Technical Description of the Logitech Brand

G502 Proteus Spectrum

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Abstract

From a ball to an optical sensor, the mouse evolved in such a way that it made computers user-friendly to a wider demographic. The purpose of this paper is to describe the design, features, and functions of Logitech's G502 Proteus Spectrum gaming mouse. It includes the history of Logitech's mouse brand, the main parts, and a brief description of the software.

Introduction

For the last 3 decades, Logitech is one of the leading companies that provides peripherals for personal computers. One of the commonly used peripherals is the mouse. Specifically, the G502 Proteus Spectrum is popular amongst those who enjoy gaming on their personal computers. The mouse is known for its high speed and accuracy due to the PMW3366 optical sensor, which is exclusive to Logitech. The highest speed the mouse can reach is 300 inches per second (Sebring, 2016.). The mouse is like its predecessor, G502 Proteus Core, except for the Proteus Spectrum's RGB (Red Green Blue light emission) capabilities.

Figure 1: Logitech G502 Proteus Spectrum. Reprinted from "G502 Proteus Spectrum Setup Guide" by Logitech International (n.d.-b).

Background

Before the invention of the mouse, computers were controlled by keyboards through command inputs (Beale, Schofield, & Austin, 2019). Computers were not popular at homes and offices due to the lack of graphical user interfaces and complicated controls. In 1968, Bill English and Douglas Eindhart, prototyped a pointing device that would revolutionize the use of computers (Beale, Schofield, & Austin, 2019, p. 158). This device consists of two wheels perpendicular to each other and connected to a circuit board. These wheels indicate the X-Y position on a display system (Doug Engelbart Institute, n.d., para. 1). The pieces, connected to one button, are covered with a wooden piece (Fig. 2). The function of the button on top is to select an item on the cursor displayed on the screen. The design of this prototype was placed into production for commercial use at Xerox for the Xerox Alto computer in 1975. The use of the computer mouse was not popularized until the release of the Apple Macintosh (Beale, Schofield, & Austin, 2019, p. 158).

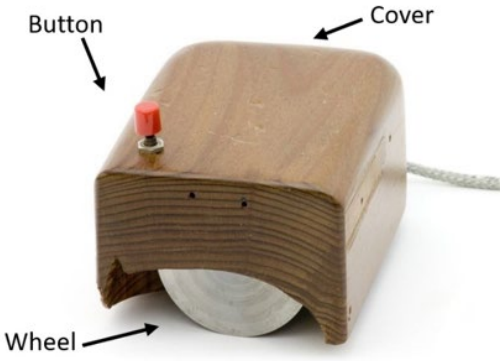

Figure 2: The Engelbart Mouse. Reprinted from "The Mouse" by Computer History Museum (n.d.)

Logitech's first debut for their mouse was in 1982, which was called the Logitech® P4 Mouse. It uses both optical laser technology and mechanical tracking, which provided more accurate tracking than previous commercial releases (Logitech International, n.d.). Three years later, Logitech released the Logitech® C7 Mouse, which was commercially successful due to its relatively low price of $99. The mouse innovations such as the middle mouse button and drawing power from the computer instead of using an external power supply (Logitech International, n.d.). Since then, Logitech branched out to various peripherals such as keyboards, cameras,

controllers, etc. Today, Logitech's products have two different markets: mouses for home and office use, and gamers. The gaming brand is called Logitech G, which is one of their most popular (Logitech International, n.d.-c).

