

IDI QUARTERLY

Infrastructure Development Institute—JAPAN



Smartphone Applications for Road Survey



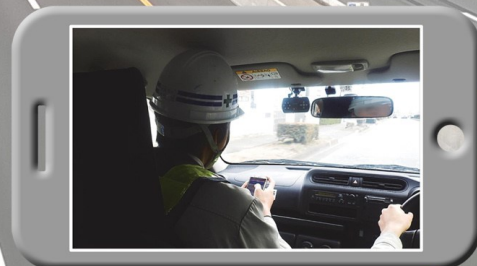
BumpRecorder



**POT
HOLE**



**Pavement
Inspection**



CONTENTS

Introduction of Low Cost Road Survey Technologies: Three Free Smartphone Applications for Road Asset Management 2

Infrastructure Development Institute – Japan (IDI)

Plaza Edogawa-bashi 3F. 1-23-6, Sekiguchi, Bunkyo-ku, Tokyo, 112-0014, JAPAN

Tel: +81-3-5227-4107 Fax: +81-3-5227-4109 E-Mail: idi17@idi.or.jp Website: <http://www.idi.or.jp/en/>

Introduction of Low Cost Road Survey Technologies

Three Free Smartphone Applications for Road Asset Management

1. Introduction

We, TOA Road Corporation, are one of the leading road construction and material manufacturing companies who have started bituminous emulsion manufacturing as a pioneer in 1930. We have embarked on Road Construction and Bituminous material manufacturing such as PMB, Modified Emulsion and others, Road Survey and Design, Sports Field Design and Construction throughout Japan.

Moreover, we have been providing government organizations and private construction companies long-term assistance on road survey, designing, material supply and construction in Japan. We recently started new challenges consisting of Solar Power Pavement technology, PPP / PFI and Oversea Business. Oversea Business consists of cooperating with JICA Projects, Technical Cooperation and Educational Programs.

Through our cooperation within the JICA Educational Program, we have become aware of road maintenance circumstances and issues in the Least Developed Countries (LDC). In principle, as roads are essential social infrastructure for economic growth, Road Maintenance and Survey works should be sustainable in order to manage Road Assets properly. However, in LDC, existing Road maintenance budgets and road survey budgets for planning road maintenance can be insufficient.

On the other hand, LDC continued their development through international investment projects and the length of Road asset to be periodically managed and maintained, became longer.

Therefore, we introduce three smartphone applications with a high quality, low-cost and easily useable road survey method for road asset management targeted towards a wide range of users (Refer to Figure-1)



Figure-1. Road Survey Technologies

<Introduced Smartphone Applications>

- (1) Bump Recorder
Simple Road Survey Application
- (2) Pothole Measure
Repair Quantity Calculator Application
- (3) Pavement Inspection
Site Inspection GPS Mapping Application

2. Outline

Road Survey Method is classified as a special survey method using a vehicle, a simple survey method, and/or an use of an AI camera (Refer to Figure-2).

However, Road survey method is selected depending on the budget, the number of equipment / tools, and any other factors in LDC. As a result, the scope of road survey is limited, and survey data are insufficient for road maintenance planning.

