Traceability Solution for SMEs

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Abstract – Our Solution is an efficient tool for solving the issue of Traceability encountered in different Small Medium Enterprises all across the world and especially in India. One of the Industry 4.0 idea suggests that every industry should be able to trace their products end to end and also should be having decent ranking in Digitalization Assessment. SMEs don't have enough resources to develop their own tools and mechanisms to attain end to end traceability and good digitalization assessment ranking and our generalized solution can be very useful which will not only provide SME with end-to-end traceability but also provide analytics and insights on data collected through the solution along with helping the industry get a better ranking in digitalization assessment. The industry can also manage their employees and their operations through the solution. Our Solution will also eradicate use of paper documents by enabling sharing of material details directly from supplier industries to customer industries.

Key Words: Traceability, digitalization, Industry 4.0, SMEs

1.INTRODUCTION

Many SMEs across the world get a Digitalization Assessment Ranking of very basic level only because of the lack of end-to-end traceability of their products. This low ranking makes them insufficient and incompatible with the current standards and parameters of the industry world. Hence to make themselves sufficient and compatible with the other industries and the requirements of their customers, Our Solution can be very helpful which will provide a generalized solution for end-to-end traceability which will help the industry increase their Digitalization Assessment Ranking. Also, it will serve other purposes like getting analytics and insights of data collected, using algorithms and Machine Learning Models.

Current Scenario does not have end to end traceability as data is stored manually in different sheets which makes it difficult to search for particular information. Paper based sheets are used for recording data which limits access to the information as well as there are issues with storage of sheets and life of them. Specific and important details of material

processes are not stored which might be necessary in future for product traceability. Entry in sheets is time consuming and validation of entries cannot be done. Timestamps are not recorded which play an important part in understanding the time taken at different processes and making the process more efficient.

Our Solution has a large audience as there are more than 42 million industries out of which as per our study more than 50% lack end to end traceability of their products. A generalized solution like ours can benefit many and can enhance their overall rankings and ratings.

2. LITERATURE SURVEY

Traceability stands for information sharing about a product including the product history, specification, or location. With the involvement of globally dispersed actors in the industry supply chain, ensuring appropriate product quality with timely supplies is crucial for surviving in this industry with ever increasing competition. Hence it is of paramount importance for a supply chain actor to track every product and trace its history in the supply chain. In this context, this paper presents a framework to implement traceability in the industry supply chain. A system approach has been followed, where firstly the usage requirement of traceability is defined, and then a framework for implementing intra-actor or internal traceability and inter-actor or external traceability is discussed.
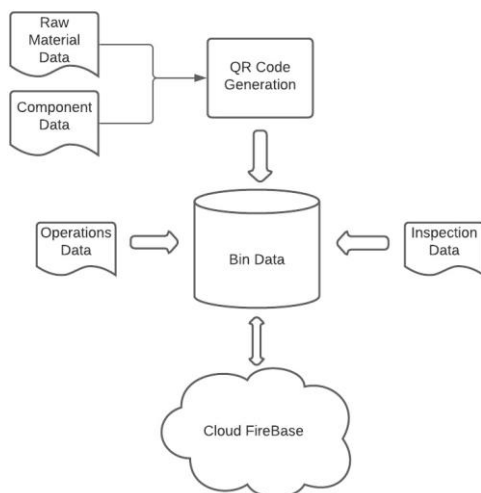
Currently SMEs are trying to achieve traceability mostly in 2 ways. First way solely focusses on the job at hand. When they work with this approach, getting the job done is their only priority and they don't believe in recording information, they take the material, perform the operation and pass it to the next operation meanwhile keeping very low or no records at all. This does get the job done but when a faulty batch is produced it is not possible to traceback from where the error originated and also to prevent them as no one is monitoring them or checking if the values are meeting the required specification. Such approach puts the SMEs in loss both financially and market based as a lot of raw material is wasted on rejected products and when the faulty products reach the market is produces a bad image of the industry thereby reducing their customer rating.

To overcome these challenges a new sheet-based approach was created. In this second way raw materials were dispatched on the basis of bins having a certain number of quantity and predefined operation flow along with a sheet. This sheet keeps track of Raw material, Operation flow, Operation status, etc. thereby keeping track of all activities and keeping their records. These sheets are then stored for future references and tracking. Although this approach soon becomes chaotic as piles of sheets is lying with the operator and in order to track a product he might need to go through multiple sheets and yet yield null as a result. Handling so many sheets and these raw data will help us temporarily but in the long run they will create more chaos then order.

