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TEMPERATURE, FLAW DETECTİON, EMF DETECTİON & DC VOLTMETER PARAMETER MONİTORİNG USİNG A WEARABLE GLOVE

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ABSTRACT

*In an automotive production unit considerable amount of time is spent on testing and observation. Therefore a need arises to address this issue with the help of any automation technique. In this paper we discuss about monitoring vital parameter in automotive industry such as Temperature, Flaw detection, EMF detection & DC voltage measurements using a wearable glove which is both time and cost efficient. An Arduino board is interfaced with a temperature sensor to monitor the temperature inside the testing area and an ultrasonic sensor is used to find flaws in an object and the corresponding temperature and distance reading is displayed on 16*2 graphics LCD. A voltage divider circuit and an EMF detection circuit are also interfaced with the Arduino board to serve as a DC voltmeter and EMF detector respectively. The DC voltmeter consists of two probes which can be placed across any electronic circuit and corresponding reading is displayed on graphic LCD. All these units are compactly fitted in a glove in order to enable continuous monitoring of parameters in a time efficient and convenient way.*

Index Terms: Temperature Monitoring Unit, Ultrasonic Flaw Detection Unit, DC Voltmeter Unit, EMF Detection Unit, Arduino Board

I. INTRODUCTİON

A solution to the problem of spending considerable amount of time on testing and observation in an automotive industry could be solved by using a wearable glove that is powered by an Arduino board to monitor the Temperature, to identify the Flaws, to detect the EMF leakage and also to serve as a DC voltmeter by measuring the voltage across a circuit. Using a compactly fitted glove to monitor the necessary parameters helps an individual to move around easily without carrying individual testing Equipments for Individual parameter measurements. Further continuous monitoring of accurate readings is possible in a time efficient manner using this glove.

The ultimate need for this project is to assist workers in an automotive industry where unnecessary time is being spent on monitoring and observation. For ease of use the glove helps; and for monitoring and testing, the sensors interfaced with Arduino board measure and send accurate readings to graphic LCD which in turn displays the reading for the user to observe and record.

II. LITERATURE REVIEW

- Design and Development of a low cost electronic hand glove for deaf and blink by Gupta, D.; Singh, P.; Pandey, K.; Solanki, J., Computing for Sustainable Global Development (INDIA Com), 2015 2nd International Conference on 2015.

There are around 285 million visually impaired people in the world and 900,000 deaf and mutes. They use sign language to communicate with others. But it's very difficult to use and understand this sign language as it contains approximately 6000 gestures. The model uses 26 gestures of hand to communicate alphabets and 10 more gestures to communicate numbers. This would help the deaf person to communicate with others by typing text on LCD screen through hand gestures. The text is converted into speech so that the blind person could hear and communicate.

Above discussed is one of the biomedical applications achieved using an Electronic Hand glove. There are a lot of Electronic Gloves researches undertaken for Automation and Medical Research purposes. Hence, we developed an Electronic Glove to reduce the complexities in Testing &Monitoring services in an automotive Industry by reducing the amount of cost and time being deliberately spent in vain. Our proposed system could assist the user with four different parameter measurements and monitoring and it is the first of its kind in the automotive testing Industry.

III. INTERFACE

3.1 Temperature Monitoring Unit

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. It has an operating temperature range of -55°C to +125°C and is accurate to ± 0.5°C over the range of -10°C to +85°C. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring [1].

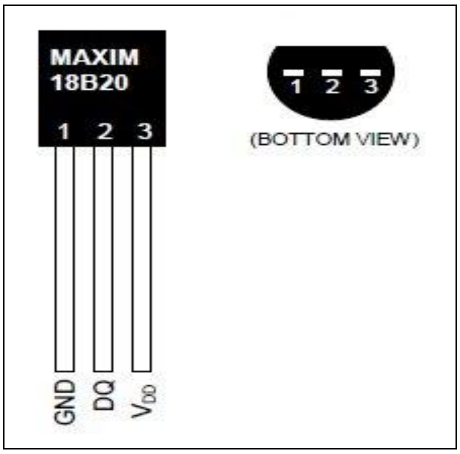

Figure 1 DS18B20 Temperature Sensor

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The internal circuit operation of DS18B20 temperature sensor is explained below [1]. There are two transistors in which one has ten times the emitter area of the other which signifies it has one tenth of the current density, since the same current is going through both transistors. This causes a voltage across the resistor R1 that is proportional to the absolute temperature, and hence produces linear output. The role of amplifier at the top of the circuit is to ensure that the voltage at the base of the left transistor (Q1) is proportional to absolute temperature by comparing the output of the two transistors. The amplifier (A2) converts absolute temperature into Celsius. The "i" in the circuit represents the constant current source circuit. All the components are fitted into the tiny package with three leads namely Vcc, output and ground. The Arduino is interfaced with temperature sensor at analog pin A1 .The temperature proportional to output voltage is measured using the sensor and the corresponding reading in Celsius is displayed on the 16*2 graphics LCD.

