DESIGN AND CONSTRUCTION OF
A LOW-COST LAPTOP
USING
RASPBERRY PI-4

DEPARTMENT OF MECHANICAL ENGINEERING

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DECLARATION

We hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of Md. Mainol Hasan, Lecturer Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thereof has been or is being submitted elsewhere for the award of any degree.

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APPROVAL

This is to certify that the project on **"Design And Construction Of A Low-Cost Laptop"** Using Raspberry Pi by Mahmudur Rahman-Student Id: BME 1602009127, Delower Hasan Babu-Student Id: BME 1602009133, Md. Masud Parvez-Student Id: BME 1602009120, Md.Millat Hossain-Student Id: BME 1602009123 has been carried out under our supervisor. The project has been carried out in partial fulfillment of the requirement for the degree of Bachelor of Science (BSc) in Mechanical Engineering of the year 2019 and has been approved as to its style and contents.

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<u>ABSTRACT</u>

A laptop computer, commonly shortened to a Desktop computer, is a mobile device, typically with a mobile operating system and touchscreen display processing circuitry, and a rechargeable battery , thin and flat package. Tablets, being computers, do what other personal computers do, but lack some input/output abilities that others have. Modern tablets largely resemble modern smartphones, the only differences being that tablets are relatively larger than smartphones.

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1.1   INTRODUCTION

A laptop or tablet computer is a portable version of computer. Laptop computer improve the user experience for certain tasks such as browsing the web, email, and playing games. Because of their mobility, ease of use, and low cost compared to desktop and laptop personal computers, tablets are being used for accomplishing the same tasks as computers, with the most frequent task accomplished on tablets being email. Although the tablet's form factor eliminates the keyboard peripheral, the soft keyboard remains a necessary and frequently used component of tablet interaction.

The Laptop affords a mobile computing experience, users often hold it with both hands while sitting, standing, or walking. This interaction technique requires a very different posture than interacting with a computer workstation. The user must hold the device while their thumbs simultaneously interact with the touch keyboard. Despite the ergonomic disparity between tablet and computer workstation interaction, the default keyboard configuration on most tablet devices is similar to a computer workstation's layout, with the keyboard located at the base of the screen.

The touchscreen display is operated by gestures executed by finger or digital pen (stylus), instead of the mouse, trackpad, and keyboard of larger computers. Portable computers can be classified according to the presence and appearance of physical keyboards. Two species of tablet, the slate and booklet, do not have physical keyboards and usually accept text and other input by use of a virtual keyboard shown on their touchscreen displays. To compensate for their lack of a physical keyboard, most tablets can connect to independent physical keyboards by Bluetooth or USB; 2-in-1 PCs have keyboards, distinct from tablets.

The form of the tablet was conceptualized in the middle of the 20th century (Stanley Kubrick depicted fictional tablets in the 1968 science fiction film A Space Odyssey) and prototyped and developed in the last two decades of that century. In 2010, Apple released the iPad, the first mass-market tablet to achieve widespread popularity. There after tablets rapidly rose in ubiquity and soon became a large product category used for personal, educational and workplace applications.

1.2 Scope of the project:

Includes (list of Deliverables):

  -It has a HDMI port for uses External Device.

  -It also has 2 USB port for data connection.

  -It also has 2 extra charging port for any mobile device.

  - It Include 4GB Ram & 32 GB Internal Storage.

  - It include a touch screen monitor and have a Touch pen.

  - It Include a Bluetooth Mouse & Keyboard.

Does Not Include:

  -It hasn't used any camera option.

  - Not include any hard disc Use only SD Card.

Project Completion Criteria:

  - The Pi 4 can boot from USB, such as from a flash drive.

  - Pre-configured to operate as a headless computer.

  - Optionally be operated with any generic USB computer keyboard and mouse.

  - It may also be used with USB storage.

  - Other peripherals can be attached through the various pins and connectors on the
    surface of the Raspberry Pi-4.

Chapter -2

2.1 Background

The laptop or tablet computer and its associated operating system began with the development of pen computing. Electrical devices with data input and output on a flat information display existed as early as 1888 with the telautograph, which used a sheet of paper as display and a pen attached to electromechanical actuators. Throughout the 20th century devices with these characteristics have been imagined and created whether as blueprints, prototypes, or commercial products. In addition to many academic and research systems, several companies released commercial products in the 1980s, with various input/output types tried out.

The development of the tablet computer was enabled by several key technological advances. The rapid scaling and miniaturization of MOSFET transistor technology (Moore's law), the basic building block of mobile devices and computing devices, made it possible to build portable smart devices such as tablet computers. Another important enabling factor was the lithium-ion battery, an in dispensable energy source for tablets, commercialized by Sony and Asahi Kasei in 1991.

Chapter-3

METHODOLOGY:

3.1 Raspberry Pi:

The Raspberry Pi 4 is the new product in the Raspberry Pi series. The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards and mice) or cases. However, some accessories have been included in several official and unofficial bundles.

The organization behind the Raspberry Pi consists of two arms. The first two models were developed by the Raspberry Pi Foundation. After the Pi Model B was released, the Foundation set up Raspberry Pi Trading, with Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity to promote the teaching of basic computer science in schools and in developing countries.

