# Technologies to estimate road bump and their potential in Senegal

by

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# PLAN

1. BACKGROUND

2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

3. FUTURE POTENTIAL BUSINESS IN SENEGAL

# 1. BACKGROUND

***OUTLINE OF SENEGAL***


Fig 1 : Localisation of Senegal

**Country :** Senegal

**Capital city** : Dakar

14 Administrative regions

**Land area** : 196,712 $km^2$

**Population** : 14,668,522

**Density** : 74,56/$km^2$

**Climate** : tropical (hot, sunny, dry)

**Landscape** : Rolling sandy plain

Highest point 648 m

**Annual rainfall** : 500 mm North

2000 mm at South

**Language**: local: Wolof

Official : French

# 1. BACKGROUND

## ***ROAD NETWORK OF SENEGAL***

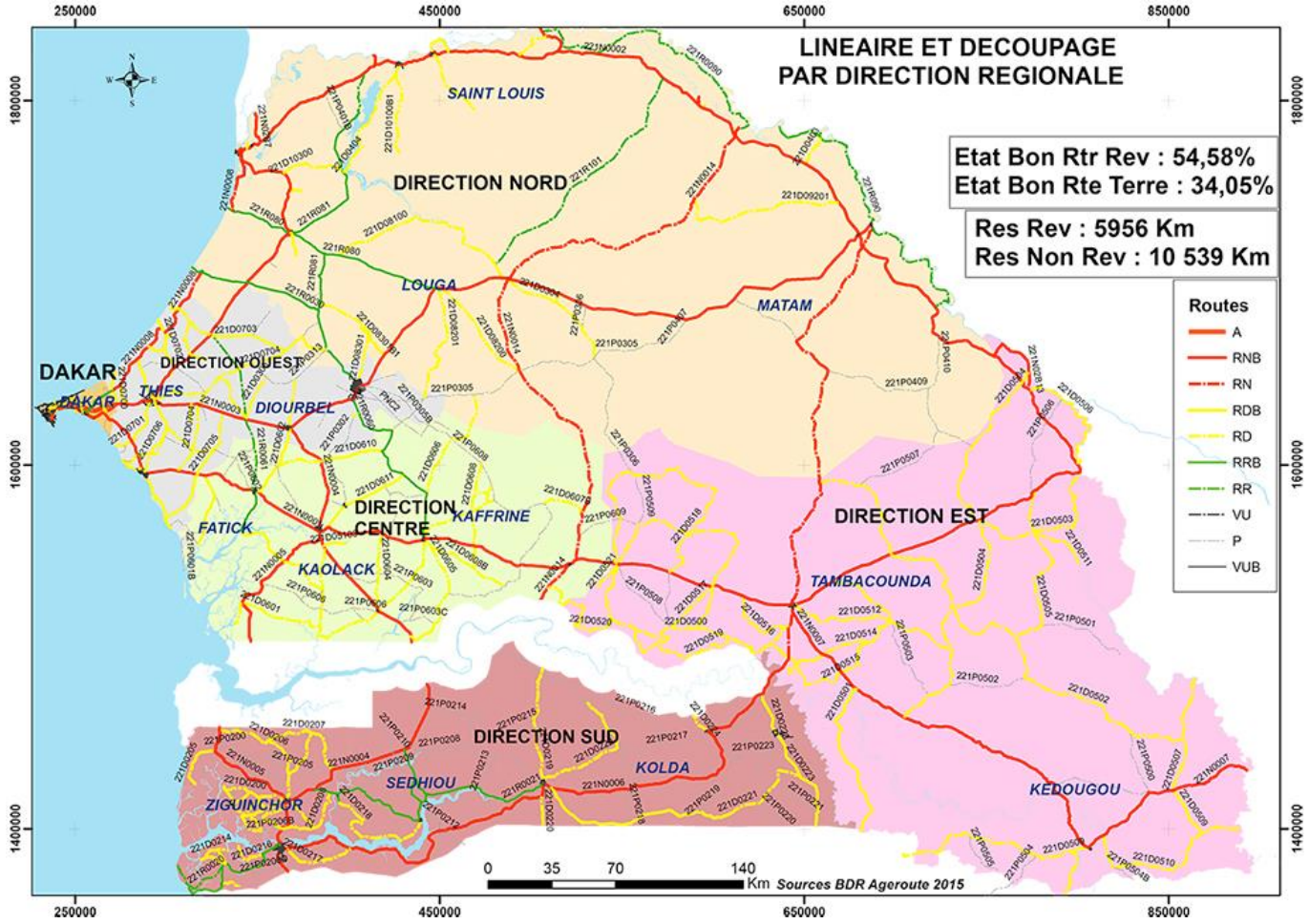


Fig 2 : Road network of Senegal

- A: highway
- RN: national road
- RR : Regional road
- RD: Municipal road
- VU: Urban road
- P : unpaved road
- B : access road

