Detecting Small Objects Using a Smartphone and Neon Camera

Lianly Rompis*, Julie Rante, and Indah Yessi Kairupan
Universitas Katolik De La Salle, Manado, Indonesia
Email: {jrante, ikairupan}@unikadelasalle.ac.id (J.R., I.Y.K.)
*Correspondence: lrompis@unikadelasalle.ac.id (L.R.).

***Abstract*—In daily life, humans often encounter difficulties when performing activities such as working or learning, particularly when handling small components such as needles, screws, clips, coin batteries and electronic components. These objects are frequently dropped and finding them can consume extra time and energy. Additionally, they pose a danger to babies and children while they are playing around.**

Given that smartphones have become essential devices for communication and are highly versatile, easily used both at work and at home, the research team from the Faculty of Engineering was motivated to study how to optimize the use of smartphones for detecting small objects. The research methodology included a literature review, observation, and analysis using a smartphone and neon camera application. This application was selected due to its unique characteristics to produce a perfect black background and color image frame.

Five small components were chosen as samples for the research: needles, screws, clips, coin batteries, and transparent Light Emitting Diodes (LEDs).

The results provide a fundamental understanding for further development of using neon cameras to detect small objects.

***Keywords*—small objects, detection, smartphones, cameras, neon**

I. Introduction

Personally, we may have encountered challenges when working with small components. For example, while sewing a bed sheet, the needle we were using might have fallen onto the floor or bed. Another issue is when installing a cupboard or door handle, we may accidentally drop a small screw and find it difficult to locate. In the engineering field, while fixing electronic equipment, a component may become detached and be difficult to find, even with the help of a broom.

These situations can greatly hinder the progress of our work and can also be dangerous, especially if there are babies or children playing or sleeping on the floor. If the fallen object is not found immediately, it can cause injury. Often, these components are dropped or scattered unintentionally, leading to additional time and effort spent searching for them.

The importance of human intelligence and smartphone technology has motivated a team from the Faculty of Engineering at Universitas Katolik De La Salle Manado to conduct basic research to find effective solutions to the problems encountered. Our team will develop a method for detecting small objects using smartphones and neon cameras. Currently, smartphones are widely used as a communication tool both at home and outside. The smartphone's camera can capture images of small objects in this study, and the neon camera application through color gradations enhances the appearance on the camera screen, allowing for adjustments to lighting and providing a clearer view of the frame of small objects.

Specifically, this study by a team of three research lecturers aims to detect five small objects that are difficult to locate and can be easily seen when dropped or scattered. These objects are needles, screws, clips, coin batteries, and transparent colored LED components.

This research is of high importance and urgency to be applied in the field, as people generally use small components in their work, both at home and in the office, as well as in assembly plants.

This technology will be useful for society, as people currently use smartphones for communication and entertainment. In offices and assembly factories, the results of this study will make a significant contribution, as there are procedures where employees cannot solely rely on machines or computers and must perform the work manually. When small components are required, smartphones and their supporting applications can be used as tools to assist humans, particularly in detecting the presence of these small components.

II. Basic Concept

Small object detection has become an essential issue and important discussion in computer vision for quite a long time. Small object detection has been applied in many sectors, such as intelligent traffic transportation, industrial automation, and other fields [1].

A. Small Object Detector

In few years lately, the making of an application has been done a lot for supporting disable persons, especially

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blind people, in recognizing the surrounding objects. The research in [2, 3] have discussed the making of an application to assist blind people to detect object using smartphone, and it is already usual to see people using smartphone applications nowadays in the era of digital transformation.

B. Neon Camera

The use of Neon Camera has been widely enjoyed by many people. As in research [4], the use of this technology is used in the fisheries industry such as sea fishing for fishermen. To attract the attention of marine animals, many fishermen experience several difficulties in carrying out their activities. Therefore, a technology was created that uses neon lights to attract pelagic fish. The tool was built with the concept of lifting nets using light with 2 types of classification, namely lift nets and haul nets. The two charts are combined with 3 types of lights that alternate with each other to attract the fish's attention. Knowing the use of neon lights is very useful in supporting human work, it is not an obstacle to developing the concept for neon lights into camera neon which is supported by the advantages possessed by the camera itself.

C. Smartphone and Image Processing

During the pandemic, the benefits of using smartphones increased. Social restrictions that are strictly maintained by the government have made workers, students, and even domestic workers carry out their duties with the help of smartphones. Viewed from the positive side, smartphones are very beneficial and help humans in this very limited era. In the last 4 years of research, researchers saw an enormous opportunity to link their research in image processing [5–9] including hardware and algorithm [10–12].

III. Methodology

This research was conducted in three procedural steps: library research, observation, as well as analysis.

A. Literature Study

Literature study is the first step taken to study the literature of small object detection and image processing. We studied the basic concept of those parameters.

B. Observation

The next step is to do an observation to study Neon Camera application and its characteristics in displaying small objects. We studied the use of Neon Camera application and how it works to detect an object, especially small objects. In this research we did observations for 5 (five) small components: needle, screw, clip, coin battery, and transparent Light Emitting Diode (LED).

