

BUILDING A DISTRIBUTED SYSTEM FOR COLLECTING HEALTH DATA USING MOBILE DEVICES

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**Capstone project report submitted in partial fulfilment of the requirements
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**Indraprastha Institute of Information Technology
New Delhi**

Student's Declaration

I hereby declare that the work presented in the report entitled **“Building a Distributed System for Collecting Health Data using Mobile Devices”** submitted by me for the partial fulfilment of the requirements for the degree of Master of Technology in Computer Science & Engineering at Indraprastha Institute of Information Technology, Delhi, is an authentic record of my work carried out under the guidance of Prof. Pushpendra Singh. Due acknowledgments have been given in the report to all materials used. This work has not been submitted anywhere else for the reward of any other degree.

Date: 03/01/2016

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Chapter 1

Introduction

1.1 Purpose

The purpose of this document is to describe the system that was used for large scale data collection using mobile devices that was researched as part of the Capstone Project undertaken in the final year of M.Tech at IIIT-Delhi.

1.2 Motivation

Data is the most important part for any research work in any field. But collecting data in a large scale from a wide variety of people that is geographically distributed and also culturally distributed has always been a challenge. Today mobile devices are becoming ubiquitous and has reached every corner of the world. Therefore we have used this mobile devices for collecting data from people using a novel approach called Open Data Kit that is a free and open-source set of tools which help organizations author, field, and manage mobile data collection solutions.

1.3 Definitions, Acronyms and Abbreviations

- ODK --- Open Data Kit
- GUI --- Graphical User Interface

1.4 References

1. <https://opendatakit.org/>
2. <https://github.com/opendatakit>
3. [Open Data Kit: Tools to Build Information Services for Developing Regions](#) Carl Hartung, Yaw Anokwa, Waylon Brunette, Adam Lerer, Clint Tseng, Gaetano Borriello In ICTD, 2010.
4. [Open Data Kit 2.0: Expanding and Refining Information Services for Developing Regions](#) Waylon Brunette, Mitchell Sundt, Nicola Dell, Rohit Chaudhri, Nathan Breit, Gaetano Borriello In HotMobile, 2013

Chapter 2

System Architecture Description

2.1 Overview of Components

2.1.1 ODK Build

ODK Build is used to build the data collection form for the survey. There are various technologies openly available for this purpose. Some are, ODK Build GUI Platform, XLS Form, Vellum, Kobo, Enketo, PurcForms or simple excel sheets can be used to create form and convert it to ODK Build format.

2.1.2 ODK Collect

ODK Collect renders forms into a sequence of input prompts that apply form logic, entry constraints, and repeating sub-structures. It collects the data from a mobile device and send it to the server.

2.1.3 ODK Aggregate

This component makes up for the server and provide functionalities like:

- provide blank forms to ODK Collect,
- accept finalized forms from ODK Collect and manage collected data,
- visualize the collected data using maps, simple graphs and other charts,
- export data,
- publish data to external systems.

2.2 Architecture and Relationships

The architecture and workflow of ODK is fairly easy to understand and visualize. It is depicted in figure 1.

