

Enhancing Harvest Performance: An Innovative Approach to Fruit Picker Design

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Abstract

A fruit picker is one example of a harvester tool used to increase harvester capacity and reduce damage caused by fruit fall. Previous products had some drawbacks, such as requiring longer time to complete the recruitment process and low efficiency. Also, there are limitations in terms of height and portability. The objective of the research is to design and develop a friendly user fruit picker in ways to reduce harvesting time and minimize fruit damage. The fabrication process consists of a rod with a cutter plier acting as a cutting machine tool. In addition, this product has been proven to save time compared to traditional methods. Results of performance analysis demonstrate that the fruit picker successfully meets its intended objectives. Based on the results and analysis, it can be concluded that this fruit picker has achieved the objectives discussed. Data shows that the innovative fruit picker performs harvesting in less time across all tested heights. Fruit picked using the new tool is in better condition, with minimal or no bruising. This confirms that the developed fruit picker significantly enhances harvesting efficiency compared to traditional methods.

Key Words: Fruit Picker, Fruit Picker Tool, Harvester Tool, Portable Fruit Picker

1.0 Introduction

Fruit harvesting represents a vital phase in the agricultural production cycle, with direct implications for the quality, yield, and profitability of fruit crops. Traditionally, the process of fruit picking has depended heavily on manual labor, rendering it time-consuming, labor-intensive, and subject to variability. It is recognized as the most labor-intensive component of orchard operations (Huang et al., 2023). Considering increasing global demand for fresh produce and persistent labor shortages, there is a pressing need to enhance the efficiency, consistency, and scalability of fruit harvesting practices.

As a tropical country, Malaysia supports cultivating a wide variety of fruit crops. According to crop statistics published by the Malaysian Department of Agriculture, an estimated 1,796,804 metric tons of major fruit crops including sweet lime, mango, mangosteen, pulasan, rambutan, and others, were produced in 2022, covering a total cultivated area of 198,111 hectares (Daniel Ameruddin et al., 2024). Since the early 1960s, mechanical harvesting techniques have been the subject of extensive research and practical application in agricultural operations. In contrast, conventional harvesting techniques remain highly labor-intensive and are generally considered inefficient in terms of both economic cost and time utilization.

In recent years, the fruit industry has become an increasingly important sector within agricultural development, with fruit harvesting identified as a critical phase in the overall production process (Zhang et al., 2024). Technological advancements in agricultural robotics, sensor systems, and artificial intelligence have created new avenues for the automation of fruit picking. Automated harvesting systems offer the potential to overcome many of the limitations associated with manual labor by providing consistent performance, reducing labor dependency, and minimizing fruit damage. These systems commonly incorporate features such as vision-guided navigation, soft robotic grippers, and mobile platforms capable of operating within diverse orchard environments.

Despite these innovations, the development of a reliable and efficient fruit-picking system remains complex. Challenges include the variability in fruit size, shape, and ripeness; visual obstructions caused by foliage; and the fragile nature of many fruits that necessitate delicate

handling. In response to these issues, this research project aims to design and develop a practical, cost-effective, and efficient fruit picker that integrates mechanical, electronic, and intelligent components particularly suited for application in small- to medium-scale farming operations.

In recent years, various simple mechanical fruit-picking devices have been developed as cost-effective alternatives to fully automated harvesting systems. These devices have been implemented in fruit production to reduce manufacturing and operational costs; however, they still exhibit notable limitations. Common challenges include limited portability, complex operation, and inadequate mechanisms to prevent fruit damage factors that can compromise the appearance and quality of the harvested produce (Hua et al., 2018). To be effective, a portable fruit picker must feature a simple, compact structure that is lightweight, easy to carry, and safe to operate. It should also minimize potential hazards, operate with low power consumption, and maintain stability and reliability during use (Wei & Chen, 2019).

