TUSAGA-Aktif EXAMPLE WITH RELATED TO LOCATION BASED ACTIVITY INTELLIGENCE

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ABSTRACT:

146 TUSAGA-Aktif (Turkey National Permanent GNSS Network-Active) continuous GPS Stations and Control Centres have been established in Turkey, considering Turkish Republic of North Cyprus (TRNC). With TUSAGA-Aktif, in any place and time, at centimetre accuracy, map and geographical information can be obtained in seconds. TUSAGA-Aktif system is one of the world's largest Contionusly Observing Reference Stations (CORS) systems in terms of number of stations and covers the area.

Every single month more than 50 users are joining to use TUSAGA-Aktif system. Today the system has more than 8000 users who are working for Governmental Organization, General Directorate of Land Registry and Cadastre, Private Companies, Municipalities, Universities and Licensed Surveyors.

CORS systems like TUSAGA-Aktif are producing different type of data such as GPS observation data, user correction data, user connection log data and etc. These data gives much information to system manager not only to improve user services but also to determine cm level of location of things, tectonic movements and water vapour and user activities on the field.

This paper presents initial studying about user activities on the field as a part of Location Based Activity Intelligence (LBAI) and Location Based Activity Recognition (LBAR) by using user connection log data.

KEY WORDS: CORS Stations, GNSS Data, GNSS Data Processing and Analysing, User location, User Activities, Location Based Activity Recognition (LBAR), Location Based Activity Intelligence (LBAI), Location Based Financial Intelligence (LBFI)

1. INTRODUCTION

TUSAGA-Aktif system has been established in May 2010, with cooperation of Istanbul Kultur University (IKU) as executive, The General Directorate of Land Registry and Cadastre (TKGM) and General Command of Mapping (GCM) as joint customers. TUSAGA-Aktif system which is operated by TKGM and HGK collectively, is operated free of charge for test purposes until June 2011. TKGM is operated control center system management, user membership and financial side. GCM is operated institutional protocols and other related work side. After that date it has been operated for a fee that the prices is determined by Inter Ministries Mapping Coordination and Planning Committee (BHİKPK).

TUSAGA-Aktif system which has more than 8000 users, store all user connection logs in SQL database as a location history. User location history file contains Loginwithorganization, Latitude, Longtitude, Height, LogtimeUTC and sessionID parameters. These parameters are useful to recognition of user activities on the field.

1.1 Location Based Activity Intelligence (LBAI) or Location Based Activity Recognition (LBAR)

In recent years we see mostly mobile phone technologies used human activity recognition to assist humans (such as nurses, scientist and parents) in monitoring others and enabling computers that anticipate human needs, so called Activities Daily Livings-ADL [1]. Automatic monitoring of Activities of Daily Living (ADLs, such as eating, drinking, cleaning, and so on) is an important component for the implementation of advanced services in the fields of Ambient Assisted Living and Assisted Cognition. In assessing the level of self-sufficiency of patients, clinicians consider the capabilities of performing basic ADLs such as cooking and eating. The automatic recognition and tracking of these activities may allow for a more reliable and cheaper automatic reporting to clinicians or relatives. At the same time, it allows for the provision of advanced services that can contribute to older people's independent life: services like reminders help in activity execution, etc [2]. Activity recognition and context-aware computing are gaining increasing interest in the AI and ubiquitous computing communities [3].

Massive and passive data such as cell phone traces provide samples of the whereabouts and movements of individuals. These are a potential source of information for models of daily activities in a city. The main challenge is that phone traces have low spatial precision and are sparsely sampled in time, which requires a precise set of techniques for mining hidden valuable information they contain [4].

2. ACTIVITY RECOGNITION BY TUSAGA-AKTIF

2.1 Data Preparation

TUSAGA-Aktif system user location history file contains Loginwithorganization, Latitude, Longtitude, Height, LogtimeUTC and sessionID parameters. This information sends to control centre by rover in NEMA format to get correction parameters to determination position cm level of the rover. Every rover appropriate NEMA coordinates recorded in SQL database in sequentially. Certain user information to be investigated can be separated from SQL database to individual file by certain date or year. Recorded data should be ordered by time and date to do activity analysing. A sample file looks like following table.

