



SAFEDETECT

Safety Within Earshot



The Problem & Market Opportunity

Our Solution

Technical Details

Results

Competitive Analysis

LATEST NEWS

4 dead, 6 wounded in mass shooting in southeast Fresno home.

BY JOSHUA TEHEE, BRIANNA CALIX, AND LARRY VALENZ

NOVEMBER 17, 2019 08:46 PM

Two children killed, gunman dead at O'Connell's in San Francisco Bay Area

UPDATED ON: JULY 29, 2019 / 11:25 PM / CBS 5

1 possible victim in shooting, police say

Updated Nov 16, 10:29 AM; Posted Nov 16, 8:03 AM

The Steady Rise Of U.S. Gun Deaths

Number of U.S. gun deaths due to firearms (1999–2017)*



@StatistaCharts

* Deaths classified as unintentional, suicide, homicide, undetermined and legal intervention/operations of war.

Source: Centers For Disease Control and Prevention

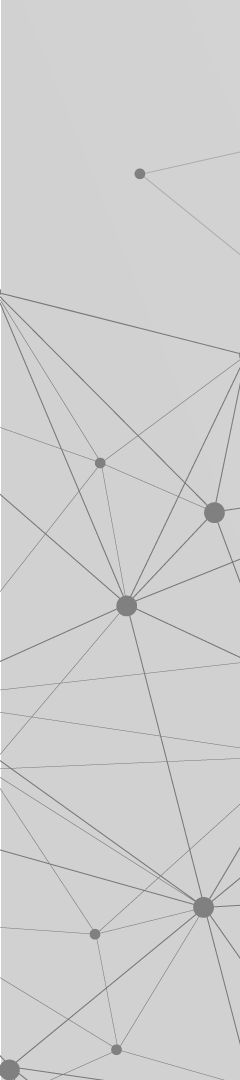
statista

at Walmart na: 'The re it hurts'

