A STUDY OF ALGORITHMS USED IN MOBILEAPPLICATION DEVELOPMENT FOR SUGAR FACTORY

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Abstract: *Enhancement of transparency, operational efficiency, and user satisfaction have been achieved through the implementation of Farmer Payment Management and Shareholder Analytics & Reporting in the sugar factory's mobile application. Farmers are accurately compensated for their crop deliveries in a timely manner with the help of the Farmer Payment Management Algorithm. By calculating the payment based on crop weight and current rates, applying any necessary deductions, and tracking the payment's status from initiation through completion, the program simplifies what was previously a labour-intensive process. Farmers are informed immediately after payment completion through real-time tracking and automated notifications. Powerful insights into the sugar factory's production and financial metrics have been provided by the Shareholder Analytics & Reporting Algorithm. Key performance indicators, such as peak production times, payment trends, and investment growth rates, are highlighted in comprehensive reports that are generated from the aggregation of data from crop yields, payment records, and investment information. Through visual dashboards, shareholders can see the data in easy-to-read graphs and charts, empowering them to make informed decisions about their investments. More strategic planning and resource allocation can be achieved with the help of these analytics, as they offer a broader view of factory operations. Real-time data synchronization, role-based access, and secure storage of sensitive data are ensured using these algorithms in a highly integrated design platform.*

Keywords:*Mobile App Development, Farmer Payment Management, Shareholder Analytics & Reporting, User Experience (UX), Real-time Data*

I. INTRODUCTION

Agricultural industries, especially in growing regions, face complicated challenges related to conversation, monetary transparency, and data accessibility among stakeholders. Farmers, shareholders, and directors are indispensable to the rural manufacturing procedure, yet the glide of statistics among those companies is frequently inefficient. The disconnect between statistics assets, manual financial monitoring, and restrained get right of entry to real-time insights avert efficient decision-making and create delays, impacting productiveness and agree with within agricultural groups. As industries worldwide embrace virtual transformation, the rural area has an opportunity to leverage present day technology to deal with those problems through mobile packages, which can be an increasing number of handy to rural groups. [1]

Effective communique is essential in agricultural settings in which well-timed updates on production, marketplace tendencies, and economic transactions can influence outcomes. but, conventional techniques of facts change, such as in character meetings or paper facts, are slow, at risk of errors, and fail to reach far off regions effectively. The want for digital solutions turns into even greater crucial in conditions where monetary transparency is a concern(inclusive of tracking bills to farmers or managing investments for shareholders). With a mobile based device, stakeholders can access and track crucial records in actual time, thereby minimizing discrepancies and improving overall operational transparency. [4]

Algorithms play an important position in such systems, as they automate complicated workflows, cope with large statistics sets, and ensure that every user's needs are met via tailor-made functionalities. for example, payment algorithms can make certain farmers receive timely and accurate reimbursement for his or her produce, while analytics algorithms offer shareholders with insights into manufacturing trends and funding performance. by means of using algorithms to manage payments, records analytics, and notifications, mobile packages create an environment where every interplayis effectively monitored and recorded. in this context, examining the algorithms that underpin agricultural apps is essential to recognize their effect on person experience, operational performance, and transparency. This assessment explores the potential of cellular algorithms designed especially for agricultural applications to transform the control of production, payment, and reporting approaches, thereby supplying a version for digital innovation in the agricultural industry. [5]

II. LITERATURE REVIEW

Khara et al. in the paper Micro Loans for Farmers, (2020), propose a blockchain-based solution to address the challenges faced by farmers in obtaining affordable microloans. The authors discuss the limitations of traditional microfinance institutions (MFIs), such as high-interest rates, lengthy loan approval processes, and lack of transparency, which create barriers for low-income farmers. Due to these challenges, farmers often resort to private moneylenders, who impose even higher rates and unsustainable terms. This study proposes a system that utilizes blockchain technology to manage microloans through a decentralized ledger, eliminating intermediaries and reducing loan costs.By using smart contracts, the proposed solution enables low-cost, secure, and real-time transactions, fostering a transparent loan environment. Farmers can broadcast loan requests with specific terms, such as desired interest rates, and investors are able to review farmers' credit scores before lending. The study emphasizes that the transparency and efficiency of blockchain can build trust among stakeholders, thus attracting more small- and large-scale investors.This blockchain-based platform also introduces a unique token system, which allows farmers to utilize the borrowed funds for specific agricultural expenses, thereby ensuring that the funds are not diverted to non-productive uses. Moreover, the envision that this system could offer repayment flexibility by allowing farmers to repay in either currency or harvested crops. This approach not only provides flexibility to farmers but also allows investors to potentially profit from crops sold at market rates. The study concludes that implementing this blockchain solution could enhance financial inclusivity for farmers, reduce dependency on MFIs, and support sustainable agricultural practices in India. [1]

Sai Pradeep K et al. in the paper Analysing Performance of Company through Annual Reports using Text Analytics (2019) proposed that text analytics can be a valuable tool in interpreting the unstructured textual data found in annual reports to evaluate a company's performance. Their research highlights that the textual component, which constitutes about 80% of annual reports, contains essential insights beyond the numerical data typically analyzed by investors. By employing sentiment and emotion analysis, using lexicons like Bing and NRC, the study examined how emotions embedded in these reports (such as positivity, trust, and fear) correlate with a company’s current performance and future returns. The results indicate a significant relationship between the emotions present in annual reports and the company's subsequent market performance, demonstrating that text analytics can aid stakeholders in making data-driven decisions based on both quantitative and qualitative information in annual reports. [2]

