

Introduction

- Current contactless vibration measurement systems use Laser Doppler Vibrometry or expensive cameras.
- As these solutions are bulky and costly, this project aims to develop a solution utilizing mobile devices which would reduce cost and increase accessibility.



Figure 1 The LDV is used for rapid non-contact measurements of vibrations (\$500,000) [1].

Objectives

Main objective:

- Develop a cost-effective software that explores the capabilities of mobile device cameras and Lidar sensors to measure in-plane and out-of-plane vibrations of 2D and 3D surfaces.
- The new software would have a limited frequency range and resolution but would be sufficient for rapid diagnostics.

References

- [1] "Laser-Scanning-Vibrometer PSV-500-HV." *Forschungsinfrastruktur*, forschungsinfrastruktur.bmbwf.gv.at/en/fi/laser-scanning-vibrometer-psv-500-hv_3974.
[2] RDI Expands Motion Amplification® Portfolio." *RDI Technologies*, 12 July 2022, rditechnologies.com/news_post/new-portable-vibration-analysis-iris-m-traveler/.
[3] Ferrer, B., Espinosa, J., Roig, A., Perez, J., Mas, M. (2013) Vibration Frequency Measurement Using a Local Multithreshold Technique
[4] Wang, Z., & Menenti, M., (2021) Challenges and Opportunities in Lidar Remote Sensing

Research Methodology

1. Research current vibration measurement technology.



Figure 2: RDI Technology's on-the-go vibration analysis product includes a high-quality digital camera, four lenses, laptop computer, tripod and USB cable for \$32,500 [2].

