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DEVELOPMENT OF A MOBILE APPLICATION FOR MONITORING

MINING FARM ACTIVITY AND CRYPTO ASSETS FOR ANDROID OS

Diploma thesis

Supervisor: assistant Andre Sääsk

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LIST OF ABBREVIATIONS AND DEFINITIONS

IDE - integrated development environment

API – application programming interface

GUI – graphical user interface

OS – operating system

ASIC - application-specific integrated circuit

ANDROID OS

Since it was difficult to find academic definition, I used wikipedia.org definition:

Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software and designed primarily for touchscreen mobile devices such as smartphones and tablets. (Android … 2018).

MOBILE APPLICATION

A mobile application is a software program you can download and access directly using your phone or another mobile device, like a tablet or music player (Federal Trade Commission 2017).

CRYPTOCURRENCY

Cryptocurrency is a digital currency produced by a public network, rather than any government, that uses cryptography to make sure payments are sent and received safely (Definition of "Cryptocurrency" … 2018).

ALTCOINS

Altcoins are the alternative cryptocurrencies launched after the success of Bitcoin. (Investopedia LLC 2018)

CRYPTOCURENCY MINING

Cryptocurrency mining is the use of special software to try to obtain new cryptocurrency (= digital currency produced by a public network rather than by a government). (Definition of "Mining" … 2018)

MINING FARM

Mining farm – is a data centre, technically equipped to mine bitcoins or other cryptocurrencies. (Mining farm … 2018).

MINING RIG

A mining rig is a computer system used for mining bitcoins. The rig might be a dedicated miner where it was procured, built and operated specifically for mining or it could otherwise be a computer that fills other needs, such as performing as a gaming system, and is used to mine only on a part-time basis. (Mining rig … 2018).

MINING POOL

In the context of cryptocurrency mining, a mining pool is the pooling of resources by miners, who share their processing power over a network, to split the reward equally, according to the amount of work they contributed to the probability of finding a block. (Mining pool … 2018).

ASIC

An Application-Specific Integrated Circuit (ASIC), is an integrated circuit customized for a particular use, rather than intended for general-purpose use. For example, a chip designed to run in a high-efficiency Bitcoin miner is an ASIC. (Application-Specific Integrated Circuit … 2018).

API

In computer programming, an application programming interface (API) is a set of subroutine definitions, protocols, and tools for building application software. In general terms, it is a set of clearly defined methods of communication between various software components. A good API makes it easier to develop a computer program by providing all the building blocks, which are then put together by the programmer. (Application programming interface … 2018).

MINER

In this thesis miner means person who own / run cryptocurrency mining farm.

HOME MINERS.

Usually such miners run cryptocurrency mining on mining rigs based on video cards. Every video card has own power consumption and every apartment has electric power limit. Because of that, home miners usually have small amount of the video cards. Usually for home miners cryptocurrency mining is not main source of income. It's rather hobby than work.

SMALL MINERS.

Usually such miners run cryptocurrency mining on mining rigs based on video cards. But some of them are run cryptocurrency mining on ASICs. Such miners use separate building of private

house or rent commercial premises. For some small miners cryptocurrency mining is main source of income, but more common it is just an additional source of income.

MEDIUM MINERS.

Such miners run cryptocurrency mining on mining rigs based on video cards as well as on ASICs. Such miners own or rent commercial premises for cryptocurrency mining. For medium miners cryptocurrency mining is main source of income. Usually they have one or two employees who monitor cryptocurrency mining farm activity and do all maintenance.

LARGE MINERS.

Most large miners run cryptocurrency mining on ASICs. Such miners own or rent commercial premises for cryptocurrency mining. For large miners cryptocurrency mining is main source of income. They have employees who monitor cryptocurrency mining farm activity 24/7 and do all maintenance.

INTRODUCTION

Nowadays cryptocurrencies like bitcoin, for example, become more and more popular. Most people have heard about them and some even start their own cryptocurrency mining. Unfortunately, there are a lot of factors influencing cryptocurrency mining farm's work stability. Because of that, miners have to monitor cryptocurrency mining farm's activity several times a day. Besides that, cryptocurrency market is not stable and prices of cryptocurrencies might change significantly even during one day.

To get maximum profit out of their mining farm activities, miners have to spend time daily to monitor mining farms' stability and cryptocurrencies' prices.

Miners can be conditionally divided into four groups: home miners, small miners, medium miners and large miners as explained above in the list of definitions. Medium and large miners has employees whose duty to monitor mining farm activity, surround and equipment temperatures, equipment loads, and so on. They mostly do it on PCs. Home and small miners has to do it themselves. And regardless of the mining farm size miners has to do it daily. For such miners, the most convenient way to do it would be to monitor mining farm activity on mobile devices such as smartphone and tablet PCs. Because of it the main target groups for my application are home and small miners.

Currently in order to be aware of cryptocurrency mining farms activity on mobile devices miners have following options:

1. To monitor mining farms activity on pools websites. In case of use multiple pools this is not very convenient. In addition, the creation of graphs and other calculations on the client side on these sites gain a heavy CPU load, which leads to a rapid discharge of the mobile device battery.
2. Some mining pools offer mining farm failure email notification. But unfortunately not all mining pools offer it and at some pools that option is not works. Beside that miner still have to visit pools web sites to get mining farm data.
3. Some mining pools has mobile application for mining farm activity monitoring. Usually, it is good solution for single pool monitoring. But in case of multiple mining pools usage miners have to use multiple mobile applications. The author tested some of them and mainly those applications show mining farm data but do not notify miner about mining farm failure.

Besides that, in order to monitor cryptocurrency prices miners has to visit corresponding web sites or to install another mobile application.

The problem

The problem solved in this work is: there are no convenient way to monitor multi pool cryptocurrency mining farms activity and cryptocurrencies prices for mobile devices working on Android OS.

The main question is how to make multi pool cryptocurrency mining farms activity and cryptocurrencies prices monitoring convenient for the user?

The aim

The aim of this diploma is to develop convenient way to monitor multi pool cryptocurrency mining farm activity and cryptocurrencies prices for mobile devices working on Android OS.

Solution

The author proposes to solve this problem by mobile application development. It will allow user to receive information about mining farms connected to different mining pools activities and cryptocurrencies prices in one application. In addition, the application will do all monitoring automatically on the background and it will notify user in case of mining farm workers failure or if altcoins price will reach desirable level.

Tasks

To achieve the aim of this work the author has to complete following tasks:

1. To choose mining pools for first version of the application
2. To make currently exist multi pool application overview
3. To choose technologies and tools for application development
4. To collect function and non-function requirements
5. To create application design and application use diagram
6. To develop database
7. To develop application
8. To run application's tests
9. Approbation of the application

Outline

This work consists from the list of abbreviations and definitions, an introduction, two chapters, a conclusion, the list of references and two appendices. In the first chapter, the author gives an overview of the technologies chosen for this work and available competing solutions. In the second chapter, the author describes in details the development process of the application. In the appendices, the author shows the source code of the application.

1   CHOSEN TECHNOLOGIES AND AVAILABLE SOLUTIONS

1.1   Chosen technologies

Currently the most known IDE for Android application development are:

1. Android Studio.
2. IntelliJ IDEA.
3. Eclipse.
4. NetBeans.

The author used Android Studio because it is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is a replacement for the Eclipse Android Development Tools as primary IDE for native Android application development. (Android Studio … 2018). And there are a lot of study courses and materials available online.

For networking the author used Volley and Jsoup libraries.

Volley is an HTTP library that makes networking for Android apps easier and most importantly, faster. Volley is available on GitHub.

Volley offers the following benefits:

1. Automatic scheduling of network requests.
2. Multiple concurrent network connections.
3. Transparent disk and memory response caching with standard HTTP cache coherence.
4. Support for request prioritization.
5. Cancellation request API. You can cancel a single request, or you can set blocks or scopes of requests to cancel.
6. Ease of customization, for example, for retry and backoff.
7. Strong ordering that makes it easy to correctly populate your UI with data fetched asynchronously from the network.
8. Debugging and tracing tools.

(Volley overview … 2018)

JSoup is a Java library for working with real-world HTML. It provides a very convenient API for extracting and manipulating data, using the best of DOM, CSS, and jquery-like methods. (JSoupe: Java HTML Parser 2018)

For the user data storage, the author used SQLite database. SQLite is a relational database management system contained in a C programming library. In contrast to many other database management systems, SQLite is not a client–server database engine. Rather, it is embedded into the end program.

SQLite is a popular choice as embedded database software for local/client storage in application software such as web browsers. It is arguably the most widely deployed database engine, as it is used today by several widespread browsers, operating systems, and embedded systems (such as mobile phones), among others. SQLite has bindings to many programming languages. (SQLite … 2018).

To learn how to develop Android application the author used official Android documentation (Guides – official documentation 2018) and free online lessons "Start Android – учебник по Android для начинающих и продвинутых" (Dmitri Vinogradov 2011).

1.2 Currently existing solutions overview

1.2.1 Single pool applications

There are many single-pool applications like Mining Pool Hub, Mining-Pool, NiceHash Mining Pool Monitor, Zcash Flypool Mining Monitor, Nanopool Mining Monitor, Ethermine Pool Stats Monitor and others. Some of them have additional features like mining pool statistic, statistic's graphs and so on. Some of them look very nice and are user-friendly, e.g. Zcash Flypool Mining Monitor. As for me the most important feature of such an application was the ability to monitor several pools and give push notifications about failures, none of these applications are direct competitors for the author.

