IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 4, April 2024

DOI: 10.17148/IJIREEICE.2024.12431

3D SCANNER USING RASPBERRY PI

Dr.T.B.Mohite Patil[1], Rutik Gurav[2], Swapnil Banchode[3], Ajinkya Kathar[4], Aniket Bulbule[5], Tejas Mohite[6]

Associate Professor, Dept. of E&TC, D Y Patil College of Engineering and Technology (Autonomous), Kasaba Bavada, Kolhapur, Maharashtra [1]

B. Tech Students, Dept. of E&TC, D Y Patil College of Engineering and Technology (Autonomous), Kasaba Bavada, Kolhapur, Maharashtra[2-6]

Abstract: The 3D Scanner product harnesses the capabilities of Raspberry Pi and state-of-the-art technology to fulfill the increasing demand for precise 3D scanning of tangible items. Through the integration of components such as Raspberry Pi, Pi Camera V2, stepper motors, LCD display, and LED lights, the system orchestrates a seamless scanning process. Its primary objective is to accurately capture physical objects, transforming them into versatile 3D digital models. Users are provided with real-time visual feedback via an LCD display and LED lights, ensuring an engaging and interactive experience. This product aims to bridge the physical and digital realms, offering a tool for transforming, replicating, and exploring real-world objects in the digital domain. By doing so, it unlocks a myriad of possibilities for applications in 3D printing, design, and immersive experiences, positioning itself as a promising endeavor at the nexus of technology and creativity.Top of Form

Keywords: Raspberry Pi, 3D scanning, point cloud, computer vision, image processing, 3D reconstruction, Low-cost 3D scanning.

I. INTRODUCTION

The 3D Scanning Machine Product utilizes Raspberry Pi 3B, Micro SD Card, Pi Camera v2, Stepper Motor, and USB 2.0 Micro B cable to create intricate 3D models, democratizing 3D scanning by leveraging the cost-effective Raspberry Pi platform.

Raspberry Pi 3B, renowned for its computational prowess, manages hardware interactions via GPIO pins, while Pi Camera v2 captures high-resolution images for model generation. The Stepper Motor facilitates controlled object movement, enabling precise 3D model creation.

The USB 2.0 Micro B cable connects Raspberry Pi 3B with other devices, facilitating data transfer and power supply for seamless communication. The Micro SD Card stores essential software and data, offering flexibility for customization in the scanning process.

This product demonstrates the amalgamation of accessible hardware and advanced software, transforming physical objects into digital models with remarkable precision and detail, all orchestrated by Raspberry Pi's capabilities.

II. METHODOLOGY

The 3D Scanner product adopts a multifaceted approach to accomplish its goals. It commences by integrating key components, such as Raspberry Pi, Pi Camera V2, stepper motors, LCD display, and LED lights. Acting as the central control unit, Raspberry Pi coordinates the entire scanning procedure. Stepper motors are employed to automate camera movements, ensuring precision by capturing the physical object from various viewpoints.

Advanced software processes and amalgamates the captured images to produce a comprehensive 3D digital model. Real-time feedback is provided to users through an LCD display and LED lights, enhancing the system's user-friendliness. This methodology amalgamates technological innovation, mechanical accuracy, and user engagement to bridge the gap between physical and digital domains, ultimately converting real-world objects into adaptable digital models for a myriad of applications.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 4, April 2024

