# Kirill Kuvshinov

# Mobile solution for gas price collection

Based on data from a Finnish gas price website

Helsinki Metropolia University of Applied Sciences Bachelor of science Media engineering Thesis 17 April 2017



Author Title	Kirill Kuvshinov Mobile solution for gas price collection
Number of Pages Date	26 pages + 16 appendices 17 April 2017
Degree	Bachelor of science
Degree Programme	Media engineering
Specialisation option	Android development, Java, PHP
Instructor(s)	Aarne Klemetti, Researching Lecturer

This project claims to address the common problem of providing drivers with actual gas prices. No app studied seems able to retrieve today's gas data only and show them in a user-friendly fashion. Some include earlier data, others rely on community feeds; still others reveal prices only along chosen navigation routes. This paper offers no universal methods to address all the challenges. It is rather an educational attempt to solve some of them from a point of view of a student and a driver.

As the subject of this project, my own approach is described at length. Generally, it includes two Android apps facilitating each other, and both contributing to own database. Thus, only current fuel prices are shown if any, the popular locations' details are uploaded to own database, and historical data kept for future reference. Navigating the driver to the nearest gas station of choice used to be part of the project, yet recent improvements by Google Maps may have invalidated the old certificate.

In addition, the mobile solution features own price updates management (auto or manual mode) and exploits www.polttoaine.net as a solid price-quoting platform. As nothing resulted from my own attempts to contact the platform admins on trainee cooperation, scraping and parsing methods are used in this project (for educational purposes only). All trademarks discussed in this paper are property of their respective owners.

	Gas price, fuel cost, price collection, Android, Java, PHP, da-
Keywords	tabase, JSON, location manager, geolocation, GPS, driver
	app, cron, Google Maps, API, certificate



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# 1 Introduction

The collection of current fuel prices for a specific area has always been on the radar of modern developers, no matter what programming language they use. These numerous apps claim to provide up-to-date information<sup>1</sup> coupled with navigation opportunities and/or distance or fuel endurance calculations along chosen routes, etc. In the multitude of choices, one runs the risk of getting lost because of the opportunities they offer.

Yet some of the apps studied and compared for this project seemed quite sophisticated to meet the simple need of a driver lost somewhere, e.g. in Finland, and in need of a reasonably priced refuel, and at a gas station as near as possible to his or her current location. The driver either has to use different apps subsequently to figure out the location and the way or rely on community-fed applications, e.g. Waze (described in 2.4), which may have no recent updates for the occasion.

The following three major reasons accounted for choosing such a topic for the final year project, namely (i) studying at Helsinki Metropolia UAS, (ii) owning a car in Finland and (iii) having a wish to engage in building an app that would help tackle this simple emergence above in a driver-friendly manner. Yielding any results from own research as such seemed a justifiable return for the time and effort invested.

Thus, the project goal was to create a price-quoting app that would highlight up-to-date prices only for the given position (identified with geolocation). This, later in the project, saw reinforcement in the form of a second app to control data uploading to own database. Therefore, the project scope grew up to two apps with different functions, thus turning into a combined mobile solution. Hence the title of the project.

# 2 Theoretical and practical backgrounds

What follows is an extensive account of the pre-study that took place in 2016 and gave shape to this project further into 2017.

<sup>&</sup>lt;sup>1</sup> The terms "information" and "data" are used here interchangeably despite their fine differences, such as that the former is an organised form of the latter [1,188-189].

# 2.1 Brief introduction to some modern price-quoting apps and platforms

For this project, counterpart quoting tools were studied for similar functionality and user interface features within January-April 2016. Understandably, by now, there may have appeared quite a number of new apps, more driver-friendly and versatile; a quick observation of Google Play website [2] confirms this assumption. Therefore, this project claims no serious competitiveness to these tools and only demonstrates own methods found valuable and acquired knowledge to make a coded product by personal contribution.

Nonetheless, given this project limitation, the study included a series of short "road testing" of the following mobile apps and platforms: GasVisor<sup>2</sup>, BenzinPrice<sup>3</sup>, Waze<sup>4</sup>, Google Maps / Street View, and Polttoaine<sup>5</sup> (as described in 2.4).

# 2.2 Significance of the topic

By the time this research started, Google had updated its Maps app so that it quoted fuel prices at gas stations found along navigation routes; although that option was available for US and Canada only [3;4;5]. That functionality might have seen a larger geographical coverage than before by the time this thesis is available for review.

Still, given that Google must be daily improving its map-oriented tools in terms of fuel prices, and given that more apps tend to appear on the market, the problem of quoting the real prices "here and now" remains among the highlights of today.

# 2.3 Own attempts to organise price collection locally

The project originally consisted in personal collection of local fuel prices based on the mentioned apps. The purpose of that practical pre-study was to make sure which app featured better updatability in the context of the emergency case described in the Introduction. That approach became the focus of this project after earlier price collection trials had failed.

<sup>&</sup>lt;sup>2</sup> https://play.google.com/store/apps/details?id=com.ima.gasvisor

<sup>&</sup>lt;sup>3</sup> www.benzin-price.ru/price.php?region\_id=78

<sup>&</sup>lt;sup>4</sup> https://play.google.com/store/apps/details?id=com.waze

<sup>&</sup>lt;sup>5</sup> www.polttoaine.net

For brevity, those trials were semi-theoretic and saw quite different tools. E.g., hidden positioning of hunter cameras in front of a gas station price stand or even thinking of quadcopters with cameras to take pictures of the same. Obviously, financial considerations intervened among other challenges, which included having to operate the flying machines and structure their flights and control crews; or having to tell the prices on the digital camera shots, with OCR (or optical character recognition<sup>6</sup>) offering to switch the thesis topic. The OCR initiative never proved to be precise enough when used on colour pictures taken at dawn or dusk, esp. with prices in light-red digits vs black background (as shown in Appendix 1). All those trials combined invited to quite a different field of study and scope, irrelevant to this paper and thus were excluded.

# 2.4 Country-specific use of price-quoting apps

With these failures and a real life necessity to live outside of Finland within the period of dealing with this project, Saint Petersburg became the testing ground for running the apps and platform mentioned in 2.1. In addition, almost all Russian gas providers would refrain from updating their prices regularly on their websites, if any, or prefer to display average prices only (as evidenced in Appendix 2.1-2.3). On the other hand, it helped to focus more on the apps at hand.

The main idea was to see how frequently all of them received price updates in order to understand how to proceed with the project. The testing spanned sporadically within January-April 2016, between mornings to night-time.

## Challenges vs favourable conditions

Below follow short analyses of pros and cons of each candidate app.

#### Google Maps / Street View

Initially thought as an ideal data provider for the OCR technique mentioned above, it turned out on the contrary. As per their declaration online (Appendix 3.1), the Google

<sup>&</sup>lt;sup>6</sup> Tesseract for PHP (https://github.com/tesseract-ocr) was tested in parallel just to find out that it required more time and effort to introduce efficiently in this project.

Maps visual information may remain unchanged for 1-3 years. What also suggested discontinuation with this tool was that the option to see fuel costs along a chosen route in the navigation mode was still unavailable in Russia. For these two reasons, this app left the test row right from the start.

# GasVisor / BenzinPrice

Since the first app here depends on the second platform's database (as mentioned at http://www.benzin-price.ru/android\_gasvisor.php under *Возможности* or "App's capabilities"), it made sense to combine them for analysis. Figure 1 shows three screenshots when used in St Petersburg.

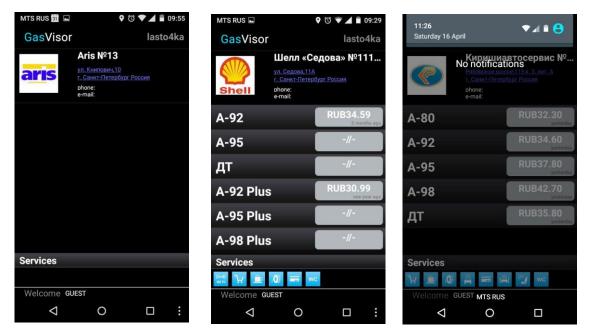
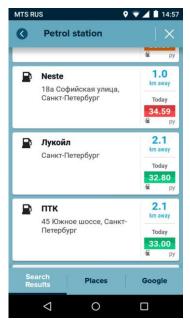


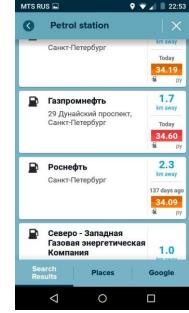
Figure 1. GasVisor at work

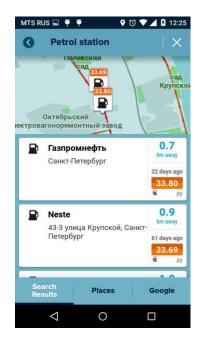
As a result, despite good station-related information, these driver crowdsourcing tools were usually late with updates and kept posting earlier prices instead (Appendix 3.2). In addition, *GasVisor* might at times display an empty screen or too outdated fuel prices (one year ago) as seen in Figure 1. These were the reasons to exclude the two from the research.

#### Waze

When compared to its counterparts, this price-quoting app, although completely dependent on the local driver community too, never exposed empty activities, and always showed better updatability (as Figure 2 demonstrates, note the coloured tags on the right







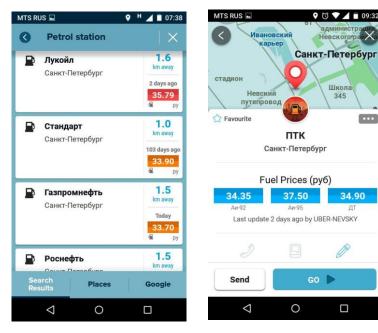


Figure 2. Waze at work

of the interface). It displayed outdated prices more seldom too.

...

This app featured a distance calculator, key to the comparison and the case described in the Introduction. It promoted Waze to a higher position in the comparison chart. Yet messing today's<sup>7</sup> prices with earlier ones spoiled the entire user experience, with the lost

<sup>&</sup>lt;sup>7</sup> For the purpose of this project, "today" when used hereinafter in relation to fuel prices means prices as retrieved/seen at request/web-site visit time.

driver case in mind. And when compared with the next candidate in the test row, it demonstrated less regularity of updates.

# Polttoaine

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13.04.	-	1.294	1.394	1.119
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13.04.	-	1.329	1.409	-
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13.04.	-	1.344	-	-
Teboil, L	assila Kau	pintie 19		
13.04.	-	1.349	1.429	1.164
Teboil, I	täväylä Var	tiokylä Linna	vuorentie 30	
13.04.	-	1.349	1.429	1.169
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This "quoter" (as sampled by Figure 3)<sup>8</sup>, enjoyed the best updatability for its target locations. The study screenshots are given in Appendix 3.3. The data from these and a number of others were used to compare their overall updatability with Russia-based locations, in the form of comparison tables (Appendix 3.4) to define which app had the best updatability. Given the country specifics described above, Polttoaine proved to be the one.

#### Defining Polttoaine as the tool to focus on

Figure 3. Polttoaine at work

Polttoaine's obvious strengths may be explained by one important difference it makes. This platform, or more precisely their database, may have good community feeds, but pri-

marily, it appears to have stronger contributions from the local gas sellers interested in promoting their prices (see their Info tab content<sup>9</sup>). Otherwise, how can one account for such regular and stable updatability? Apart from its pros, Polttoaine has the following minor cons too:

• While the app launches, the emergency-scenario driver described in the Introduction, has to select his/her location manually, among the many ones hard-listed in the app; the driver may be unaware of the location;

• The app offers earlier prices that may come topmost since they are 95E-ordered by default; therefore, the driver is offered sort of overabundance of data [1,78], which is distractive;

• The app lives on officious ads (see the screen bottom of Figure 3).

These minor weaknesses were actually the launch pad for forming own attitude towards how a better app should look. I.e. it would first help the case driver out with geolocation

<sup>&</sup>lt;sup>8</sup> https://play.google.com/store/apps/details?id=com.generum.polttoaine

<sup>&</sup>lt;sup>9</sup> Polttoaine.netin hintatiedot päivitetään autoilijoiden ja muiden asiasta kiinnostuneiden ilmoittamien tietojen perusteella (www.polttoaine.net/index.php?cmd=info).

and, second, spare him/her time for choosing a reasonable refuel by showing only today's prices if any (with distances pre-calculated and ordered from the shortest in respect to the stop location). That scope later grew larger as another app surfaced to help build own database of fuel prices that might be valuable to market researchers if the project was to live on.

# 3 Building own apps and their analysis

This chapter deals mainly with own methods crystallized by the long process that the previous chapter detailed. It also describes how own apps were created to produce a combined mobile solution for gas price collection.

3.1 Forming own methods to address gas price collection

More generally, although mock-ups were at times used (see below) on every piece of paper at hand to get an idea how it would look, the main process that gave shape to the apps was via the traditional trial and error approach while coding. Other thoughts included how to make a difference, e.g. tackle the weaknesses identified in the previous chapter.

The entire project was initially about creating a single app ("User app") that would quote today's prices, if any, as displayed by Polttoaine. However, when tried for the first time in 2016, the app had to connect to a Metro MySQL table and showed only pre-inserted fake prices. The challenge was in populating that table with real Polttoaine's prices, so that the app met the project goal.

Any server-side retrieval was out of the question because of such considerations as extra load on the Metro server and its IP exposal. Exploiting proxies might be an option [1,148-149], but that would rather be outside the project scope. Therefore, data had to be collected from Polttoaine by the User app itself. That was the time when a greater part of its Java code had to be revisited to make it:

- follow a valid URL as the location request dictated (e.g. http://www.polttoaine.net/[location]);
- retrieve today's fuel prices if any;
- and list them to the worried driver from the emergency case.

*DISCLAIMER:* With all the Internet ethics and local law observance due, scraping<sup>10</sup> and parsing techniques applied to www.polttoaine.net under this project were for educational purposes only, and with an intention to attempt creation of a better non-commercial product, given the initial emergency case for this project.

Own scrape-and-parse code (based on the *jSoup* Java library<sup>11</sup>) proved efficient in filtering today's prices from Polttoaine. However, the earlier prices, if any, remained intact and discarded, which looked very inefficient in terms of resource usage. It then sparked another idea: in the same code run, why not upload the historical prices to own database too?<sup>12</sup> Before doing this, the app would check if the location had already been requested today, thus eliminating the urge to upload same data every time a similar request was made by other users.

Clearly enough, uploading today's prices too in the same code run, before today was over, made no sense because more updates could appear on the webpage until midnight (and squeeze out earlier prices at the bottom of the webpage as seen in Appendix 4). Hence, the mobile solution at that stage needed a second app to check for the requested locations' latest prices after 00:00.

