Maratha Vidya Prasarak Samaj's
Karmaveer Adv. Baburao Ganapatrao Thakare College Of Engineering
Nashik-13.
KBTCOE

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGG.

Departmental TeChronicle **Month: -February 2023**

Vol. - 04, Issue – 4

Department Vision:-

To be recognized as an excellent department offering competent technical education to create competent electronics & telecommunication engineers for the benefit of the common masses.

Department Mission:-

Committed to serve the needs of society through innovative teaching learning processes, promoting industry-institute interaction to provide competent and cultured electronics and telecommunication engineers.

Program Educational Objectives:-

1. *To impart state of art technical education in the Electronics & Telecommunication Engineering.*
2. *To promote society beneficial projects and activities.*
3. *To develop soft skill, team work, professional ethics and multidisciplinary approach for the carrier enhancement.*
4. *To bridge the gap between Industry-Institute through collaboration with Industries, Institutions and Universities.*
5. *To provide suitable infrastructure and facilities in tuned with advancing technological evaluation.*

Greeting,

Department of Electronics and Telecommunication is celebrating national science day by unveiling technical newsletter "TeChronicle" VOL-4, ISSUE-4 on 28th February 2023.

The day is observed every year to commemorate the discovery of the 'Raman Effect' by Sir C.V. Raman on 28th February 1928. He was awarded the Nobel Prize in Physics; 1930 for the same.

INTEL QUARK MICROCONTROLLER: X86 RIGHT FOR IOT

[Mr. V. R. Sonawane, Dept. of E & TC]

It seems that every semiconductor company has a microcontroller solution for the Internet of Things (IoT) today. We are seeing specs for low power, high performance, and high integration microcontrollers from the usual core suppliers.

Intel's new IoT microcontroller product line is the Intel Quark microcontroller family, and it emulates the small yet highly powerful subatomic particle it is named after. With the Intel Quark microcontroller, Intel has rolled out its groundbreaking 32-bit i486 architecture – that's right, the same CPU architecture used to run desktop PCs is now powering little embedded IoT applications.

The x86-based Intel Quark microcontroller D2000

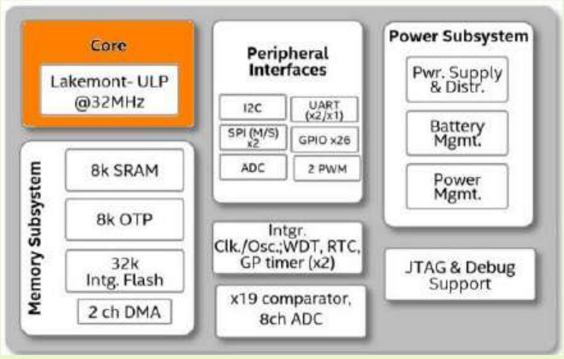


Figure 1: Intel Quark Microcontroller D2000 Block Diagram (Source: Intel)

The latest Intel Quark brand in the product line is the Intel Quark microcontroller D2000. It starts with a single-threaded i486 register-based core, then adds the six Intel Pentium™ optimization instructions, resulting in a 32-bit Pentium-compatible instruction set architecture (ISA) without the SIMD or x87 floating point support. The Pentium instruction set actually has some surprising features that make it applicable to embedded code, such as a single-cycle 32×32 multiply as well as some bit test instructions. There are also some unusually complex logic instructions such as a "*Bit-wise Logical AND and NOT*".

The instruction set has a flexible opcode size, some instructions are 32-bits long, while stack instructions need just a single byte. This flexibility helps compilers generate more compact code.

The Pentium's mature ecosystem by choosing a Pentium-compatible instruction set, Intel has made the Intel Quark processor core compatible with the large number of Pentium compilers out there, giving it additional optimizations from a code development ecosystem even more mature than ARM. This also allows access to a vast library of Pentium-ISA compatible code which can be easily ported to the Intel Quark microcontroller. Thread-X and Zephyr are two popular small footprint x86 RTOS packages that can fit easily in the Intel Quark microcontroller. There are a number of legacy RTOSs available that were tested, verified, and made solid 30 years ago that can run flawlessly.

The Intel Quark processor core includes memory block protection, an internal AHB bus interface, a JTAG port, a wakeup controller, and an interrupt control unit (ICU).

When looking at the low power figures of the Intel Quark microcontroller D2000, the numbers are surprising. Running the device at 32MHz at 3.3V, the draw is only 8mA. This results in a 32-bit Pentium-ISA core with the power draw of some 8-bit microcontrollers. HALT current, with only the core and the Real Time Clock (RTC) running, results in a current draw of just 697nA. These are impressively low numbers for what is, let me remind you again, an Intel 32-bit embedded Pentium microcontroller.

