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PI TOP: HARDWARE-ENABLED SUPERCOMPUTER

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Abstract - *According to the most recent research, we discovered that teachers who are proficient in using digital tools could help students develop higher-order thinking skills, give them unique and creative ways to express what they have learned, and better prepare them to deal with ongoing technological change in both the real world and the workplace. India needs cost-effective and cutting-edge educational equipment to support this revolution in education. An essential part of STEM education is technology. We created affordable educational laptops for teachers, students, and schools. This laptop is user-friendly and has strong connectivity and processing power. The physical computing feature will improve the young students' programming abilities and creativity.*

Key Words*: *Raspberry Pi, Laptop, Operating Systems, Supercomputer, Affordable, Programming.

1. INTRODUCTION

Information technology is a rapidly evolving field that frequently offers the public new solutions. To communicate, distribute, create, store, and organize information, schools use a variety of ICT tools. The use of smartphones and tablets or tablet computers for having to learn during lectures, as well as the "flipped classroom" model, where pupils watch live and documented lectures at home on the smart device and use class time for more interactive activities, are some examples of how ICT has sometimes become an integral part of the teaching-learning process. These methods can promote higher-order thinking skills, offer unique and personalized ways for learners to express their identities, and keep students better equipped to deal with continuing technological changes in both the globe and the workplace when instructors are digitally literate and trained to use ICT.

Devices like the Raspberry Pi are often used as examples of this phenomenon. Engineers were able to create a low-cost, hand computer with convincing technical specifications thanks to ongoing miniaturization and inexpensive components. These microcomputers can perform a wide range of tasks, from industrial applications to domestic entertainment. The Raspberry Pi Foundation raised the bar even further by questioning themselves to create a flexible tool to raise the caliber of IT instruction. This project demonstrates how a low-cost project can give educational institutions new capabilities that will enable them to give students opportunities to learn how to develop and use applications that they will come across in the future. The project's independent project-based structure turned out to be a crucial element in its successful design and execution.

The construction of large cluster computers has become affordable thanks to the availability of low-cost, high-power single-board computers like the Raspberry Pi. This paper outlines a cheap and simple method for giving students programming experience on supercomputers without using simulation or visualization methods. To help readers understand the benefits of writing programmes to make use of parallel computer architectures, a sample prime search programme created to run on a multi node cluster is provided along with run-times.

In this paper, we suggest a low-cost laptop for education that has the distinctive capability of physical computing. Raspberry Pi, a single-board computer, was used in the design of this laptop. This device is compatible with a number of programming languages, including C, C++, Python, Java, and Scratch. It offers top-notch software for performing office tasks like creating spreadsheets, word processing, and presentation preparation. It uses an open source operating system based on Linux and can be used for both educational and non-educational purposes.

2. PROBLEM STATEMENT

A new area of the digital world arises due to the current epidemic COVID- 19 which is being faced worldwide, while the world is still espousing social distance practice. System Technology takes a step ahead in order to deal with this issue where nearly all of India is working from home. scholars of seminaries/sodalities are floundering to manage with expensive tackle(Laptop/ Desktops). To overcome this challenge, I've come up with the exceptional idea of using a low- cost bias which can save millions of dollars on a laptop/ desktop.

More and more students are looking for opportunities to gain experience with emerging technologies that

personally interest them but may go beyond the intended curriculum. This essay examines a single, independent project in which a student used the parallel processing power of ten Raspberry Pi devices to build a supercomputer. The value of this paper lies in its understandings of how impartial tasks may be used for students to gain outside of the education system to increase their intellectual presence in the field, how to nurture a comprehensive community of learners for the immediate society, provide a way for learners to earn course credit without causing financial hardship for the college, and at last this specific project of building a supercomputer

Numerous people have started to use 'Raspberry Pi 4 B with Raspberry Pi OS'. This helps to connect to their online classroom, surf the internet, connect office systems to virtual machines, and has power for real multitasking and productivity.