Thus, all the locations, requested today and saved in own database (via the User app) in the form of their historical prices, could now have their latest prices uploaded too. That was how the "Admin app" came into play (more detailed in the subsection *Admin app* below). It would use an alarm broadcast receiver to start a "late update" at given time (via a time picker). Once in the database, the prices would never disappear like from Polttoaine's website and might be accessed (possibly via the User app in the future), e.g. by fuel market specialists or statistics researchers.

The programming tools used for the project (chronologically since 2015):

- Eclipse IDE for Java developers;
- Android development tools for Eclipse;

<sup>&</sup>lt;sup>10</sup> Arguably, it may be considered as simulation of the browser activity and is to become the only future technique of getting raw data from the Web [6,4;6,165-167].

<sup>&</sup>lt;sup>11</sup> https://jsoup.org

<sup>&</sup>lt;sup>12</sup> Of course, with all legal issues in place, i.e. once installed and before the first launch, the app should give a warning that the user agrees to share the information viewed for a specific location or any similar message. - KK

- Eclipse for PHP developers;
- MAMP (to run servers locally);
- phpMyAdmin (on the Metro student server);
- Android Studio;
- PhpStorm;
- yEd UML tool (http://www.yWorks.com);
- NinjaMock (https://ninjamock.com).

The testing methods included the traditional single unit runs, which if successful were integrated in the main code of the apps.

## User app

With Appendix 5 showing this app's capabilities UML scheme and activity flowchart, the following is a use case that claims to match the emergency described in the Introduction.

- 1. The worried driver (User) is stationary in or near a Finnish city (hopefully covered by Polttoaine's database): the gas tank is (almost) empty. There is need for a refuel.
- 2. User may be very unfamiliar with the place and there is barely anyone to ask the way to the nearest gas station, leave alone the prices.
- 3. User may wish to consider distance-vs-price options if given any. He or she either Googles for any nearest gas station or launches the User app.
- 4. User has the location service checked. If disabled, the app prompts User to enable or exit.
- 5. User has Internet connection checked. If disabled, the app prompts User to enable or exit.
- 6. User has the position coordinates written to the shared preferences right on the spot. The app takes some time to confirm User's location. Although unaware of the place, User can tell the city or municipality by the road signs. Reverse geocoding is used (coordinates to an address). If wrong, rerun or exit (use another app?).
- User taps OK, and if the location is among the ones hard-coded in app, User sees a list of gas stations with today's prices only and other info starting from the nearest gas station: station icon, address, bonuses/comments if any, fuel prices (e95, e98, Diesel), distance.

- 8. If the location is being requested for the first time today, User has to agree to share the information (s)he is going to see with the local driver community (such a dialog may pop up at the very launch). User sends nothing if another driver has requested the location today.
- 9. This way, the app saves the location's earlier prices to own database if they are absent there.
- 10. User taps on an option to open Google Maps, which takes over with the navigation (pending).
- 11. User closes the app when convenient.
- 12. Compared to Polttoaine's, this one makes a difference:
  - data order-wise, no earlier prices shown (except in the future, they may be as Figure 7 shows), options start with the nearest station, the drivers sees kms too;
  - data updatability and persistence-wise, the app updates own database as described in Appendix 5, and spares the driver's mobile data traffic if other drivers have already requested the same location today or yesterday;
  - usability-wise, no ads.

With the User app tentatively titled as *GasGuide*, mock-ups further detail how the UI was originally conceived and imagined (loc service and Internet connectivity checks are skipped for brevity):



Figure 4. Confirm loc



Figure 5. Choose and tap

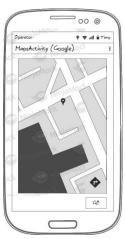


Figure 6. Navigate (pending)



As Figure 4 demonstrates, the user has three options when geocoding is over, i.e. either retry if wrong, quit the app or confirm his/her location to carry on. The next step (Figure 5) is waiting for available options to download and scrolling through them. The list features fuel prices and other data just retrieved from Polttoaine, so that they match the app header (directly under e95 and other types of fuel, with the distance column finishing the row).

Figure 7. No-today'sprices case (pending)

The data include gas station addresses, fuel bonuses and other information the user may need. Each fuel brand has its icon to the right if available. When the user makes a decision, a tap on the choice leads to Google Maps (Figure 6).

As a location-aware app, this one had to follow the recommendations in the field, especially in terms of battery consumption [7]. For that reason, e.g. the LocationManager() method used in the app was first tried on its own in a short series of unit tests, with toasting and logging available with Android Studio that helped add a few adjustments to provide for better fix correction and control over the requestLocationUpdates() known for shortening battery life. The following code excerpt demonstrates the final version based on the quoted resource.

```
@Override
public void onLocationChanged(Location location) {
    // run a loc fix accuracy/update check here before writing to shared prefs
    // using the source's recommendation to maintain a current best estimate
    final int TWO_MINUTES = 1000 * 60 * 2;
    String latitude, longitude, accuracy, timestamp, provider;
    // as read from shared prefs
    mSharedPref = mCntx.getSharedPreferences(SHARED_PREF_LOC_LAT_LNG,
    Context.MODE_PRIVATE);
    latitude = mSharedPref.getString("Lat", "");
    longitude = mSharedPref.getString("Lat", "");
    longitude = mSharedPref.getString("Lac", "");
    timestamp = mSharedPref.getString("Lac", "");
    timestamp = mSharedPref.getString("Ts", "");
    provider = mSharedPref.getString("Ts", "");
    if (!latitude.equals("") && !longitude.equals("") && !accuracy.equals("")
        && !timestamp.equals("") && !provider.equals("")) {
        // Check whether the new location fix is newer or older
        long timeDelta = location.getTime() - Long.parseLong(timestamp);
        boolean isSignificantlyNewer = timeDelta > TWO_MINUTES;
        boolean isSignificantlyOlder = timeDelta < -TWO_MINUTES;
        boolean isSignificantlyOlder = timeDelta < -TWO_MINUTES;
        boolean isSever = timeDelta > 0;
        // If it's been more than two minutes since the current location, use
           the new location
        // because the user has likely moved
        if (isSignificantlyNewer) {
            // Toast.makeText(mCntx,
            // "Writing loc to SharedPrefs since it's significantly newer",
            // Toast.LENGTH_LONG).show();
    }
```





In line with the flowchart introduced in Appendix 5 for the User app, writing the coordinates thus received from the device location tools (GPS, network or Wi-Fi or all combined) to the shared preferences starts separately, under an async task [8]. This helps keep the UI thread busy with other things in parallel (popping dialogues, toasting warnings and prompts to the user, etc).

Similarly, other pieces of code, as recommended excerpts were first tried and tuned outside the main code of the app; then, if successful, they would be included in the app and checked again for any runtime errors. At this stage, the entire app would be saved under the next number version and so on, so that there always was an opportunity to roll back to the previous stable version.

# Admin app

The reason to create a second app as part of the combined mobile solution hereunder was briefly introduced in the beginning of this chapter. Still, a sample use case is required to give a detailed view of what this app can offer to an admin responsible for keeping an eye on own database of fuel prices, provided that the User app does it regular job as the popular locations identifier in the combined mobile solution scheme.

- Admin knows that the User app has added more locations, requested today, to own database. It means that their historical prices are already tabled in own database, but their today's prices are not, since this is the logic of the Uses app: "today is not over yet, and more price updates may be appearing on Polttoaine's webpage. Why save them in the middle of today? Wait until it is over", etc.
- What will happen to them by the end of today? They will stay displayed on Polttoaine well into tomorrow, just to be placed under or written over by more updates to come (i.e. the three-day approach suggested in Appendix 4).
- 3. In order to upload the latest prices of today (of the locations requested today via the User app), Admin either schedules an automatic upload (via a timed alarm trigger) or waits till the end of the day, then uploads these locations' latest prices manually.
- 4. The auto mode implements Wi-Fi (un)locking to save the battery.
- 5. UI-wise, Admin can check the next alarm time, i.e. when the auto mode is scheduled. (If there is a dash instead, no alarm is set.)
- 6. Admin can use the default time picker to schedule/start an alarm (any time).
- 7. Admin has various options available:
  - Simulate the User app, esp. when physically outside of Finland
  - Cancel timed alarms

- See an activity report (auto/manual mode)
- Clear the report
- 8. Admin taps on "Manual" to activate the manual mode, where Admin can:
  - See locations requested yesterday (if any)
  - See requested two days ago (if any).
  - Use either to update own database (JSON format, if data available) from the device, the server being spared extra loads. The data are saved to the shared preferences for persistency.
  - See the previous session upload data (JSON format, in a scrollable window at the screen bottom)
- 9. Admin taps back to return to the main activity (alarm-based, auto mode).
- 10. Admin closes the app when necessary.

If one evaluates the entire two-app approach, it can be seen that, database-wise, the User app saves the locations requested today in a separate table, then after 00:00, a server cron [9] moves them, say, to a yesterday locations table, in order to keep both the former empty and ready for the new day, and the latter populated for roll-back cases (as demonstrated in Figure 43, Appendix 5). The Admin app then steps in and checks on the recent locations by the end of today, in that second table. Now that today is over, the Admin app downloads each location's details from Polttoaine and saves them as recent prices to the respective tables in own database.

This way, one can be sure that no more today's prices for these locations will appear as they used to (see Appendix 4 for increments in today's prices) on Polttoaine's webpage because today has gone, and tomorrow has come. And that way, one can be sure that all popular locations' prices stay in own database. That was the logic behind introducing the Admin app to reinforce the mobile solution for gas price collection under this project. In addition, yesterday's locations migrated from the first table are purged by a second cron on the server and saved into a JSON file for the sake of item 7 above (being able to upload from two days ago, should anything go wrong in the auto mode).

In conclusion to this theoretical part, a third cron would be necessary to purge own database of outdated table content, whose duration would be up to the admin to decide on. For the sake of this project, any locations with prices dating two weeks back or earlier, are removed to ZZ\_[location] archive tables; tackling their growth remains outside the scope hereof.

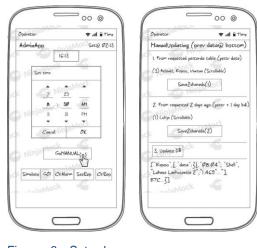


Figure 8. Set alarm (auto mode)

Figure 9. Update from SharedPrefs (1 or 2)

As to the look and feel of the Admin app, the mock-ups in Figures 8 and 9 demonstrate the initial idea (two separate activities with various options).

Designing the Admin app was in parallel with developing database interactions based on the tree-day approach highlighted in Appendix 4, its upload functionality primarily borrowed from the User app.

# 3.2 Limitation of the project

With the User app completed by February of 2016, and the Admin app surfacing in late 2016, developing them to stable versions has taken almost all the remainder of the time stipulated for the 2017 spring graduation. Due to a part- and then full-time job with a Russian company in St Petersburg, all Metropolia courses being completed, the greater part of the project was carried out and tested in St Petersburg, rather than any major city in Finland. It presupposes that some reverse geocoding limitations may also ensue in the combined mobile solution scheme, given that, as experience has shown, Google may at times choke on municipal areas of different countries, especially when there are many subdivisions: the adrress.getLocality() vs the address.getSubAdminArea() [10].

## The Google over-query limit (the User app)

At the time of experimenting with the Google Maps API for distance calculations for this project, only 50 requests per second were allowed for no-licence uses. Presently, the quota may have changed; still the same limit is in force [11]. For this reason, the User app has to force delays in calculating distances between the available gas stations' and the user's addresses.

As tests show, if there are up to 50 locations to process in this regard, and if the calculations are limited to two distances per second, there is usually only 1% of failures. However, in this case the app takes much time in listing the results (the distances are integral to the UI). Moreover, for five distance calculations per second, the malfunction is diverse, e.g. 29 : 19, 14 : 34 or 19 : 29 (i.e. go vs no-go results); yet the time spent is noticeably shorter.

A major recent problem that may have related to the same, is the User app's inability to activate its former Google Maps part, which may be due to certificate alterations in the provider's policy.

# The community approach (the User app)

Despite feeding on Polttoaine's data, the User app would perform better if it allowed for driver community input. For the time being, the app's UI has no feature as such.

On the other hand, the User app is indeed dependent on the local community requests. I.e. the more frequently drivers ask for today's prices, the more up-to-date is own database.

## Archive tables growing in volume (the Admin app)

As the tabled data in own database become two-week old, they are removed into their respective archive tables, named ZZ\_[location], by a server cron programmed to fulfil this on a regular basis. It helps to keep actual information within limits, so that requests are served faster; still the ZZ tables may become overpopulated with time. So far, the mobile solution under this project has no means to tackle this problem.

## 4 Results

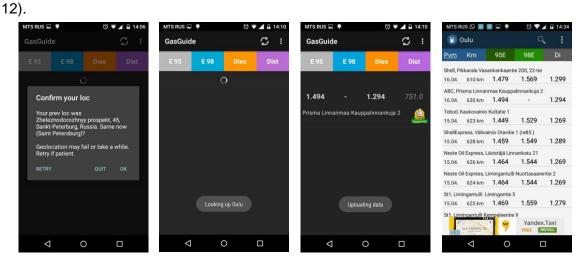
With the project limitations taken into account, the combined mobile solution does almost everything as it should, except for the former navigation. It definitely needs more attention if it is to claim to become a remote competitor of its counterpart app from Polttoaine.

# 4.1 Overall performance of the two-app approach

In order to demonstrate how this approach works in real life, following are mobile screenshots of both the apps in action, in the same order as mocked up in the previous chapter. For the database approach, more screenshots are added after those of the apps.

## User app

If the app's mock-ups are compared to the actual look and feel (Figures 10, 11), there seems to be only colour, the pending no-today's (Figure 13) and Google Maps scenarios that differentiate them. Still, most of the functionality declared is in place, except the Google Maps case (detailed in 4.2). For easier comparison of the User app vs its Pol-ttoaine's counterpart, one of the latter's screen shots is added, too (as shown in Figure 13)



#### Figure 8. Confirm loc



Figure 11. No-today'sprices case (pending)

#### Figure 9 (two). Choose and tap

#### Figure 10. Polttoaine's app

As Figure 10 confirms, the test location was St Petersburg, yet to simulate a Finnish location, Oulu was chosen and hard-coded into the User app to see the actual prices come into light. And both the apps showed first 1:2 and then 2:3 options (see Figures 11, 12 and 14) in favour of the Polttoaine's app.

Figure 14 demonstrates also that data retrieved almost at the same time by the two apps, may be slightly different (compare the official Polttoaine webpage with the output of both the apps; as well as note the different distance values).

Tapping on either option offered by the Use app (Figure 14) failed to open the Google Maps activity for unknown reasons so far.