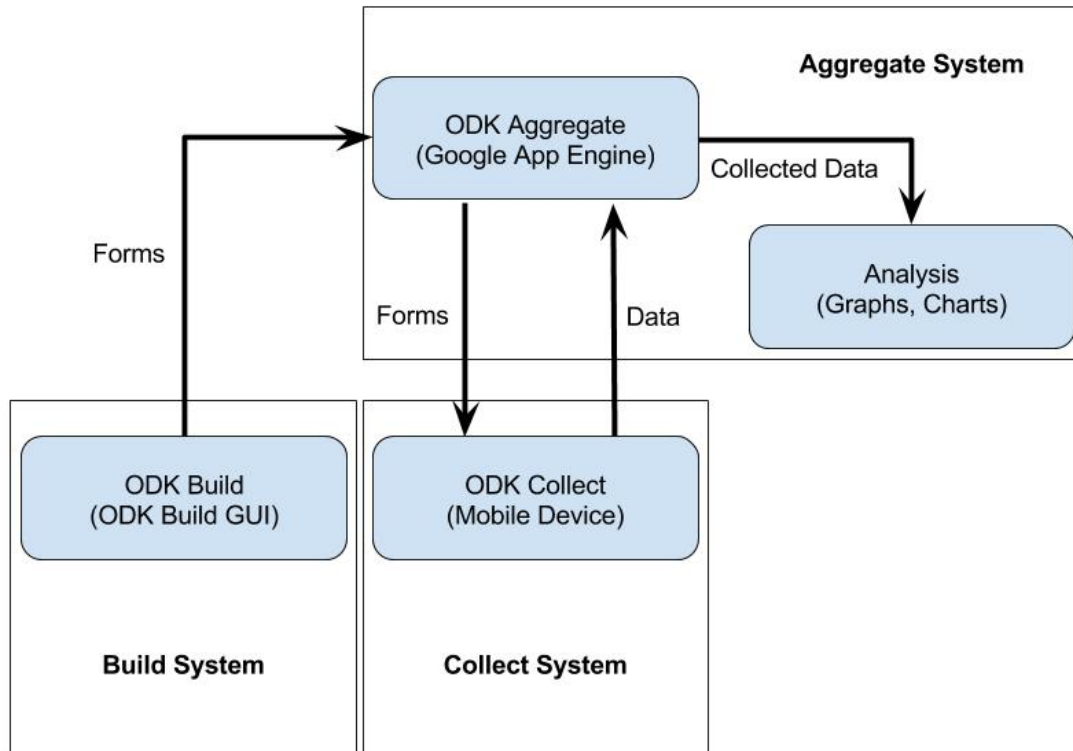


Figure 1 - ODK Architecture

The **Build System** sends the final form to the **Aggregate System** to store the forms. This form is collected by the **Collect System** to take the user entry and then the data is sent back to the **Aggregate System**. The **Aggregate System** is the final system to show the user data analytics in various forms.

Chapter 3

Detailed Component Description

3.1 ODK Build

Build is the process of making forms which can be designed in a number of ways according to the requirement and then converting it in a standard form which then can be uploaded to the server. We have used odk gui interface which provides a simple clean interface for making forms. It features a drag and drop feature where components of the form can be simply dragged and dropped in the order of the questions. The properties of every single question can be simply changed using the side menu with all the attributes.

3.1.1. Components present -

1. Text
2. Numeric
3. Date/Time
4. Time
5. Location
6. Media
7. Barcode
8. Choose One
9. Select Multiple
10. Metadata
11. Group