An efficient picking system should be designed not only to prevent fruit injury and accidental drops but also to maintain an appropriate stem length and incorporate sterilization of the cutting blades to reduce the risk of disease transmission between plants (Mohamed, 2017). Enhancing harvesting efficiency in such agricultural contexts requires the development and implementation of fundamentally innovative devices. These tools must combine high energy efficiency, lightweight construction, and mobility to ensure effective field performance (Antonov & Nikitenko, 2020). The ongoing advancement of intelligent agricultural technologies presents significant potential for innovation. As technological capabilities expand and application scenarios diversify, robotic harvesting systems are expected to play an increasingly vital role in modern agriculture (Hu et al., 2024).

2.0 Methodology

A wide range of simple fruit picker designs is commercially available, with pole-based models being the most widely adopted. This preference is primarily attributed to their improved safety relative to ladder-assisted harvesting methods (Daniel Ameruddin et al., 2024). Despite its importance in agricultural production, manual harvesting continues to pose significant challenges due to its physically demanding nature (Gursoy et al., 2023). The fruit picker employed in this study incorporates a mechanical design noted for its structural simplicity, high portability, user-friendly operation, and cost efficiency (Hua et al., 2018).

Material selection for each component of the device was based on key considerations such as mechanical performance, cost-effectiveness, practical usability, and availability of resources (Daniel Ameruddin et al., 2024). While mechanical fruit picking equipment offers efficiency benefits, it also carries the risk of damaging both fruits and branches during the harvesting process. This is particularly evident in vibratory harvesting techniques, where fruits may fall directly to the ground, resulting in bruising and physical damage to the produce and surrounding foliage (Zhang et al., 2024).

This project, an innovative fruit picker, features a telescopic aluminum pole that can extend up to 4 meters, enabling users to adjust its length based on their height and the position of the fruit to be harvested. This adjustable feature enhances usability and ensures effective harvesting for a variety of fruit types and tree heights.

The pole is made of lightweight yet durable aluminum, making it easy to carry and handle during prolonged use. Its sturdy construction ensures it can withstand regular field operations without bending or breaking. To enhance user comfort, the handle is ergonomically designed and constructed from lightweight aluminum with a stainless-steel grip that provides a firm,

slip-resistant hold, reducing fatigue and improving control during use. The integration of a mechanical cutter with a net-hose connected to a collection basket has significantly contributed to enhancing the efficiency and speed of the fruit harvesting process. (Anne Almendral et al., 2018).

The innovative fruit picker is equipped with a fabric mini net or basket, thoughtfully designed to catch and hold fruits immediately after cutting. This feature plays a crucial role in maintaining the quality and freshness of harvested fruits by minimizing impact and preventing bruising, especially for delicate varieties. The use of soft yet durable fabric ensures that the fruits are securely held and can be gently retrieved, making the picking process both efficient and fruit friendly.

Table 1: Mechanical Specifications of Fruit Picker

	Component	Material	Specification / Feature
1	Telescopic Pole	Aluminium	Extends to 4 meters, adjustable to suit user needs
2	Handle	Aluminium and Stainless Steel	Ergonomic design with stainless steel grip for better control
3	Basket/Net	Fabric	Mini net to catch and hold picked fruit, preventing bruising
4	Cutter Mechanism	Stainless Steel	Plier-style blade for clean cutting of fruit stems

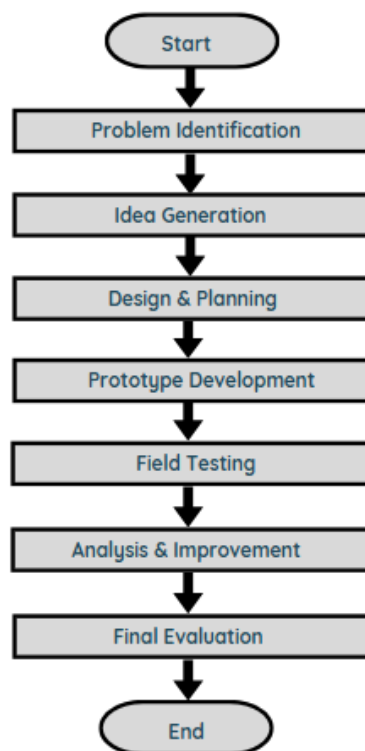


Figure 1: Flow Chart of Development of Fruit Picker

The development process of the fruit picker device was guided by a structured engineering design methodology, ensuring that each stage contributed systematically to the creation of an efficient and user-friendly harvesting tool. Figure 2 shows the final design of innovative Fruit Picker.

