OPTICAL NON-CONTACT FUEL LEVEL INDICATOR FOR AUTOMOTIVE APPLICATION

Case studies :

Abstract

Fuel indicator is an integral part of any automotive instrument cluster. Measurement of the fuel remaining in the reservoir is an important factor in order to calculate the distance which can be travelled with the remaining fuel. Different types of fuel indicator systems are available in the market which are prone to non linearity and mechanical loading. In India, the percentage of people using mopeds are comparatively high and replacement of the fuel tank if damaged demands a very big-budget affair. therefore it calls for a solution. Consequently, the paper proposes to design and fabricate low-cost fuel indicator system which overcomes these vulnerabilities. The system addresses the problem of non-linear behaviour of fuel level indicator typically employing a float and a potentiometer. The system uses an LED as a source of light and a number of LDR’s as receivers. As the light passes through the optical opening in the tank it gets diffused, absorbed and reflected through the fuel. The amount of light received on the other side is a function of fuel present in the reservoir. Since there is multiple receiving points (LDRs) whose readings are averaged, the readings have negligible effect from the turbulence within the reservoir due to the shaking of vehicle itself. In the fabrication of the a signal condition circuit is used in order to convert resistance in voltage and is assembled with an Arduino that quantifies and presents the volume on an LCD.

I. INTRODUCTION :

Indicator is used to convey the information regarding the volume of the fuel remaining in the reservoir of the vehicle along with other critical data such as speed of the vehicle, odometric reading. Various methods are employed in order to achieve the same feat. These principles include, but are not limited to Pressure sensing[5], magneto-metric Floats, Weight sensing[5]. The most widely used technique consists of a Float with a signal conditioning circuit(fig. 1). In case of critical fuel sensing applications like aviation and aerospace, weight of the fuel is considered since the volume of the fuel changes with respect to temperature. The proposed fuel sensor system aims to overcome these issues by using a passive sensor that does not require an active power supply. This ensures that the sensor is not affected by physical orientation and mechanical forces,providing accurate measurements regardless of the shape and size of the fuel tank.The system also utilizes the dynamic memory of an Arduino to keep a record of the fuel entering the tank and the fuel present at any given time. This helps in accurately calculating the volume of fuel in the tank.The goal of the proposed system is to provide a cost-efficient solution without compromising on the accuracy of measurement. It aims to improve upon existing analog strip or capacitive sensor techniques, which are inefficient or costly to install. By developing a more reliable and accurate sensing method, the proposed system can

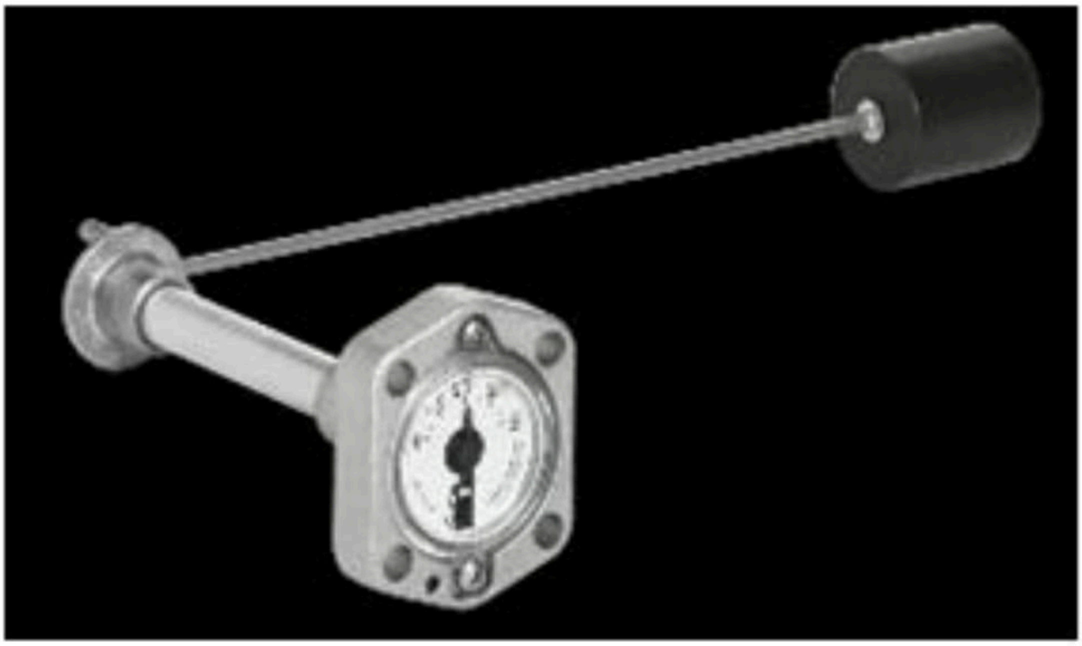


Figure 1: Float type fuel level indicator

II.PROPOSED SYSTEM :