C. Analysis

The last step is to conduct an analysis. An analysis is carried out to determine the appropriate procedures and methods so that the ability of Neon Camera to detect small objects can be improved and recommended for the best expected results.

Our research methodology is described in the following Fig. 1.

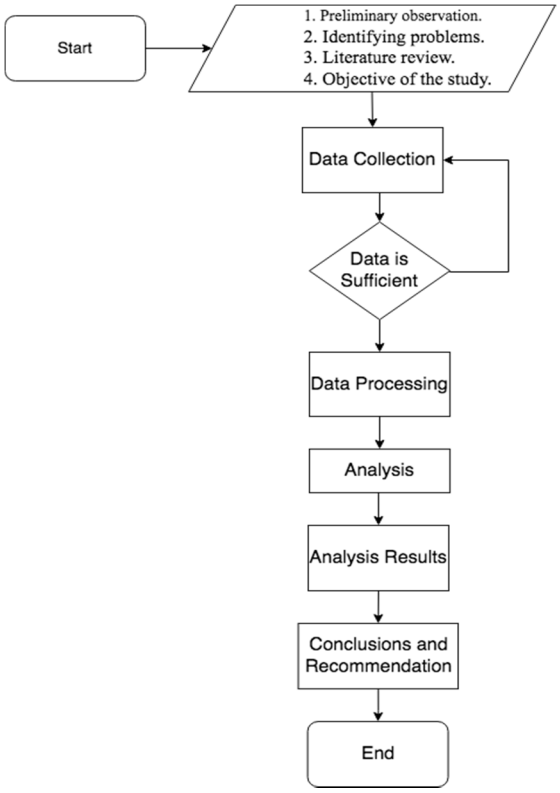


Figure 1. Flowchart of our research methodology.

So, basically what we wanted to do in this basic research is to use Smartphone and Neon Camera to overcome difficulties in human daily life while dropping small components or items and hard to find them again in a short time.

IV. Results and Analysis

A. Results

From our observation, neon camera application displayed a black background and color frame of image as shown in Fig. 2.

Figure 2. A screw, LED, coin battery, clips, and needle were putted on a table and detected by neon camera application using smartphone.

When we did indoor research, we threw some coins on the floor and detected using neon camera, we got a result as shown in Fig. 3.

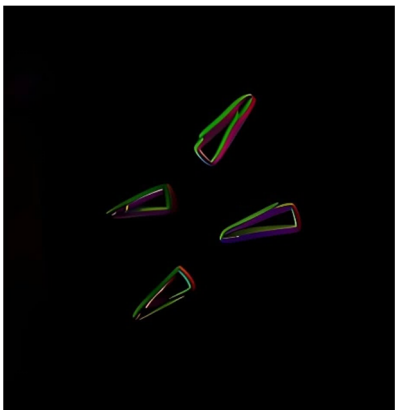


Figure 3. The frame of clips detected by neon camera (in the afternoon and cloudy weather).

Another indoor research with a little lighting from a lamp gave different displays of detection. As shown in Fig. 4. The displays shown on the smartphone screen were brighter.

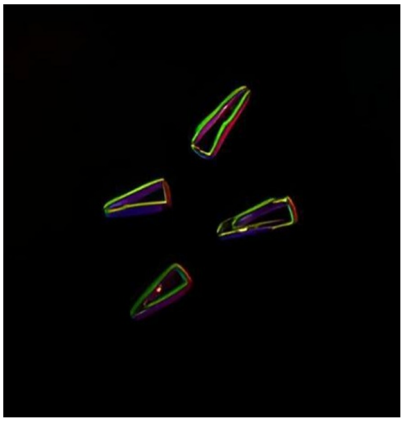


Figure 4. The frame of clips detected by neon camera (with a little light from a lamp).

In fact, neon camera application does not have a zoom feature. So, it is quite difficult to see clearly when the small objects are scattered on the floor as been described in Fig. 5.

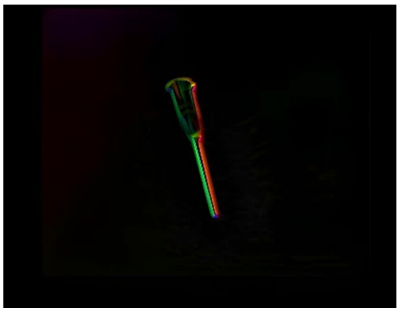


Figure 5. A needle on the floor detected by neon camera.

We can take a picture and then zoom to get bigger picture, but it gives blurry result as can be seen in Figure 6.

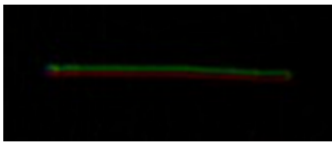


Figure 6. Blurry image of needle on the floor after being zoomed.