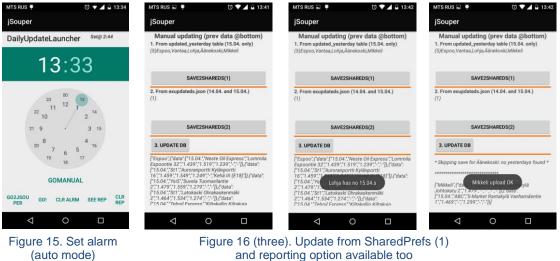
Finally, before the usual run of the code was altered for Oulu, the no-today's prices modelled option (Figure 13) was obviously handled correctly, since this location was not among the Finnish ones, hence no data for it.

Jakeluase	ema				PVM	95E10	98E	Di	
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ABC, Pris	ma Linnanmaa	Kauppalinna	ankuja 2	Kartta	16.04.	1.494		1.29	4
Shell, Haa	palehto Parkki	isenkankaar	tie 5 (*E99+)	Kartta		1.449	*1.569	1.26	9
Shell, Pikk	arala Vasanka	inkaantie 20	0, 22-tie (*E99-	+) 🛃 Kartta	16.04.	1.479	*1.569	1.29	9
ABC, Prisi	ma Limingantu	Nuottasaa	rentie 1	🔁 Kartta	15.04.	1.484	1.564	1.29	4
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E 95	E 98	Dies	Dist	<u>Pvm</u>	Km	95E	98E		Di
E 95	E 90	Dies	Dist	Shell, Haa	palehto Pa	arkkisenkar	nkaantie 5		
				16.04.	626 km	1.449	1.569	1	.26
1.479	*1.569	1.299	734.0		arala Vasi 610 km	ankankaant 1.479	tie 200, 22-ti <b>1.569</b>		.29
ikkarala Vi E99+, 22-tii	asankankaant e	ie 200,			ma Linnan 630 km	maa Kaupp 1.494	alinnankuja -		.29
1.449	*1.569	1.269	749.0	Teboil, Ka 15.04.	ukovainio 623 km	Kultatie 1 1.449	1.529	1	.26
laapalehto E99+	Parkkisenkan	kaantie 5,	Shell		ess, Väliva 628 km	inio Oravitie 1.459	e 1 (re85 ) 1.549	1	.28
					Express, L 626 km	ävistäjä Lin 1.464	nankatu 21 1.544	1	.26
				Neste Oil	Express, L	imingantull	li Nuottasaa	rentie :	2
				15.04.	624 km	1.464	1.544	1	.269
				St1, Limin	gantulli L	imingantie	Yande	ex.Tax	
				N N	and the second	100		-	-

Figure 12. Own app's input appears to match the webpage

#### Admin app

Similarly, the other app belonging to the combined mobile solution is visualised below. Its provisional title is *jSouper DailyUpdateLauncher*, it was named so after a library with a resembling name (footnoted in 3.1) was experimented with and lay as the foundation. Manual mode examples (auto mode excluded for brevity except its report) include:



and reporting option available too

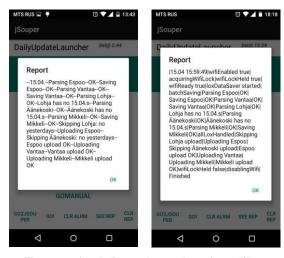


Figure 17 (two). Reporting options (auto "|" vs manual "--"). Note the battery saving technique used in the auto mode (Wi-Fi (un)locking).

As Figures 15 and 16 demonstrate, the update process was via the manual mode, after the data had been saved to the shared preferences of the device. The uploading was toasted and duly reported as it should be (Figures 16, 17). Note the minor difference in the way the auto and manual modes showed their reports separators ("|" for auto vs "--" for manual).

# Database

Since these two apps are integral to the combined mobile solution for gas price collection, its overall performance will be incomplete without demonstrating the back-end process, i.e. what happens in the database. The following figures are meant to give an idea in this regard.

If the way the previous screenshots appear is viewed in chronological sequence, it can be noted that:

1. The test user is in Oulu requesting fuel prices for today via the User app. It then sends that information to the database; since it shows that it is uploading data, the location is being requested for the first time. It means that Oulu should appear in the today's locations table (as Figure 18 shows).

Päivitetty viimeksi: 16.04. klo.14:00		— 🛒 Server: mysql.metropolia.fi » 🍘 Database: kirillk » 🔜 Table: requested_today
<b>6</b>		🗉 Browse 🧏 Structure 🗐 SQL 🔍 Search 👫 Insert 🚍 Ex
	ONEL Merrora	Showing rows 0 - 4 (5 total, Query took 0.0007 seconds.)  SELECT * FROM `requested_today`
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Valitse kaupunki		Edit Be copy G Delete 455 Espo
	Keskihinnat: 1.481 1.562 1.297	🖂 🥜 Edit 👫 Copy 🥥 Delete 440 Enontekiö
Valitse kaupunki/Tie 💌		
Etai tarkemmin	Shell, Pikkarala Vasankankaantie 200, 22-tie (*E99+) 🔂 Kartta 16.04. 1.479 *1.569 1.299	🔲 🥜 Edit 👫 Copy 🥥 Delete 441 Helsinki
Listiane	ABC, Prisma Linnanmaa Kauppalinnankuja 2 🔁 Kartta 16.04. 1.494 - 1.294	
Pikalinkit	ABC, Prisma Limingantuli Nuottasaarentie 1 📴 Kartta 15.04. 1.484 1.564 1.294	🔲 🥜 Edit 👫 Copy 🥥 Delete 442 Lohja
Näytä PK-Seutu	Teboil Kaakkurinhovi Kaakkurinkulma 1 🔁 Kartta 15.04. 1.499 1.579 1.309 Teboil Kaukovainio Kultatie 1 🗗 Kartta 15.04. 1.449 1.529 1.269	- OF A BION O DIA 445 ON
Näytä Turun seutu	Teboll, Kaukovainio Kultatie 1         Xartta         15.04.         1.49         1.529         1.269           Seo, Alppia Kaarnatie 30         Kartta         15.04.         1.528         1.398	🔲 🥜 Edit 👫 Copy 🥥 Delete 445 Oulu
Näytä Tampereen seutu	Neste. Hiironen Kilakivenkuja 2 23 Kartta 15.04. 1.519 1.579 1.359	
A REAL PROFESSION AND A REAL	Neste Oil Express, Lävistäjä Linnankatu 21	Figure 18. Oulu is in the
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Näytä Jyväskylän seutu	St1, Limingantuli Limingantie 5 SKartta 15.04. 1.469 1.559 1.279	requested_today table
Näytä Porin seutu	Seo, Kaakkuri Kaakkurinojantie 1 🔁 Kartta 15.04. 1.499 1.579 1.319	
Näytä Seinäjoen seutu	ShellExpress, Válivainio Oravitie 1 (re85 0.999) 🔂 Kartta 15.04. 1.459 1.549 1.289	
Näytä Kaikki asemat	St1, Limingantulli Kempeleentie 9 🔂 Kartta 15.04. 1.469 - 1.279	
Näytä 20 Halvinta	ABC, Kaakkuri Palokankaantie 301 🔁 Kartta 15.04. 1.489 1.569 1.299	
Näytä 20 Kalleinta	ShellExpress, Knuutilankankaantie 1 🔁 Kartta 14.04. 1.434 - 1.254	
ney te to reacting	Neste Oil Express, Kiiminki, Jääli Välikyläntie 5 🔂 Kartta 13.04. 1.459 1.539 1.279	
Maakaasuasemat	Shell, Pateniemi Kaljantie 1 (*E99+) 🔁 Kartta 13.04. 1.494 *1.614 1.294	
Veneasemat	ABC, Pateniemi Keskuskatu 2 🔂 Kartta 13.04. 1.499 1.579 1.299	

Figure 19. Oulu data (official)

2. All but today's (16.04) prices from Oulu (Figure 19) are supposed to have been uploaded to own Oulu's table in the database. Figure 20 confirms it.

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🗇 🥜 Edit 💈	Copy 🥥 Delete	42	2017-04-15	3	Neste Oil Express	Lāvistājā Linnanka	tu 21	1.	464	1.544	1.269		-
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📺 🥜 Edit 🤅	Copy 🥥 Delete	52	2017-04-13	3	ABC	Pateniemi Keskusl	catu 2	1.	199	1.579	1.299		

Figure 20. Oulu data (retrieved into own database)

3. Moreover, the Admin app revealed the locations requested yesterday (15.04) were Espoo, Vantaa, Lohja, Äänekoski, and Mikkeli (Figure 16). It means that their data should be in their respective tables of own database (see the thesis

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Figure 21. Locations requested yesterday are store in a separate table

last page figure too). This presumption is confirmed by Figure 21.

4. Given that a manual upload of their prices was attempted (as indicated in Figures 16, 17), all of them except today's (16.04) should be in the respective tables of the database. For brevity, only the first three locations vs their Polttoaine's counterparts are shown in Figures 22-24.

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Ē	2 Edit	i Cor	y 😂 Delet	e 622	2017-04-15	ABC Deli	Mikkelä Mikkelänkallio 1	1.479	1.549	1.319	E85 0.959	-
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6	2 Edit	Cor	y 🤤 Delet	e 623	2017-04-15	Teboil Express	Mäkkylä Turuntie 14	1.484	1.564	1.284	*	110-tie
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St1, Auroranportti Kylänportti 16, Kehä III (E18)	Kartta	15.04.	1.459	1.549	1.249
Ysi5, Suvela Tuomarilantie 2	Kartta	15.04.	1.479	1.559	1.279
St1, Latokaski Ohrakaskenmäki 2	Kartta	15.04.	1.464	1.534	1.274
Teboil Express, Kiltakalio Kiltakuja 2	Kartta	15.04.	1.464	1.544	1.279
St1, Bemböle Turuntie 203 (Re85 0.999), 110-tie	Kartta	15.04.	1.444	1.534	1.224
Neste Oil Express, Karakallio Tornihaukantie 1	Kartta	15.04.	1.454	1.534	1.244
Neste Oil, Viherlaakso Rajamännynahde 1 🛃	Kartta	15.04.	1.529	1.609	1.339
St1, Karamalmi - KII Karapellontie 11 (RE85 0.969)	Kartta	15.04.	1.454		1.249
Shell, Bemböle Bellinmäki 2, 110-tie (*E99+)	Kartta	15.04.	1.454	*1.574	1.234
Neste Oil Express, Lommila Lommilanrinne 1	Kartta	15.04.	1.454	1.534	1.254
Teboil Express, Lommila Lommilantie 12	Kartta	15.04.	1.444	1.544	1.244
ABC Deli, Mikkelä Mikkelänkallio 1 (E85 0.959)	Kartta	15.04.	1.479	1.549	1.319
Teboil Express, Mäkkylä Turuntie 14, 110-tie	Kartta	15.04.	1.484	1.564	1.284
Neste, Muurala Nimismiehenpelto 1	Kartta	15.04.	1.499	1.589	1.349
St1, Leppävaara Hannu Olavinpojantie 3, 110-tie, Kehä I 🗾 🛃	Kartta	15.04.	1.499	1.579	1.309
St1, Lähderanta Pitkäjärventie 1	Kartta	15.04.	1.464	1.544	1.254
Neste Oil, Nihtisilta Nihtisillankuja 2	Kartta	15.04.	1.519	1.599	1.339
ShellExpress, Sepänkylä Palomiehentie 2	Kartta	15.04.	1.454	1.529	1.249
ABC, Karaportti Karaniityntie 2 (E85 0.989)	Kartta	15.04.	1.499	1.569	1.309
Neste Oil, Otaniemi Miestentie 1, Kehä I 🔁	Kartta	14.04.	1.429	1.509	1.299
Neste Oil, Mankkaa Sinikalliontie 1-3, 1-tie 🔛	Kartta	14.04.	1.439	1.519	1.249
Teboil Express, Leppävaara/Perkkaa Hevosenkenkä 2, Kehä I 🛃	Kartta	14.04.	1.494	1.574	1.304
ABC, Nihtisita 4	Kartta	14.04.	1.479	1.559	1.279
Shell, Leppävaara Vanha maantie 2 (*E99+)	Kartta	14.04.	1.514	*1.634	1.324
Ysi5, Nihtisilta Kutojankulma 2 😝	Kartta	14.04.	1.459	1.529	1.259
Shell, Vallikallio Vallikallionkatu 9, Kehä I (*E99+)	Kartta	13.04.	1.509	*1.629	1.299
St1, Mäkkylä Turuntie 2 (Re85 0.999), 110-tie 🛃	Kartta	13.04.	1.489	-	1.289
Neste Oil Express, Kauklahti Mänkimiehentie 3	Kartta	12.04.	1.449	1.509	1.239

#### Figure 22. Espoo handled

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					2017-04-15	Neste Oil Express	Ansakuja 2	1.439	1.519	1.229		
	2 Edit	Copy	Delete	337	2017-04-15	Shell	Ruskeasanta Tuusulantie 10	1.459	*1.579	1.249	*E99+	
8	2 Edit	Copy	Delete	334	2017-04-15	St1	Petikko Tillipojanlenkki 2	1.459	-	1.249	Re85 0.999	Kehā III (E1
3	2 Edit	Copy	Delete	340	2017-04-15	St1	Rajatorppa Köysikuja 1	1.484	1.559	1.269		
8	🥒 Edit	Copy	Delete	339	2017-04-15	Neste Oll Express	Myyrmäki Raappavuorentie 2	1.474	1.554	1,259		
3	2 Edit	Copy	Oelete	336	2017-04-15	St1	Veromies Virkatie 7	1.444	1.524	1.234	-	Kehā III (E1
23	🥒 Edit	Copy	Oelete	333	2017-04-15	Teboil Express	Tuupakka Tuupakantie 2	1.459	1.539	1.249		Kehä III (E1
-	2Edit	Copy	Oelete	338	2017-04-15	Neste Oil Express	Siltamäki Kirkkotle 2	1.439	1,519	1.229	-	-
1	🥜 Edit	Copy	Oelete	307	2017-04-13	Neste Oil Express	Ilmakehä Teknobulevardi 1	1.449	1.529	1.239		
5	2 Edit	Copy	Co Delete	303	2017-04-13	Neste Oil Express	Martinlaakso Martinlaaksontie 1	1.474	1.554	1.264	-	
8	🥒 Edit	Li Copy	Delete	306	2017-04-13	St1	Simonkylä Vanamontie 13	1.499	1,579	1.299		
-	2 Edit	Copy	O Delete	308	2017-04-13	Teboil	Tammisto Valimotie 10	1.509	1.609	1.299	-	-
9	🥒 Edit	Copy	Delete	300	2017-04-13	Teboil Express	Tuupakka Tuupakantie 2	1.469	1.549	1.259		Kehå III (E
-	2 Edit	Copy	C Delete	305	2017-04-13	Shell	Kaivoksela Kaivokselantie 1B	1.499	*1.619	1.289	*E99+	-
21	2 Edit	Copy	Oelete	304	2017-04-13	Neste Oil	Martiniaakso Vihertie 39	1.519	1,599	1.319		
1	2 Edit	Copy	Oelete	302	2017-04-13	Neste Oil	Keimola Itä Hämeenlinnanväylä 601	1.504	1.584	1.319	-	3-tie
21	2 Edit	Copy	C Delete	310	2017-04-13	Neste Oil Express	Kaivoksela Kaivokselantie 1A	1.469	1.549	1.259		
1	2 Edit	Copy	O Delete	309	2017-04-13	Neste Oil Express	Ansakuja 2	1.469	1.549	1.259	-	-
11	2 Edit	Copy	O Delete	299	2017-04-13	Neste Oil Express	Hakkila Tukkukaupankuja	1.454	1.534	1.244		
ni.	2 Edit	Te Copy	A Delete	297	2017-04-13	Shell	Ruskeasanta Tuusulantie 10	1.459	*1.579	1.249	*E99+	-
el Ri	2	2.000	O Delete		2017-04-13	SI1	Petikko Tiilipojanlenkki 2	1.474		1.264	Re85 0.999	) Kehä III (E
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			- E.		2017-04-12	Teboil Express	Varisto Martinkyläntie 72		1.584			
	-		-		2017-04-12	Teboil	Kaivoksela Vanha Kaarelantie 35		1.589			
		-	-		2017-04-12	ABC	Prisma Jumbo Vantaanportinkatu 3		1.589			0.10
			Oelete		2017-04-12	Neste Oil	Varisto Ulkonitynkuja 2		1.589			

