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Instantaneous fuel consumption measurement system of vehicle for troubleshooting and studying the effective factors

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Abstract: The use of fossil fuels as an important factor in providing the power required for agricultural activities and also, as an important source of energy in the transportation industry has a great importance. In this regard, on the one hand, researchers are looking for ways to reduce fuel consumption while engine power is increasing or in other words an increase in engine efficiency and on the other hand it is a trying for a better design of power transmission systems (from the gearbox to the design of vehicle tires), in order to move forward the engine power with the least loss of the vehicle or to transform the engine power to the activity of desired machine in the parts of the agricultural Machinery. To do the mentioned research, we required to measure the fuel of the engine with the change of variable parameters simultaneously. For this purpose, in this study, design and the construction of a system for installation on an agricultural tractor was considered, that with two number of a specific type of flow meter which is in the sweep direction of fuel flow, Can record and display the fuel flow rate at 500 ms, and the total time spent in a specified time interval. By this means the investigation, experimentation and research on the measurement of agricultural tractors Such as the impact of external and internal factors on the car engine and the fuel consumption, in a more accurate and easier form is possible.

Key words: *Design; Flow meter; Fuel; Tractor; Engine*

1. Introduction

Every day with the development of technology in the world and at the same time with modernization of the vehicles, advanced control systems installed on them, that helped to improve engine performance and provide more convenient for passengers, prevent high damage or unexpected events. In this respect, we can point to the various sensors on the engine intake air temperature, air temperature sensors inside the vehicle, the engine injector fuel injection systems, electronic controls, and dozens of other examples. The sensor is a sensation element that its duty is converting physical quantities such as pressure, temperature, humidity, and the electrical parameters of continuous (analog (or unlinked (digital). These sensors are used in a variety of measuring devices, analog and digital control systems like PLC. The sensors and the ability to connect to the various devices such as PLC's cause that sensor become an integral part of the automatic control system. Sensor sends information from the moving parts of the system to a control unit and changes the status of the systems' performance. The sensors that can be used in vehicle, including vehicle speed sensor, engine speed sensor, throttle position sensor, intake air pressure sensor, intake air temperature sensor, coolant temperature sensor, and many more. On the other hand, one of the sensors used in industry is the measurement of fluid flow sensors, which are very important, and its application is from the measurement of blood flow in the veins of man to the measurement of the flow rate of liquid oxygen in a wide range of the missile. Measurement of fluid flow measurement is in the most industrial processes such as petroleum, power, petrochemical, food and the water and the wastewater, that need the amount of fluid passing through a particular place in their daily work. Registration of the substance used or transmitted by flow measurement is done and the cost is determined on the basis of it. Therefore, measuring the flow rate has a special status in industry. Flow meters are classified according to the type of technology used, and how to install a flow meter for measuring the quantity. With control of fuel vehicles, agricultural tractors, now mainly tank level measurement system is installed, that Of course it does not have the ability to simultaneously measure the fuel. Isao Kano and his colleagues from Sanshine industrial companies, during the research in the journal SAE, design a fuel sensor for monitoring the motor boat. Many companies like Thomson Micron and calicos sensors for measuring flow and fuel, air and oil have internal combustion engines. Uichi Shimasaky and his colleagues also in SAE Journal by measuring the ion flow could design a system to monitor the fuel consumption of the engine. Alexander Balkan In a study designed a system for monitoring fuel consumption of the diesel engine. Device used in this study is a tool that displays real-time of the fuel consumption, and easily possible the

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study on the usage of fuel consumption in relation to internal and external factors affecting it.

2. Materials and Method

The measuring system consists of the following components:

2.1. Electronic circuitto

Electronic circuitto design and build a system requires an electronic circuit for receiving and storage of digital pulses that are sent from 1 and 2 sensors flow meter. Fig.1 depicts an Overview of the relationship between the participants in the system that in following its introduction and some of its characteristics will be discussed.

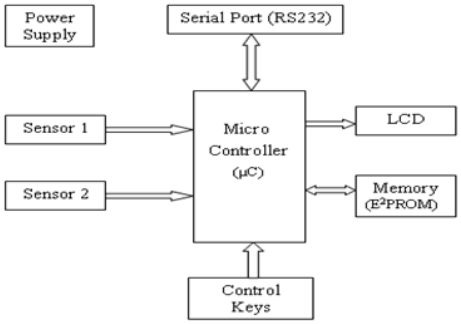

Fig. 1: Overview of the components used in the fuel measurement system

2.1.1. Power Supply

The power supply of the Device provided by a transformer and a rectifier circuit of the City Power, and it has the ability to work with batteries (e.g. tractor battery) with voltages from 15 to 7.5 volts, that a regulator from family 78xx provides stability and reduces the voltage if needed Fig.2.