1.2.2 Multi-pool applications

There are some multi-pool applications like Майнинг наблюдатель, PoolWatch – Mining Monitor, Mining Pool Status, Mining Pool Watcher are available on the Google Play market. But the author managed to find only one multi-pool application with user friendly GUI which can monitor multi-pool mining farms activities on many popular mining pools. That application called "Майнинг наблюдатель".

"Майнинг наблюдатель" main activities and settings views are visible in figure 1 and figure 2.
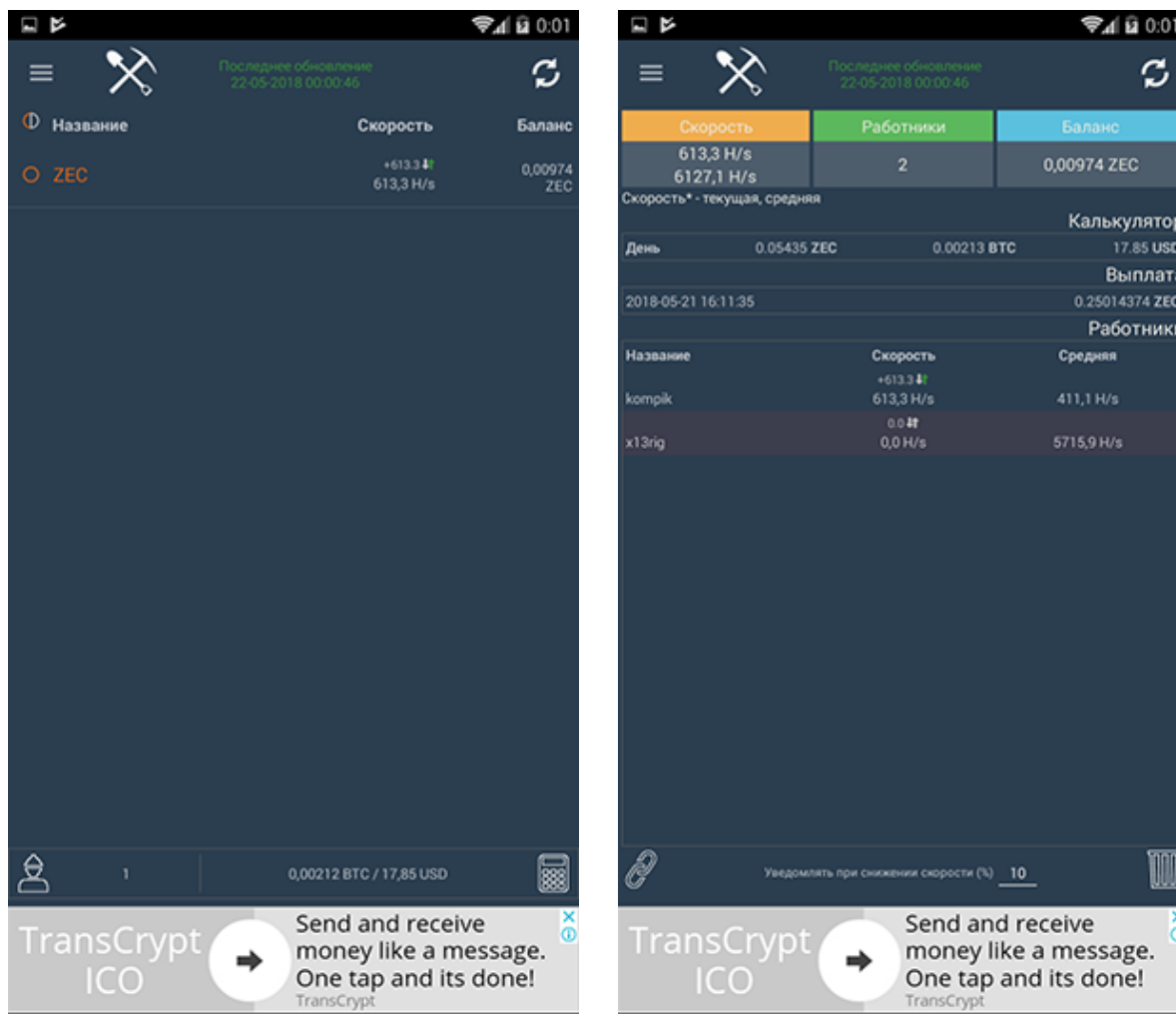
Figure 1. "Майнинг наблюдатель" main activities views (Source: author)

The author tested it with smartphone and tablet PC. This application has following pros and cons:

Pros:

1. The application can monitor up to 11 different mining pools.
2. It can show mining farm activities as well as mining farm's workers activities.

Cons:

1. According to the application settings, it should run a background service and inform the user in case of mining farm failure, but the author did not get any such notifications about my devices, even when he certainly knew there were failures.
2. In order to be notified, the user should set hashrate differences in percent, after which the application will inform the user if hashrate difference exceeds it. Such approach will not work well if users have mining rigs with big differences in hashrate power.

3. It does not show or monitor cryptocurrency prices.
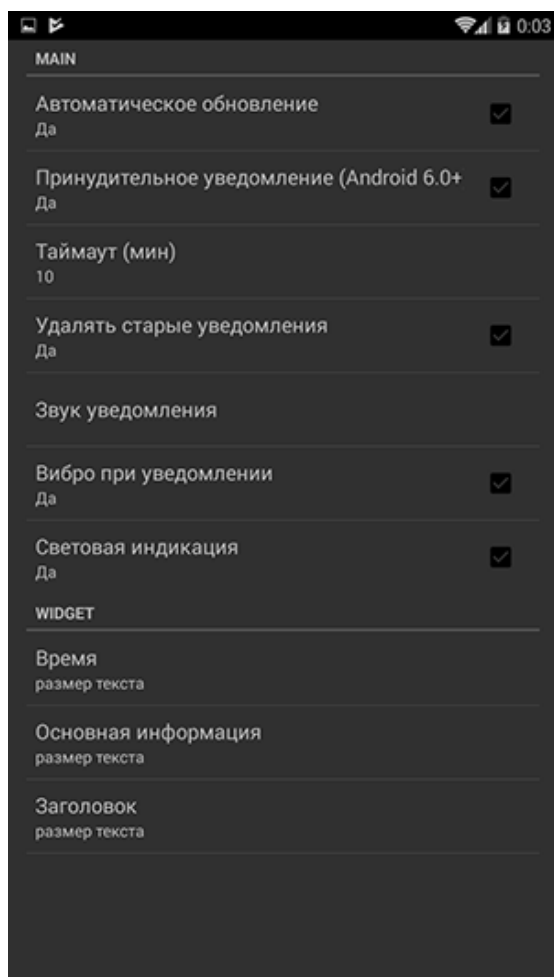4. The user cannot edit saved mining rig data.

Figure 2. "Майнинг наблюдатель" settings activity view (Source: author)

1.2.3 Conclusion

The author lists most of the applications he was able to find on the Google Play market in the **Ошибка! Источник ссылки не найден.**. Some of them the author has tested, in which case he marks in the table if he found the application user-friendly or not. As there were many applications which lacked the functions he needed, he did not extensively test them, as it would take too much time and give little outcome for his research.

Table 1. Functional requirements

Application name	Monitors one mining pool	Monitors multiple mining pools	Shows prices for cryptocurrencies	Push notifications about failures	Push notifications about price changes	User-friendly	Can monitor popular mining pools
Майнинг наблюда-тель[1]	+	+	-	*	-	+	+
Mining Pool Hub[2]	+	-	+	-	-	+	-
Mining-Pool[3]	+	-	*	-	-	*	-
PoolWatch – Mining Monitor[4]	+	+	-	-	-	-	+
Mining Pool Status[5]	*	*	*	-	-	-	-
NiceHash Mining Pool Monitor[6]	+	-	+	-	-	-	+
Mining Pool Watcher[7]	+	*	+	+	-	-	-
Zcash Flypool Mining Monitor[8]	+	-	+	-	-	+	+
Nanopool Mining Monitor[9]	+	-	+	-	-	+	+
Ethermine Pool Stats Monitor[10]	+	-	+	-	-	+	+
Mining Helper	+	+	+	+	+	+	+

Data: created by the author.

[1] https://play.google.com/store/apps/details?id=com.belous.v.miningobserver
[2] https://play.google.com/store/apps/details?id=xyz.cryptomines.miningpoolhub
[3] https://play.google.com/store/apps/details?id=com.zeykit.dev.miningpoolfr
[4] https://play.google.com/store/apps/details?id=com.apaluk.android.poolwatch
[5] https://play.google.com/store/apps/details?id=com.manard.litecoinapi
[6] https://play.google.com/store/apps/details?id=xyz.cryptomines.nicehash
[7] https://play.google.com/store/apps/details?id=it.angelic.mpw
[8] https://play.google.com/store/apps/details?id=xyz.cryptomines.zcash
[9] https://play.google.com/store/apps/details?id=xyz.cryptomines.nanopool
[10] https://play.google.com/store/apps/details?id=xyz.cryptomines.ethermine

With an asterisk (*) the author marks applications which claim to have some options, but he was not able to confirm them.