Wiring Diagram
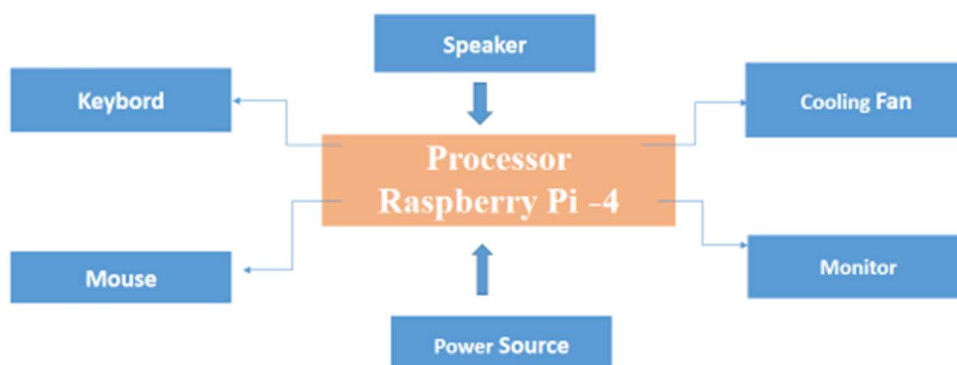
Application:

Raspberry Pi 4 can be used as a tiny, dual-display, desktop computer as well as robot brains, smart home hub, media center, networked AI core, factory controller, and much more. With Raspberry Pi 4, you can run two monitors at once at up to 4K resolution.

The speed and performance of the Raspberry Pi 4 is a step up from earlier models to provide the user a complete desktop experience. Whether you're editing documents, browsing the web with a bunch of tabs open, juggling spreadsheets or drafting a presentation, you'll find the experience smooth and very recognizable but on a smaller, more energy-efficient and much more cost-effective machine.

Raspberry Pi 4 comes with Gigabit Ethernet, along with onboard wireless networking and Bluetooth. It has upgraded USB capacity along with two USB 2 ports you'll find two USB 3 ports, which can transfer data up to ten times faster than previous models.

This is the 4GB RAM variant of Raspberry 4 Model B.
The Raspberry Pi 4 uses a Broadcom BCM2711 System on a chip with a 1.5 GHz 64-bit quad-core ARM Cortex-A72 processor, with 1MB shared L2 cache.

Specifications	Description
Processor Model	Raspberry 4 Model B(4GB)
CPU	Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
Released	24 June 2019 – Raspberry Pi 4 Model B launched
RAM	4 GB LPDDR4-3200 SDRAM
Wi-Fi IEE 802.11 wireless	b/g/n/ac dual band 2.4/5 GHz
Connectivity	2 USB 3.0 ports; 2 USB 2.0 ports. - Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards) 2-lane MIPI DSI display port 2-lane MIPI CSI camera port 4-pole stereo audio and composite video port
HDMI	2 × micro-HDMI ports (up to 4kp60 supported)
Audio/Video Outputs	4-pole stereo audio and composite video port - H.265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode) - OpenGL ES 3.0 graphics 2x HDMI (rev 2.0) via micro-HDMI, composite video (3.5 mm CTIA style TRRS jack), MIPI display interface (DSI) for raw LCD panels
On-board storage	Micro-SD card slot for loading operating system and data storage
Ethernet	10/100/1000 Mbit/s
Bluetooth	5.0
Battery	9000mah
Power	5V 3A (for full power delivery to USB devices)
Supported Operating system	FreeBSD Linux NetBSD OpenBSD Plan 9 RISC OS Windows 10 ARM64 Windows 10 IoT Core

Figure (3.1): Raspberry Pi 4

Processor

This Computer use The Raspberry Pi 4 Broadcom BCM2711 SoC with a 1.5 GHz 64-bit quad-core ARM Cortex-A72 processor, with 1MB shared L2 cache.

RAM

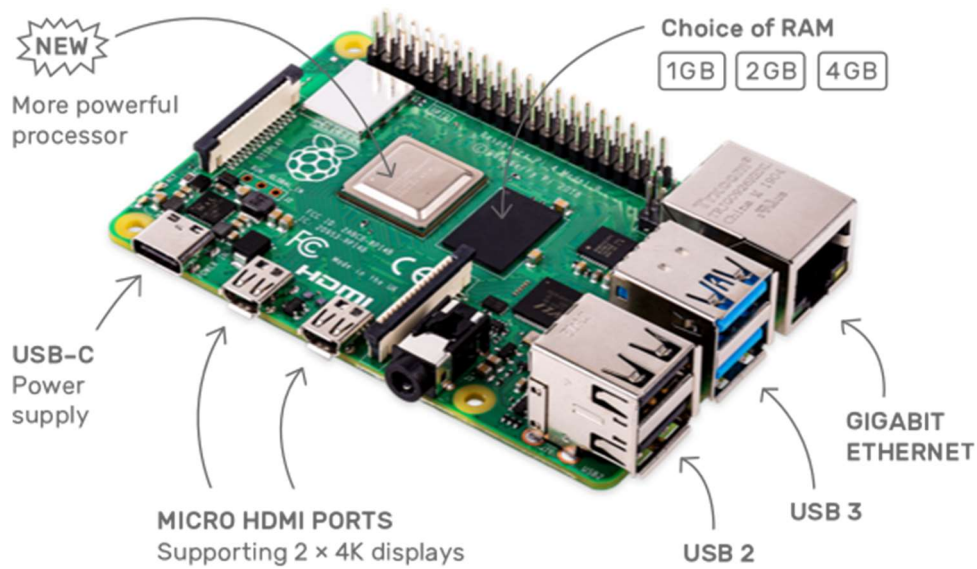The Raspberry Pi 4 has a choice of 1, 2 or 4 GB of RAM. We used 4 GB LPDDR4-3200 SD Ram in this computer.

Figure (3.2): Raspberry Pi 4 Diagram

Networking

The Raspberry Pi 4 has full gigabit Ethernet (throughput is not limited as it is not funnelled via the USB chip.) It also Support Wi-Fi & Bluetooth system

Storage

We Used 32 GB internal Storage by SD Card.

