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MEGATRONIC TRAINER AND ROBOTIC IN TAGOLOAN COMMUNITY COLLEGE: AN IMPLICATION TO ELECTRONIC ENGINEERING TECHNOLOGY

by:

Frederick W Gomez PhD, Michael L Lopez ECE-MTTE, Filomino S Lupiba ME- MA

Abstract

This Research and Development (R&D) is an innovation on the field of Electronic Engineering Technology in Tagoloan Community College. It showcases the Megatronic Trainer (MT) in a robotic configuration for risk reduction disaster preparedness respond. It is a combination of the existing analog and digital electronic trainer that can detect and response the environmental stimulus such as: earthquake, volcanic eruption, fire, water, wind and smoke stimulus. Thus, this Research and Development (R&D) is designed with analog and digital components. The project R&D the developer designed, developed, and test the accuracy of the trainer for patent. It is expected that the environment would be resilient to the natural and man-made hazard and making the home of mankind in the Pacific region a better place to live. This MT interface the electronic variables using the analog and digital components, modules, and computers. The functions of this MT can be tested with its content parameters. Thus, MT is operated optimally in a high level of magnitude frequency and hone the theoretical learning of the Electronic Engineering Technology learners in real world landscaping the geographic prone areas on risk reduction management.

Keywords: Megatronic Trainer and Robotic

INTRODUCTION

The Megatronic Trainer (MT) is an innovation of analogue-digital trainer. Working with electronics both analog and digital signals, inputs and outputs is relevant to the present generation. This electronic project R&D and development have been done to interact with the real, analog world and the microprocessors, computers, and logic logarithm units are purely digitized components (Coates, 2019). These two types of signals are different electronic languages; some electronic components are bi-lingual, others can only understand and speak one of the two. All of the electronics be divided into two broad categories: analog and digital (EETech Media, 2019). Thus, this Megatronic Trainer (MT) designed and developed by the researchers in Tagoloan Community College is to cope-up the need of the real world of the "time and space" needed for the future reinventiveness and innovation in the field of electronics. One of the most common examples is the difference between analog and digital devices of a clock. On the analog clock, the time is represented by hands that spin around a dial and point to a location on the dial that represents the approximate time (EETech Media, 2021) On a digital clock, a numeric display indicates the exact time. *Analog* refers to circuits in which quantities such as voltage or current vary at a continuous rate. When one turn the dial of a potentiometer, for example, one change the resistance by a continuously varying rate. The resistance of the potentiometer can be any value between the minimum and maximum allowed by the pot (Electronicsforu, 2018).

If one creates a voltage divider by placing a fixed resistor in series with a potentiometer, the voltage at the point between the fixed resistor and the potentiometer increases or decreases smoothly as one turns the knob on the potentiometer (Sahat, 2021). In *digital* electronics, quantities are counted rather than measured. There's an important distinction between counting and measuring. When one *count* something, one gets an exact result. When one *measure* something, one gets an approximate result. So, which is more accurate — analog or digital? In one sense, digital circuits are more accurate because they count with complete precision (Kingbright, 2019. One can precisely count the number of jelly beans in a jar. But if one weighs the jar by putting it on an analog scale, the reading may be a bit imprecise because one can't always judge the exact position of the needle (Spark Fun, 2019). The needle on the scale is about halfway between 4 pounds and 5 pounds. Does the jar weigh 4.5 pounds or 4.6 pounds? One can't tell for sure, so you settle for approximately 4.5 pounds. On the other hand, digital circuits are inherently limited in their precision because they must count on fixed units. Most digital thermometers, for example, have only one digit to the right of the decimal point. Thus, they can indicate a temperature of 98.6 or 98.7 but can't indicate 98.65. Here are a few other thoughts to ponder concerning the differences between digital and analog systems: A system is digital isn't the same as saying that it's binary. *Binary* is a particular type of digital system in which the counting is all done with the binary number system (E-Gizmo, 2019). Nearly all digital systems are also binary systems, but the two words aren't interchangeable. Many systems are a combination of binary and analog systems. In a system that combines binary and analog values, special circuitry is required to convert from analog to digital, or vice versa. An input voltage (analog) might be converted to a sequence of pulses, one for each volt; then the pulses can be counted to determine the voltage (Lowe, 2019).

From the generic term a trainer is a bag type and suitable for use on the table. It is resistant to breakage, can be top stored. Aluminum frame structure and ABS-material. The top cover can be divided and lockable. The Digital Trainer (DT) is a compact unit for training exercise and for the practical absorption of knowledge in all fields of basic logical functions, contactless control, digital and computer technique (Cokesen Electronik, 2019). Furthermore, electronic trainer is a simple teaching equipment to guide learners through their first steps in the field of electronics. It consisted of a bread-board plate mounted on printed circuit platform where power supply and signals are distributed in order to use them in practical experiments while the digital trainer has the same purposes of electronic trainer but different interior components such like integrated circuits and logic gates. It allows the practical study of a wide range of electronics subjects, including DC (Direct Current) and AC (Alternating Current) circuits, electrical networks, semiconductors, logic gates and fault-finding techniques (Rashid, 2018). The unique design of this trainer includes a heavy duty casing with transparent protective cover. When use, the cover folds back to provide an angle support for the unit. With the cover closed, trainers become stackable for easy storage. A range of optional experiment cards may be plugged into the trainer to address further subject areas, including electronic systems, transistor amplifiers, linear and digital systems, telecommunications, and microprocessors. The trainer is supplied with a comprehensive set of carrier-mounted components and a digital curriculum disc providing a comprehensive course of electronic study. The trainer includes the following devices and features: patching area for use with component set, connection system for optional plug-in experiment cards, on-board signal generator providing square wave and sine wave signal sources, 8 logic switches and 2 pushbutton switches for use as control inputs, zero insertion force socket to accommodate dual-in-line integrated circuits, buzzer, white and red LEDs, and headphone, two OR gates, and inverter, transistor switch and relay, 8 logic monitor LEDs for displaying logic outputs, 2 red and 2 green LED monitors for traffic light simulation activities, 2 seven-segment displays with decoder/drivers, connection panel providing 2mm and 4mm sockets, test pins for oscilloscope probes and connector for powering prototyping boards, full short circuit/overload protection, easy-to-use switched fault facility for fault-finding activities on the trainer and experiment cards, connecting leads, shorting links and power supply adapter (LJ Create, 2015).