DOI: 10.17148/IJIREEICE.2024.12431

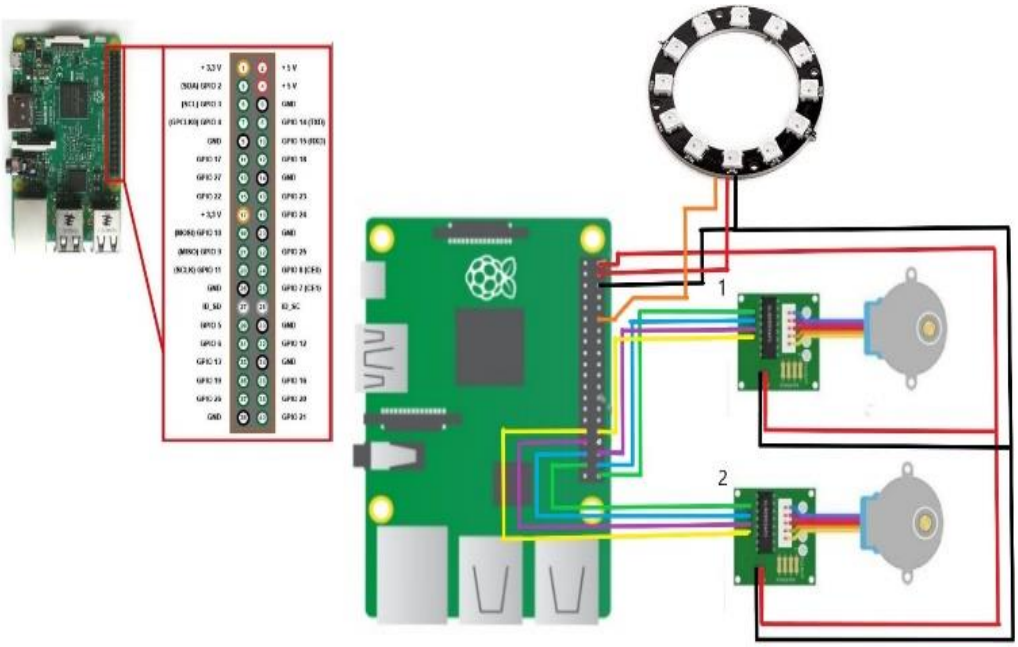

FIG -1: SIMULATION MODEL

III. WORKING

The simulation of the 3D Scanner product replicates the operational dynamics of the system within a virtual realm. It commences with the Raspberry Pi, serving as the core of the simulation, overseeing the entire process. The Pi Camera V2, virtually represented, captures images of the target object from diverse angles for scanning. Simulated stepper motors precisely guide the virtual camera to ensure comprehensive data capture. Within the virtual domain, a structured or laser light source is utilized to illuminate the virtual object, facilitating the scanning process.

The essence of the simulation lies in the 3D scanning and data processing algorithm, digitally analyzing the captured images and reconstructing them into a 3D digital model with precision and intricacy. User engagement is simulated through a virtual LCD display and LED lights, enabling real-time monitoring and interaction within the simulated environment.

This simulated setup mirrors the actual 3D scanning procedure, enabling testing, validation, and refinement of the system's algorithms and mechanisms before practical implementation. It serves as a valuable tool for optimizing the system's performance and ensuring its ability to consistently convert physical objects into elaborate 3D digital models.

A Raspberry Pi 3B-driven 3D scanning marvel. Powered by the Pi Camera v2, Stepper Motor 28BYJ48, and Neo-pixel LED 5V RGB LED Ring WS2812B, this innovation redefines precision. Meticulously engineered, it captures intricate object details with unmatched accuracy. Orchestrated by the Raspberry Pi, these components seamlessly integrate, transforming captured images into intricate 3D models through advanced algorithms. Beyond technical prowess, this creation holds transformative potential across diverse domains, from artistic expression to industrial replication. Its compact form factor houses a symphony of cutting-edge technology and creative ingenuity. This product is a testament to the fusion of electronics, artistry, and innovation. By reshaping the boundaries of perception, creation, and interaction within the three-dimensional realm, it stands as a symbol of progress. Its user-friendly interface empowers creators to explore its capabilities, making it a valuable tool for professionals and enthusiasts alike. From concept to execution, this 3D scanning machine encapsulates the spirit of exploration, advancement, and harmonious integration, propelling us into a future where precision meets limitless possibilities.

3.1 Raspberry Pi: The Raspberry Pi is a compact, cost-effective single-board computer ideal for serving as the central processing unit of your 3D scanning device. Renowned for its adaptability and minimal energy usage, it offers a wide range of capabilities. Utilizing the Raspberry Pi, you can execute diverse software applications to manage the scanning operation, capture images, and analyze the acquired data.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 4, April 2024

DOI: 10.17148/IJIREEICE.2024.12431

3.2 Pi Camera V2: The Raspberry Pi Camera Module V2 is a top-notch camera attachment designed to link with the Raspberry Pi's CSI (Camera Serial Interface) port. It boasts the capability to capture images and videos in high resolution, rendering it ideal for acquiring the visual data essential for 3D scanning applications. The camera can be affixed in a stationary position on the scanning setup or attached to a movable arm to capture images from various perspectives.

3.3 Stepper Motor: Stepper motors are frequently employed in 3D scanning setups to manage the motion of either the scanning platform or the camera. These motors operate by moving in distinct steps, enabling precise regulation over rotation or linear displacement. Their functionality is pivotal in relocating either the scanning subject or the camera to capture images from diverse viewpoints, a critical step in crafting a comprehensive 3D model.

3.4 LCD Display: An LCD (Liquid Crystal Display) screen serves as an effective user interface for your 3D scanning apparatus. It is capable of showcasing pertinent information regarding the scanning procedure, such as settings, progress updates, and previews of captured images. Through the LCD display, users can conveniently engage with the scanning machine, modifying parameters or initiating and halting scans as needed.