Figure (3.3): Transcend SD Card

Software

Operating system

Various operating systems for the Raspberry Pi can be installed on a MicroSD, Mini SD or SD card, depending on the board and available adapters; seen here is the MicroSD slot located on the bottom of a Raspberry Pi 4 board

We Used raspbian buster operating system.

Display

Introduction:

This 10.1-inch IPS LCD display with a resolution of 1023X600 is a great accessory for Raspberry Pi. It works with Raspberry pi 3 & 4 and requires no additional modification of the Raspbian boot image.
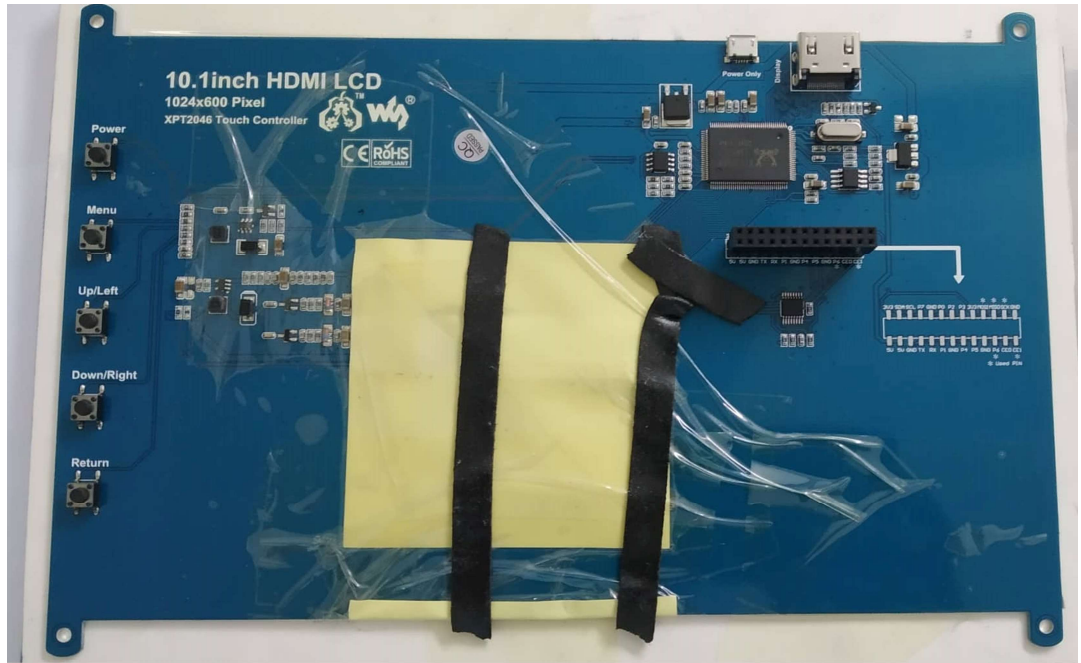

Figure (3.4): 10.1 Inch display

Figure (3.5): 10.1 Inch Display Back Panel

Figure (3.6): Monitor Touch Pen

Features:

Display Size: IPS LCD 10.1 Inch

Resolution:1024 X 600 HD resolution

Aspect Ratio: 16:9

Controlling: XPT2046 Touch controling

Panel Type: IPS

Response Time: 2ms

Brightness: 250 nits

Contrast Ratio: 400:1

User friendly OSD menu that can be controlled via controlled by a Touch Pen & finger

It also has HDMI

Video

2x HDMI (rev 2.0) via micro-HDMI, composite video (3.5 mm CTIA style TRRS jack), MIPI display interface (DSI) for raw LCD panels.

Charging & Power Supply

Charger:

This is a high-quality power adapter. It can supply up to 3 amps of current while keeping the voltage at 5V DC through its high-quality USB type reversible connector.

Figure (3.7): Raspberry Pi 4 Charger

Charging Control module

1. This product is suitable for 3.7V Li-Polymer Battery.

2. Both sides of the board marked with + and - two batteries joints, pay attention: do not the battery positive and negative reversed, otherwise it will burn out the power supply board.

Figure (3.8): Charging control module

4. Automatic sleep mode, double-click the button, lights will be lit, and then double-click will turn off lights. (And then double-click will function with SOS will start SOS, and then double-click will turn off lights)

Lithium polymer battery:

A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated as LiPo, LIP, Li-poly, lithium-poly and others), is a Rechargeable Battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte.

High conductivity semisolid (gel) polymers form this electrolyte. These batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, like mobile devices and radio-controlled aircraft.

Lithium-ion cells in pouch format are being investigated to power battery electric vehicles. While it is possible to use a large number of cells of small capacity to obtain required levels of power and energy to drive a vehicle, some manufacturers and research centres are looking into large-format lithium-ion cells of capacities exceeding 50 Ah for this purpose. With higher energy content per cell, the number of cells and electrical connections in a battery pack would certainly decrease but the danger associated with individual cells of such high capacity might be greater.

Figure (3.9): Lithium polymer battery

Working Principle

Just as with other lithium-ion cells, LiPos work on the principle of intercalation and de-intercalation of lithium ions from a positive electrode material and a negative electrode material, with the liquid electrolyte providing a conductive medium. To prevent the electrodes from touching each other directly, a micro porous separator is in between which allows only the ions and not the electrode particles to migrate from one side to the other.

Figure: Li-PO Battery

Safety

LiPo cells are affected by the same problems as other lithium-ion cells. This means that overcharge, over-discharge, over-temperature, short circuit, crush and nail penetration may all result in a catastrophic failure, including the pouch rupturing, the electrolyte leaking, and fire.