However, Elprocus (2015), interfacing the process of connecting devices together they can exchange the information and proves easier to write the programs. To assure the functionality of all the parts of one technology it should be interfaced correctly. The team researchers conducting this research and developmental project find a suitable solution to sustain the deficiency on the actual knowledge to justify the theories made practice into progress. The team researchers think that the best way to cure the inability is by purchasing each component that cannot justify the basic information logic to the operation on this electronic circuits on Megatronic Trainer suitable to Tagoloan Community College. However, the presence of all these components that can complete the practical circuit given by the team researchers as a professor of this reinvention and innovation would eliminate the reasons that may defined the future problem. With the combined multimedia infrastructure and the presence of all components in electronics plus electrical, mechanical and measuring tools that work as a practicing Megatronic Trainer machine will surely give the stimulus to the roadmap on robotic Megatron (Alexan, 2019) that uplift the slowing capacity of practical learning in the electronic robotics.

Lastly, this Megatronic Trainer as designed and developed in the wisdom of electronic logarithm with the analogue and digitized trainer are not yet available in the market because of the combination of these valuable multimedia infrastructure. From that end, the wisdom of the team researchers would help the professor, learners and the personnel in the workplace to ease the routinary work that would "fatigue and decomposed their own time and space" while at work (Tejano, 2018). They decided to designed, developed, create, innovate and reinvent this practical multimedia infrastructure with the addition of some basic electronic circuits, modules and programmable devices that will fill-up the gaps in the field of electronic engineering technology. As the technocratic advancement constantly changing, this leads to landscape the R&D development of the new Megatronic Trainer. Thus, the purpose of this paper is to produce a trainer which called Megatronic Trainer which has a combination of the existing analogue and digital trainer to perform technical interfacing robotic multimedia infrastructure.

METHODS

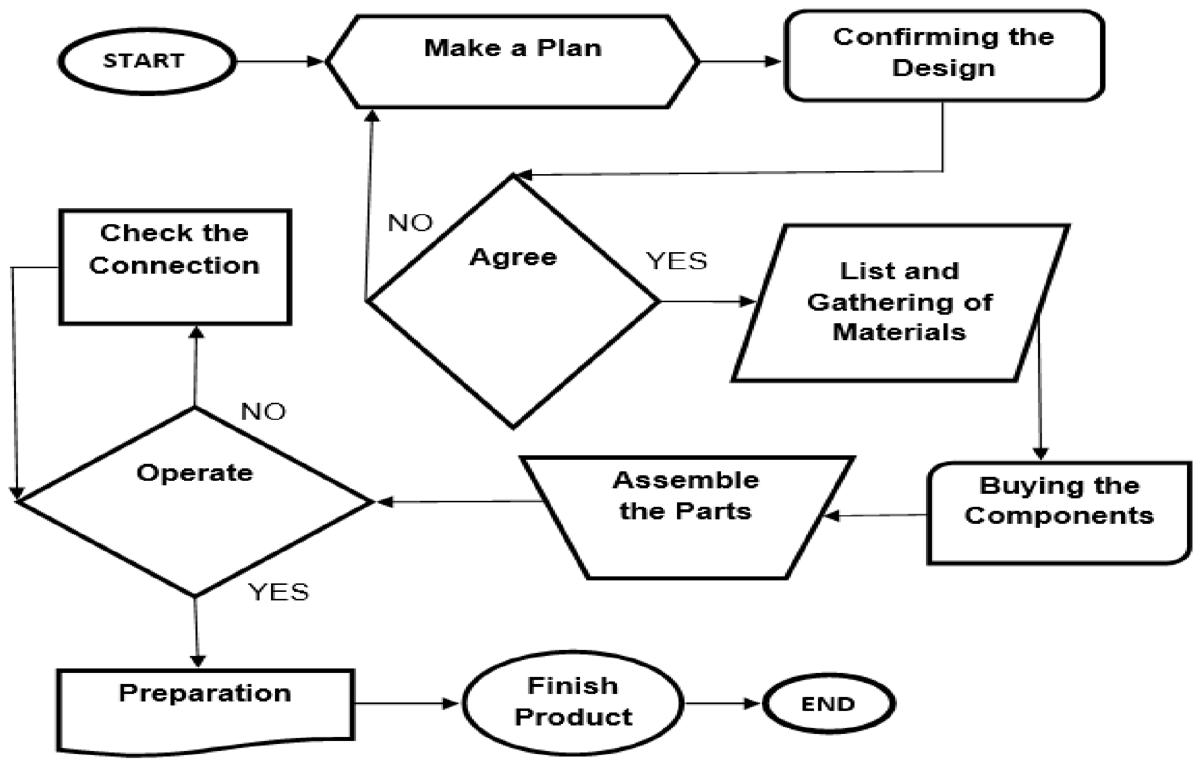
The team researchers design, develop, reinvent and innovate the Megatronic Trainer and utilized the lens from the developmental research. It is used as a method in order to roadmap the concepts develop by the team researchers and translate into a real and a usable one that can fill-up the gaps in the field of work. The developmental research on Megatronic trainer encompassed the progressive changes that occur on technology that developed and devolved by its sophisticated multimedia infrastructure. The usability and its function of developmental research is to evaluate changes overtime. Subsequently, the study pays attention on the development and design of the Megatronic Trainer that caters the interfacing of different electronic variables such as analogue, digital and advance electronics multimedia infrastructure. The researcher sought to produce the Megatronic Trainer based on the following roadmap below:

Phase Procedure in the making of the Megatronic Trainer (MT)

The phase procedure of the study was the following: project design, project development, operation and testing procedures, and evaluating the output. The project design will present as a block diagram of the circuit/variables need for the development. On the other hand, the project development are stages present as a flow chart to explain how the team researchers develop MT. The operation and testing procedures are explanation on how to test the functionality of the output device or the Megatronic Trainer. The fourth phase is the evaluation procedures where team researchers provide final testing and results on accuracy and satisfactory performance.

Project Design. The project design shows the different parts and components that was needed to complete the Megatronic Trainer. As shown in figures below, components of both analog and digital electronic trainers were presented. The figures show the connection and relation of the circuits to show how components, devices or circuits will be connected to other circuits. It is clearly showing in the figures below that all the circuits are connected to the power supply which gives the main source of electricity to power each circuit and can interface to another basic electronics logarithm.