LoginWithO	Latitude	Longitude	Height	LogTimeUTC	SessionID
KECIOREN Kad Md/K01066803	39,972094833	32,875120517	939,542000000	14.05.2015 07:17	386866
KECIOREN Kad Md/K01066803	39,972088600	32,875126183	942,033000000	14.05.2015 07:17	386866
KECIOREN Kad Md/K01066803	39,972092650	32,875120367	940,739000000	14.05.2015 07:18	386866
KECIOREN Kad Md/K01066803	39,972094950	32,875116167	939,764000000	14.05.2015 07:18	386866
KECIOREN Kad Md/K01066803	39,972080850	32,875151517	938,951000000	14.05.2015 07:19	386866
KECIOREN Kad Md/K01066803	39,972111150	32,875134950	936,249000000	14.05.2015 07:19	386866
KECIOREN Kad Md/K01066803	39,972113467	32,875110400	936,437000000	14.05.2015 07:20	386866
KECIOREN Kad Md/K01066803	39,972113550	32,875110667	936,485000000	14.05.2015 07:20	386866
KECIOREN Kad Md/K01066803	39,972062750	32,874977200	937,134000000	14.05.2015 07:21	386866
KECIOREN Kad Md/K01066803	39,972029850	32,874898400	937,313000000	14.05.2015 07:21	386866
KECIOREN Kad Md/K01066803	39,972029433	32,874898700	937,377000000	14.05.2015 07:22	386866
KECIOREN Kad Md/K01066803	39,972028900	32,874898833	937,388000000	14.05.2015 07:23	386866
KECIOREN Kad Md/K01066803	39,972028067	32,874893900	937,395000000	14.05.2015 07:23	386866
KECIOREN Kad Md/K01066803	40,017157633	32,855088833	1103,077000000	14.05.2015 08:12	388371
KECIOREN Kad Md/K01066803	40,017155783	32,855104100	1107,258000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017156217	32,855099150	1106,653000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017155217	32,855098583	1106,885000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017155450	32,855097817	1106,959000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017154717	32,855096167	1107,106000000	14.05.2015 08:14	388406
KECIOREN Kad Md/K01066803	40,017157267	32,855095917	1107,821000000	14.05.2015 08:14	388406
KECIOREN Kad Md/K01066803	40,017157283	32,855097167	1107,601000000	14.05.2015 08:15	388406
KECIOREN Kad Md/K01066803	40,017156533	32,855097700	1107,242000000	14.05.2015 08:15	388406
KECIOREN Kad Md/K01066803	40,017157617	32,855100567	1107,052000000	14.05.2015 08:16	388406
KECIOREN Kad Md/K01066803	40,017156967	32,855095233	1107,565000000	14.05.2015 08:16	388406
KECIOREN Kad Md/K01066803	40,017157700	32,855095683	1107,558000000	14.05.2015 08:17	388406
KECIOREN Kad Md/K01066803	40,017055750	32,855368117	1111,050000000	14.05.2015 08:18	388406
KECIOREN Kad Md/K01066803	40,017024883	32,855456700	1111,901000000	14.05.2015 08:19	388406
KECIOREN Kad Md/K01066803	40,017021733	32,855454967	1111,917000000	14.05.2015 08:19	388406
KECIOREN Kad Md/K01066803	40,017023417	32,855458883	1111,834000000	14.05.2015 08:20	388406

Table- 1. User log data structure

2.2 Used Method

There are many searches about activity intelligence as literatures which are referenced for our application.

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In recent decades, activity-based analysis using GPS equipment as data collector has being a hot issue. Most this kind of researches focus on data from wearable GPS recorder for person because of easy detailed activity logging and interactive validation with users [5]. Euclidean distance between consecutive measurements is proportional with the speed of movement. During stationary periods, the distance values stay relatively small (< 5). The slow and fast walking periods show a distinct difference from the stationary period. The driving traces show the most rapid changes in the radio environment, greater than either walking or stationary. Fast walking and slow driving sometimes overlap in their range of Euclidean distance values, which may result in false recognition between the two states. For a given speed, the Euclidean distance values are not constant because changes in signal strengths are both a function of speed as well as the physical environment, such as buildings, people, or vehicles. Based on these findings we extracted a set of seven different features to use in classifying a set of GSM measurements as either stationary, walking, or driving [6].

GPS (global positioning system) location data is used to recognize the high-level activities in which a person is engaged and to determine the relationship between activities and locations that are important to the user. Everyday activities such as “working,” “visiting,” “travel,” and to recognize and label

significant locations that are associated with one or more activity, such as “work place,” “friend’s house,” “user’s bus stop.” Such activity logs can be used, for instance, for automated diaries or long-term health monitoring can be segmented [7].

