**INTERNSHIP PROPOSAL**

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| **1. Project Title:** | Cloud based Real-time Analytical Monitoring of Photovoltaic Systems and Weather Parameters |
| **2. Proposer(s):** | *SE-25-PT-07* |
| **3. Sponsor/Client:** | *(Name, Address, Telephone No. and Contact Name)*  *Dr. ZHAO Lu*  *Head of Solar System Technology group*  *Solar Energy Research Institute of Singapore (SERIS)*  *National University of Singapore (NUS)*  *Contact: +65 6601 1716*  *Email: lu.zhao@nus.edu.sg* |
| **4. Aims/Objectives:** | The aim of the project is to develop a cloud based platform for integrating and managing real-time Analytical Monitoring of PV systems performance - from small rooftop systems to large ground-based PV power plants in the multi-MW range across different climate zones and supervise and control of weather stations health**.**  Collected data will be used for extensive research programmes on yield projections, which are of vital importance to project developers as well as investors and degradation studies of PV modules & systems. |
| **5. Requirements Overview:** | The project will involve the development and deployment of a web-portal, integration with the current Central Monitoring System, setting up of cloud based VPN and Database.  All blueprints, required documents and detailed requirements will be provided by the company.  The requirements and the scope of the project are as defined below.  **1: Central Web portal for Real-time (“live”) data transmission for key PV system and meteorological parameters- which includes:**   * Designing the front-end framework (Cloud Web Application) to help end user to visualise real-time and analytical data in an interactive and easy-to use manner. * Development and Design of the Web Framework for efficient visualization of the incoming data from remote stations. This includes the interaction between the backend systems and database. * High-quality visualisation of measured data online or onscreen for various target groups: operations managers, engineers and general public. * Design and development of module to stream 1-10 second resolution for various DC and AC parameters of a PV system, plus meteorological parameters such as irradiances measured with different devices and inclinations, temperatures (module, ambient), relative humidity and wind speed/direction * Design and development of software module for tailoring of alarms upon a system failure (e.g. inverter trips, grid outages, system underperformance, etc), SERIS engineers receive a warning (e.g. via SMS or/and Email), thus enabling a fast reinstatement of the PV system’s operation. * Design and development of software module for automated daily download and data back-up routines (preferred WebDAV)   There will be different kind of devices from different vendors. Those devices will send the data in every second to the cloud service. The data which will be sent to the cloud service are not structured properly which means different number of parameters, different parameters’ sequences and different values will be sent from different kind of devices. The cloud service, which will receive those data, must be able to handle those data in every one second. Then the cloud service shall able to transform the data into structured data format and store in the database. There will be an algorithm for transforming unstructured data into structured data. A new device from another vender, which will send the data in new format, sequence and values, shall be added without modifying the algorithm which means that algorithm must not be touched whenever there is a new device coming in. It should be in a way of configurable.  There will be a Web Application which will have the following modules:   * User management(roles, users and personas), which will allow the root user to create the user and assign to different roles and different personas * Device management, which will allow the admin users to created the device and configurable the data format which will be sent from the new device. Admin shall also assign the new device to the respective persona for data access. * Real time data analysis which will use a lot of rich user interface (mostly graphs) by using the data that are sent every second. This module will be used by respective personas (user group) in a limited data access. Not all user interfaces and data will be accesses freely. There will be an access control for all data and screens.   There will be another module which will detect the system health. This module will send the warning (SMS or EMAIL or others) to the respective engineers whenever there is something wrong in the system.  There will be another module which will use WebDAV for data backup purpose.  **2: Integration with Current Central Monitoring System to Exchange Information – which includes:**  Design and Develop Integration Modules for data communication to remote stations, Database and customised services. Integration systems will enable information exchange and between various sources into easy to deliver format.  The Platform has to be designed in such a scalable way that further services can be added in the future.  *Scalability Guidelines and Initial Architecture will be provided by company. Further discussions and modifications will be done as required.*  Because of different modules and applications are running independently and data flow between those modules and applications should be smooth, so there must be a good integration architecture which is flexible, stable and scalable. A lot of Integration broker or Queue services will be used for this. Also that central system can broadcast the data to external parties or others whoever subscribes to use the service to get the data from the central system.  **3: Setting up Cloud Database**  Design and Development of database for acquired data from real-time workloads.  The setup environment shall be cloud based and proper access control and security measurement needs to be implemented.  *Detail guidelines will be provided by company.*  The database has to be designed in such a scalable way that further sites can be added in the future with minimal effect to the existing system.  **4: Access Control and Data Security - which includes**  It is required to developed and configure VPN connections between remote devices to Central Monitoring Server Application with highest data security by using Virtual Private Cloud.  *Tenancy, Roles and Permissions related information will be provided*  Cloud VPN must be set up for the data communication between devices and the application which will detect the device health. And the system will send those health related data to the web application to show in the real time device health status in the browser.  **5: Dashboards and Analytics**  Design graphs and charts, to display the weather and DC/AC electrical parameters from various remote sites.  Based on the real-time data, data analytics shall be done on system health and performance.  Additionally, the user shall able to download the data from respective site. *More details will be provided during detailed discussion.* |
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| **Non-functional Requirements:**  Scalability: The system will be initially deployed for the Phase one with two to three remote stations.  Based on amount of successful migration rate, it will be scaled to other stations as well.  Availability: In line with industry standards.  Deployment on production will be done after each release.  **6. Resource Requirements** | |
| (a) Hardware: | Windows Laptop  All other infrastructure, if required/cloud services will be provided by the company |
| (b) Software: | HTML5, CSS, JavaScript, jQuery (including libraries), REST Framework  Necessary Amazon Web Servicies  SQL/NoSQL Databases  LabVIEW  Git for Code Repository  Any other open-source library as needed |
| (c) Others: | - |
| **7. Methods and Standards:** | All releases will be in accordance to the planned milestones set down by the company.  Software and industry best design practices to be followed.  All integration shall be delivered before the end of last phase.  Blueprints, detailed requirement documents will be provided by the company.  Team members will liaise to sign a NDA with company. |

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| **Programme Name:** | **Project No:** | | **Student Batch:** |
| **Accepted/Rejected/KIV:** | | | |
| **Students Assigned:** | | | |
| **Advisor Assigned:** | | | |
| **Assessed by:** | | **Date:** | |