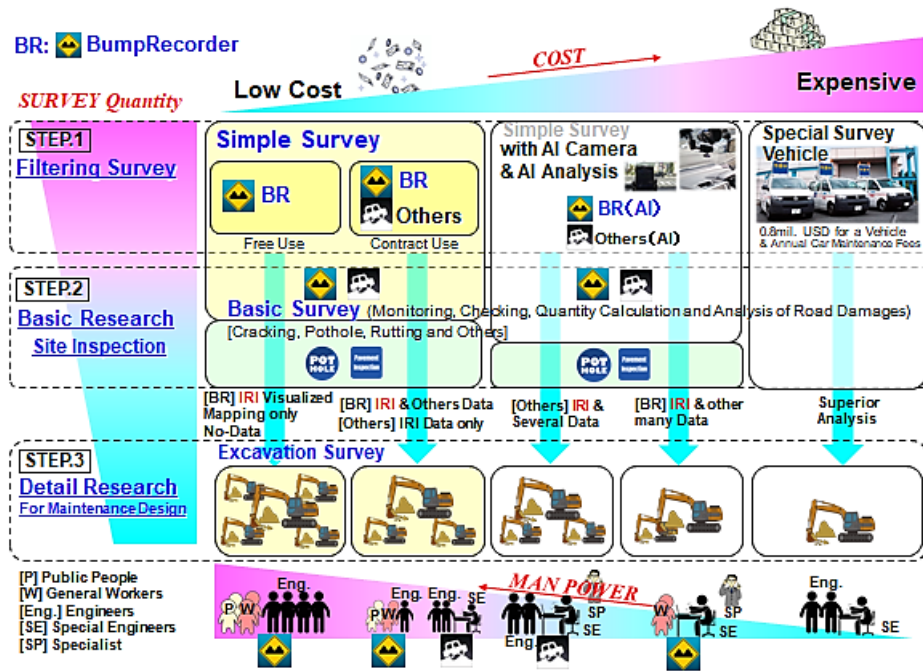


Figure-2. Road Survey Method Classification

Road survey should progress from filtering survey to detailed survey step by step.

Filtering survey is important for the initial budget assessment and should widely cover survey areas in each country. Therefore, filtering survey tools require simplicity and utility for the surveyors, being low-cost and, not requiring any special tools in LDC.


From this background, our low-cost road survey concept is as below:

STEP 1: Filtering survey using “BumpRecorder”

STEP 2: Performing a Basic Research Survey using the following three applications: “BumpRecorder”, using a smartphone with a camera, “Pothole Measure”, and “Pavement Inspection”

Detailed Research is applied by an Excavation survey for detailed road maintenance design. However, our proposed survey method can be applied by a smartphone, excluding Excavation Survey works.

Details of these road survey applications are as follows.

(1) **BumpRecorder App./Web** 
(App. is Free for Android)

BumpRecorder application can be used for Simple Road Survey. Survey indexes include IRI (International roughness index), Flatness, MCI, Bump, PCR, Crack, Speed and LT value for the Train Upset Measurement.

Additionally, the smartphone camera can be used for a Basic Survey practically without any additional cost, and an AI camera can be combined as required in the future.

(2) **Pothole Measurement (Free App.)** 

Pothole Measure application is for Supporting Road Survey works and can quantify repair material. Measured Records can be output as PDF and CSV files.

This application can be applied to not only potholes, but also on the cracks of pavements.

(3) **Pavement Inspection (Free App.)** 

Pavement Inspection application is for Supporting Road Survey works on-site and inspection results can be mapped on a GPS Map.

Mappable Contents are Cracking, Rutting and Longitudinal Unevenness.

3. Detailed Description

3-1. BumpRecorder Application



3-1-1. Features (inc. Scope of Application)

This application can survey road surface characteristics, and easily visualize and quantify measured data, improving the efficiency of survey works with necessary but limited manpower. It is possible for anyone to easily measure road surface characteristics regardless of the use of special survey vehicles.

The Measuring Accuracy is Class-2 (Other smartphone applications are Class-3 on CSIR) by means of Automatic Calibration function.

Therefore, BumpRecorder road survey can be conducted by any local vehicle and anyone using a smartphone. As a result, this survey method can be applied in many islands and heavy rural areas as well as urban areas effectively.

After the survey, measured data can be easily uploaded and visualized on the WEB site.

Survey processes does not cause human error by setting initial geographical information because survey results at every survey section will be segregated automatically and invariantly on GPS map for every survey on the basis of the World Grid Square Method.

3-1-2. How to USE

BumpRecorder application can be downloaded from Google Play for free.

- (1) After opening the application, the smartphone must be set in the vehicle to check for satellite supplement (necessary to receive 5 satellite signals for survey).
- (2) After receiving satellite signals and tapping “REC”, BumpRecorder will start the survey.
- (3) By tapping “REC” again, the survey can be stopped and the data will be saved.
- (4) Saved data can be displayed on the data list and be checked on the survey route map.
- (5) Approximately 10 minutes later after uploading the data, BumpRecorder WEB Site will display survey results.

