UI- Evaluation

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This document describes UI Evaluation exercise which is executing couple of test cases, jotting down the observations followed by recommendations and evaluations for a device under test which here is standard multimeter.

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Description of multimeter:

My device of choice is a standard Multimeter. Multimeter is an electronic measurement device that combines several measurement functions in one unit. A typical multimeter would include basic features such as the ability to measure voltage, current resistance and continuity of circuits. They are used to troubleshoot electrical problems in a wide array of industrial and household appliances.

Multimeter comes in two types i.e. analog and digital ones. Analog multimeters comes with pointer which moves over a scale calibrated for all the different measurements that can be made. Digital multimeters display the measured value in numerals. Digital multimeters are now far more common than analog ones.

For an analog meter movement, DC voltage is measured with a series resistor connected between the meter movement and the circuit under test. A set of switches allows greater resistance to be inserted for higher voltage ranges. The product of the basic full-scale deflection current of the movement, and the sum of the series resistance and the movement's own resistance, gives the full-scale voltage of the range. As an example, a meter movement that required 1 milliampere for full scale deflection, with an internal resistance of 500 ohms, would, on a 10-volt range of the multimeter, have 9,500 ohms of series resistance.

Digital instruments, which necessarily incorporate amplifiers, use the same principles as analog instruments for range resistors. For resistance measurements, usually a small constant current is passed through the device under test and the digital multimeter reads the resultant voltage drop; this eliminates the scale compression found in analog meters, but requires a source of significant current. An auto-ranging digital multimeter can automatically adjust the scaling network so that the measurement uses the full precision of the A/D converter.

Every multimeter comes with a display (digital display in case of digital or analog pointer for analog multimeter), a red probe and a black probe. Red probe can be considered as positive and black probe to be negative.

Multimeter has a selector switch or a knob though which users can adjust the settings depending on what the parameters (Potential difference , resistance , current) to check for .

Pictorial description of controls and settings in multimeter

image source: http://mechatronics.iit.edu/uploads/Resources/multimeter.png

Typical usage scenarios

Typical usage scenarios of Multimeter are voltmeter, ohmmeter, ammeter and circuit continuity tester as describe below.

Multimeter as voltmeter

Multimeter can be used as a voltmeter for measuring potential difference between two electrical points. Device can measure either the AC or DC voltage flowing through a circuit. Voltage is a difference in potential energy between the two points. To test any appliances, the users must initially have to choose either AC or DC.

Multimeter as Ohmmeter

Multimeter can be used as ohmmeter. Device finds the resistance in a circuit, which is given in ohms. A user can find the resistance at any point in a live circuit or battery source then putting in an approximate range he or she expects to contain the number of ohms.

Multimeter as Ammeter:

Multimeter can be used as ammeter. Device measures current flowing through a closed circuit by interrupting that circuit. Device needs to be connected in series, which means that all the circuit's current will flow through the multimeters circuit. The user will still need to select the range in which he or she expects the current to fall. This feature is used less often than the others, so some multimeters do not measure current at all.

Multimeter to test continuity.

Multimeter can be used for testing continuity of an electric circuit to determine if an electrical path can be established between two points . The circuit under test need to completely de-energized prior to using Multimeter. Tester needs connect two leads of the multimeter to the circuit that is the target for continuity testing.

Test procedure description

I have considered below two use cases for the Device UI evaluation.

1. Measuring potential difference across two points using multimeter.
2. Measuring resistance across two points using multimeter.

Use case 1: DC Voltage measurement using multimeter

Test case demands measuring voltage difference between two terminals in a standard battery with multimeter and equipment to be used are multimeter, black and red probe and a battery.

Multimeter needs to be switched on by moving the jack by operating the round knob present in the center of the multimeter. Black probe needs to be fixed to COM port. Black probe in the COM port is needed for all the test scenarios. Red probe shall be plugged into volts slot. This slot can be seen as clearly marked as " V/Ω" and is generally seen in the lower part of multimeter. It is often that red probe needs to be switched slots depending on the use case . Position of red probe differs when multimeter takes the role of voltmeter or ohmmeter and ampmeter. So a special attention needs to be paid while plugging in the red probe. Plugging into wrong slot can blow up fuses in multimeter.

Most important step in the test case is to adjust the knob to point to DC voltage setting . DC voltage is marked as "V " followed by horizontal line and three dashed line below it as shown in below picture. It is worth to note that certain multimeters come manual range settings in which case relevant range setting has to be set , usually of a AA battery it can be under 2 V.

Now we have two probes plugged in and multimeter ready for measuring volts and a working battery. Make a contact between the red probe to positive terminal of battery and black probe to negative end of battery. Display in the multimeter shows the potential difference between the terminals in volts.

Use case 2: Resistance measurement using multimeter for resistetor.

Test case demands measuring resistance across two points in a circuit of arbitrary points .In general resistance is measured across any circuit components , resistors etc.
Terminals needed for measuring resistance across two points are a resistor or any other circuit for which the resistance has to be measured , multimeter and, black and red leads.

