Preliminary Results: Lunar Impact Flash Observations

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The project is split into three main parts, the observation and collection of video, the use of detection software to detect flashes in the video, then the analysis of the images of flashes obtained to find out if they are cosmic rays or lunar impact flashes and to produce a light curve of any impact flashes found.

Observational Work:

Both members of the group have been trained on the two telescopes (both the Meade and Celestron telescopes) available for the lunar impact flash observations. After starting the project, various amateur astronomers were contacted in the hope that they could provide observations and perhaps do simultaneous observations with other astronomers of similar latitudes. A group of 10 different amateur astronomers was made, from various places in the UK and mainland Europe, with the observations being held in Italy, Germany and Switzerland. A member of the group of amateur astronomers, Antonio Mercatali recently detected flashes from observations done earlier this year, in Italy, seen below:

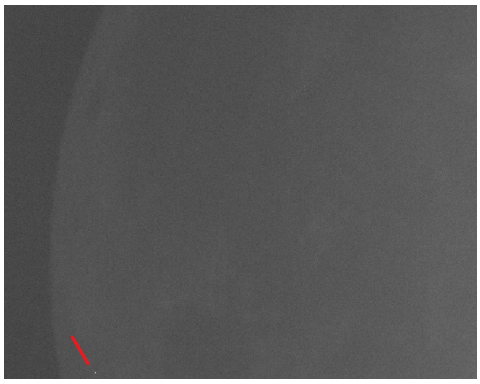

Figure 1 – An image taken by Antonio Mercatali with a C8 Celestron at f/3.3 telescope and an astronomical ASI 120MM video camera.

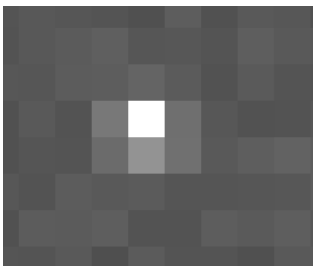

Figure 2 – A zoomed in section of the flash in figure 1, detected on the 26/01/15 at 19:52:17 UTC.

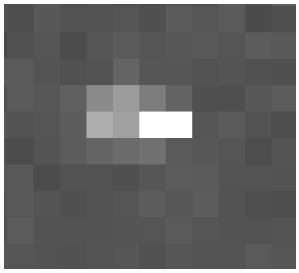

Figure 3 – Zoomed in section of the flash in the northern lunar hemisphere near the limb, this was also detected by Antonio Mercatali, on the 26/01/15 at 20:00:17 UTC.

The video clips containing these images will soon be obtained and analysed, though at first glance, figure 2 is most likely a comic ray, due to its point-like nature. As far as observations in Aberystwyth, the group first started with a series of short observations using the filter wheel on the Meade telescope. This was done initially to find out which filter would be best to work with. However, even though filters, such as the infrared filters have their advantages (in the case of the infrared filter, the heat of the impact could be measured), due to the fact that observations were alongside the amateur astronomer group, it was decided to forgo the use of any filter to keep consistency across results with other observers.

Since the start of the project, attempts to observe have been made of a total of 47 nights so far, since August, which had the desired Moon phase (between New Moon and First Quarter and between Last Quarter and New Moon). However due to the weather, faults in equipment and periods without access to the internet at the appropriate speed there has been no successful viewing of flashes as of yet. Observations were also attempted on 10 nights after First Quarter and Full Moon, however, even though these nights were clear, there was too much haze around the Moon to detect plumes and many of clear nights are accompanied with wind greater than 25 mph, so it would have be unwise to use the equipment. To compensate for the lack of results, the focus on the project so far has been processing archived video.

Detecting flashes in archived video and the use of detection software:

To detect impact flashes the video needs to be fed through detection software as images. The project has two different programs readily available, one created by Dr. Tony Cook, and LunarScan. The former has been primarily used so far. Approximately 13.5 hours of archived video has been processed so far. Out of the images proceed 10 flashes were found, 3 of which have been looked at in detail and are believed to be lunar impact flashes. An example of one of these is in figure 4.

