method it is possible to minimise the error to great extent and also will help in automatic detection of flatness/ inclination.

Key Words: conductivity of liquid, detection circuit, LED.

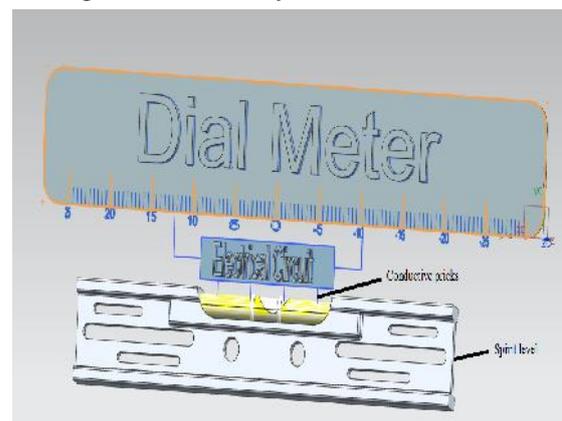
1. Introduction:

A spirit level is a device designed to indicate whether the surface is Horizontal or vertical. It has wide application is Carpentering, metal work, engineering work, photographic or video graphic work etc. The use of bubbles of air confined in a gently curved tube is frequently referred to as use of a so-called spirit level. Another early type of level detector depended upon the principle of a pendulum either visually monitored or electrically monitored. Gas bubble and pendulum type levels are generally lacking in sensitivity or readability, although the reliability of such instruments is fairly good when undamaged. Electrical or electronic detection or interpretation of the results from such instruments have resulted in better accuracy and reliability and have allowed remote sensing by digital or analog signals and readout. U.S patent No. US7743520 B1 entitled “ Digital Level apparatus convertible for remote sensing”, june 29,2010 to Michael A.Jiorle discloses a method for quickly and accurately levelling the surface in vertical and in horizontal plane. Researcher developed digital spirit level.

2. Design Methodology:

In this work we are converting the present design of spirit level to the smart one. There will be a cylindrical spirit level as shown in figure 1 and few parallel prick pairs having conductive tip will

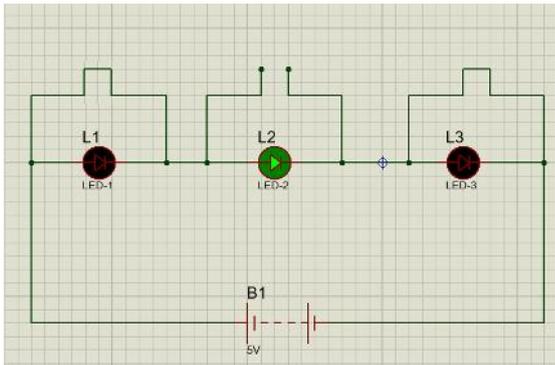
be inserted in spirit level at a regular interval. There will be a coating of hydrophobic material on the interior walls of whole apparatus except the prick tips, there by resulting in non sticky property. Now each pair of parallel prick is connected to a relay circuit and this circuit will sense the loss of conductivity in the pair of parallel prick at any given location due to the movement of air bubble (as shown in fig 2 a relay circuit) which will lead us to have an accurate value of misalignment shown by the LED circuit.



3. Circuit Methodology/ Sensing Circuit:

In the given circuit pair of prick will be connected in parallel with the LED and there will many such combinations (pricks with LED) connected in series with each other. The whole arrangement will

be connected to the battery of 5V. At a given instant only one pair of prick will be in contact with air bubble then current will be bypass through the LED;s (L2) and it will indicate the passage of current while the other LED's (L1 & L3) will be off.



4. Manufacturing of smart Spirit Level:

For manufacturing of given design the following components are needed,

- Material of body of spirit level
- Wires or pricks with hydrophobic coating
- Sensing circuit
- Display unit
- Battery for energy source

The following describes everything mentioned above

a) Material of body of spirit level

Polystyrene plastic that withstands temperature between -15°C to $+60^{\circ}\text{C}$, high transparency and durability is used to manufacture above spirit level.

b) Pricks with Hydrophobic coating

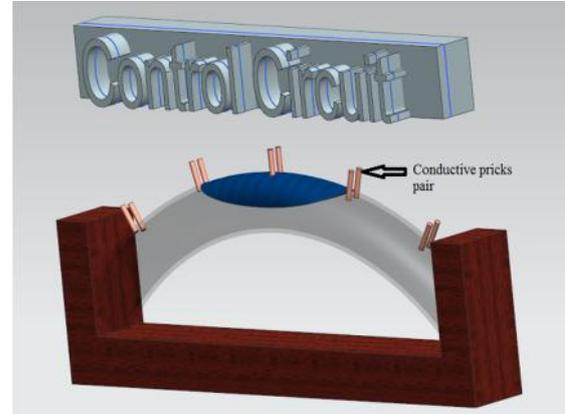
Copper wire coated with polymer material is used, these wires are kept inside the spirit liquid with depth of 1 cm. polymeric material coating prevents liquid to adhere on surface of wire thereby resulting in higher accuracy.

c) Working/ Prototype

Round Spirit level for Higher Calibration:

If it is required to calibrate the smart spirit level to the flatness of different surfaces then curved arrangement of spirit level will be used in order to have good accuracy in calibration. The same arrangement of pair of parallel will be connected to the liquid inside the spirit level. But the movement of bubble in the curved spirit level

will be slightly low as compare to the straight one thereby resulting in the better accuracy.



5. Applications of Smart spirit level:

-) Since this is cheap technology therefore can be used in any gymnastic machines to check their balance or horizontalness.
-) In all the design and manufacturing of automobiles and aerospace.
-) Wide application in 3D alignment
-) Flatness of machines and civil works instrument.

6. Cost Estimation:

S.No	Components	Rate in INR	No Req.	Net cost INR
1	Material (glass tube)	10	1	10
2	Wires	8	.25	2
3	LED	1	7	7
4	spirit	20	1	20
5	Circuit accessories	-	-	20
Total				59

7. Comparison between existence spirit level and smart spirit level:

The smart spirit level is automatic as compared to normal spirit level. No manual inspection is required while using smart spirit level as compared to normal spirit level.

The digital inclinometer available in the market are too costly as compared to smart spirit level. The

digital inclinometer have very high accuracy as compared to smart spirit level but digital inclinometer cant be used in rough conditions

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