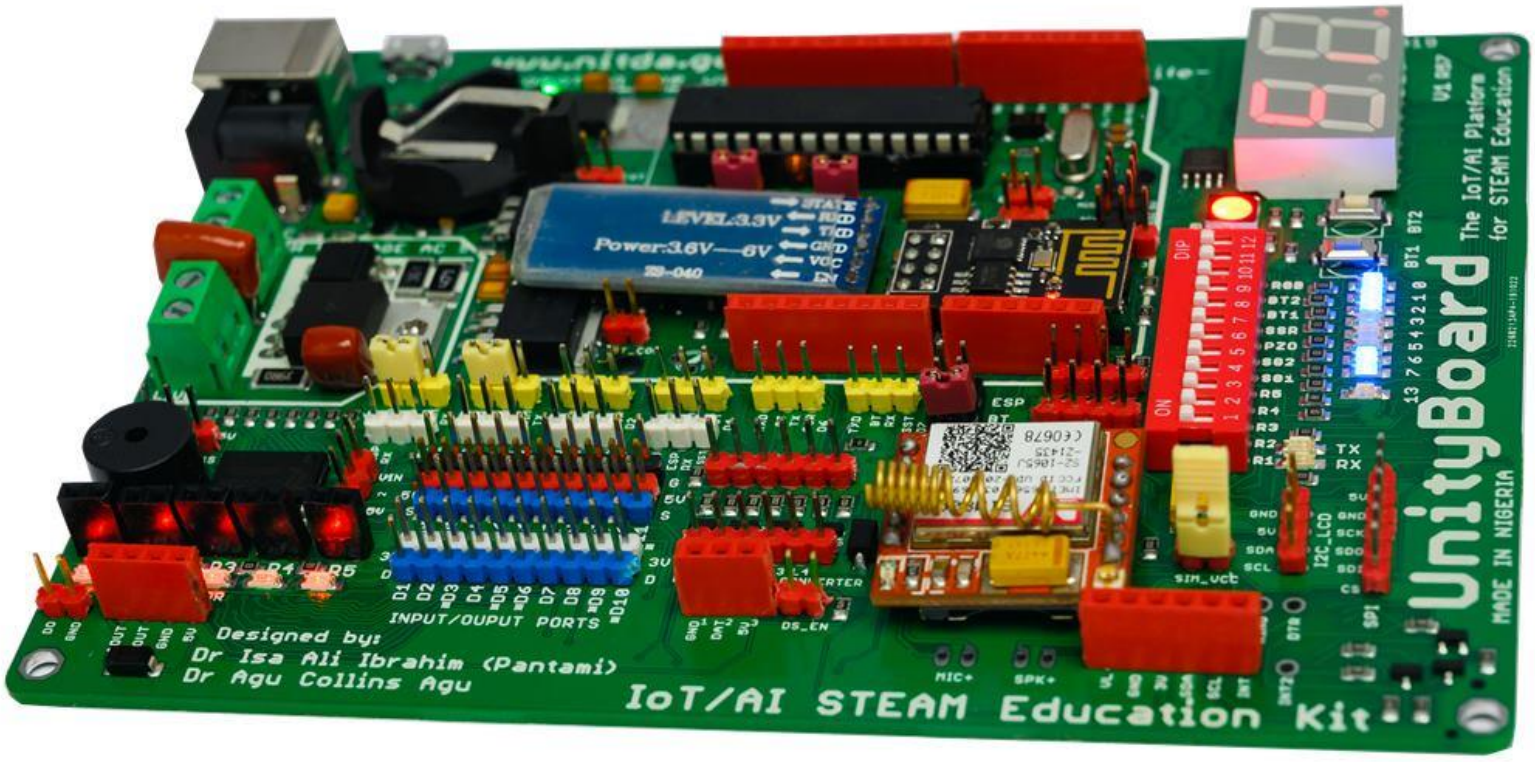
UNITY BOARD

GETTING STATRTED (DRAFT)

- A NITDA Research and Innovation Product to drive Indigenous Education Technology and Skills for the 4th Industrial Revolution-