2. Research articles with similar/relevant objectives

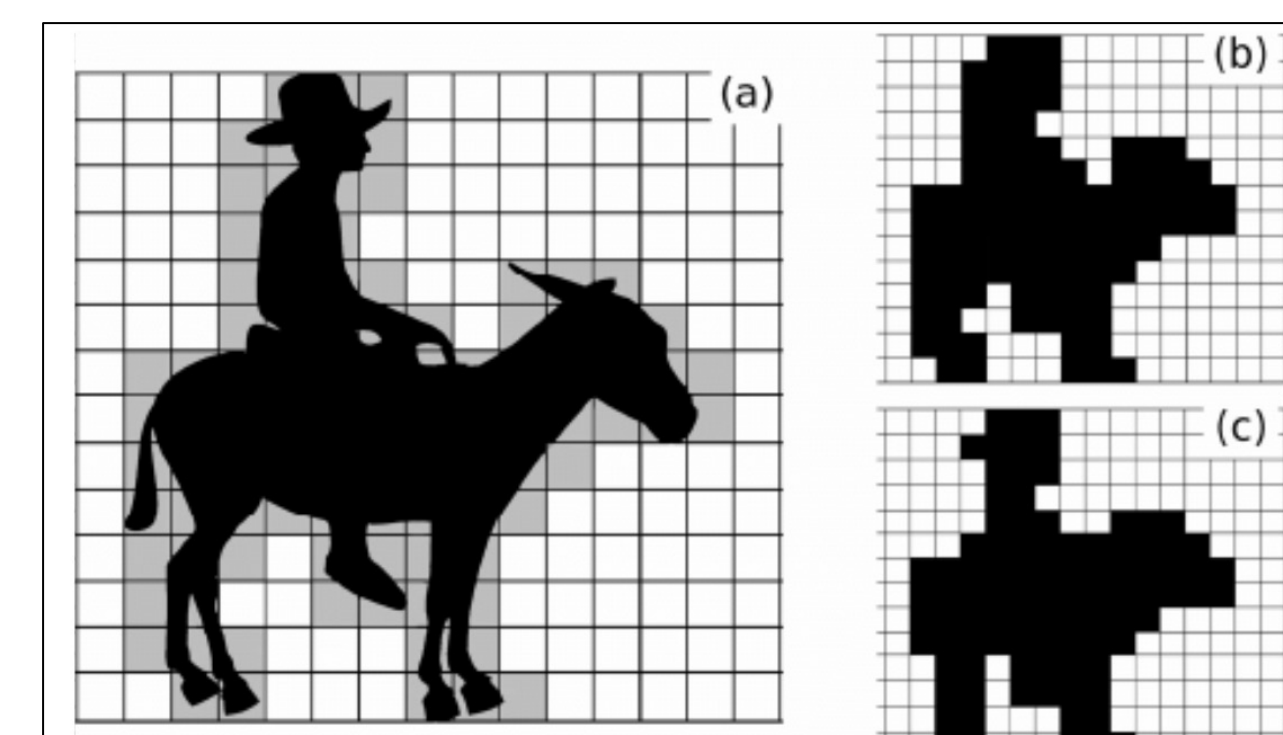


Figure 3: A study performed by the University of Alicante aims to measure vibration based on pixel displacements using low-quality videos. [3].

3. Develop an algorithm.
4. Research coding languages to identify best option for the software.
5. Begin experimental coding to identify and fix issues in the algorithm.

Results

- A new algorithm was developed that satisfies the stated objectives.