3.5 LED: LEDs (Light Emitting Diodes) play diverse roles in a 3D scanning apparatus. They offer uniform and regulated illumination throughout the scanning procedure, ensuring consistent lighting conditions essential for capturing precise textures and details on the subject. Additionally, LEDs can signify the status of the scanning process, indicating when the system is prepared for capture, processing data, or has completed a scan.

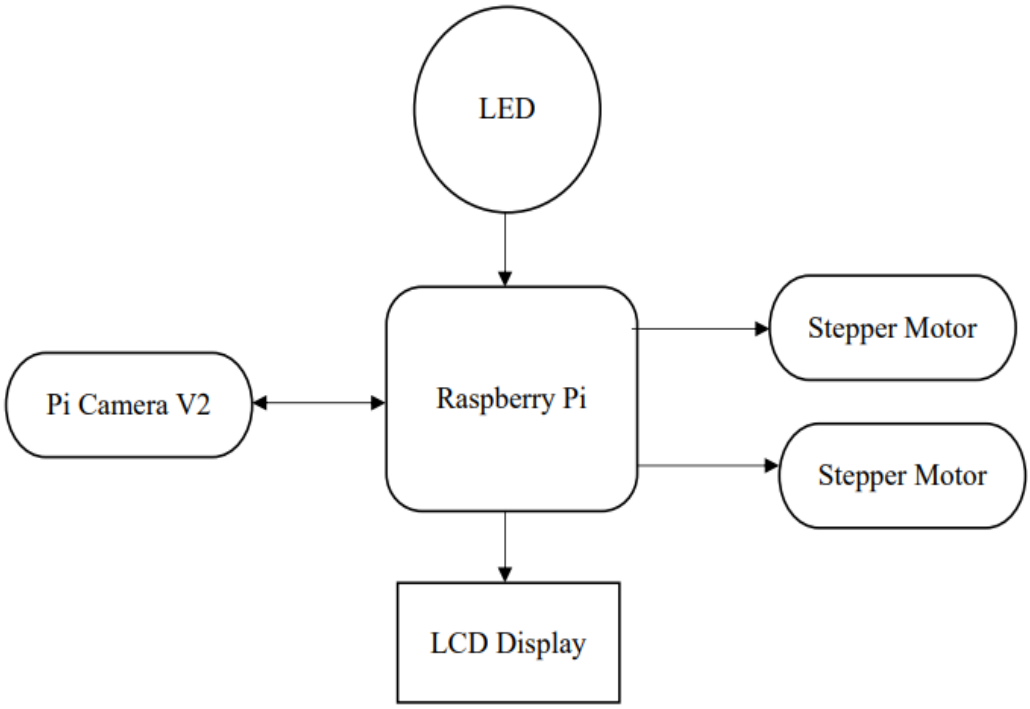

FIG -2: BLOCK DIAGRAM OF 3D SCANNER

IV. DATABASE CREATION

- **Capture Images:** Raspberry Pi takes images from various angles using a camera.
- **Feature Extraction:** Software identifies key points using image analysis.
- **Depth Calculation:** Software computes depth to create a 3D point cloud.
- **Point Cloud Generation:** Points form a 3D representation of the object.
- **Post-Processing:** Refine mesh, remove noise, fill gaps.
- **File Output:** Final 3D model saved in formats like OBJ or STL.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 4, April 2024