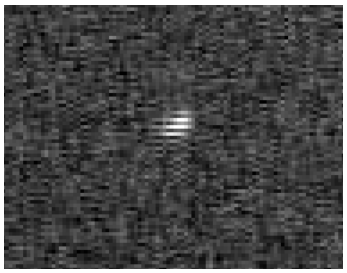

Figure 4 – Zoomed in section of the flash found by Dr. Tony Cook on the 19/10/01 at 00:18:58 UTC

Project Direction and Future Observations:

Although the weather has been less than ideal to make observations the project will proceed unheeded by taking various steps to accommodate for the weather. Firstly, any further findings from the group of amateur astronomers working with the project will be processed, as well as processing more archived video. This includes video from America, which has multiple simultaneous observations. Secondly, the detection software will be looked at in more detail, comparing results when feeding images through the available software from university (devolped by Dr. Tony Cook) to that of the freeware, LunarScan. Also, preparations are underway to create another program to the compare the former two, seen in Figure 5.

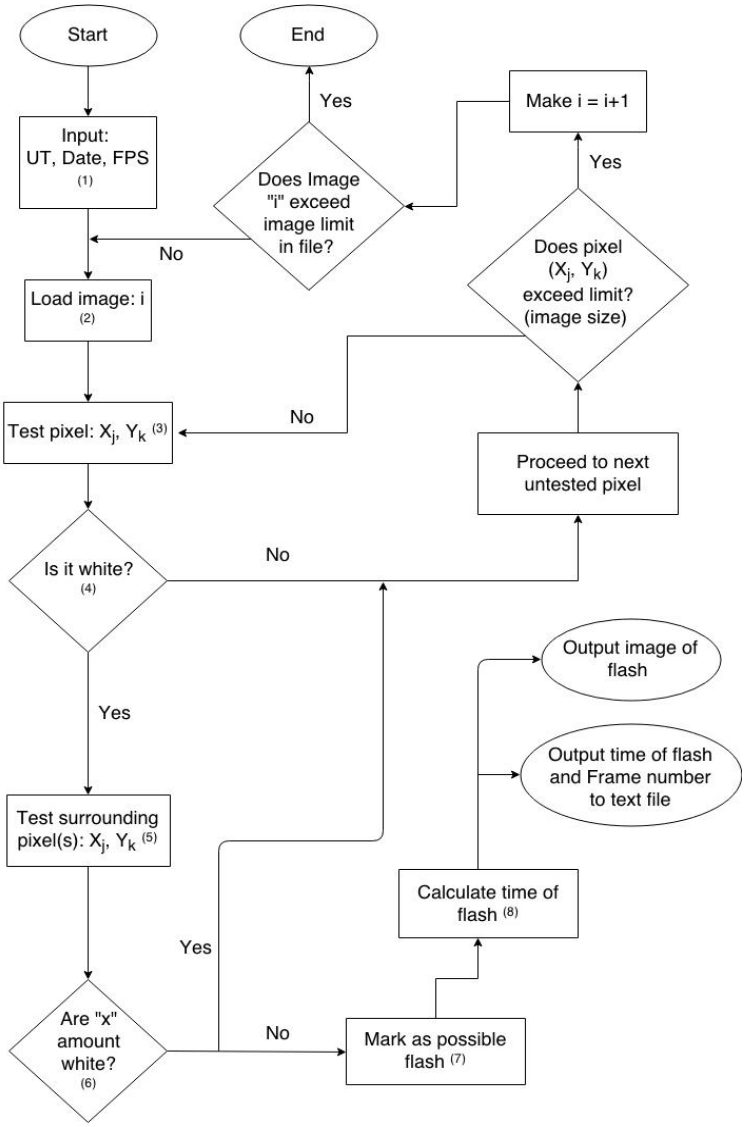

Figure 5 – A flow diagram of the stages of a program in development to detect impact flashes

Figure 5 shows a flow diagram of a proposed program to detect impact flashes, which will output the time of the impact flash as well as the image. Numbered sections on the flow diagram are explained more below:

1) Images will also be loaded, but these other factors need to be loaded in manually.
2) "i" will be set to the first image in the file.
3) X_j, Y_k, represent the coordinate points of the pixel, first will be 1, 1.
4) "White" will be a factor that can be adjusted to a value between 0 and 225. (E.g White$\geq$215)
5) Again another variable factor (can be set to test multiple surrounding pixels).
6) "x" value is also variable imputed into the code.
7) A square may be put around the impact area to make it easier to locate on the flash.
8) Time = Frame number/FPS + Start time

As well as improving and creating detection software, archived data will be used to produce light and Gaussian curves of lunar impact flashes found and simultaneous images will be used to compare flashes from different viewpoints.

Also, to compensate for the bad weather in Aberystwyth, observations will be made in the West Midlands over the next few months with a Celestron Astromaster 130mm EQ, with a ZWO ASI120MM Monochrome Astronomy Camera.