Based on the research given above, the author may conclude that there is currently no application for Android platform, which would have all the features he needs from a mining helper application.

2 APPLICATION DEVELOPMENT PROCESS

2.1 Choosing mining pools for the application

Currently the popular web site www.coinmarketcap.com shows more than 1500 cryptocurrencies. A lot of them are mineable and can be mined on several mining pools.

The author decided to add following mining pools in to the first version of application:

1. ethermine.org
2. ethpool.org
3. etc.ethermine.org
4. zcash.flypool.org
5. etc.nanopool.org
6. eth.nanopool.org
7. etn.nanopool.org
8. pasc.nanopool.org
9. sia.nanopool.org
10. xmr.nanopool.org
11. zec.nanopool.org

The author chooses those mining pools because of following reasons:

1. Currently those mining pools are quite popular.
2. They have API services and those services works fine.
3. All nanopool.org mining pools have similar API requests, rest of the chosen pools also have similar API requests.

For demo purpose of that work the author will use zcash.flypool.org and xmr.nanopool.org.

For those mining pools following monitoring options are available:

1. zcash.flypool.org

1.1 Pool has email mining farm failure notification in beta testing stage, but the author has never been notified about it.

1.2 Android Play Market offer several applications. Most of them are single pool application.

2. xmr.nanopool.org

1.3 Pool has email mining farm failure notification and its works well.

1.4 Android Play Market offer several applications. Most of them are single pool application.

The most of those applications has built in advertisement modules or payable functions.

2.2 Functional requirements

The functional requirements of application are listed in table 2. The listed requirements describe the main functionalities of the application and they must be satisfied.

Table 2. Functional requirements

ID	Requirement	Priority
1	The user must be able to add new mining rig for monitoring.	High
2	The user must be able to edit or delete saved mining rig.	High
3	The user must be able to monitor mining farm and mining farm's workers activities.	High
4	The user must be able to set mining farm's workers amount.	High
5	The application must inform the user in case of workers failure (if active workers amount is not equal set workers amount).	High
6	The user must be able to add new cryptocurrency for monitoring.	Medium
7	The user must be able to edit or delete saved cryptocurrencies.	Medium
8	The user must be able to monitor saved cryptocurrencies prices.	Medium
9	The user must be able to set desirable cryptocurrency price.	Medium
10	The application must inform the user if saved cryptocurrency price reached desirable level.	Medium
11	The application must run the background service to inform the user in case of workers failure or if saved cryptocurrency price reached desirable level.	High
12	The user must be able to choose how often the background service should run.	Medium

| 13 | The user must be able to choose if the background service will monitor active workers amount or saved cryptocurrencies prices or both. | Medium |

Data: created by the author.

2.3 Non-functional requirements

The non-functional requirements of application are listed in table 3. The listed requirements describe the limitations of the application.

Table 3. Non-functional requirements

ID	Requirement	Priority
1	The application must run on smartphones and tablet PCs with Android version 4.4.2 and above	High
2	The application's GUI must be in English.	High
3	The application should use as less battery power as possible.	Medium

Data: created by the author.

2.4 Application design

The Android application consists of the following views:

1. Main activity
2. Workers list activity
3. Show pool list activity
4. Add pool activity
5. Edit pool activity
6. Show altcoins activity
7. Add altcoins activity
8. Edit altcoins activity
9. Settings activity

Main activity view is the view that is displayed when application is started. On that view the user can see mining farm ID, pool name, current and average hashrates, valid and on some pools invalid shares for last 1 hour, amount of workers the user set for that mining farm and amount of active workers, estimate earnings in altcoins, bitcoins and American dollars per day and per month, unpaid balance in altcoins, bitcoins and American dollars for each mining farm.

By the main activity menu, the user can open show altcoins activity or show pool list activity or settings activity.

The layout of the main activity view and the main activity menu are visible in figure 3.

Each mining farm table is clickable. By clicking on it the user can open workers list activity to monitor mining farm worker's activity.

If amount of workers the user set for the mining farm and amount of active workers is not equal, text colour will be change to red and sound notification will be played. It will inform the user that there are some malfunctions with mining farm workers.

The layout of the main activity view with notification is visible in figure 4.

Figure 3. Main activity view on the left and main activity menu on the right (Source: author)

Figure 4. Main activity view with notification (Source: author)

Workers list activity view is the view that is displayed when the user clicked to mining farm table to monitor mining farm worker's activity. On that view the user can see the worker's ID and name, current and average hashrates, valid and, on some pools, invalid shares for the last 1 hour and when the worker was seen last time.

If user want to get additional information about the mining farm and its workers, the user can open it in web browser by clicking "Open in browser" link.

The layout of the workers list activity view is visible in figure 5.

Figure 5. Worker list activity view (Source: author)

Show pool list activity view shows mining pools saved by the user. The user can see the mining pool name, cryptocurrency the user mine on that mining pool, cryptocurrency's wallet address or cryptocurrency's wallet address and payment ID, number of workers the user going to use on that mining pool.

By the show pool list activity menu, the user can open add pool activity to add new mining pool to the mining pool list, open show altcoins activity or main activity or settings activity.

The layout of the show pool list activity view and the show pool list activity menu are visible in figure 6.

Each mining pool table is clickable. By clicking on it the user can open edit pool activity to edit that mining pool data or to delete it.
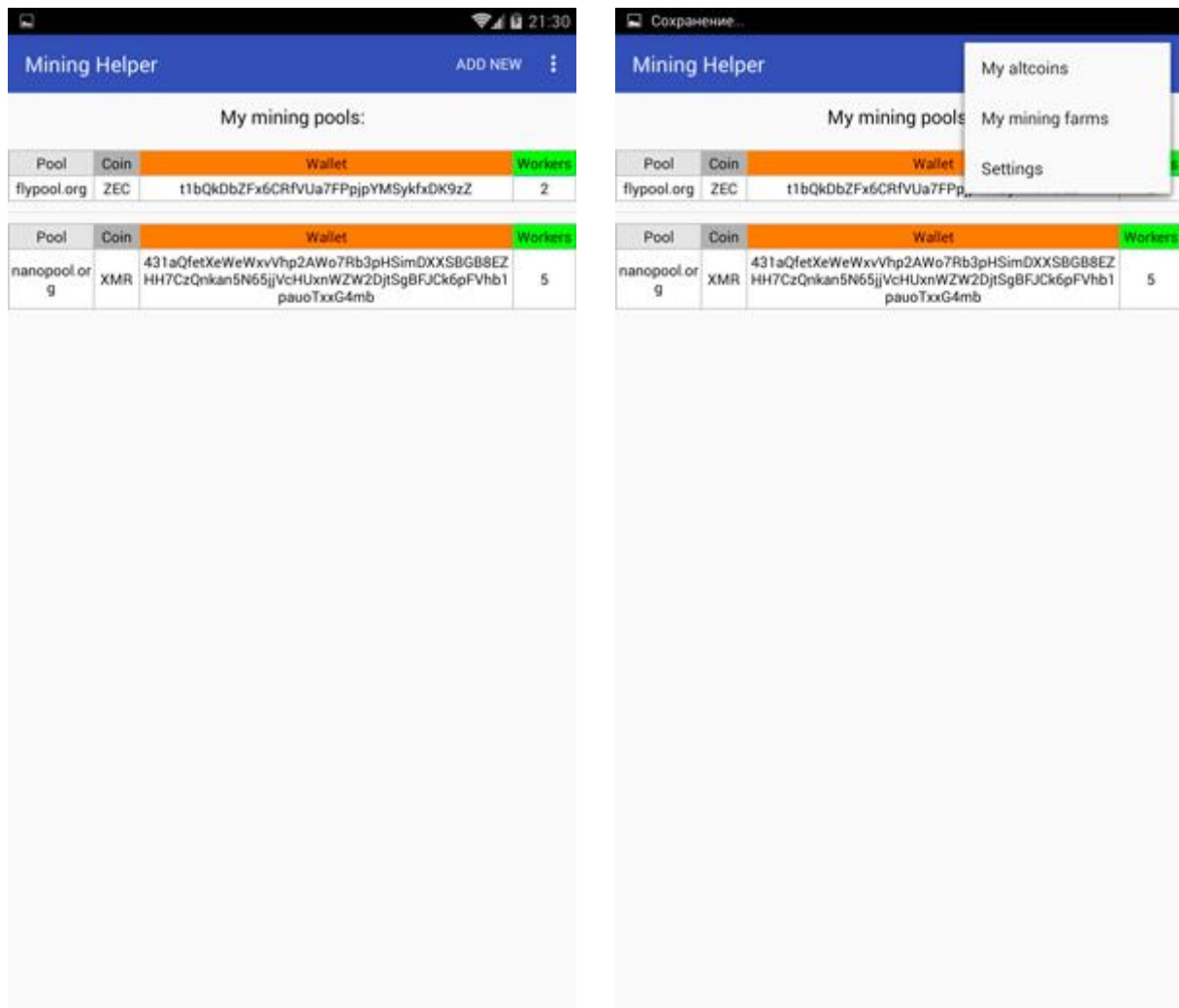
Figure 6. Show pool list activity view on the left and the show pool list activity menu on right (Source: author)

Add pool activity view allow the user to add new mining pool for monitoring. The user can choose mining pool name and the altcoin he or she going to mine on that pool from dropdown lists, can enter cryptocurrency's wallet address or cryptocurrency's wallet address and payments ID and number of workers he or she going to use on that mining pool. After "ADD MINING POOL" button will be pressed, all the data will be saved in database.