V	a	n	ta	а	

Jakeluasema	PVM	95E10	98E	Di
Keskihinnat:		1.478	1.560	1.271
Teboil Express, Tuupakka Tuupakantie 2, Kehä III (E18) 🚺 Kartta	15.04.	1.459	1.539	1.249
St1, Petikko Tiilipojanlenkki 2 (Re85 0.999), Kehä III (E18) 🛃 Kartta		1.459		1.249
Neste Oil Express, Ansakuja 2 🔂 Kartta	15.04.	1.439	1.519	1.229
St1, Veromies Virkatie 7, Kehä III (E18) 🔂 Kartta	15.04.	1.444	1.524	1.234
Shell, Ruskeasanta Tuusulantie 10 (*E99+)	15.04.	1.459	*1.579	1.249
Neste Oil Express, Siltamäki Kirkkotie 2 🔂 Kartta		1.439	1.519	1.229
Neste Oil Express, Myyrmäki Raappavuorentie 2 🛛 🛃 Kartta	15.04.	1.474	1.554	1.259
St1, Rajatorppa Köysikuja 1 🛃 Kartta		1.484	1.559	1.269
Neste Oil Express, Hakkila Tukkukaupankuja	13.04.	1.454	1.534	1.244
ABC Deli, Petikko Petikontie 29, Kehä III (E18)	13.04.	1.509	1.589	1.309
Neste Oil, Keimola Länsi Hämeenlinnanväylä 600, 3-tie 🛛 😭 Kartta	13.04.	1.464	1.544	1.269
Neste Oil, Keimola Itä Hämeenlinnanväylä 601, 3-tie 🛛 🛃 Kartta	13.04.	1.504	1.584	1.319
Neste Oil Express, Martinlaakso Martinlaaksontie 1 🛛 🚦 Kartta	13.04.	1.474	1.554	1.264
Neste Oil, Martinlaakso Vihertie 39 🔂 Kartta	13.04.	1.519	1.599	1.319
Shell, Kaivoksela Kaivokselantie 1B (*E99+)	13.04.	1.499	*1.619	1.289
St1, Simonkylä Vanamontie 13 🔂 Kartta	13.04.	1.499	1.579	1.299
Neste Oil Express, Ilmakehä Teknobulevardi 1 🔁 Kartta		1.449	1.529	1.239
Teboil, Tammisto Valimotie 10 🛃 Kartta		1.509	1.609	1.299
Neste Oil Express, Kaivoksela Kaivokselantie 1A 🔁 Kartta		1.469	1.549	1.259
Teboil Express, Varisto Martinkyläntie 72		1.484	1.584	1.284
Teboil, Kaivoksela Vanha Kaarelantie 35	12.04.	1.509	1.589	1.299
ABC, Prisma Jumbo Vantaanportinkatu 3 🔁 Kartta		1.509	1.589	1.299

# Figure 23. Vantaa processed

	Browse	RS	tructure		SQL 🔍 Se	arch 📑	Insert	Export	🔛 Impe	ort 🥜	Operatio	ons	nă Triș	ggers	
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Lohja				
Jakeluasema	PVM ▼	95E10	98E	Di
Keskihinnat:		1.485	1.565	1.288
ABC, Virkkala Tynninharju Maksjoentie 9 🛃 Kartta	16.04.	1.489	1.564	1.289
Teboil Express, Tynninharju Maksjoentie 🛃 Kartta	16.04.	1.469	1.544	1.269
St1, Holmankuja 2	16.04.	1.474	1.564	1.284
ABC, Grillimarket Tytyrinkatu 4	12.04.	1.509	1.589	1.309

# Figure 24. Lohja inserted too

For space and brevity, no cron job screenshots are furnished for this paper.

## 4.2 Errors explained

Unfortunately, the major problem of the combined mobile solution is the sudden malfunction of the Google Maps activity as shown in Figure 25. Own approaches to address this error included online searches, yet so far no valid solution has been found, except redesigning the entire activity and test-run it from scratch.

Among other problems encountered in this project was the formation of valid links to reach a target location. E.g. http://www.

polttoaine.net/Espoo were easily followed by the code, whereas such as http://www.polttoaine.net/ /Keha\_%20III%20(E18), i.e. Kehä III (E18), or

http://www.polttoaine.net/Pyha\_ja\_rvi (i.e. Pyhäjärvi) were not.

Own methods were introduced to overcome the latter. More specifically, for umlauts and the space substitution in the links:



his.keyword = keyword.replaceAll(" ", "%20").trim();

After running these, links to the Polttoaine's 150-location webpage were followed by the code and opened gates to their html code without any problem.

# 5 Evaluation of the results

What follows is an attempted objective evaluation of the performance of own combined mobile solution for gas price collection, including comparisons with Polttoaine's app. Overall, but for the single major drawback represented by the Google Maps activity malfunction, the solution works, provided the local drivers use it and agree to share the information they get from Polttoaine.

# 5.1 Efficiency of own methods

Despite the need for further code rearrangement and more effective methods, own mobile approach has shown that:

- 1. The test locations are recognised correctly, which is much help to the worried driver case described in the Introduction.
- 2. Gas station options, though limited by the Google over-query limit (chapter 3.2), are true to those displayed on the gas prices provider's website.
- 3. Own database gets populated with only most requested location's data and can be developed further to give access to interested parties.
- 4. Own database uploading can be handled by an admin in either the auto or manual mode, with reporting and toasting available.
- 5. No ads are shown in the process (no distraction/disturbance).
- Failures include the map activity and the pending no-today's prices case, thus historical prices are unavailable at present. In addition, no own app's tools have been designed to counter the archive tables overpopulation mentioned in chapter 3.2.

Next subsection deals with the key feature comparison to the Polttoaine app to see benefits and drawbacks of own approach.

# 5.2 Benefits and drawbacks vs studied tools

Although claiming no rivalry with the counterpart app, own apps offer the following pros and cons when compared with the Polttoaine app (in the same order as 5.1 above):

- 1. Unlike the comparison app, own one recognises current location.
- 2. Polttoaine's app may at times deviate from its cousin webpage, whereas own app scrapes them as they are (see Figure 14).
- 3. No official ways are known to access the Polttoaine database historical prices, whereas own database features a fair collection of them, provided local drivers are motivated to use the mobile solution from now on.
- 4. Unlike the comparison app, own one offers some database update management tools.
- 5. Own apps do not feed on ads.
- 6. Drawbacks include no own app's option to use local driver community input (unlike Polttoaine's app that has it); no navigation to the gas station chosen (Polttoaine has it too); no tools to counter the archive tables' growth in own database; the tables there are numerous, unrelated, and with repeated structures.

As a major side note, back to Figure 14, the distances calculated by both the apps do differ. Therefore, this distance was resized on the Google Maps webpage to show the



following:

Comparing the results reveals that own app's length is closer to the resized one in both cases. This speaks for one major benefit in favour of the User app.

Figure 26. Deviation in distance calculations by the two apps

With these finishing this subsection, it can be concluded

that keeping the comparison in mind will help both parties in improving their apps in future and implementing better usability scenarios.

## 6 Conclusion

In conclusion, it should suffice to state that the initial emergency pictured in the Introduction, with the worried driver, unaware of the location (s)he is at and with an emptying gas tank, may have received a new solution in the form of the two apps and database detailed in this project. Although for the time being, the Google Maps activity lacks operation readiness, the system seems to qualify generally to proceed with further development as a promising, possibly, more driver-friendly tool.

As for the Admin app, its tasks may as well be server-run, yet the mobile solution in question seems to provide for more tangible control over the process right on the go.

It goes without delving into much detail that the system will depend on the local driver community too, since it is their location requests that are the prime mover for this project, and the latter was not meant to scrape and parse all the locations Polttoaine covers daily. That would seem to offer another topic for a thesis of a web security or antibot student.

The Google over-query, as a limitation for this project, may be surpassed by finetuning the process milliseconds suitable for the occasion. On the other hand, the emergency driver from the Introduction may feel frustrated at having to list through multiple options if there are so many as 20 or 50, and may as well be content with choosing among just 5-8 stations instead.

The combined mobile solution for gas price collection introduced in this project could be more efficient if the following requirements were met:

- The Google Maps activity is back and operational;
- The over-query limit is curbed via caching or other means;
- The single geolocation mode is reinforced by a manual input alternative, should the driver ignore the need for position recognition;
- The show-earlier prices case is introduced and tested for whether it is actually necessary;
- The archive tables' growth is checked by a fourth cron that stores outdated information in JSON-formatted files;
- The repeated structure of the database tables is substituted by more efficient tools in order to save space and time and eliminate the need for archiving.

Further study may be recommended to build on the project by introducing non-MySQL methods too. Additionally, other collection methods than getting updates from gas providers or driver communities, as described in Appendix 1, may encourage the continuation of this project.

# References

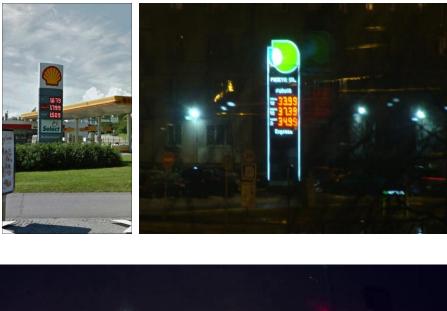
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# Appendix 1. Challenges of OCR

The images on this page originate from Google Street View, own photo camera, and own dashcam respectively to the order they appear here, unnumbered. When trying to recognise these via the mentioned Tesseract-PHP script, the results were discouraging, since the colour digits were never read correctly.





Own attempts to change these colour images into black and white gave no positive results: when taking pictures, one had to make sure the price tag was ideally centred. That, however, never helped even after treatment by various methods (as self-explanatory Figures 27-31 demonstrate).

# Appendix 1 29



Figure 27. Cropped



Figure 28. Cropped, negated



Figure 29. Cropped, negated, greyscale (CNG)



Figure 30. CNG+lit+contrasted

Figure 31. CNG+lit

e95 21.34 e98 33.45

Figure 32. A .doc file screen shot was read like "e95 21.34e98 33.45"

Unlike colour images, BW screenshots, as simple as black text vs white background (Figure 32), were read without any problem. Those attempts clearly explained, carrying on with two separate topics would take more time than allocated for writing one thesis.

# Appendix 2. Retrieving country-specific fuel data

 For this item, see below a screenshot of a website specialised in quoting only average fuel prices in St Petersburg. The text in fine print underneath the title (*Gas prices in St Petersburg*) reads that their hard-working bots are daily busy collecting fuel data from various gas stations of the city. Not every station is ready to provide this information, so today's major choices are the following. And only two options follow.

1.000				1000 1000 00000				🖲 🕙 🕞 🤶 🗖 Sat 30 Jan 11:56
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C fi 🗋 www.repmy	.ru/ceny-na-be	nzin.html						<u></u>
рды 🏂 Plugins 🚞 Metre	a 🚞 AIF 🚞	myDev 🚞 Mis	• 📕 📶 🖪 E	]_ 🖸 Python 🚦	🖬 Android 🔛 🖸	Webmail 🖉 🗋 g	gg_deage.php 🗋 gg.php %	
👄 Автосалоны	🤭 Автосер	овисы	🧇 Автомойки	10 ш	иномонтажи	🄲 Эвакуато	іры 📄 Заправки	📋 Автомагазины 😪 Разборі
Sugrec								Q
ATL Rep	Обслуживание ратонобилей в Петербурге	ł			Annormania		Доверенность Удобная форма доверенности на г	автомобиль
🔶 / Серенсы •	/ Шинный ка	лькулятор						Ссылки по теме
Цены на бе	нзин в	Петерб	іурге					В Европе и мире выбирают лучшие автомобили
Наши трудолюбивые робо предоставляют эту информ	ты ежедневно с	обирают инфор	мацию о ценах на				ж слиску всех заправок	Европейский континент уже определился с лучшим автомобилем года, а мировое сообщество автомобилистов только назвал претемдентов на этот титул, лучщего
заправках основных сетей		арасноя наяти	тути решения это	inpoonena. mai	er cer officientine de	na na ochann na	О Петербурга	Тюнинг авто СПб
*								Евросиб Сервис Центр
								Инавто Вольво
Название компании	Цены:	аиво	АИ92	АИ95	АИ98	ДТ		В якваре четверть российских автомобилей была произведена в Санкт-Петербурге
		-	34.08	37.33	~	34.88	🞲 Станции этой сети	По данным Федеральной службы государственной статистики России в перви
💋 Татнефть								месяце 2014 года конвейерами российски автомобильных предприятий было
Татнефть КиришиАвто	сервис	31.70	33.70	36.80	42.10	35.00	📅 Станции этой сети	