Project Development. The project R&D development showed how the team researchers plan the development of Megatronic Trainer (MT). As shown in Figure 1, at the start of the project, the developer



meet-up and discussed and crafted a plan for their innovation. After the confirmation of the design, the listing and gathering of the materials follows. It was followed by the buying of the components and other integrated wiring (Taupa, Allan (2018) assembled it afterwards. Then, proceeded to the operation of the trainer. The testing was then operated. When all the preparation and testing were done, the finish product was then ready for validity and reliability testing. That mark-up the end of the project R&D development. In figure 1 the development flow chart of the study explains the flow how the study progressed and is validated by the final output of Megatronic Trainer (MT). The last part is the final output of the study, where it determines the trainer's total quality performance.

Operation and Testing Procedures. The team researchers conducted testing and evaluation procedures to test the functionality of components and its operation. 1stplug the power cord in the outlet and turn on the power supply by switching on the power button. 2ndcheck the blue LED if it is all glowing since its indicating functional flow of power supply. 3rd test the functionality of every component using the present instrument parameters (Analogue & multi-meters) in Megatronic Trainer (MT). 4th conduct a technical interfacing of available components in the Trainer to test the connections. 5th if everything is functioning without any problems the Megatronic Trainer can now perform technical interfacing activities.

Evaluation Procedure. The Megatronic Trainer (MT) will be evaluated using practical testing techniques. The following are the variables to be used: Input (electronic components); Actual Output; Expected Output; Efficiency; Reliability and Annotations testing.

RESULTS AND DISCUSSION

The presentation, analysis and interpretation of the collected and gathered data by the team researchers, on how to use the different parameters to measure its output, and evaluate how the project works well. The following sections will describe and discuss the projects R&D characteristic.

***Project Description*.** The Megatronic Trainer (MT) can perform numerous task of interfacing such as digital electronic, analogue electronic activities and Programable modules.

Operation. To operate the Megatronic Trainer (MT), the user must read first the instructions on how to manipulate the device. Plug the power cord to the outlet and turn on the switch. The device has power indicators that will notify the user that it was ready to operate. The Megatronic Trainer (MT) physically display the different types of electronic components; Resistor, Capacitor (Mylar, Ceramic, Electrolytic & Trimmer), Potentiometer (Mono & Stereo), Tact Switch, Light Emitting Diode (LED), Transistor (NPN & PNP), Thermistor, Light Dependent Resistor (LDR), Breadboard, Digital IC's (Decade Counter, Logic Gates, 555 Timer & Relay. It also counts the basic electronic circuits; Latching, Timer, Dark & Light Activated & Amplifier Circuit and other ready attached component for robotic manipulation.

To begin interfacing and building a circuit the user must have a Schematic Diagram (SD) for reference, finalize the material and components needed for the activity, the user can use male connecting wires for the interlinking, the Megatronic Trainer (MT) offer 4 plates of prototyping boards for the interfacing of circuits. The component belongs to the device that can be adjust and use for personal ideas that refers to the desire circuit of the user. In order to identify if the used connecting wires and components are functional use measuring tools for clarifying (Digital &Analogue Multi-tester) the continuity and functionality of the components present in the activity. The user should assemble the circuit first before supplying electricity (DC) and make sure that the voltage needed for the circuit is accurate to avoid destructions of materials and components, if the user successfully completes the activity, turn off the power supply and disconnect all the connections inserted in the prototyping area.

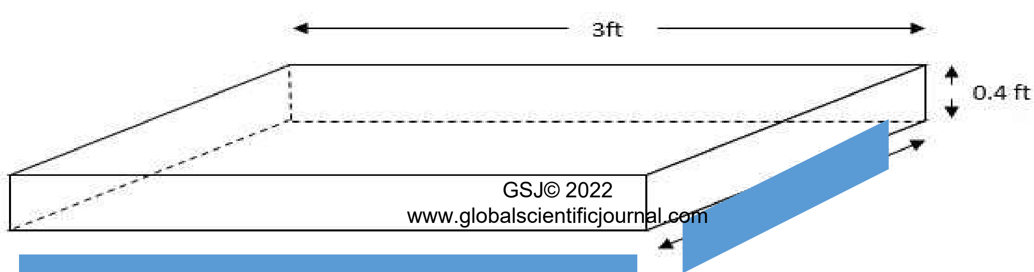
Project Structure

Appearance. The Megatronic trainer (MT) looks like a rectangular prism. Its whole body are made of acrylic fiber and its covered by leatherette. The design was crafted using the existing designed Megatronic Trainer (MT) in the market however, there other parts of the MT that are designed and developed for the purpose. The final outcome of the project R&D is illustrated in figure 2.

Figure 2. Actual Appearance of Megatronic Trainer

***Features*.** The features of the Megatronic Trainer (MT) are the following. It can perform digital electronic activities. It can perform basic analogue activities such as; Amplifier circuit, Latching circuit, Light & Dark activited circuit, Timer Circuit and Radio receiver circuit. It can perform programmable modules and can manipulate the designed robotic. It can be easily fixed because the parts are exposed and are easily disassembled.

Dimensions. The figure below showed the actual dimensions of Megatronic Trainer.