3.1.2. Attributes present -

1. Name
2. Label
3. Data Name
4. Default Value
5. Read Only
6. Required
7. Range

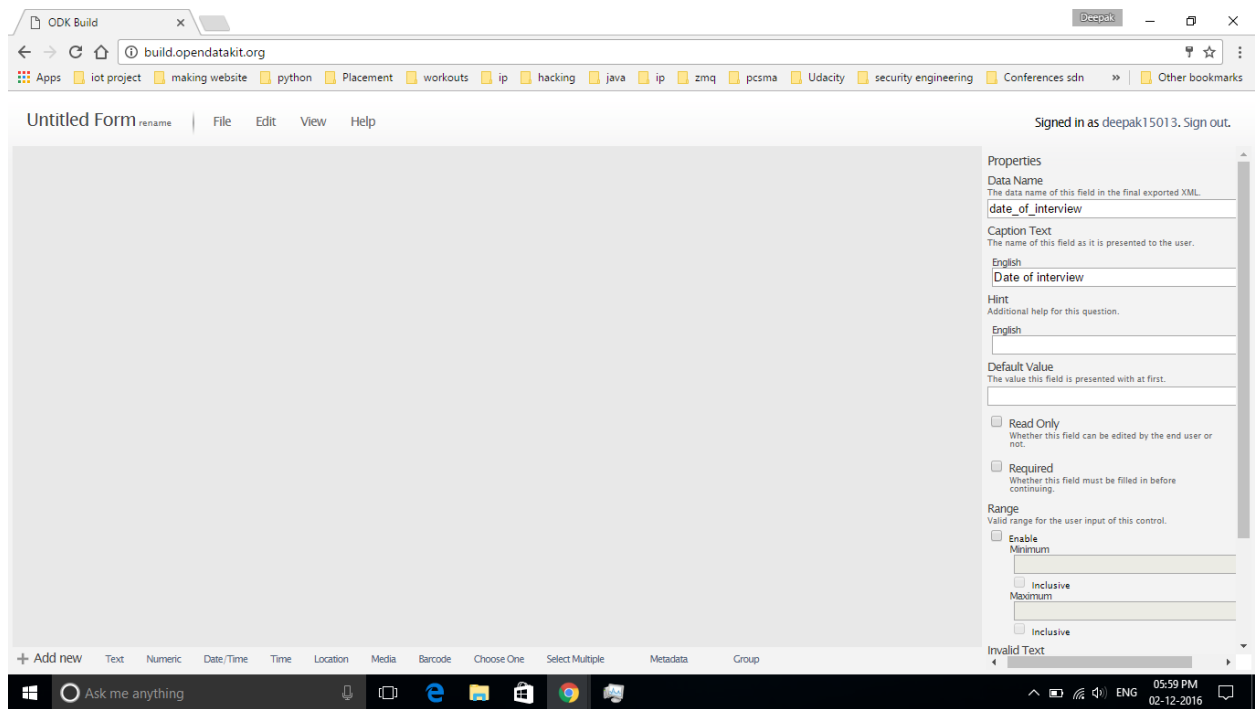


Figure 2 - ODK Build GUI Platform

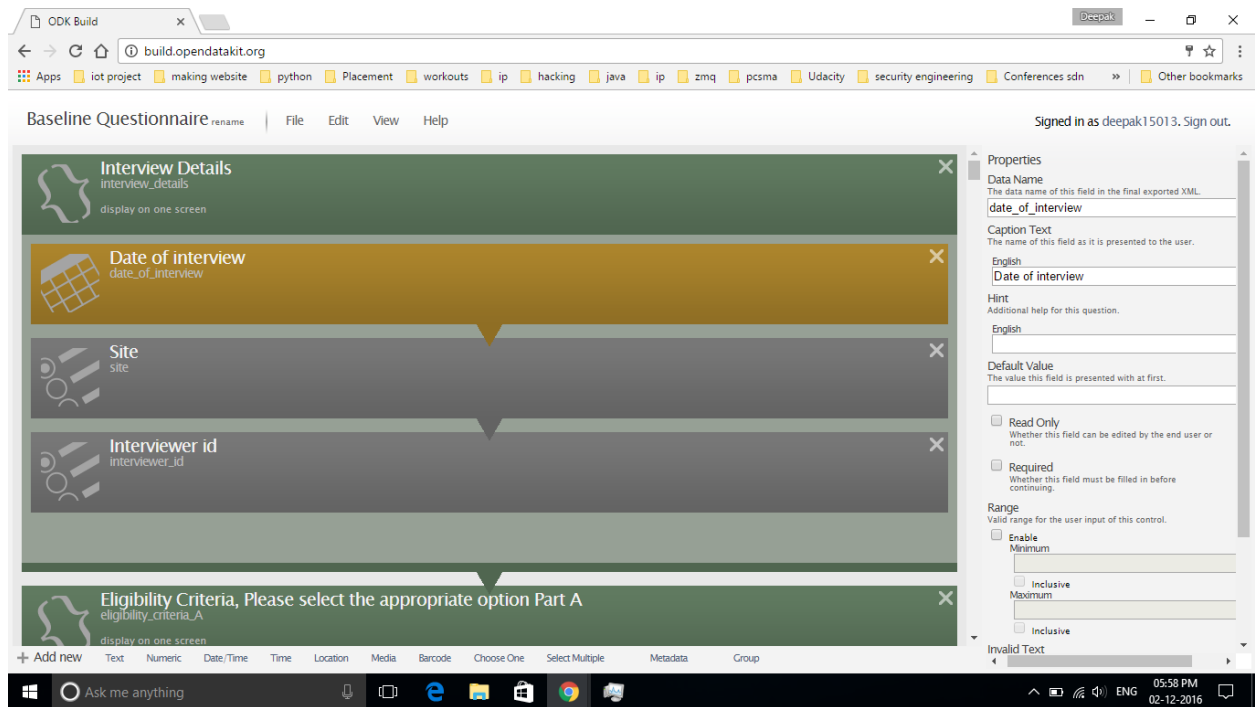


Figure 3 - ODK Build Components and Attributes

3.2 ODK Collect

This is the process of collecting the data. In this process mobile devices are used to get form from the server and then can be used offline to fill the data from the users any number of time. At last the collected data must be sent back to the server, where the analysis can be done.