2. Next image demonstrates that prices shown are for evaluation only and subject to change by gas stations:

nap/id/509e9af7907850664d1cecd5/c/ Alf 🚞 myDev 🚞 Misc 🇾 🚺			📔 🚾 Webmall	/ 🗋 gg_deage.php 🗋 gg.php	p 🐮	යි 🥶
MultiGO TONN	1BO				Регистрация   Вход	
ЛЕНТА К	APTA A3C	мобильные прил	ожения регио	ны		
**** = (*) 2.00 KM		27/07				
AA3C Nº433 NESTE r. Calico filemepsypir, nep. Helikunorow ***** (0) 2.62 kM	95 92 ДТ			8		
A3C №104 ПТК (СПб) r. Cawor-Flerep5ypr, np-r. Левзшоворог, ★ ★ ± ± ± (1) 2.76 км	95+ 95 92 ДТ				Leaflet   @ MultiGo 2012-2016	
АЗС №004 ПТК (СПб) г. Санкт-Петербург, лл. Театральная, * * * * * (0) 2.85 км	95 92		P006 ПТК (СПб)		(1)	
АГЗС СЕВЕРНОЕ г. Санкт-Петербург, наб. Выбортская, ***** (1) 2.98 км	7A3	Расположение	Типы топлива	Топливные карты Услуги	Отаывы Акции	
АЗК №002 СургутНефтеГаз	98 95	98+	отсутствует			
<ul> <li>r. Санкт-Петербург, наб. Песочная, д</li> <li>* * * * (5) 3.00 км</li> </ul>	92 <u>Д</u> Т	98	41.10	29.01.2016 PM-0006 (0)		
A3C Nº168 ПТК (СПб)	98 95	95+	отсутствует 🖉			
<ul> <li>г. Санкт-Петербург, наб. Алтекарокая</li> <li>★★★★★ (1) 3.03 км</li> </ul>	92 <u>Д</u> Т	1 95	37.50 🖉	29.01.2016 PM-0006 (0)		
		92+	отсутствует 🖉			
К АЗС №145 ЛУКОЙЛ г. Санкт-Петербург, наб. Выборгская,	98+ 95+ 95 92+	92	34.45 🖉	29.01.2016 PM-0006 (0)		
***** (0) 3.05 KM	92 ДТ+	80	отсутствует 🖉			
АЗС №179 ЛУКОЙЛ г. Санкт-Петербург, ул. Арсенальная,	95+ 95 92+ 92	ДТ+	отсутствует			
***** (3) 3.11 KM		I AT	нет цены 🖉			
A3C №18 ЛИНОС	98 95	ГАЗ	отсутствует			
Косинст Петербург, наб. Выборгская, + + + + + (0) 3.18 км	92 <b>Д</b> Т					

3. An excerpt from a correspondence history between me and a local Neste station (translated by me):

From: DS Spb <ds.spb@neste.com> Subject: Re: prices available at your website Date: 8 February 2016 at 10:09:25 GMT+3 To: Kirill Kuvshinov <Kirill.Kuvshinov@metropolia.fi> Good morning Kirill, If you are interested in our gas station prices, the site cannot provide this information.

You may want to visit any of our stations individually to learn about current price. Fuel delivery can be calculated by a special calculator if you pls follow this link. http://www.nesteoil.ru/ru/content/calculator

7 February 2016, 19:05 Kirill Kuvshinov <Kirill.Kuvshinov@metropolia.fi>
wrote:
Good evening,
Kindly advise where I can see fuel prices on your website.
Best regards,
Kirill
-Best regards,
Corporate sales office
Neste Saint Petersburg, OOO
+7 (812) 703 06 15
ds.spb@neste.com
www.neste.ru

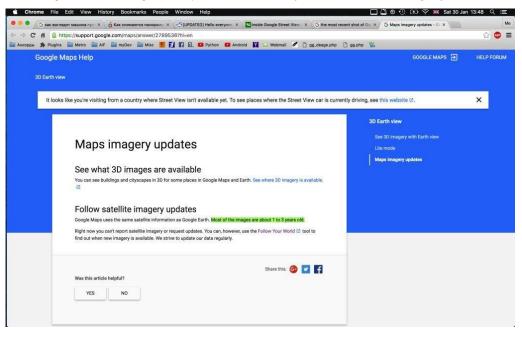
4. However, some local gas providers do have their prices published (see the excerpt below from Lukoil).

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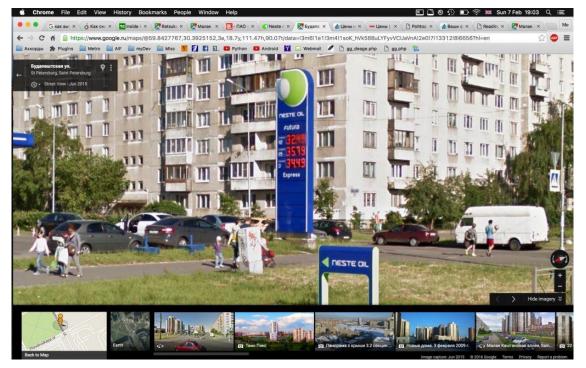
Compare the screenshot date and time with the price lists available at request time to see they are outdated as of 7 February 2016.

# Appendix 3. Visual comparisons of test apps output

1. Google Maps image policy allows for 1-3 years of "stale" imagery.



Indeed, a 2016 shot below reveals that the image capture occurred a year ago (see the right bottom part vs the right top one).



2. Moscow and Nizhniy Novgorod reinforced St Petersburg as test locations to see their overall updatability. *BenzinPrice* seldom showed actual prices at request time. Find below, in the three subsequent images, examples for St Petersburg (digits 78 in the link), Nizhniy Novgorod (52), and Moscow (77), these numbers representing the traffic police area codes. With the shooting dates and time compared to the tabled data, chronological gaps become apparent. More (screen)shots are available on request.

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	3		34.35		37.35	38.65	42.05		35.20				ЕКА - г. Москва, Боровское шоссе	сайт компании			
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<u>сайта</u> <ul> <li><u>Утилита для iGo</u></li> <li>Primo</li> </ul>	7		34.20		37.20	37.90			35.20				ЕКА - г. Москва, ул. Архитектора Власова, 2BC1	сайт компании	22 года продаем дизтопливо СПБ, с доставкой для наших клиентов. ГОСТ!		
<ul> <li>GasVisor (для Android)</li> <li>GasVisor (для</li> </ul>	8		34.20		37.20				35.20				АЗС - г. Москва, 4- й Лесной переулок, 2	сайт компании	ОПТ Топливные карты Топливные талоны Контакты		
iPhone)	9		34.25		37.15	38.15			35.20				ЕКА - г. Москва, Бережковская набережная, 30А	сайт компании	1m.ru Адрес и телефон Санкт-Петербург		
<u>Обратная связь</u> Вопросы-ответы	10		34.10		37.10	37.80			35.40				ЕКА - г. Москва, Проектируемый проезд № 552, пересечение с Изюмской ул., вл.9	сайт компании			
	11		34.10		37.10								АЗС - г. Москва, ул. Каланчевская, 43	сайт компании	Дизельное топливо		
Жаловаться здесь!	12		34.10		37.10				35.40				ЕКА - г. Москва, Бартеневская ул., 6 стр. 1	сайт компании	В СПБ! Дизельное топливо отлич- ного качества! Доставка в		
	13		34.15		37.05	37.85			35.20				ЕКА - г. Москва, Новоорловская ул.	сайт компании	короткие сроки! Подробнее velestopilvo.ru		
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	16		34.15		36.95								ЕКА - г. Москва, ул. Панфилова, 2AC1	сайт компании			
	17		34.29		36.89				35.20				ЕКА - г. Москва, ул. Подольских курсантов, 26А	сайт компании	Дизельное топливо!		

3. Unlike the other candidate tools, Polttoaine usually showed updates already in the morning (see Helsinki and Espoo as the most updated locations in Finland, in the two images below).

ABC, Pitájánmál Neste Oli Expres	Helsinki se, Mannerheiminte Rejotankatu 3 Ni Vanha Viendre 31 (Ed5 0.899)		PVM	95E10	98E	Di	App Store Android Market		
kaupunki upunki/Tie i n ABC, Pitäjänmäi Neste Oli Expres		)[					Android		
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upunki/Tie O n ABC, Pitájánmái Neste Oll Expres		😂 Kartta		1.325	1.407	1.120			
n Neste Oil Expres		El Kartta		1.520	1.407	1.120	( manufacture )		
ABC, Pitájánmái Neste Oll Expres		🖬 Kartta					Street, other Street, South		
ABC, Pitájánmál Neste Oli Expres			17.04	1.329	1.409	1.139			
Neste Oll Expres		E2 Kartta		1.354	1.434	1.159			
	ss, Roihuvuori Roihuvuorentie 22	C Kartta		1.309	1.389	1.099			
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	stipeliontie 18 (*E99+)	C Kartta		1.329	*1.449	1.099			
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	Näytä Seinäjoen seutu	Teboil Express, Lommila Lommilantie 12	🖸 Kartta 1			1.074					
	Näytä Kaikki asemat	St1, Lähderanta Pitkäjärventie 1	😂 Kartta 1			1.084					
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	Näytä 20 Kalleinta	Ysi5, Suvela Tuomarilantie 2	El Kartta 1			389 1.109					
		St1, Mankkaantie 2	and the second second			1.089					
	Maakaasuasemat	Teboil Express, Leppävaara/Perkkaa Hevosenkenkä 2, Kel				1.139					
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	Keyyt polttoöliy	Neste, Matinkylä Gräsanlaakso 2	Kartta 1			129 1.179					
	Pelletti	St1, Olariniuoma Olariniuoma 17	Kartta 1			449 1.114					
		Shell, Haukilahti Ahventie 2 (*E99+) Teboil, Niittykumpu Luomankuja 2	Kartta 1			129 1.169					
	Ulkomaat	Neste Oil, Olari Uuskartanontie 2	Kartta 1			1.109					
	Tilastot	Teboli Express, Kiltakallio Kiltakula 2	Kartta 1			394 1.109					
	Valitse asema	ABC Deli, Mikkelä Mikkelänkallio 1 (E85 0.959)	Kartta 1			19 1,149					
		Neste Oil Express, Frisilä Pilspanmäentie 2	Kartta 1			99 1.109					
	Valitse asema	Teboli Exoress, Enisilä Kultinmäentie 26	Kartta 1			99 1.114					
	Valitae aberria	Shell, Suomenoja Finnoonristi 1 (*E99+)	Kartta 1			454 1.129					
		Shell, Olari Komeetankatu 1 (*E99+)	Kartta 1			454 1.129					
	*	St1, Bembőle Turuntie 203 (Re85 ), 110-tie	Kartta 1		319 1.	99 1.079					
	Asemia vhteensä: 564	ShellExpress, Sepänkylä Palomiehentie 2	Kartta 1			1.089					
	Paerina yneense, oov	ABC, Nihtisita 4	Kartta 1		349 1.4	29 1.159					
	The second secon	Neste Oil Express, Kauklahti Mänkimiehentie 3	El Kartta 1	6.04. 1	309 1.	1.079					
		Neste Oil Express, Karakallio Tornihaukantie 1	Kartta 1		314 1.4	104 1.079					
	Kertokaa havaintonne bensan ja dieselin hinnoista	Ysi5, Nihtisilta Kutojankulma 2	🖾 Kartta 1	5.04. 1	309 1.	379 1.099					
	ilmoituslomakkeella, sähköpostilla alla olevaan	Neste Oli, Nihtisita Nihtisilankula 2	Kartta 1	5.04 1	349 1.4	1.169					

Compare the screenshot date and time of 2016 in the upper right-hand corner with the tabled data. Only morning shots are used to show already the difference vs other apps and tools. More screenshots for the period of January-April 2016 are available on request.

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4. As the research continued, it became obvious that the tabled results (exampled in the two tables below) confirmed the idea that Polttoaine was the most updated app among the other candidates. Note the digits under the parts of the day; they explain how frequent the updates were during the observation day.

Date	City	Morning	Midday vs day	Evening/night	Time
	Moscow	0	mada) to da)		11:59; 21:15.
	N.Novgorod		0		12:01: 21:16.
	St.Pete	0	0 0		11:59; 21:14.
	Moscow		0		15:00; 23:18.
	N.Novgorod		0		15:00: 23:19.
	St.Pete		0		14:58; 23:17.
	Moscow				23:01.
	N.Novgorod				23:02.
	St.Pete			1	23:00.
2.2.16	Moscow		0	7	12:35; 21:03.
2.2.16	N.Novgorod		0	0	12:37; 21:04.
2.2.16	St.Pete		0	1	12:36; 21:04.
3.2.16	Moscow		16	16	15:45; 21:29.
3.2.16	N.Novgorod		13	13	15:46; 21:30.
3.2.16	St.Pete		1	1	15:46; 21:31.
4.2.16	Moscow	0	77	80	09:48; 16:02; 23:38.
4.2.16	N.Novgorod	0	0	1	09:49; 16:05; 23:38.
4.2.16	St.Pete	0	1	1	09:50; 16:06; 23:39.
7.4.16	Moscow			1	
7.4.16	N.Novgorod			0	
7.4.16	St.Pete			2	
9.4.16	Moscow			1	
9.4.16	N.Novgorod			0	
9.4.16	St.Pete			0	
	Moscow	0	0	5	
	N.Novgorod	0	0	0	
	St.Pete	0	0	0	
	Moscow	0	0	0	
	N.Novgorod	0	0	0	
	St.Pete	0	0	0	
	Moscow	1	1 vs 2		10:48; 12:11 15:28; 22:22.
	N.Novgorod	0	0 vs 0		10:50; 12:12 15:30; 22:23
	St.Pete	0	2 vs 2		10:46; 12:07 15:25; 22:20.
	Moscow	0	71		09:14; 13:27; 21:10.
	N.Novgorod	0	0		09:15; 13:25; 21:10.
	St.Pete	0	0 vs 3		09:13; 13:29 13:38; 21:08
	Moscow	0	0		09:03; 12:05 ; 21:11.
	N.Novgorod	0	0		09:04; 12:07; 21:12.
	St.Pete Moscow	0	1		09:03; 12:04; 21:10 21:47
		0			07:27; 14:04; 21:29.
	N.Novgorod	0	0		07:30; 14:05; 21:30.
	St.Pete	0	2		07:26; 14:04; 21:29.
	Moscow	0	0		11:15; 16: 22; 21:28.
	N.Novgorod St.Pete	-	-		11:16; 16:23; 21:29.
	Moscow	0 +2 by V	aitto 1		11:12 11:28; 16:21 16:34 08:56; 12:06; 22:43.
	N.Novgorod	0	0		08:56; 12:07; 22:47.
					08:57 09:09; 12:06 12:16;
	Moscow	0 +2 by V	0 +2 by Waze 0 vs 0		12:45 14:51; 22:33.
	N.Novgorod		0 vs 0 0 vs 0		12:46 14:53; 22:34.
	St.Pete		0 +3 by Waze		12:44 12:59; 14:50 14:57;
	Moscow	0	0 +3 by Waze		09:23; 13:02
	N.Novgorod	0	0		09:24; 13:02
	St.Pete	0	0		09:22; 13:00
	0.1 0.0	0	0		00.LL, 10.00