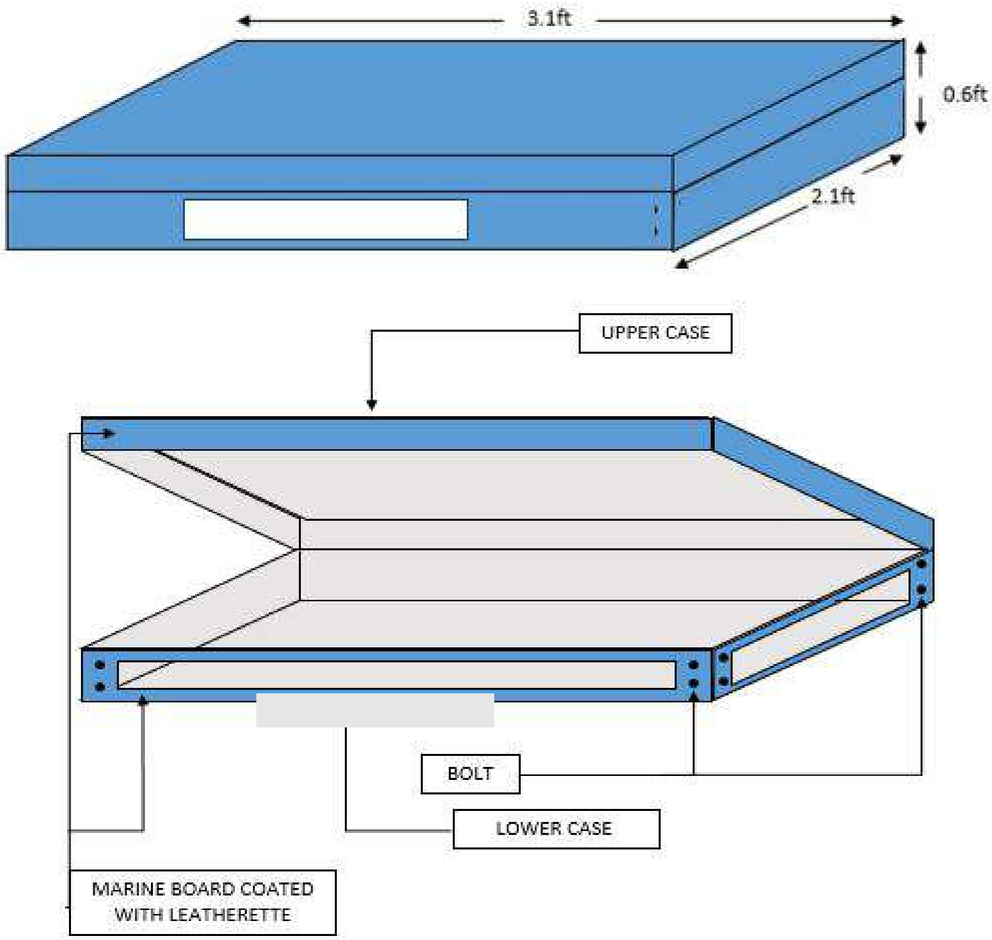


Figure 3. Actual Dimension of Megatronic Trainer

Specifications

The following were the different specifications of some digital components in Megatronic Trainer.

Figure 4. Arduino Uno

The Arduino Uno was illustrated in figure 4. **Arduino Uno** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button (Arduino, 2019). For this Megatronic Trainer, it has the following specifications: microcontroller is ATmega328, operating Voltage is 5V, input Voltage is 7-12V, input voltage (limits) is 6-20V, digital I/O Pins is 14(of which 6 provide PWM output), analog Input Pins is 6, DC Current per I/O Pin is 40mA, DC Current for 3.3V Pin is 50mA (32KB of which 0.5 KB used), flash memory is Boollcader, SRAM is 2KB, EEPROM is 1KB, and clock speed is 16 MHz. Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output (DesignSpark, 2021)

Figure 5. Rain Sensor

Figure 5 above is an illustration of the rain sensor. The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity through a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount of water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level (Openhacks, 2019). Specifically, it has the following features: adopts high quality of RF-04 double sided material. It has an area of 5cm x 4cm nickel plate on side. It has anti-oxidation, anti-conductivity, w/ long use time and driving ability is over 15mA. Its potentiometer adjusts the sensitivity and its working voltage is 5V. Its output format is digital switching output (0&1) & analog voltage output AO. Its pin configuration is VCC is 5V DC, GND is ground, DO is high/low output, and AO is analog output.

Figure 6. Bluetooth Module

Figure 6 is the HM-10 is a small 3.3v SMD Bluetooth 4.0 BLE module based on the TI CC2540 or CC2541 Bluetooth SOC (System On Chip). The HM-10 is made by Jinan Huamao and is one of many Bluetooth devices they produce including the HM-11 which is operationally the same as the HM-10 but has a smaller footprint with fewer pins broken out (Curry, 2017). Specifically, it has +2.5V to +3.3V, requires up to 50mA, uses around 9mA when in an active state, use 50-200uA when asleep, RF power: -23dbm, -6dbm, 0dbm, 6dbm, Bluetooth version 4.0 BLE, Xssdsx default baud rate for serial connection is 9600, default PIN is 000000, default name is HMSoft. Its *PIN description are the following:* state Connection status, VCC Power in 3.6V to 6V, GND Common ground, TXD Serial UART transmit, RXD Serial UART receive, and BRK Break pin.

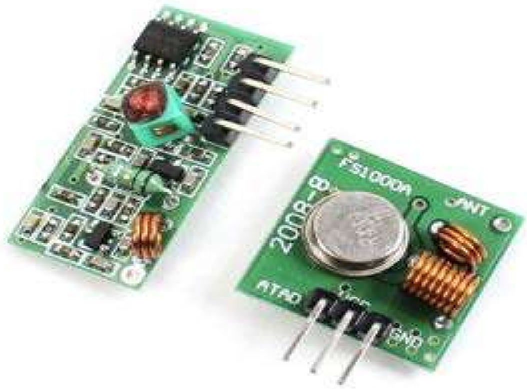
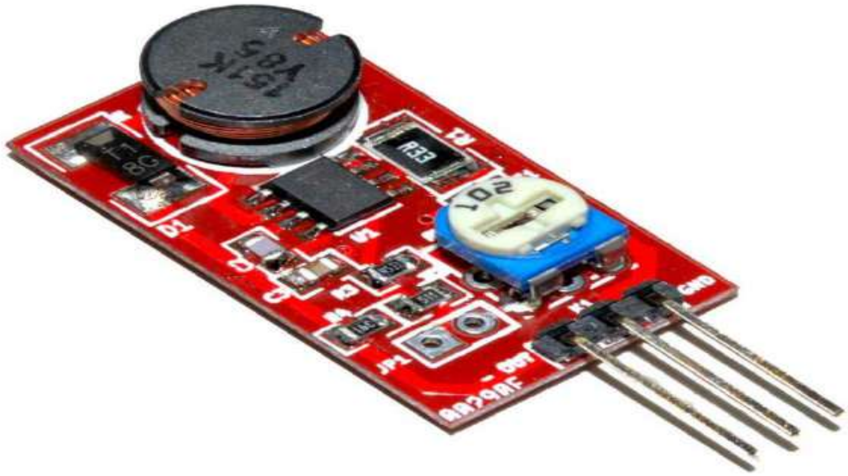


Figure 7 433 Mhz RF Transmitter and Receiver

Figure 7 is the RF transceiver (Both transmitter & Receiver) module is a wireless remote control module which both can transmit and receive the RF Signal (Robomart, 2015).It has the following features of 433 Mhz RF transmitter and receiver, frequency is 433.92 MHZ**, o**perating voltage is3-12 vdc, data rate is up to 8 kbps**, w**orks with HT12E or other decoder. The applications of 433 Mhz RF transmitter and receiver are the following: automatic wireless health monitoring system in hospitals for patients, pick n place robot with Soft Catching Gripper, RF controlled robotic vehicle with LASER beam arrangement, Channel RF Based Remote Control, Hi-Tech wireless equipment controlling system, home/office security system (Safeguard) using RF, incoming /outgoing vehicle alert from main gate, industrial automation system using RF, detecting the conditions of remote areas through data acquisition system using RF module, RF based wireless remote control project, electrical apparatus control system in a plant using RF wireless communication, modern house automation (AC/DC) using RF communication, remote areas data acquisition using RF module (IQRA



University, 2019), unique office communication system using RF, and wireless data acquisition system using RF.