List of Parts and Function

The Logitech G502 Proteus Spectrum comes with a wider variety of customization options, higher tracking resolution, and speed, and lighter weight compared to its previous generations. The mouse comes with 12 buttons, 11 of which can be programmed using a software called the Logitech G Hub (Logitech International, n.d.). The RGB lighting on the mouse can also be customized with the software. The device draws power from the computer as it is connected to it via a Universal Serial Bus (USB) port. The minimum weight of this mouse is 168 grams with the cables. The weight can be increased utilizing attachable 3.6g weights along the bottom of the mouse, beneath the cover. The depth, width, and height are 40mm, 75mm, and 132mm, respectively. The device can track up to 12,000 dots per inch, providing high accuracy to the user (Sebring, 2016). The materials consist of rubber on the palm and thumb rest, heavy metal on the scroll wheel, and Teflon (MV Technology, 2016). This provides enough comfort for a user to endure prolonged periods of usage. 9 main parts allow the Logitech G502 Proteus Spectrum to function and provide fidelity: upper exterior (Fig. 1), lower exterior, chassis, switches, scroll wheel, microcontroller unit, optical sensor chip (Fig. 10), wire, and software. Most parts are listed in Figure 3.

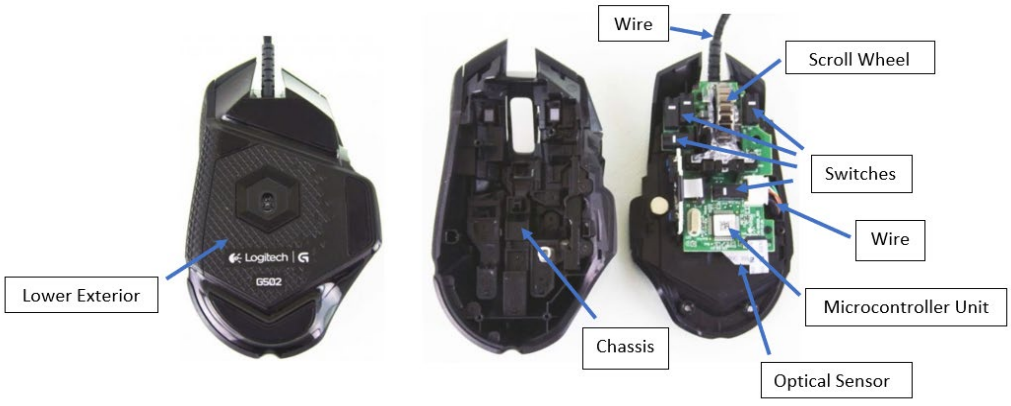

Figure 3: Logitech G502 Proteus Spectrum Parts. Reprinted from "Logitech G502 Proteus Spectrum RGB Tunable Gaming Mouse Review" by C. Sebring (2016).

I. UPPER EXTERIOR

The purpose of the upper exterior is to provide an ergonomic fit on the user's hand and protect the interior parts from accumulating dust over time. The left and right-click buttons, and the lower portion consist of matte-textured plastic to create a slight grip on the palm. On the left side of the mouse, there is a curve (Fig. 4) that is rubberized and contains diamond patterns for a stronger grip on the thumb (Sebring, 2016, para. 14). The middle portion of the exterior has a translucent part in the shape of the logo of Logitech Gaming. The reason for this is to allow the emission of RGB lighting. The other buttons on this mouse are composed of plastic with a glossy finishing.

Figure 4: Upper Exterior of the Logitech G502 Proteus Spectrum. Reprinted from "Logitech® G502 Proteus Spectrum Setup Guide" by Logitech International (n.d.-b).

II. LOWER EXTERIOR

At the bottom of the mouse (Fig. 3), 6 Teflon parts support the mouse when it drags across a surface. Teflon is a synthetic chemical that has a low coefficient of friction (Whitford Corporation, 2019, para. 24), so it will allow the user to drag the mouse smoothly. The middle portion of the lower exterior is a cover that leads to weight racks (Fig. 5). The user can place up

to five weights, each weighing 3.6 grams. The racks are patterned in a way that allows the user to change the center of mass of the mouse to their benefit (Sebring, 2016, para. 22).

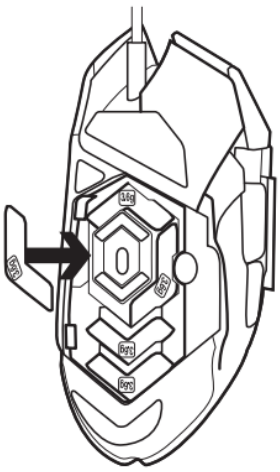

Figure 5: Weight Racks of the Logitech G502 Proteus Spectrum. Reprinted from "Logitech® G502 Proteus Spectrum Setup Guide" by Logitech International (n.d.-b).