# 1. BACKGROUND

***ROAD NETWORK OF SENEGAL***

| | Classified road network (km) | Non classified road network (km) | Total (km) | Percentage % |
|---|---|---|---|---|
| Paved road (km) | 4805 | 1151 | 5956 | 36 |
| Unpaved road (km) | 4214 | 6325 | 10539 | 64 |
| Total (km) | 9019 | 7476 | 16495 | |
| Percentage % | 55 | 45 | | |

Table 1 : Road network of Senegal

Fig 3: paved road

- Classified road is managed by AGEROUTE representing the ministry in charge of road
- Non classified road is managed by local communities
- 54.58% of paved road : good condition
- 34.05% of unpaved road : good condition

Fig 4: unpaved road

# 1. BACKGROUND

***STATE OF THE CLASSIFIED ROAD NETWORK OF SENEGAL***

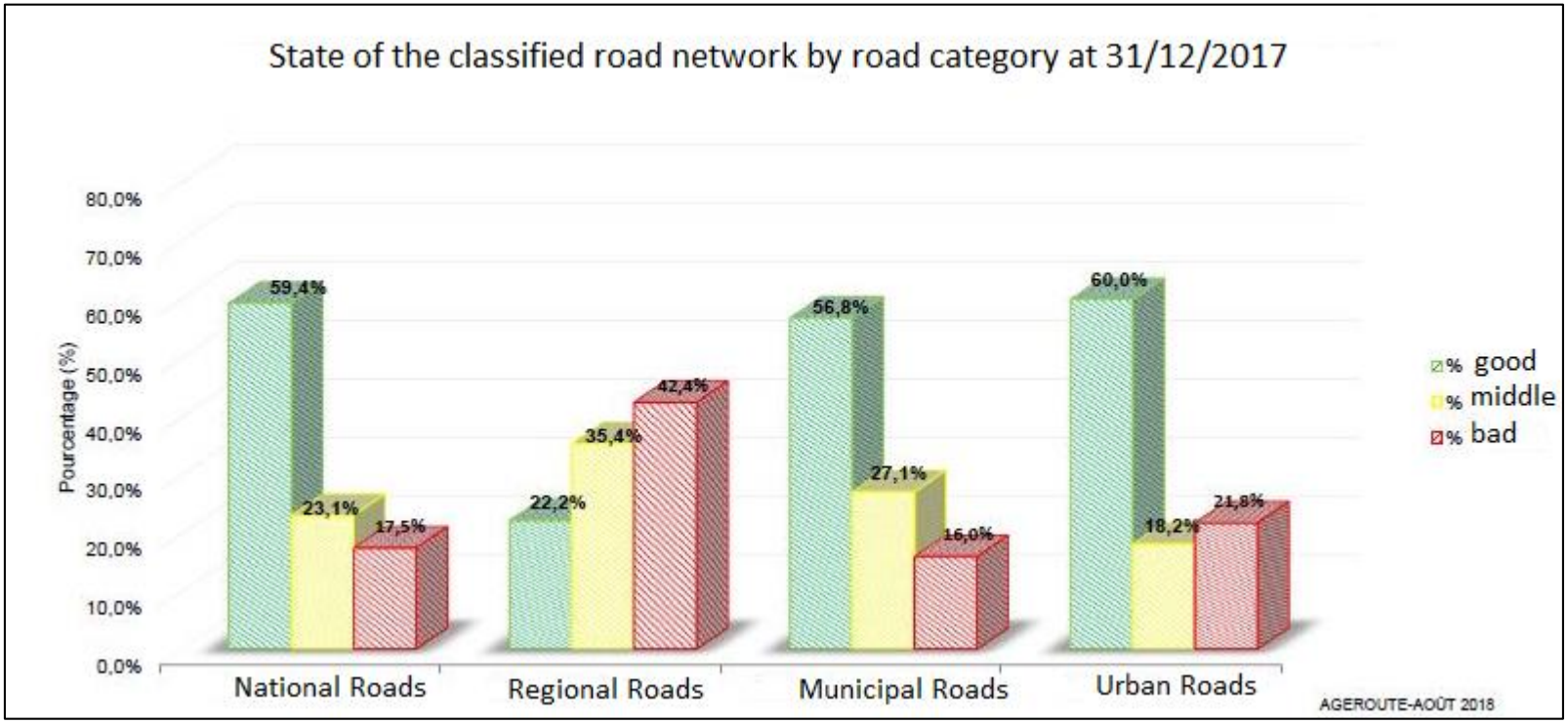


Fig 5: State of the classified road network by road category at 31/12/2017

- More than 50% of the national, municipal and urban roads are in good condition
- In regional road, the proportion of road in bad condition is higher

# 1. BACKGROUND

***EVOLUTION OF THE CLASSIFIED ROAD NETWORK OF SENEGAL***

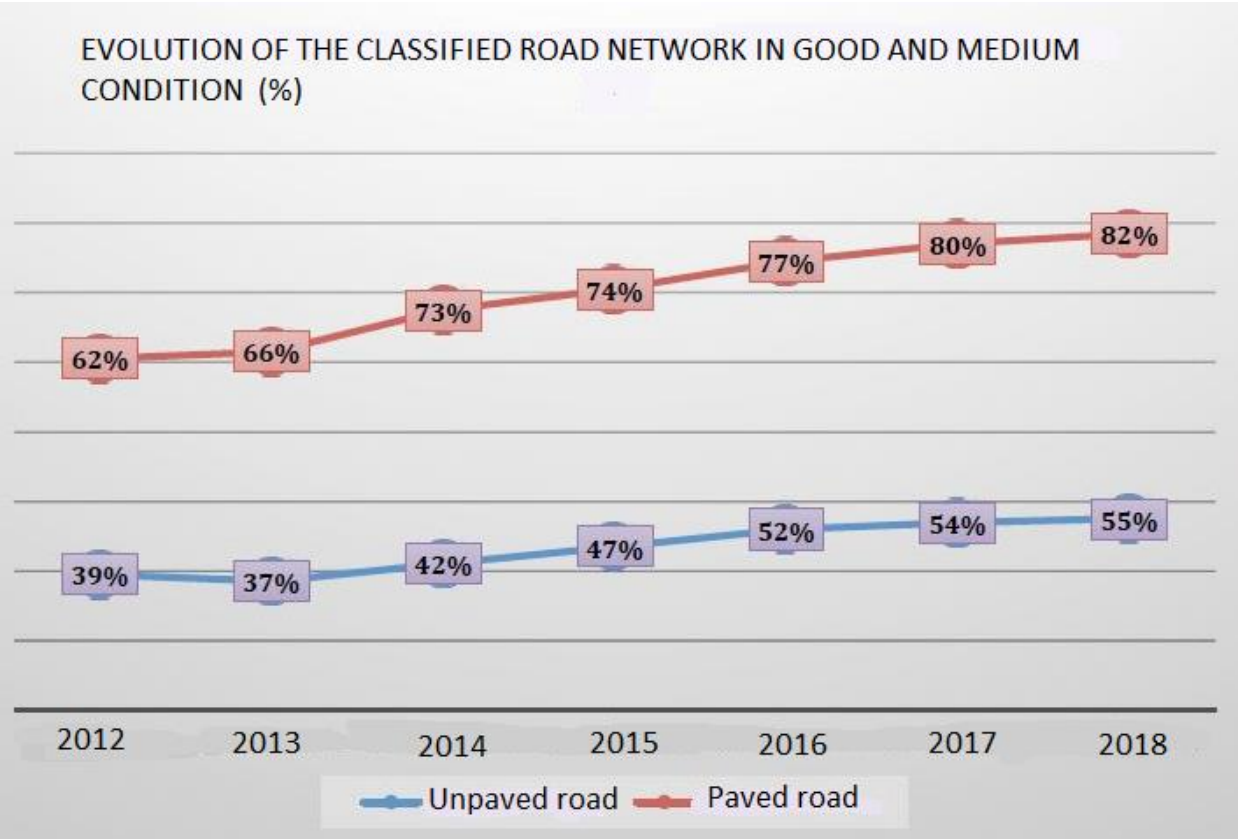


Fig 6 : Evolution of the classified road network in good and medium condition (%).