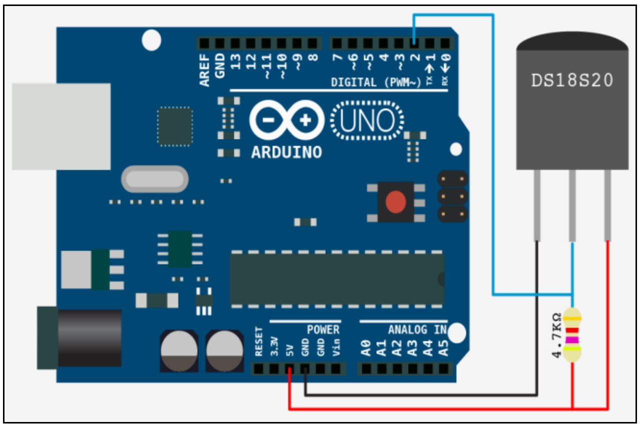

Figure 2 Interfacing of LM35 with Arduino

3.2 Ultrasonic Flaw Detection Unit

The flaw detection is achieved with the help of Ultrasonic sensor HC-SR04 .Ultrasonic sensor module HC - SR04 has a non-contact measurement function, and provides accuracy upto even 3mm.The range of this sensor varies from 2cm to 400cm The modules consist of a ultrasonic transmitter, receiver and control circuit. It has four pins namely Vcc, Trig, Echo and GND.

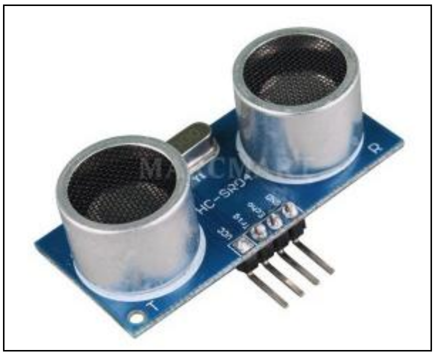

Figure 3 Ultrasonic Sensor - HC-SR04

This Ultrasonic sensor works on a principle similar to sonar which evaluates distance of a target by interpreting the echoes from ultrasonic sound waves. It works by sending out ultrasonic frequency waves using IO trigger pin and when those waves are reflected upon striking the surface, it is collected by the echo pin. The Vcc pin provides necessary input voltage for the operation. The range or distance is measured using the formula,

Distance = propagation time × velocity of sound (340M/S)/2

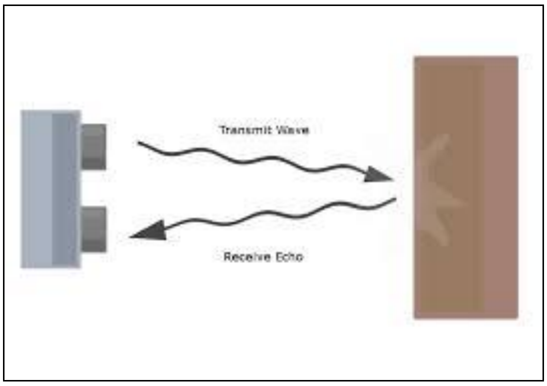

Figure 4 Ultrasonic Sensor HC-SR04 Operational Diagram

This sensor pins are interfaced in the following order: Vcc to pin 2, Trig to pin 8, Echo to pin 9, GND to pin 5 of the Arduino. The range values are recorded by the sensor, if it is found to be constant throughout the surface of an object, then it is concluded that there is no flaw present in the object, Otherwise if there is actually a flaw in the object, then deviations in the recorded values can be observed, thus proving that there exists a flaw in the object. The range values are displayed on the 16*2 graphic LCD continuously for the user to observe any deviation is observed. In order to get notified about the accurate readings a buzzer is made to sound if the range recorded is more than 10 cm, as accurate readings are observed when sensor is as close to the object under observation [6].