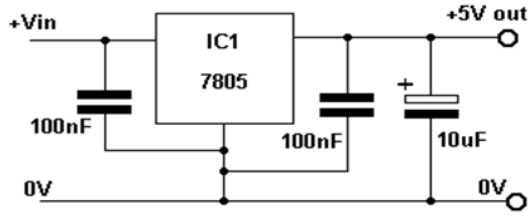

Fig. 2: Schematic view of the power supply

2.1.2. The screen and the controller buttons

The screen and the controller buttons
Screen is a liquid crystal screen capable of displaying 2 lines of 16 characters (Fig.3). Screen and controller buttons are the means of communicating with the user.

Fig.3: Illustration of an LCD

2.2. Memory

Memory must record the information and samples getting from flow meter. It is impossible to directly transfer the samples collected in some areas such as agricultural land to computer. So there is obviously need an appropriate amount of memory. This memory must be fast and have the ability to retain information without power. For this purpose that an EEPROM ICs manufactured Atmel AT24C256 is used (Fig.4).

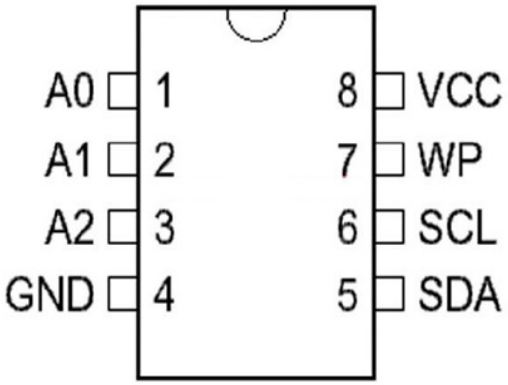

Fig. 4: Atmel AT24C256 is used

2.3. Serial port interfaces

Due to mismatch between the voltages level and a computer, as shown in Fig.5, it requires a microcontroller interface circuit voltage level.

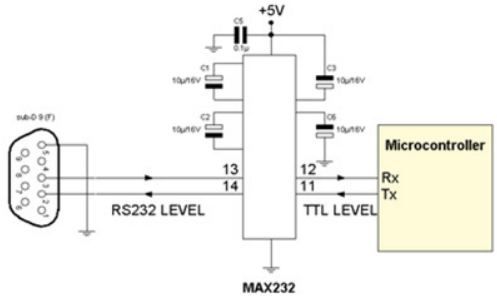

Fig. 5: Schematic view of the communication interface circuit

2.4. Main controllers

The most important part in the design of the control Device is actually a micro-controller ICs from AVR family name Amega16 is manufactured Atmel Fig. 6.

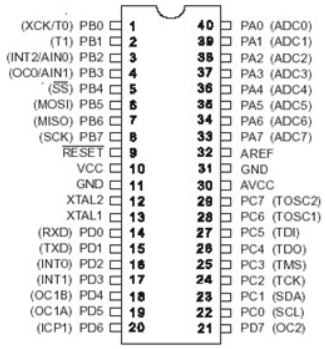

Fig.6: Atmega16 microcontroller

2.5. Flow meter sensor

To measure the amount of fuel flow path from the sensor, a flow meter was used. As Fig.7 shows, the flow meter was like a turbine type, that appropriate range for them is 1.0 to 5 liters per minute. Their output is pulse shape.

2.5.1. The system works as follow:

Fig.7: Flow meter sensor

3 Micro Timer Counter was used in the design of the system, Counter Timer located in mode Counter with external pulses received from the base (T1 and T2) and count output pulse. Third Counter Timer in timer mode, are created the 500 ms. after the passage of time the number of pulses 1 and 2 obtained and through the consumption rate is calculated. Then the calculated values are stored in the memory and are displayed simultaneously on the screen. When the data sent to the computer, samples read from memory and transfer to computer. Figure 9 is a flowchart for the sensor that is installed on the tractor, Fig.8 is a flowchart for the testing and evaluation of the flow meter shows the circuit of the system in detail.