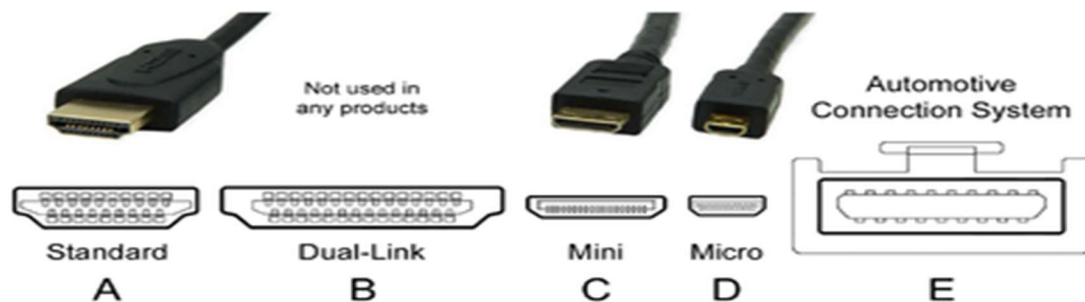# HDMI (High-Definition Multimedia Interface)

Figure (3.10): HDMI Cable

Micro HDMI to Standard HDMI Cable. Can be used with Raspberry Pi 4 to connect to a HDMI monitor.

The HDMI Alt Mode for USB Type-C connector allows HDMI-enabled source devices to utilize a USB Type-C connector to directly connect to HDMI-enabled displays, and deliver HDMI signals and features over a simple cable without the need for protocol and connector adapters or dongles.

This enables two of the most popular solutions for connectivity to come together the small form factor, reversible, and multi-purpose USB Type-C connector being adopted by smartphones, tablets and PC products, and the HDMI connector, which is the leading display interface with

an installed base of billions of displays. Over 355 million HDMI-enabled display devices are expected to ship in 2019,

To ensure baseline compatibility between different HDMI sources and displays (as well as backward compatibility with the electrically compatible DVI standard) all HDMI devices must implement the sRGB color space at 8 bits per component.

There are five HDMI connector types. Type A/B are defined in the HDMI 1.0 specification, type C is defined in the HDMI 1.3 specification, and type D/E are defined in the HDMI 1.4 specification.

The HDMI alternate mode lets a user connect the reversible USB-C connector with the HDMI source devices (mobile, tablet, laptop). This cable connects to video display/sink devices using any of the native HDMI connectors. This is an HDMI cable, in this case a USB-C to HDMI cable.

ON Off Switch:

This type of switch are usually used for power on off in a laptop.

Figure (3.11): On Off Switch

FILAMENT:

There are numerous filaments available but here Acrylonitrile Butadiene Styrene (ABS) is used and its chemical formula is $(C_8H_8)_x \bullet (C_4H_6)_y (C_3H_3N)_z$. Its glass transition temperature is 108°C. It is amorphous in nature and made up of polymerizing styrene and acrylonitrile with addition of polybutadiene

Figure (3.12): FILAMENT

Cooling Fan

A small blower fan is used to direct air across a laptop computer's CPU cooler. It absorbs heat inside from motherboard.

Figure (3.13): Cooling Fan

Heat sink or cooler

A heat sink is a thermal conductive metal device designed to absorb and disperse heat away from a high temperature object such as a computer processor. Usually heat sinks are outfitted with built-in fans to help keep both the CPU and the heat sink at an appropriate temperature.

Figure (3.14): Heat sink or cooler

Heat sink Compounds

Thermal compound, also known as thermal paste and thermal grease, is a material used to fill the microscopic gaps between a computer's CPU and its heat sink. Thermal compound significantly increases the heat sink's ability to cool the CPU, allowing the CPU to run at a higher speed and improve system performance.

Figure (3.15): Heat Sink Compounds

3.12 Speaker:

the purpose of speakers is to produce audio output that can be heard by the listener. Speakers are transducers that convert electromagnetic waves into sound waves. The speakers receive audio input from a device such as a computer or an audio receiver.

All laptop computers feature fully integrated built-in speakers. Many times, the speakers are located within the casing either above the keyboard or below the keyboard; near the corners. The speakers will rarely be located on the screen portion of the laptop

Figure (3.16): Speaker

3.13 Male Female Connector:

This connector are used for connect to two connector easily.

This one side have male connector and another side have female connector.

Figure (3.17): Male Female Connector

3.15 Screw for Joint:

This type of screw is used for the joint of various part of laptop. Like as casing, monitor, keyboard, dock station

Figure (3.21): Screw

Design

We designed in this laptop by solid work software and printed by a 3D printer. This laptop has two part.

1. Upper part this called tablet.

2. Lower Part this called a dock station.

Primary Design:

Fig: Primary Design Display Back Part By PCV Board
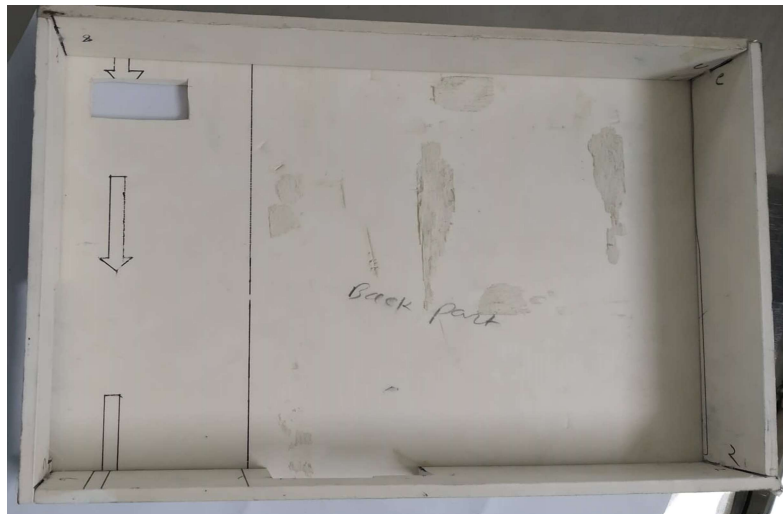
Fig: Design Display Back Part By PCV Board