Origin: National Information Technology Development Agency (NITDA) - **www.nitda.gov.ng**

Category: EDUCATION TECHNOLOGY

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Manufacturer: td4pai IoT Hub, Kuje, FCT. NIGERIA - **www.td4pai.org.ng**

Applications:

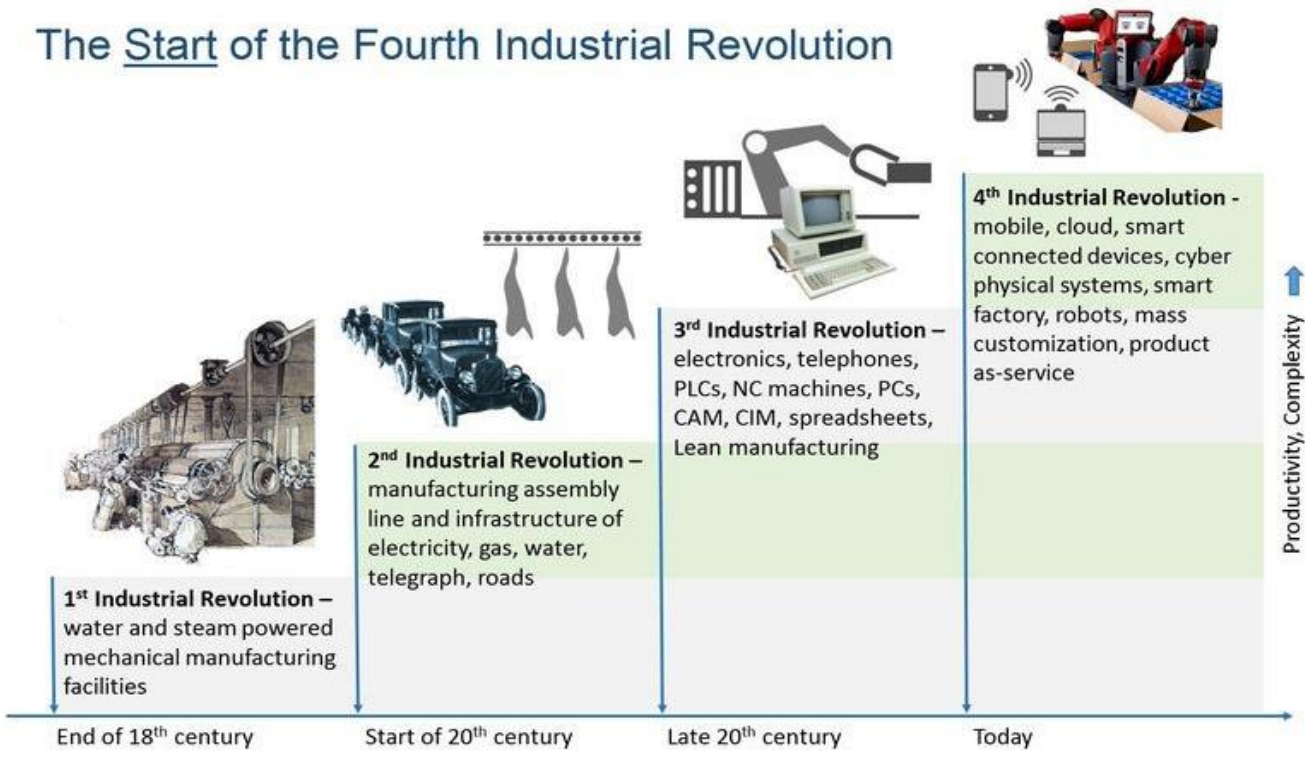
Learning embedded programming, developing and testing firmware
Security Systems
Early Warning System for flooding & oil spillage
Pipeline Protection
SCADA
Tracking Systems & Fleet Management
Data Acquisition Systems
Grid/Infrastructure Monitoring, Environment Monitoring, etc)
Smart Cities

Driving Indigenous Education Technology and Skills for the 4th Industrial Revolution.

Currently, we are facing a range of new technologies that combine the physical, digital and biological worlds, impacting all disciplines, economies and industries, and challenging our ideas about what it means to be human.