Automatic recognition of human activities can support many applications, from context aware computing to just-in-time information systems to assistive technology for the disabled. Knowledge of a person’s location provides important context information for inferring a person’s high-level activities. This dissertation describes the application of machine learning and probabilistic reasoning techniques to recognizing daily activities from location data collected by GPS sensors [8].

An average walking speed is somewhere around 3 miles per hour, but fast walkers and power walkers can often walk at speeds at or above 5 miles per hour. The speed at which you feel more comfortable running than walking is known as your "break point," and a typical break point would be somewhere between 4 and 5 miles per hour. For most people, a running stride allows a higher overall maximum speed than a walking stride [9]. An interesting example can be found in cell phone and web based application for different purposes [10].

In our work we choose Ankara Provinces users log data. We grouped users in different sectors and calculate Euclidean distance between consecutive measurements is proportional with the speed of movement. We grouped user activity in seven categories. We also include measurement season of day and season of year and some visual anomaly detection such as illegal activity.

Activity	**Velocity**
Stationary	V <= 0,03m/sn
Slow walking	V <= 1,1 m/sn
Fast walking	V <= 2,2 m/sn
Running	V <= 4,5 m/sn
Slow driving	V <= 7 m/sn
Medium driving	V <= 20 m/sn
Fast driving	V >= 21 m/sn

Season of Day	**Season of Year**
Morning	Spring
Noon	Summer
Evening	Autumn
Night	Winter

Table- 2. User activity group

2.3 Visual Checking

In Ankara Provinces user measurements (of course logging data) merged QGIS software sector by sector. In fact SQL database designed according to user identification which can be easily separated in their sectors. We have five sector categories. These are Private Sector, Government Organization, Licensed Surveyors, Universities and Land Registry and Cadastre Organization (GDLRC).

We calculated distance and time differences between user points in the same day and same session ID to identify user activities. As an example a licensed surveyor and local cadastral officers should be work his responsibility area.

And also user measurements have been overlaid digital orthophoto WMS services. And visual checking has been implemented by analyzing; distribution of measured points, distances and time differences between points in the same day and same session ID. On the other side heat map used to understand their regional activities.

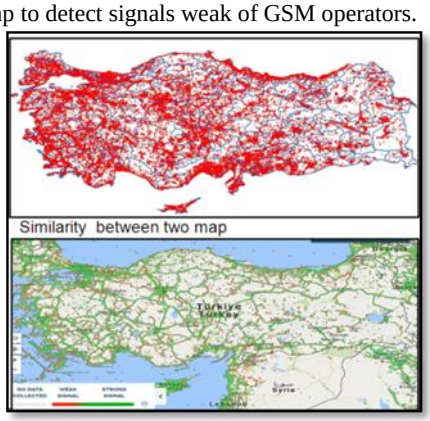
Local cadastral offices managers, licensed surveyors owners, owner of private companies and other managers have a right to check their GNNS activity log data last one month and last 50 session by using TUSAGA-Aktif web platform.

2.4 Calculation and Mapping

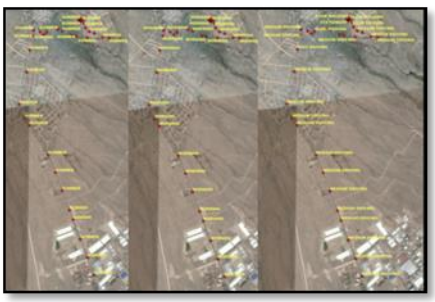
User activity can be questioned by written query from database for daily requeriments. By getting coordinates, date, time and session id of user measurement some activity can be calculated and mapped. Such as;

- User activity map
- Individual user or user sector heat map
- Distance and veloncity between consecutive measurements
- User activity within the day groupped by sension ID
- User activity season of day groupped by time
- User activity season of year groupped by date

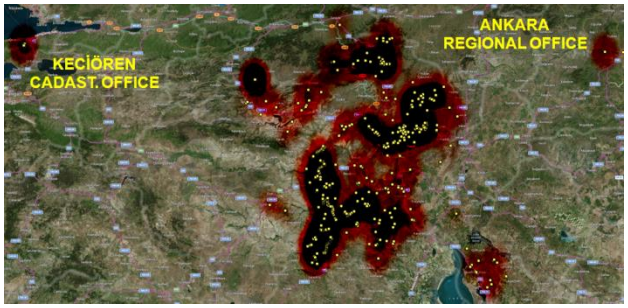
Users measurements can be are mapped and compared GSM signal map to detect signals weak of GSM operators.