# 1. BACKGROUND

***RELATION BETWEEN QUALITY OF ROAD AND IRI***

IRI and quality of road defined by WAEMU (West African economic and monetary union)

| State level | Uni (in IRI) m/km | Fissuring % | Pullout % | Number of pothole/km | Edge lace m²/km | Security feature |
|---|---|---|---|---|---|---|
| 0 (bad) | 8 | 25 | 30 | 50 | 300 | Inexistant |
| 1 (middle) | 6 | 15 | 20 | 25 | 100 | bad |
| 2 (good) | 3 to 4 | 5 | 10 | 10 | 10 | Acceptable except singular points |
| 3 (very good) | 2 | 0 | 1 | 1 | 0 | Acceptable |

Table 2 : IRI and quality of road defined by WAEMU

## ***WHAT IS POULLOUT AND SHORE LACE?***

### PULLOUT

It consists of a disappearance of the binder enveloping the aggregates of the pavement surface layer

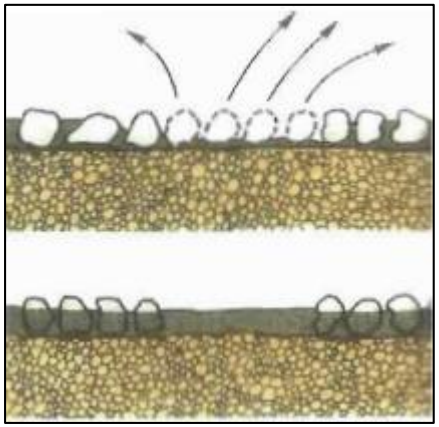

Fig 7 : Pullout

### EDGE LACES

Also called **Spalling**, they are breaks of the edges of the pavement causing a significant reduction in the width of the road

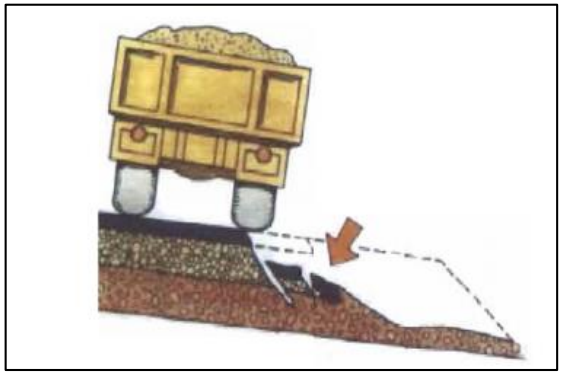

Fig 8 : Shore lace or spalling

## 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

***TECHNOLOGIES OF PAVEMENT INSPECTION***

New Technologies includes many functions for pavement inspection:

- Bump measurement
- Push car
- Photo-report

***BUMP MEASUREMENT TECHNOLOGIES***

- It is IRI class 2
- It can calculate IRI, JRI, crack, linearity
- Reference speed of driving car is 80km/h
- It uses smartphone for collecting data
- Different section length can be used: 20m, 40m, 80m, 160m
- Calculated parameters (IRI, crack) are stable
- Good repeatability of the measurement

## 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

***ESTIMATION OF ROAD BUMP***


Fig 9: Road bump measurement using smartphone

Whatever the position of the smartphone during the measurement, the system can adjust and give accurate data. Therefore, the smartphone should be fixed to avoid vibration