It is not practical to detect and then screenshot and zoom the picture. We need a flexible detection. So, the only thing we can do is to bring our smartphone close to the floor so we can get a clear frame of image for better detection. This made a detection on the table or on the bedsheet are more preferred

B. Analysis

After several research being done, we got two important findings: a solid background supports better display of detection and does not bring any noise from other frames of background patterns (Fig. 7 and Fig. 8) and an additional light shining on the objects being detected will brighter the frame of the picture (Fig. 9). We can clearly see the difference between both pictures.

Figure 7. A pattern background interfered the detection of an object using neon camera.

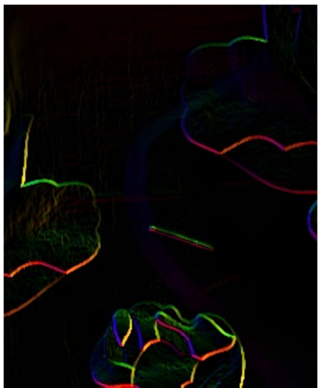
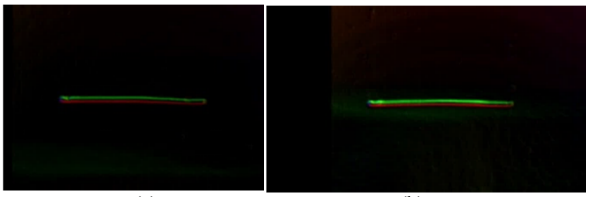


Figure 8. A solid background supports better detection of an object.



(a) (b)

Figure 9. A detection of needle on the table (a) without and (b) with additional light.

V. Conclusion

Based on our research results, observations, and analysis, we can conclude that a neon camera application can be used to detect small objects with a smartphone.

Improved detection requires a solid background and additional lighting. Further research could be conducted using additional flashlights and magnifying glass structures to enhance the quality of the image, providing a clearer and sharper display of small objects located at a considerable distance, such as on the floor.

This research is fundamental and can be applied to other important detection purposes related to the characteristics of the neon camera.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

L.R. is a team leader for this research and coordinate the research activities including finalizing the final report and research paper for publication. J.R. and I.Y.K. both are conducted the research together with L.R. J.K. help prepared and analyzed the data and wrote the paper. I.Y.K help designed the flowchart of research methodology, analyzed the data, and wrote the paper. All authors had approved the final version.

References

[1] X. Gao, M. Mo, H. Wang, and J. Leng, "Recent advances in small object detection," *Journal of Data Acquisition and Processing*, vol. 36, June 2021.

[2] S. Ariyani, A. B. Nugroho, and A. S. T. Mubarok, "Alat bantu pendeteksi objek untuk tuna netra berbasis AI mobilenet pada Raspberry Pi 3B," *Jurnal Teknik Elektro dan Komputasi (ELKOM)*, vol. 4, no. 1, pp. 73-90, 2022.

[3] M. Fachriyan, "Pembangunan aplikasi pengenalan objek terdekat untuk penyandang tunanetra menggunakan Mlkit dan text to voice berbasis android," Universitas Komputer Indonesia, 2019.

[4] S. Najamuddin and M. Palo, "Efektivitas penggunaan berbagai jenis lampu listrik untuk menarik perhatian ikan pelagis kecil pada bagan tancap," *Jurnal Penelitian Perikanan Indonesia*, vol. 19, no. 3, pp.157-165, 2016.

[5] C. Bohrmann-Linde and S. Kleefeld, "Can you see the heat? — using a thermal imaging camera in the chemistry classroom," *World Journal of Chemical Education*, vol. 7, no. 2, pp. 179-184, April 2019.

[6] S. Gustafsson and A. Persson, "Detecting small and fast objects using image processing techniques," thesis, Computer Engineering, School of Engineering, Jönköping Univ., Sweden, 2021.

[7] Y. Liang, Y. Han, and F. Jiang, "Deep learning-based small object detection: a survey," presented at the 8th International Conference on Computing and Artificial Intelligence (ICCAI '22), New York, NY, USA, 2022.

[8] G. X. Hu, Z. Yang, L. Hu, L. Huang, and J. M. Han. (September 2018). Small object detection with multiscale features. *International Journal of Digital Media Broadcasting.* [Online]. Available: https://www.hindawi.com/journals/ijdmb/2018/4546896

[9] Y. Zhang, X. Guo, J. Ma *et al*., "Beyond brightening low-light images," *International Journal of Computer Vision*, vol. 129, pp. 1013–1037, January 2021.

[10] V. Rao, D. Mukherjee, and S. Savitha, "Implementation of morphological gradient algorithm for edge detection," *Lecture Notes on Data Engineering and Communications Technologies*, vol. 114, Singapore, Springer, 2022.

[11] M. Gandhi, J. Kamdar, and M. Shah. (November 2019). Preprocessing of non-symmetrical images for edge detection. Augment Hum Res. 5. [Online]. Available: https://doi.org/10.1007/s41133-019-0030-5

[12] P. Smruthi, K.B. Prajna, J. G. John, and A. T. Pasha, "Hardware implementation of machine vision system for component detection," *Lecture Notes in Electrical Engineering*, vol. 928, Springer, Singapore.