III. CHASSIS

The chassis (Fig. 3) is the physical mainframe of the mouse. It maintains the shape of the mouse and prevents the interior from shaking as there are screw holes that connect to the lower exterior (Mr. Fixoff, 2020). In addition, the various shapes on the chassis allow the buttons on the upper exterior to be placed on the mouse. Once pressure is placed on a button, the chassis will activate the switch.

IV. SWITCHES

The interior of the Logitech G502 Proteus Spectrum contains 3 printed circuit boards (Mr. Fixer, 2020). A printed circuit board (PCB) is a board that has lines that transfer electrical signals from one end to another. These lines are composed of copper, which is a good conductor of electricity (SparkFun Electronics®, n.d., para. 4). On top of the board, there are electrical components that are soldered. In this mouse, there are electrical switches (Fig. 6), designed by OMRON Industrial

Automation (Sebring, 2016, para. 23), soldered onto the PCB. Most of the switches are labeled with G from 1-9. The purpose of these switches is to activate an electrical signal to the brain of the mouse when held down by the user (OMRON Corporation, n.d.-a, para 1). When the signal is sent to the microcontroller unit (the brain), signals are outputted to the computer. These signals that are outputted are programmed by Logitech to do various tasks (Fig.7).

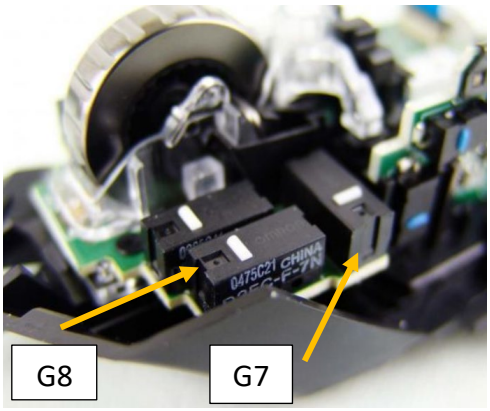

Figure 6: Switches of the Logitech G502 Proteus Spectrum. Reprinted from "Logitech G502 Proteus Spectrum RGB Tunable Gaming Mouse Review" by C. Sebring (2016).

These switches have functions by default but can be reprogrammed through the G Hub software. With the DPI up/down buttons, the user can increase/decrease their mouse sensitivity by a value based on their settings in the G Hub software. The DPI shift button sets the mouse to certain sensitivity once activated. If clicked again, the sensitivity resets to the default DPI. The wheel shift mode changes the type of rotation in the scroll wheel (Logitech International, n.d.-b).

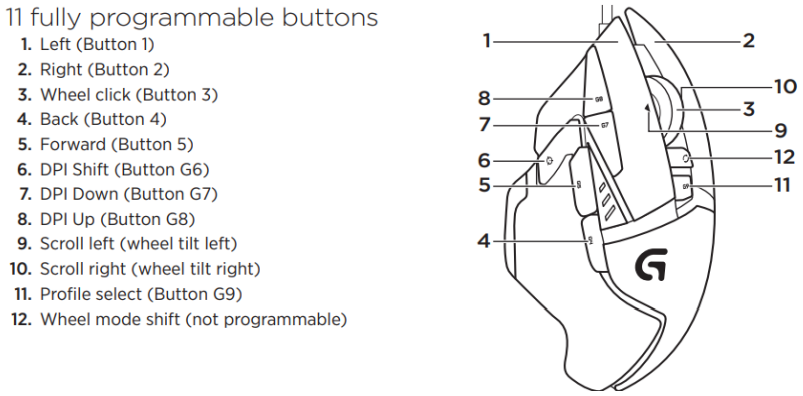

Figure 7: Programmable Buttons of the Logitech G502 Proteus Spectrum. Reprinted from "Logitech® G502 Proteus Spectrum Setup Guide" by Logitech International (n.d.-b).