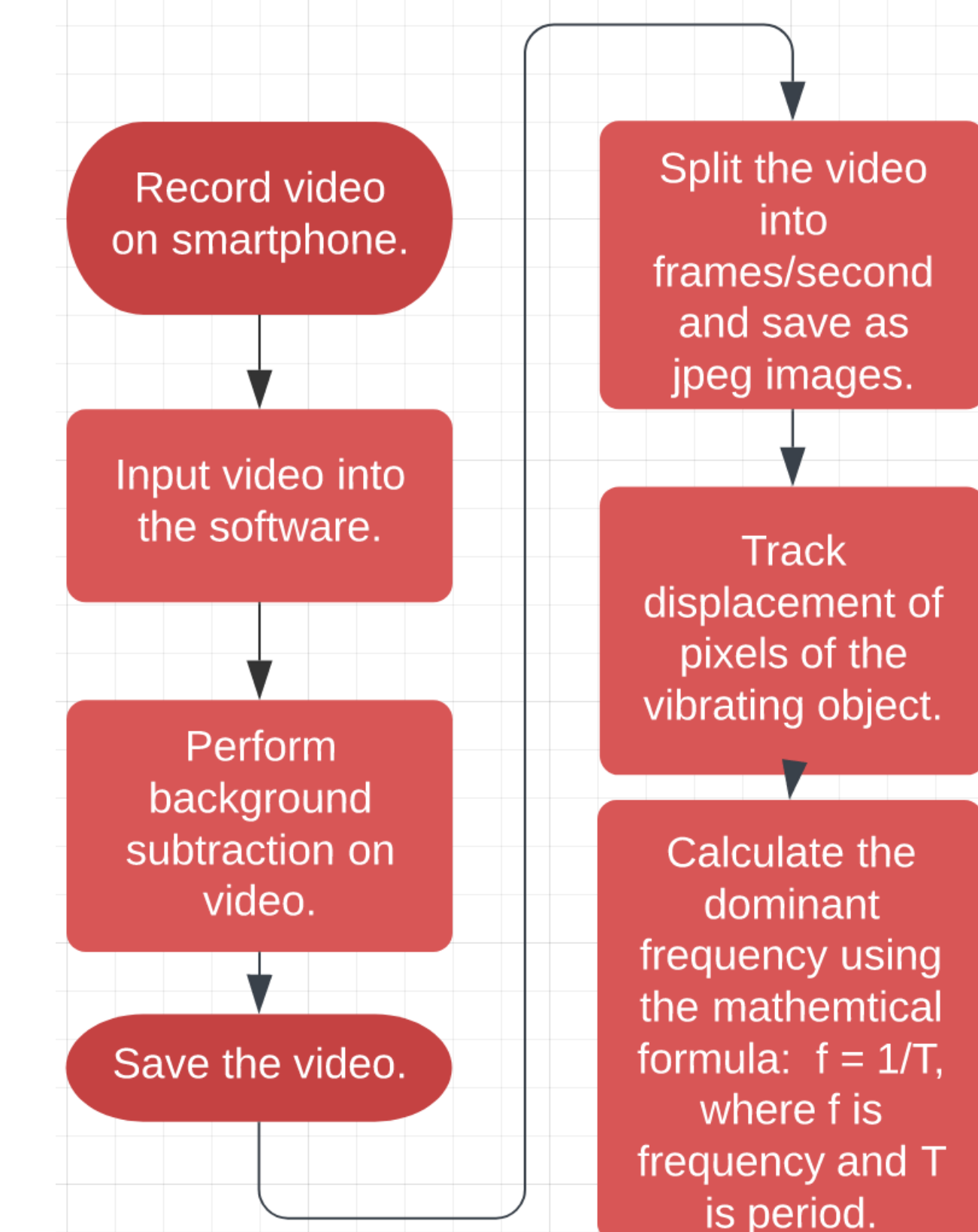


Figure 4: High level outline of the developed algorithm.

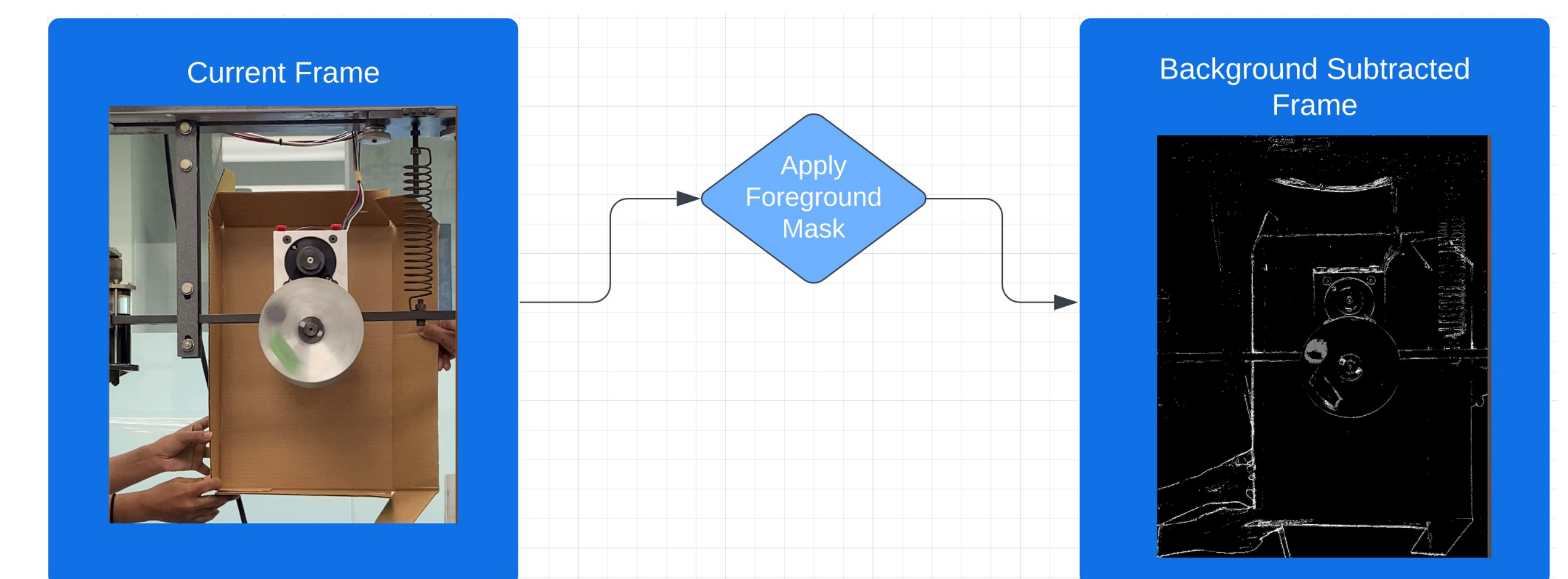


Figure 5: Background subtraction process using Python: input the video, apply foreground mask, output frames with moving objects as white, and static objects as black.

Conclusions

- An algorithm was developed to use background subtraction and pixel displacement to calculate in-plane vibrational frequency.
- Future steps explore means of tracking pixels, and how Lidar can be incorporated for extending vibration analysis to out-of-plane motion [4].