Platforms -

1. Android - ODK Collect APK
2. IOS - Coming Soon (Porting to IOS)

3.2.1 ODK Collect Screenshots-

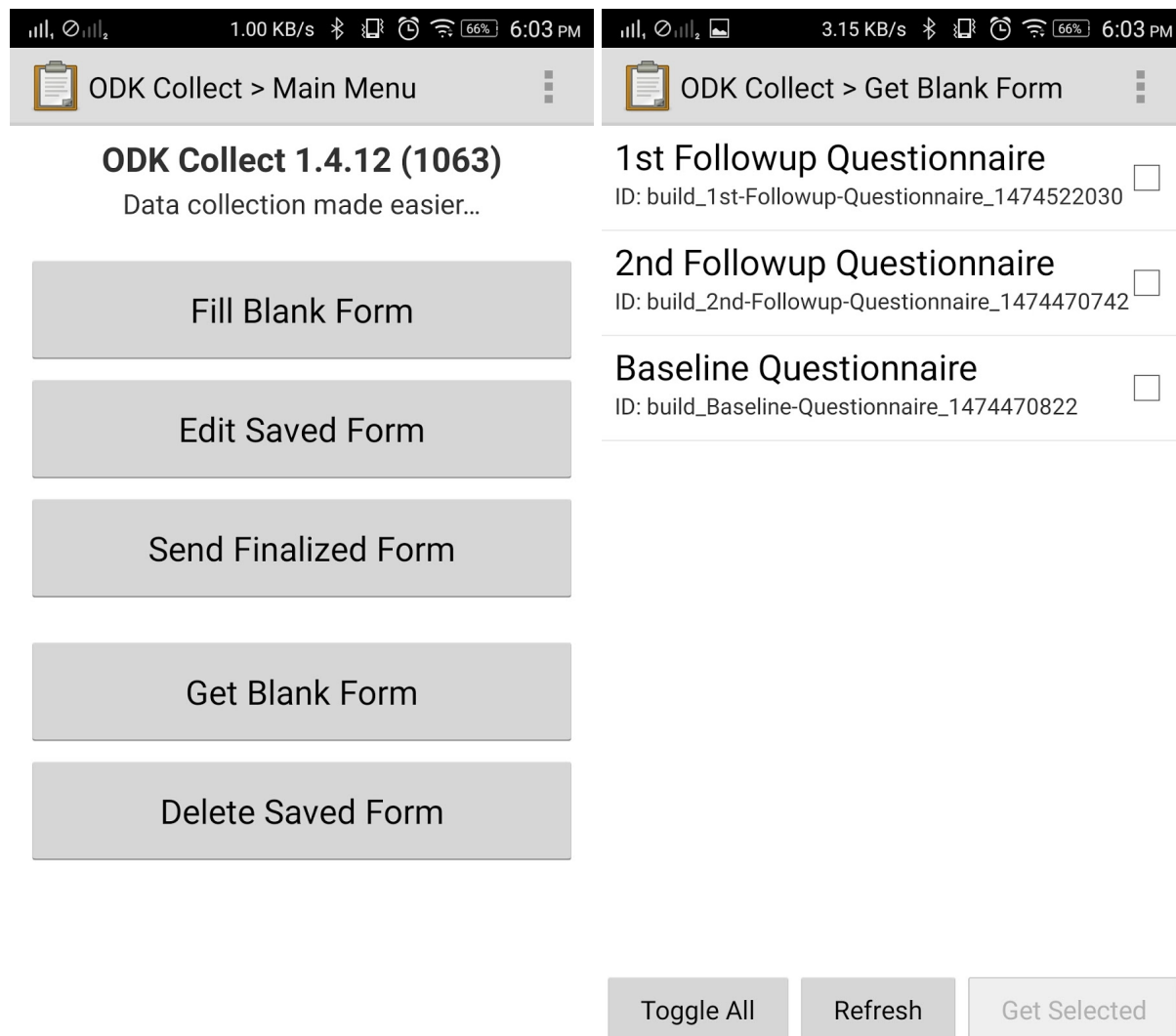