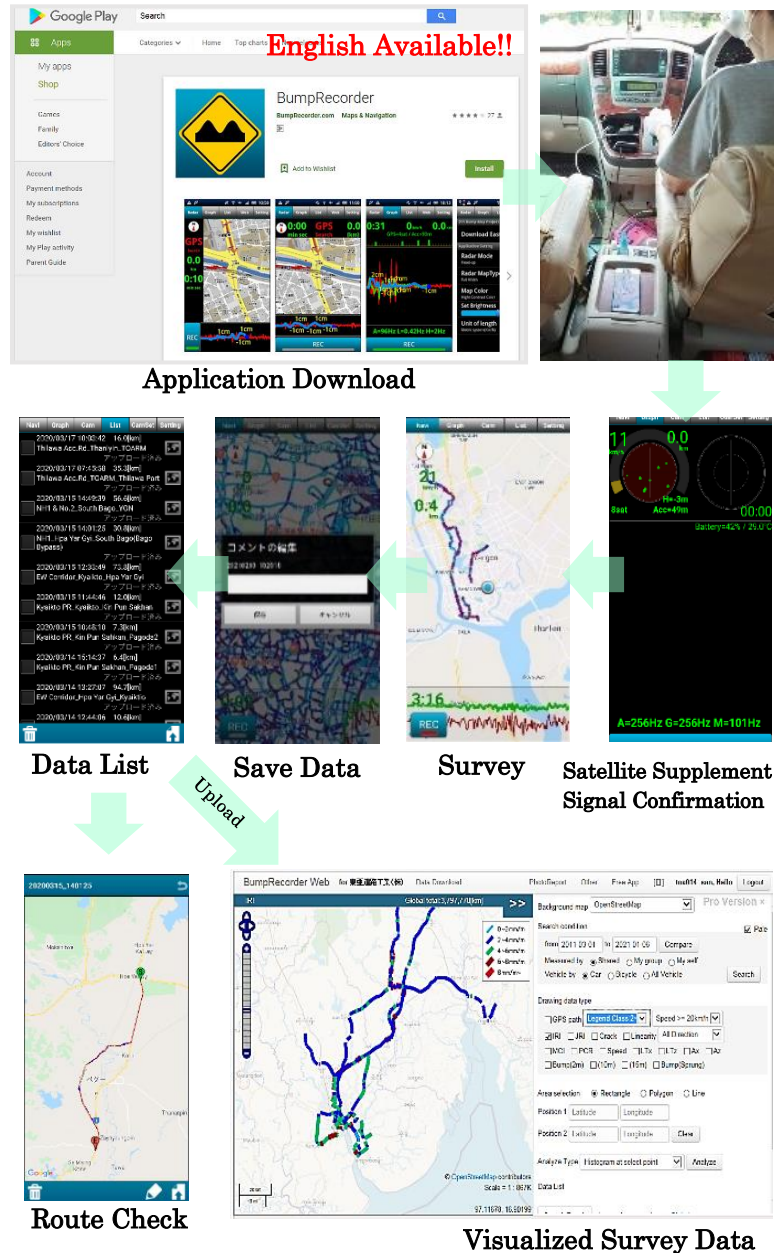


Figure-3. How to use BumpRecorder

3-1-3. Anticipated Results

A sample of BumpRecorder survey results in Myanmar is shown in Figure-3. Viewing the visualized survey data will be free, however, a cloud server fee will be incurred for managing the data base, analyzing data confidentiality and/or downloading Survey valued data.