Date	City	Morning	Midday vs day	Evening/night	Time
30.1.16		1		39	11:50; 21:23.
30.1.16	Helsinki	1		13	11:52; 21:22.
31.1.16	Espoo		13	14	15:36; 23:23.
31.1.16	Helsinki		20	24	15:38; 23:22.
1.2.16	Helsinki			15	23:07.
1.2.16	Espoo			15	23:08.
2.2.16	Helsinki		7	11	12:43; 21:07.
2.2.16	Espoo		2	15	12:43; 21:07.
3.2.16	Helsinki		0	29	15:49; 21:33.
3.2.16	Espoo		1	17	15:49; 21:34.
4.2.16	Espoo	2	7	18	09:54; 16:08; 23:36.
4.2.16	Helsinki	7	12	22	09:53; 16:08; 23:36.
7.4.16	Espoo		4	8	
7.4.16	Helsinki		5	11	
9.4.16	Espoo		0	43	
9.4.16	Helsinki		0	7	
10.4.16	Espoo		0	14	
10.4.16	Helsinki		0	19	
11.4.16	Espoo	4	4	12	
11.4.16	Helsinki	8	9	20	
12.4.16	Espoo	1	1 vs 2	15	10:42; 12:04 15:11; 2
12.4.16	Helsinki	1	3 vs 3	7	10:43; 12:05 15:24; 2
13.4.16	Espoo	0	3	15	09:10; 13:30; 21:05.
13.4.16	Helsinki	0	1	5	09:12; 13:32; 21:07.
14.4.16	Espoo	2	2	14	09:59; 12:01; 21:13.
14.4.16	Helsinki	1	3	10	09:59; 12:03; 21:15.
15.4.16	Espoo	0	9	18	07:30; 14:03; 21:26.
15.4.16	Helsinki	0	2	8	07:31; 14:01;
16.4.16	Espoo	0	27	30	11:17; 16:19; 21:25.
16.4.16	Helsinki	0	0		11:18; 16:20; 21:26.
17.4.16	Espoo	11	12	19	08:59; 12:04; 22:38.
17.4.16	Helsinki	2	6	17	09:00; 12:05; 22:39.
18.4.16	Espoo		6 vs 6		12:47 14:49; 22:35.
18.4.16	Helsinki		5 vs 5	17	12:48 14:48; 22:36.
19.4.16	Espoo	3	4		09:25; 13:03
	Helsinki	0	0		09:26; 13:04

Clearly enough, the tables suggest that Polttoaine revealed better regularity of updates within the pre-study period.

# Appendix 4. Polttoaine's fuel display policy visualised

According to their policy, or their Info tab, "Hintatiedot pysyvät näkyvillä 5 vuorokautta ilman uutta päivitystä" (link given in 2.4's footnotes), the website quotes prices for the last 5 days. When displayed on a single page, historical data tend to disappear as updates arrive. In order to see clearly how they work, a series of Espoo screenshots<sup>13</sup> follow to show the process chronologically, within a sample two-day span limit:

Espoo					Espoo						
Jakeluasema			95E10	98E	Di	Jakeluasema	PVN	95E10	98E	Di	
Keskihinnat:			1.482	1.555	1.349	Keskihinnat:		1.482	1.554	1.349	
Neste Oil Express, Lommila Espoontie 32	Kartta	22.02.	1.429	1.509	1.299	Neste Oil, Otaniemi Miestentie 1, Kehä i 🔁 🛚	rtta 22.02	. 1.449	1.499	1.359	
Neste Oil Express, Lommila Lommilanrinne 1	Kartta	22.02.	1.429	1.509	1.299	ABC, Otaniemi Miestentie 1	rtta 22.02	. 1.469	1.539	1.36	
Teboil Express, Lommila Lommilantie 12	Kartta		1.429	1.509	1.299	St1, Mäkkylä Turuntie 2 (Re85 0.999), 110-tie	rtta 22.02	. 1.514	-	1.36	
Neste Oil Express, Karakallio Tornihaukantie 1	Kartta	and the second second	1.454	1.534	1.309	St1, Leppävaara Hannu Olavinpojantie 3, 110-tie, Kehä I	rtta 22.02	. 1.479	1.559	1.334	
ShellExpress, Sepänkylä Palomiehentie 2	Kartta		1.449	1.519	1.299	Shell, Vallikallio Vallikallionkatu 9, Kehä I (*E99+)	rtta 22.02	. 1.494	*1.624	1.34	
Teboil, Kivenlahti Vanha Jorvaksentie 1	🛃 Kartta		1.519	1.599	1.369		rtta 22.02		1.584	1.35	
Teboil, Niittykumpu Luomankuja 2	🛃 Kartta	21.02.	1.519	1.599	1.369	Teboil Express, Leppävaara/Perkkaa Hevosenkenkä 2, Kehä I 🔁	rtta 22.02	1.474	1.554	1.32	
Neste Oil, Mankkaa Sinikalliontie 1-3, 1-tie	🛃 Kartta	21.02.	1.449	1.519	1.319		rtta 22.02		*1.624	1.34	
ABC, Nihtisilta 4	🛃 Kartta	21.02.	1.469	1.539	1.309		rtta 22.02	and the second se	1.509	1.29	
St1, Karamalmi - KII Karapellontie 11 (RE85 0.899)	🛃 Kartta	21.02.	1.464	-	1.319		rtta 22.02		1.509	1.29	
Neste Oil, Nihtisilta Nihtisillankuja 2	🛃 Kartta	21.02.	1.514	1.594	1.399						
St1, Lähderanta Pitkäjärventie 1	🛃 Kartta	21.02.	1.464	1.544	1.319		rtta 22.02		1.509	1.29	
St1, Leppävaara Hannu Olavinpojantie 3, 110-tie, Kehä I	🛃 Kartta	21.02.	1.484	1.564	1.339		rtta 21.02		1.534	1.30	
Teboil Express, Mäkkylä Turuntie 14, 110-tie	🛃 Kartta	21.02.	1.504	1.584	1.359		rtta 21.02		1.519	1.29	
Teboil Express, Leppävaara/Perkkaa Hevosenkenkä 2, Kehä	I 🛃 Kartta	21.02.	1.479	1.559	1.334		rtta 21.02		1.599	1.36	
Shell, Leppävaara Vanha maantie 2 (*E99+)	🛃 Kartta	21.02.	1.499	*1.629	1.354		rtta 21.02		1.519	1.31	
ABC, Juvankartanontie 33 (E85)	🛃 Kartta	21.02.	1.439	1.519	1.309		rtta 21.02		1.599	1.36	
St1, Bemböle Turuntie 203 (Re85 0.919), 110-tie	🛃 Kartta	21.02.	1.469	1.549	1.319		rtta 21.02		-	1.31	
Shell, Bemböle Bellinmäki 2, 110-tie (*E99+)	E Kartta		1.479	*1.599	1.329		rtta 21.02		1.594	1.39	
Neste Oil, Viherlaakso Rajamännynahde 1	Kartta	20.02.	1.519	1.599	1.384		rtta 21.02		1.544	1.31	
Ysi5, Suvela Tuomarilantie 2	Kartta		1.479	1.559	1.329		rtta 21.02		1.539	1.30	
St1, Mäkkylä Turuntie 2 (Re85 0.999), 110-tie	Kartta	20.02.	1.514	-	1.369		rtta 21.02		1.519	1.30	
Ysi5, Nihtisilta Kutojankulma 2	Kartta	20.02.	1.469	1.539	1.319		rtta 21.02		1.549	1.31	
ABC, Karaportti Karaniityntie 2	Kartta		1.509	1.579	1.364	Shell, Bemböle Bellinmäki 2, 110-tie (*E99+)	rtta 21.02	1.479	*1.599	1.32	
ABC, Kivenlahti Kivenlahdentie 7	Kartta		1,459	1.539	1.349	Neste Oil, Viherlaakso Rajamännynahde 1	rtta 20.02	1.519	1.599	1.38	