tin Bureau USA TODAY NETWORK

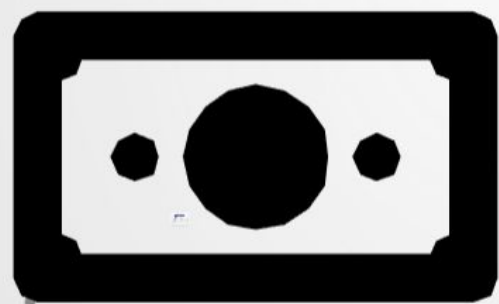
ET Nov. 18, 2019

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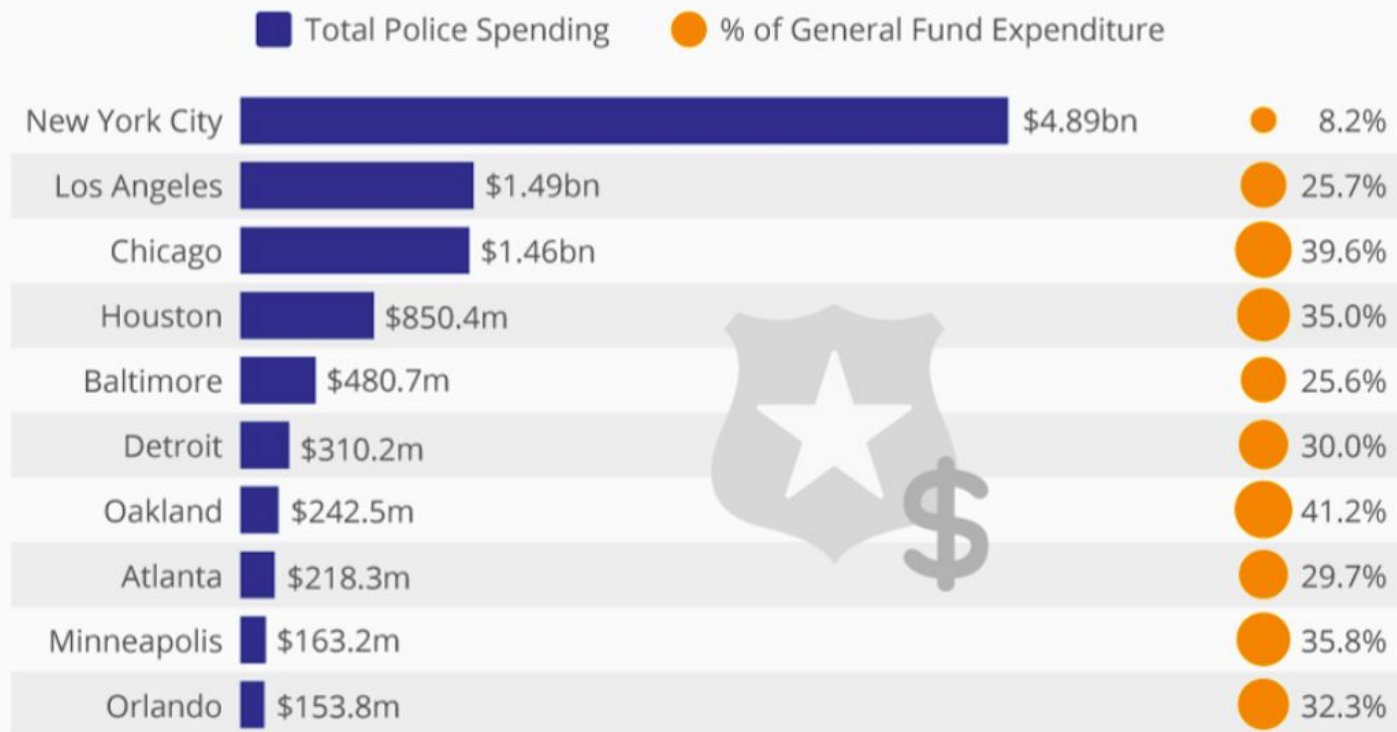
ANIMATRON



Birmingham	AL	Fort Myers	FL	Cambridge	MA	Plainfield	NJ
Montgomery	AL	Gladeview	FL	Chelsea	MA	Pleasantville	NJ
Little Rock	AR	Hillsborough	FL	Everett	MA	Trenton	NJ
Glendale	AZ	Jacksonville	FL	New Bedford	MA	Las Vegas	NV
Nassau	Bahamas	Lake Park	FL	Pittsfield	MA	Elmont (Nassau County)	NY
Bakersfield	CA	Miami	FL	Revere	MA	Freeport (Nassau County)	NY
East Palo Alto	CA	Miami-Dade County	FL	Somerville	MA	Hempstead	NY
Fresno	CA	Miami Gardens	FL	Springfield	MA	Long Beach	NY
Oakland	CA	Palm Beach County	FL	Worcester	MA	Newburgh	NY
Redwood City	CA	Riviera Beach	FL	Minneapolis	MN	New York City	NY
Richmond	CA	Tampa	FL	Jennings (STL County)	MO	Rochester	NY
Sacramento County	CA	West Palm Beach	FL	Kansas City	MO	Syracuse	NY
Sacramento	CA	Atlanta	GA	Moline Acres (STL County)	MO	Roosevelt (Nassau Co)	NY
Salinas	CA	Savannah	GA	St. Louis	MO	Uniondale (Nassau Co)	NY
San Diego	CA	Calumet City	IL	Goldsboro	NC	Cincinnati	OH
San Francisco	CA	Chicago	IL	Greenville	NC	Columbus	OH
San Mateo County	CA	Peoria	IL	Rocky Mount	NC	Toledo	OH
San Pablo	CA	Rockford	IL	Wilmington	NC	Youngstown	OH
Stockton	CA	East Chicago	IN	Omaha	NE	Pittsburgh	PA
Denver	CO	South Bend	IN	Atlantic City	NJ	Cape Town	South Africa
Bridgeport	CT	Louisville	KY	Camden	NJ	Columbia	SC
Hartford	CT	Baton Rouge	LA	East Orange	NJ	Jackson	TN
New Haven	CT	Baltimore	MD	Newark	NJ	Newport News	VA
Washington DC	DC	Boston	MA	Paterson	NJ	Milwaukee	WI
Wilmington	DE	Brockton	MA	Piscataway	NJ		

How Much Do U.S. Cities Spend On Policing?