V. SCROLL WHEEL

Unlike the other switches in the PCB, the switch that the scroll wheel uses are activated through the back-and-forth rotation of the wheel (Sebring, 2016, para. 29). This type of switch is called the rocker switch (OMRON Corporation, n.d.-b, para.1). This switch was placed below the scroll wheel and soldered to the PCB. There are two types of rotations: ratchet scrolling and smooth scrolling (Logitech International, n.d.-a, p. 3). Ratchet scrolling is when the scroll wheel rotates at an incremental pace, while smooth scrolling is at a continuous and frictionless pace. Smooth scrolling was made possible through Logitech's MicroGear™ Technology (Logitech International, n.d.-a, p. 1), The modes can be changed using the wheel mode shift button (Fig. 7).

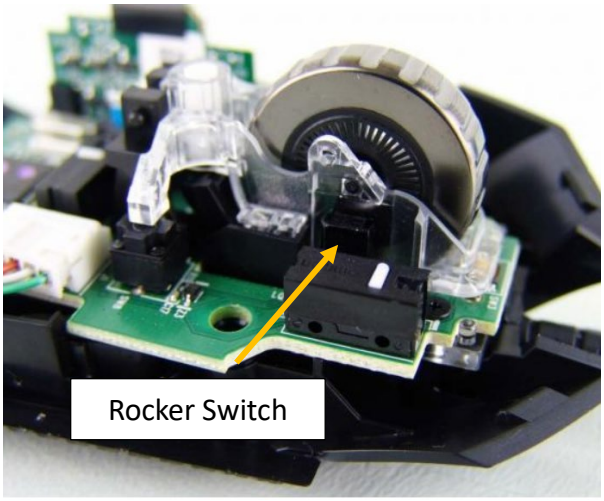

Figure 8: Rocker Switch of the Logitech G502 Proteus Spectrum. Reprinted from "Logitech G502 Proteus Spectrum RGB Tunable Gaming Mouse Review" by C. Sebring (2016).

VI. MICROCONTROLLER UNIT

A microcontroller unit (MCU) is a device soldered on the PCB that controls other electronic parts such as memory connected to the board (Keim, 2019, para. 6). In other words, the MCU can be seen as a computer. The Logitech G502 Proteus Spectrum uses the 32-bit Arm Cortex-M3

MCU (Sebring, 2016, para. 28). Arm Limited is the company that provides such processors. This part is located below the wheel mode shift switch (Fig. 9). According to Arm, the Cortex M3 is cost-efficient because it delivers high performance for a low cost (Arm Limited, n.d.). Inside the MCU, there is the Central Processing Unit (CPU), called the Armv7-M, which enables the switches to have various functions in the mouse (Arm Limited, n.d.). The white ribbon cable in Figure 8 is connected to another PCB below (Mr. Fixoff, 2020). This PCB contains an optical sensor. The data read by the sensor is transferred to the CPU via the ribbon cable.

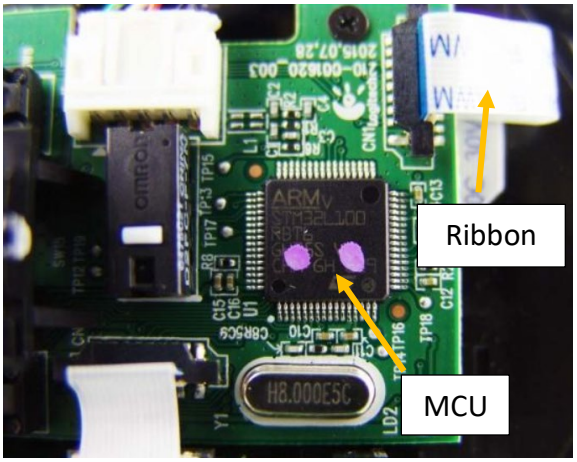

Figure 9: The Microcontroller Unit and Ribbon Cable of the Logitech G502 Proteus Spectrum. Reprinted from "Logitech G502 Proteus Spectrum RGB Tunable Gaming Mouse Review" by C. Sebring (2016).