#### Figure 34. Same day's evening

Jakeluasema         PVM         95E10         98E         Di           Keskihinnat:         1 473         1.546         1.366           Keskihinnat:         1 473         1.546         1.366           Vališ, Suvela Tuomanilantile 2         25 Kartta         22.02         1.429         1.509         1.209           Keskihinnat:         2.02         1.429         1.509         1.209         Adsc. Nintsilla 4           AGC, Nintsilla 4         2.02         1.429         1.509         1.209         Helso OL Express, Acarkalio Tornihaukantile 1         2.02         1.449         1.519         1.219           AGC, Nintsilla 4         2.02         1.409         1.559         1.309         1.309           AGC, Chanemi Mestentile 1         2.02         1.409         1.539         1.309           AGC, Chanemi Mestentile 1         2.02         1.409         1.539         1.309           AGC, Chanemi Mestentile 1         2.02         1.401         1.524         1.309           Shell, Upphavare Anna manite 2 (FE9+)         2.02         1.401         1.541         1.400           Shell, Valibalio Valibalio Valibalio Valibaliontile 3.110-le         2.021         1.401         1.541         1.541           Shell, Valibali	Espoo						
Keskhinnat:         1.473         1.546         1.336           Yal5, Suvela Tuomarilantie 2         Xartal         23.02         1.429         1.509         1.504           Yal5, Suvela Tuomarilantie 2         Xartal         23.02         1.429         1.509         1.504           Neete OL Express, Karakallo Tornhaukantie 1         21.421         2.022         1.443         1.519         1.274           Schultzpress, Sepärkylä Palomiehentie 2         2.4471         22.02         1.409         1.504         1.504           ABC, Nintsilla 4         22.02         1.409         1.504         1.204         1.604           ABC, Charanti Misestnie 1         2.4471         2.022         1.409         1.504         1.204           Red, Charanti Misestnie 1         2.4471         2.022         1.404         1.409         1.304           Red, Charanti Misestnie 1         2.4471         2.022         1.414         1.404         1.404           Red, Charanti Misestnie 1         1.4411         2.4471         1.564         1.349           Shell, Leppavaare Janckowski Howendowski 2         1.4441         1.449         1.452         1.449         1.452           Shell, Cappavaare Janckowski 1/10-16         2.4471         2.502         1.		PVM ▼	95E10	98E	D		
ABC, Retrait 4           Yalos E OI Express, Karakalio Tornihaukante 1         Z karta 22.02         1.429         1.509         1.309           Sheti OI Express, Karakalio Tornihaukante 1         Z karta 22.02         1.449         1.509         1.309           Sheti OI Express, Karakalio Tornihaukante 1         Z karta 22.02         1.469         1.559         1.309           Sheti OI Express, Karakalio Tornihaukante 1         Z karta 22.02         1.469         1.559         1.309           Sheti OI Express, Sepalakyla Pulomiehenie 2         Z karta 22.02         1.460         1.559         1.309           Sheti OI, Karamityntie 2         Z karta 22.02         1.460         1.559         1.309           ABC, Karapotti Karamityntie 2         Z karta 22.02         1.460         1.559         1.309           Sheti OI, Channer Mestentie 1         Z karta 22.02         1.449         1.359         1.309           Sheti OI, Vaniere Mestentie 1         Z karta 22.02         1.449         1.359         1.364           Sheti OI, Karamit Mestentie 1         Z karta 22.02         1.449         1.549         1.349           Sheti OI Express, Lommila Lommilarine 2 (ESP+)         Z karta 22.02         1.449         1.540         1.340           Shit Lapphavara Hancu Oiknikkija Turunite 1.10 <t< th=""><th>]</th><th></th><th>1.472</th><th>1.545</th><th>1.3</th></t<>	]		1.472	1.545	1.3		
Yel5, Suvela Tuomarlante 2       Xarta       22.02       1.429       1.509       1.500         Neeto OI Express, Karakallo Tomhuakante 1       1       24.471a       22.02       1.439       1.519       1.207         AGC, Nihristia 4       1       24.471a       22.02       1.449       1.509       1.500         Shell Express, Karakallo Tomhuakante 2       2       Xarta       22.02       1.449       1.509       1.509         Shell Express, Sepärkylä Palomiehenke 2       Xarta       22.02       1.460       1.559       1.209         ABC, Karantityttie 2       Xarta       22.02       1.469       1.509       1.509       1.500         ABC, Canonim Miestenite 1       1       Xarta       2.02       1.449       1.509       1.500         Ristic OL, Canoniem Miestenite 1       1       Xarta       2.022       1.449       1.509       1.500         Ristic OL, Canoniem Miestenite 1       1       Xarta       2.022       1.449       1.509       1.500         Ristic UARDAWARA Variha manetic 2 (F690)       Xarta       2.022       1.449       1.500       1.500       1.500       1.500       1.500       1.500       1.500       1.500       1.500       1.500       1.500       1.500					_		
Yato, Survial Uromanialo 2         Extrata [23.02         1.420         1.400         1.600	😂 Kartta		1.489	1.559	1.		
Nete OI Express, Karakailo Tomihukanite 1         Z karta j 22.02         1.48         1.519         1.279         peet_press, Gaphya Patometerors 2           Shell Express, Separkylä Palomiehentie 2         X karta j 22.02         1.409         1.559         1.309           Shell Express, Separkylä Palomiehentie 2         X karta j 22.02         1.409         1.559         1.309           Shell Express, Separkylä Palomiehentie 2         K karta j 22.02         1.409         1.579         1.309           Shell Express, Separkylä Palomiehentie 2         K karta j 22.02         1.409         1.579         1.309           Shell Colamient Mestenite 1         E karta j 22.02         1.409         1.309         HAC, Kargortt Karamitymin 2           ABC, Channent Mestenite 1         K karta j 22.02         1.449         1.569         1.309           Neste OIL Canterient Mestenite 1         K karta j 22.02         1.444         1.564         1.349           Shell, Valikailo Vandez (Redo Songh) 10-bie         K karta j 22.02         1.449         1.569         1.304           Shi Lappakaara Hannu Gampiparite 3, 110-bie, Kehä 1         K karta j 22.02         1.454         1.354         1.360           Shi Leppakaara Hannu Gampiparite 3, 110-bie, Kehä 1         K karta j 22.02         1.459         1.369         1.460 (209)         1.460	🔁 Kartta		1.449	1.519	1		
ABC, Ninsilia 4         2) Kartta         22.02         1.460         1.539         1.309           Shell Express, Sepärkylä Palomiehente 2         Kartta         22.02         1.460         1.549         1.309           Shell Express, Sepärkylä Palomiehente 2         Kartta         22.02         1.469         1.559         1.309           Shell Express, Sepärkylä Palomiehente 2         Kartta         22.02         1.469         1.559         1.309           Shell Express, Sepärkylä Palomiehente 2         Kartta         22.02         1.469         1.539         1.309           ABC, Kanzpotti Karanitynte 2         Kartta         22.02         1.469         1.539         1.309           ABC, Contamin Mestente 1         Kartta         22.02         1.449         1.554         1.329           Shell, Upphavaara Varina maante 2 (1599+)         Kartta         22.02         1.449         1.564         1.349           Shil, Leppävaara Varina maante 2 (1599+)         Kartta         22.02         1.449         1.564         1.349           Shil, Leppävaara Hancu Gavepojarini 3.110-lie, Kehä I         Z kartta         22.02         1.449         1.559         1.344           Shil, Leppävaara Hancu Gavepojarini 3.110-lie, Kehä I         Z kartta         2.02         1.449			1.459	1.539	1		
Shell Express, Separkylä Palomiehente 2         Kartta         22 02         1.409         1.540         1.209           BAG, Karapotti Karanitynie 2         Kartta         22 02         1.409         1.540         1.209           BAG, Karapotti Karanitynie 2         Kartta         22 02         1.409         1.540         1.540           BAG, Karapotti Karanitynie 2         Kartta         22 02         1.409         1.579         1.309           BAG, Colamiem Mestente 1         Extrata         22 02         1.409         1.579         1.309           Reito OL, Chaniem Mestentie 1         Extrata         22 02         1.441         1.564         1.309           Reito OL, Chaniem Mestentie 1         Extrata         22 02         1.449         1.309         Netto OL, Exposite Novematheme 1           Reito ML, Malkido Markanite 2 (Reito Poly)         Extrata         22 02         1.449         1.520         Netto OL, Exposite Novematheme 1           Rith. Makylä Turinte 1, 110-lie         Kartta         22 02         1.454         1.349         Netto OL, Chaniem Markanite 1           Rith Libékaram Hannu Glavingpartie 3, 110-lie, Kehal I         Kartta         22 02         1.454         1.350         Netto OL Chaniem Markanite 1         Netto OL Chaniem Nethematheme 1           Rith Li	🔁 Kartta		1.469	1.549	Ŀ		
ABC, Karapotti Karanitynie 2         Kartta         22.02         1.809         1.579         1.359           ABC, Karapotti Karanitynie 2         Kartta         22.02         1.409         1.539         1.809           ABC, Marapotti Karanitynie 2         Kartta         22.02         1.409         1.539         1.809           ABC, Marapotti Karanitynie 2         Kartta         22.02         1.449         1.539         1.809           ABC, Marapotti Karanitynie 2         Kartta         22.02         1.449         1.539         1.809           Bibli Valikiloi Valikilonkaku 7, Mehal (*E9P+)         Kartta         22.02         1.449         1.541         1.809           Shell, Lepplavaara Varha maanie 2 (*E9P+)         Kartta         22.02         1.449         1.624         1.349           Shti, Lepplavaara Varha maanie 2 (*E9P+)         Kartta         22.02         1.449         1.624         1.349           Shti, Lepplavaara Varha maanie 2 (*E9P+)         Kartta         22.02         1.449         1.624         1.349           Shti, Lepplavaara Harno Glenkys Turutie 1, 110-10         Kartta         22.02         1.449         1.559         1.344           Neeto OL Express, Lommila Lommilaritore 1         Kartta         22.02         1.429         1.500 <td>😂 Kartta</td> <td></td> <td>1.514</td> <td>1.594</td> <td></td>	😂 Kartta		1.514	1.594			
ABC, Otaniemi Miestentie 1         IX kartta         22 02.         1.469         1.538         1.368         ABC, Koverlah Koveninkine 2           Veste OL, Otaniemi Miestentie 1         IX kartta         22 02.         1.449         1.499         1.369         ABC, Koverlah Koveninkine 2           Fibel Express, Logenavara Perkkaa Hevosenkenkä 2, Kehä II EX kartta         22 02.         1.449         1.469         1.369         Netto CI, Esponstenti Kearaliyline 2           Shell, Vallikallo Vallikallovkalu 9, Kehä I (*E99+)         IX kartta         22 02.         1.449         1.624         1.349           Shell, Vallikallo Vallikallovkalu 9, Kehä I (*E99+)         IX kartta         22 02.         1.449         1.624         1.349           Shell, Leppävaara Varia maante 2 (*E99+)         IX kartta         22 02.         1.444         1.454         1.349           Sitt, Leppävaara Varia maante 2 (*E99+)         IX kartta         22 02.         1.444         1.584         1.359           Sitt, Leppävaara Varia maante 2 (*E99+)         IX kartta         22 02.         1.449         1.584         1.359           Neeto O IZ press, Lommila Lommilartine 2         IX kartta         22 02.         1.449         1.509         1.309           Neeto O IZ press, Lommila Lommilartine 13, Tolee         IX kartta         21 02.	0.899) EXartta		1.469	1.549	Ľ		
Nacko Clamma Interementation         Image: Stratt	(1.899) C Kartta		1.409	1.574	F		
Veste 0., Oraniem Messenie 1, kenta 1 <ul> <li>Alter 0, Cameri Messenie 1, kenta 1</li> <li>Cameria 1, Cameria 1,</li></ul>	Kartta		1.489	1.569	h		
Telodi Express, Lopphvaara Parkkaa Hevosenkenka 2, Kohi 12 karta 12 202         1.474         1.554         1.329           Beldi Walkikol Volkaa         Maaki 1 (1994)         2 karta 12 202         1.494         1.544         1.329           Shell, Valkikoli Volkaa         Karta 12 202         1.494         1.544         1.349         1562         5563         <	Kartta		1.429	1.509	i		
Shell, Valkalio Valkalio Nakla (1) (Sel9)       2) kartta       22.02       1.49       1.62       1.349       Tool. Exponsible Voin-biodele 2         Shell, Leppivaara Vanha maanle 2 (FB9)       2) kartta       22.02       1.49       1.624       1.349         Shill, Leppivaara Vanha maanle 2 (FB9)       2) kartta       22.02       1.694       -1.384       30.00         Shill, Leppivaara Vanha maanle 2 (FB9)       2) kartta       22.02       1.694       -1.384       30.00         Shill, Leppivaara Vanha maanle 2 (FB9)       2) kartta       22.02       1.694       1.584       3.00         Shill, Leppivaara Vannu Olavinpojanila 3, 110-lie, Kehal I       2) kartta       22.02       1.429       1.509       1.309         Neete Oi, Express, Lommia Lommiarine 1       2) kartta       22.02       1.429       1.509       1.309         Neete Oi, Minkwaa Sinkaliontie 1:3       1:0:1:1:1:1:1:1:1:1:1:1:1:1:1:1:1:1:1:1	El Kartta		1.429	1.509	h		
Shell, Lepptvaara Varha maanie 2 (1994)       IS karttaj (2202, 1.444, 14.624, 1.349)       61.14849 (14.641, 13.49)         Str. Makkylä Turunie 2 (Re55 0.999), 110-bie       Karttaj (2202, 1.444, 14.624, 1.349)       17.169, 100, 100, 100, 100, 100, 100, 100, 10	C Kartta		1.439	1.519	ih		
St1, Makkylä Turuntle 2 (Re85 0.999), 110-ble       12 kartta       22.02       1.514       -       1.384         Teboli Express, Makkylä Turuntle 14, 110-ble       12 kartta       22.02       1.494       1.584       1.389         Teboli Express, Makkylä Turuntle 14, 110-ble       12 kartta       22.02       1.494       1.584       1.389         Neate Oli Express, Lommila Espoontle 32       12 kartta       22.02       1.429       1.509       1.384         Neste Oli Express, Lommila Lommilamine 1       12 kartta       22.02       1.429       1.509       1.299         Neste Oli Express, Lommila Lommilamine 12       12 kartta       22.02       1.429       1.509       1.299         Neste Oli Mankaa Sinkalitorite 1.3       1.14e       12 kartta       2.02       1.429       1.509       1.399         Neste Oli Mankaa Sinkalitorite 1.3       1.4ee       1.kartta       2.102       1.439       1.509       1.399         Neste Oli Mankaa Sinkalitorite 1.3       1.4ee       1.kartta       2.102       1.439       1.509       1.309         Neste Oli Kinkungu Lommalkung 2       1.292       1.439       1.519       1.309       Neeto Ol Express, Lommila Lommalkung Reporte 2         Teboli Kinkungu Lommalkung 2       1.242       1.519       1.589			1,499		h		
Tebol Express, Makkylå Turuntle 14, 110-lie         I Kartta         22.02         1.984         1.959         ARC. Garan Meeterine 1           St1, Leppakvarn Hannu Clavingspintle 3, 110-lie, Kehä I         I Kartta         22.02         1.479         1.569         1.334           Neste OI Express, Lommia Exponden 52         I Kartta         22.02         1.479         1.569         1.334           Neste OI Express, Lommia Exponden 52         I Kartta         22.02         1.429         1.509         1.394           Neste OI Express, Lommia Lommilantine 1         I Kartta         22.02         1.429         1.509         1.294           Tebol Express, Lommia Lommilantine 1         I Kartta         21.02         1.429         1.509         1.509         1.511           Tebol Express, Lommila Lommilantine 13, 1-16         I Kartta         21.02         1.449         1.509         1.504 </td <td>E Kartta</td> <td></td> <td>1.429</td> <td>1.509</td> <td>ir</td>	E Kartta		1.429	1.509	ir		
St1, Leppènaara Hannu Olavimpojante 3, 110-lie, Kehä I         2 Kartta         2.022         1.479         1.559         1.334           Neste Oli Express, Lommia Espochie 32         2 Kartta         2.202         1.429         1.509         1.334           Neste Oli Express, Lommia Espochie 32         2 Kartta         2.022         1.429         1.509         1.334           Tebol Express, Lommia Espochie 32         2 Kartta         2.022         1.429         1.509         1.394           Tebol Express, Lommia Espochie 32         2 Kartta         2.022         1.429         1.509         1.394           Tebol Express, Lommia Lommaniante 12         2 Kartta         2.020         1.429         1.509         1.509         50%           Need OL, Minkes Sinkellonte 1         2 Kartta         2.02         1.439         1.509         1.309         Fibrit Uspeara Henno Oknyegienis 1.           Tebol Express, Lommia Express, Sinkellonte 1         2 Kartta         2.102         1.459         1.309         Fibrit Uspeara Henno Oknyegienis 2.         Need OL Express, Lommia Expr	Kartta		1.469	1.539	İ.		
Neste OI Express, Lommila Espoonte 32         Karttaj         22.02         1.429         1.500         Teolo Express, Lommila Lommilarine 1           Neste OI Express, Lommila Lommilarine 1         Karttaj         22.02         1.429         1.500         Teolo Express, Lommila Lommilarine 1           Exploratione 12         Karttaj         22.02         1.429         1.500         Teolo Express, Longhana Honn, Oevinguieto 3.1           Fool Express, Lommila Lommilarine 12         Xarttaj         22.02         1.429         1.500         Teolo Express, Lommila Lommilarine 12           Fool Express, Lommila Lommilarine 12         Xarttaj         21.02         1.439         1.500         Teolo Express, Lommila Lommilarine 12         Teolo Express, Lommila Lommilarine 12         1.500         Teolo Express, Lommila Lommilarine 12         Teolo Express, Lommila Lommilarine 12         1.500         Teolo Express, Lommila Lommilarine 12	🛃 Kartta	22.02.	1.449	1.499	ĴĊ.		
Neste OI Express, Lommila Lommilanrine 1         27 Karttal         22.02         1.422         1.509         151. Loppsware themo developpine 3.1           Tebol Express, Lommila Lommilanrine 12         27 Karttal         22.02         1.423         1.509         159.           Tebol Express, Lommila Lommilanrine 12         27 Karttal         21.02         1.423         1.509         1.999           Neste OI, Mintkas Sinkallonite 1-5, 1-lei         27 Karttal         21.02         1.439         1.509         Nesto OI Express, Lommila Lommilanne 72, 1209           Tebol, Kintkyumpu Luomankuja 2         27 Karttal         21.02         1.519         1.509         Nesto OI Express, Lommila Lommilanne 72           Tebol, Nittykumpu Luomankuja 2         27 Karttal         21.02         1.519         1.509         Nesto OI Express, Lommila Lommilanne 72           Tebol, Nittykumpu Luomankuja 2         27 Karttal         21.02         1.519         1.509         Tebol, Kontial knalu Antekante 72	🔁 Kartta	22.02.	1.504	1.584			
Teboli Express, Lommila Lommilantie 12         Xarttaj         Z2 02.         1.429         1.509         SML Updataja Validarianare 2(*169)           Neste Oli, Mankkaa Sinkialliontie 1-3, 1-lie         Zkarttaj         Z1 02.         1.449         1.519         1.319           Teboli, Kiveniahti Vanha Jorvaksentie 1         Zkarttaj         Z1 02.         1.549         1.509         1.809           Teboli, Kiveniahti Vanha Jorvaksentie 1         Zkarttaj         Z1 02.         1.519         1.509         1.809           Teboli, Kiveniahti Vanha Jorvaksentie 1         Zkarttaj         Z1 02.         1.519         1.509         1.809           Teboli, Kiveniahti Qanha Jorvaksentie 1         Zkarttaj         Zkarttaj         Z1 02.         1.519         1.509         1.809           Teboli, Kiveniahti Qanha Jorvaksentie 2         Zkarttaj         Zkarttaj         Zi 02.         1.519         1.509         Teboli Stress, Lommila terzi           Neste Oli, Nittisillan Nitisillan Nitajaj 2         Zkarttaj         Zi 02.         1.514         1.594         1.399         Teboli Koveniahti Vanha Jorvaksentie 1			1.474	1.554			
Dest Oil, Miniska Sinkallionie 1-2         Dest Artifis (2-242, 1-342)         1-300         1-300         Mark         Sinkallionie 1-2         Dest Oil, Miniska Sinkallionie 1-3         Dest Oil Miniska Sinkallionie 1-3         Dest Oil Miniska Sinkallionie 1-3         Dest Oil Miniska Sinkallionie 1-3         Dest Oil, Miniska Sinkallionie 1-3         Dest Oi			1.479	1.559	][		
Neste OI, Mankkaa Sinkalliontie 1-3, 1-tie         Z kartta   21.02         1.449         1.519         1.339         Neeto OI Spress, Lormite Esponte 32           Teboli, Kilveniahti Vanha Jorvaksentie 1         Z kartta   21.02         1.519         1.589         1.389         Neeto OI Spress, Lormita Lormitantine 2           Teboli, Kilveniahti Vanha Jorvaksentie 1         Z kartta   21.02         1.519         1.589         1.389         Tebol Spress, Lormita Lormitantine 2           Teboli, Nittisiltan Nithisiltan Nithisiltan Nita Nithisiltan Nita 2         Z kartta   21.02         1.514         1.594         1.399         Tebol Kiveniahti Vanha Jorvaksentie 1	99+) Cartta		1.494	*1.624			
Teobil, Kiveralahi Vanha Jonvalsentie 1         Cartal 2102         1.519         1.589         1.389         Need D Egyss. Lomaia Lomaiania Teobil, Nittykungu Luomainkuig 2         Cartal 2102         1.519         1.589         1.389         Need D Egyss. Lomaia Lomaiania Teobil, Nittykungu Luomainkuig 2         Cartal 2102         1.511         1.589         1.389         Teobil Egyss. Lomaia Lomaiania Teobil, Nittykungu Luomainkuig 2         Cartal 2102         1.514         1.589         1.389         Teobil, Nittykungu Luomainkuig 2           Verse Oil, Nittistia Nittsiliankuiga 2         Cartar 2102         1.544         1.584         1.589         1.584         1.58	99+) CI Kartta		1.494	1.509	ir		
Teboli, Niitykumpu Luomankuja 2         Xarttal         21.02.         1.509         1.369         Teboli Epress, Lommila Lommilante 12           Neste Oil, Niitsilla Nihtsillankuja 2         Xarttal         21.02.         1.514         1.599         Teboli, Kivertahit Varha Jovaksente 1			1.429	1,509	ir		
Neste Oil, Nihtisilta Nihtisillankuja 2 🔁 Kartta 21.02. 1.514 1.594 1.399 Tebol, Kivenlahti Vanha Jorvaksentie 1	Kartta		1.429	1.509	ir		
	Kartta	21.02.	1.519	1.599	Т		
	Kartta		1.519	1.599	ir		
ABC (hamphatecentic 22 /ERE)	Kartta	21.02.	1.439	1.519			
St1, Låhderanta Pitkäjärventie 1 🔁 Kartta 21.02. 1.464 1.544 1.319 St1, Bembóle Turunile 203 (Re85 0.919), 1			1.469	1.549	ĨĊ		
ABC, Juvankartanontie 33 (E85 ) 🚺 Kartta 21.02. 1.439 1.519 1.309 Shell, Bemböle Bellinmäki 2, 110-tie (*E99+			1.479	*1.599			
St1, Bemböle Turuntie 203 (Re85 0.919), 110-tie 📴 Karttal 21.02. 1.469 1.549 1.319 Neste Oil, Viherlaakso Rajamännynahde 1	😂 Kartta		1.519	1.599	][		
Shell, Bernböle Bellinmäki 2, 110-tie (*E99+)         Kartta         21.02.         1.479         *1.599         1.329           ABC Deli, Tapicia Katevalantie 3 (E85 0.955)	), Kehä I 🔁 Kartta		1.469	1.539			