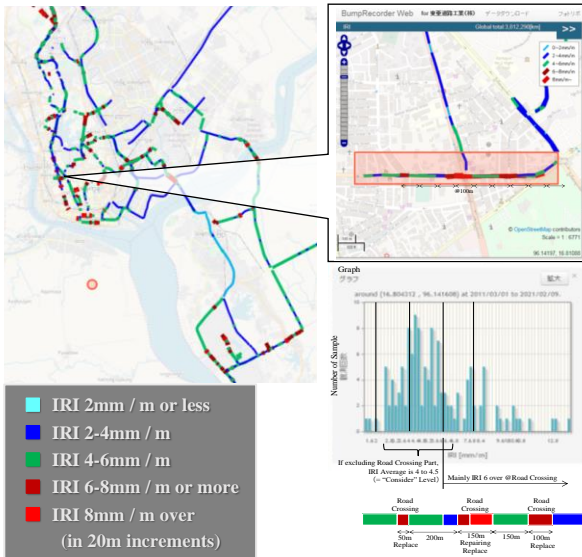


Figure-3. BumpRecorder Surveyed IRI Data and Data Analysis in Myanmar

IRI data surveyed by BumpRecorder are evaluated by IRI value specified by government road authorities in each country. This data analysis can support maintenance planning to judge partial repairing or full pavement width re-laying, and to estimate the budget of road maintenance.

In case there is no criterion for evaluating IRI value, the maintenance plan should be determined depending on the type of pavement, prioritization, allocated budget and any other conditions in each country (Refer to Figure-4).

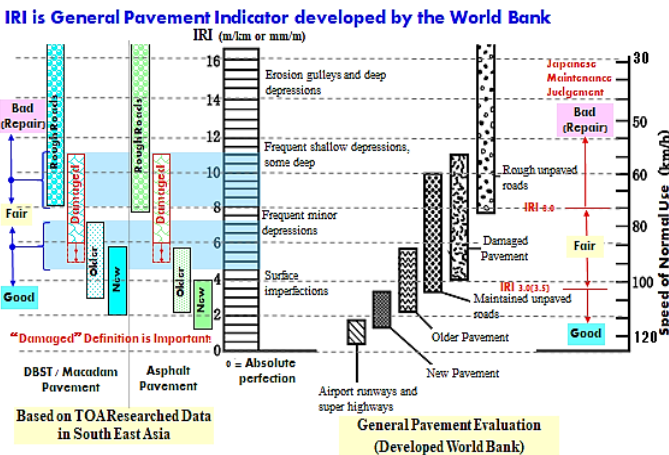


Figure-4. IRI Data Evaluation

Infrastructure Development Institute – Japan

Furthermore, BumpRecorder can count the height and number of bumps, also recording traffic speed. Traffic speed data can be viewed for planning smooth transport.

Additionally, prioritization of access roads from rural to urban areas can be recognized, and defective points can be extracted by the data analysis referring to IRI and Traffic Speed (Refer to Figure-5 and 6).

