Experiences from training mid-level professionals in Open Source Geospatial Technologies

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Abstract—**Open source technologies have played a major role in making the lives of developers easier. It has provided them an accessible and active community as well as the freedom to modify, reuse and most importantly understand the underlying concept of the technology rather than just using it as a means to an end. Now in this day and age majority of the real world applications have one or the other aspect which has to use geographic information in one way or another. It can range from just using the data for visualisation to spatial analysis to even having the whole application built around geospatial technology.**

Organizations with workforce from engineering background are facing challenges in understanding, analyzing and developing solutions in the multi-disciplinary domains which use geospatial technology. FOSS4G software and APIs play a major role in helping these organizations overcome these challenges by enabling their workforce understand the underlying design principles of the tools, explore the APIs to design and develop customized solutions.

This paper aims to consolidate the experiences of a training and capacity building programme conducted for non-GIS professional developers to provide them the basic concepts and the necessary knowledge to use Open-source Geospatial technologies. The curriculum was designed such that it emphasised on the adoption of open source philosophy, practices and code development along with including the ethics of open source software development. There were around 25 participants in this programme all of whom were engineering employees of Electronics Corporation of India Limited (ECIL) with a work experience ranging from 5 to 15 years in the field of software development.

Keywords- Geospatial, FOSS4G, Open source, Programming, Training.

I. Introduction

Geospatial Technology is made up of Geographical Information Systems (GIS), Global Positioning Systems (GPS), Remote Sensing (RS), and emerging technologies that assist the user in the collection, analysis and interpretation of spatial data [1]. In the recent past, geospatial technologies have made new developments that gave multiple ways to capture, collate, assimilate and visualize data and various analytical models. But, at the same time, a lack of appropriate understanding have led to a set of uses that are limited by the tools rather than the needs of the application domains.

All the developers and technical officers in the industry are lacking the knowledge of FOSS4G software and API's that could help them use the state of the art methods to make better applications. A systematic understanding of the basic Geospatial software framework along with the ability to modify and add modules depending on the domain of application and level of user interaction by accessing the source code of the software is needed to respond appropriately to the current and future needs.

In this paper the authors present an effort of a training and capacity building programme conducted for non-GIS professional developers to provide them the basic concepts and the necessary knowledge to use Open-source Geospatial technologies , over a period of eight days in Hyderabad, India.

II. Participants and Course Content

The participants of this training and capacity building program were a mixture of Senior Technical Officers, Engineers and Technical Managers in Electronics Corporation of India Limited (ECIL), having industrial experience ranging between 5 to 15 years. All of them were engineering graduates and post graduates in the field of electronics, computer science and information technology belonging to various divisions of ECIL involved in software programming, designing and development of solutions for a range of industrial and military sectors.

All of the participants had very little exposure to open source geospatial technologies and API's in spite of working in the company that is taking many government projects involving geospatial technologies. The prior GIS background was lacking in the participants and they were very sceptic and uneasy to learn new theories and technologies.

Keeping the challenges in mind the programme essentially focused on tackling three main challenges - development of problem solving skills by going back to the basics on how to

http://foss4gindia.in/

approach a problem and design a proper workflow to achieve a solution; understanding of what spatial data is and how it is handled by covering basic concepts of GIS; providing insights on the usage of the existing FOSS4G softwares and libraries, developing an understanding of the existing source code and giving the necessary knowledge to modify it as per the need.

III. Training Pedagogy

The training structure was designed in a way to teach the basics of geospatial technologies that will help the participants use free and open source software for making their own standalone applications.

Three main challenges were identified for the same and tackled in the following ways -

A. Geospatial Science concepts

As the participants were from a background with no or very little knowledge of geospatial science, the initial focus was on imparting this knowledge to them. This was done by explaining the geospatial concepts through a combination of theoretical sessions and lab activities. The theoretical sessions covered the core concepts of GIS along with giving the overview of spatial informatics and its widespread usage in the world. In parallel, the lab activities fulfilled the role of showing the application and computational aspect of the concepts just learnt.

The topics covered comprised of the following -

- Overview of GIS and Introduction to the terminology

- Types of Spatial data and Projection Systems

- Spatial data handling, querying methods and concepts

- Georeferencing techniques

- Spatial data access methods

These were covered through a series of lectures and the lab sessions explored the usage of QGIS [2] and application of the techniques using real world data.