Figure 4 - ODK Collect Android Main Menu and Get Blank Form

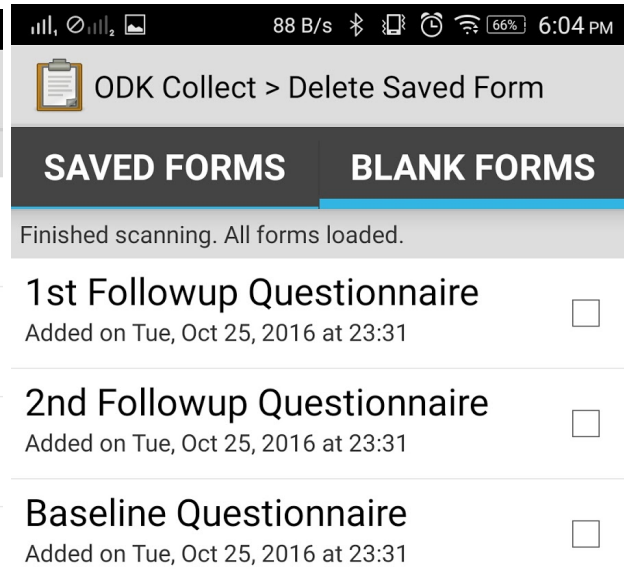
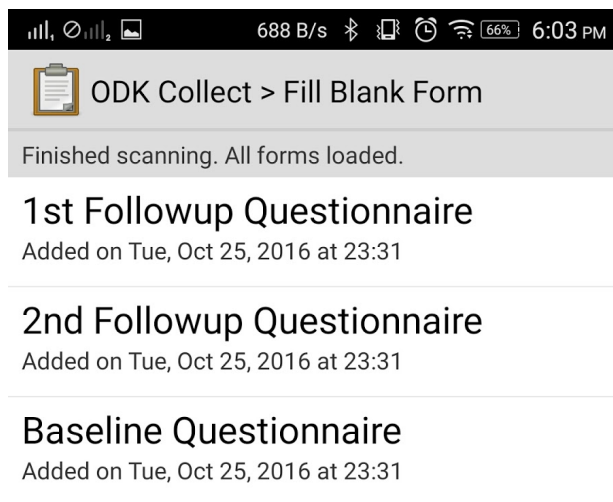