Total police budget and share of cities' general fund expenditure in 2017*



* Selected cities

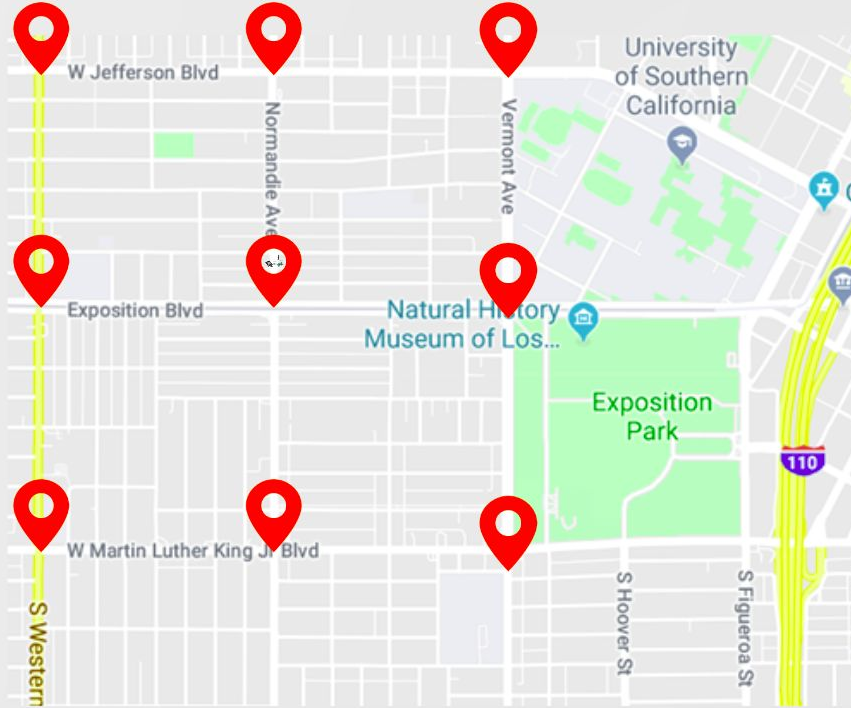


@StatistaCharts

Sources: The Center for Popular Democracy,
Law for Black Lives, Black Youth Project 100