VII. OPTICAL SENSOR CHIP

In a mouse, the job of the optical sensor is to read the movement of the mouse using infrared light. When the light is beamed at the surface, it is reflected by a sensor. That sensor creates an image from the light and sends it to a digital signal processor. The signal can detect changes in the images and which direction it changed (InfoSpace Holdings, n.d., para. 2). Inside the Logitech G502 Proteus Spectrum, the PCB below the upper PCB contains the optical sensor (Fig. 10). On this PCB, one side contains the digital signal processor and the other has the

infrared camera (Mr. Fixoff, 2020). The sensor's name is PMW3366DM and it is designed by PixArt. This sensor can read up to 12,000 dots per inch (PixArt Imaging Inc., n.d.). This means that the camera can process 12,000 images per inch.

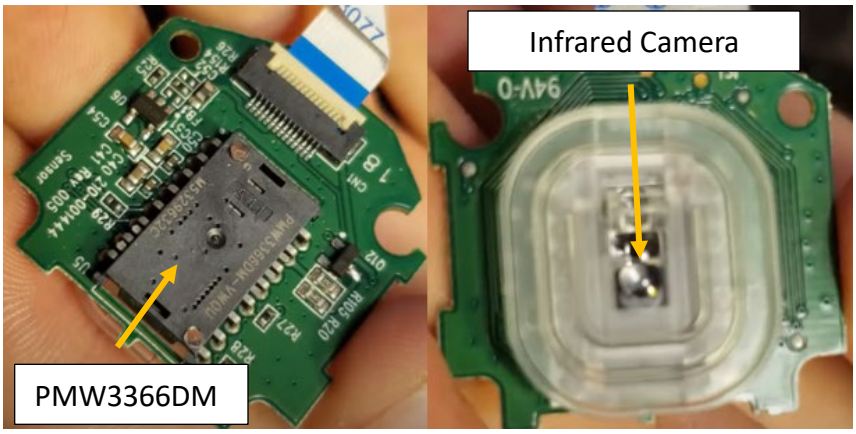

Figure 10: Optical Sensor and Infrared Camera of the Logitech G502 Proteus Spectrum. Reprinted from "Refurbishing Logitech G502 Mouse, Disassembly, Reassembly" by Mr. Fixer (2020).

VIII. WIRES

The wire portion (Fig. 3) of the Logitech G502 Proteus Spectrum allows the mouse to function as it provides current from the computer. The multicolored wire (Fig. 3) connected on the top PCB is the same wire that connects to the computer via the USB port (Logitech International, n.d.). The USB cable also allows the transfer of data, giving the mouse permission to control the computer and vice versa.

IX. SOFTWARE

Logitech uses their proprietary software, Logitech G Hub, to allow users to reprogram the buttons to their fitting. Moreover, they can create profiles and change how the buttons function in each one. Therefore, users can choose their preferential controls without manually changing them every time. They can also set these profiles to different games and applications on the computer. If such a game launches, then the function of the buttons will change per the profile

settings. The RGB lighting functionality of the Logitech G502 Proteus Spectrum can be customized. For example, the lighting can be changed from a strobing to a pulsating effect. The profile settings that users created can be uploaded to the community hub for other users to download.

Conclusion

The first mouse was a simple solution for controlling a computer and evolved into high precision control device that popularized the use of computers at home. Today, mouses are one of the most used yet overlooked tools in modern society, especially with the increase of remote activities. Many people do not realize the complex process of manufacturing that the easy-to-use peripherals go through.

There has been growth in the field of personal computer (PC) gaming. Logitech tended to the needs of this market with the release of their Logitech G™ brand mouses. These mice are pricier than office mice, as they provide more features. When the Logitech G502 Proteus Spectrum was released in 2016, it gave users more options with its RGB options. The popularity of this mouse increased further as the price went down with time. It provided high-quality material, accurate controls, and a myriad of options at an affordable price.

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