The paper proposes a low cost, contactless system, that could potentially replace the conventional float system. As shown in the diagram, LDRs and LEDs are placed at the top and the bottom respectively (Converse is also possible). The intensity of light being transmitted at bottom by the LED is, by logic, higher than the intensity of light being received at the top by the LDR. It was chosen as a source of light as it low cost, small and has a longer

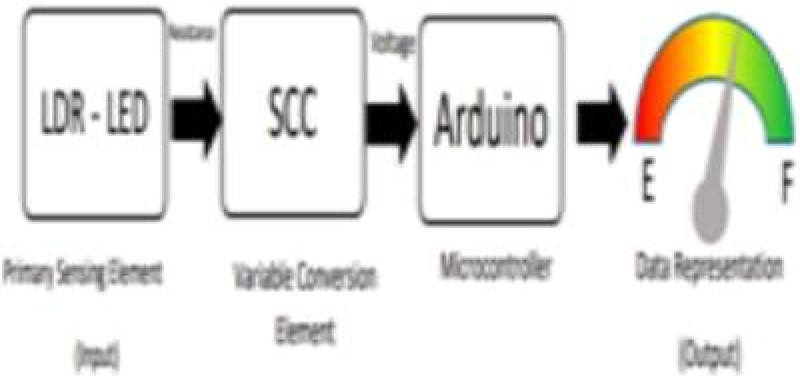


Figure 2: Block Diagram of the proposed system

life compared to florescent or other forms of light. The amount of light that is lost, in other words, absorbed by the fluid in between is proportional to the “path length” or the height if the fluid. If the cross section of the container is known, the volume of the fluid

III. DESIGN AND METHODOLOGY:

The initial developmental trials were carried out using a transparent PET bottle as shown in the figure. The level of fluid was systematically varied, and resistance values of the LDR was recorded. Here are some factors that were considered during the process.

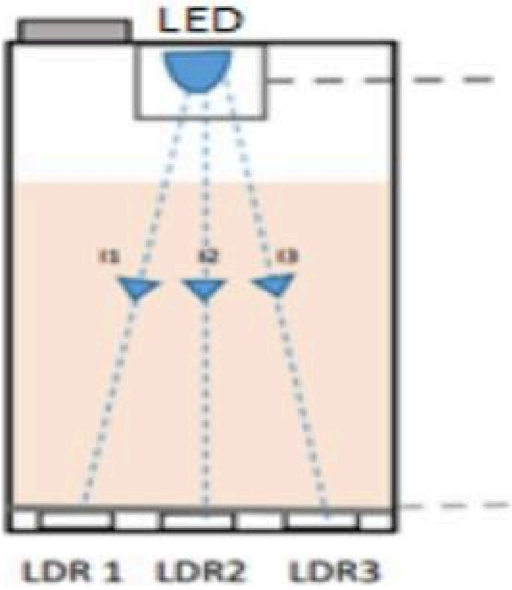


Figure 3: Schematic diagram of the System

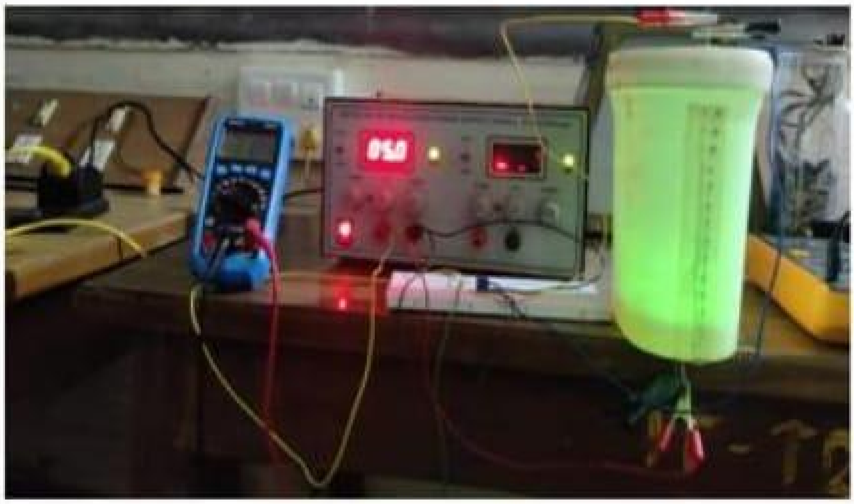
1. The intensity of LED greatly affected the result. The supply voltage was kept constant throughout the development.