For edge computing where the Intel Quark brand D2000 is powering a small sensor node, these power figures can result in almost two years of battery life off a 9V lithium battery.

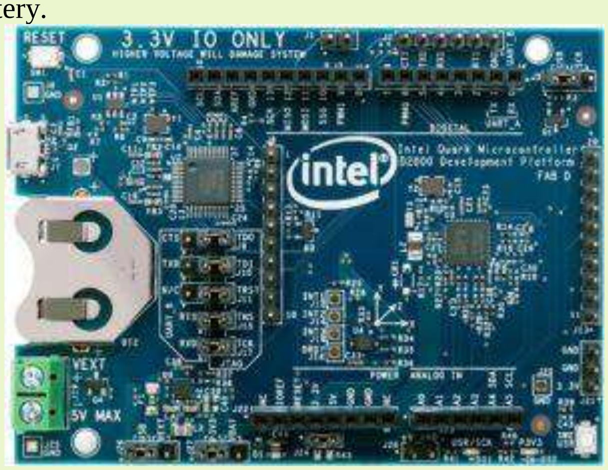


Figure 2: Intel Quark brand D2000 Developer Board with Arduino Headers (source: Intel)

It is tied to 32KBytes of Flash program memory and 8KBytes of SRAM. An additional 8KBytes of Flash, divided into two 4KB banks, is available for data storage. It can be treated like EPROM; alternately, it can be set to be one-time programmable (OTP) in one or both 4KB banks. For fault-tolerant IoT applications this allows for local storage of critical sensor data if, for example, the Intel Quark microcontroller determines that the wireless connection to the sensor hub has been lost and data needs to be saved locally.

The Intel Quark microcontroller D2000 sports the usual range of communication peripherals which includes a real-time clock (RTC), two 16550-compatible 2Mbaud UARTs, a master/slave I2C, and two SPIs. The analog to digital converter (ADC) on the Intel Quark microcontroller D2000 has 19 channels and can be configured to convert 12, 10, 8, or 6-bits, with speeds from 3.3Msps (6-bits) to 2.4Msps (12-bits). This is quick enough to grab plenty of atmospheric sensor data in a fast-changing environment.

The Intel Quark brand D2000 Development Board (figure 2) provides a wide variety of powerful features in a cost-effective environment. It includes a 6-axis accelerometer with 12-bit resolution, a 3-axis geomagnetic sensor, and a temperature sensor. It includes connectors for Arduino Uno-compatible shields for expanded functionality, and has a battery holder for a CR2032 coin cell capable of powering the board in low-power event driven applications for a couple of months. Application code for the Intel Quark microcontroller family is built using the Intel System Studio for Microcontrollers (Figure 3). With this code development package, developers can quickly build IoT sensor node applications including remote positional sensing, free fall detection, tilt-compensated compass, or dead reckoning applications.

The Intel Quark MCU SE – taking intelligent sensor nodes to the next level. The new Pattern Matching Recognition Engine in the Intel Quark microcontroller SE provides machine identification of previously learned digital objects. The engine is composed of a network of parallel arithmetic units, called Neurons, which perform two types of pattern recognition. The first is called K-nearest neighbor (KNN) and the second is call radial basis function (RBF). Both allow the Intel Quark microcontroller to do some pretty impressive edge processing by performing simple pattern detection on sensor data. Upon processing a pattern, the engine returns one of three states: identification, uncertain, or unknown. Up to 32,768 identification categories can be programmed.

The pattern matching engine features 128 arithmetic units operating in parallel. In this configuration, each arithmetic unit is referred to as a neuron. The recognition time is constant, providing the added advantage in embedded systems applications of making the engine deterministic.

While this pattern matching engine can seem complicated at first glance, in reality, it supports four main operations:

1. Load a vector knowledge base to the engine
2. Read the vector knowledge base from the engine
3. Load a pattern to be recognized into the engine
4. Read the results of pattern recognition from the engine

Now, if the Pattern Matching Engine is tied into the Sensor Subsystem, the Sensor Subsystem can pass a

series of vectors representing, for example, vibration, temperature, current, and audio data, to the Pattern Matching Engine which can match it against a stored dataset. If the dataset finds a hit of a pattern it has been looking for, it can trigger a wakeup event to the main x86 processor. The x86 can then make a decision to, for example, turn a switch on or off, or send an alert of the match to the main sensor hub.
This level of processing in an inexpensive chip is uncommon in microcontrollers found today, and adds significant cost-effective value to simple IoT sensor nodes. Complex processing that would normally be sent wirelessly from the node to the main sensor hub or a cloud server can be performed locally at the sensor node itself. This not only saves processing power at the sensor hub, but it also saves the node's battery power. In an IoT node, the power draw of the node must be worth the value of the data. The more processing that can be performed at the node level, the less data needs to be transmitted wirelessly, saving power.