The layout of the add pool activity view is visible in figure 7.

The dropdown list options are visible in figure 8.

Figure 7. Add pool activity view (Source: author)
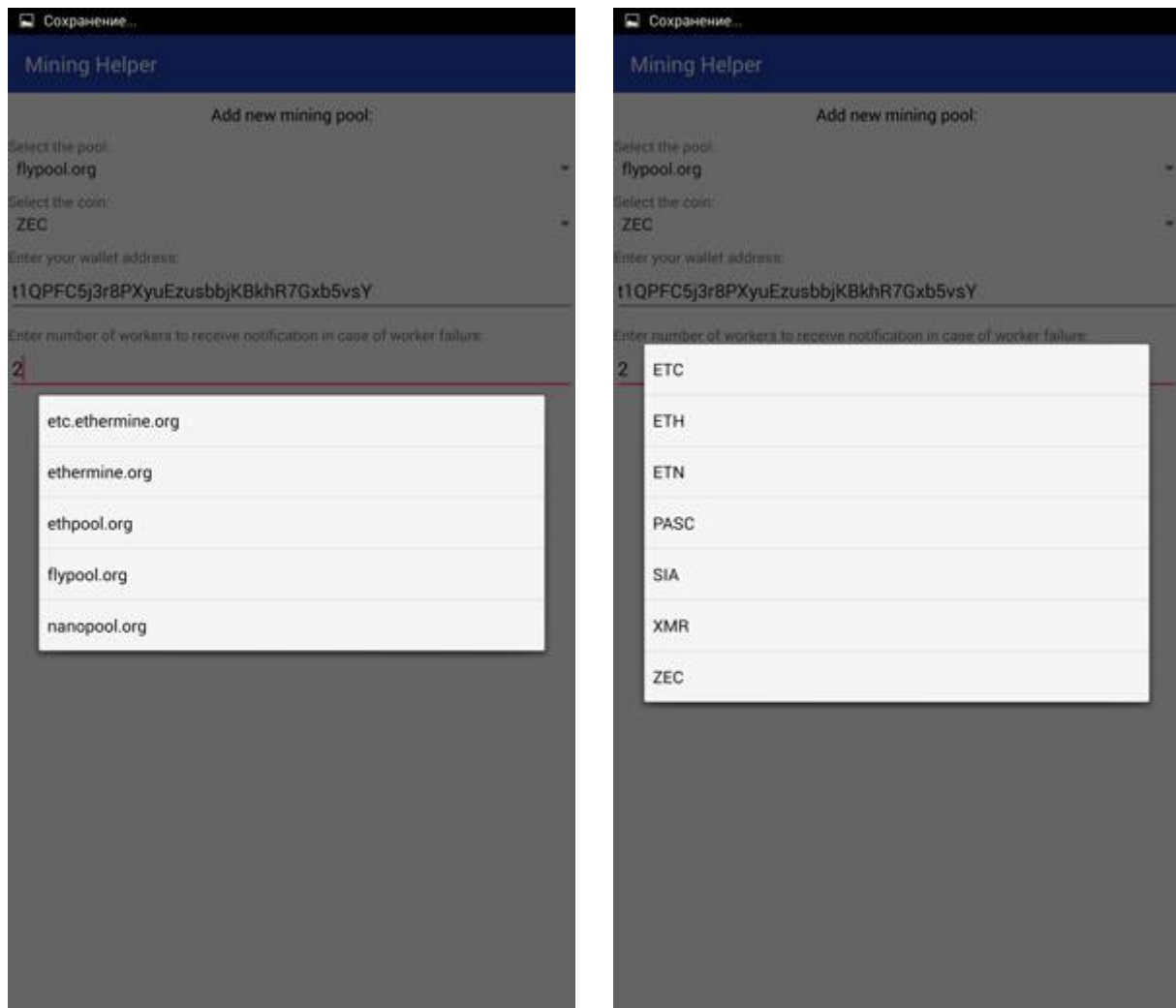
Figure 8. Mining pools dropdown list options from the left and cryptocurrency dropdown list options from the right (Source: author)

Edit pool activity view allow the user to edit saved mining pool's data or to delete it from the database. The user can see the mining pool ID, to edit mining pool name and the altcoin he or she going to mine on that pool, can edit cryptocurrency's wallet address or cryptocurrency's wallet address and payments ID and number of workers he or she going to use on that mining pool. If "UPDATE" button will be pressed, the database record will be update. If "DELETE" button will be pressed, the database record will be deleted.

The dropdown list options available for the user to edit mining pool name or the altcoin he or she going to mine on that pool are visible in figure 8.

The layout of the edit pool activity view is visible in figure 9.

Figure 9. Edit pool activity view (Source: author)

Show altcoins activity view shows cryptocurrencies saved by the user for monitoring. The user can see cryptocurrency name, cryptocurrency's price changes in percent for last 1 hour and for last 24 hours, to see set and current price in chosen by the user currency.

By the Show altcoins activity menu, the user can open add pool activity to add new altcoin to the cryptocurrency list, can refresh cryptocurrency list to get updated cryptocurrency price, open main activity or show pool list activity or settings activity.

Show altcoins activity view and the show altcoins activity menu view are visible in figure 10.

Each cryptocurrency table is clickable. By clicking on it the user can open edit altcoin activity to edit that altcoin data or to delete it from database.
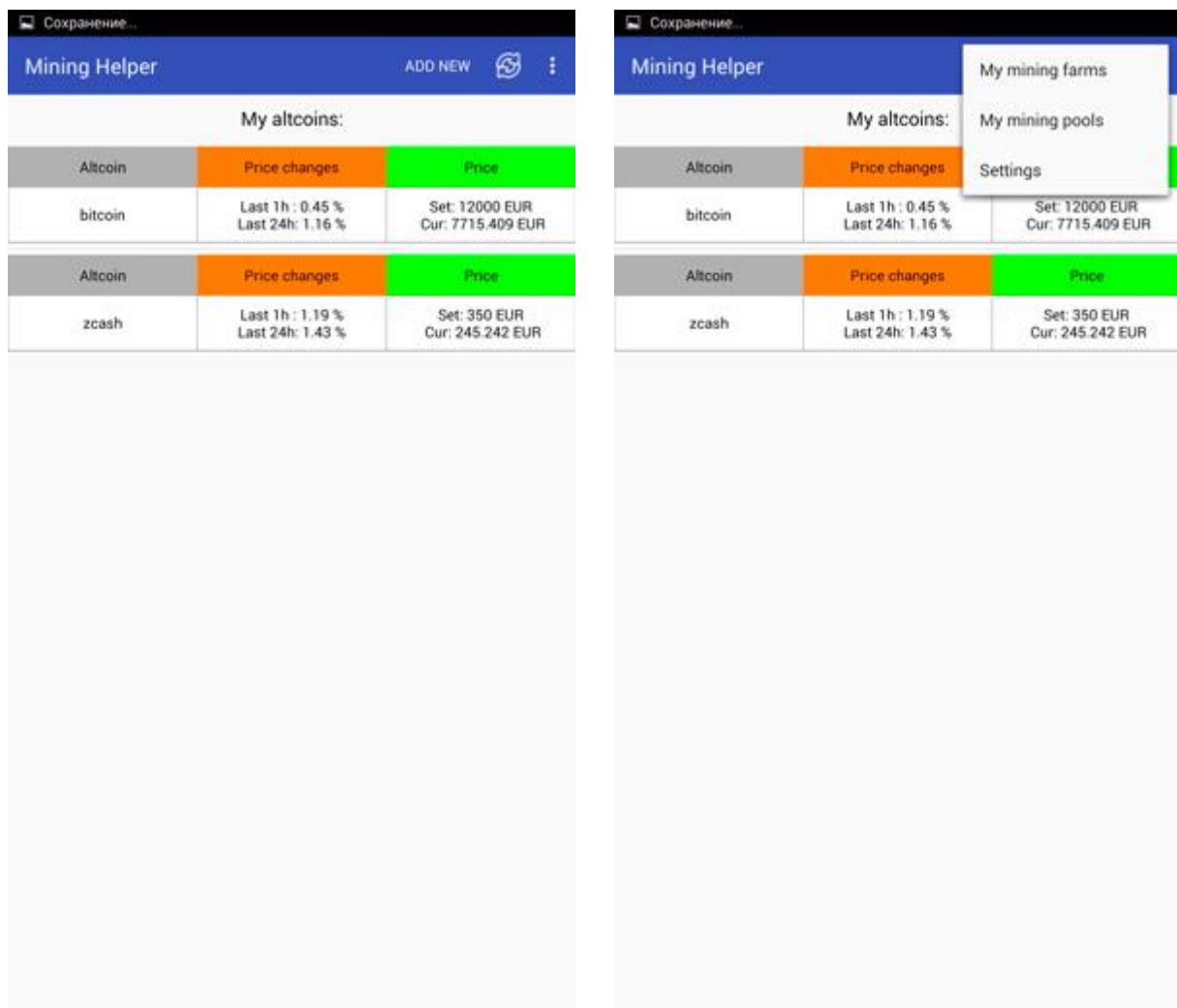
Figure 10. Show altcoins activity view on the left and the show altcoins activity menu on the right (Source: author)

Add altcoins activity view allow the user to add new cryptocurrency to the list for monitoring. The user can choose altcoin and currency from dropdown lists, can enter desirable altcoin's price. After "ADD ALTCOIN" button will be pressed, all the data will be saved in database.