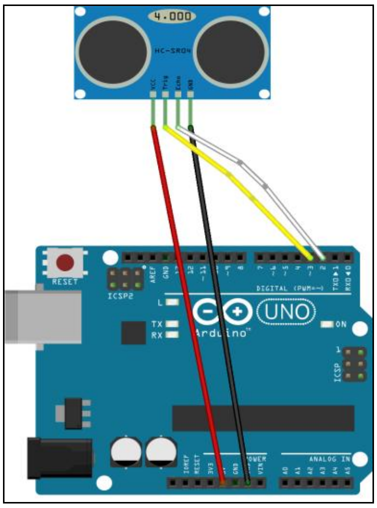

Figure 5 Interfacing of HC-SR04 with Arduino

3.3 Dc Voltmeter Unit

The Dc voltmeter unit works on principle of voltage divider circuit. Figure 6 is a voltage divider with no significant load. The output voltage is the voltage across R_2. To find the voltage across R_2 we need to find the current through it. The current through R_2 is the same as the current anywhere else in the circuit. The current in the circuit is given by the equations,

$$I = E / (R_1 + R_2) \quad (1)$$

The voltage across R2 is given by

$$V_O = I R_2 \quad (2)$$

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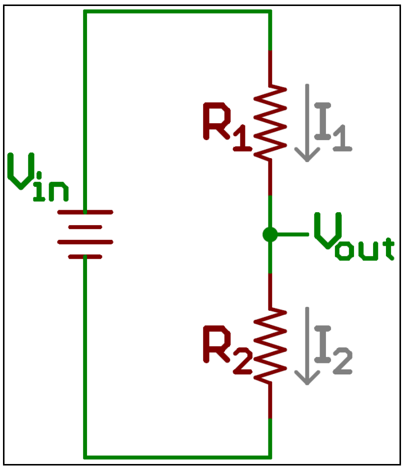

Figure 6 Voltage Divider Circuit Diagram

Substituting equation (1) into equation (2) gives us the voltage divider equation

$$V_O = E\, R_2 / (R_1 + R_2) \qquad (3)$$

Usually the input voltage to a voltage divider is not a battery E but sometimes a known voltage V_{IN}. In this case the equation would be

$$V_O = V_{IN}\, R_2 / (R_1 + R_2) \qquad (4)$$

Here in this project R1 = 220 Ohms and R2 = 220 Ohms. In order to find out the voltage across a device or a circuit, a set of two probes one being positive and other one negative is paced across the circuit and the ground respectively. The corresponding reading measured is displayed on the display. The DC voltmeter can be used to measure voltages of range from 0-30v only..

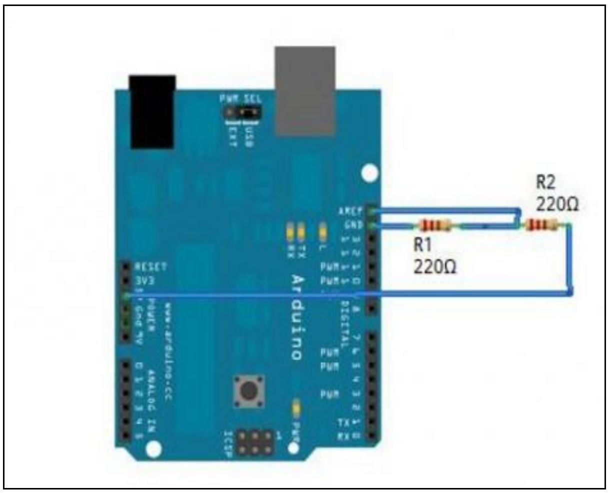

Figure 7 Interfacing of Voltage Divider Circuit with Arduino

3.4 EMF Detection Unit

The EMF detection unit is used to solve the purpose of tester used in checking whether any EMF leakage occurs in a circuit or device. The EMF detection circuit basically consists of resistor wound across a copper wire and is connected to analog pin 5 of the Arduino and incase of EMF leakage, a LED is made to switch on to indicate the presence of EMF leakage happening in the circuit. A 3.3M resistor is used in the EMF detection circuit with Arduino Interface.

Below shown in the figure 8 is the interfacing between EMF detection circuit with the Arduino board and the LED indicator is also shown.

