PUSHPIN

Highest-accuracy, fastest turnaround, lowest cost **parcel change detection**

OVERVIEW

WHO ARE WE?

WHAT MAKES US BETTER?

DEMONSTRATION

NEXT STEPS

COMPANY

FOUNDED IN 2015

BASED IN MINNEAPOLIS

24-PERSON COMPANY

- 3 principals, 3 consultants, and 18 analysts

FLAGSHIP PRODUCT IS PUSHPIN PLATFORM

- Stems from map challenges at founder's previous company
- Deep learning applied to aerial imagery
- Human + machine symbiosis
- Two pending patents; more in the pipeline

Change Report
Edina

| | Overview | Map | Changes | Tax Impact | Sectors |

Overview

Project Name	Edina	
Created	August 11, 2017	
Sectors	53	
Total Parcels	11,637	
Changed Parcels	1,562	13%
Unchanged Parcels	10,075	87%
Reviewed Parcels	1,164	10%
Reviewer Agreement	1,081	93%
Assessed Value Increase	$72,490,000	
Annual Tax Increase	$724,900	
Old Imagery	http://gis.hennepin.us/arcgis/services/imagery/UTM_Aerial_2009/MapServer/WMSServer?request=GetCapabilities&service=WMS	
New Imagery	http://gis.hennepin.us/arcgis/services/imagery/UTM_Aerial_2015/MapServer/WMSServer?request=GetCapabilities&service=WMS	

Map

Changes

Type	Count	Frequency
Addition	424	3.6%
Construction	33	0.3%

PRINCIPALS

RANDY MILBERT
Founder and President

Graduated from MIT in 2000; founded Primordial in 2002; secured $15M in government contracts for Ground Guidance off-road route planning software; sold government-wide Ground Guidance license in 2012; sold company to Polaris Industries (NYSE:PII) in 2013

ANDREAS ROBINSON
Chief Technology Officer

Graduated from the University of Minnesota in 2004 with master's in computer science; joined Primordial in 2006; led multimillion dollar Army, Air Force, and DARPA projects; developed machine learning algorithms for extracting features from satellite imagery
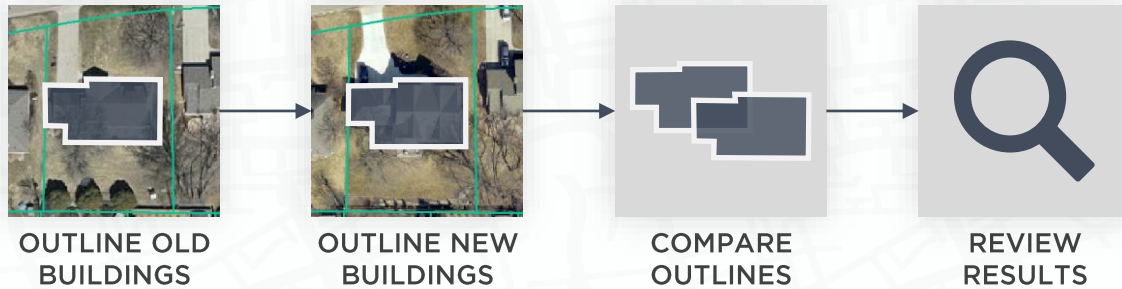
GRADY HANNAH
VP Business Development