The layout of the add altcoins activity view is visible in figure 11.

The dropdown list options are visible in figure 12.

Figure 11. Add altcoins activity view (Source: author)
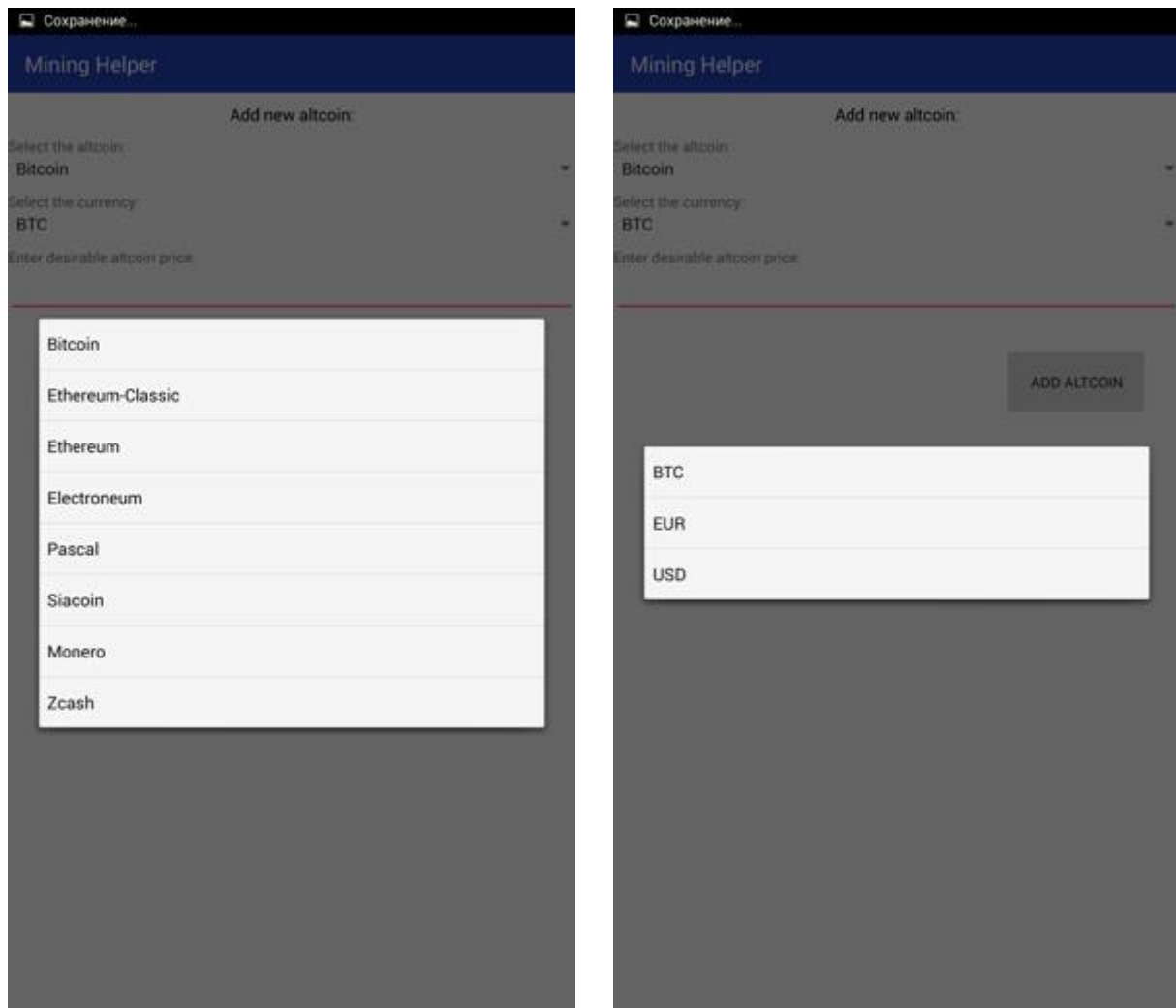
Figure 12. Cryptocurrency dropdown list options from the left and currency dropdown list options from the right (Source: author)

Edit altcoins activity view allow the user to edit saved cryptocurrency data or to delete it from the database. The user can see the altcoin ID, to edit altcoin and the currency he or she going to sell altcoins for and enter desirable price. If "UPDATE" button will be pressed, the database record will be update. If "DELETE" button will be pressed, the database record will be deleted.

The layout of the edit altcoins activity view is visible in figure 13.

The dropdown list options are visible in figure 12.
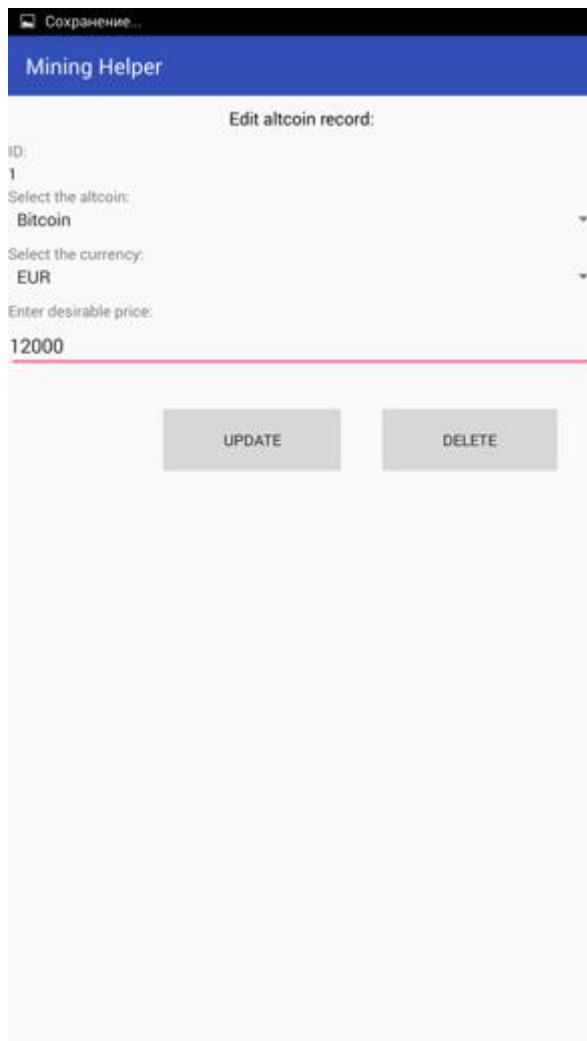
Figure 13. Edit altcoins activity view (Source: author)

Settings activity view allow the user to set automatic background control service settings. The user can choose interval for how often automatic background control service will run from dropdown list, can choose if he or she want automatic background control service to monitor mining farms or cryptocurrency's prices only or both of them and user can switch it on / off.

By the settings activity menu, the user can open show altcoins activity or main activity or show pool list activity.

Settings activity view and settings activity menu view are visible in figure 14.