Advancements in the digital technology are shifting how people learn, live, and work leading to changes in skill requirements; The World Economic Forum predicts net job growth overall, with as many as four new roles emerging for each role lost, leading to the government confronting a unique challenge — growth in employment opportunities and a shortage of potential employees with the skills to occupy both new and existing roles.

The obvious challenge ahead, then, is how to design new approaches to education so that students are prepared to navigate these disruptive technologies, calling for the government to focus on the kind of education which is needed to prepare learners and education systems for the 4th industrial revolution. Just as important as what skills students will need, is what skills teachers will need and how their role will change.



Therefore, without bold reforms and clear policies to guide us through, many people will lack the necessary skills to fill new positions in economies and societies that are anticipated to be fundamentally different. Consequently by bridging critical thinking and problem-solving with entrepreneurship and design, liberal arts programs may be positioned to generate the kinds of intuitive thinkers that understand the future.

There is an increasing need to fast track capacity development in emerging technologies such as IoT through hands-on trainings and workshops (vocational training) to demystify the underlying technology and building blocks which translates to skills acquisition that will transition Africa into an outsourcing destination and manufacturing economy.

The fact remains that the market share of IoT will be in billions of US Dollars with over 50 billion devices connected. Now the question is: Do we engage the usual Adoption Model or get innovative and engage the Adaptation Model.

I would recommend the later; underscoring the need for scarce skills development & acquisition to enable us achieve Technology Adaptation and Customization, which will be a big shift from the traditional Technology Adoption that has kept us as CONSUMERS with no DIGITAL SOVEREIGNTY.

Africa has woken up to these challenges by the introduction of the Local Content Policy in ICT and the Executive Orders in some countries, mandating the patronage of indigenous products and services.

The countdown has commenced for massive explosion in hardware development such as the UNITY BOARD to drive the penetration and application of IoT technology in Africa.

Enforcement of the enabling laws will be a major catalyst in materializing start-ups to drive the knowledge economy.

Description:

Unity Board is a made-in-Nigeria Education Technology Platform, a hardware which is also an embedded AI/IoT STEAM Education Kit to drive learning and teaching of IoT, Robotics and Artificial Intelligence to accelerate local content development and indigenization of technology through human capital development in emerging technologies. STEAM, stands for Science, Technology, Engineering, Arts and Maths which aims to embed problem solving capability through creative thinking and problem-based learning methods, especially at the early age.

Unity Board is a creative medium for advancing teaching and learning, designed specifically as hands-on learning tools to help today's students build skills for the creative and digital economy through critical thinking, collaboration, communication, curiosity, problem solving and invention.

It teaches Physical Computing combining hardware and software by focusing on teaching of computer science and computational thinking creating a perfect way to introduce middle school and older students to physical computing that opens up a world of opportunities in the fields of robotics, Internet of Things (IoT), engineering, fashion, medical industries, environmental sciences, performing arts and more; ensuring better preparedness to enter the workforce of the future.

UNITY BOARD - IoT/AI Steam Education Kit

Unity Board will spark the spirit of innovation in learners, and ignite great things! When students are free to invent and create, they begin to see technology as a means for solving real-world problems and taking their learning to the next level.

By introducing the Internet of Things (IoT) in education via UnityBoard and allowing Internet based communications to happen between physical objects, sensors and controllers will change educational institutions massively. By embedding sensors in objects and integrating cloud computing, augmented reality, wearable technologies and big data in this platform, different parameters of the educational environment can be measured and analysed to provide useful information. It will also create a new interaction between people and the environment in educational environment.

The Internet of Things (IoT) is a technological revolution that enables pervasive interaction between objects, people and environments. Data will be gathered by embedded sensors and actuators, which are then sent to specialized applications to create actionable information. IoT has been acknowledged as one of the foundation stones of Industry 4.0, due to its potential to change the existing industrial and business processes.

With the advent and growth of the IoT, physical environments are becoming smarter and more interconnected than ever before. This has changed the way we live by improving sustainability, efficiency, accuracy and economy in almost every aspect of our lives. IoT has been leveraged in many industries such as healthcare systems, traffic management, energy management, education, environment monitoring, smart homes and smart cities.