Figure 8. eDC-2416N DC/DC Negative Output Boost Converter

Figure 8. above showed eDC-2416N DC/DC negative output boost converter I has up to -16VDC output from a single +5VDC input, adjustable output from single +5V supply. Output is adjustable from = Vin to +24VDC. 3W @ +15V output, 2.4W @ +24VDC output. Three terminal positive voltage regulator pin layout (E-Gizmo Mechatronix Central, 2019).

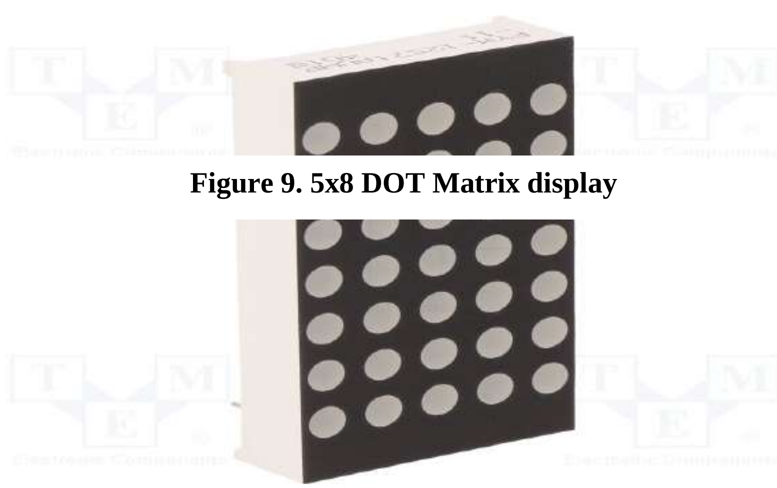


Figure 9. 5x8 DOT Matrix display

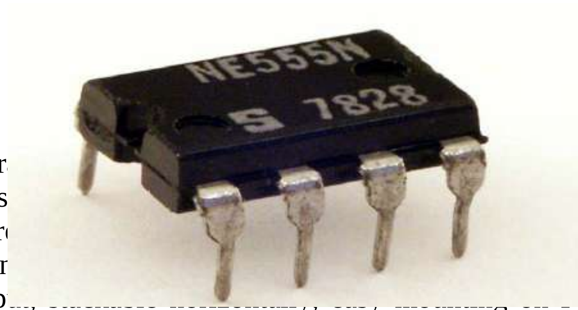


Figure 9 illustr ncy red source color devices are made with gallium ars light emitting diode. The green source color devices ar ing diode (Kingbright, 2019). Its features include z 2.4ir with low current operation, high contrast and light outp C. boards or sockets, multicolor available, mechanically rugged, with standard gray face, white dot, and RoHS compliant.

Figure 10. 555 Timer IC

Figure 10.555 displayed the 555 timer IC is an integral part of electronics projects. Be it a simple project involving a single 8-bit micro-controller and some peripherals or a complex one involving system on chips (SoCs), 555 timer working is involved. These provide time delays, as an oscillator and as a flip-flop element among other applications (Electronicsforu, 2018).

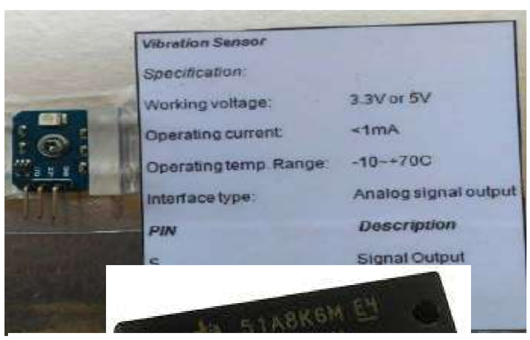


Figure 11. Vibration Sensor

Figure 11 showed the vibration sensor. This is used originally as vibration switch because of its high sensitivity; it is sensitive to environment vibration, and generally used to detect the ambient vibration strength. When module did not reach the threshold in shock or vibration strength, DO port output gets high level and when external vibration strength exceeds the threshold, D0 port output gets low level. Small digital output D0 can be directly connected to the microcontroller, for the microcontroller to detect low level, thereby to detect the ambient vibration. Small digital output DO can directly drive the relay module, which can be composed of a vibration switch (Tinkbox, 2019).

Figure 12. Logic Gates

Figure 12 displayed the logic gates used in the Megatronic Trainer. A logic gate is a small transistor circuit basically, a type of amplifier, which is implemented in different forms within an integrated circuit. Each type of gate has one or more (most often two) inputs and one output. The principle of operation is that the circuit operates on just two voltage levels, called logic 0 and logic 1. When either of these voltage levels is applied to the inputs, the output of the gate responds by assuming a 1 or a 0 level, depending on the particular logic of the gate. The logic rules for each type of gate can be described in different ways, by a written description of the action, by a truth table, or by a Boolean algebra statement. Boolean statements use letters from the beginning of the alphabet, such as A, B, C etc. to indicate inputs, and letters from the second half of the alphabet, very commonly X or Y and sometimes Q or P to label an output. The letters have no meaning in themselves, other than just to label the various points in the circuit. The letters are then linked by a symbol indicating the logical action of the gate (Coates, 2019).

Figure 13. Seven Segment

Figure 13 illustrated the seven segment. The *7-segment display*, also written as “seven segment display”, consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown in figure 13. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed. An additional 8th LED is sometimes used within the same package thus allowing the indication of a Decimal Point, (DP) when two or more 7-segment displays are connected together to display numbers greater than ten. Each one of the seven LEDs in the display is given a positional segment with one of its connection pins being brought straight out of the rectangular plastic package. These individually LED pins are labelled through representing each individual LED. The other LED pins are connected together and wired to form a common pin (AspenCore, 2019).