statista

Introducing SafeDetect

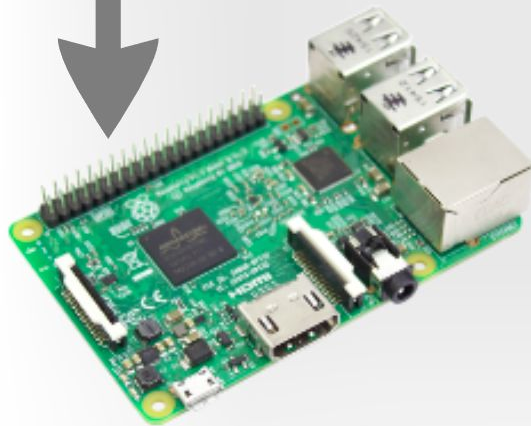


Network: A unit on each block

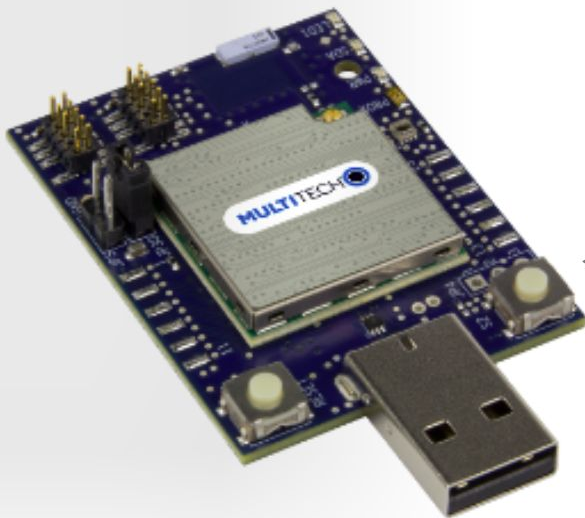
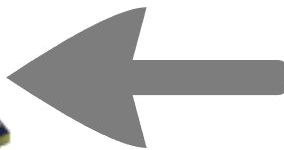
Each Unit will be based around an xDot Multitech chip