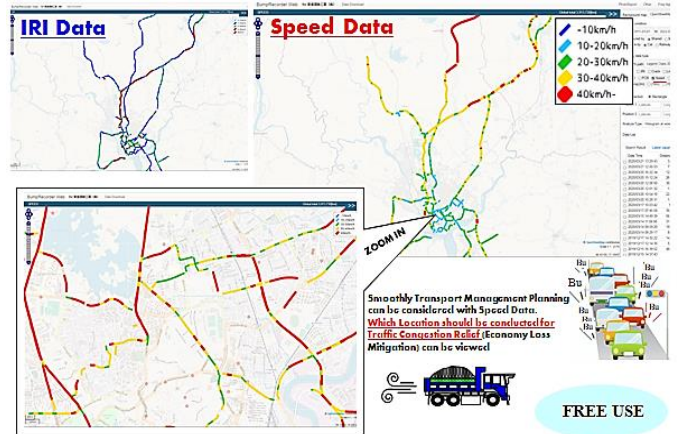


Figure-5. Use of Traffic Speed Data for Transport and Construction Planning

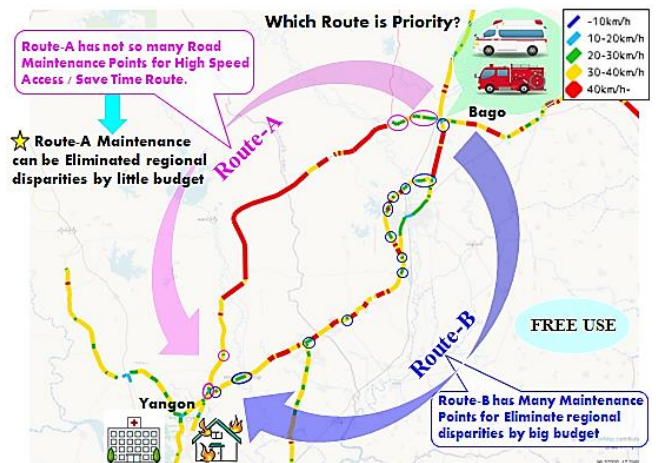


Figure-6. Recognition of Road Prioritization from Traffic Speed Data

These BumpRecorder survey results can be used for the prioritization of road maintenance, consideration of budget assessment, as well as filtering and sectionalizing (extracting detailed survey section).

Filtering of survey results is very important for supporting work with limited manpower (engineers), reduction of survey costs, proper road maintenance planning, improvement of work performance, and the consideration for the effect of pavement life cycle cost (LCC) on Road Asset Management.

3-2. Pothole Measurement Application

3-2-1. Features (inc. Scope of Application)



Pothole Measurement Application is for calculating the quantity of Pavement Repairing Materials which can quantify the amount of asphalt concrete mixture and tack coat to be applied to both potholes and patching locations.

This application will be useful to support both site surveyors and chief engineers with its function to automatically prepare a report displaying photos and GPS Information.

3-2-2. How to USE

Photo-1 displays how to use the Pothole Measurement application. The Procedure is very simple.

- (1) Firstly, tap the “Photo” button on the interface of the application.
- (2) Secondly, take a photo of the repair area, paint it with your finger, and tap the “NEXT” button.
- (3) Thirdly, input the height and estimated thickness of the repair part on your smartphone (camera) and tap the “calculate” button.
- (4) Lastly, the measured results can be saved and be output for report preparation.

In case of larger Repair areas, where they are larger than the camera’s focus range, calculated data of a sample unit will be multiplied by a number such as shown in Photo-2.

3-2-3. Anticipated Results

Through “JICA Road Asset Management KCCP”, issues such as Insufficient number of engineers, Long road survey distance (2,000km / rainy season) and Difference in survey results due to engineer’s experience were reported.

Pothole Measurement application can solve or mitigate such issues.

