Extended Meteor Hunting With Smartphones as Surveillance Cameras

Vizi, P. G.[1] , Berczi, Sz.[2], Csizmadia, Sz.[3] Hegedus, T.[4]; [1]MTA Wigner RCP H-1121 BUDAPEST, Konkoly Th. 29-33. vizi.pal.gabor@wigner.mta.hu; [2]Eötvös University, Institute of Physics, H-1117 Budapest, Pázmány Péter sétány 1/a., Hungary; [3]Vega Astronomical Society H-8900 Zalaegerszeg, Berzsenyi u. 8., Hungary; [4]Baja Astronomical Observatory, 6500 H-Baja, Szegedi út, Kt. 766, Hungary

Introduction: We describe a new and very cost effective method which became available nowadays for fireball and meteor hunting by deploying smartphones or tablets - using the spare time of them or with reusing old phones - to extend and expand the possibilities to collect more fireball and meteor tracking data and to position falling.

Preliminaries: Authors described in their previous works some methods and examples of successful meteor hunting by gaining information from accidental random fireball records of surveillance or ski resort cameras and gave some methods about estimating the components of medium sized meteors which don't give discoverable amount of fallen pieces. [1][2][3]

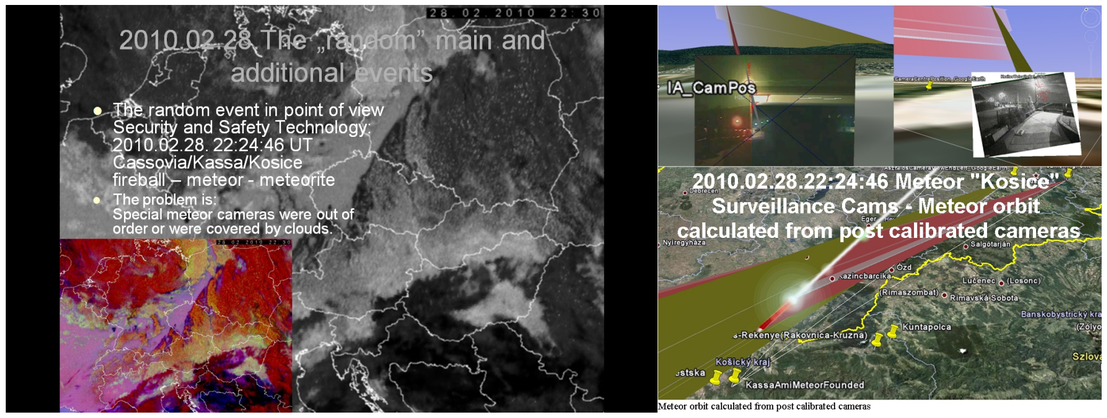

Figure 1 2010.02.28. 22:24:46 Meteor "Kosice" [1][2]

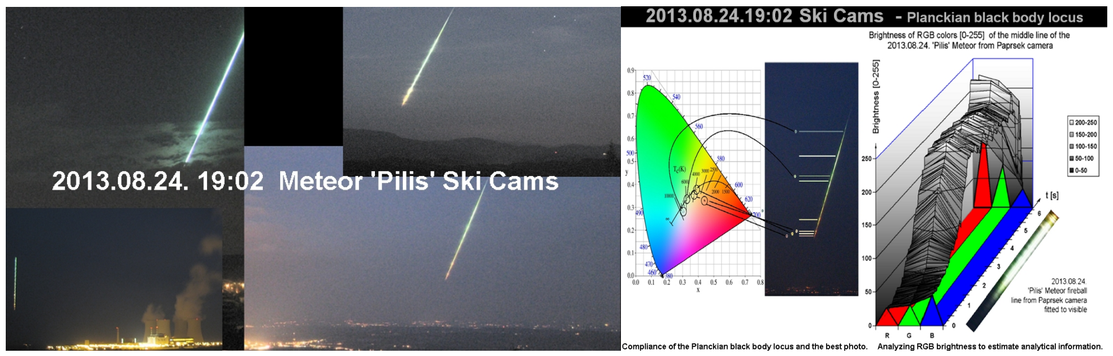

Figure 2 The medium sized Meteor 'Pilis' event [3]

Technical background: *Past:* Sophisticated and well designed and coordinated meteor cameras can cover the sky above a country or a region and can give precise orbit, trajectory and time data with meteor tracking programs. Those systems are well calibrated. The sum of the covered field is relatively small on the sky above globally.

In the past decades computers and connected cameras gave us potential possibilities to collect fireball and meteor data. But the process was relatively complicated and only enthusiasts could spend money and working time to build a system.