Microphone
streams audio
to Raspberry Pi



Raspberry Pi
sends results
to xDot





R-Pi

X-Dot

Microphone





Microphone

R-Pi

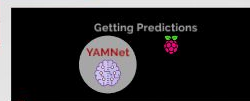
X-Dot

Processing and Buffer Audio Data

Thread #1



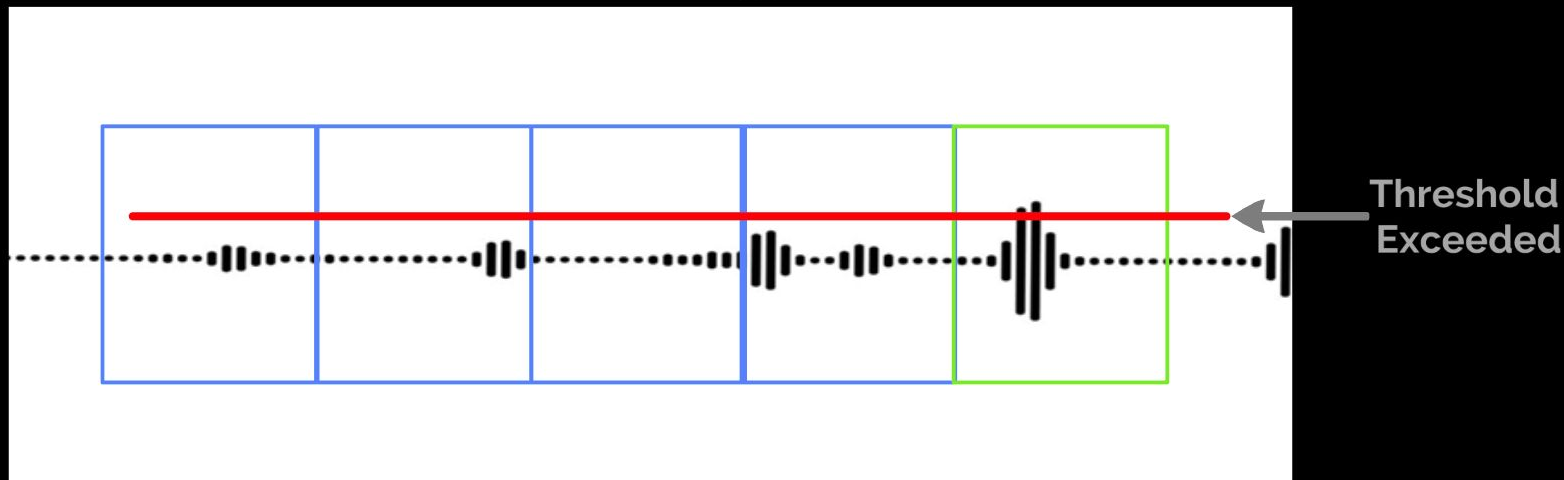
Thread #2



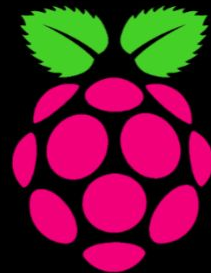
Main Thread



Streaming Data



Getting Predictions

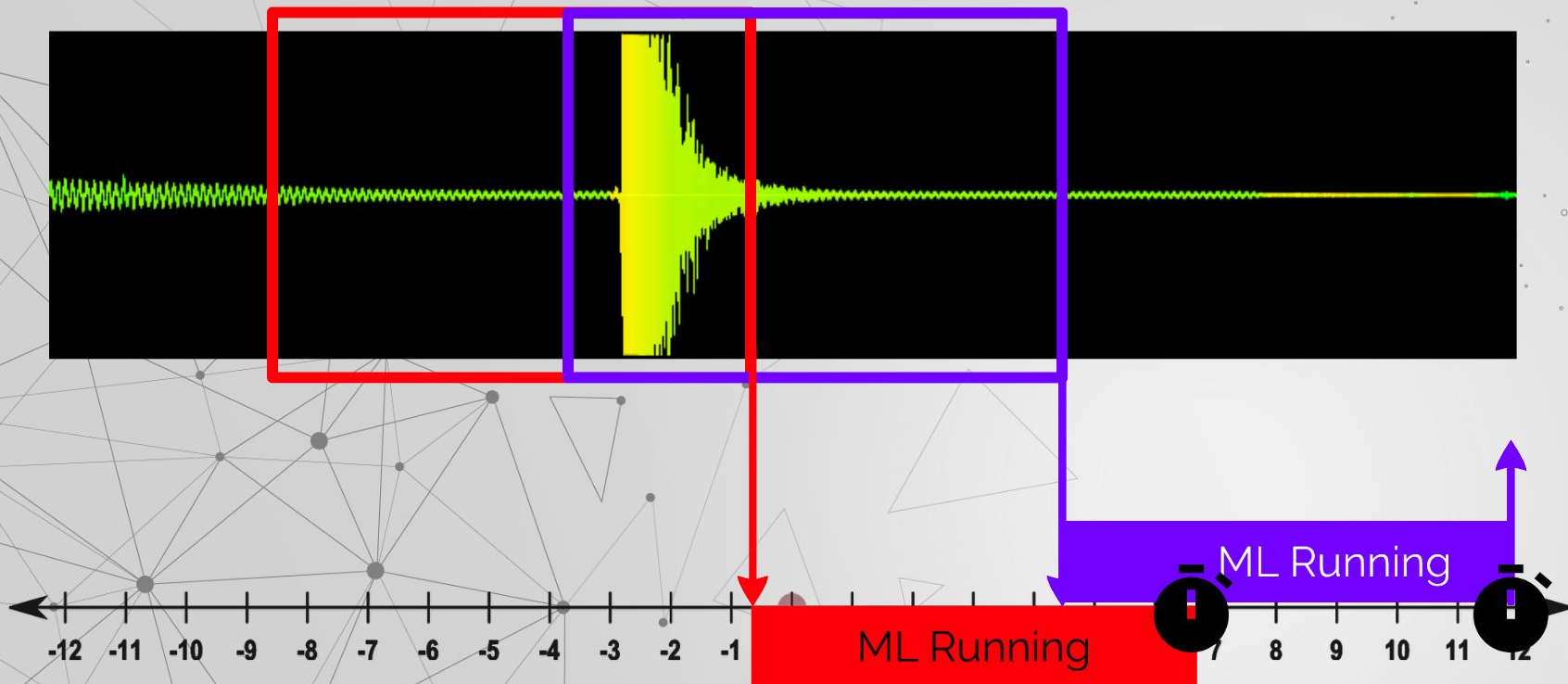


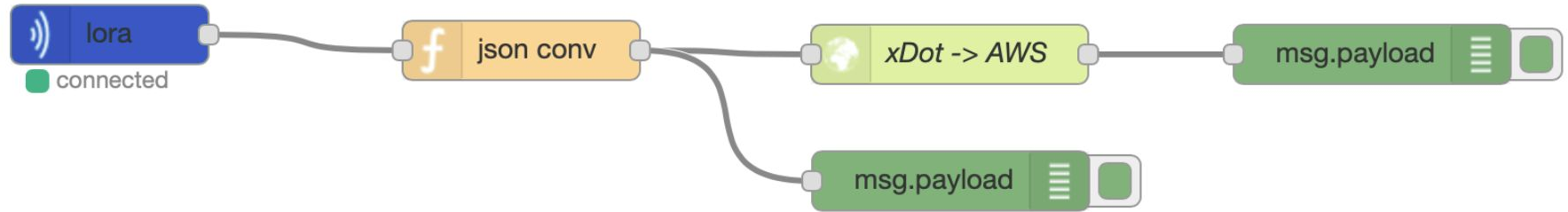
```

118 // Set the Data Rate to maximum
119 if (dot->setTxDataRate(max_dr) != mDot::MDOT_OK) {
120     logError("failed to set TX datarate to DR1");
121 }
122 pc.printf("TX DR: %i\r", dot->getTxDataRate());
123
124 int ARR_SIZE = dot->getNextTxMaxSize(); // get the max packet size
125 ARR_SIZE -= 5; // for the commas & colons in there
126 char arr[ARR_SIZE];
127 int sig_start = 0;
128 std::vector<uint8_t> tx_data;
129 while (true) {
130     // clear the array and vector
131     memset(arr, 0, ARR_SIZE);
132     tx_data.clear();
133
134     char c = 'f';