3. METHODOLOGY

a. System Architecture

The project aims to provide its users with a generalized solution which they can directly implement in their industries. Considering the main roles in an industry, there are owner, manager and operator. The responsible person can add and delete roles and assign particular permissions to them as per requirements. The user can login through his email and password or using his phone number and OTP. The architecture is such that the user is redirected to the screen which corresponds with his permissions and role. Coming to the main architecture for the working of end-to-end traceability, the user can create a bin for every lot which is to be processed. Details starting from Raw Material Details sent by the supplier, component details of the component to be made from the lot, different operation details, different quality check details and details of dispatch all gets stored and the data is synced with cloud storage so that it can be accessed and recorded at any point of time by anyone with real time updates.

b. System Design

The system design is based on simplicity and user-friendly ideas. The design starts with a login or registration button screen which the user can select as per his status. After registering the user is asked to login. Login can be done by both phone number and OTP and also through email and password as per the convenience of the user. After logging in, the user sees the interface customized as per his allowed permissions. The user if allowed can then create, edit, update and delete different operations, templates, component, etc. The user can also select the record option where he can input data for some particular bin or some material and can also generate QR Code for a new bin. The user can also select the analytics option to view analytics and insights of the collected data. And also, there is an option for tracing where he can trace back to any information by either scanning a QR code or by entering the code directly. Scanning of QR Code takes place at many points and it is very quick so that the user has a smooth experience. Overall, the application is user friendly and easy to use. The design includes the following users by default but can be added and removed by the admin.
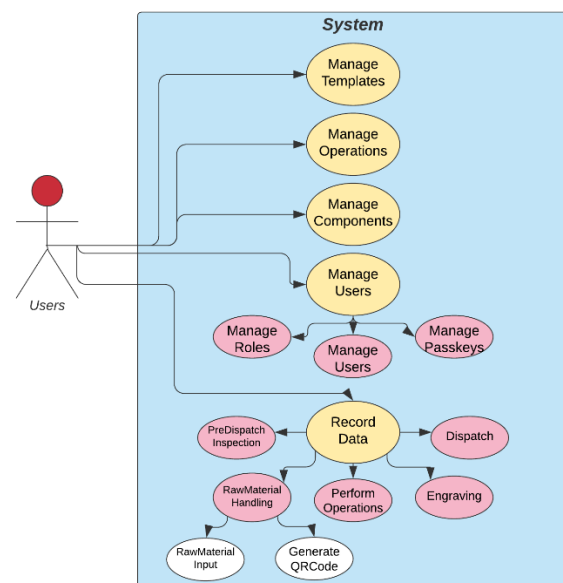
1. Owner
Owner is the most powerful person and has all the permissions and power to control the employees of his industry. He can view the analytics and insights.

2. Manager
Manager is the admin head and is responsible for assigning roles and permissions to operators and also to create passkeys for new employees.

3. Operator
These are the lower-level employees which are granted only necessary permissions corresponding to their jobs and can only access the app for those jobs.

System architecture Diagram

Use Case Diagram

c.   System Working

1. Creation of Templates, Operations and Components-
This is the process where the user Owner or Manager creates templates for different processes like Raw Material Input, Operations Details Input, Inspection Details Input, etc. which are to be filled. He also creates operations and components according to the industry.

2. Raw material Input-
This is the process where raw material entry is done using predefined templates. The responsible user just needs to select the appropriate template and fill it with the details for the particular lot of raw material received.

3. QR Code Creation-
Before processing the raw material lot, the user creates a QR Code which contains details of the Raw Material to be used, Component details for the component to be made and other necessary details. This QR Code is then physically printed and pasted on a container containing the raw material lot which will be processed further.

4. Operation Details Input-
As the material lot moves ahead, at every operation certain pre-defined detail particular to the operation are filled by the operator which he does by scanning the QR Code of the container.

5. Operation Specific Inspection Details Input-
The Quality Inspector user then performs inspection particular to last performed operation and fills the recorded data into the solution again by scanning the QR Code of the container.

6. Pre-Dispatch Inspection Details Input-
For the final Inspection before Dispatch, the user performs detailed inspection on the final product and records the data by scanning the QR Code of the container. He can also refer to expected values for comparing the expected and obtained values of inspection.

7. Dispatch Details Input-
After completion of all processes, the finished product can be dispatched and the details for dispatch can be filled in the solution by selecting the appropriate dispatch template and filling the details into it.