Ex) Asphalt Mixture
 24.84 kg/loc. * 5 loc. = 124.20kg

Tack Coat
 0.42 L/loc. * 5 loc. = 2.1L

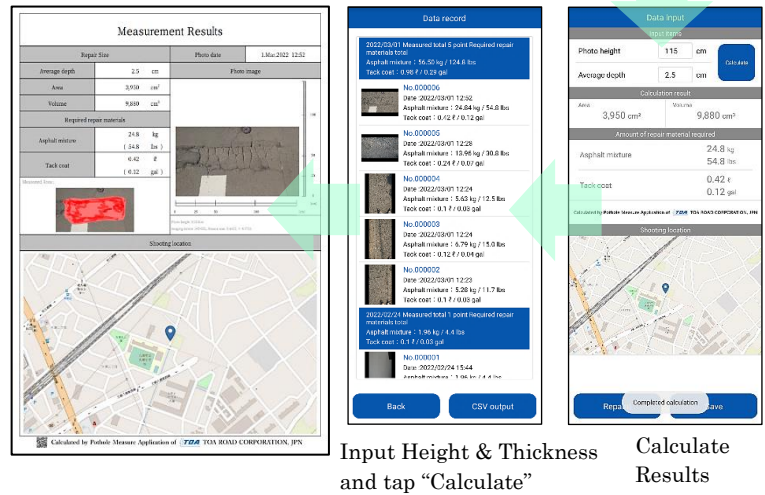
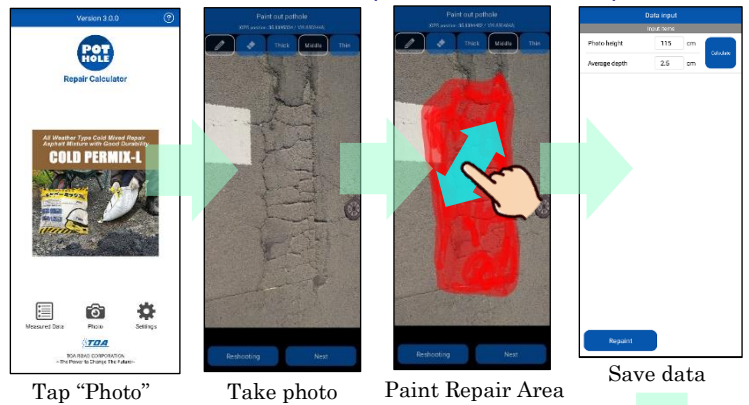
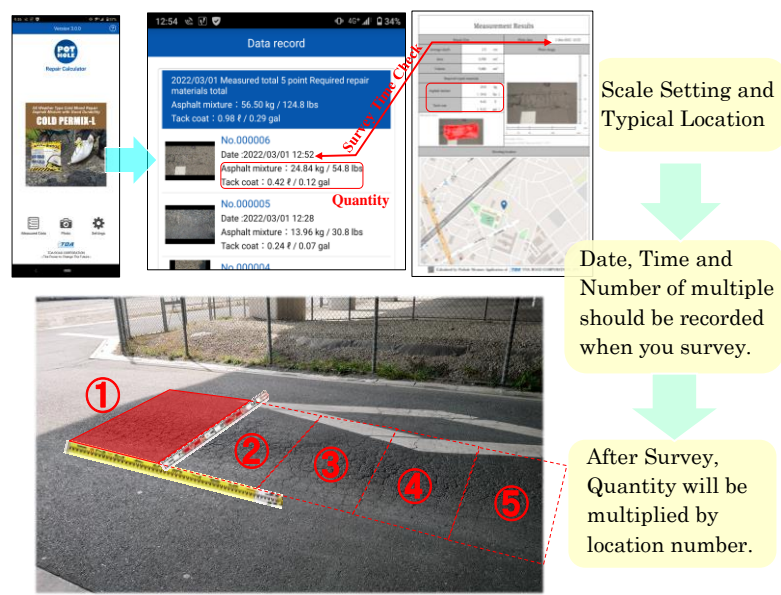


Photo-1. How to use Pothole Measurement



Note: In case of Too Many Potholes, Approximate Quantity can be also estimated easily by same procedure as this method.

Photo-2. How to use for Large Repairing Area

3-3. Pavement Inspection Application



3-3-1. Features (inc. Scope of Application)

Pavement Inspection is a GPS mapping application which can perform inspection on-site and visualize survey results on a GPS Map. Contents of Inspection include Cracking, Rutting and Longitudinal Evenness.

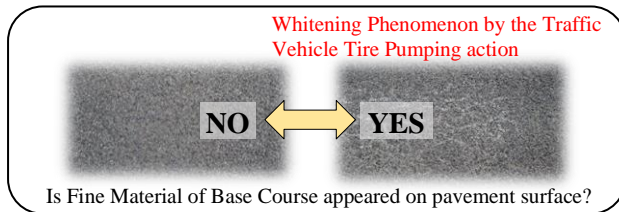
However, for Longitudinal evenness, the aforementioned BumpRecorder IRI data can be used for the evaluation of road conditions on behalf.

Inspection Results can be recorded by a screenshot and locational details can be checked by enlarging them on GPS Map.

3-3-2. How to USE

Photo-3 displays how to use Pavement Inspection. The procedure is very simple.

- (1) Firstly, tap the “Carry out Inspection” button on the interface of the application.
- (2) Secondly, select the inspection item and tap the “Start inspection” button.
- (3) Thirdly, results during inspection will be recorded automatically and continuously. Inspection and evaluation can be finished by walking at the same time.
- (4) Fourthly, stop the inspection by tapping the “end” button and save data.
- (5) Lastly, inspection results can be checked on Data records.