Technology sales and business development veteran; spent 15 years in senior roles in tech-forward Silicon Valley companies; sold ground-based image capture technology to assessor market at Facet Technologies; responsible for Pushpin sales and marketing
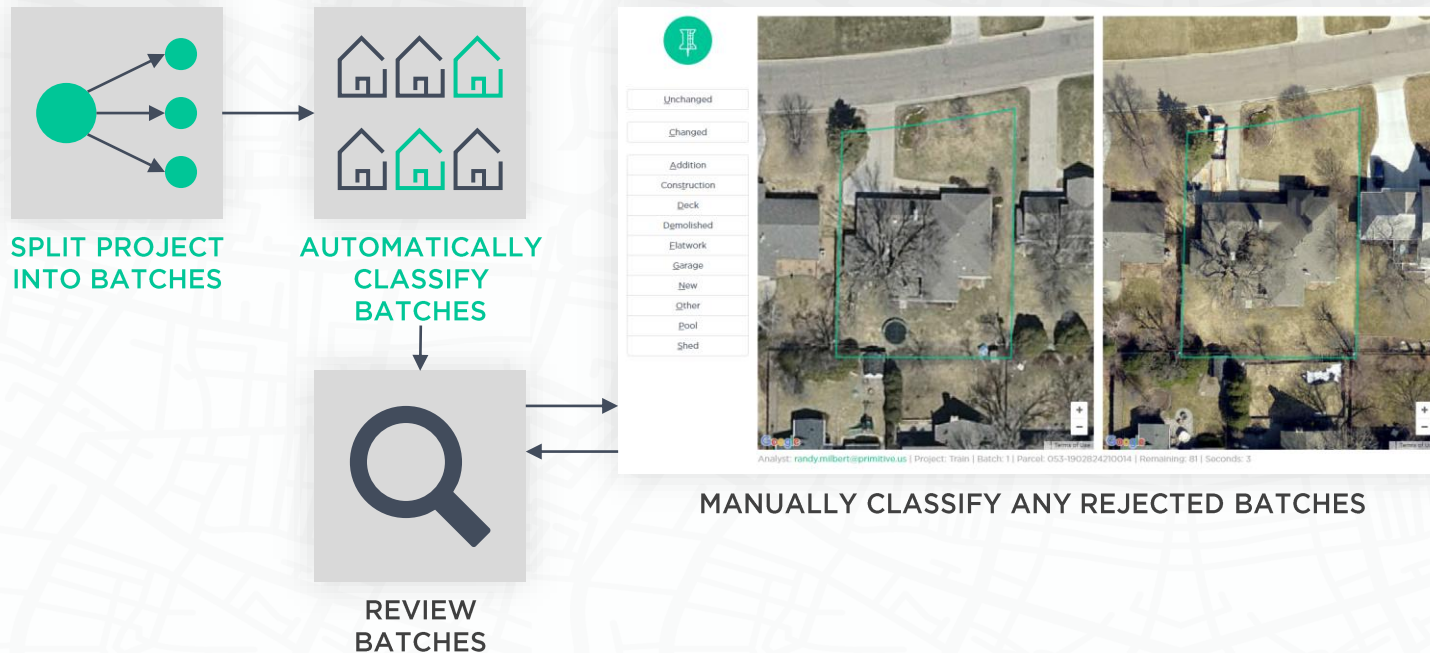
WHAT MAKES US BETTER?

COMPETITION

Manual **Automated**

OUTLINE OLD BUILDINGS → **OUTLINE NEW BUILDINGS** → **COMPARE OUTLINES** → **REVIEW RESULTS**

PUSHPIN

SPLIT PROJECT INTO BATCHES → **AUTOMATICALLY CLASSIFY BATCHES** → **REVIEW BATCHES**

MANUALLY CLASSIFY ANY REJECTED BATCHES

Unchanged
Changed
Addition
Construction
Deck
Demolished
Flatwork
Garage
New
Other
Pool
Shed

ADVANTAGES

ALL PARCEL CHANGES
Pushpin recognizes all parcel changes, not just main structure changes

CATEGORIZED RESULTS
Pushpin classifies changes into 10 categories, facilitating prioritization

< 4 WEEK TURNAROUND
Pushpin is 10X faster, completing countywide projects in weeks

25¢ PER PARCEL
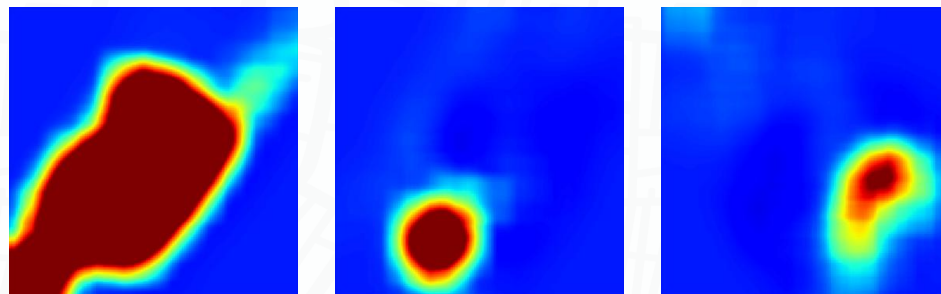Pushpin is 3X cheaper, charging just 25¢ per parcel for 100K+ parcels