Figure 5 - ODK Collect Android Fill Blank Form and Delete Saved Form

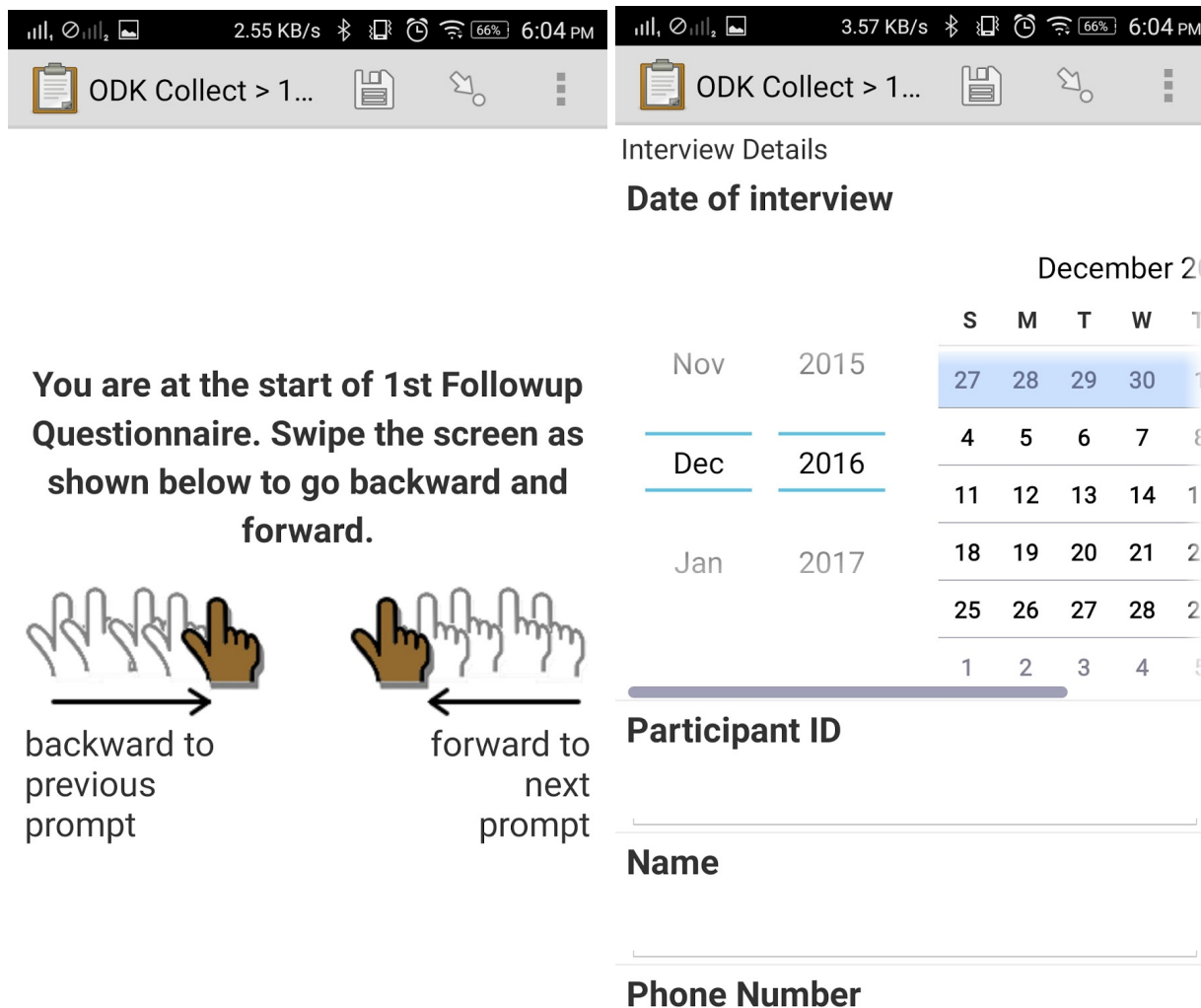
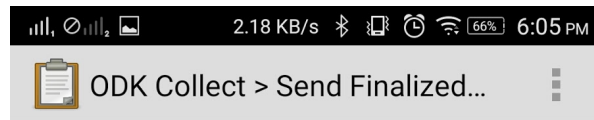


Figure 6 - ODK Collect Android Start Screen and Question Set



1st Followup Questionnaire

Finalized on Fri, Dec 02, 2016 at 18:05



Figure 8 - ODK Collect Android Submitting Finalized Form

3.3 ODK Aggregate

ODK is being used to conduct socio-economic and health surveys with GPS locations and images, along with this ODK is being used to create decision support for clinicians and for building multimedia-rich nature mapping tools.