In our opinion, the classroom can greatly benefit from the inexpensive, quick, intuitive, engaging, and long-lasting physical computing solutions available today. The raspberry pi is one of many integrated, carefully crafted physical computing devices that has the potential to firmly establish physical computing as a crucial component of contemporary computer science education. These board-level embedded devices should eventually have greater computational power, better wireless connectivity, better physical construction kit integration, and greater extensibility. They will also probably become less expensive and smaller than current products, which will make them even better suited for a range of school projects and uses like wearable technology, robotics, and gaming.

In the natural and environmental sciences, data collection is easily supported by physical computing devices. The next generation of scientists will be engaged and educated as physical computing devices—natural sources of sensor data—become more and more relevant in the rapidly developing field of data science. Finally, both students and amateurs can be given the tools they need to start a maker-to-market journey in a variety of application domains.

But there are still a lot of difficulties. Teachers and technology developers must work closely together to design an end-to-end experience that is compelling for both students and teachers. A seamless and engaging end-to-end experience depends on tight hardware and programming environment integration. Of course, it is also imperative to have high-quality curriculum, instruction, and teacher preparation.

3. LITERATURE SURVEY

Only 26.42% of Indian schools have computers, according to a government survey conducted by the Department of School Education & Literacy and National University of Educational Planning and Administration (NIEPA). In India's 36 states and union territories, 1.52 million schools were included in the report for the academic year 2014–15. Students in secondary schools have a critical need for an affordable educational laptop to learn about fundamental programming and physical computing. This gadget will give students in schools an easy way to learn programming and physical computing.

The abundance of excellent educational apps and websites that can be accessed is undoubtedly a benefit of computers being so widely used. Learning can take the form of entertaining and instructive games, movies, and lessons that will help students advance their understanding of everything from vocabulary to mathematics, typing to logical reasoning, and everything in between. Atal Tinkering Labs (ATLs) were established by the Indian government in a number of locations to offer makers and innovators cutting-edge facilities. This ATL's requirement for physical computing devices and computers in large quantities can be satisfied with a cheap and simple device.

Physical computers with computing capabilities are extremely rare. Three products that are currently on the market are similar: Pi-Top, ExpEYES (previously known as Phoenix), and BBC micro:bit. The BBC micro:bit is a practical programmable computer that includes Bluetooth, motion detection, and a built-in compass. With its built-in compass or "magnetometer," 25 LEDs, two programmable buttons, and five input/output ports, the Micro:bit can be connected to other devices or sensors. To students in the UK between the ages of 11 and 12, BBC distributed about 1 million devices. Because the BBC Micro:bit lacks a display, programming requires a computer or laptop. A cheap platform for computer-assisted science experiments is called ExpEYES. It is created by the New Delhi-based Inter-University Accelerator Center.

It has 50 experiment GUIs, 12 bit analogue input/output, digital input/output, time interval measurements, waveform generation, and test equipment functionality. The best feature of this device is that its hardware is open source, but programming it also necessitates a computer or laptop. In the end, it serves as a cheap platform for scientific experiments. A modular laptop called the Pi-top offers resources for developing creative do-it-yourself (DIY) projects and bringing inventions to life. The system's brain is a Raspberry Pi single-board computer. A quad-core Arm cortex processor running at 1.4GHz, four USB ports, 40 GPIO pins, an HDMI port, Gigabit Ethernet port, wireless LAN (Wi-Fi), and a display interface are all

included. This device costs about 27000 INR, which is a very high and nearly identical price.

For students, this is a cost-effective laptop for learning, tinkering, and conducting experiments whenever and wherever they like. They can be liberated from lab hours and, in some cases, get around the issue of individual students' need for equipment. For presentations, demonstrations, experiments, and the creation of new experiments, projects, and prototypes, teachers and educators can use their personal laptops. Engineers can pick up skills in sensor interfacing, GUI programming, physical computing, electronics, microcontroller programming, computing, and a variety of programming languages. Hobbyists can purchase a nice device to pass their time more efficiently. This tool can be used by innovators to demonstrate concepts and create original products.