Figure 35. This Feb 23 afternoon



<sup>&</sup>lt;sup>13</sup> As taken from http://www.polttoaine.net/Espoo.

Usually, the page has a limited number of lines. As updates appear on top of the list (blue-, green- and orange-bordered rectangles in Figures 33-38), the previous prices tend to disappear. In addition, it may also occur that all of today's prices take up the entirety of the page, thus leaving no space for historical data.

Espoo	Espoo										
Jakeluasema		PVM	95E10	98E	Di	Jakeluasema		PVM	95E10	98E	Di
Keskihinnat:			1.471	1.544	1.331	Keskihinnat:	-		1.471	1.546	1.33
					172					· · · ·	
Neste Oil, Viherlaakso Rajamännynahde 1	🔁 Kartta	23.02.	1.499	1.579	1.369	ABC, Nihtisilta 4	🛃 Kartta	24.02.	1.489	1.579	1.30
St1, Leppävaara Hannu Olavinpojantie 3, 110-tie, Kehä I	🔁 Kartta	23.02.	1.479	1.559	1.334	Neste Oil, Nihtisilta Nihtisillankuja 2	🛃 Kartta	24.02.	1.514	1.594	1.38
ABC, Karaportti Karaniityntie 2	🔁 Kartta	23.02.	1.504	1.574	1.354	Ysi5, Nihtisilta Kutojankulma 2	E Kartta	24.02.	1.459	1.539	1.31
St1, Karamalmi - KII Karapellontie 11 (RE85 0.899)	🔁 Kartta	23.02.	1.469	•	1.299	ShellExpress, Sepänkylä Palomiehentie 2	E Kartta	24.02.	1.469	1.549	1.29
St1, Lähderanta Pitkäjärventie 1	🔁 Kartta	23.02.	1.469	1.549	1.299	Teboil, Niittykumpu Luomankuja 2	Kartta	and in the local division in the local divis	1.519	1.599	1.36
Neste Oil, Nihtisilta Nihtisillankuja 2	🔁 Kartta	23.02.	1.514	1.594	1.389	Ysi5, Suvela Tuomarilantie 2	Kartta	_	1.459	1.539	1.31
ABC, Nihtisilta 4	🔁 Kartta	23.02.	1.489	1.559	1.309	Teboil Express, Mäkkylä Turuntie 14, 110-tie	Kartta		1.494	1.574	1.35
Neste Oil Express, Karakallio Tornihaukantie 1	🛃 Kartta	23.02.	1.459	1.539	1.289			-			
Neste Oil, Mankkaa Sinikalliontie 1-3, 1-tie	🚼 Kartta	23.02.	1.449	1.519	1.319	Teboil, Kivenlahti Vanha Jorvaksentie 1	Kartta	24.02.	1.519	1.599	1.36
ShellExpress, Sepänkylä Palomiehentie 2	Kartta	23.02.	1.469	1.549	1.319	St1, Mäkkylä Turuntie 2 (Re85 0.999), 110-tie	🔁 Kartta	24.02.	1.499	<u> </u>	1.36
ABC, Kivenlahti Kivenlahdentie 7	🔁 Kartta	23.02.	1.489	1.569	1.339	ABC, Karaportti Karaniityntie 2	🔁 Kartta	And in case of the local division of the loc	1.504	1.584	1.35
Teboil, Espoonlahti Kivenlahdentie 2	E Kartta	23.02.	1.439	1.519	1.319	Neste Oil, Viherlaakso Rajamännynahde 1	🛃 Kartta	23.02.	1.499	1.579	1.36
Neste Oil Express, Kivenlahti Maininkitie 11	Kartta	23.02.	1.439	1.509	1.309	St1, Leppävaara Hannu Olavinpojantie 3, 110-tie, Kehä I	🛃 Kartta	23.02.	1.479	1.559	1.33
Neste Oil, Espoonlahti Kivenlahdentie 5	🔁 Kartta	23.02.	1.429	1.509	1.339	St1, Karamalmi - KII Karapellontie 11 (RE85 0.899)	🛃 Kartta	23.02.	1.469	-	1.29
St1, Mäkkylä Turuntie 2 (Re85 0.999), 110-tie	E Kartta	23.02.	1.499		1.349	Neste Oil, Mankkaa Sinikalliontie 1-3, 1-tie	🔁 Kartta	23.02.	1.449	1.519	1.31
Ysi5, Suvela Tuomarilantie 2	Kartta	23.02.	1.429	1.509	1.309	Neste Oil Express, Karakallio Tornihaukantie 1	🔁 Kartta	23.02.	1.459	1.539	1.28
ABC, Otaniemi Miestentie 1	Kartta	22.02.	1.469	1.539	1.369	St1, Lähderanta Pitkäjärventie 1	🛃 Kartta	23.02.	1.469	1.549	1.29
Neste Oil, Otaniemi Miestentie 1, Kehä I	Kartta	22.02.	1.449	1.499	1.359	ABC, Kivenlahti Kivenlahdentie 7	🛃 Kartta	23.02.	1.489	1.569	1.33
Teboil Express, Mäkkylä Turuntie 14, 110-tie	Kartta	22.02.	1.504	1.584	1.359	Neste Oil Express, Kivenlahti Maininkitie 11	🛃 Kartta	23.02.	1.439	1.509	1.30
Teboil Express, Leppävaara/Perkkaa Hevosenkenkä 2, Kehä	I El Kartta	22.02.	1.474	1.554	1.329	Neste Oil, Espoonlahti Kivenlahdentie 5	🛃 Kartta	23.02.	1.429	1.509	1.33
Shell, Vallikallio Vallikallionkatu 9, Kehä I (*E99+)	C Kartta	22.02.	1.494	*1.624	1.349	Teboil, Espoonlahti Kivenlahdentie 2	🛃 Kartta	23.02.	1.439	1.519	1.31
Shell, Leppāvaara Vanha maantie 2 (*E99+)	Kartta	22.02.	1.494	*1.624	1.349	ABC, Otaniemi Miestentie 1	🔁 Kartta	22.02.	1.469	1.539	1.36
Neste Oil Express, Lommila Espoontie 32	Kartta	22.02.	1.429	1.509	1.299	Neste Oil, Otaniemi Miestentie 1, Kehä I	E Kartta	22.02.	1.449	1.499	1.35
Neste Oil Express, Lommila Lommilanrinne 1	Kartta	22.02.	1.429	1.509	1.299	Shell, Leppävaara Vanha maantie 2 (*E99+)	🔁 Kartta	22.02.	1.494	*1.624	1.34
Teboil Express, Lommila Lommilantie 12	Kartta	22.02.	1.429	1.509	1.299	Shell, Vallikallio Vallikallionkatu 9, Kehä I (*E99+)	🔁 Kartta	22.02.	1.494	*1.624	1.34
						Teboil Express, Leppävaara/Perkkaa Hevosenkenkä 2, Kehä	ET Martha	22.02	1.474	1.554	1.32
Teboli, Niittykumpu Luomankuja 2	Kartta	21.02	1.519	1.599	1,369	Neste Oil Express, Lommila Lommilanrinne 1	Kartta	-	1.429	1.509	1.2
Feboil, Kivenlahti Vanha Jorvaksentie 1	C Kartta		1.519	1.599	1.369	Neste Oil Express, Lommila Espoontie 32	Kartta		1.429	1.509	1.29
ABC, Juvankartanontie 33 (E85.)	Kartta		1.439	1.519	1.309	Teboil Express, Lommila Lommilantie 12	Kartta		1.429	1.509	1.2
St1, Bemböle Turuntie 203 (Re85 0.919), 110-tie	Kartta		1.469	1.549	1.309	ABC, Juvankartanontie 33 (E85.)	Kartta		1.439	1.519	1.3
Shell, Bemböle Bellinmäki 2, 110-tie (*E99+)			1.469	*1.599	1.319	St1, Bemböle Turuntie 203 (Re85 0.919), 110-tie			1.469	1.549	1.3
	Kartta						Kartta	And in case of the local division of the loc			
Ysi5, Nihtisilta Kutojankulma 2	🛃 Kartta	20.02.	1.469	1.539	1.319	Shell, Bemböle Bellinmäki 2, 110-tie (*E99+)	🔁 Kartta	21.02.	1.479	*1.599	1.32

Figure 37. This Feb 23's 22:59 (remains the same at 04:00, 05:00, 08:00 Feb 24)

Figure 38. This Feb 24's 16:30 (10 updates)

Other observations include that:

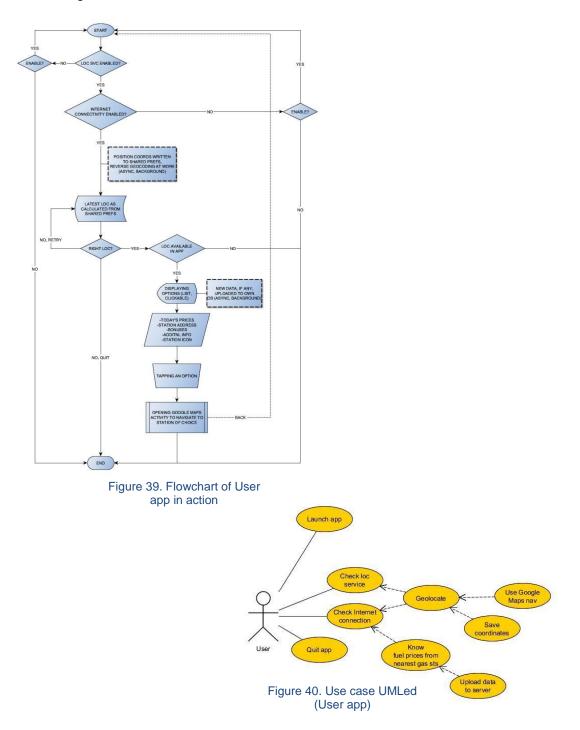
- Usually, today's, yesterday's and, at times, earlier prices fill up the entire page;
- 30-min or hourly updates may start at 07:00 or halt for a part of the day.

With these observations, came the understanding that the usual price span was between today, yesterday and earlier prices, which later formed the three-day approach for own database structure. For the implementation details, refer to the *Admin app* subsection of 3.1.

# Appendix 5. User and Admin apps: use cases

User app

A simplified UML scheme and a flowchart representation of the User app in action are shown in Figures 39,40.



# Admin app

Similarly, a simple UML scheme and a flowchart representation of the Admin app in action are given in Figures 41,42.

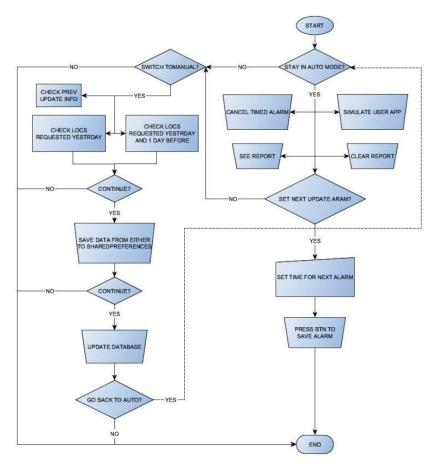


Figure 41. Flowchart of Admin app in action

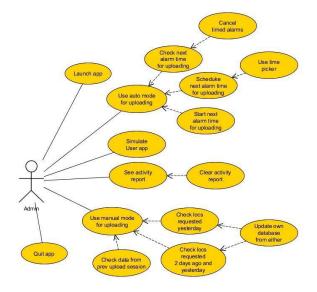
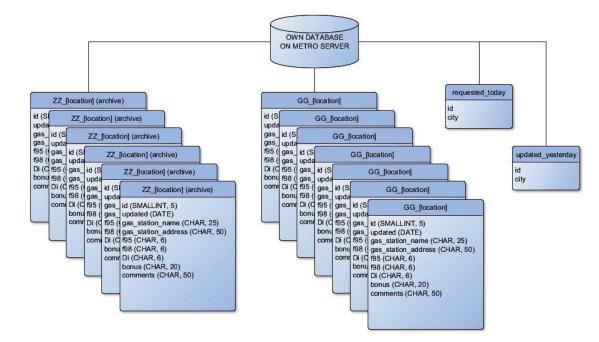


Figure 42. Use case UMLed (Admin app)



The Admin app is related to own database, so it is important to show its structure to understand the simple interactions there (see Figure 43 below).

Figure 43. Simple, unrelated DB scheme of the project, with the three-day approach in mind

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