Oil Level Measurement in Front Fork

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Abstract - This paper studies the use of instrument devised to measure the oil level in front fork, to control the manual errors occurred during measurement. The work attains to establish the mechanism of measuring the oil level before the fork being tested for its durability. Encoder-decoder circuit mechanism has been used here. The adequacy of the instrument is tested by its repeatability and vernier scale. Use of IR sensor, proximity sensor (metal detector) and a simple live wire sensor is done. The tests are conducted on the forks of bikes with diameters ranging from Bajaj Platina to Bullet (18mm-32mm). After the measurement of volume, the values are used in Damping force testing.

Keywords: **Encoder-decoder, Front fork, Sensors**

I. INTRODUCTION

With the advancement of science and technology, the importance of numbers succeeding the decimal point has increased by leaps and bounds. Quality is obtained as the precision is maintained. Level sensors detect the level of substances that flow, including liquids, slurries, granular materials and powders. The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low.
There are many physical and application variables that affect the selection of the optimal level monitoring method for industrial and commercial processes. The selection criteria include the physical: phase (liquid, solid or slurry), temperature, pressure, vacuum, chemistry, dielectric constant of medium, density (specific gravity) of medium, agitation, acoustical or electrical noise, vibrations, mechanical shock, tank or bin size and shape. Also important are the application constraints: price, accuracy, appearance, response rate, ease of calibration or programming, physical size and mounting of the instrument, monitoring or control of continuous or discrete (point) levels.

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II. LITERATURE SURVEY

Ultrasonic sensors are most widely used for their precision in measurement, their 18 kHz frequency transmitter receiver pair gives precise output of liquid level but the condition is that liquid density must be greater than 850kg/m^3. Here, the three different types of oils which are used are of density lower than 832kg/m^3. This technology is limited by shapes of surfaces and the density or consistency of material. In order to find the level of liquid with comparatively lower density this instrument is devised, the properties of sensors used here are checked individually, so assembly of these three sensors proves to satisfy the objective. Moreover the oil is non-conducting. Hence use of this instrument would furnish important data; making its use prominent, in precisely measuring the air volume in front fork.[2]

III. EXPERIMENTAL

A.Block diagram:-

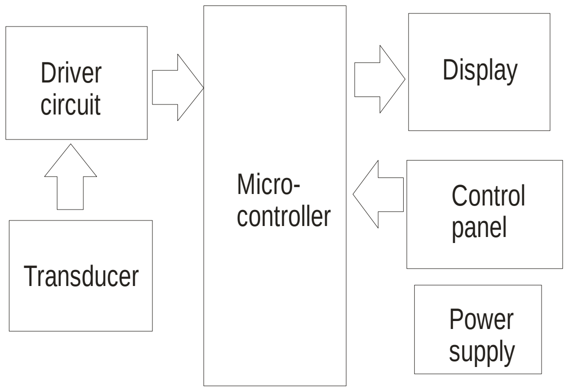

Fig1:Block diagram

B. Transducer:-
A transducer is a device that converts one type of energy to other. The conversion can be to or from electrical, electro-mechanical, electromagnetic, photonic, photovoltaic, or any other form of energy. While the term *transducer* commonly implies use as a sensor/detector, any device which converts energy can be considered a transducer. The work of transducer is to convert the input into electrical form. Here simple pair of live wires is mounted on upper PCB and upper part of lower PCB is given copper coating to make the circuit closed, when liquid level is encountered by the buoyant cylinder filled with thermocol; due to force of surface tension the thermocol exerts upward force due to which the PCB lifts up and consequently the circuit is completed.

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Fig2: Live wire sensor

C.Signal conditioning:-

When the lowering of the live wire sensor takes place the encoder decoder circuit formed of the positive print and IR sensor pair comes into action. Basically the circumference of the cylinder mounted on shaft is equal to the number of positive print dots on the acrylic sheet. This mechanism is done with a view that for every single increment in the pulse the dot on the positive print is intercepted by IR sensor pair, for every pulse that is counted by IR pair adds to the controller count for its depth measurement of oil.[3] [5]

As the motor assembly is the most crucial part involved here, the selection of motor is done taking following conditions into consideration.[4]

- The time required for measuring depth should be minimum
- Precision should also be maintained
- Since circumference of the cylinder is 78 mm, it means one revolution lowers the live wire sensor by 78mm.
- A higher rpm motor when used, a single slip in the pulse count can increase the error.