# 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

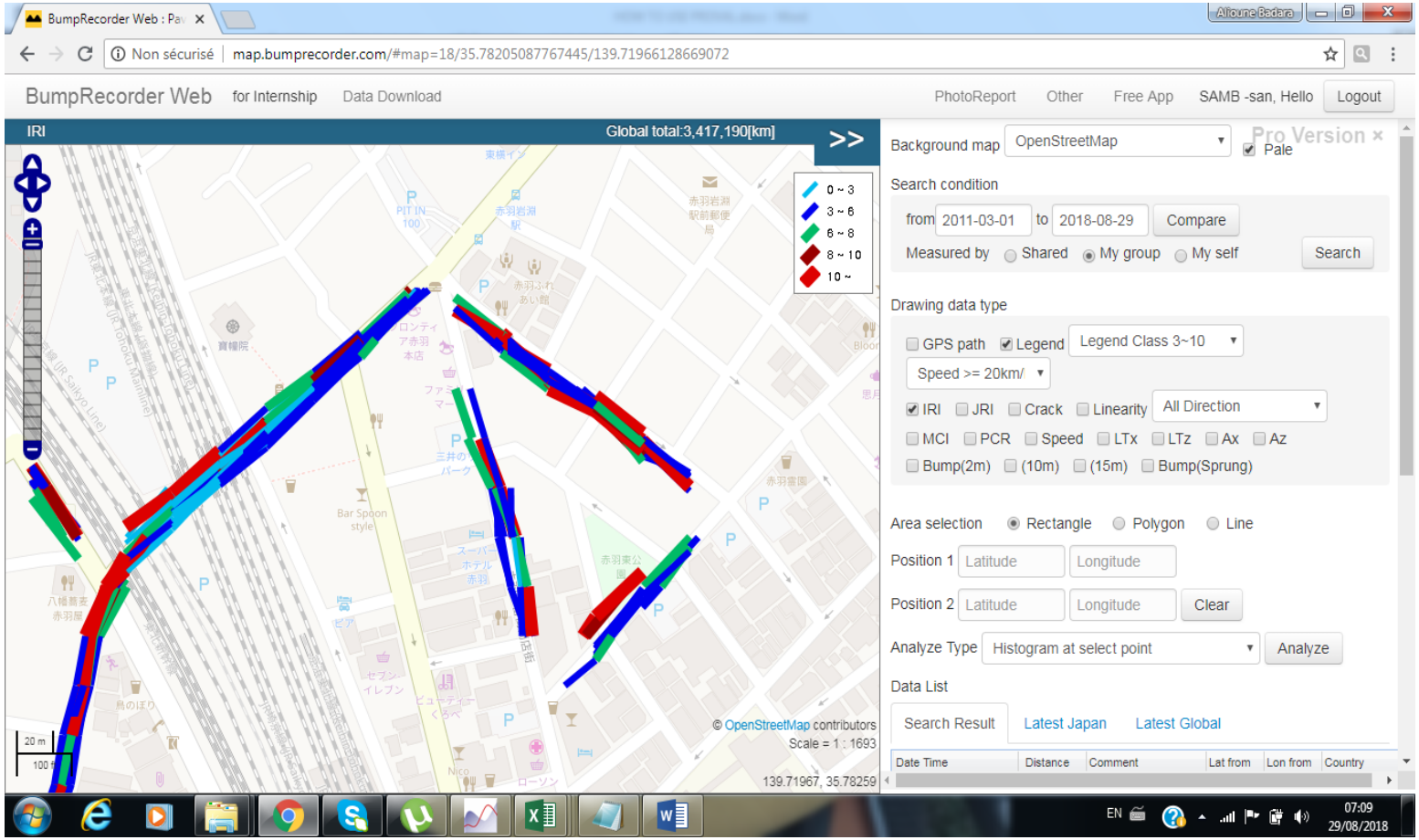


Fig 10: IRI measurement in Tokyo area

After measurement by smartphone, data can be upload and using bump application to calculate IRI, JRI, crack…

