Kashif: Hybrid Buried Anti-personnel Landmines Detection System

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Team 10

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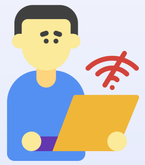
Introduction

❑Problem Statement & Objective

Over 5K people annually are killed or injured by landmines, with more than 110M still active across 60 countries. Kashif is a novel solution that brings safety and precision to demining operations. Utilizing Ground Penetrating Radar, Acoustic Sensors, and AI, Kashif is deployed on a semi-autonomous Unmanned Ground Vehicle , allowing soldiers to detect various types of landmines across vast areas without putting their lives at risk.

❑ Constraints



Function with no internet

Limited to 100K SAR

Restricted to KSA terrains

Limited advanced resources

❑ Target Specifications

Inference Time: <10s

Depth of Detection: <30cm

Safe Distance: >6m (End-user to UGV)

F1-score (accuracy): 90%

System set-up Time: <1min

Types of Landmines: > 5 types

Prototype Design

❑Ground Penetrating Radar (GPR)

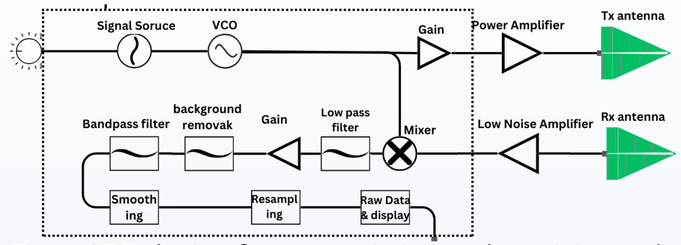
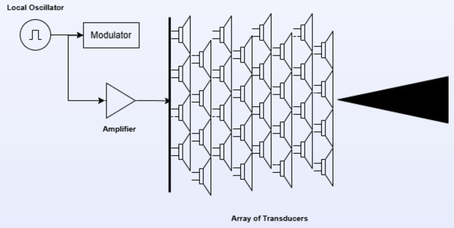


Fig 1. GPR design for transmitting and receiving radar signals (reaching 30cm depth)

❑Acoustic System (AS)



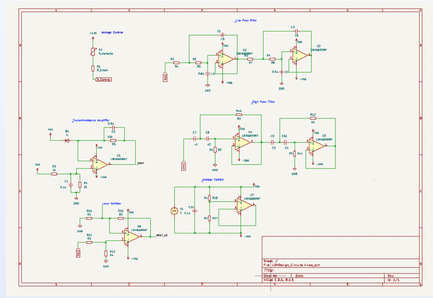


Fig 2. Parametric arrays for ground shaking and LASER for measuring the displacement differences.

❑Unmanned Ground Vehicle (UGV)

Fig 3. Final UGV design showcasing a suspension system for navigating varied terrains and a detachable sheet mechanism.

❑Computing System

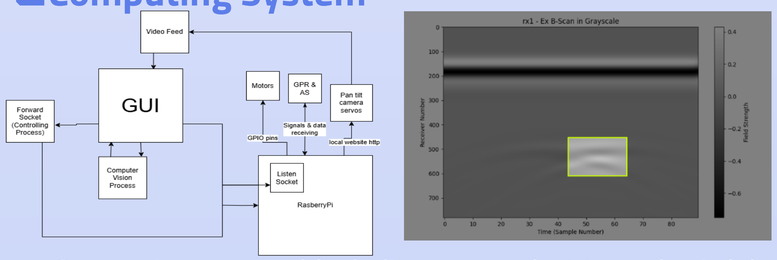


Fig 4. Computing system block diagram, and 100 synthetic labeled B scans.

Test

AS was tested in the lab, where the GPR experiments were done on sand, where the metallic landmine is object beneath the ground. Computer vision task was tested on 760 images.

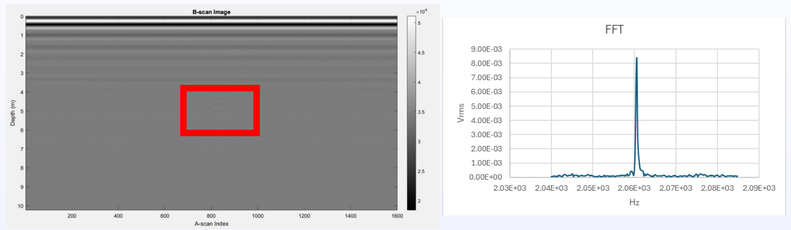


Fig 5. GPR B scan image and AS test

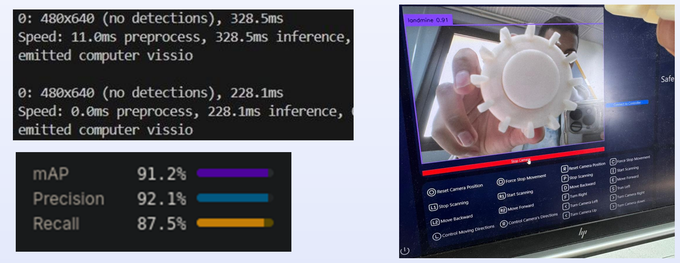


Fig 6. Computer Vision was trained on 4719 images and validated on 1235, then it was tested on 760.

Safe distance was measured to be ~12m using a LAN through ESP32

Conclusion

Kashif demonstrates the integration of ground penetrating radar (GPR) and acoustic sensors, enhanced by AI for landmine detection. This hybrid approach provide a safer, more efficient and cost-effective solution for landmine clearance, in addition to a computer vision for detecting upper mines.

Future Work

1. Secure investment to refine the prototype into a market-ready product.
2. Acquire the first customer.