AUTOMATIC CLASSIFIER

1 **START WITH A CUSTOM NEURAL NETWORK BASED ON RESNET 50**

- ResNet 50 is the 50-layer residual network that won the ImageNet Large Scale Visual Recognition Competition (ILSVRC) in 2015
- Pushpin customized this network for parcel change detection (e.g. supporting two input images)

2 **PRETRAIN USING IMAGENET DATASET**

- Pushpin pretrained the network using the ImageNet dataset
- This dataset includes 1.2 million images of everyday objects manually classified into 1,000 categories

3 **TRAIN USING PUSHPIN PARCEL DATASET**

- Pushpin further trained the network using 400K image pairs manually classified as changed or unchanged
- Changed parcels also include one or change type (addition, construction, deck, demolished, flatwork, garage, new, other, pool, shed)

6

CHANGE HEATMAPS

CHANGED   **UNCHANGED**

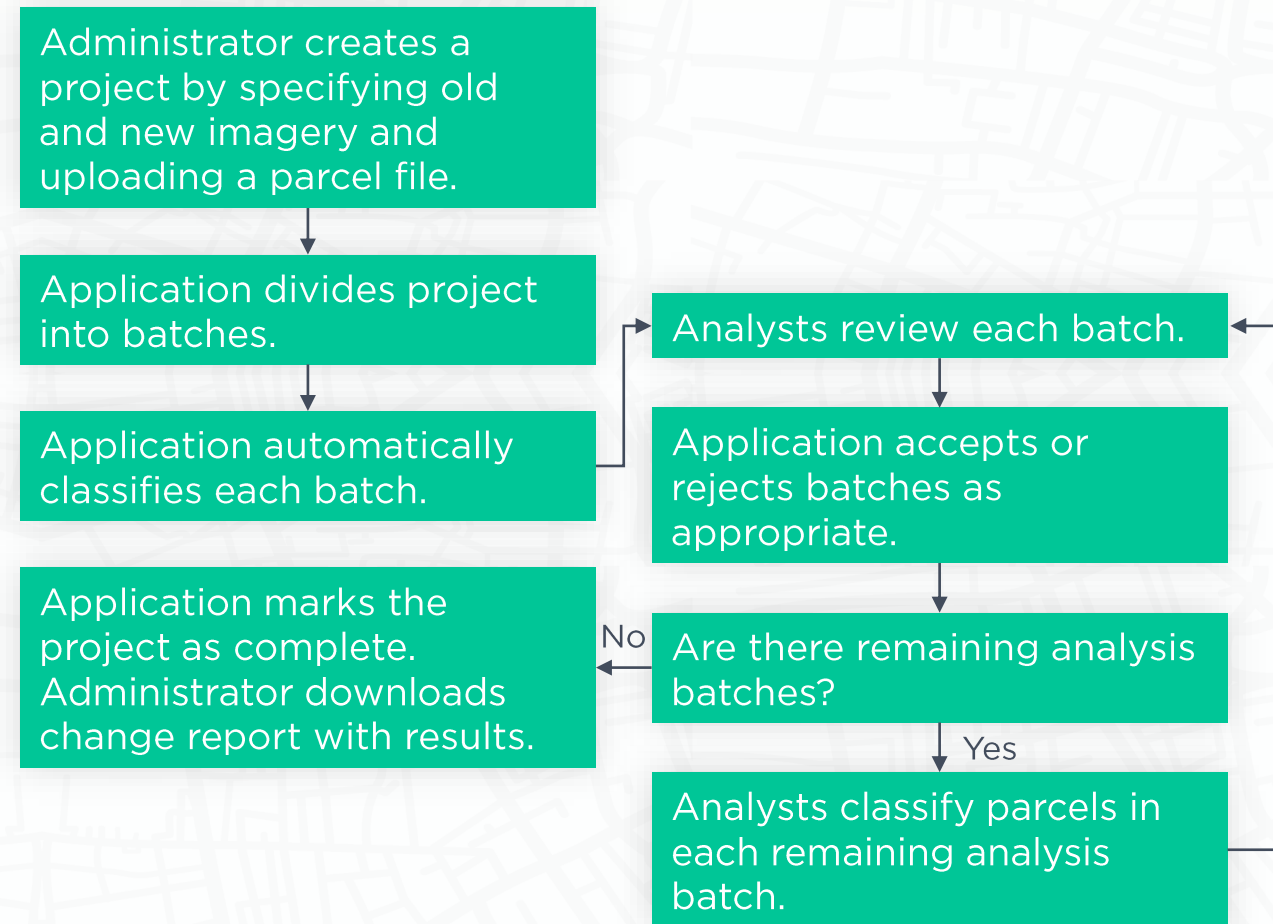|	CHANGED			UNCHANGED		
OLD						
NEW						
HEATMAP						
OUTPUT	1	1	1	0.000491	0.000605	0.000645