## 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

***ESTIMATION OF SPEED AND GPS ACCURACY***

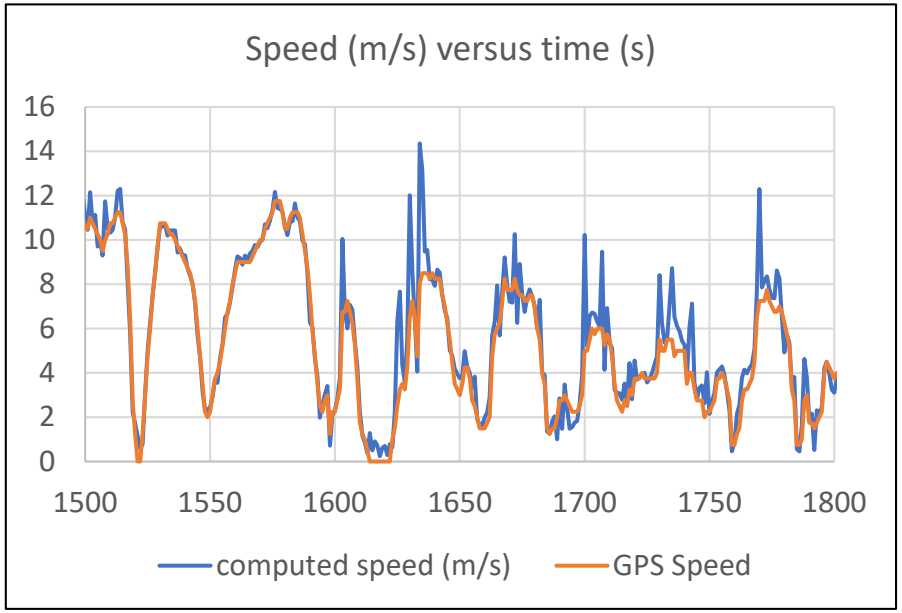


Fig 11: Estimation of speed accuracy


Fig 12 : Estimation of GPS accuracy

The two speed have same trend; anyway, computed speed is more stable and more accurate

more the bubbles are wide, more the accuracy of the GPS decrease

## 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

***PUSH CAR MEASUREMENT TECHNOLOGIES***

Fig 13: Push car measurement

Fig 14: Roller of measurement

Fig 15: Setting of smartphone on the roller

The purpose of this technology is to check the profile and the flatness of road by fixing by anti slip gel pads the smartphone to the roller at the working speed of about 5km/h.
Data provide only time device (msec), distance (m) and elevation (mm) but not IRI values.
The value of IRI can be calculated using a special software

## 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

***PHOTO REPORT APPLICATION***

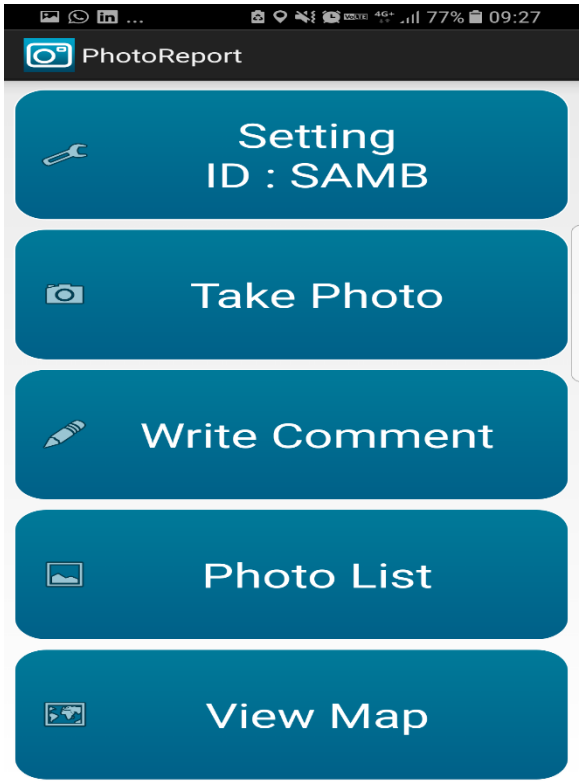


Fig 16: Photo report application

Photo report is an application developed for pavement inspection.

It provide detail position and can be used to make report quickly in PDF format.

The report in PDF format shows the information about time, order, comment for the taken photos

Therefore, it is impossible to take photo if the GPS cannot work (under building or tunnel, cloudy)