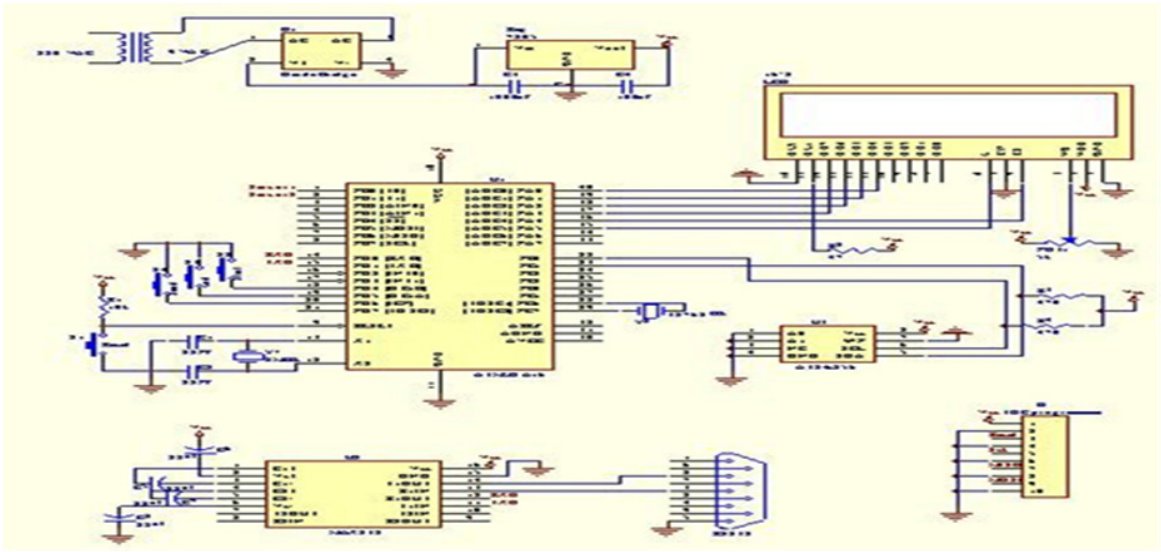

Fig.8: Flow chart to display and store the flow through a flow meter

Developed a mathematical model of the flow volume and pulse output:

For the mathematical model, the mass flow rate alone in a programmed circuit according to the flowchart in Fig.9 located and evaluated. As for the passage of a certain volume of fluid (water), the number of pulses sent from the sensor was recorded. According to Fig.9 a correlation coefficient has a value of 9909 flow meter that is the calibration Eq.1 is obtained,

$$V = 0/1365P + 103/62 \qquad (1)$$

Which (V) according to amount of flow (lit) and (P) is the number of pulses send by the sensor flow meter.

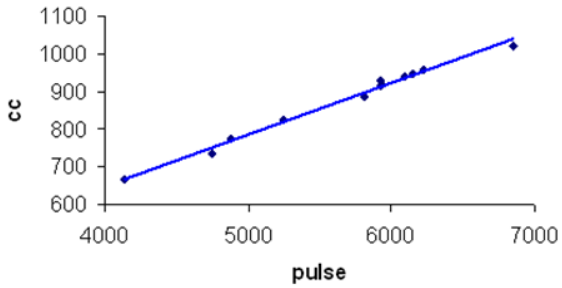

Fig.9: Relationship Chart pulse was sent and the actual amount of flow passed through flow meter

According to Table 1 percent error of rate tester (% E) by using the Eq.2 for each replication were

measured and then the mean value is calculated as a percentage of the error.

In Eq.2, (V_i) is the actual volume (cc) and (V_f) is volume flow that display by flow meter according to (cc),

$$\%E = \frac{V_i - V_f}{V_i} \times 100 \qquad (2)$$

That calculated values show that the mean percentage of errors in the measurement of the flow meter is 84/0% in the total scale.

Table 1: error percentage of rate tester

V_i	V_f	$\%E$
930/0	912/5	1/88
938/6	934/8	0/41
956/0	953/1	0/31
944/7	943/0	0/18
734/9	751/4	2/25
668/2	668/7	0/08
826/6	820/4	0/75
773/9	769/6	0/56
1022/0	1038/2	1/59
918/7	912/8	0/64
886/1	896/8	1/21
913/4	911/4	0/22
Ave=876/1	Ave=876/1	Ave=0/84%

3. Device installation

For full-scale measurements and practical form, the device on a JD 3140 diesel engine installed. Two methods can be used for this work. 1. The method uses two Sensors and 2.the method using a single sensor

3.1 The use of two sensors

Because in the diesel engine fuel injection pump surplus is returned to the tank, in addition to sensor that was placed in the way of the fuel injector pump (Fig.13, 14), a fuel flow meter was also back on track (see Fig.15). And engine intake flow rate calculated by subtracting the flow through the sensor. After showing in the screen every 500 ms LCD, saved by hard disk (Fig. 10).