PENDING PATENT

UNITED STATES PROVISIONAL PATENT APPLICATION

INVENTORS: Randy Milbert and Andreas Robinson

FILED: September 21, 2017

ABSTRACT:

The present disclosure is a computer-implemented method for identifying property changes by analyzing differences between old and new imagery. An administrator begins by providing links to old imagery, new imagery, and a parcel file. The application then divides the project into batches and automatically classifies each batch. Analysts review these batches and reject those that are insufficiently accurate. Analysts manually classify rejected batches. Once all batches are accepted, the administrator can download a change report. The change report includes overall project statistics, a breakdown of changes by type, a heatmap showing areas of rapid change, and an estimated tax impact. The application also divides the results into geographic sectors to facilitate fieldwork.

Administrator creates a project by specifying old and new imagery and uploading a parcel file.

↓

Application divides project into batches.

↓

Application automatically classifies each batch.

Analysts review each batch.

↓

Application accepts or rejects batches as appropriate.

↓

Are there remaining analysis batches?

No →

Yes ↓

Analysts classify parcels in each remaining analysis batch.

Application marks the project as complete. Administrator downloads change report with results.

SAMPLE CUSTOMERS

PAYING

MARICOPA COUNTY, AZ

LEE COUNTY, FL

TRAVIS COUNTY, TX

CARSON CITY, NV

HILLSBOROUGH COUNTY, FL

TRIAL

HARRIS COUNTY, TX

SCOTT COUNTY, IA

DUVAL COUNTY, FL

SUMTER COUNTY, FL

ATCHISON COUNTY, KS

TESTIMONIALS

"Pushpin is applying to real property assessment the same kind of artificial intelligence algorithms that Google uses in its autonomous cars. Our testbed was a set of four areas of the county, each of which presents a different challenge for change detection via aerial photography. After we examined these small pilot areas with this constantly learning technology, we believe our office has a new opportunity to improve the accuracy, turnaround time, and cost for detecting a variety of changes."

ERIC BAILS   **Chief Technology Officer, Maricopa County Assessor, Arizona**

"We fly new aerial photographs of Lee County every year to help with our parcel inspection and valuation process. Pushpin allows us to leverage that investment by identifying changes in parcels without costly on-site inspections. Having a full accounting of new construction, additions and demolitions is important in developing a fair and equitable tax roll for everyone. Pushpin is a great new tool we plan on utilizing to increase the accuracy of our data collection process."

KEN WILKINSON   **Property Appraiser, Lee County, Florida**

"Pushpin enabled us to analyze our zone 3 properties in a fraction of the time and cost that was previously possible. We performed a careful review of the results and were so pleased that we asked Pushpin to analyze our zone 4 properties in the next fiscal year. We enjoy working with innovative partners like Pushpin that enable us to lower costs and increase efficiency."

BOB HENRIQUEZ   **Property Appraiser, Hillsborough County, Florida**

DEMONSTRATION

- Review change detection case studies
- Review sample change report

NEXT STEPS

START A FREE TRIAL

- We will analyze 1,000 parcels in your county for free
- We will deliver a detailed change report plus a spreadsheet highlighting changes
- We will complete the project within 5 business days

CONSIDER USING US FOR YOUR ENTIRE COUNTY

- If the trial goes well, hire us to perform change detection for your entire county
- We have the highest accuracy, fastest turnaround, lowest cost solution

RANDY MILBERT

Founder and President

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