2. The testing was initially done with water, then water – ink combination, water - food colour, and finally with petrol. The system was developed with a petrol level measuring system. Critical elements would have be redesigned for a diesel measuring system.

3. The Transparency of the container was also an issue. Initially a transparent PET bottles, then an semi transparent malt box and finally an actually a tank from an old moped was used in the final stage demonstration..

4. The colour of the LED was chosen in accordance with linearity of the change in resistance of the LDR. As shown in figure, green LED had the most linear performance. Usage of red LED was ruled out as the colour of the fluid under measurement was near to red. A red fluid would not absorb any amount of red colour.

The probes of the LDR were fed to a signal condition circuit that would proportionally convert resistance to voltage. This was required microcontroller would need voltage as an input and resistance would not do the job. The microcontroller was programmed to take average of 3 resistance values in case of a tilt in the tank. It would then compute the volume of the fuel by multiplying the level of the fuel with the cross sectional area of the tank at that point. This was then printed on the LCD through I2C protocol



Wearable Sweat Biosensors

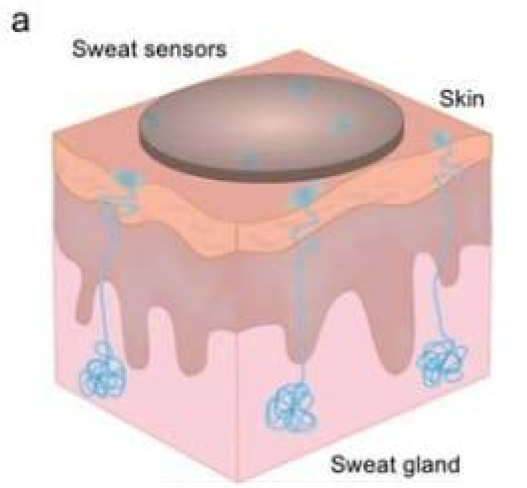
Case studies :

Abstract

Wearable perspiration biosensors enable real-time analysis of the sweat composition and can provide insightful information about health conditions. In this review, we discuss the recent developments in wearable sweat sensing platforms and detection techniques. Specifically, on-body monitoring of a wide spectrum of sweat biomarkers are illustrated. Opportunities and challenges in the field are discussed. Although still in an early research stage, wearable sweat biosensors may enable a wide range of personalized diagnostic and physiological monitoring applications

I.INTRODUCTION :

Wearable biosensors are expected to play a significant role in future healthcare as they allow real-time and non-invasive (or minimally invasive) monitoring of an individual's health state [1-4]. Currently commercialized wearable sensors are only capable of tracking an individual's physical activities and vital signs but fail to provide insightful physiological information at the molecular level. Human sweat, an important body fluid that can be retrieved conveniently and non-invasively, contains rich information about our health and fitness conditions. Therefore, sweat can be an ideal candidate for developing wearable chemical biosensors (Figure 1) [3-21] which may provide insightful physiological information. In the past decade, tremendous progress has been made on developing such sweat biosensors as illustrated in Table 1. These wearable biosensors have been used to measure the detailed sweat profiles of a wide spectrum of analytes including metabolites, electrolytes and heavy metals during various indoor and outdoor physical activities.