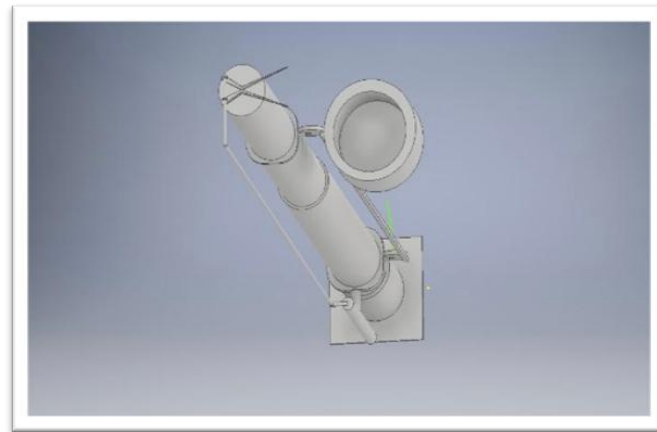


Figure 2 : Final design of Fruit Picker

3.0 Discussion

The innovation behind this fruit picker tool effectively addresses key limitations associated with traditional fruit harvesting methods. By integrating an ergonomic design—characterized by lightweight construction and adjustable height with features that enhance fruit handling, such as a fabric net and precision cutting mechanism, the device significantly improves harvesting efficiency. Furthermore, it minimizes post-harvest losses and contributes to safer, more sustainable agricultural practices.

Table 2: Comparison of time taken for fruit pickup using the Innovative Fruit Picker and Traditional Fruit Picker.

Fruit Picker				Traditional Fruit Picker		
NO	Times (seconds)	Height (m)	Fruit Condition	Times (seconds)	Height (m)	Fruit Condition
1	10	2.0	No bruise	21	2.1	Bruise or damage
2	14	3.2		28	3.4	
3	19	3.9		34	4.0	

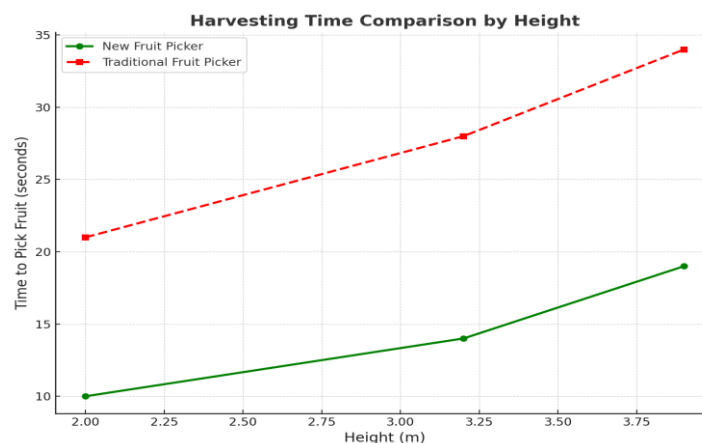


Figure 3: Harvesting time comparison by height using the Innovative Fruit Picker and Traditional Fruit Picker.

From data shows that the new fruit picker performs harvesting in less time across all tested heights. Fruit picked using the new tool is in better condition, with minimal or no bruising. The tool is more efficient and gentler, especially at higher elevations up to 4 meters.

Table 3: Impacts of Inovation Fruit Picker

NO	Criteria / Specification	Details
1	Avoid fruit damage caused by fall	Fruit Picker using fabric net to hold the fruits
2	Lightweight	The holder pole is made of aluminium, a strong yet light material.
3	Adjustable height	The picker's pole is extendable up to 4 meters.
4	Cutter Blades	The fruit cutter uses a plier-type blade mechanism.

