

# Fine-tuned Segment Anything Model effectively extracts building features, while the Bayesian Regression model performs best by using multiple features & Horse shoe for population prediction.

## Integrating High-Resolution Imagery and Machine Learning for Small and Informal-Area Population Estimation in Melusi (Atteridgeville, Pretoria)

### INTRODUCTION

- Rapid urbanisations has increased the growth of informal settlements
- Traditional census methods in these areas are often expensive, slow and inaccurate
- This study investigates the use of drone imagery and machine learning to estimate population size and density in Melusi informal settlement, Pretoria.

### PROBLEM STATEMENT

Traditional census methods are expensive, slow and inaccurate due to:

- Rapid structural changes
- Unplanned dwelling arrangements
- Incomplete or inaccurate population records

These challenges limit accurate decision-making for policy makers, urban planners and government institutions, often resulting in inadequate service delivery and resource allocation.

### PROJECT OBJECTIVES

- Extract building features using the Segment Anything Model (SAM)
- Population estimation using Bayesian Regression model

### STUDY AREA

Melusi region in Atteridgeville, Pretoria

Characterised by informal housing and high population density



### METHODS

Given:

- High resolution drone image of the area
- Household survey for population counts

1. QGIS was used to slice the high resolution drone imagery into digestible image tiles
2. CVAT was used to annotate the images into dwellings
3. A fine-tuned Segment Anything model was used for dwelling extraction
  - A Bayesian regression model was applied for population estimation

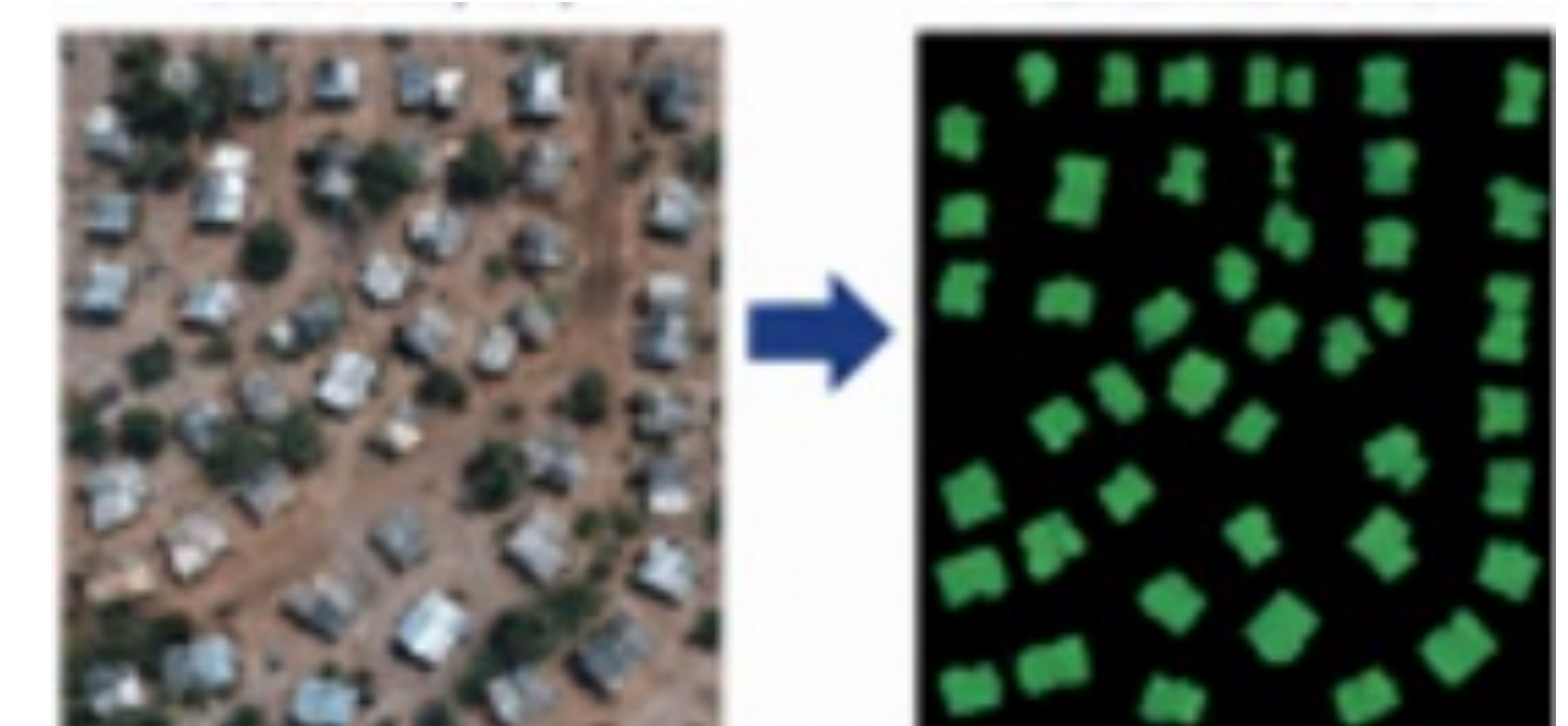
### RESULTS & DISCUSSION

#### Fine-Tuned Segmentation model

Mean IOU	Mean Dice Coeff	Recall	Precision
88.6%	94.3%	93.8%	95%

- The fine-tuned SAM model effectively extracts building footprints in dense informal settlements with high accuracy levels.
- This results in reliable derivation of building density metrics for population estimation

Drone image      Predicted Segmentation



#### Bayesian Regression

- M1: Area only | M2: Multi-features | M3: M2 & Horseshoe

Model	MAE	RMSE
M1	0.84	1.02
M2	0.79	1.05
M3	0.71	0.93

- This model showed great potential predictive power but lower accuracy due to limitations in labelled data.
- Further model refinement and accurate training data is required for reliable operational deployment.

 Kgoboko Maripane, Thabo Chesane

Department of Computer Science

Faculty of Engineering,  
Built Environment and  
Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en  
Inligtingtegnologie / Lefapha la Boetšenere,  
Tikologo ya Kago le Theknolotši ya Tshedimošo

Capstone Project - MIT 808

Course Coordinators:

Dr. Vukosi Marivate (vukosi.marivate@cs.up.ac.za)  
Abiodun Modupe (abiodun.modupe@cs.up.ac.za)