Conclusion

Intel has taken a big step by re-introducing their familiar x86 32-bit Pentium architecture into the microcontroller arena, but this makes sense in the IoT application field. The x86 Pentium architecture leverages a development ecosystem of compilers, debuggers, and evaluation tools that spans 30 years. While the Intel Quark microcontroller D2000 introduces an entry-level 32-bit microcontroller architecture into the marketplace, the Intel Quark microcontroller SE brings new intelligence into small cost-effective nodes, rivaling existing solutions and introducing a new era of innovation in the Internet of Things.

BEAGLE BOARD

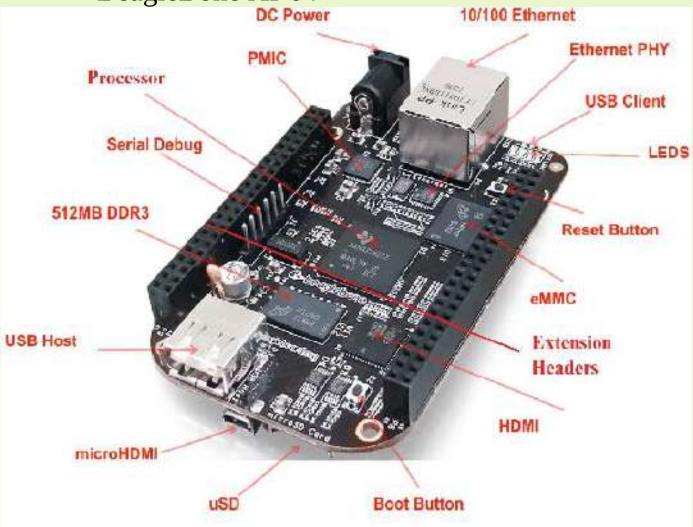
[Ms. T.S.Deshmukh - Asst.Professor]

The BeagleBoard is a low-power open-source single-board computer produced by Texas Instruments in association with Digi-Key and Newark element. The BeagleBoard was also designed with open-source software development in mind, and as a way of demonstrating the Texas Instrument's OMAP3530 system-on-a-chip. The board was developed by a small team of engineers as an educational board that could be used in colleges around the world to teach open-source hardware and software capabilities. It is also sold to the public under the Creative Commons share-alike license. The board was designed using Cadence OrCAD for schematics and Cadence Allegro for PCB manufacturing; no simulation software was used.

Features: The BeagleBoard measures approximately 75 by 75 mm and has all the functionality of a basic computer. The OMAP3530 includes an ARM Cortex-A8 CPU (which can run Linux, Minix, FreeBSD, OpenBSD, RISC OS, or Symbian; a number of unofficial Android ports exist), a TMS320C64x+ DSP for accelerated video and audio decoding, and an Imagination Technologies PowerVR SGX530 GPU to provide accelerated 2D and 3D rendering that supports OpenGL ES 2.0. Video out is provided through separate S Video and HDMI connections. A single SD/MMC card slot supporting SDIO, a USB On-The-Go port, an RS-232 serial connection, a JTAG connection, and two stereo 3.5 mm jacks for audio in/out are provided.
Built-in storage and memory are provided through a PoP chip that includes 256 MB of NAND flash memory and 256 MB of RAM (128 MB on earlier models). The board uses up to 2 W of power and can be powered from the USB connector, or a separate 5 V power supply.

Variants of BeagleBoard:

- Rev. C4 specifications.
- BeagleBoard-xM.
- BeagleBone.
- BeagleBone Black.
- BeagleBoard-X15.
- PocketBeagle.
- BeagleBone AI-64



The most powerful AI platform available is BeagleBone AI-64, is built on a proven open-source Linux approach, bringing a massive amount of computing power in an easy-to-use single board computer. BeagleBone AI-64 brings a complete AI and Machine Learning System to developers with the convenience and expandability of the BeagleBone platform and the peripherals on board

Beagle Boards support for a wide range of programming languages such as java, python, C, C++, remote control access, availability of ethernet port and networking services like FTP, TELNET, SSH are some of the prominent features of BeagleBone Boards and hence they can be used for a vast range of applications. Depending on the board selected, they can be used in diverse areas like IoT devices, Robotics, Drones, Linux and Cloud Computing Servers etc.