Field Applications:

Unity Board is the perfect platform that brings both Professionals and Students (Industry and Academia) together; a made-in-Nigeria IoT (internet of things) fully featured Development Board & Educational Kit bringing internet of things at your fingertips with the possibility of talking to the cloud, creating great opportunities to assimilate smart technologies, design the next big thing and solve unique problems.

UNITY BOARD - IoT/AI Steam Education Kit

It is maker friendly and fully compatible with Arduino and peripheral modules making it programmable via Arduino IDE and compatible with all the example codes and libraries for Arduino. It is also compatible with Graphical Programming Environment such as XOD, ArduBlock, Scratch for Arduino (S4A), Minibloq, Modkit, Visuino, Embrio, GraspIO etc

Unity Board, an end-to-end platform helps IoT developers avoid tunnel vision and its consequences by providing a comprehensive set of hardware and software components that easily combine into complete IoT applications, providing developers with a head start on their custom designs.

IoT applications bring a particularly tight convergence between hardware and software components, requiring developers to account for myriad details in each domain; Unity Board creates a single platform designed to facilitate that convergence through an ecosystem that provides a unified platform of components and services designed to address the entire IoT application hierarchy.

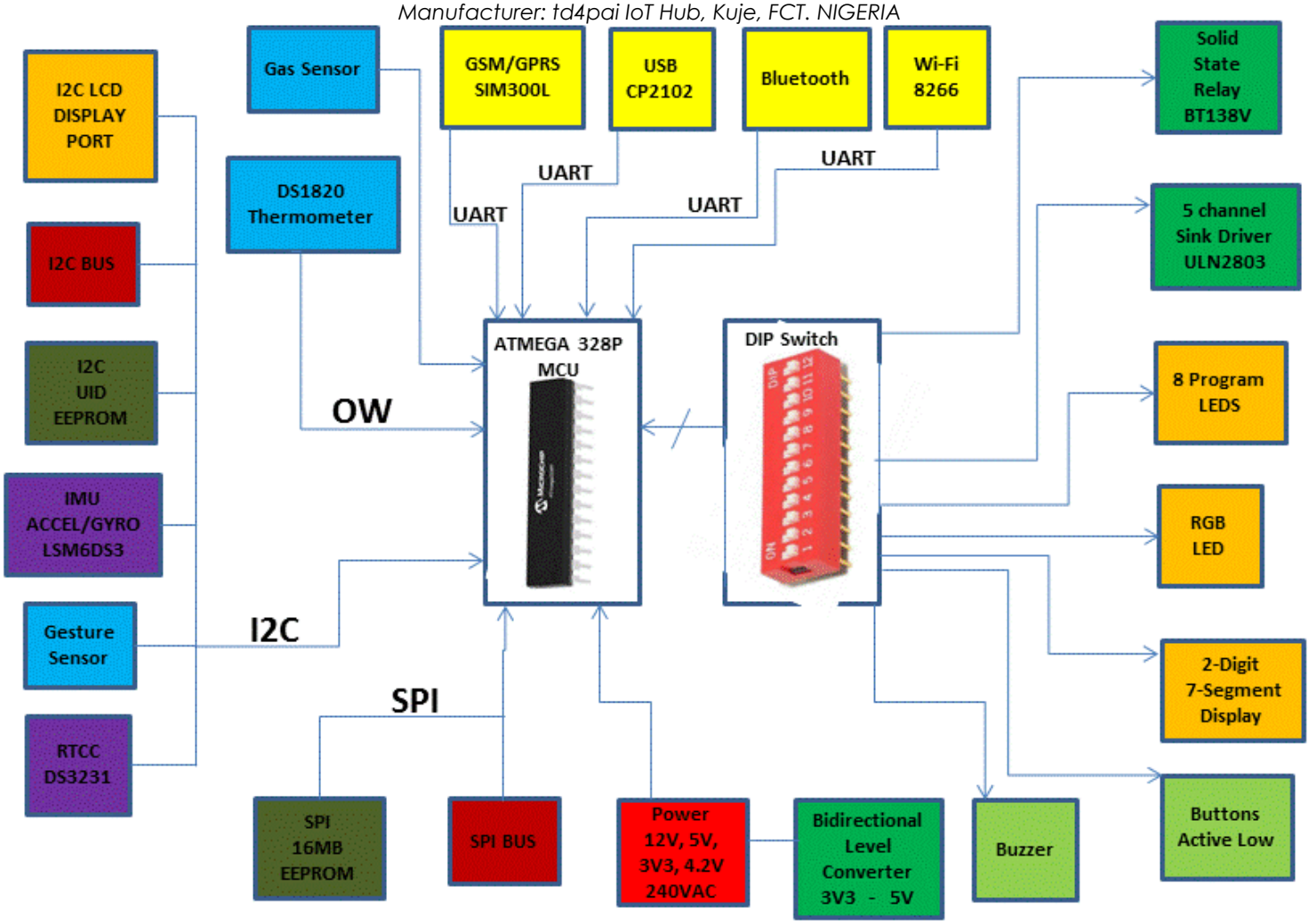
At the lowest layers of the IoT hierarchy, hardware modules support high-performance data acquisition and signal processing while providing multiple wireless connectivity options.