3.2 The use of a sensor

In this installation, the return of the fuel from the injector instead of unloading the tank by a three-way and by a primary suction pump, like a closed circuit re-enter the cycle of Consumption. Thus by placing the sensor flow meter in place between the fuel tank and the pump intake, the whole tractor consumption is obtained (Fig. 13)

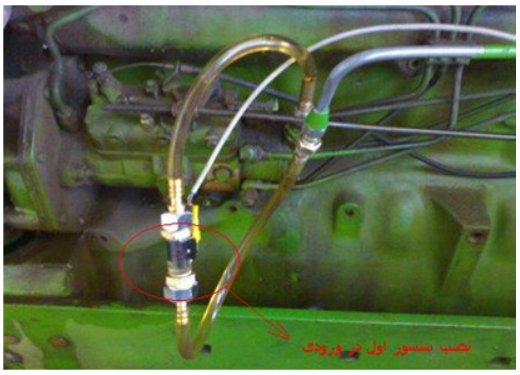

Fig. 10: Injector pump water mill JD 3140 and the place of the entrance of the fuel to the pump

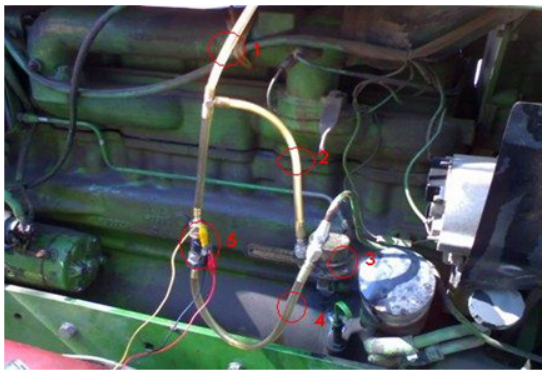

Fig. 11: The location of the sensor flow meter at the entrance of the fuel to the injector pump

Fig. 12: The location of fuel flow meter sensor in the input and output of the fuel, 1- Sensors measure the amount of fuel input, 2- sensors measure the amount of fuel 3- Unloading the fuel tank as measured by the tractor

Fig.13: Installation path by means of a sensor The return of fuel from injectors, 2. Primary fuel pump inlet 3. Primary pump (diaphragm) 4. Siphoned fuel from the tank by the primary pump, 5. flow meter sensor

It is possible to use both methods, but each has advantages and disadvantages. In the method that we use one sensor, despite the accurately measure rises, because one sensors removed, in general, tractors, due to closed cycle and lack of cooling goes out of the ordinary mode through backing to the tank, and when the tractors used a lot, some problems create. Besides, because of the proximity of the pump and the sensor, beats and the pulse generated by the pump, creates a negative effect on the way and operation of the sensor flow meter. On the other hand, the use of two sensors in a sweep of fuel do not change in normal circumstances of a tractor, And it is appropriate for operational tests and farm tests.

4. Results and discussion

Generally system is made up of features, some of which are mentioned below:

1. The ability to monitor the flow of fuel into a portable form or stored on the hard disk.
2. Show flow rate moment of fuel per 500 milliseconds.
3. Easily installed in the fuel flow path or any other place on the track.
4. The possibility of measuring the instantaneous consumption or the total consumption in any desired distance from the track.
5. Ability to Save 32,800 samples.
6. Possibility to work with electricity or car.
7. Work in petrol and diesel engines.
8. Forecast two sensors for gasoline engines, which are used to measure the return fuel injector and increase the accuracy of fuel consumption.
9. Filtering systems and noise software to remove noise from the engine.
10. Maintaining samples up to 10 years without electricity.
11. The possibility of connecting any sensor with digital output.
12. Possibility of upgrade the system with a computer program.
13. Using the AVR Microcontroller with speed16 MHZ.
14. Very low cost of the device, about a few thousand dollars.
15. Ease of use and operator (recorded samples with just pressing a button).

References

Alexander Balakin, ViTech Co 2007"Diesel Engine Fuel-Injection Measurement System "National Instruments Corporation

Heinz Heisler , 2002, advanced vehicle technology, london

Isao Kanno - Sanshin Industries Co., Development of Fuel Flow Sensors and Engine Fuel Monitoring Systems for Marine Engines SAE Journal. SAE Off-Highway Engineering Magazine Online Product Guide - Electronics.htm

Jing Ping Liu, Henning Kleeberg , Dean Tomazic "A Model for On-Line Monitoring of In-Cylinder Residual Gas Fraction (RGF) and Mass Flowrate in Gasoline Engines" SAE Journal.

Yuichi Shimasaki, Hidetaka Maki ;Junko Sakaguchi ; Study on Combustion Monitoring System for Formula One Engines Using Ionic Current Measurement; SAE.