Fig: Design Display Front Part By PCV Board

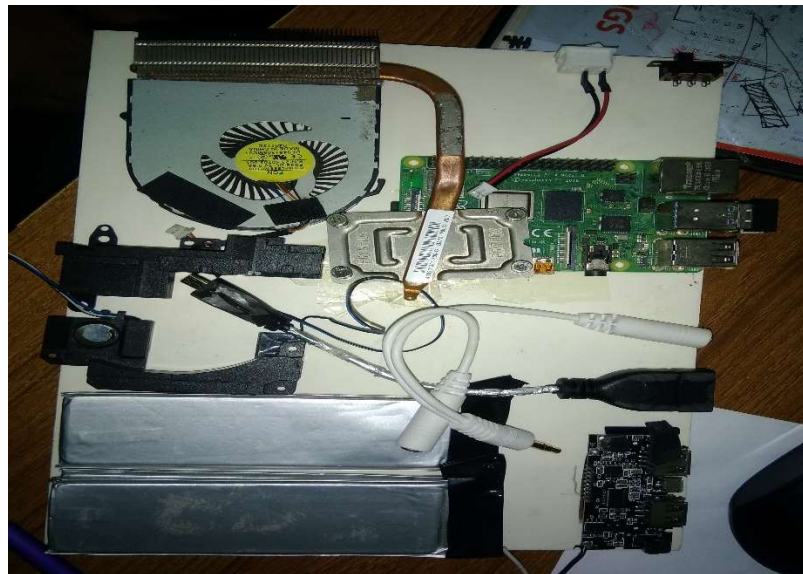Fig: Design Display Back Part By PCV Board

Fig: Primary assembly

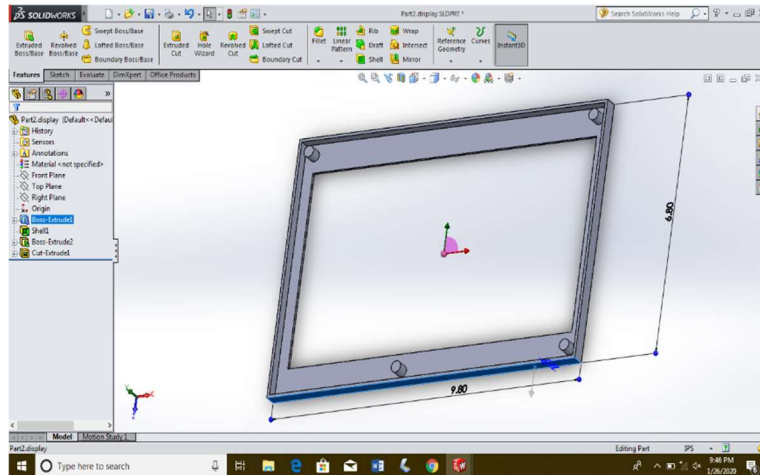Fig: Work In a lab

Fig: Project Demo

Solid Work Design

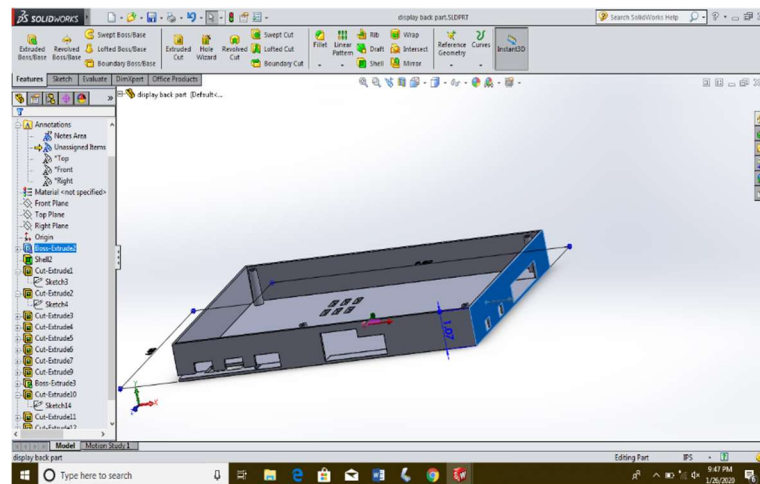Fig: Solid Work Design Display Upper Part
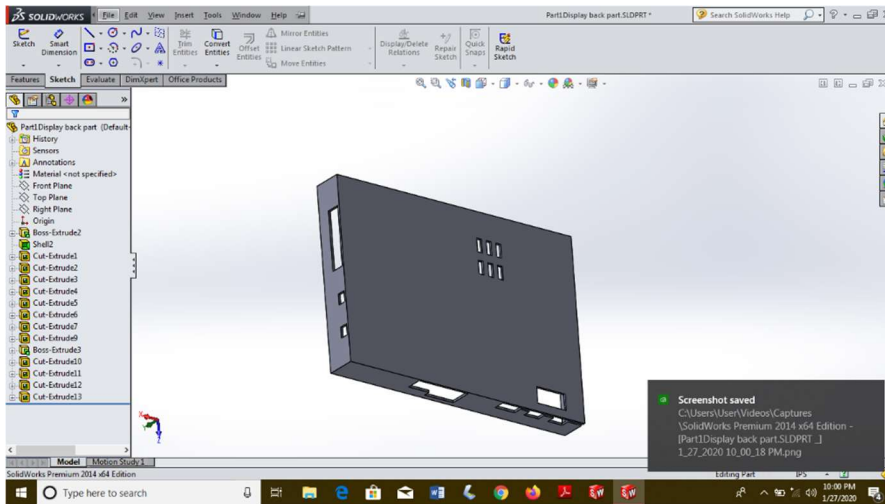