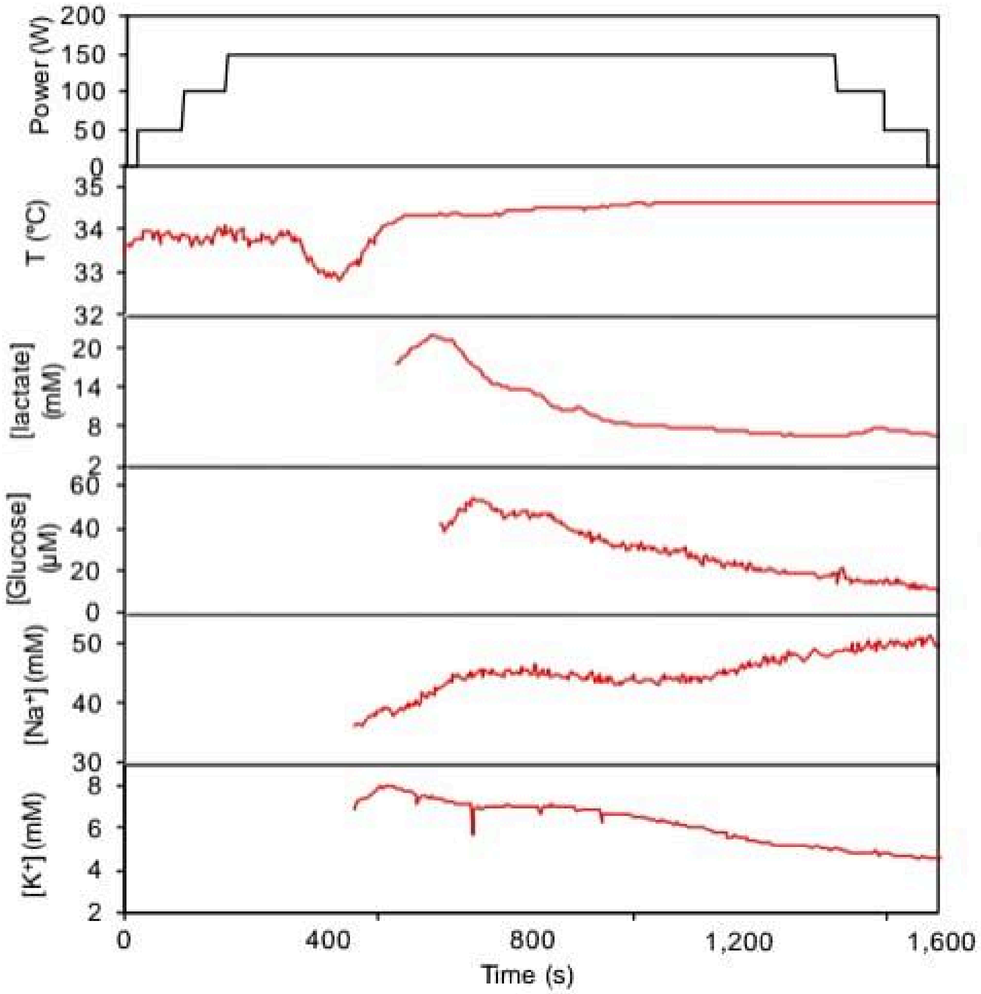


II. REAL TIME ON BODY SWEAT ANALYSIS FOR HEALTH MONITORING

The sweat biosensors can be worn on body for real-time perspiration analysis during a variety of physical activities, allowing non-invasive health monitoring. Recently, the onbody evaluation of sweat biosensor wide range of physiological and clinical investigations.

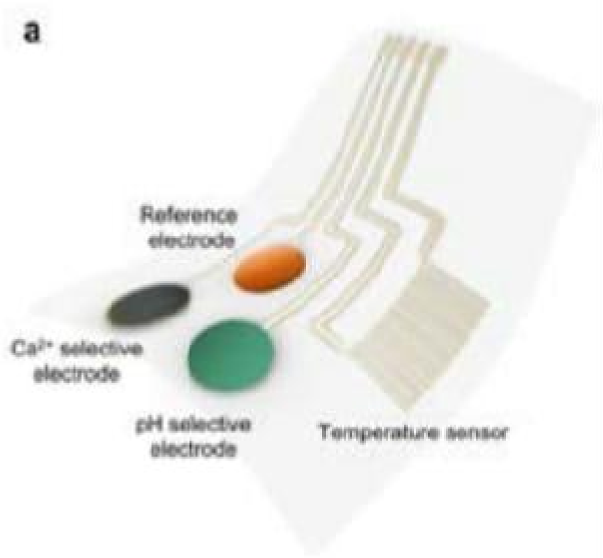
A. Real time analysis of major sweat metabolites (glucose and lactate) and major electrolytes (Na+ and K+)