Multimeter needs to be switched on by moving the jack by operating the round knob present in the center of the multimeter. Black probe needs to be fixed to COM port. Black probe in the COM port is needed for all the test scenarios. Red probe shall be plugged into resistance slot. This slot can be seen as clearly marked as " V/Ω" and is generally seen in the lower part of multimeter. It is often that red probe needs to be switched slots depending on the use case . Position of red probe differs when multimeter takes the role of voltmeter or ohmmeter and ampmeter. So a special attention needs to be paid while plugging in the red probe. Plugging into wrong slot can blow up fuses in multimeter.

As discussed in precious test case , . It is worth to note that certain multimeters come manual range settings in which case relevant range setting has to be set. These values depend on the range of resistance for the circuit under test. If we are measuring resistance across the leads smallest available range should be good enough. Multimeter used in our case is manufavured by Fluke which is quite good and has auto range functionality.

The differentiating and most important step compared to previous test case is that knob has to be set to measure resistance. The two probes plugged in their relevant slots and multimeter ready for measuring resistance across a resistor.
Make a contact between the red probe to one end of the resistor and black lead to other end. Display in the multimeter shows the resistance across two points in the resistor whose valued depends on the resistance offered by resistor.

Observations from test case executions

My choose my wife to use for this test and I kept taking notes on while she executes the test cases. Fortunately she claimed to have some idea on resistance, volts and current from her study days but not a vivid user of electrical measurement devices by any means. This shall not be a matter of concern as our target is just to execute the above discussed test cases and not achieving best possible accuracy.

It should be noted that I asked to speak loud what she thinks while operating the device which would help me to do less guess work for noting the observations. I here onwards would refer her as tester for our discussion.

Equipment offered:

1. Fluke multimeter
2. AA battery
3. A resistor with one kilo ohms
4. Pair of leads.

Observations for test case1 :DC Voltage measurement using multimeter

Observation 1: Initially tester spent time at turning the knob ruffling it too many times in an effort to get familiarity of the device and was keenly noticing the changes in the display. My guess is that the tester is trying to understand and read settings presented by the knob. It looked like tester is trying to gain familiarity with the device.

Observation 2 : Tester tried recollecting her past knowledge of Volts/Ohms/AC/DC. Tester said that there are too many other options like Hold, preset, continuity etc. I guess tester is correct to an extent .It was the same feeling with me as well when I first time used the multimeter , too many buttons and choices are presented with out any clear markings.

Observation 3: Tester made sure that knob is set to off position before she started experiments. My guess was that tester is far too apprehensive with the device and making sure not to blow up or short circuit.

Obesrvation 4: Tester had the probes connected to correct slots with the red and black markings . In the process of doing this ,Tester had no trouble at plugging in the black lead.

She had to spend some time for plugging the red one. This is because device has two red slots marked as you in picture, one for the volts and resistance measurement others for measuring current.

Observation 5: Tester has turned the knob to the place pointing to “V/ Ω” to measure the resistance. She held no trouble in noticing where to point the knob as the place is clearly marked.
Observation 6: Tester had tried connecting the lobes to positive and negative ends of battery. She displayed bit of hesitation initially while connecting the lobes in an effort to check the polarity of the lobes against the battery markings and had to confirm with me which of the lobe has to be touched first. I had briefly jumped in to say not worry and bring some confidence in her by saying sequence doesn’t matter.

Observation 7: She was happy to see the display read the voltage displayed as 1.1 v

Observation for test case2 :Resistance measurement using multimeter across the leads

Observations for this second test case are so different to my surprise. Tester exhibited a kind of comfortability and ease at using the device. This can be classic example of design excellence of the device where second usage is walk in the park.

Observation1: Tester had plugged in black lobe to common as to the previous test case. She made sure that red lobe has is also holds the similar previous position as it is same slot that is used to measure the resistance as well.

Observation2: During the second test ,Tester has not considered the knob settings for resistance .Fortunately as volts and resistance has the same knob settings, so this hasn’t been any problem.

Observation 2: Tester had checked with me the polarity issue for measuring the resistor and I had the same answer again “not to worry”. She connected the lobes to alternate ends of resistor to find the measurement on the display.

Recommendations

There aren’t too many recommendation that I can suggest as this product from Fluke is excellently designed. This is evident from the testers ease at handing the device while executing second test case. Also partly to the fact that, tester had confidence that she has the best product and probably expensive product which has auto range settings and proper validation controls in place not to blow fuses in case of a user error.

Anyhow ,I have couple of recommendations that came to my mind.

- There can some kind of “First time user” physical button on the device , by operating this user can get some kind of interaction based instructions displayed regarding device usage based on feedback from the user on he or she is trying to test either voltage , current ,resistance, continuty.etc. By providing this option users does not need any external help.
- I have notice a negative readings while tester is testing with wrong polarity, May be it is better to advice to user to exchange polarities for correct values unless user is not intentionally checking for polarity.

Learned from evaluation.

I feel this device is a classic example for design to excellence. This excise also demonstrated below points

- Basic rule concept of “Designing complex activities in a simple way”.
- Proved Don Norman’s design concepts: Device with a good design is the one that needs no help using it second time. This is demonstrated by the ease tester has executed second test case when compared to the first one.

References

http://en.wikipedia.org/wiki/Multimeter