3-3-3. Anticipated Results

Evaluation during site inspection should be determined by the judgement of the classification depending on road class, pavement type, budget, prioritization, or any other conditions in each country same as IRI data evaluation.

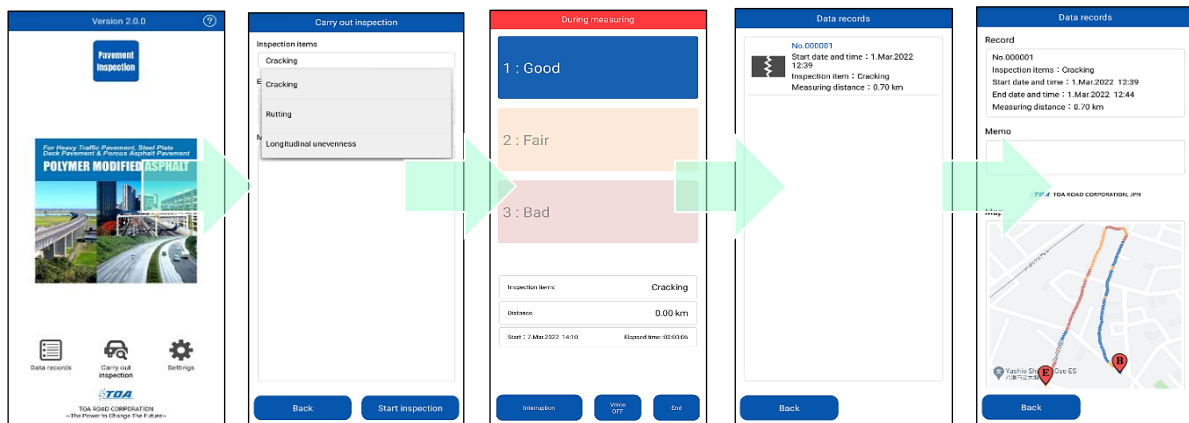
An evaluation example is shown in Photo-4 for reference. The observation (monitoring) of damaged pavement on-site is indispensable.

This inspection is not a formal method in accordance with the evaluation classification, requiring a detailed check on whether the cracked area, appearing to have a whitened surface, is caused by the fine material of base course or not.

Before using Pavement Inspection, the Pavement evaluation method should be lectured to engineers and individuals in charge of road survey.



Photo-4 Pavement Evaluation



Tap “Carry out Inspection”

Select Inspection Item

Walking and Inspection

Saved Data on list

Check GPS

Photo-3 How to use Pavement Inspection

4. Record of implementation

BumpRecorder has been utilized through JICA projects such as the “Formulation of the National Transport Master Plan in the Republic Cuba (2018-2020)”, and “JICA Technical Cooperation Project in Myanmar (2019-2022)”. We have been assigned as surveyors by several municipal governments for road asset management in Japan continuously and have been utilizing road survey for our private company’s road research in Myanmar and Rwanda (2018-2022). (Refer to Photo-5)

Pothole Measurement and Pavement Inspection were the only domestic smartphone applications until year 2021, but these two applications were modified to have an English version, which started to be shared free worldwide as one of the TOA Road Corporation’s SDGs activities to support road survey in LDC (Since Apr.2022).

5. Conclusion

The road maintenance work and planning requires data of IRI, Cracking, Rutting, Repair Quantity Calculation, Photo, Site Visual Inspection and Excavation survey for checking the bearing capacity and existing pavement structure.

Our proposed low-cost road survey methods can carry out the required road survey by a smartphone only, excluding excavation survey. These applications are free and can be used not only in urban areas, but are also most effective in Rural area and Islands where people suffer from insufficient budget for road survey.

In conclusion, we would like to express our deepest gratitude for giving us this opportunity, and we hope that the low-cost road survey method using smartphone applications introduced here can support road survey works and maintenance planning for road asset management in your country.