Physiological monitoring of sweat lactate and sodium using wearable sweat sensors has been demonstrated on different platforms [7, 9, 16, 17]. Simultaneous measurements of multiple sweat analytes using a fully-integrated sensing system was also reported during a cycling exercise [4]. Figure 6 shows that, as perspiration begins, both lactate and glucose levels in sweat decrease gradually. The decreased sweat lactate and glucose levels is owing to the dilution effect caused by an Increase in sweat rate, which is visually observed as exercise continues. Sweat [Na+] increases and [K+] decreases in the **beginning of perspiration, in line with the previous exsitu studies from the collected sweat samples [4]. Both [Na+] .**



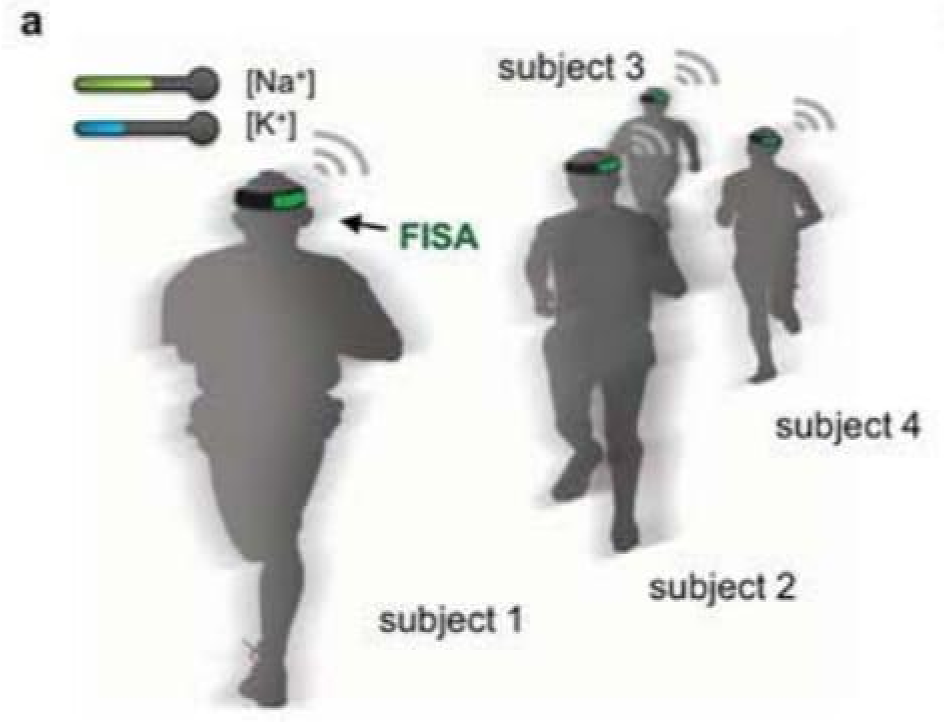
B. Real time sweat Ca2+ and pH monitoring

Calcium is an essential component for human metabolism, and pH is crucial for potential disease diagnosis. Sweat pH sensors have been measured optically and electrochemically [7, 21]. A fully integrated wearable sensing device (Figure 7a) has also been demonstrated for simultaneous evaluation of pH and Ca2+ in human perspiration which is particularly important considering that free Ca2+ level in biofluids is dependent on pH [6]. Figure 7b displays the sweat profiles of a subject during a constant load cycling exercise: sweat pH increases gradually for 5 min and then stabilizes in the remaining cycling exercise while the Ca2+ sensor shows an opposite trend. The responses of these sensors were validated with a commercial pH meter and inductively coupled plasma-mass spectrometry .



C. Dehydration monitoring

Monitoring hydration status is of the utmost importance to athletes because fluid deficit impairs endurance performance. The sweat biosensors can be potentially used for effective and non-invasive monitoring of the electrolyte loss (Figure 11a) [4]. Figure 11b shows that sweat [Na+] measured from an integrated sensor array was stable throughout running in euhydration trials (with regular water intake). On the other hand, a substantial increase in sweat [Na+] was observed in dehydration trials (without water intake) after 80 min when subjects had lost a large amount of water (Figure 11c). The results show that through sweat composition analysis, insightful information applications.



D. Glucose correlation study

The wearable sweat biosensors can potentially be used for diabetes monitoring and control. A graphene-base delectrochemical device has recently been developed to measure real-time sweat glucose through pH calibration [14]. With the aid of this device, a correlation between sweat glucose data from the wearable diabetes patch and those from commercial glucose assay as well as blood glucose data from a commercial glucose meter was observed