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Figure 14. Analogue and Digital Multimeters

Figure 14 displayed analogue and digital multimeters. Multimeters are tools used to measure current, voltage and resistance. They are very useful instruments that can be utilized in a number of fields, the primary users being electricians. There are two primary types of multimeters, one begins the analog and the other is the digital. The primary difference between the two is the display, an analog multimeter uses a needle to show the value, while a digital multimeter will show the results as numbers on the screen (Hernando, 2016). There are pros and cons to both devices, and this R&D development will tackle both these issues. To make measurements on a scale calibration an analog multimeter moves a needle along the scale. These devices are excellent for reading voltage, current, resistance, frequency and signal power. A switched-range analog multimeter can be very affordable; however, they can be a bit difficult to use. For users who are new to multimeters may have trouble reading the resistance scale. The analog multimeter also exhibits low resistance and high sensitivity with scales down, which can make it difficult to use (Robomart, 2015). The advantages of using an analog multimeter is when checking a diode, the analog is usually more accurate. Other than that, many professionals choose to use a digital multimeter.

As mentioned above, the main difference between a digital and analog multimeter is the display. The digital multimeter displays the reading in digits most times on a LED or LCD screen. This makes taking measurements much more accurate. These tools are often used for measuring voltage because of its higher resistance of 1 M or 10 M. Overall, digital multimeters are much easier to read and provide more accurate readings. These days many analog multimeters are a thing of the past, and many professionals choose to use digital multimeters. Hopefully this article has explained the difference of the two multimeters and will be helpful when shopping for a multimeter (Simply Smarter Circuitry, 2019).

Figure 15. Light and Dark Activated Circuit

Figure 15 showed the light and dark activated circuit. The input to the inverting input will be the voltage across the LDR that is light dependent. At darkness the resistance of the LDR will be high and so do the voltage across it (Circuits Today, 2018). Dark Activated Relay Circuit (DARC). This dark activated switch can trigger a relay to operate an AC lamp at Sunset. The LDR (Light Dependent Resistor) has very high resistance as high as 10 Meg ohms in dark which reduces to a few Ohms in bright light (AspenCore, 2019).

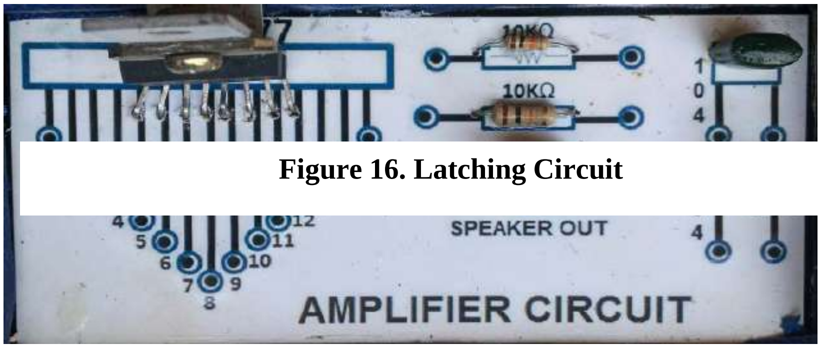

Figure 16. Latching Circuit

Figure 16 is the showcased latches and flip-flops. These are the basic elements for storing information. One latch or flip-flop can store one bit of information. The main difference between latches and flip-flops is that for latches, their outputs are constantly affected by their inputs as long as the enable signal is asserted (Jalani, 2015). In other words, when they are enabled, their content changes immediately when their inputs change. Flip-flops, on the other hand, have their content change only either at the rising or falling edge of the enable signal. This enable signal is usually the controlling clock signal. After the rising or falling edge of the clock, the flip-flop content remains constant even if the input changes (Yeditepe, 2019).

Figure 17. Amplifier Circuit

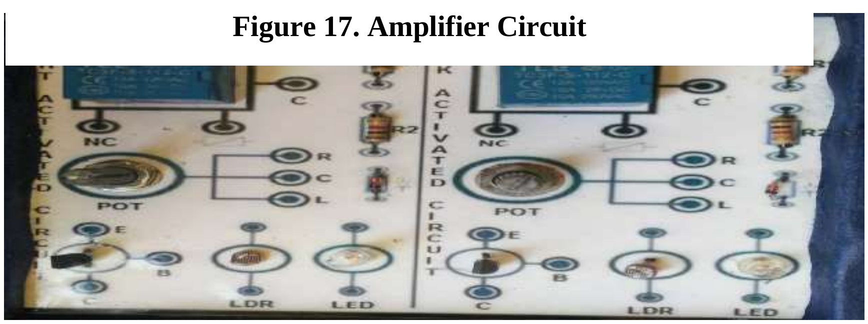

Figure 17 displayed the amplifier circuit.

Operational amplifiers have a basic task. They take an input potential (voltage) and produce an output potential that's tens, hundreds, or thousands of times the magnitude of the input potential. In an amplifier circuit, the LM386 takes an audio input signal and increases its potential anywhere from 20 to 200 times (Circuit Basics, 2019).

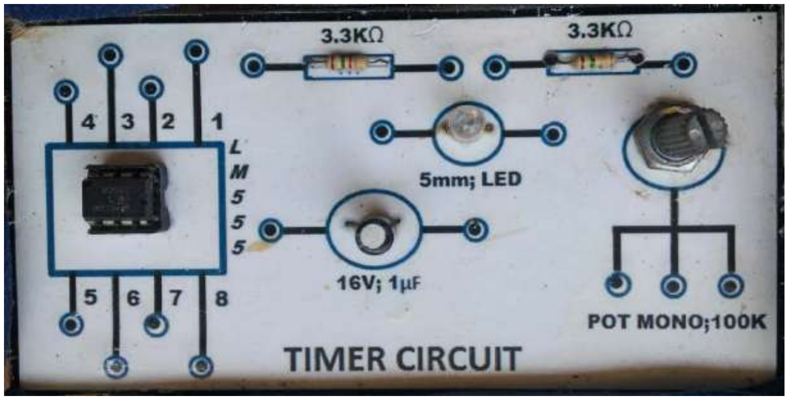

Figure 18. Timer Circuit

Figure 18 is the timer circuit was illustrated in figure 18. The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200 mA or drive TTL circuits (Texas Instruments, 2015).