B. Open Source philosophy, tools and technology

This aspect of the program had emphasis on adoption of Open Source philosophy, practices and code development along with instilling ethics of open source in the participants. They were given an overview of FOSS along with the details of various kinds of open source licensing and their impact on the way they can use those softwares.

Since GDAL [3] is one of the most widely used FOSS4G library providing the most basic functions like reading different formats of geospatial data, it made sense to introduce them how to use it. The next step was to tutor them to understand the source code, its flow and structure along with providing insights on how to utilize existing code and capabilities and the manner in which they can be modified to suit their purpose. This was done with the integration in Qt IDE environment [4]

so as to provide an easier way for the participants to develop applications and see the final output of their work.

C. Problem Solving Skills

One of the main challenges was to re-focus these professionals to the basics of problem solving. It involved scoping and defining what the problem actually is, dividing the problem into small individual units, designing a workflow based on the possible use cases and finally applying domain based solutions on them in the form of programming constructs. Our aim was to bring about a shift from a tool-driven thought process to implementation of ideas tackling real world problems.

To help visualize the design and the interaction of individual components of the system a session on Unified Modeling Language (UML) was taken [5]. Finally to evaluate the wholesome understanding of the training, a project was given to participants in the team of 3 members which required them to apply all the concepts learnt as well as the tools and libraries explored.

IV. Conduct of Training

A. Participant Performance

The programme constituted of theory lectures as well as hands on sessions, followed by daily assignments. Previous day's assignments were evaluated every morning and most of the participants were able to complete it on time and even those who were not able to do so were clear on the approach to be followed for the assignment.

In the second half of the programme groups of three members were formed and various geospatial application based projects were assigned such as - missile firing interface, aerial survey method interface, temperature monitoring and alarm system, railway collision avoidance system, line-polygon topological relationship interface.

Instead of directly letting the participants start the coding of the project, they were first asked to design UML diagrams of the problem to identify various use cases and different components of the system. After they finished this task they were asked to tackle these individual components by defining the algorithmic approach for them. Only after they had a clear idea of both the system they are designing as well as the algorithmic approach, they were asked to move to the implementation of the project. The trainers were available throughout this process helping them wherever there was a blockage or doubt.

After the completion of the project they were asked to give a presentation stating the exact problem they tackled, along with the algorithmic approach and a working demo of their application.

All the nine groups were able able to finish the project or at least the major part of it. From this we can infer that they were able to grasp the geospatial concepts well and use the

geospatial technologies along with their existing coding skills and abilities to develop geospatially enabled applications with a better understanding than before. The performance of the teams on the project was evaluated on three parameters - user interface, presentation and algorithmic approach.
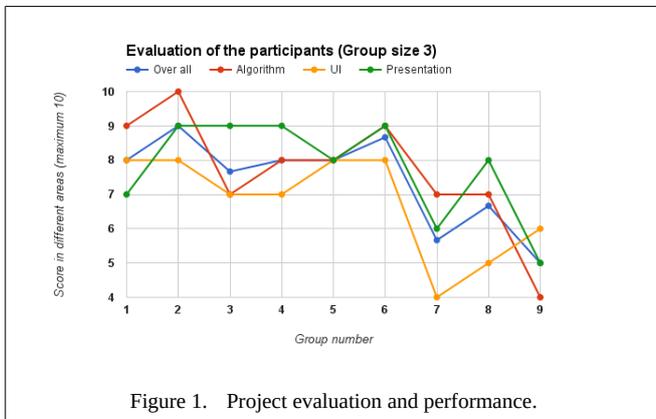

Figure 1.   Project evaluation and performance.

From the figure 1 we can see that almost all the teams performed well except a few due to time constraint and complexity of the problem.

B. Feedback

After the completion of the workshop, feedback was taken from the participants for the evaluation of the program on basis of the resource person, the participant's interest and background, the course content and material provided and finally their takeaway from the program.