Unity Board reduces bread-boarding and adopts a modular and scalable architecture that addresses challenges facing the IoT adoption, adaptation and deployment in Africa; in diverse areas such as:

1. Government 2. Healthcare 3. Fleet management and telematics
4. Security 5. Utilities & Service Providers 6. eAgric etc

BLOCK DIAGRAM OF UNITY BOARD

Manufacturer: td4pai IoT Hub, Kuje, FCT. NIGERIA



Specifications and Features of Unity Board

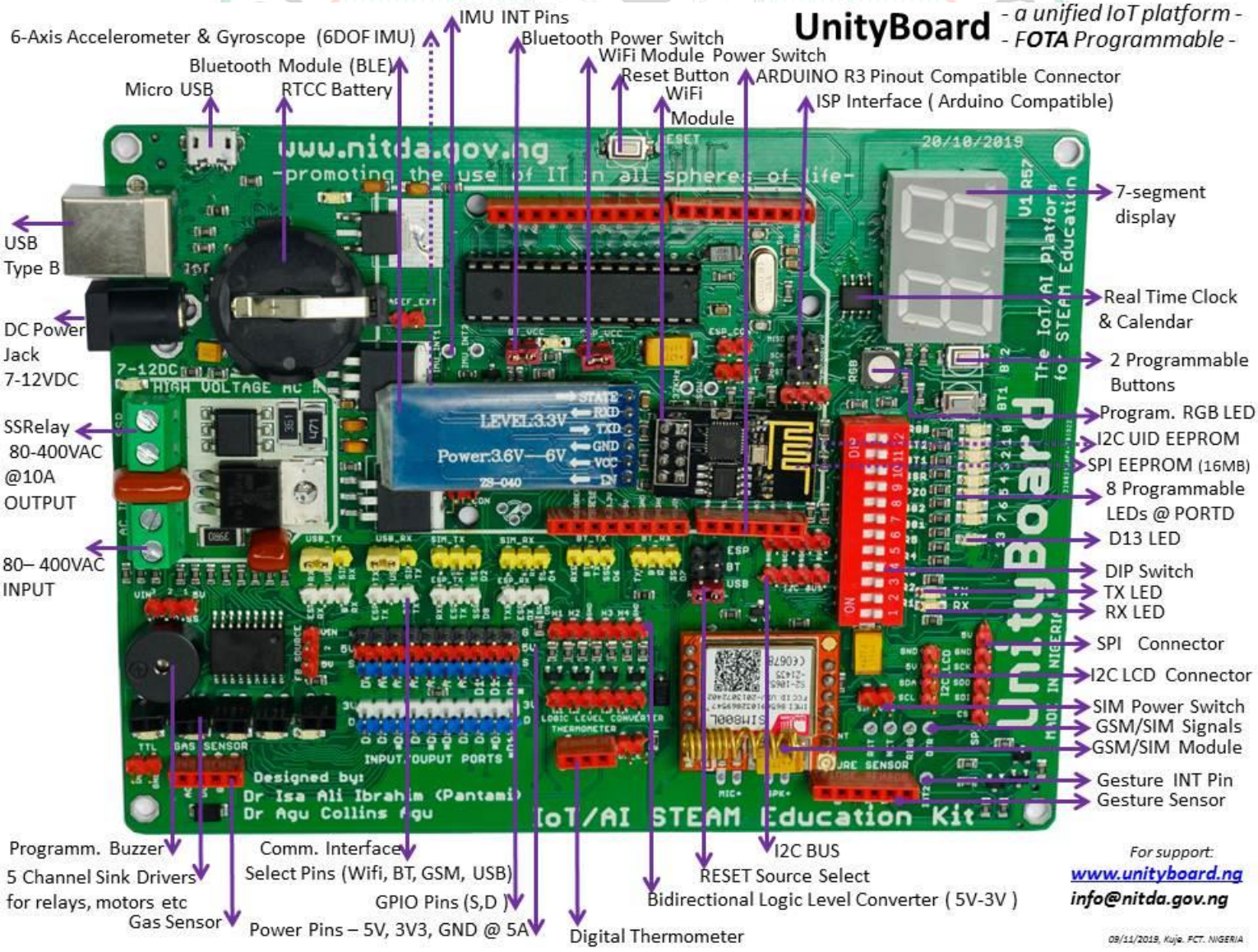
PCB layers:	2
Dimensions:	150mm x 113mm x 1.6mm
Copper Weight:	1 oz
Material Details:	FR4-Standard Tg 130-140C
Surface Finish:	HASL
PCB Colour:	Green
Flying Probe Test:	Fully Tested
PCBA (mix):	SMT & THT