The dropdown list of available time intervals options is visible in figure 15.
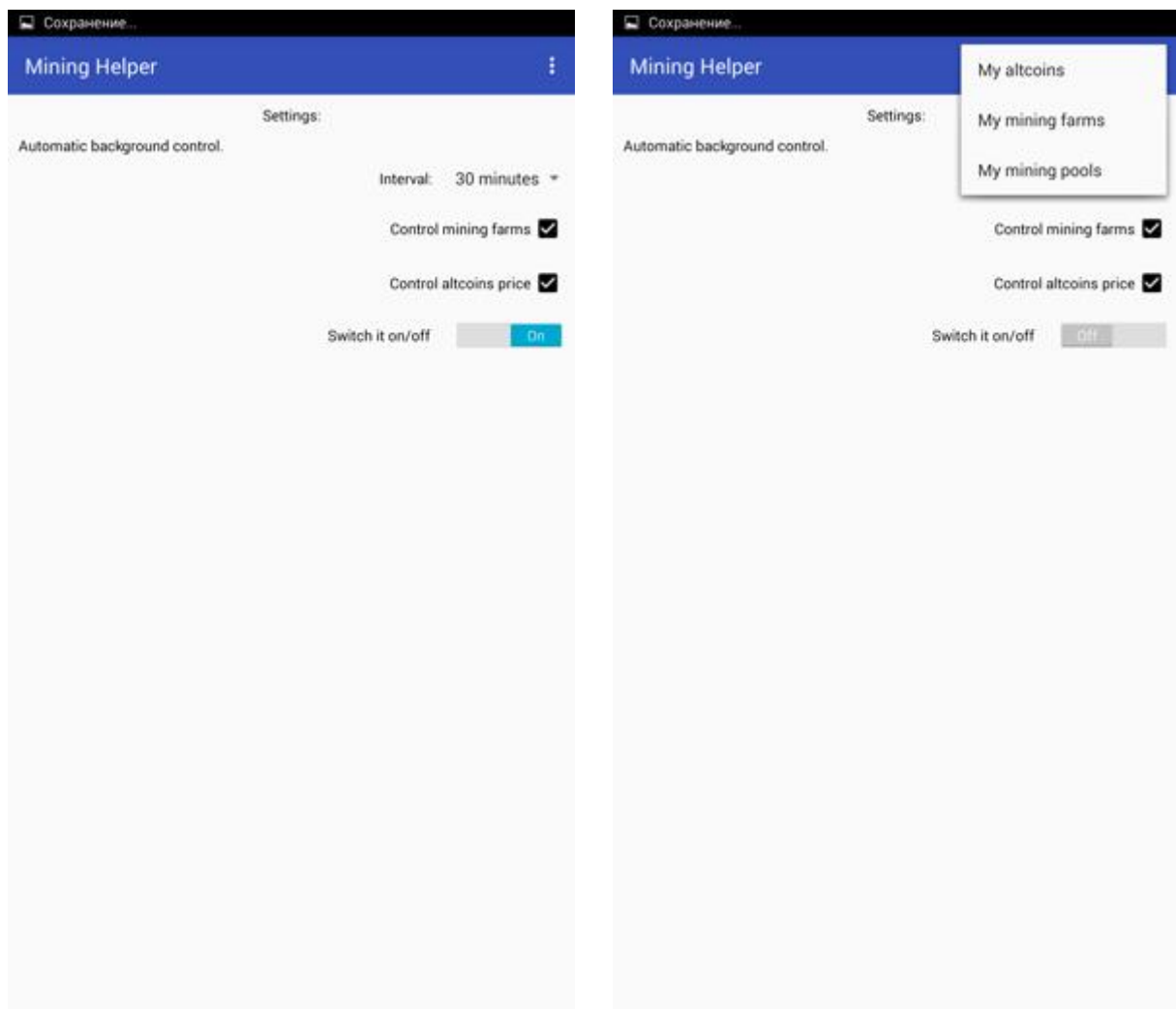
Figure 14. Settings activity view on the left and settings activity menu on the right (Source: author)
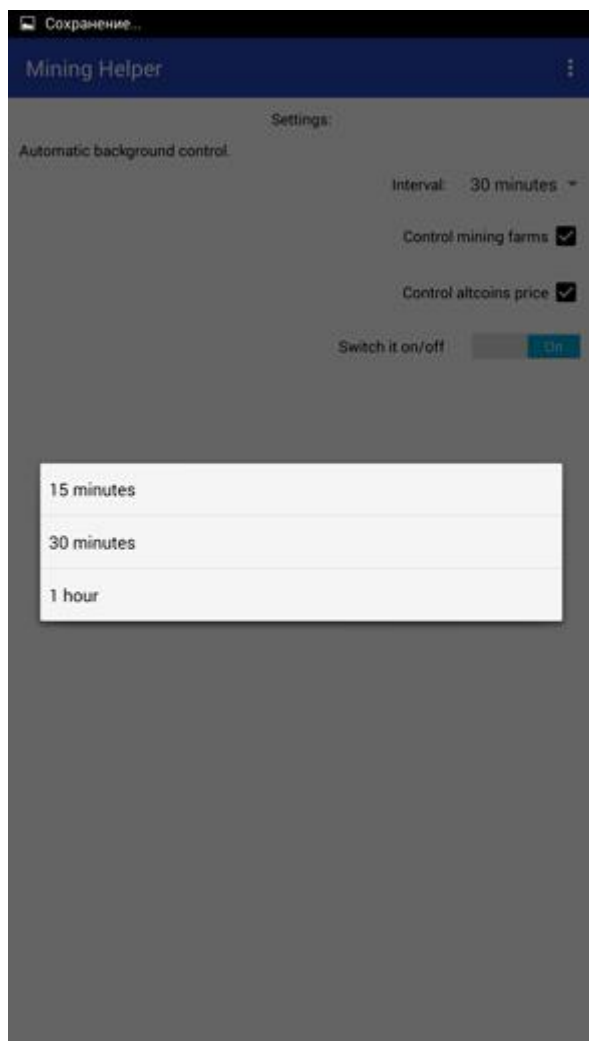
Figure 15. Time intervals dropdown list options (Source: author)

2.5 Application use diagram
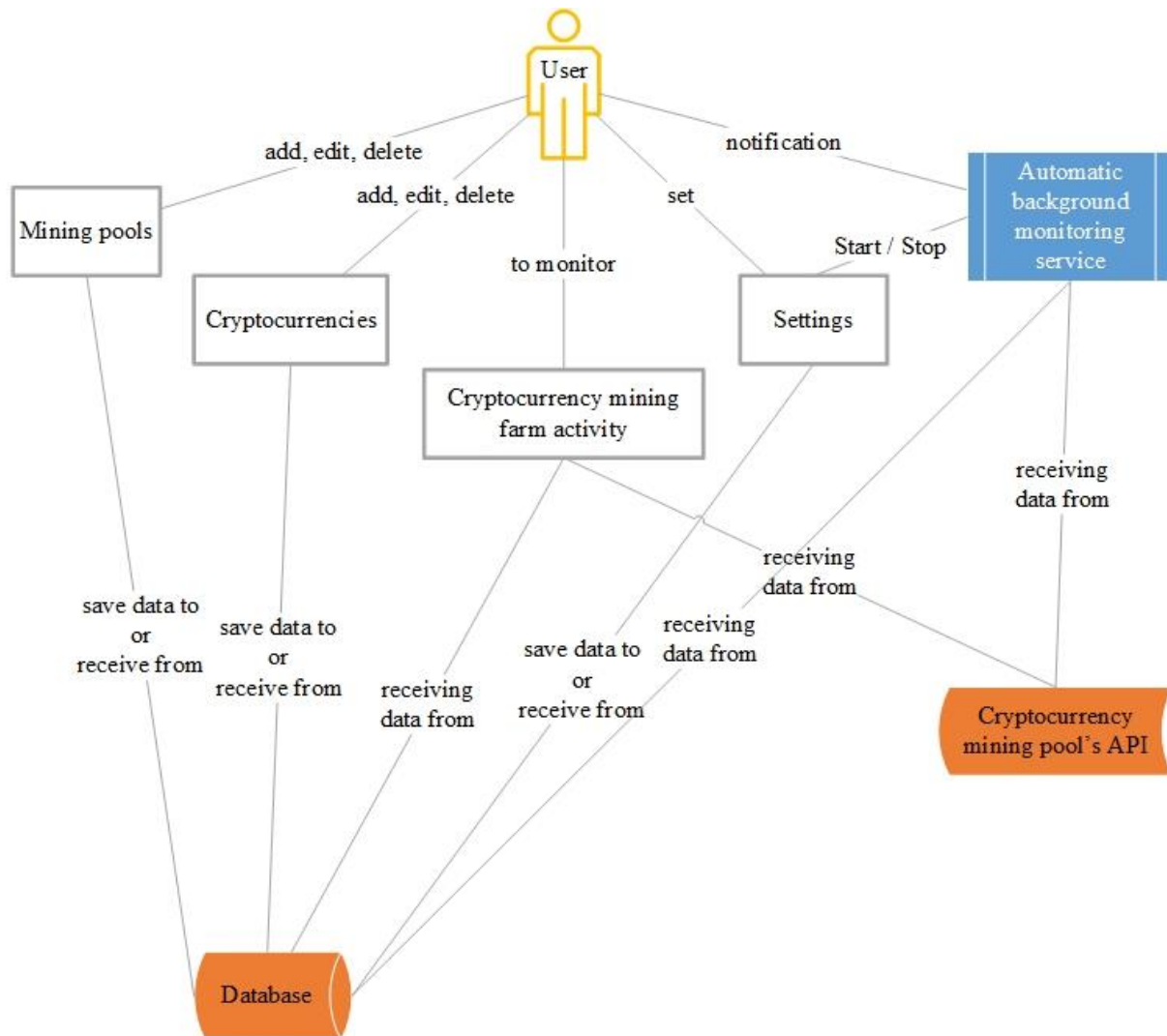
Figure 16. Mining helper application use diagram (Source: author)

Figure 16 demonstrates the use of Mining helper from the view of the user.

2.6 Database development

To store user's data, the author used SQLite database.

The author called application's database "MiningDB" database.

MiningDB consist of 3 separate tables:

1. TABLE_POOLS
2. TABLE_SETTINGS

3. TABLE_ALTCOINS

Database tables are visible in figure 17.