135     pc.printf("ready\n");
136
137     for(int i = 0; i < ARR_SIZE && c != '!'; i++){
138         c = pc.getc();
139         arr[i] = c;
140     }
141
142     for(int i = 0; arr[i] != '!' && i < ARR_SIZE; i++) {
143         if(arr[i] == '!') {
144             break;
145         }
146         tx_data.push_back(arr[i]);
147     }
148     send_data(tx_data);
149 }
150 return 0;
151 }

```

Time Synchronization





Multilateration

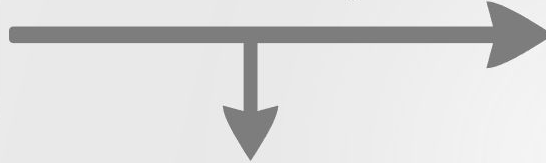
Node-Red



IoT Core

Is constantly listening for a message from node-red

After a gunshot is heard, Rules are asserted to send to Lambda and S3



S3



AWS Lambda

```
{
  "statusCode": 100,
  "body": "\\this is where the gunshot occurred\\",
  "lat": "34.019752000000075",
  "long": "-118.29413399999996"
}
```

Summary

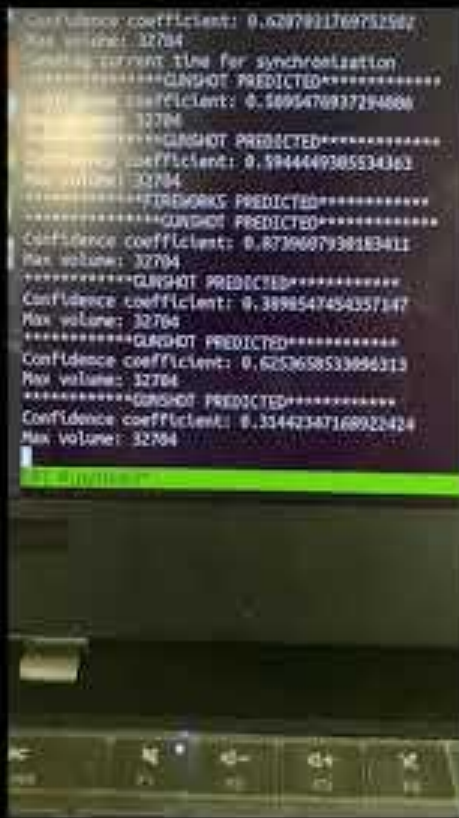
Code SHA-256 e79Kn7eZB9pw09wJyW5yJXD5gW0V6L3W6RKAz0KmrU+	Request ID 58ab68ab-fb61-4a4f-95fa-6eb5f1ec473f
Duration 1592.16 ms	Billed duration 1600 ms
Resources configured 128 MB	Max memory used 128 MB