1. Microcontroller:	ATmega328P
Operating Voltage:	5V
Input Voltage:	7-12V
Digital I/O Pins:	14
PWM Digital I/O Pins:	6
Analog Input Pins:	6
DC Current per I/O Pin:	20 mA
DC Current for 3.3V Pin:	3A
DC Current for 5V Pin:	3A
Flash Memory:	32 KB (ATmega328P)
SRAM:	2 KB (ATmega328P)
EEPROM:	1 KB (ATmega328P)
Clock Speed:	16 MHz

2. 2Mbit EEPROM (OFF-CHIP MEMORY COULD BE USED AS ANTI-COUNTERFEIT MEASURE TO PROTECT THE BOARD)
3. 128MBit SPI Serial EEPROM – Can store 32 000 fingerprints
4. Real-time Clock & Calendar (RTCC) with backup battery holder
5. 6-DOF Inertia measurement Unit (IMU)
6. OTA capability
7. Arduino compatible pins (R3 Shield Compatible)
8. integrated GSM/GPRS Module;
9. integrated Wi-Fi (ESP8266);
10. integrated Bluetooth LE
11. I2C Bus connector;
12. USB Type B Port
13. Micro USB Port
14. Programmable Piezo Buzzer;
15. Programmable RGB LEDs;
16. Gas Sensor Port (MQ Series)
17. Thermometer Port (One Wire)
18. ICSP PORT
19. RX/TX Debugging Pins from CP2102
20. 2 Programmable Push Buttons (Active Low).
21. Input Voltages: 7-12VDC (via BARREL POWER INPUT); 110-400V AC ; 5VDC via USB;
22. Output Voltages: 5VDC; 3VDC; 7~ 12VDC, 110-400V AC
23. 2 Solid State Relays with Opto-coupler & Snubber (4KW@380VAC)
24. 5-Channel Relay and Motor (Sink) Driver (1A@50V)
25. Programmable 8 LEDs
26. I2C LCD Display Port

27. 2-Digit 7-Segment Display
28. Microphone Port
29. Speaker Port
30. SPI
31. UART
32. 4-Port Logic Level Converter
33. 2 IMU Interrupt Pins
34. DIP Switch for function select
35. Gesture Sensor Port