The figures 2, 3 and 4 summarizes the responses of the participants on each of the key points as mean values (between 1 to 10). From the figure 3 we can see that most of the participants lacked the prior knowledge of GIS essentials, due to which they felt the need of more time to be given to learn and understand the technologies and implementation to develop better spatially enabled applications.
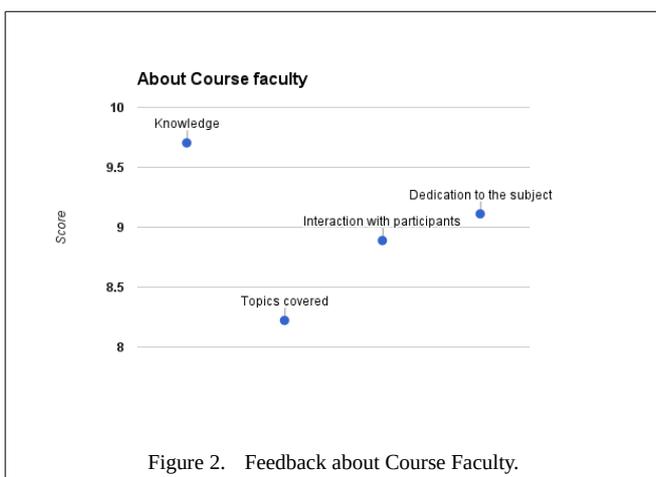

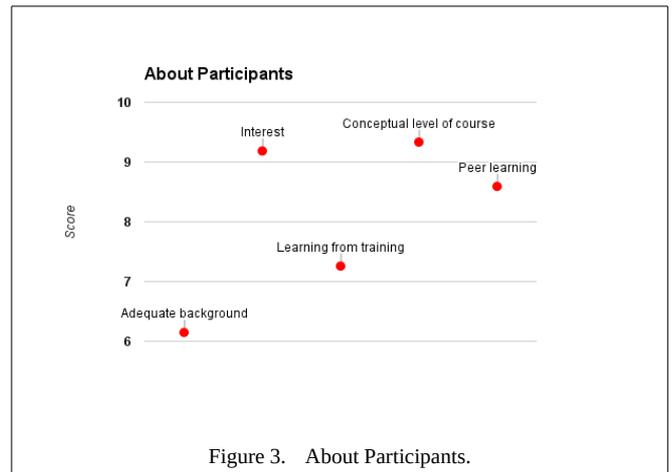Figure 2.   Feedback about Course Faculty.
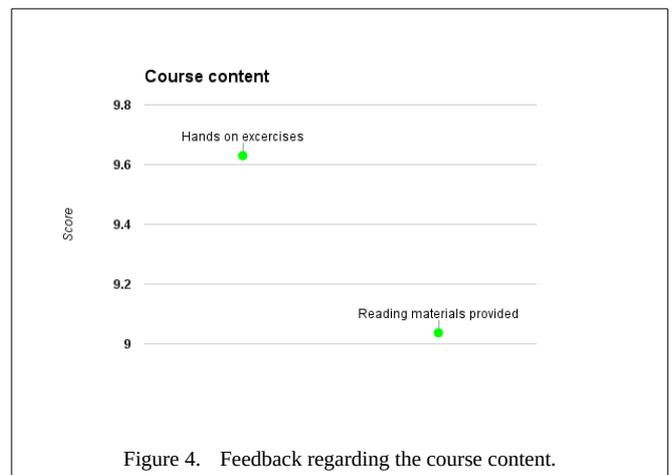

Figure 3.   About Participants.

Figure 4.   Feedback regarding the course content.

Also as part of the feedback the participants were asked about the shortcomings and what more could have been done in similar kind of workshops. Majority of them felt that the duration of the workshop could be further extended to help them grasp the new concepts and the tools explored. Also they faced difficulties in some of the concepts of GIS which involved a lot of domain based knowledge. They expressed interest in being part of future workshops covering more on GDAL and other OSGeo technologies like PostGIS, GeoTools.

In the interest of FOSS4G community development in India, about half of the participants volunteered to be involved and help in OSGeo-India activities and events that can bring in larger benefits to one and all in this sphere of technology.

V.   CONCLUSION

This training programme provided us a good opportunity to develop and design the right curriculum for mid-level professionals with non-GIS background. The challenge was in re-orienting these participants from their established practice of

make-do with the tools available to explore and develop skills for structurally defining a problem, identifying suitable programming constructs along with the selection of right set of tools and libraries towards the larger goal of problem solving.

This was also an invaluable experience for the tutors in coming up with such a curriculum and would result in formation of larger teams to help in faster adoption of these technologies and steadfast its further development.

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AUTHORS PROFILE

Dr. K.S. Rajan is the head of Lab for Spatial Informatics, IIIT Hyderabd. He is one of the founding members and also plays the role of treasurer for OSGeo-India. He is an active researcher with many relevant publications in the field.

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