Fig No. 1. ExpEYES main board

Fig No. 2. Micro:bit

The micro:bit offers an experience that is accessible to beginners but also offers a lot of headroom for more advanced usage, including as an embedded controller in class and hobby projects. The micro:bit packs a lot of functionality into a small and reasonably priced package. The Raspberry Pi is a logical next step for those looking to move beyond the Micro:bit. It's more difficult to set up but supports a wide variety of applications, making the Pi an incredibly versatile general-purpose computer. The Pi is a self-contained, Linux-based computer. There are a number of models, including the Raspberry Pi 3 Model B+ and the most recent Raspberry Pi 4.

Connecting a keyboard, mouse, monitor, SD card, and USB power supply to a Pi is the first thing to do. Raspian, the operating system for the Raspberry Pi, must be installed on the SD card. The 40-pin connector on the Pi is intended for connecting to actuators, sensors, and other physical computing devices.

By using software and hardware that can sense and react to the analogue world, physical computing is characterized as "the construction of interactive physical systems." It links together a variety of mechatronics-related tasks. Computer science, robotics, electrical engineering, and embedded development. Physical kits based on microcontrollers and the usage of computers in educational contexts is common for a long period of time for environmental research and scientific interactive art, robotics, and sensing. Electronic prototyping is particularly popular with Arduino. For customers to create interactive electronic things, it offers a software package and hardware. computers with just one board, such as the Raspberry Pi, in comparison to platforms that use microcontrollers. We interact with SBCs, additional storage is provided via the display or displays. Strong process power and capability. Memory cards are needed for SBCs that have an operating system installed, ready for use as a computer.

4. PROPOSED SYSTEM

The system's single board computer (SBC) is its core component. Memory, a processor, LAN and WiFi interfaces, and an audio/video interface make up the SBC. For storing data and loading the operating system, use a memory card and otherwise internal memory. The open source nature of Linux and the abundance of free software make it a viable option for operating systems. Graphical user interface (GUI) can be presented on a standard HDMI monitor or touch screen when used as a display device. When a display doesn't have a touch screen, a standard USB keyboard and a mouse are used as the input devices. A single board computer (SBC) offers an external peripheral interface (GPIO) to connect different sensors and electronics parts