Figure 19 Speaker

Figure 19 is the displayed speaker. In order to translate an electrical signal into an audible sound, speakers contain an electromagnet is needed. A metal coil which creates a magnetic field when an electric current flow occurred. A microphone (a small device that produce sound wave) uses the same mechanism as a speaker in reverse to convert sound into an electrical signal (Physics.org, 2019).

Figure 20. Resistor

Figure 20 is the displayed resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor (Rouse, 2019).

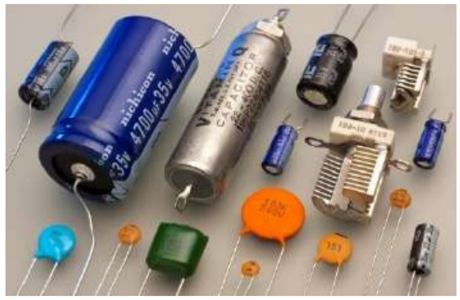

Figure 21. Relay

Figure 21 is the relay in Megatronic Trainer switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized (Galco Industrial Electronics, 2019).

Figure 22. Capacitor

Figure 22 are displayed capacitors is an electronic component that stores electric charge. The capacitor is made of 2 close conductors (usually plates) that are separated by a dielectric material. The plates accumulate electric charge when connected to power source. One plate accumulates positive charge and the other plate accumulates negative charge. The capacitance is the amount of electric charge that is stored in the capacitor at voltage of 1 Volt. The capacitance is measured in units of Farad (F).The capacitor disconnects current in Direct Current (DC) circuits and short circuit in Alternating Current (AC) circuits (RapidTables, 2019).

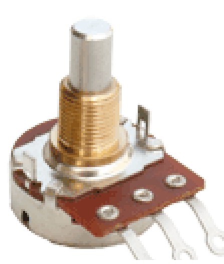

Figure 23. Potentiometer

Figure 23 a potentiometer is manually adjustable variable resistor with 3 terminals. Two terminals are connected to both ends of a resistive element, and the third terminal connects to a sliding contact, called a wiper, moving over the resistive element. The position of the wiper determines the output voltage of the potentiometer. The potentiometer essentially functions as a variable voltage divider. The resistive element can be seen as two resistors in series (potentiometer resistance), where the wiper position determines the resistance ratio of the first resistor to the second resistor (EETech Media, 2019).

Figure 24. Tactile Switch

Figure 24 a tactile switch is an on/off electronic switch that is only on when the button is pressed or if there is a definitive change in pressure. Tact switches react to user interaction with the button or switch when it makes contact with the control panel beneath. In most cases this is usually a printed circuit board (PCB) (Future Electronics, 2019).

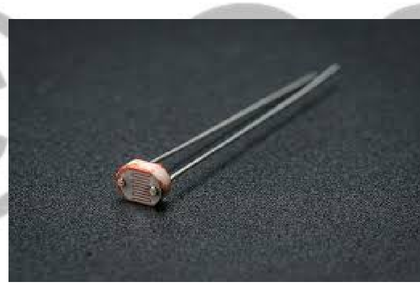

Figure 25 Light Dependent Resistor (LDR)

Figure 25 is a Light Dependent Resistor or Photoresistor, which is a passive electronic component, basically a resistor which has a resistance that varies depending of the light intensity. A photoresistor is made of a high resistance semiconductor that absorbs photons and based on the quantity and frequency of the absorbed photons the semiconductor material gives bound electrons enough energy to jump into the conduction band. The resulting free electrons conduct electricity resulting in lowering resistance of the photoresistor. The number of electrons is dependent of the photons frequency (AspenCore, 2019).

Figure 26 Transistor

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Figure 26 is a transistor device that regulates current or voltage flow and acts as a switch or gate for electronic signals. Transistors consist of three layers of a semiconductor material, each capable of carrying a current (TechTarget, 2019).

Figure 27. Thermistor

Figure 27 a thermistor is a temperature-sensing element composed of sintered semiconductor material which exhibits a large change in resistance proportional to a small change in temperature. Thermistors usually have negative temperature coefficients which means the resistance of the thermistor decreases as the temperature increases (Omega Engineering, 2019).

Figure 28. Power Supply

Figure 28 a power supply is a component that supplies power to at least one electric load. Typically, it converts one type of electrical power to another, but it may also convert a different form of energy – such as solar, mechanical, or chemical - into electrical energy. A power supply provides components with electric power. The term usually pertains to devices integrated within the component being powered. For example, computer power supplies convert AC current to DC current and are generally located at the rear of the computer case, along with at least one fan. A power supply is also known as a power supply unit, power brick or power adapter (Techopedia, 2019).

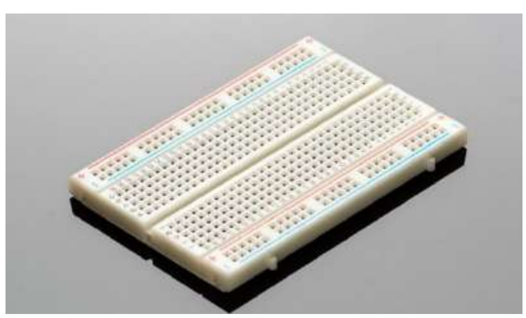
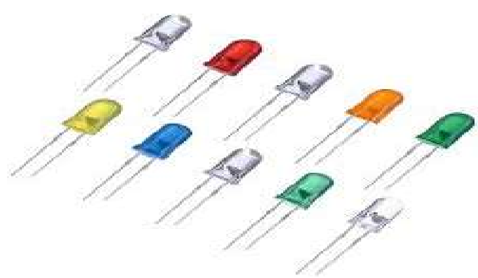


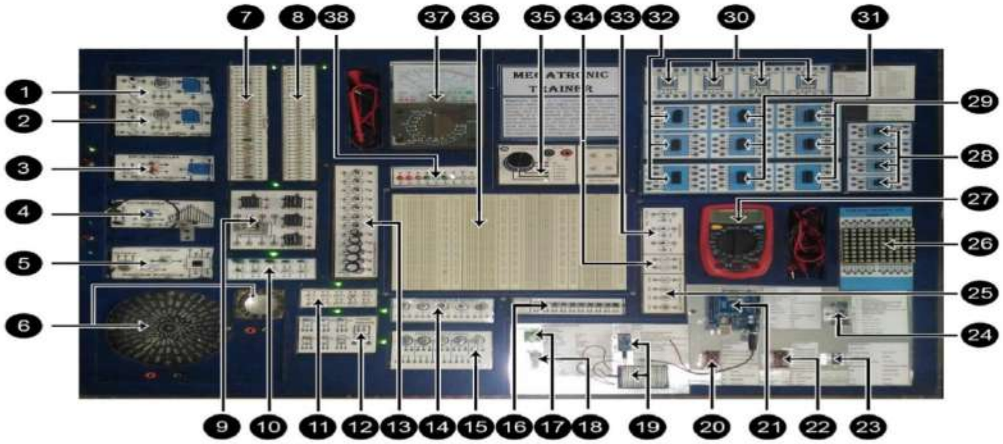
Figure 29. Breadboard

Figure 29 a breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate (Wiring, 2019).