Taking all these things into consideration motor with 10 rpm and 0.8 kg torque is used here. So even if the depth of 234 mm if required to measure takes just 18 seconds, with precision.

D. Microcontroller:-

Microcontroller is used for performing a dedicated form of work. Here a dedicated work is expected so microcontroller is used. The work of controller is to take the digital output and convert into volume of air present in it. This is done by initially taking digital output converting into numerical form and then multiplying by the formula programmed in the controller and giving an output on the LCD screen. The processing work of the input data is done by controller itself. The data is given into various voltage levels by the ADC depending on the previously set levels enables us to get the height of oil from the top of the shock absorber assembly. In order to avoid the error due to improper mounting of shock absorber it is susceptible for error.[6] [7]

E. Encoder-Decoder:-

In figure 3, the thick lines of positive print assists the IR sensors to count the pulses while lowering of the live wire sensor takes place. Combination of black spots and transparent acrylic plastic makes IR sensor to generate high and low pulses, which are counted by the controller.[10]

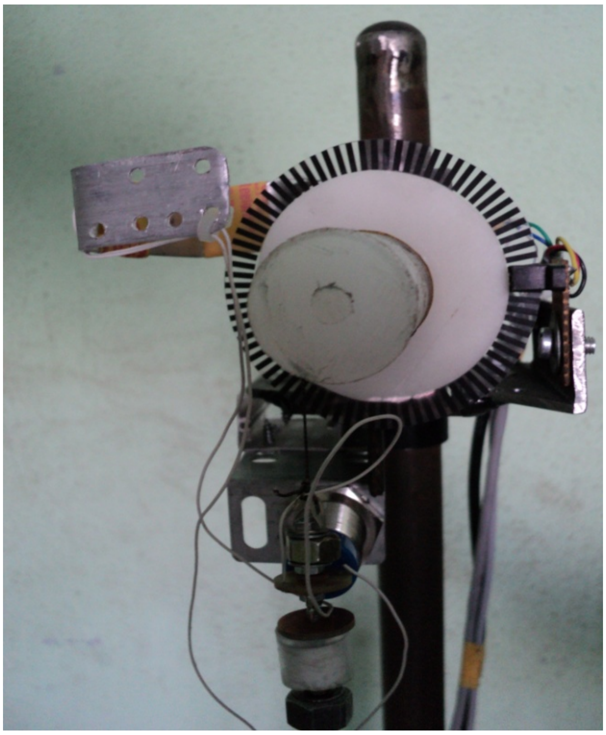

Fig 3: Encoder decoder assembly

F.Control Panel:-

As there are many parameters present in this project it is necessitated to give a control panel to it. The oil level that is to be measured in the shock absorbers is not going to remain the same. The height, diameter, datum of shock absorber is going to vary; as it will be used in R&D department much flexibility is needed. Depending on the parameters the calculations are done in the controller and direct display of air volume present is given. The work of control panel is to give the values of various parameters present in the calculations such as ID, height and etc. are given by this control panel unit. It simply consists of a push buttons.[8]

G.Display:-

A 16x2 LCD display is used to give the final output. It is also shared by the control unit. Various parameters input through control unit while giving can be visualized at this display only. The only place to see the data is this unit. It also serves the function of displaying the status of work. It has a lot of work to do as it is only place where all the functioning is already present in human readable form and also it serves as the last output needed. [9]

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Table I: Economy of project

Sr No.	Component	Price
1	Stand	1500
2	Positive printing	200
3	Cylindrical drum	300
4	Motor	300
5	Sensors	1300
6	Controller kit	4000
7	Miscellaneous	400
	Total	8000