BOARD LAYOUT



COMPETITIVE MATRIX

	FEATURES	UnityBoard		Libelium WASPMOTE	FlyportPRO	Ublox C027	ARDUIN YUN	Pi
1	Microcontroller	Atmel ATmega328P @16MHz		ATmega1281	PIC 24FJ256GB206	ARM Cortex M3	ATmega32u4	BROADCOM SoC
2	SPI EEPROM 32MB	YES		TBD	TBD	TBD	NO	NO
3	I2C UID EEPROM	YES		YES	YES	YES	NO	NO
4	Realtime Clock & Calendar (RTCC)	YES		YES	YES	NO	NO	NO
5	6-Axis Accelerometer & Gyroscope 6-DOF Inertia measurement Unit (IMU)	YES		NO	NO	NO	NO	NO
6	Bi-directional 3V3 to 5V Logic Level Converter	YES		NO	NO	NO	NO	NO
7	Arduino Compatible pins (R3 Shield Compatible)	YES		NO	NO	YES	YES	NO
8	integrated GSM/GPRS Module;	YES		NO	NO	YES	NO	NO
9	integrated WiFi (ESP8266);	YES		NO	YES	YES	NO	YES
10	integrated BlueTooth LE	YES		NO	NO	NO	NO	NO
11	I2C Bus;	YES		NO	NO	NO	NO	NO
12	USB Type B Connector	YES		NO	NO	NO	YES	NO
13	Programmable Buzzer;	YES		NO	NO	NO	NO	NO
14	Programmable RGB LED;	YES		NO	NO	NO	NO	NO
15	Programmable 8x LEDs	YES		NO	NO	NO	NO	NO
16	I2C LCD Display CONNECTOR	YES		NO	NO	NO	NO	NO
17	Programmable 2-Digit 7-Segment Display	YES		NO	NO	NO	NO	NO
18	Microphone input;	YES		NO	NO	NO	NO	NO
19	Speaker output;	YES		NO	NO	NO	NO	NO
20	2 Programmable Push Buttons (Active Low).	YES		NO	NO	NO	NO	NO
21	INPUT VOLTAGES: 12V DC (via BARREL POWER INPUT); 80-400V AC	YES		NO	NO	NO	NO	NO
22	Output Voltages: ~ 12V, 110-400V AC	YES		NO	NO	NO	NO	NO

23	**Gas Sensor Connector**	**YES**		NO	NO	NO	NO	NO
24	**Digital Thermometrer connector**	**YES**		NO	NO	NO	NO	NO
25	**Gesture Sensor Connector**	**YES**		NO	NO	NO	NO	NO
26	**1 Solid State Relays with Opto-coupler & Snubber (4KW@380VAC)**	**YES**		NO	NO	NO	NO	NO
27	**Driver for Soft Relay (7KW@380VAC)**	**YES**		NO	NO	NO	NO	NO
28	**5-Channel Relay and Motor (Sink) Driver**	**YES**		NO	NO	NO	NO	NO
29	**DIP Switches for activating/de-activating on-board peripherals.**	**YES**		NO	NO	NO	NO	NO
30	**Micro USB Connector**	**YES**		YES	TBD	TBD	TBD	YES
31	SPI Pinout	**YES**		YES	YES	YES	YES	YES
32	UART	**YES**		YES	YES	YES	YES	YES

UNITY BOARD PERIPHERAL MAPPING

S/N	Peripherals/Functions	ARDUINO Equivalent Pins	Comm. Protocol	DIP Switch Position	Jumper Position	Remarks
1	Realtime Clock & Calendar (DS3231)	SDA = A4 ; SCL = A5	I2C	NONE	NONE	Device Address:
2	Serial Memory (24AA256UID)	SDA = A4 ; SCL = A5	I2C	NONE	NONE	Device Address:
3	16MB MEMORY (MX25L12845GM2I-08G)	D8 (CS); D11 (MOSI); D12(MISO); D13 (SCK)	SPI	NONE	WP = OPEN	
4	IMU _ Accelerometer & Gyroscope (LSM6DS3)	SDA = A4 ; SCL = A5	I2C	NONE	NONE	Device Address:
5	Gesture Sensor (APDS-9960) The APDS-9960 is a multipurpose sensor that can be used for Ambient Light, RGB Sensing, Proximity Sensing, and Gesture Detection	SDA = A4 ; SCL = A5	I2C	NONE	NONE	Device Address:

6	Thermometer (DS1820)	D9	OW	NONE	DS_EN= Closed	Device Address:
7	Gas Sensor (MQ series)	A1	Analog	NONE	TTL=OPEN	Device Address:
8	Buttons (BT1) Active Low	D2	Digital	DIP.10=ON	None	None
9	Buttons (BT2) Active Low	D3	Digital	DIP.11=ON	None	None
10	Buzzer (Passive)	D5	Digital	DIP.8=ON	PIEZO_SS = Middle & 5V Pins CLOSED ; FB_SOURCE = Middle & 5V Pins CLOSED	None
11	RGB LED	RED = D9 ; GREEN = D10 ; BLUE = D11	Digital (PWM)	DIP.12=ON		
12	8 LEDs	LED0 =D0; LED1 = D1; LED2 = D2; LED3 = D3; LED4 = D4; LED5 = D5; LED6 =D6; LED7 = D7	Digital	DIP.12=ON		
13	2-Digit 7-Segment Display (Segment 1)	G = D0; F = D1; E = D2; D = D3; C = D4; B = D5; A = D6; DP = D8 ; Seg1 = A2	Digital	DIP.6=ON		
14	2-Digit 7-Segment Display (Segment 2)	G = D0; F = D1; E = D2; D = D3; C = D4; B = D5; A = D6; DP = D8 ; Seg2 = A3	Digital	DIP.7=ON		
15	Solid State Relay-BT138V (240VAC)	A0	Digital (PWM)	DIP.9=ON		
16	Sink Drivers (ULN2803)	R1=D6; R2=D9; R3=D10; R4=D11; R5=A1	Digital	R1=DIP.1=ON ; R2=DIP.2=ON; R3=DIP.3=ON; R4=DIP.4=ON; R5=DIP.5=ON		
17	WiFi (ESP8266)	Connections to the MCU Software Serial Receive (SSR D8) = D8 ; Software Serial Transmit (SST D5) = D5	UART (9600)		ESP_TX = ESP_TX & SSR D8=CLOSED : ESP_RX = ESP_RX & SST D5=CLOSED ; ESP_VCC=CLOSED	DIP Switch =ALL OFF

18	Bluetooth	Connections to the MCU Software Serial Receive (SSR D6) = D6 ; Software Serial Transmit (SST D7) = D7	UART (115200)		BT_TX = BT_TX & SSR D86=CLOSED : BT_RX = BT_RX & SST D7=CLOSED ; BT_VCC=CLOSED	DIP Switch =ALL OFF
19	GSM/GPRS	Connections to the MCU Software Serial Receive (SSR D2) = D2 ; Software Serial Transmit (SST D4) = D4	UART (9600)		SIM_TX = SIM_TX & SSR D2 Pins=CLOSED : SIM_RX = SIM_RX & SST D4 Pins=CLOSED ; VCC_SIM=CLOSED	DIP Switch =ALL OFF
20	Programming using the USB interface		UART (115200)		USB_TX=RXD & USB Pins = CLOSED : USB_RX=TXD & USB Pins=CLOSED : RST_SEL= USB Pins=CLOSED	DIP Switch =ALL OFF
21	OTA Programming via BLE		UART (115200)		BT_TX=RXD & BT_TX Pins = CLOSED : BT_RX=TXD & BT_RX Pins=CLOSED : RST_SEL= BT Pins=CLOSED	DIP Switch =ALL OFF

AWARDS/ENDORSEMENTS

Endorsement and Award of Honour to NITDA by Federal Ministry of Education. The National Information Technology Development Agency (NITDA) won the Education Technology Development Agency of 2020 award for developing the Unity Board, an Indigenous Education Technology Platform for STEAM Education at EdTech Summit organised by the Federal Ministry of Education in collaboration with AFRITEX on March, 2020 at the International Conference Centre in Abuja. Nigeria.