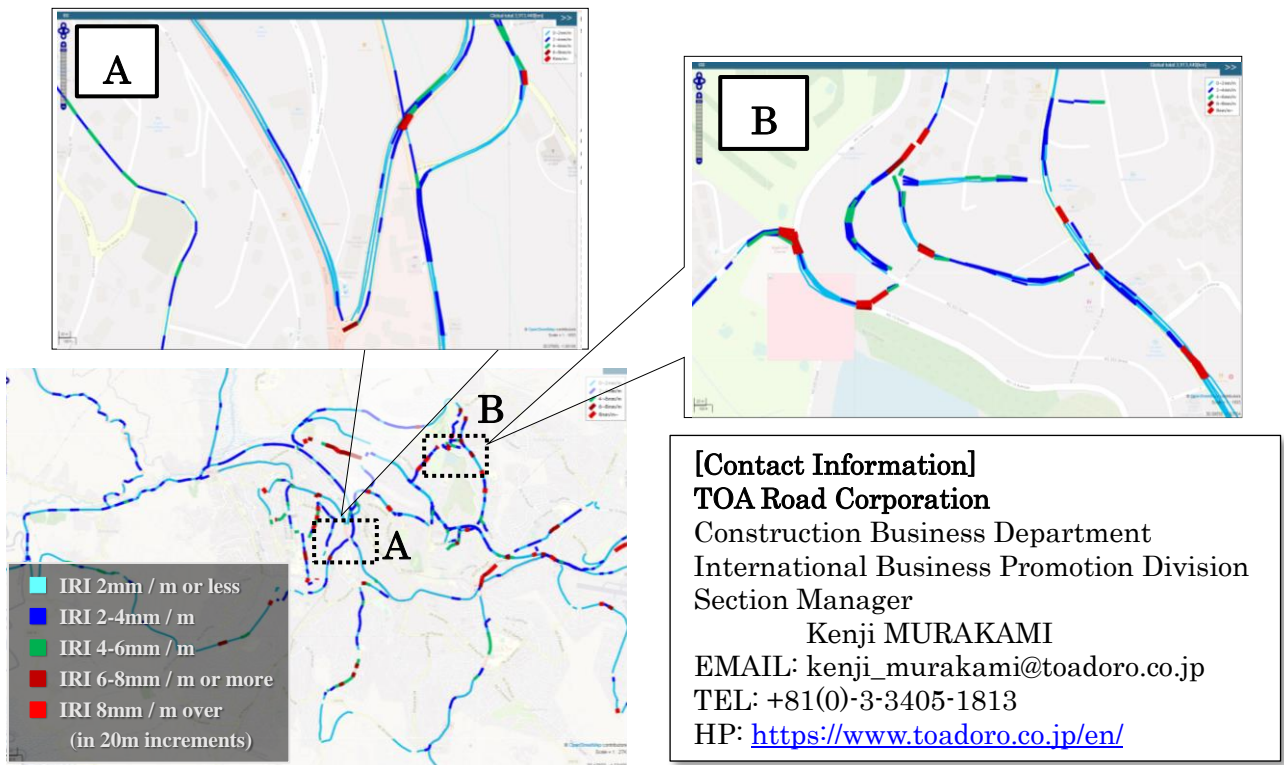


Photo-5. BumpRecorder Survey in Rwanda

Technical Cooperation by BumpRecorder Co., Ltd.

Application from



BumpRecorder Simple Road Survey Application



Pothole Measure Repair Quantity Calculator Application



Site Inspection GPS Mapping Application



About IDI and IDI-quarterly

Infrastructure Development Institute-Japan (IDI) is a general incorporated association operating under the guidance of Ministry of Land, Infrastructure, Transport and Tourism of Japanese Government.

IDI provides consulting services to facilitate international assistance to developing countries, to promote international exchange of information and human resources, and to support globalization of project implementation systems targeting both developed and developing countries in the field of infrastructure.

IDI has been publishing a free quarterly journal called “IDI Quarterly” since 1996 to introduce information related to public works and construction technologies developed in Japan, to foreign countries. We have distributed the journal to administration officials in more than 90 countries around the world via e-mail.

It will be highly appreciated if you could send us your opinions, impressions, etc. regarding the articles.

We also welcome your specific requests regarding technologies you would like to see on following Quarterly issues.