

2016-05-26

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Recommended Citation

Gersztyn, Jason, "Pothole Pal – Interactive Infrastructure Tracking App" (2016). *Academic Excellence Showcase Proceedings*. 41.
<https://digitalcommons.wou.edu/aes/41>

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Pothole Pal – Interactive Infrastructure Tracking App

Jason Gersztyn | Western Oregon University



Abstract

For individuals who want to report, avoid, or even correct potholes found on roadways, the Pothole Pal is an interactive mobile application that records the locations of potholes. Information is tracked in real-time as the car travels, using GPS tracking technology and an accelerometer. Each occurrence of a hazard will be pinged on a map and saved. This data will be displayed to the user in the form of an easy-to-read map. The app will be sure to not confuse dips and bumps with erratic driving. Unlike similar applications where potholes are reported manually, our product provides far more functionality and is practical for everyone. It encourages people to contribute, creating a safer, more efficient drive for all. Motorists will be able to locate potholes ahead of time. Governments will be able to see infrastructure issues and resolve them accordingly.

Prior Research

- Potholes are a major irritation to motorists, bicyclists and pedestrians alike, many of which will go unreported due to being in low traffic areas or from negligence.
- Potholes can also be a serious hazard, some of which require near immediate attention due to being in high traffic areas or as a result of being subjected to harsh conditions that lead to rapidly worsening conditions.
- Only rudimentary reporting mechanisms are in place to record and remedy potholes, almost all of which are established by city or state governments.
- There are no major applications or efforts in place to track potholes on a wide scale.
- Therefore, this application creates a valuable resource that not only the general public, including motorists and pedestrians can use, but may also be used by government to actively track the locations of road hazards and remedy them in a timely and efficient manner.

Hypothesis

- Potholes are a persistent and potentially destructive hazard in modern infrastructure, especially since there are few efficient mechanisms for reporting and repairing them in a timely manner.

Procedure

```
//take the three points and compute the vector product
double vectorProduct = Math.sqrt(x * y + y * z + z * x);
//listen for a significant amount of movement; a higher number means less sensitivity
if (Math.abs(vectorProduct) > 14) {
    //add a marker at the specified coordinates
    Location location = null;
    //request the location from the device
    try {
        location = LocationServices.FusedLocationApi.getLastLocation(mGoogleApiClient);
    } catch (SecurityException e) {
        Log.i(TAG, "Not able to get location");
    }
    //get the current time at this very moment
    long currentTime = System.currentTimeMillis();
    //we do not attempt to add a point if the last update was less than x (?) seconds ago
    if (Math.abs(currentTime - lastUpdate) > (7 * 1000)) {
        //not a valid location
        if (location == null) {
            try {
                LocationServices.FusedLocationApi.requestLocationUpdates(mGoogleApiClient, mLocationRequest, this);
            } catch (SecurityException e) {
                Log.i(TAG, "Connection with Google Services failed.");
            }
        } else {
            //validate the change in location and record it
            onLocationChanged(location);
        }
        //the last moment in time a point was added
        //update this when a new point is added
        lastUpdate = currentTime;
    }
}
```

The app is listening to see if a pothole is hit

```
// If a location was registered, then we want to handle it here
private void handleNewLocation(Location location) {
    Log.d(TAG, location.toString());
    //request and store the coordinates
    double currentLatitude = location.getLatitude();
    double currentLongitude = location.getLongitude();
    //store the coordinates as a movement object
    LatLng latlng = new LatLng(currentLatitude, currentLongitude);
    //get the current date and time
    SimpleDateFormat date = new SimpleDateFormat("dd-MM-yyyy HH:mm:ss a");
    String currentDate = date.format(new Date());
    //define a marker with the coordinates and helpful text
    MarkerOptions options = new MarkerOptions()
        .position(latlng)
        .icon(BitmapDescriptorFactory.defaultMarker(BitmapDescriptorFactory.HUE_RED))
        .title("Location: " + Double.toString(currentLatitude) + ", "
            + Double.toString(currentLongitude) + "; Time: " + currentDate);
    //add a marker to the map; does not add to database
    mMap.addMarker(options);
    //allow access to the database
    data.open();
    //convert lat and lng to strings
    String latstr = Double.toString(location.getLatitude());
    String lonstr = Double.toString(location.getLongitude());
    //add a marker to the map and store it inside of the database
    data.addMarker(new PotholeObj("Location: " + Double.toString(currentLatitude) + ", "
        + Double.toString(currentLongitude) + "; Time: " + currentDate, latstr + ", " + lonstr));
    //close the data source
    data.close();
}
```

Adding a new marker to the map after pothole encounter



User interface with the location of several potholes shown

- Gathering data about anything is a considerable task. Since there are tens of thousands of motorists on the road each day, it would seem to be quite simple to collect the data with little effort by means of individuals conducting their daily commutes. The application implements the GPS and accelerometer functionality present in virtually every smartphone available today. During a motorist's commute, the application is constantly recording and waiting for specific movement to occur. When the motorist hits a pothole, the application will recognize this and the information about the hazard and its location will be recorded.
- Automatic recognition of pothole locations is only one way to record the data. Many people travel by other means, including bicycles, public transit and even walking. To add an extra layer of accessibility to the application, as well as encouraging all people to contribute, the application allows users to manually input the data. By locating the area on the map and clicking, the pothole will be added to the database along with thousands of other potential roadside hazards.

- Of course, all this data would be useless without it being accessible, which is why all of the information related to potholes is readily available to all who use the application. Utilizing the rapidly expanding technology that is cloud-based storage, this data is easily distributed to a user's mobile device.

Results

- After gathering the data and examining it more closely, it is quite apparent that many potholes exist along thoroughfares within our region. While the severity of these hazards range in severity, it is imperative that governments take action and repair infrastructure problems as rapidly as possible. This application will provide a great service to them. In the meantime, current motorists and pedestrians alike will be able to track the locations of these hazards and prepare for them accordingly. This provides a great service and is the first line of defense against possible disasters.

Conclusion

- This application covers a very narrow problem in a much larger picture. Infrastructure is in constant need of maintenance and no city or state government can realistically manage it within its entirety. With the help of the public making their own contributions, they can at least make advancements in a small portion of it, that being potholes. Individuals will also gain awareness as to the frequency that these hazards effect their daily lives, ultimately wanting to do their own part in rectifying the problem.

Discussion



Sights such as these will hopefully be a far less common occurrence

- There is no technique which allows for perfect tracking and resolution of road hazards, such as potholes. At the very least, raising awareness and the potential for discussion about these problems will be the first step. There is no need for governments to patch and repair all potholes, but they must at least be aware of the ones which are the most apparent hazard. It may even be helpful for motorists to purposefully encounter these hazards, as they will be more prominently recognized as they are reported by more individuals.