MiningDB database
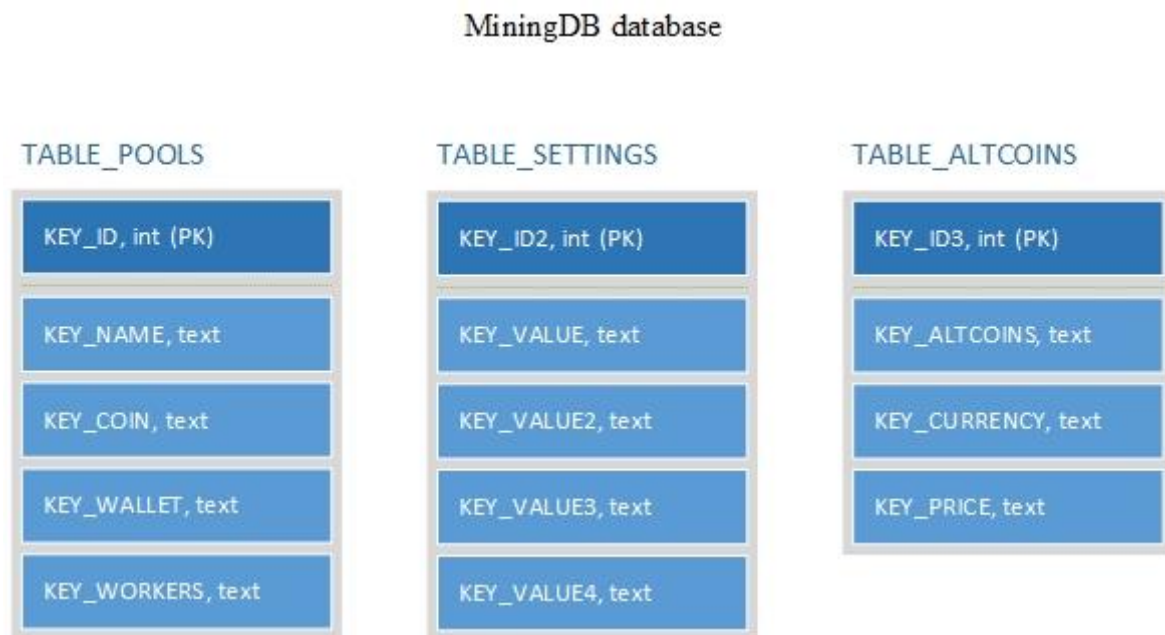
Figure 17. Application database tables (Source: author)

The database tables TABLE_POOLS and TABLE_ALTCOINS may store same data in different rows and according to the database normalization rules the author was supposed to create separate tables to avoid many to many relations (for example many mining pools allow to mine same altcoin and many altcoins can be mined on one mining pool). It will allow to avoid data duplication and suppose to reduce database size.

But considering the following facts, the author decided not to create additional tables:

1. Usually miners prefer to build one or two mining farms, one farm based on NVidia graphic cards and the second based on AMD graphic cards. Because of that most of the application's users will store one or two records and additional tables may take more memory than possible duplicated data itself.

2. More complicated database requests will take a bit more computing power, which leads to a bit faster battery drain.

Android offers to store application settings in to preferences. It seemed to be the better way to store settings data. The author has tried it, but unfortunately he has found that when he leaves the application by clicking on "back" button it worked well, and when he closes the application with "home" button and then kills the application, last settings changes were not saved. He did not find solution for that problem and decided to store settings data in database table.

2.7 Activities

Mining Helper application includes the following activities:

2.7.1 MainActivity

MainActivity is one of the most important classes of the application. It is the first activity the user sees when application is started. It is meant to show to the user mining farms data and to inform the user in case of workers malfunctions.

The general principles of work:

At activity starts, database connection will be established and all the data stored in "TABLE_POOLS" table will be added to corresponding ArrayLists. After that, in recursive method, for each mining pool record saved by the user, URL will be formed to make a data request from mining pool's API service. When requested data will be received a new object, an instance of the MyPoolsObj.class will be created and added to the object's list. When data for each mining pool record will be received and objects will be added to the object's list, the list will be passed to the MainListViewAdapter, which will create and display data tables for each mining farm. Each mining farm's data table is clickable. If the user will click on it WorkersListActivity will starts and corresponding record ID will be passed to it. In case of workers malfunction visual and sound notification will run.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

MainActivity menu consist the following items: Refresh, My altcoins, My mining pools, Settings.

Click on Refresh menu item will restart MainActivity.

Click on My altcoins menu item will start ShowAltcoinsActivity.

Click on My mining pools menu item will start ShowPoolsListActivity.

Click on Settings menu item will start SettingsActivity.

2.7.2 WorkersListActivity

WorkersListActivity starts when the user clicks on mining farm data table in MainActivity view. It is meant to show to the user mining farm's workers activities data and allow the user to open mining farm page on mining pool's web site to get more data.

The general principles of work:

When the user will click on mining farm data table in MainActivity view the record ID will be passed to WorkersListActivity. After that database connection will be established and data from corresponding record ID from "TABLE_POOLS" table will be added to corresponding ArrayLists. Then URL will be formed to make a data request from mining pool's API service and to form link to mining farm's page at mining pool's web site. When requested data will be received, a new object, an instance of the WorkerObj.class will be created and added to the object's list. When data for each mining farm workers will be received and objects will be added to the object's list, the list will be passed to the WorkerListViewAdapter, which will create and display data tables for each mining farm worker.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

2.7.3   ShowPoolsListActivity

ShowPoolsListActivity starts when the user clicks on corresponding menu item. It's meant to show to the user mining pool's data stored in database.

The general principles of work:

At activity starts, database connection will be established and all the data stored in „TABLE_POOLS" table will be added to corresponding ArrayLists. After that, in recursive method, for each mining pool record saved by the user, a new object, an instance of the SavedPoolsObj.class will be created and added to the object's list. And the list will be passed to the SavedPoolsListAdapter which will create and display data tables for each mining pool. Each mining pool's data table is clickable. If the user will click on it EditPoolActivity will starts and corresponding record ID will be passed to it.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

ShowPoolsListActivity menu consist the following items: ADD NEW, My altcoins, My mining farms, Settings.

Click on ADD NEW menu item will start AddPoolActivity.

Click on My altcoins menu item will start ShowAltcoinsActivity.

Click on My mining farms menu item will start MainActivity.

Click on Settings menu item will start SettingsActivity.

2.7.4 AddPoolActivity

AddPoolActivity starts when the user clicks on corresponding menu item. It is meant to allow the user to add new mining pool data for mining farm monitoring.

The general principles of work:

To add new mining pool, the user should choose mining pool and altcoin available for monitoring from corresponding dropdown lists, enter altcoin wallet or altcoin wallet and payment ID and enter number of workers to received notification in case of worker failure. If user will enter zero to worker's field, then the user will not receive notification in case of worker failure at that mining farm.

When all the data will be entered and "ADD MINING POOL" button pressed, database connection will be established and all the data stored in database, AddPoolActivity will be closed and ShowPoolsListActivity will start.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

2.7.5 EditPoolActivity

EditPoolActivity starts when the user clicks on mining pool's data table with corresponding record ID. It is meant to allow the user to edit or delete stored in database mining pool's data.

The general principles of work:

To edit mining pool data, the user may choose mining pool and / or altcoin available for monitoring from corresponding dropdown lists, edit altcoin wallet or altcoin wallet and payment ID or edit number of workers to received notification in case of worker failure. If user will edit to zero workers number in worker's field, then the user will not receive notification in case of worker failure at that mining farm.

When all the changes will be done and "UPDATE" button pressed, database connection will be established and the corresponding record in database will be updated.

If "DELETE" button will be pressed, database connection will be established and the corresponding record will be deleted from database.

After any of those button will be pressed EditPoolActivity will be closed and ShowPoolsListActivity will start.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

2.7.6 ShowAltcoinsActivity

ShowAltcoinsActivity starts when the user clicks on corresponding menu item. It's meant to show to the user cryptocurrencies, stored in database, prices.

At activity starts, database connection will be established and all the data stored in „ TABLE_ALTCOINS " table will be added to corresponding ArrayLists. After that, in recursive method, for each altcoin record saved by the user, URL will be formed to make a data request from coinmarketcap.com API service. When requested data will be received a new object, an instance of the AltcoinObj.class will be created and added to the object's list. When data for each altcoin record will be received and objects will be added to the object's list, the list will be passed to the AltcoinsListAdapter, which will create and display data tables for each altcoin. Each altcoin data table is clickable. If the user will click on it EditAltcoinsActivity will starts and corresponding record ID will be passed to it.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

ShowAltcoinsActivity menu consist the following items: ADD NEW, Refresh, My mining farms, My mining pools, Settings.

Click on ADD NEW menu item will start AddAltcoins activity.

Click on Refresh menu item will restart ShowAltcoinsActivity.

Click on My mining farms menu item will start MainActivity.

Click on My mining pools menu item will start ShowPoolsListActivity.

Click on Settings menu item will start SettingsActivity.

2.7.7 AddAltcoins

AddAltcoins activity starts when the user clicks on corresponding menu item. It's meant to allow the user to add new altcoins for cryptocurrency price monitoring.

The general principles of work:

To add new altcoin, the user should choose altcoin and currency available from corresponding dropdown lists and enter desirable altcoin's price. When all the data will be entered and "ADD

ALTCOIN" button pressed, database connection will be established and all the data stored in database, AddAltcoins activity will be closed and ShowAltcoinsActivity will start.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

2.7.8 EditAltcoinsActivity

EditAltcoinsActivity starts when the user clicks on altcoin data table with corresponding record ID in ShowAltcoinsActivity. It is meant to allow the user to edit or delete stored in database altcoin's data.

The general principles of work:

To edit altcoin data, the user may edit altcoin and / or currency available from corresponding dropdown lists and / or edit desirable altcoin's price.

When all the changes will be done and "UPDATE" button pressed, database connection will be established and the corresponding record in database will be updated.

If "DELETE" button will be pressed, database connection will be established and the corresponding record will be deleted from database.