Components -

1. **Submissions** - All the data submitted by the user can be found here. The data can be visualized using different types of graphs, charts, etc. This data can be exported to different formats for further processing, storage or analysis.
2. **Form Management** - Add, delete, export or publish a form
 - a. Forms List
 - b. Published Data
 - c. Submission Admin

The screenshot displays the ODK Aggregate Submissions Page. The browser address bar shows the URL: <https://odkaggregate-143519.appspot.com/Aggregate.html#submissions/filter///>. The page has a navigation bar with 'Submissions' and 'Form Management' tabs. Below the navigation bar, there are buttons for 'Filter Submissions' and 'Exported Submissions'. The main content area shows a table of submissions for the '2nd Followup Questionnaire' form. The table has columns for 'meta instanceID', 'interview_details date of interview', 'interview_details study id', 'interview_details name', 'interview_details phone number', 'interview_details husbands phone number', 'interview_details interviewer id', 'pregnancy_outcome po que1', and 'pregnancy po'. Three submissions are listed, each with a red 'X' icon in the first column.

meta instanceID	interview_details date of interview	interview_details study id	interview_details name	interview_details phone number	interview_details husbands phone number	interview_details interviewer id	pregnancy_outcome po que1	pregnancy po
69c5-44d2-97b0-3d65881a4e4f	Thu Nov 03 00:00:00 UTC 2016	ID101	Aditya	9425592628	9425592629	SM	Fri Oct 28 00:00:00 UTC 2016	11
uid d68a483a-be59-490c-8413-d85b71079e76	Fri Sep 30 00:00:00 UTC 2016	ID104	Aarti	9425592630	9425592639	AD	Wed Sep 21 00:00:00 UTC 2016	05
uid 6cda065b-0074-4e5b-b5cc-5042daf33869	Tue Jul 05 00:00:00 UTC 2016	ID3005	Mansi	9526292875	9724267272	SM	Mon Jun 20 00:00:00 UTC 2016	01