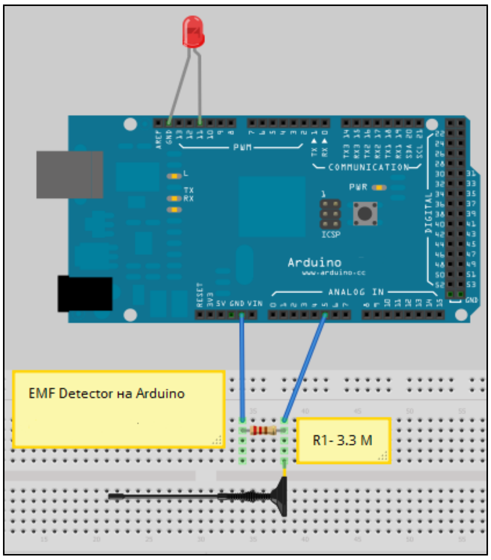

Figure 8 Interfacing of EMF Detection Circuit with Arduino

3.5 LCD Display

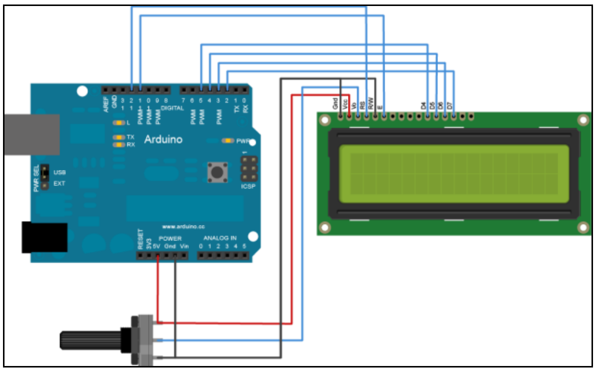

Figure 9 Interfacing of LCD Display with Arduino

The Measured parameters are displayed in the LCD Display which is placed at the top of the glove. The LCD Display used over here is 16*2 Graphics LCD Display [3].

3.6 Arduino Board

The board we have used in this interface is Arduino UNO. The Arduino UNO is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button [2]. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The UNO differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter [2].

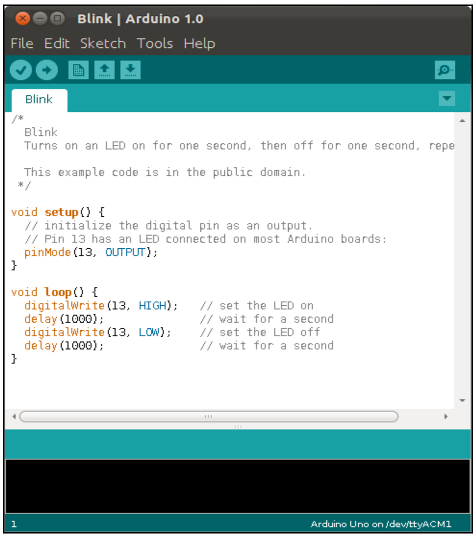

Figure 10 Screenshot of the Arduino Coding Workspace

IV. WORKING

All the four units mentioned above namely Temperature monitoring unit, Flaw detection unit, EMF detection unit & DC voltmeter unit are all fitted compactly into a Wearable glove. The temperature sensor measures the room temperature and displays the readings in the Graphics LCD.

The Ultrasonic sensor detects the presence of the flaw (if there is any) and displays the accurate range readings on graphics LCD. A buzzer is made to alarm if the readings measured are greater than 10 cm. This is done to ensure accurate readings are obtained every time. The DC voltmeter unit uses the voltage divider circuit to measure the voltage across any circuit. Two probes namely positive and negative placed across the circuit to measure its voltage ranging from 0 to 30V.

The EMF detection circuit triggers a LED to indicate the presence of EMF leakage. All these units are compactly fitted in a single glove in order to enable continuous monitoring of parameters in a time efficient and convenient way.

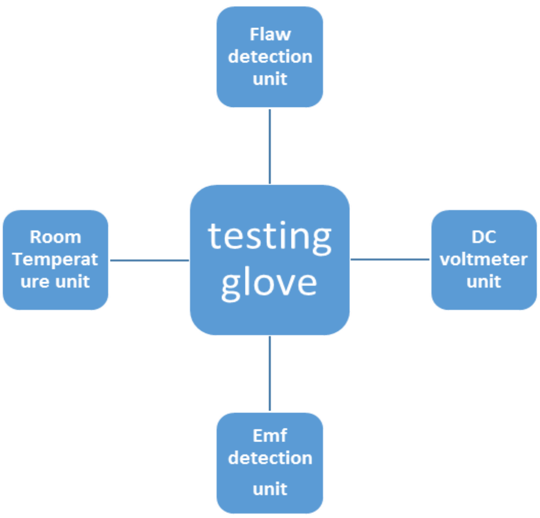

Figure 11 Block Diagram for the Working of the Interface

Figure 12 Prototype Model of the Proposed System

V. ADVANTAGES

- It is designed to serve as both time efficient and economically feasible device which is needed for testing, observation and fault diagnosis simultaneously performing the tasks accurately
- Ease of use as fitted compactly in Glove
- First of its kind in testing environment, because of multiple features in a single wearable hand glove
- Rechargeable Power source can be used i.e. 9V batteries which can be charged again.

VI. CONCLUSION

We have designed a glove which serves as a solution to the problem of spending considerable amount of time on testing and observation in an automotive industry. This glove is fitted with four units to measure temperature, identify flaws, detect EMF leakage and finally can also serve as digital voltmeter. All the four units are compactly fitted with the glove to enable continuous monitoring of parameters in a time efficient and convenient way. It is also economically feasible device that can be used for testing, observation and fault diagnosis in an automotive industry.

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