Annexure – 1

Cover Page of the Proposal

Title of the Proposal -
Research the evolution, age of Lunar South Craters and anticipate appropriate landing sites for future human exploration.

Name and Designation of PI -

Prof. Dr. Jayashree Khanapuri

Head of Department Electronics and Telecommunication.

Telephone, Fax and E-mail Address - jayashreek@somaiya.edu

Name of Institution with full Address -

Name - K. J. Somaiya Institute of Engineering and Information Technology

Address - Somaiya Ayurvihar Complex Eastern Express Highway Near Everard Nagar, Sion East, Mumbai, Maharashtra 400022.

Signature of PI with Date

Signature of Head of Institution

Announcement of Opportunity (AO) proposal Submitted to Science Programme

Office, ISRO HQ on

ISRO Proposal Format

1. Application Institution

- **K.J. Somaiya Institute of Engineering and Information Technology**

2. Title of the Research Proposal
   - **Research the evolution, age of Lunar South Craters and anticipate appropriate landing sites for future human exploration.**

3. Name of the Principal Investigator:
   - **Prof. Dr. Jayashree V. Khanapuri**

4. Names of other investigators with the names of their Institution
   - **Sahu Aklant**
     K.J. Somaiya Institute of Engineering and Information Technology
   - **Kadlag Omkar Abasaheb**
     K.J. Somaiya Institute of Engineering and Information Technology
   - **Aryaveer Krishna**
     K.J. Somaiya Institute of Engineering and Information Technology
   - **Barude Yogesh Revan**
     K.J. Somaiya Institute of Engineering and Information Technology
   - **Gangapurwala Pratik Prashant**
     K.J. Somaiya Institute of Engineering and Information Technology
   - **Paradkar Rohit Santosh**
     K.J. Somaiya Institute of Engineering and Information Technology

5. Proposed duration of Research Project
   - **2 Years**
6. Amount of grant requested (in Rs.)

1st Year	**2nd Year**	**Total**

Staff
Equipment and Supplies
Others
Total

7. a) Bio-data of all the Investigators (Format-A).
   b) Brief description of the Research Proposal with details of budget (Format-B).
   c) Declaration (Format-C).

8. I/We have carefully read the terms and conditions for ISRO Research Grants and agree to abide by them. It is certified that if the research proposal is approved for financial support by ISRO, all basic facilities including administrative support available at our Institution and needed to execute the project will be extended to the Principal Investigator and other Investigators.

Name Institution Designation

Principal Investigator
Co-Investigator(s)
Head of the Department/Area
Head of the Institution

1.

Format A

Bio-data of the Investigator(s)*

1. Name
2. Date of Birth (dd/mm/yyyy)
3. Designation
4. Degrees conferred (begin with Bachelor's degree)

Degree	Institution conferring the degree	Field(s)	Year

5. Research/training experience (in chronological order)

Duration	Institution	Name of work done

6. Major scientific fields of Interest
7. List of publications
8. Email id and Telephone number of PI
9. Email id of the Head of the academic institution

* Bio-data for all the investigators should be given, each on a separate sheet.

Format B

Proposal Preparation Format

1. *Title of the research proposal*

- ❖ **Research the evolution and age of Lunar South Craters and anticipate appropriate landing sites for future human exploration.**

2. *Summary of the proposed research*

KJSIEIT has made it a point to focus on the complete development of its students. As a result, the students work hard to emphasize the significance of "research" activities and its role in the overall growth of a country. The college Students', its Management share an amicable goal. The long-term goal of prominent organizations around the world has been lunar exploration. Apollo, Copernicus, and Chandrayaan were amazing missions that allowed human civilization to gain a brief understanding of lunar geology, morphology, and its sciences. Long-term exploration demands the use of water. To commemorate India's Chandrayaan mission's discovery of water on the lunar South Pole, the main goal of our proposal is to "**Research the evolution and age of lunar south craters and anticipate appropriate landing sites for future human exploration**". Using SAR and IIRS data, we will use machine learning algorithms to forecast age and use MIDAS/ PDS4 to detect water locations. Water has been discovered on both older and younger craters in the Atkin basin. As a result, determining one's age is critical when looking for water. We can discover relevant flats on its surface using several open-source python packages. Using OHRC data, we can even rule out the potential of boulders and land future rovers on the lunar surface automatically. This will increase the chances of successful research efforts, open doors to new opportunities, and give credence to the country.