4. RESULTS

We have developed our proposed solution as an android application. The application's front is designed in XML and backend is in Java, we have used Android studio as development platform. We followed Incremental model for solution development. In incremental model requirements are broken down into mu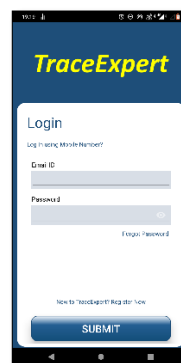ltiple standalone modules of solution development cycles. It is done in steps from analytical design, implementation, testing/ verification, maintenance.

We used Google Firebase for authentication and database. Google Firebase is a powerful platform for mobile and web applications. Firebase can power app's backend, including data storage, user authentication, static hosting, and also provide services like Crashlytics, Performance Monitoring, Test Labs, Analytics etc. Firebase Authentication provides backend services, easy-to-use SDKs, and ready-made UI libraries to authenticate users to app. It supports authentication using passwords, phone numbers, popular federated identity providers like Google, Facebook and Twitter, and more.
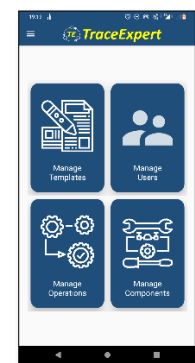
Cloud Firestore is a flexible, NoSQL, scalable database for mobile, web, and server development from Firebase and Google Cloud. Like Firebase Realtime Database, it keeps your data in sync across client apps through real-time listeners and offers offline support for mobile and web so you can build responsive apps that work regardless of network latency or Internet connectivity. Cloud Firestore also offers seamless integration with other Firebase and Google Cloud products, including Cloud Functions.

Application login module enable users to login into our solution using Phone number or email address. There is also an option for resetting the password incase the users forgets the password. In-order to disable unverified employees from logging in and viewing industry data, the login module doesn't allow unverified users to log into the application. (Image 1)

Manage Module enables user to manage different customizations for their industry. They can perform CRUD operations on templates in Manage Templates Option, on components in Manage Components Option and on Operations in Manage Operations Option. In the Manage Users Option the user can manage roles and permissions for the employees of the industry using the application. (Image 2)

Image-1: Login Module   **Image-2**: Manage Module

Record module covers the options for recording of data at different stages. First option is Raw material handling which covers raw material entry and generation of QR code. Then comes Perform Operations where details for different operations and the machines involved can be filled into the application. Next is Perform QC which is for quality inspection data filling. Also, there is Engraving Option where on scanning the QR code of container the code to be engraved in displayed. After that is Pre-Dispatch Inspection where the final inspection is done before sending it out for delivery. Finally Dispatch where after all operations being performed the product can be sent to the customer. (Image 3)

Trace Module is the main module which serves the objective of our solution. In Trace Module, the user can input or directly scan the QR Code for the material details to be traced back. On successful scanning the module shows all the details for the particular material so that easy tracing can be done. Details of Bin Code, Component Details, Inspection Details and other necessary details can be observed through this module and easily tracing can be done. (Image 4)
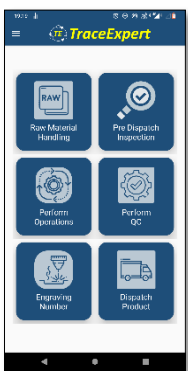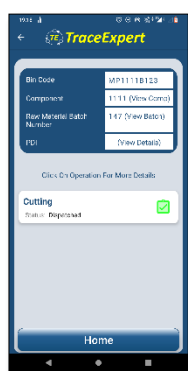

Image-3: Record Module   **Image-4**: Trace Module

The solution developed will help in increasing digital assessment ranking, and will ensure End to End traceability.

5. CONCLUSIONS

The solution will solve many objectives required for attaining end to end traceability along with various other segments that will help the industry make their processes better. The use of cloud services will provide safe, secure and fast data access from anywhere in the world. Data Analytics on the data collected will enable the SME to take decisions based on Analytical Reasoning which will make their working more efficient. Easy Customizability of the solution will allow a large audience to be a part of this solution and get benefitted from it. User and role management will ease the task of SMEs with organizing its employees with desired permissions only. Use of QR Code will ensure easy and quick data access and storing which will decrease the time required to perform the different operations. Authentication will help keeping the industry data secure and away from people who shouldn't have access to it. Overall, this solution provides SMEs with end-to-end traceability which can help them not only make their functioning more efficient but also increase their Customer Ratings and Digitalization Assessment Rankings.

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