Log output

The section below shows the logging calls in your code. These correspond to a single row within the CloudWatch log group corresponding to this Lambda function. [Click here](#) to view the CloudWatch log group.

```
dev. id and timestamp: 00-80-00-00-04-01-76-2B , 1576224925.979
dev. id and timestamp: 00-80-00-00-04-01-75-EC , 1576224926.979
node1 location: [34.019752, -118.294134]
node2 location: [34.019725, 118.294136]
node3 location: [34.019725, -118.294079]
[34.019752000000075, -118.29413399999996, 60.0]
Email sent! Message ID:
0100016f0336679f-a77e5841-48c1-447a-99c8-1541069e3455-000000
```

AWS Simple Email Service (SES)



False Negative Rate



```
*****GUNSHOT PREDICTED*****  
Confidence coefficient: 1.0  
Max volume: 32704  
*****GUNSHOT PREDICTED*****  
Confidence coefficient: 0.20822346210479736  
Max volume: 32704  
Sending current time for synchronization  
*****GUNSHOT PREDICTED*****  
Confidence coefficient: 0.5388664603233337  
Max volume: 32704
```

TABLE I

False Negative Rate	0.0504
True Positive Rate	0.9496

False Positive Rate



Context Filtering Algorithm

	t	t-1	...	t-N
Firework	0.54	0.73		0.64
Barking	0.12	0.21		0.18
...
Gunshot	0.60	0.44		0.20
Car Horn	0.21	0.11		0.12

Weight	w_1	w_2	...	w_N
--------	-------	-------	-----	-------

Diagram illustrating the Context Filtering Algorithm. It shows a sequence of time steps $t, t-1, \dots, t-N$ and a corresponding sequence of weights w_1, w_2, \dots, w_N . The algorithm calculates the weighted average (EWA) for each event across these time steps. The background features a network graph with nodes and edges.



EWA
0.67
0.14
...
0.34
0.18

Diagram illustrating the result of the Context Filtering Algorithm. It shows the calculated EWA (Exponential Weighted Average) for each event across the time steps. The background features a network graph with nodes and edges.

Press Esc to exit full screen



The screenshot was added to your OneDrive.

OneDrive

False Positive with Firework History	False Positive
0 out of 180	4 out of 167

Without our context
filtering: 2.4%
With our context
filtering: 0%



Our Competitors



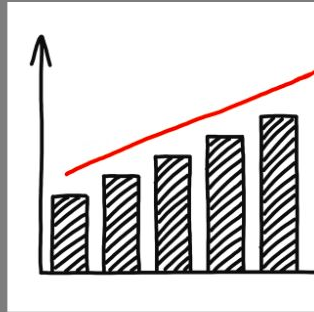


- Not easily portable
- Expensive
- High false positive rate
- 40 second response time

After Too Many Shots Missed, Fall River, Mass., Ends Deal with ShotSpotter

ShotSpotter says it can no longer offer service to Fall River for free after officials balked at funding a system working less than 50 percent of the time.

Competitive Advantage



ShotSpotter Pricing

- 3 mile radius in Durham, North Carolina
- 20 to 25 sensors per square mile
- \$235,000 initial costs for the first year
- \$195,000 annually thereafter

SafeDetect Pricing and Cost Breakdown

Component	Unit Price
SafeDetect System	\$60
LoRA Conduit Using RasPi	\$170
AWS Monthly Charges (calculated from https://calculator.aws/#/)	\$150/month per system (conservatively)

- Same 3 mile radius in Durham
- 200 sensors per square mile
- Approximately \$50,000 + \$2000/year to set up our system
- Can price up to profit

Q & A