Figure 30. Light Emitting Diode

Figure 30 a light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an *infrared-emitting diode* (IRED) (TechTarget, 2019).





Analogue		Digital
1. Light Activated Circuit	25. Light Dependent Resistor (LDR)	17. RF Reciever Module
2. Dark Activated Circuit	33. Transistor (NPM, PNP)	18. RF Tramsmitter Module
3. Latching Circuit	34. Thermistor	19. Rain Sensor
4. Amplifier Circuit	35. Power Supply	20. Step Up Converter
5. Timer Circuit	(220 VAC)	21. Arduino Uno
6. Speakers	(3 VDC)	22. Negative Output Converter
7. Resistors (½ watts)	(4.5 VDC)	23. Vibration Sensor
8. Resistors (¼ watts)	(6 VDC)	24. Bluetooth Module
9. Relays	(9 VDC)	26. 5x8 DOT MATRIX LED
10. Capacitors (Mylar)	(12 VDC)	27. Digital Multitester
11. Capacitors (Ceramic)	36. Breadboards	28. 555 Timer IC
12. Capacitors (Trimmer)	37. Analogue Multitester	29. NOT GATE IC (7404)
13. Capacitors (Electrolytic)	38. Light Emitting Diode (LED)	30. Seven Segment (10 pins)
14. Potentiometer (Mono)	(White, Green, Red)	31. OR GATE IC (7432)
15. Potentiometer (Stereo)		32. AND GATE IC (7408)
16. Tack Switch		

Figure 31. System Analytics in Analogue & Digital

Project Capabilities and Limitations

This part discussed the capabilities of the whole system as well as the various components in the Megatronic trainer.

System . The capability of this study is to illustrate the different circuits and modules that build in our trainer, from analogue circuit, digital circuit amd programmable module. It uses as a trainer for installing the parts and to visualizing the different circuits and modules. Its capable in doing hands on activities for electronic circuits especially interfacing analogue and digital circuits which is the main focus of the study.

Components. Its components are power supply- a kind of device with electronic circuit that supplies DC devices. Arduino Module is a device that has an open source computer hardware and software, it also plays as programmable device. Relay is a kind of voltage controller, it also plays an open and close switch. The breadboard is a practical tool used for prototyping new technology.

Limitations. It has the following limitations. It is only for teaching purposes and only for technical interfacing of basic electronics. It cannot use in micro technology and it has a lesser suitable to perform binomial activities when it comes to microelectronic circuit.

Distinct Parts. The distinct parts: analogue circuit is the most of the fundamental electronic components; resistors, capacitors, inductors, diodes, transistor and operational amplifiers are all inherently analog, circuit built with a combination of solely these components are usually analog. The digital circuit is typically constructed from small electronic circuit called logic gates that can be used to create combinational logic, each logic gate designed to perform a function of Boolean logic when acting on logic signal. The programmable module (Arduino) source electronics platform on easy to use hardware and software and a tool for fast prototyping.

Figure 32. The testing of the Megatronic Trainer

Project Evaluation Phase

Research design. The researchers designed the Megatronic Trainer to have an additional instructional material in the school that can be used by the instructor and students to have more visualization of the topic that be discused. The trainer was implemented at the laboratory of Engineering Technology major in Electronics, in which trainer is more demanded because of hands on activity in the school. It was composed of the following basic parts: Analogue circuit, Digital circuit and Programmable modules with this component it can be use as a normal trainer that can be find in the manufacturer of instructional material. But the researchers had an idea they modify it because we all know that some of the trainer can only perform one circuit either analogue or digital circuit. So the researchers modified it in way of combaning the analogue and digital circuit. Also it has an additional programmable modules to perform more activities.

Evaluation material . The Instruments used by the researchers to evaluate the Megatronic trainer is Multi Meter. Through the help of this instruments the researchers will find out that the trainer had function well. An electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter can measure voltage, current, and resistance. Analog multimeters use a microammeter with a moving pointer to display readings. The figure on the next page showed the components of the Megatronic electronic trainer. The next page will display the components of the Megatronic Trainer.

Functional Testing. The researchers test the functionality of the trainer by turning on the power supply. As shown above, the power supply of the Megatronic Trainer (MT) was turned on. The LED lighted on. The blue and red LED were used to test if the circuits were functional. It was loaded beforehand. Since it lighted, the circuits of the Megatronic Trainer (MT) were all functional. The green LED was used to indicate that the power supply was turned on.

CONCLUSION AND RECOMMENDATIONS

This project-based R&D on the *Megatronic Trainer* (MT) was put into reality in the hopes of helping future Engineering Electronic Technology learners to broaden their community-based learning. In creating this project R&D development, it was an intent to design, develop, and test applicable theories into practice and apply in aid of the frontline services needed for public interest. After the process each part are tested and measured according to their functionality. Each components and circuits, requires a well elaborated and defined instruction to be operated optimally. Now, based on the functional testing, assessment and evaluation procedures performed by the team researchers, the Megatronic Trainer (MT) ends-up with functional operations with zero irregularities. The Megatronic Trainer works skillfully done with caution without haste and complacency in terms of interfacing analogue and digital electronic components. The trainer's overall performance is likely, favorable and acceptable from the lens of the Electronic Computer Engineer (ECE) and Mechanical Engineer (ME) to the learners and faculty. It can perform various activities, and it is accurate in terms of performing the given task. Even though the trainer cannot perform the infinite cycle due to the insufficient of the power supply wherein the stimulus in the environment are not sensible for the MT to recognized however, it useful to the learners who wants to learn the basic electronics logarithm. It can be made handy and integrative robotic and microelectronic circuits. And lastly, increase the external power supply so that the Megatronic Trainer (MT) can function to its minimum and maximum effectiveness and efficiency.

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