# 2. NEW INVESTIGATION METHOD TO BE IMPLEMENTED

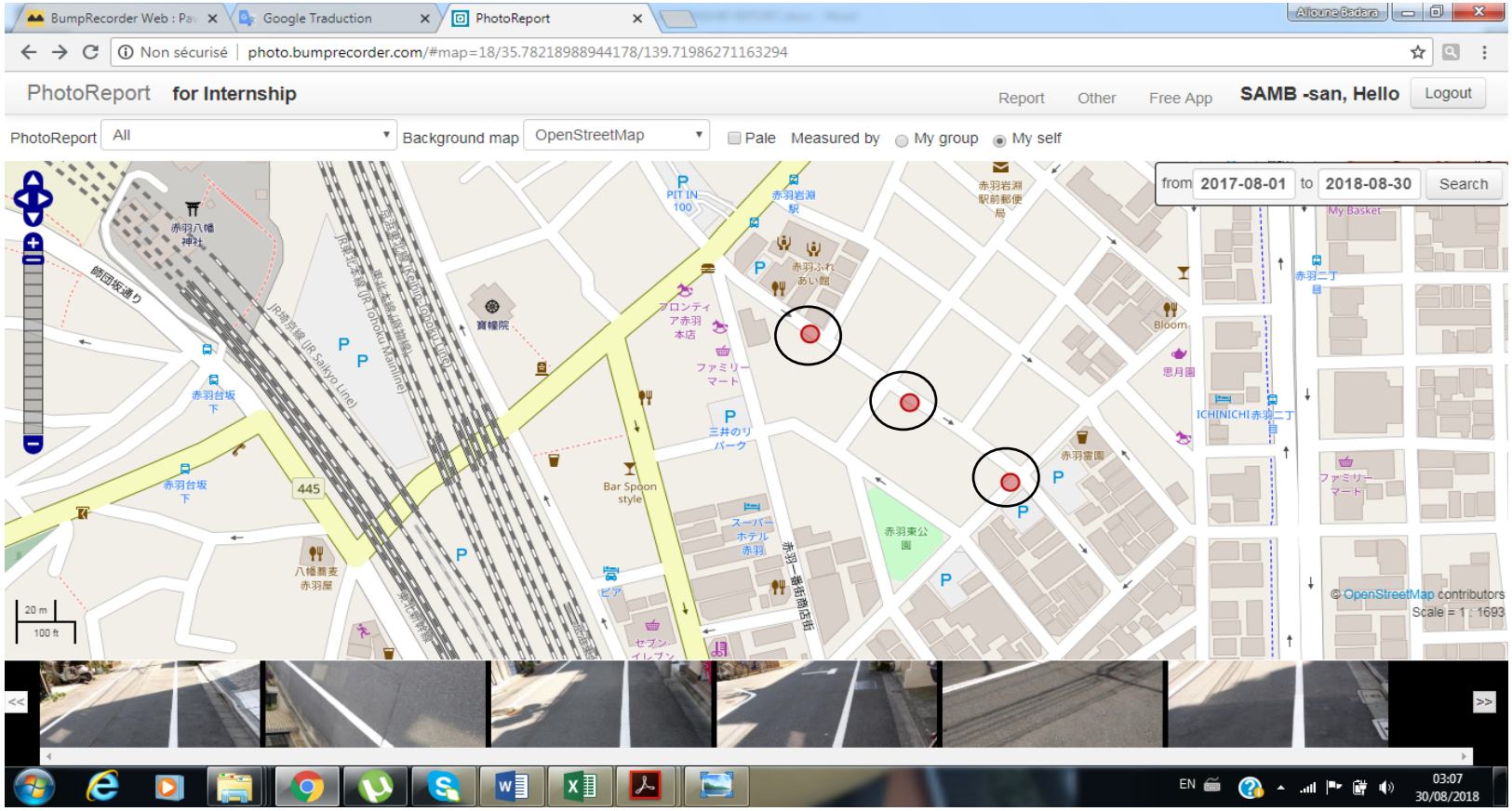


Fig 17: Photo report mapping

This application is very simple to use and can provide information about the current state of the road, the details positions.

It can help the road administrators to take decision regarding the road maintenance

## 3. FUTURE POTENTIAL BUSINESS IN SENEGAL

***POTENTIALS OF ROAD BUMP ESTIMATION IN SENEGAL***

- Attractive country in term of business,
- Presence of road agency, annual maintenance program, road funds
- More consideration of road authorities in comfort of road users (measure of IRI in the rehabilitation of the National Road RN2 in 2017)
- Need of more appropriate pavement inspection methods replacing or improving the actual methods
- Possibility of using smartphone application for data collecting in a limited time may be useful for the road authorities
- Possibility of uploading and obtaining data immediately after measurement may help authorities to make quickly decision about repair work and maintenance
- Visual inspection can be done using photo report application and the reporting time may be reduced

## 4. FUTURE POTENTIAL BUSINESS IN SENEGAL

***FACTORS PROMOTING BUSINESS IN SENEGAL***

- AGEROUTE senegal

  The Agency representing the Ministry in charge of the roads,

- PERA : annual road maintenance program managed by AGEROUTE

- Road fund (FERA)

  Ensure the collection of all the resources necessary for the maintenance of the entire national road network

  Ensure transparent and efficient management of the operation and maintenance of the road network.

- National Equipment Budget

  cover the counterparts of external financing and periodic maintenance and new road construction works.

# THANK YOU FOR YOUR ATTENTION