After any of those button will be pressed EditAltcoinsActivity will be closed and ShowAltcoinsActivity will start.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

2.7.9 SettingsActivity

SettingsActivity starts when the user clicks on corresponding menu item. It is meant to allow the user to choose if he / she want to run automatic background monitoring for cryptocurrency mining farms or for altcoins price or both. The user can choose time intervals available in dropdown lists to control automatic background monitoring runs intervals, can select what he / she want to monitor and switch the background monitoring on and off.

The general principles of work:

To start automatic background monitoring, the user should choose how often he / she want to run background monitoring, check or uncheck what he / she want to monitor and switch the automatic background service on. When interval time or any checkbox states will be changed or switch state will be changed to off, automatic background service will be stopped, database

connection will be established and database record will be updated. If switch state will be changed to on, MyBackgroundService will be started, database connection will be established and database record will be updated.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

SettingsActivity menu consist the following items: My altcoins, My mining farms, My mining pools.

Click on My altcoins menu item will start ShowAltcoinsActivity.

Click on My mining farms menu item will start MainActivity.

Click on My mining pools menu item will start ShowPoolsListActivity.

2.8 Adapters

2.8.1 MainListViewAdapter

MainListViewAdapter is meant to receive mining farm's objects list, to retrieve the data of each object from it, and to place that data to the correct cell of the mining farm data table, in main activity view.

2.8.2 WorkerListViewAdapter

WorkerListViewAdapter is meant to receive worker's objects list, to retrieve the data of each object from it, and to place that data to the correct cell of the worker's data table, in workers list activity view.

2.8.3 SavedPoolsListAdapter

SavedPoolsListAdapter is meant to receive saved pool's objects list, to retrieve the data of each object from it, and to place that data to the correct cell of the saved pool's data table, in show pool list activity view.

2.8.4 AltcoinsListAdapter

AltcoinsListAdapter is meant to receive altcoin's objects list, to retrieve the data of each object from it, and to place that data to the correct cell of the saved pool's data table, in show altcoins activity view.

2.9 Baseclasses

2.9.1 MyPoolsObj

MyPoolsObj class is used to represent the mining farms. The following information is stored in the class:

- String name
- String hashrate
- String shares
- String activeWorkers
- String unpaidCoins
- String unpaidUSD
- String unpaidBTC
- String coinsPerDay
- String coinsPerMonth
- String usdPerDay
- String usdPerMonth
- String btcPerDay
- String btcPerMonth
- String coin
- Boolean alarm

2.9.2 WorkerObj

WorkerObj class is used to represent the workers. The following information is stored in the class:

- String worker
- String lastSeen
- String hashrate
- String shares

2.9.3 SavedPoolsObj

SavedPoolsObj class is used to represent the saved mining pools. The following information is stored in the class:

- String pool

- String coin
- String wallet
- String workersNum

2.9.4 AltcoinObj

AltcoinObj class is used to represent the altcoins. The following information is stored in the class:

- String altc
- String priceChanges
- String altcPrice

2.10 Receivers

2.10.1 BootBroadcastReceiver

BootBroadcastReceiver is a receiver that detects when the device is booted. On device boot the MyBackgroundService is called to stars automatic background monitoring.

2.10.2 MyAlarmReceiver

MyAlarmReceiver is a receiver that detects when MyBackgroundService class method are called and run them.

2.11 Service

MyBackgroundService an intent service. It is meant to run automatic background mining farm activity and cryptocurrency prices monitoring and to inform the user in case of workers malfunctions or if altcoins price reached desirable level.

The general principles of work:

At service starts with both monitoring options checked, database connection will be established and all the data stored in „TABLE_POOLS" table will be added to corresponding ArrayLists. After that, in recursive method, for each mining pool record saved by the user, URL will be formed to make a data request from mining pool's API service. When requested data will be received service will check if number of active workers of each mining farm is not equal to zero and equal to number of workers set by the user. If those numbers are not equal, then sound notification will run, led light of smartphone will flash and push notification will be created.

When mining farm's control will be done, database connection will be established again and all the data stored in „TABLE_ALTCOINS" table will be added to corresponding ArrayLists. After that, in recursive method, for each altcoin record saved by the user, URL will be formed to make a data request from coinmarketcap.com API service. When requested data will be received service will check if price of each altcoin reached desirable by the user price. And if reached, then sound notification will run, led light of smartphone will flash and push notification will be created.

During execution the user will be informed by popup notifications in case of errors or unexpected situations.

2.12 Application tests

Mining Helper application tests ware perform manually multiple times for each action. The application was tested on Android device emulator "Nox" on PC, on smartphone "Xiaomi Redmi note 2" and on tablet PC "VOYO Q101". Sometime the application worked well on one device and did not work on others devices with error messages. Multiple tests on several devices allowed to solve most of possible application's issues, but still there could be some unexpected issues which will be solved in future.

2.13 Approbation of the application

For the application approbation, the author asked 5 peoples (they are not miners) to use the application and to give him feedback about it. As approbation result following conclusion was made:

- In general, application is easy to use and the user can use it intuitively.
- "Back" buttons could be added to some of the application's views and / or views switching by screen swiping could be developed to make "Mining Helper" more user friendly.
- Some more user friendly popup messages could be created.

When those changes will be done, the author will create corresponding topic on cryptocurrency mining forum. By this topic, he will find group of people who will agree to use the application and to fulfil feedback form. After few days of the application use, they will fulfil detailed feedback form. The author will analyse it and will do some changes if necessary. And then he will ask them to test the application again.

2.14 Further development

Usually it's quite a long process to develop totally finished mobile application, especially for one developer and if it's his or her the first application. The Mining Helper was no exception and there could be some issues which will be solved in the future. Also new features will be added to the application to make Mining Helper as efficient and user-friendly as possible.

Nearest future plans of application development are:

1. To add new mining pools.
2. To add Multilanguage GUI.
3. To make some GUI changes to make it more user friendly.

CONCLUSION

The diploma thesis theme is "Development of a mobile application for monitoring mining farm activity and crypto assets for Android OS"

The aim of the diploma thesis was to develop convenient way to monitor multi pool cryptocurrency mining farm activity for mobile devices working on Android OS.

As a result of the thesis, an Android application called Mining Helper was developed. Mining Helper provides convenient way for cryptocurrency mining farm activity and cryptocurrencies prices changes monitoring. It's not only allow the user to get all the information he or she need to know in one mobile application, but allow the user to run automatic background monitoring with audio and visual notification in case of mining farm's workers failure or if altcoins price reached desirable level. It will allow the user to get maximum profit of his or her crypto currency mining farms without spending additional time on monitoring.

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RESÜMEE

Antud hetkel erinevad krüptorahad saavad populaarsemaks iga päevaga. Mõned inimesed ainult kuulsid midagi krüptorahadest, teised aga alustavad krüptoraha kaevandamist. Neid, kes asusid teisele teele ootavad mõned tehnilised probleemid. Näiteks, erinevate asjaolude tõttu võivad kaevandusarvutid töötada ebastabiilselt. Krüptorahade vahetamiskursid on samuti ebastabiilsed ja saavad oluliselt muutuda ööpäeva jooksul. See sunnib inimesi, kes tegelevad kaevandusega, regulaarselt kontrollima oma kaevandusarvutite aktiivsust ja sealhulgas kaevatavate krüptorahade hindu, et saada maksimaalset kasumit.

Antud töö pealkiri on "Mobiilse rakenduse arendamine kaevandusfarmi aktiivsuse ning krüptovarade jälgimiseks". Selle tööga lahendatud probleem seisnes selles, et turul ei olnud mugavat mobiilset rakendust, millega saaks korraga jälgida erinevaid krüptorahasid kaevavate arvutite aktiivsust ning samal ajal jälgida ka krüptorahade kursside muutusi. Töö peamine küsimus oli selles, kuidas koondada erinevaid krüptorahasid kaevavate arvutite aktiivsuse ja krüptorahade kursside muutuste andmeid ühte kasutajasõbralikku kasutajaliidesega mobiilsesse rakendusse.

Antud diplomitöö eesmärk oli töö küsimusele vastava mobiilse rakenduse arendamine Android OS platvormile. Valminud rakendus võimaldab kasutajal saada kogu töö probleemis nimetatud informatsiooni ühest kohast. Peale seda saab rakendus töötada taustarežiimis ja teavitada kasutajat, kui tekkib rike mõne kaevandusarvutiga või kui mõne krüptoraha hind jõuab kasutaja poolt määratud väärtuseni.

Diplomitöö tulemusena sai loodud mobiilne rakendus „Mining Helper", mis sisaldab kogu töö eesmärgis nimetatud funktsionaalsust, millega on diplomitöös püstitatud eesmärk täielikult saavutatud.

Tulevikus plaanib autor lisada rakendusse mitme keel toe, lisada suurema krüptoraha hulga toe, võimaldada lisada andmeid rohkematest andmeallikatest ning teha kasutajaliidese veel mugavamaks.

APPENICIES

Appendix 1. The source code

The source code can be downloaded by following link:

https://drive.google.com/open?id=1XxbfScX0WsapkNLyIYzSDp6imU6Gm03T

Appendix 2. Installation instructions

1. Download the MiningHelper.apk file from:
2. https://drive.google.com/open?id=19m5z2eJiN4xhqZ5WXUqx7RIREwI5qbo4
   Copy the apk file to your Android device.
3. Run file explorer on your device, find the file and run it.