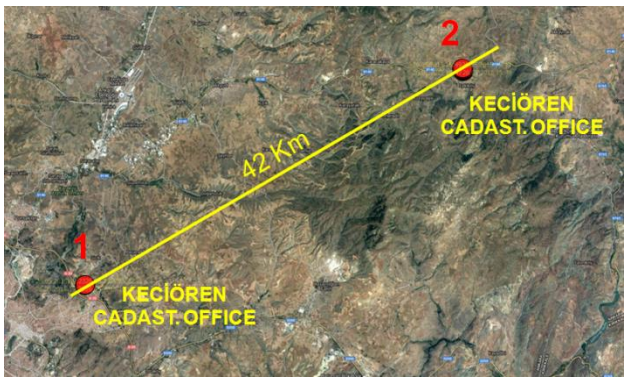
According to user adjacent location history; User activity or behaviour can be detected easily like stationary, slow walking, fast walking, running, driving,etc.



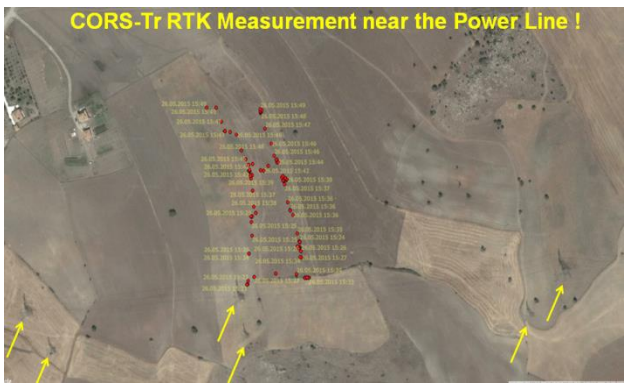
Local authorities and private company’s owner can investigate their GNSS activities (measurements last one month or last 50 sessions) which can be mapped by using Trimble Pivot Platform since 2016



Two diffrent GNSS users within the same organization try to use/share usage rights by using same user name and password at the same time



Following picture shows CORS-Tr RTK Measurement near the Power Line.



Licensed surveyor activities out of their responsibility area.

3. RESULTS

As a results of TUSAGA-Aktif user activities;

- CORS-Tr User activity map shows,GSM Operator's coverage and performance.
- User activity on the field can be formulated by their consecutive measurements.
- GNSS Owner or Users are sharing their user name and password.
- İllegal activity out of the certain activity area can be detected easily.
- GNSS Owner and User should have Privacy Policy
- Authorities should investigate their user activities

Consequently, to prevent illegal usage of GNSS, we restricted local cadastral offices usage rights by their responsibility boundaries. On another hand, terminal ID, SIMCard No, User and password authentication is included because of some security reasons. Also universities and educational institutions usage rights are restricted by their campus boundaries.

REFERENCES

[1] Danny Wyatt,Matthai Philipose and Tanzeem Choudhury (2005) Unsupervised Activity Recognition Using Aoutomatically Mined Common Sense

[2] C.Nicolini, B.Lepri, S.Teso, A.Passerini, From on-going to complete activity recognition exploiting related activities

[3] L.Liao, D.Fox, H.Kautz, Location-Based Activity Recognition using Relational Markov Networks

[4] P.Widhalm,Y.Yang, M.Ulm,S.Athavale,M.C.Gonzalez, Discovering urban activity patterns in cell phone data

[5] L.Huang, Q.Li, B. Li, Automatic activity identifaction from raw GPS vehicle tracking data

[6] T.Sohn, A.Varshavsky, A.LaMarca, M.Y. Chen,T.Choudhury, I.Smith, S.Consolvo, J.Hightower,W.G. Griswold,E.de Lara, Mobility Detection Using Everyday GSM Traces

[7] Lin Liao, Dieter Fox, and Henry Kautz, Location-based Activity Recognition

[8] Lin Liao, Location-Based Activity Recognition

[9] url: http://www.livestrong.com/article/364340-what-is-the-difference-between-walking-running-strides/

[10]http://labs.strava.com/heatmap/#5/11.51367/45.61404/blue/both