Nowadays: The level of evolution of technology achieved nowadays gives us cheap smart phones and tablets. Large online network can be created by spare time of smartphones' while charging at night with downloadable free 'online cloud data' surveillance programs. Older unused smartphones can be a part of the network also. Cameras of smartphones with surveillance software can record and share immediately the fireball events. Smartphone operating systems guarantee the correct timing, global positioning by GPS, also direction and orientation of the picture by built in acceleration sensors. All data are recorded and transmitted immediately to a commonly reachable server.

Calibration and error estimation: Error estimation and corrections can be calculated immediately after connection to the network. However it is recommended to improve the position data after a significant event

Legal usage: Surveillance systems and programs have been written intentionally to prevent against thieves, burglars and robbers. It is the task for users to choose a correct view direction which can serve both the classical surveillance and meteor hunting functions together and according to the local valid laws. A necessary bad cause – efforts against crime – can additionally serve the science; it gives an extra meteor hunting function.

Safety: It is possible to use safely smartphones as shared cameras by turning off the personal data transmission but all necessary data can be shared at the same time for example. GPS position, camera direction etc. as described above.

Login methods and programs: We use Android phones and all of them can handle more accounts. We suggest to create account login names from locations (GPS), azimuth and altitude degrees. Example: name first: Meteor, last: Hunter, e-mail from the GPS in decimal mh4748179512045@gmail.com which means 47.48 North (4 digits), 17.95 East (4 digits), azimuth 120° (3 digits, 0-360), altitude 45° (2 digits 0-90). We use the Alfred surveillance program on Android phones, which sends an automatic 5 sec long video to a server from a sky event. We organize and coordinate contributors sending an e-mail to authors. See Figure 5

Automatic calculations: It is possible to compute the orbits of fireballs from shared smartphone pictures by using EXIF info and with 3D scanner programs. EXIF info contains all necessary picture data like GPS position, angle of view of camera, resolution, etc. Automatic preliminary orbit analysis goes on its way.

Improving: After the startup period experts or enthusiasts can write and develop they own improved open system programs for Android, Windows Phone or iPhone platform.

Examples: As we described in our previous works several analysis were made successfully after surveillance function camera observations. We analyzed fallen pieces of Meteor Cosice [1][2] and we estimated the composition of the medium sized 'Pilis' event from brightness of RGB colors using the Planckian black body locus diagram. [3].

We collected and processed some recent events to achieve the available results. We tried to synchronize videos of the same events using timing of the most reliable time data and the brightness of the fireball through the frames of the video. Results are collected into a multi window video where main flash frames are the synchronous events of the serial of frames.

Smartphones give similar good quality pictures as visible in examples described above and we can expect higher resolution in the future.

Figure 3 2015:03:15 19:44:06 Event 'Switzerland' [4]

Figure 4 2015.04.06. 17:30:53 Event 'Buk' [5]

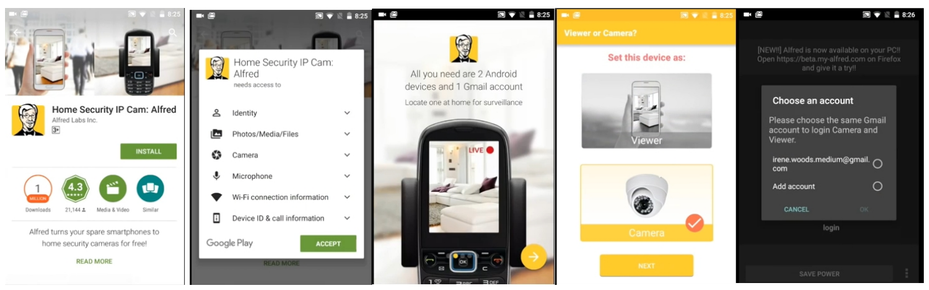

Figure 5 Alfred – the Android Surveillance system

Summary: Usage of smartphones and tablets can enhance the covering of fireball and meteor events and improve the availability of data immediately. However the calibrated meteor finder camera network can give more accurate data but it is better than nothing and expands the covering of events. Quick share of digital data can enlarge the possibility to collect more contemporary meteorites for study or analyze records of fireballs to determine their components. The network can increase easily and relatively at very low cost.

References:

[1] Vizi et al. (2012) LPSC 43rd Abstract #2816
[2] Vizi et al. 35th NIPR Symposium on Antarctic Meteorites Paper E31.
[3] Vizi et al. (2014) LPSC 45th Poster #2838
[4] 2015:03:15 19:44:06 Event 'Switzerland' https://youtu.be/DC3yfx6Pq-Q
[5] 2015.04.06. 17:30:53 Event 'Buk https://youtu.be/GUA0Z7FJIZU