DOI: 10.17148/IJIREEICE.2024.12431

V. FLOWCHART OF SYSTEM

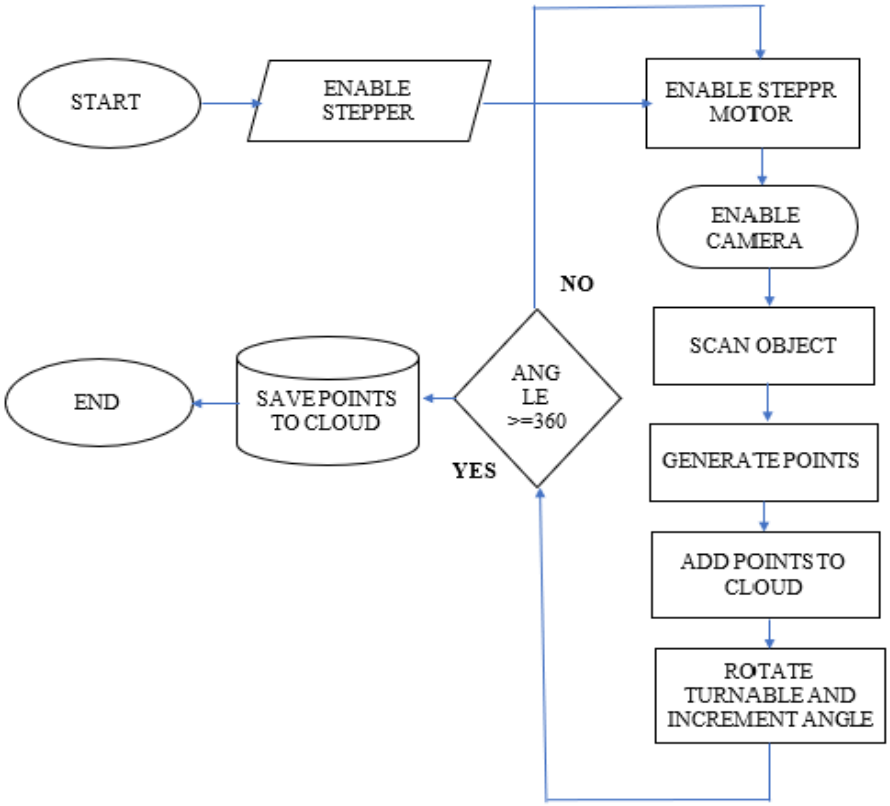

FIG -3: FLOW CHART OF 3D SCANNER USING RASPBERRY PI

VI. RESULT

The 3D Scanner using Raspberry Pi successfully demonstrates the potential of this low-cost platform for creating accurate 3D models of physical objects. The integration of various components, including Raspberry Pi, camera, stepper motors, LCD display, and LED lights, facilitates a user-friendly and efficient scanning process.
Key findings include:

- **Precise 3D Model Generation:** The system captures intricate details of objects from multiple viewpoints, resulting in high-fidelity 3D models.
- **Cost-Effective Development:** Utilizing Raspberry Pi as the core component keeps the overall system budget-friendly.

This 3D scanner opens doors for various applications, including:

- **3D Printing:** Creating digital copies of objects for replication through 3D printing.
- **Reverse Engineering:** Analyzing existing objects for design improvements or reproduction.
- **Design and Education:** Offering a valuable tool for design exploration and educational purposes in 3D technology.

VII. CONCLUSION

From this product, we conclude that the "3D Scanner using Raspberry Pi" product epitomizes the fusion of technology and creativity. It not only accomplishes the remarkable task of converting physical objects into intricate 3D models with exceptional precision but also demonstrates the seamless integration of diverse components such as stepper motors, Raspberry Pi, and a high-quality camera. The user-friendly interface featuring an LCD display and LED lights enhances the accessibility and usability of the product. These digital replicas of real-world objects hold the potential to revolutionize numerous industries, spanning from manufacturing to design and immersive experiences. This product underscores the boundless opportunities for connecting the physical and digital realms, offering fresh avenues for exploration and innovation.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 4, April 2024

DOI: 10.17148/IJIREEICE.2024.12431

VIII. ACKNOWLEDGEMENT

It is matter of great satisfaction and pleasure to present the Research paper on, "3D SCANNER USING RASPBERRY PI". With great pleasure we express our deep sense of gratitude to our guide **Dr. T. B. Mohite** for their valuable guidance, discussion and constant encouragement for successful completion of product work. He gives us suggestions and constructive criticism from time to time in friendly manner, which perhaps his unique characteristic We wish extended thanks to all staff members who directly or indirectly helped us for completion of our product.

REFERENCES

[1]. Prasad, B. Debnath [2020]: "Development of a 3D Scanner Using a Raspberry Pi and its Comparison with a Conventional 3D Scanner" a low-cost 3D scanner built using a Raspberry Pi and a rotating platform.
[2]. Rohit Gupta: "3D Scanning Using Structure Light and Laser Light Scanning Technology" The generation of 3D model is required in various applications like in manufacturing industry to reverse engineering.
[3]. Yogesh Tarange: "Implementation of 3D Scanner Using Arduino" a low-cost 3D scanner built using a Arduino Kit.
[4]. Y. Tang: "Structured light 3D scanner using a Raspberry Pi" The paper explains the design of the system, including the light production setup, camera synchronization, and data processing.
[5]. Raspberry Pi., ''Raspberry Pi OS," 2020. [Online]. Available: https://www.raspberrypi.org/software/.
[6]. Python, ''Python For Beginners," 2020. [Online]. Available: https://www.python.org/about/gettingstarted/.