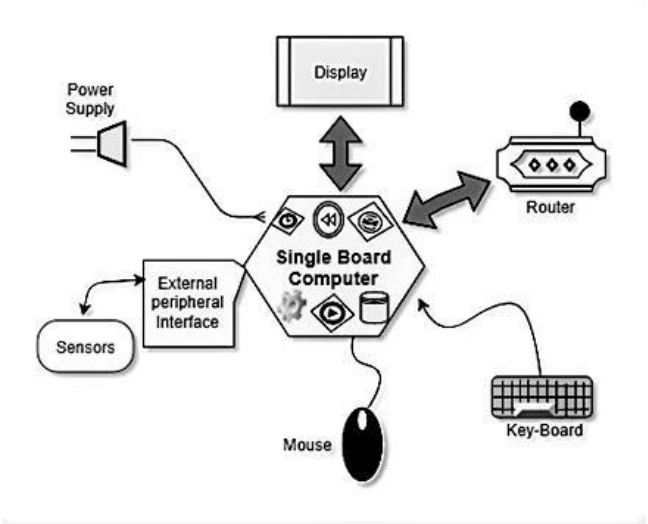

Fig No. 3. Blocked diagram of Proposed System

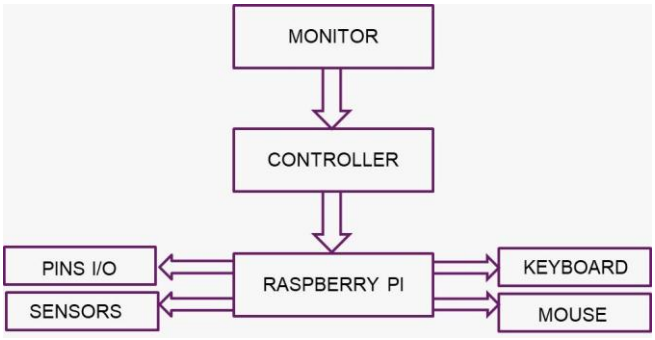

Fig No. 4. Simplified Block Diagram of the Proposed System

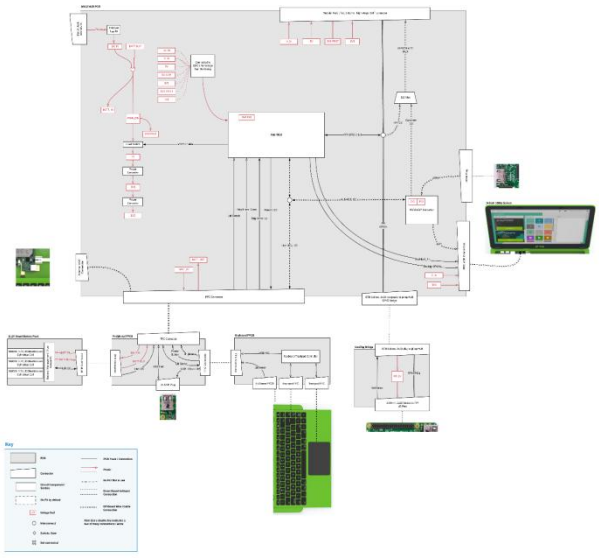

Fig No. 5. Circuit Diagram of the Proposed System

Fig No. 6. Expected Output

5. DETAILS OF DESIGN

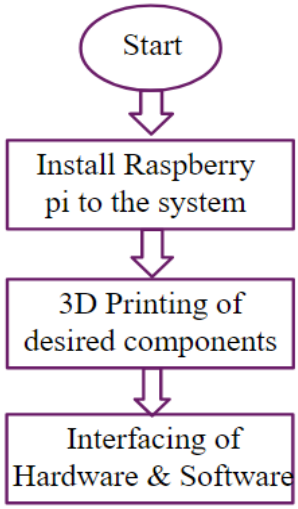

Fig No. 7. Flow Chart

6. CONCLUSIONS

"Building interactive physical systems by using software and hardware that can sense and respond to the analog world" is the definition of physical computing. Electrical engineering, mechatronics, embedded development, robotics, and computer science are all interconnected by physical computing. For years, academic institutions have made extensive use of physical computing devices and toolkits based on microcontrollers for robotics, interactive art, environmental sensing, and scientific experimentation. A well-liked platform for electronic prototyping is Arduino. It offers users hardware and software packages so they can create interactive electronic objects. Comparing single-board computers like the Raspberry Pi to such microcontroller-based platforms, there are advantages. SBCs, with their additional storage capacity and high processing power, are connected to displays or monitors. SBCs are tiny computers, so in order to function as a computer, a memory card must be loaded with the operating system.

This computer is developed to be used for educational purposes. It can be used to make word documents, spreadsheets & presentations. It can also pierce the internet and connect people to the vast amount of resources available. It can be used for learning to write codes, developing software, building circuits, developing projects, etc. Its main advantage is its portability and affordability. It has a manufacturing cost so low, that it is a lot cheaper than most computers. Therefore, a greater number of people can afford them. Raspberry Pi's performance is compared with some of the more popular boards and development platforms across the board by size, computing power and overall costs of the software solutions. Based on performed analysis, it can be articulated that Udoo, has the best performances among all of the considered IoT hardware platforms, but at the same time its price is relatively high. On the other hand, A detailed analysis on the Raspberry Pi has shown that it's the perfect platform for a PC in the area of sensor network. That is why it makes Raspberry Pi the perfect platform for interfacing with a wide assortment of external peripherals and is used in a broad scope of implementations.

Communications and Information Technology can affect how well students learn. According to the most recent research, we discovered that teachers who are proficient in using digital tools can help students develop higher order thinking skills, give them unique and creative ways to express what they have learned, and better prepare them to deal with ongoing technological change in both the real world and the workplace. India needs cost-effective and cutting-edge educational equipment to support this revolution in education. An important part of STEM education is technology. We created affordable educational laptops for teachers, students, and schools. This laptop is user-friendly and has strong connectivity and processing power. The physical computing feature will improve the young students' programming abilities and creativity.

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