Fig 4: Instrument designed

Flowchart

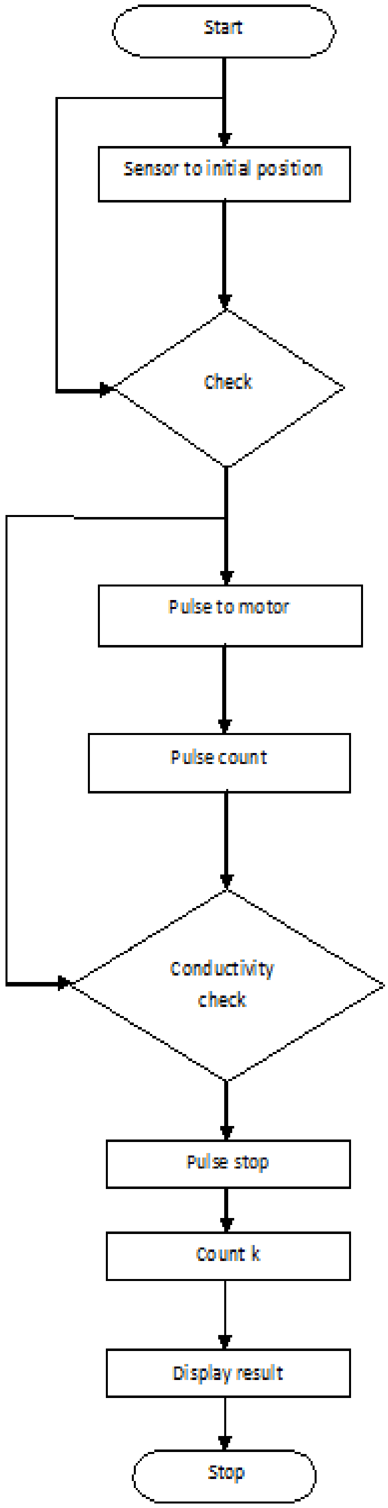

Fig 5: Flow chart

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Table II: Readings obtained

Sr. no.	Inner diameter (mm)	Depth by sensor (mm)	Depth by vernier caliper(mm)	Volume by sensor (mm^3)	Mean volume(mm^3) V_m	Volume by vernier caliper (mm^3)V_c
1.	18	135 135 133	134	34,353.3 34,353.3 33,844.4	34183.66	34,098.84
2.	20	142 143 143	142	44,610.62 44,924.77 44,924.77	44820.05	44,610.62
3.	24	158 158 157	159	71,477.51 71,025.12 71,025.12	71476.04	71,929.90
4.	28	162 161 162	161	99,751.85 99,136.98 99,751.85	99546.89	99,136.98
5.	32	152 153 152	153	122,245.65 123,049.90 122,245.65	122513.73	1,23,049.90

Error in Percentage= $\Delta V/V_c$

$\Delta V = V_c - V_m$

ΔV- deviation in volume

V_c - volume according to vernier caliper

V_m - mean volume measured by instrument

1. (84.82/34098.84)*100= 0.25 %
2. (209.43/ 44610.62)*100= 0.47%
3. (453.86/71929.9)*100= -0.63%
4. (409.91/ 99136098)*100=0.40%
5. (536.16/123049.9)*100=0.43%

So the error varies with the variation in inner diameter of the fork being tested. But still under any testing conditions the margin of error is not more than 0.63%

IV. Results

The experiments are conducted for the forks with diameter as 18, 20, 24, 28&32 and also with different depth of oil with varying fork diameters. It has been observed that the percentage error does not exceed 0.63% as per calculations in (Table II). Hence use of this instrument reduces varying human errors.

VI. Conclusions

1. The error is less when calculated for forks with less diameter, as the walls of the fork itself acts as guide ways for the live wire sensor.
2. With the increase in diameter takes place due to oscillations generated the error is increasing.
3. Furthermore increase in diameter reduces the error again. So in all the highest error is not less than 0.63%.
4. Since there is provision for horizontal glide way to the limit of 900mm, future use on forks with height more than currently used 740mm fork can be done
5. For diameter anything greater than 18mm this project will serve the purpose.

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