3. *Objectives*

A brief definition of the objectives and their scientific, technical and techno-economic importance

4. *Major scientific fields of interest*

A brief history and basis for the proposal and a demonstration of the need for such an investigation preferably with reference to the possible application of the results to ISRO's activities. A reference should also be made to the latest work being carried out in the field and the present state-of-art of the subject.

5. *Literature Survey*

[1] In this paper in detail System of the Lunar Crater is studied. It gives a review of how craters were formed and their morphology and composition are discussed.

[2] In this paper, the Age chronological standards for the inner lunar system are discussed in the paper mainly focuses on the age estimation of the Martian and Lunar surface. Some age estimations of the lunar crater and their related ejecta were plotted against the crater densities. And different age systems such as pre nectarian, nectarian, lower imbrian, upper imbrian, Copernican, and Eratosthenian systems are dicussed in detail.

[3]In this paper, morphological and topographical observations are carried out. For morphological observations, Spectroscopic data from the ISRO's Chandrayaan-1 hyperspectral imaging sensor, Moon Mineralogy Mapper (M3) has been used. For mineralogy of crater and topographical analysis data mainly from Lunar Reconnaissance Orbiter Camera (LROC) missions, Wide Angle Camera (WAC), Narrow-Angle Camera (NAC), and Lunar Orbiter Laser Altimeter (LOLA) was used. High-resolution Digital Elevation Model was utilized for analyzing the topography of the crater. Kriging interpolation was used for generating a 3D surface. The crater shows mineral diversity as analyzed utilizing M3 data. Minerals were identified on the basis of their distinct spectral signatures in the visible to near-infrared (VNIR) region. The presence of Fe2+ Ca2+ and Mg2+ in the structure of common rock-forming lunar minerals produces these spectral absorption features that are indicative of their presence.

[4] In this paper Mini-SAR (Synthetic Aperture Radar) payload on Chandrayaan 1 is discussed. This payload gave signs of water on lunar surface. The attribute used for this detection was known as CPR (circular polarization ratio), but is observed that

only CPR is not sufficient to characterize the lunar surface. So, a statistical study of Mini-SAR images is required to determine best fit density function for pixel distribution.

[5]Shackleton crater is likely formed by a ~1.5 km diameter chondrite-like impactor, impacting with a vertical velocity of ~15 km/s. A minimum impact melt volume of ~20 km3 is likely to have been produced at a 90◦ impact angle (decreasing to ~13 km3 at 45◦ using scaling laws) with distribution concentrated solely in the crater floor, directly beneath the point of impact

[6]It proposed an extraction algorithm from a DEM based on impact crater shape characteristics. The experimental results implied that the proposed extraction algorithm precisely extracts lunar impact craters.

[7] Impact craters, which can be considered the lunar equivalent of fossils, are the most dominant lunar surface features and record the history of the Solar System. In this paper problems of automatic crater detection and age estimation have been addressed. From initially small numbers of recognized craters and dated craters, i.e., 7895 and 1411, respectively, we progressively identify new craters and estimate their ages with Chang'E data and stratigraphic information by transfer learning using deep neural networks. This results in the identification of 109,956 new craters, which is more than a dozen times greater than the initial number of recognized craters. The formation systems of 18,996 newly detected craters larger than 8 km are estimated. Here, a

new lunar crater database for the mid-and low-latitude regions of the Moon is derived and distributed to the planetary community together with the related data analysis.

[8] A new model has been developed to estimate dielec tric constant ( ) of the lunar surface using Synthetic Aperture Radar (SAR) data. Continuous investigation on the dielectric constant of the lunar surface is a high priority task due to future lunar mission's goals and possible exploration of human outposts. For this purpose, derived anisotropy and backscattering coeffi cients of SAR images are used. The SAR images are obtained from Miniature Radio Frequency (MiniRF) radar onboard Lunar Reconnaissance Orbiter (LRO). These images are available in the form of Stokes parameters, which are used to derive the co herency matrix. Derived coherency matrix is further represented in terms of particle anisotropy. This coherency matrix's elements compared with Cloud's coherency matrix, which results in the new relationship between particle anisotropy and coherency matrix elements (backscattering coefficients). Following this, estimated anisotropy is used to determine the dielectric constant. Our model estimates the dielectric constant of the lunar surface without parallax error. The produce results are also comparable with the earlier estimate. As an advantageous, our method estimates the dielectric constant without any prior information about the density or composition of lunar surface materials. The proposed approach can also be useful for determining the dielectric properties of Mars and other celestial bodies.