Figure 9 - ODK Aggregate Submissions Page

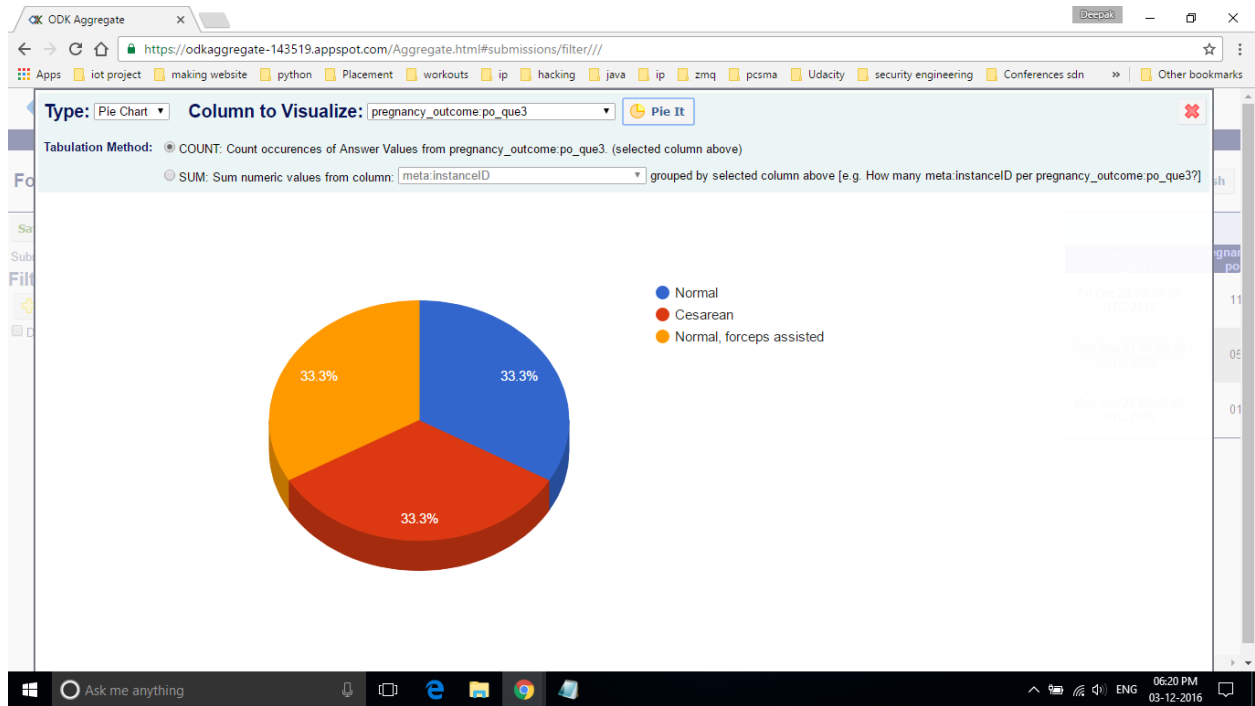


Figure 12 - ODK Aggregate Pie Chart Visualize Tool

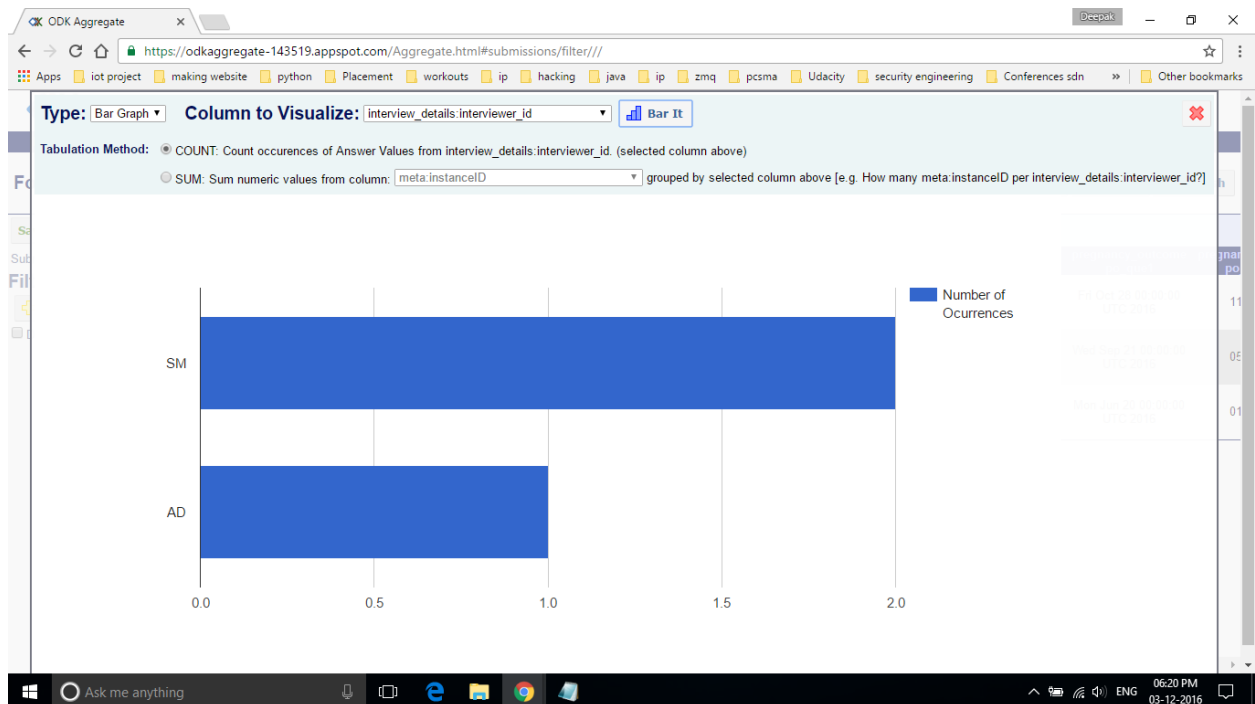


Figure 13 - ODK Aggregate Bar Chart Visualize Tool