Fig: Solid Work Design Display Back Part
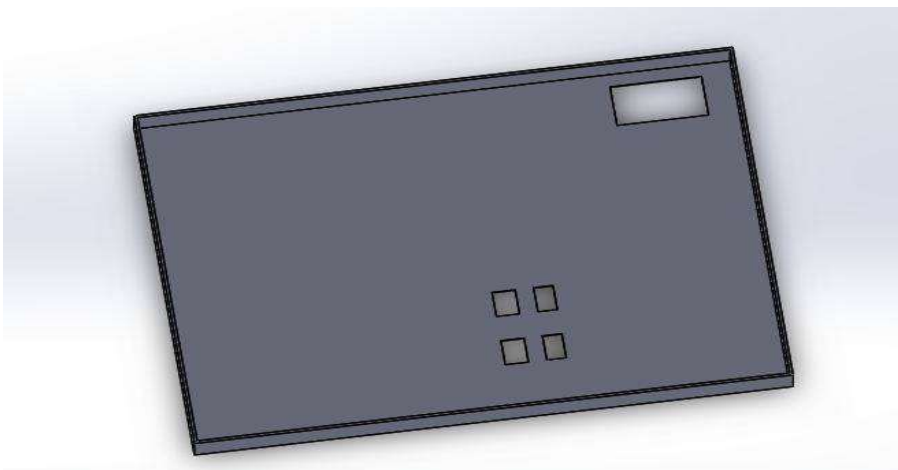
Fig: Solid Work Design Display Back Part

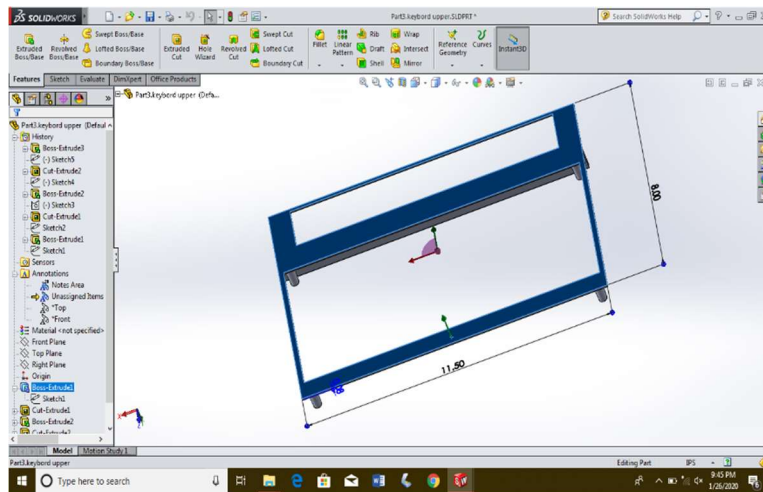Fig: Solid Work Design Display Back Part

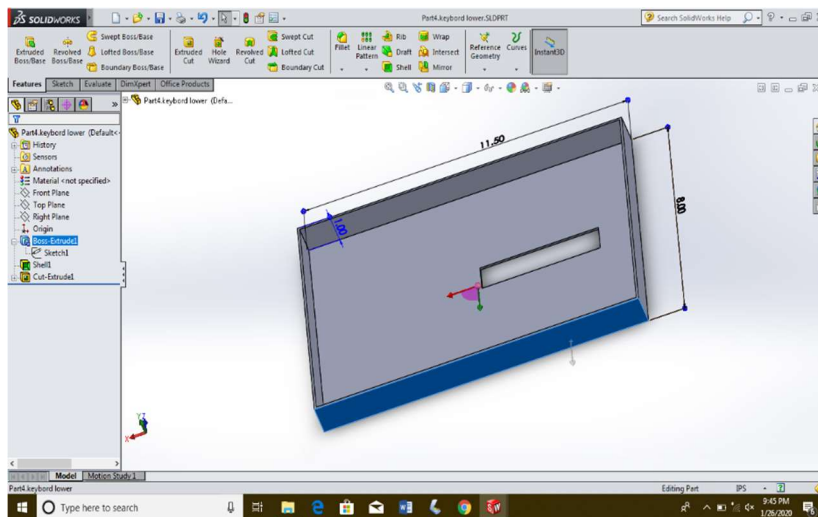Fig: Solid Work Design Keyboard / Dock Station Upper Part