Table 3 shows the impacts of Innovation Fruit Picker. The usage of fabric net reduces fruit bruising and spoilage, ensuring better post-harvest quality and increasing the market value of harvested fruits. The holder pole is made of aluminum, strong yet light material that provides easy use and reduces operator fatigue, making the tool more efficient and comfortable for prolonged use.

The fruit Picker, which is extendable up to 4 meters enables safe harvesting from tall trees without ladders, increasing accessibility and reducing the risk of injury. The fruit cutter uses a plier-type blade mechanism that allows clean cutting of fruit stems, minimizing damage to both fruit and tree branches for better sustainability and repeated harvesting.

4.0 Conclusion

The development of an innovative fruit picker represents a significant step toward modernizing traditional agricultural practices. By addressing common challenges such as fruit damage from falling, inefficient manual labor, and limited reach, this tool offers a practical solution that is both user-friendly and cost-effective. The integration of a fabric net, lightweight aluminum pole, adjustable height mechanism, and precision cutter blade ensures that fruits are harvested with minimal damage, improved safety and enhanced efficiency.

This innovation not only contributes to better post-harvest quality but also supports the productivity and well-being of farmers by reducing physical strain and reliance on risky manual methods. As agriculture continues to evolve, such tools play a crucial role in supporting smallholder farmers and commercial growers alike, paving the way for smarter, safer, and more sustainable farming operations.

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References

- Anne Almendral, K. M., Mae Babaran, R. G., Jones Carzon, B. C., Patrick Cu, K. K., Lalanto, J. M., & Abad, A. C. (2018). *Autonomous Fruit Harvester with Machine Vision*. www.stereolabs.com
- Antonov, S., & Nikitenko, G. (2020). *Fruit picking tool based on linear motor*. *Engineering for Rural Development*, 19, 609–613. <https://doi.org/10.22616/ERDev.2020.19.TF136>
- Daniel Ameruddin, H., Ridhuan Zafian, A., Imran Haziq Nazruddin, M., & Mariam Basharie, S. (2024). *Mechanical Fruit Picker*. 5(3), 145–150. <https://doi.org/10.30880/mari.2024.05.03.020>
- Gursoy, E., Navarro, B., Cosgun, A., Kulić, D., & Cherubini, A. (2023). *Towards vision based dual arm robotic fruit harvesting*. <http://arxiv.org/abs/2306.08729>

- Hu, S., Xin, J., Zhang, D., & Xing, G. (2024). *Research on the Design Method of Camellia oleifera Fruit Picking Machine*. Applied Sciences (Switzerland), 14(18). <https://doi.org/10.3390/app14188537>
- Hua, Y., Yang, J., Zhou, X.-G., Tin Lee, C., Zhang, N., Bai, Z., Yuan, X., Zhao, H., & Quan, L. (2018). *A Novel Portable Scissors-Type Fruit Picking Device*. International Journal of Horticultural Science and Technology, 5(2), 159–163. <https://doi.org/10.22059/ijhst.2018.266682.256>
- Huang, S., Pan, K., Wang, S., Zhu, Y., Zhang, Q., Su, X., & Yu, H. (2023). *Design and Test of an Automatic Navigation Fruit-Picking Platform*. Agriculture (Switzerland), 13(4). <https://doi.org/10.3390/agriculture13040882>
- Mohamed, T. H. A. (2017). *An Innovative System for Picking Mango Fruit*. In J. Soil Sci. and Agric. Eng., Mansoura Univ (Vol. 8, Issue 9).
- Wei, X., & Chen, Y. (2019). *An efficient portable fruit picker*. Journal of Physics: Conference Series, 1168(2). <https://doi.org/10.1088/1742-6596/1168/2/022084>
- Zhang, J., Kang, N., Qu, Q., Zhou, L., & Zhang, H. (2024). *Automatic fruit picking technology: a comprehensive review of research advances*. Artificial Intelligence Review, 57(3). <https://doi.org/10.1007/s10462-023-10674-2>