[9] Slope maps reveal that the rim of Shackleton has average slopes <15°; however, the majority of EVA targets occur on the flanks of the ejecta blanket where slopes exceed 15° Therefore, a rover would be a valuable asset to the Artemis missions.

[10] [11] In this paper, the data from Imaging Infrared Spectrometer was used and by using the methods such as data reduction, lunar surface temperature estimation using per-pixel method, thermal emission correction, empirical line correction, OH and H2O Absorptions were observed in IIRS spectra. Further Quantification of OH and H2o was done. This paper has properly provided important inputs on the hydration feature of the Moon and this will help in a proper understanding of lunar geology.

6. *Approach*

A clear description of the concepts to be used in the investigation should be given. Details of the method and procedures for carrying out the investigation with necessary instrumentation and expected time schedules should be included. All supporting studies necessary for the investigation should be identified. Necessary information of any collaborative arrangement, if existing with other investigators for such studies, should be furnished. The Principal Investigator is expected to have worked out his collaborative arrangement himself. For the development of balloon, rocket and satellite-borne payloads it will be necessary to provide relevant details of their design. ISRO should also be informed whether the Institution has adequate facilities for such payload development or will be dependent on ISRO or some other Institution for this purpose.

7. *Data reduction and analysis*

A brief description of the data reduction and analysis plan should be included. If any assistance is required to form ISRO for data reduction purposes, it should be indicated clearly.

8. *Available Institutional facilities*

Computers with LINUX and Windows Compatible systems.

9. *Fund Requirement*

Detailed year-wise break-up for the Project budget should be given as follows

9.1 Equipment & Supplies

1st Year	**2nd Year**	**Total**
1,30,000/- **(for PC with following Specifications: Core i5 (8600K) (16 GB RAM/NVIDIA GeForce GTX 1060 Graphics/1 TB Hard Disk/120 GB SSD Capacity/Free DOS/6 GB Graphics Memory) Mid Tower (Dorylus CL600K CPU))**	**10,000/-** **(For external Hard disks: to storing processed Data and to mobilize from ISRO to the institution or any other processing center)**	**1,40,000/-**

Total: 1,40,000/-

(Note: Please specify various individual items of equipment and indicate foreign exchange requirement, if any)

9.2 Contingency

1st Year	**2nd Year**	**Total**
50,000/- **(If in case the hardware doesn't support the system or has restricted access, in that case for the project to continue smoothly we require a**	**50,000/-** **(If in case the hardware doesn't support the system or has restricted access, in that case for the project to continue smoothly we require a**	**1,00,000/-**

cloud-based system hence for yearly charges of cloud processing Virtual Machines we need an estimated amount)	**cloud-based system hence for yearly charges of cloud processing Virtual Machines we need an estimated amount)**	

Total: 1,00,000
(Note: Please specify the items and indicate foreign exchange requirements, if any.)

9.3 Travel

1st Year	2nd Year	Total
25,000/-	**25,000/-**	**50,000/-**

Total: 50,000/-

9.4 Other project costs, if any (give details)

1st Year	2nd Year	Total
5000/- (Documentation)	**5000/- (Documentation)**	**10,000/-**

a. Grand Total = 3,00,000/-

In Words: Three Lakh Only.

10. Whether the same or similar proposal has been submitted to other funding agencies of the Government of India. If yes, please provide details of the Institution & the status of the proposal.

NO

Format C

Declaration

I/We hereby agree to abide by the rules and regulations of ISRO research grants and accept to be governed by all the terms and conditions laid down for this purpose.

I/We certify that I/We have not received any grant-in-aid for the same purpose from any other department of the central government/state government/public sector enterprise during the period to which the grant relates.

Name Designation Signature

Principal Investigator
Head of the Department/Area
Head of the Institution

Seal of the Head of the Institution