Fig: Solid Work Design Keyboard / Dock Station Back Part

3D Printing Design and Output:
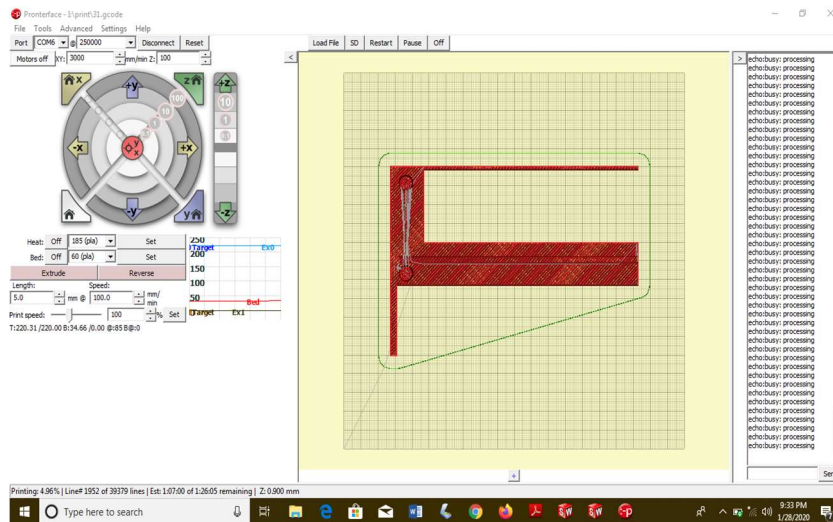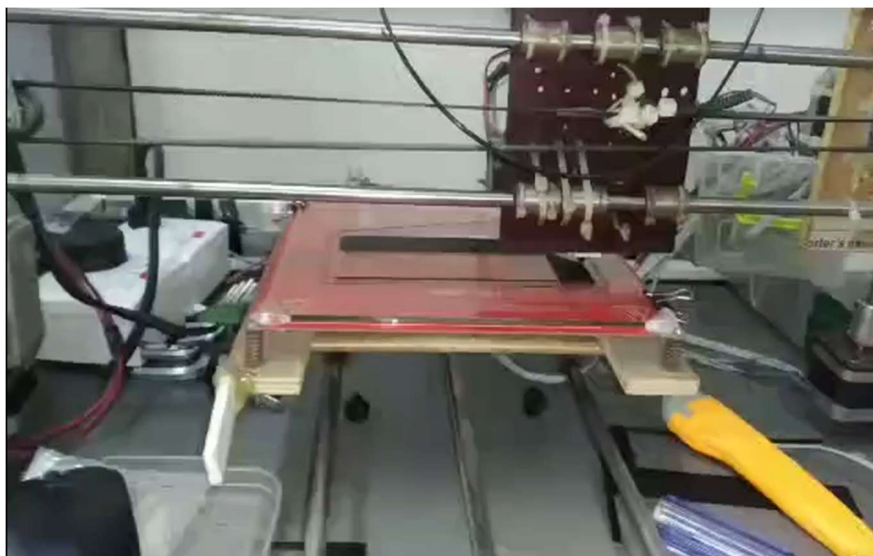

Figure:3D Printing software
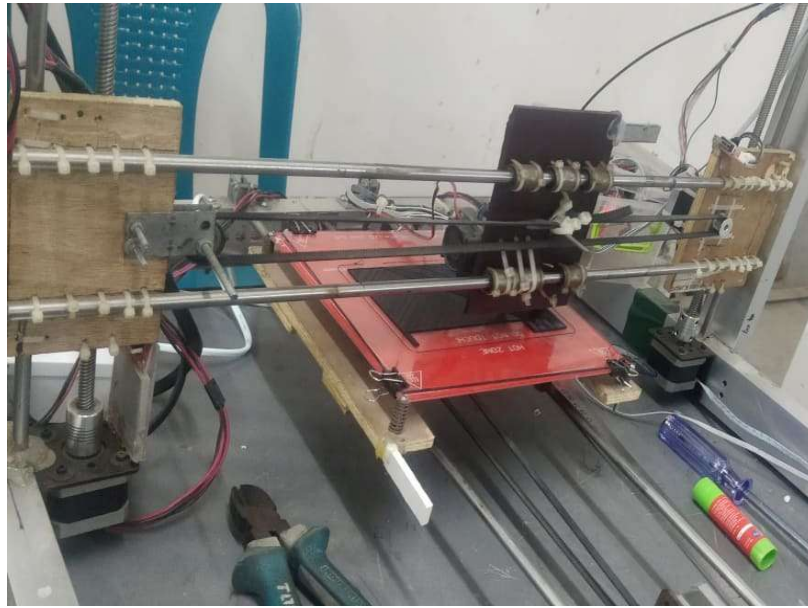

Figure:3D Printing In Lab

Figure:3D Printing In Lab

Figure:3D Printing In Lab

Figure: Logo in 3D Printing

Figure:3D Printing Logo

Figure: Display Part assemble

Figure: Laptop Casing By 3D output

Figure: Laptop Casing By 3D output

Figure: Output Product

Figure: Parts assemble

Figure: Parts assemble

Final Product:
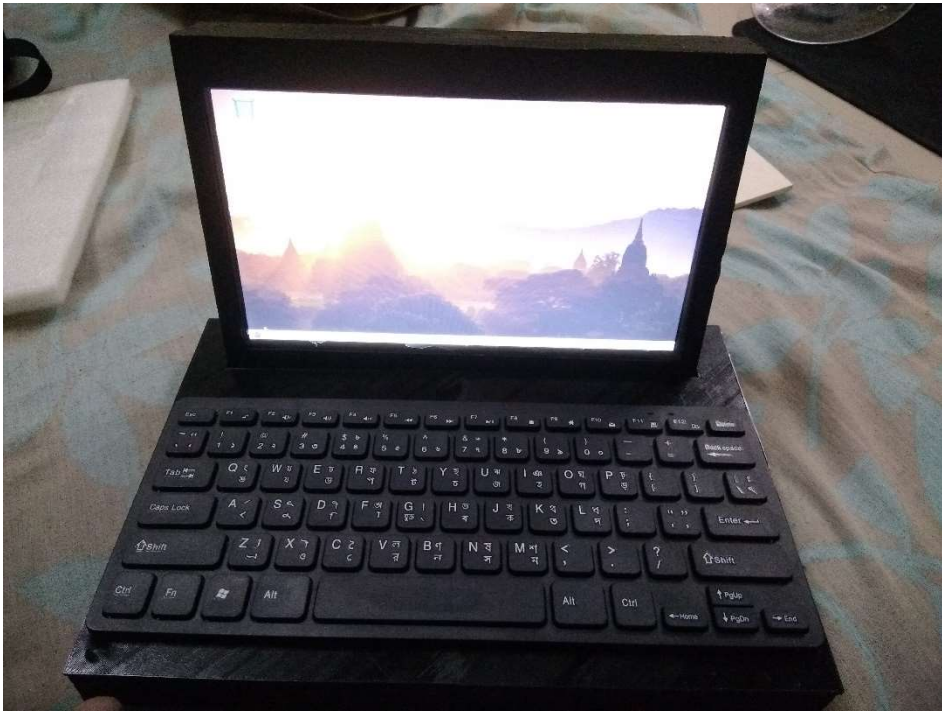
Final Product:

CHAPTER – 4

DISCUSSION AND CONCLUSION:

4.1 COMPARISON OF OUR LAPTOP WITH CONVENTIONAL LAPTOP IN MARKET:

Fig: Our Project (Laptop)   **Fig: Dell Laptop**

Our Project Laptop	Dell Laptop
Very Low Cost, Only TK 12000	High Cost Min TK 30000
Electric power consumption is low, used only 15 Watt 5V DC	Electric power consumption is high, used minimum 45 Watt 19V DC
It can be easily Customized	It not easy to Customized

4.2 ADVANTAGE OF LOW COST LAPTOP:

1. Mobility: The first and main advantage of this laptop is the lightweight, compact size, the built-in battery in the laptop allowing it to easily move from one place to another.

2. You can used It by a laptop and also used by a tablet using touch pen.

3. Internet access is the second advantage for the rise in demand for the laptop because it provides the ability to access the Internet through wireless technology Wi-Fi.

4. The laptop can work offline from its battery. It has a strong battery backup.

4.3 CONCLUSION:

Considering whether tablets will replace laptops in the near future requires research into the needs of household users. It was very handy and portable. It was not only a laptop you can use this by a tablet computer. Physical features, software components, performance and price differences were all examined. According to this research, tablets are likely to replace laptops. In addition, for gaming, tablet software there are many gaming accessories is available. However tablets appear to be the more economical choice. Based on all the results and information, it would appear that in time tablets are more likely to be the preferred choice of the average home user but any changes will probably take time for the technologies to fully meets people's needs. At the moment for the home user, laptops seem to meet their needs adequately, but given enough time for the technology to develop and more user exposure to touch screen navigation, tablets will be the way of the future.

4.4 References:

1. Cellan-Jones, Rory (5 May 2011)."A£15 computer to inspire young programmers". BBC News.

2. June 23, Nick Heath in Hardware on; 2019 "Raspberry Pi 4 Model B review: This board really can replace your PC". Tech Republic.

3. Dé specialist voor smartphone, tablet en laptop reparaties (4 January 2013). "Laptop reparatie". Smartrepair Den Bosch, Nijmegen, Tilburg, Almere en Utrecht (in Dutch). www.smart-repair.nl. Retrieved 30 March 2017.

4. Merten, Dr. Maik (14 September 2019). "Raspi-Kernschau - Das Prozessor-Innenleben des Raspberry Pi 4 im Detail" [Raspi-kernel-show - The inner life of the Raspberry Pi 4 processor 0in detail]. (in German). 2019.

5. Müller H, Gove JL, Webb JS (2012) Understanding tablet use: A multi-method exploration. Proceedings of the 14th Conference on Human-Computer Interaction with Mobile Devices and Services (Mobile HCI 2012).

6. Trudeau MB, Udtamadilok T, Karlson AK, Dennerlein JT (2012a) Thumb motor performance varies by movement orientation, direction, and device size during single-handed mobile phone use. Human Factors and Ergonomics 54: 52–59.

7. Park YS, Han SH (2010b) One-handed thumb interaction of mobile devices from the input accuracy perspective. International Journal of Industrial Ergonomics 40: 746–756.

8. "HDMI Adopters and Founders". HDMI. Retrieved April 14, 2015.

9. "HDMI: Resources: Knowledge Base". hdmi.org.

10. "HDMI Manufacturer HDMI Alt Mode for USB Type-C Connector". www.hdmi.org. Retrieved September 18, 2016.

11. Bruno Scrosati, K. M. Abraham, Walter A. van Schalkwijk, Jusef Hassoun (ed), Lithium Batteries: Advanced Technologies and Applications, John Wiley & Sons.

12. M. B. Armand; J.M.Chabagno; M. Duclot (20–22 September 1978). "Extended Abstracts". Second International Meeting on Solid Electrolytes. St. Andrews, Scotland.

13. M. B. Armand, J. M. Chabagno & M. Duclot (1979). "Poly-ethers as solid electrolytes". In P. Vashitshta; J.N. Mundy & G.K. Shenoy (eds.). Fast ion Transport in Solids. Electrodes and Electrolytes. North Holland Publishers, Amsterdam.

14. Murata, Kazuo; Izuchi, Shuichi; Yoshihisa, Younes (3 January 2000). "An overview of the research and development of solid polymer electrolyte batteries".

15. https://www.raspberrypi.org/blog/

16. Bardini, Thierry (2000). Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing. Stanford: Stanford University Press. p. 98. ISBN 978-0-80473871-2.

17. Chapweske, Adam (2003-04-01). "Computer Engineering Tips – PS/2 Mouse Interface". Computer-engineering.org. Retrieved 2013-03-10.

18. Nakamura, S.; Tsukamoto, M.; Nishio, S. (26–28 August 2001). Design and implementation of the double mouse system for a Window environment. IEEE Pacific Rim Conference on Communications, Computers and Signal Processing.