References:

BBB GPIO interactive map – An interactive map of the GPIO of the BeagleBone Black
tinkernow.com – DIY website largely based on BeagleBone, resources for setup, operating, and projects.
https://www.beagleboard.org/

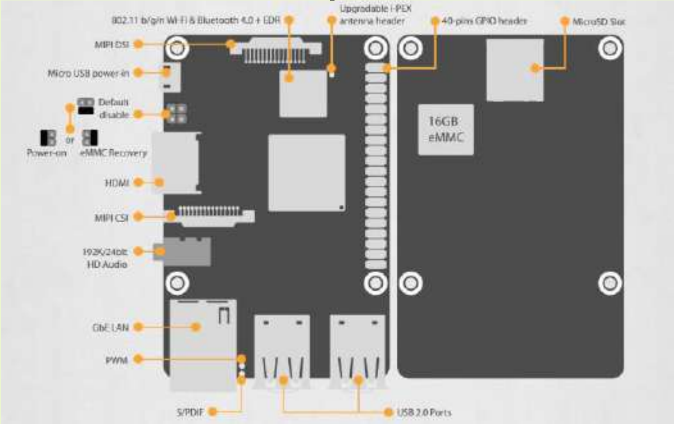
https://www.educba.com/

ASUS TINKER BOARDS

[Sneha Chaudhari – T.E. E&TC]

The ASUS Tinker Board is a single-board computer launched by ASUS in early 2017. Its physical size and GPIO pinout are designed to be compatible with the second and third-generation Raspberry Pi models. The first released board features 4K video, 2GB of onboard RAM, gigabit Ethernet and a Rock chip RK3288 processor running at 1.8 GHz.

The new and improved Tinker Board S is a single board computer (SBC) that offers greater durability, better stability and an overall improved user experience for DIY enthusiasts and makers everywhere.



Best User Experience: -

HDMI-CEC-ready for complete video entertainment, allowing users to command both Tinker Board S and a TV with a single remote control.

Audio jack plug-in detection and auto-switch to 3.5mm audio jack from other interfaces.

ASUS's intent to release a single-board computer was leaked shortly after CES 2017 on SlideShare. ASUS originally planned for a late February 2017 release, but a UK vendor broke the embargo and began advertising and selling boards starting on 13 February 2017, before ASUS's marketing department was ready.

Features: -

•With its powerful and modern quad-core ARM-based processor the Rockchip RK3288, Tinker Board offers significantly improved performance versus other popular SBC boards.

•Featuring a powerful but energy-efficient design, Tinker Board supports next-generation graphics and GPU computing API's. Powered by an ARM-based Mali-T764 GPU, Tinker Board's GPU and fixed-function processors allow for a wide range of uses, including high-quality media playback, gaming, computer vision, gesture recognition, image stabilization and processing, as well as computational photography and more.

•Further improving on key areas found lacking on many SBC boards, Tinker Board is equipped with an HD codec that supports up to 24-bit/192kHz audio.

•Tinker Board features standard maker connectivity options, including a 40-pin GPIO interface that allow for interfacing with a range input from buttons, switches, sensors, LEDs, and much more.

•Tinker Board also features a full-size HDMI output. Additionally, it includes four USB 2.0 ports for extensive peripheral and accessory connectivity.

•Careful consideration went into the design and development of the Tinker Board to ensure that it provides a superior user experience for first-time builders or for seasoned hobbyists. Builders will appreciate the color-coded GPIO header, which makes it easy to recognize respective pin headers.

Applications: -

•A Debian-based distribution ensures a smooth and functional experience, directly out of the box. Whether it's browsing the web, watching videos, or writing scripts, TinkerOS is a great starting point for your next project or build.

•Furthermore, TinkerOS has been carefully designed to be extremely lightweight and responsive.

•TinkerOS also includes a number of popular applications allowing for easy programming and development. These include IDLE / Python as well as Squeak / Scratch.

•Beyond TinkerOS and its Debian Linux offering Tinker Board also support the Android Operating system. This allows for an entirely different usage scenarios ranging from media playback, gaming, and much more.

•Tinker board is also working closely with a wide range of popular applications to enable support & optimize functionality.

Reference:

https://tinker-board.asus.com/product/tinker-board.html