INTRODUCTION

A multimeter can be a hand-held device useful for basic fault finding and field service work, or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies and wiring systems.

Daniel Brateris Dwight Bedford, David Calhoun, Aaron Johnson, Nickolas Kowalski, Thomas Mukalian, Justin Reda, Anthony Samaritano, and Robert R. Krchnavek[1] develop a prototype pen-style DMM that uses Bluetooth to communicate with an Apple iPhone. In their work they portrayed on a smartphone enabled digital multimeter, which measures the value of voltage, current and resistance. They state that the two primary advantages of a smartphone-enabled DMM are compact size due to using the smartphone as the display and the opportunity for
customized user interfaces for specific applications. From their work we found that there is a scope for developing a digital multimeter that can measure more parameters.

**OBJECTIVE**

In addition to demonstrate the application of the skills and knowledge we acquired as Electronics and communication engineers in an innovative way, the objectives of this device is also to ease recording and interpreting values of scalar quantities, by making the process of analyzing data quicker, more efficient in its operation.

Using this device makes efficient usage of time and measures quantities at rigid places. This device plots a graph on an android device using Bluetooth wireless technology. A Bluetooth module is connected to the main device which communicates with the android mobile.

**METHODOLOGY**

**Voltage Implementation**

Arduino analog inputs can be used to measure DC voltage between 0 and 5V. The range over which the Arduino can measure voltage can be increased by using two resistors to create a voltage divider. The voltage divider decreases the voltage being measured to within the range of the Arduino analog inputs.

**Current implementation**

Usage of shunt resistors, current transformers and usage of Hall-effects sensors are some such available methods. ACS712 sensor operates according to the Hall-effect principal and it can be used for DC current measurement. There is no need of auxiliary circuits for this sensor it is an immense advantage over the other available methods. The analog output pin is connected to Analog pins.
**Resistance implementation**

One end of the resistor pair is hooked up to 5V and the other end is hooked up to ground. The 5 volts that the arduino provides gets divided up between the 2 resistors, depending on the value of the 2 resistors. The resistor which holds the greater resistance gets more of the voltage, according to ohm's law formula, $V=IR$. The voltage that falls across a component is directly proportional to the amount of resistance it contains. Using this principle, we can set up a mathematical model to determine the resistance, based on the voltage division. The resistance is measured through analog pin A2.

**Frequency implementation**

The frequency is measured using the inbuilt pin in the arduino atmega Microcontroller. The digital pin 47 is Interrupt pin. This is used to count the number of pulses raised in certain duration of time. The number of pulses are counted. This count corresponds to the frequency of the signal. The frequency range measured is from 0-3MHz.

**Temperature implementation**

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 (temperature sensor) is used to measure the temperature in the circuit. The analog pin A4 reads the voltage reading from 0-5V and those readings are calibrated to give the temperature values accordingly.

**Humidity implementation**

The DHT 11 is the sensor which is used to measure the humidity. The analog pin A4 reads the voltage reading from 0-5V and those readings are calibrated to give the humidity values accordingly. It uses a capacitive humidity
sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin.

**Distance implementation**

The sensor used to measure the distance is HC-SR04. The output of the distance is taken from digital pins 18 and 19. This ultrasonic module measures the distance accurately which provides 0cm - 300cm with a gross error of 2cm. Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping. The module can easily be interfaced to micro controllers where the triggering and measurement can be done using two pin. The sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor.

**Soil moisture implementation**

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. Since analytical measurement of free soil moisture requires removing a sample and drying it to extract moisture, soil moisture sensors measure some other property, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for moisture content. The sensor used to measure the soil humidity is SA SM01. The output of the soil humidity is taken from pin A3.

**Light intensity implementation**

A photo resistor or light-dependent resistor we are using in our project is LDR, is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. The element used to measure light intensity is light dependent resistor. The circuit consists of LDR in series with resistor. The light intensity is directly
proportional to the voltage drop across the resistor. The light intensity is measured at analog pin A7.

**RESULT AND CONCLUSION**

When the user writes A on an application developed by name Arduino sensors the below screen gets displayed giving the values and graph of the voltage.

![Arduino application screenshot](image1)

When the inputs G the temperature the results get displayed. The below picture is the result of temperature.

![Temperature screenshot](image2)
Conclusion

Several working prototypes have been built and tested. Design variations include battery types and whether DMM control should be software based (smartphone) or hardware based (pen-style DMM). For a very small amount of money, one can obtain an instrument that measures voltage, current, resistance, frequency, temperature, humidity, soil humidity. With the advent of smartphones, we see another possibility for advancement in DMMs. The two primary advantages of a smartphone-enabled DMM are compact size due to using the smartphone as the display and the opportunity for customized user interfaces for specific applications. Software-based control also simplifies the design.

Although formal accuracy measurements were not performed, the prototype demonstrated comparable performance to a commercial handheld DMM. Measurements are transferred in real time to the android smartphone. The design met the overall product goals and is ready for safety evaluations.

FUTURE SCOPE
All these sensors with the microcontroller can be integrated into a PCB to make the device more compact and efficient.
We can add more number of slaves (parameters).
The present used multimeter can be replaced by using our device.

REFERENCE