Piang-or Loahavilai et al., in the paper Human Asset Management at the End-of-Life Phase (2017), propose a model for managing aging workers in industrial settings by adapting the Reliability Centered Maintenance (RCM) approach. They argue that older workers, despite physical deterioration, accumulate valuable competence over time and should be evaluated as critical human assets rather than simply phased out due to age. The authors introduce a "Reliability Centered Manpower" model, which incorporates factors like performance, competence, and physical capability to assess whether older workers should continue in their roles, be reassigned, or be considered for retirement. This model enables managers to make rational, fair decisions on manpower planning that balances productivity, experience retention, and physical demands on aging employees. [3]

David et al., in the paper The Analysis of Shareholder Theory and Stakeholder Theory (2011), state that the shareholder theory emphasizes maximizing shareholder wealth as the primary purpose of a corporation, while the stakeholder theory advocates for a more balanced approach, considering the interests of all stakeholders, including employees, customers, and the community. Their analysis highlights the ethical and practical implications of each theory, concluding that while shareholder theory aligns with traditional profit-maximization goals, stakeholder theory fosters sustainable development by balancing various interests, potentially benefiting the corporation and society in the long term. [4]

C. Xu et al. in the paper Research on Measuring Method of Farmers' Bearing Capacity to Agricultural Water Price (2010), proposed a method for evaluating farmers' capacity to bear agricultural water prices. The authors state that understanding farmers' economic affordability and mental endurance is crucial for successful water price reform and sustainable agricultural practices. Their method includes surveying farmers' water use and willingness to pay, using tools like participatory rural appraisal (PRA) and structured questionnaires. They divided farmers' bearing capacity into two main aspects: economic affordability, which depends on income and production costs, and mental endurance, measured by willingness to pay (WTP) for irrigation. Their framework proposes that economic affordability is best assessed by examining water fees as a percentage of total income, agricultural production costs, and net income. For mental endurance, they suggest analyzing farmers' WTP through statistical methods to identify a reasonable price they would accept.The authors conclude that accurate measurements of affordability and endurance can inform a fair cost-sharing model, reducing water waste and increasing farmers' engagement in water conservation. This model aims to balance water price with agricultural sustainability by involving farmers directly in water management decisions. [5]

Wang et al. in the paper A Research Framework of the Relationship Between Payments for Environmental Services and Poverty Alleviation in China (2009), proposed a framework exploring how Payments for Environmental Services (PES) can be effectively leveraged to reduce poverty in China's rural regions. They emphasize that while PES schemes are primarily environmental mechanisms, they have the potential to alleviate poverty by providing income opportunities to low-income participants in ecologically valuable areas. Their framework addresses three main aspects: the selection criteria for poor participants in PES programs, the potential socioeconomic impacts of PES on these participants, and a comparative research method to evaluate livelihood outcomes. The authors conclude that understanding these dynamics can aid in designing PES programs that align environmental and poverty reduction goals, ensuring equitable resource distribution and supporting sustainable rural livelihoods. [6]

III. ALGORITHM

1. Farmer Payment Management Algorithm

This algorithm is designed to automate the payment process for farmers after crop deliveries, ensuring timely and accurate financial transactions. When a farmer delivers crops, the system calculates the amount owed based on crop weight and applicable rate per ton. The algorithm applies any necessary deductions (such as transportation fees or taxes), tracks the payment status (initiated, processing, completed), and records each transaction. Once the payment is finalized, the system notifies the farmer through push notifications or SMS, updating them on the payment details. This automation improves transparency and reduces delays in the payment process, which helps in building trust between the farmers and the sugar factory.

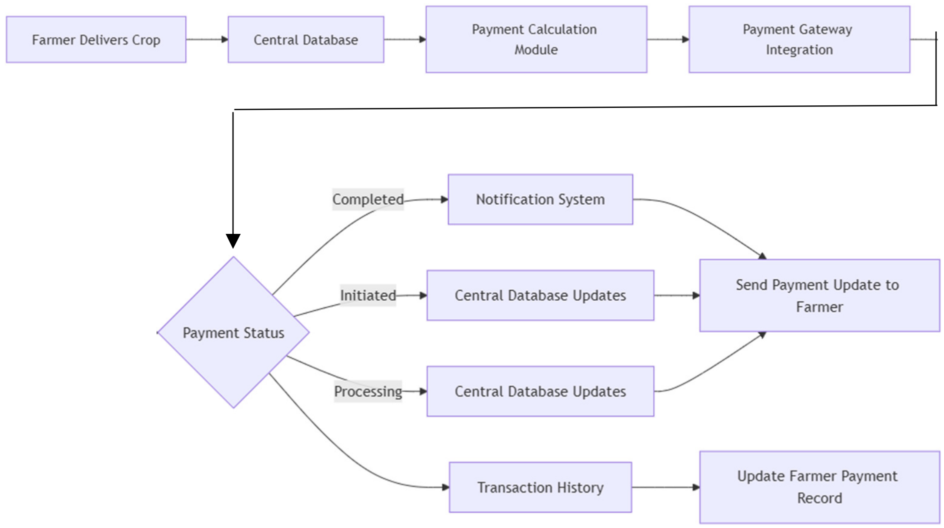

Fig. 01. Architecture of Farmer Payment Management Algorithm

Working and Process:

1. **Capture Crop Delivery Information:**The system records the total weight of the crop delivered by the farmer.Retrieve the current rate per ton from the database based on the type and quality of the crop.
2. **Calculate Total Payment:**Multiply the crop weight by the rate per ton to calculate the gross payment amount.
3. **Apply Deductions (if applicable):**Deduct any applicable fees, such as transportation costs, taxes, or quality-based penalties.Calculate the net amount payable: Net Payment=Total Payment−Deductions
4. **Initiate Payment Process:**Begin the payment process through the integrated payment gateway (e.g., Razor pay, Stripe).Set the payment status to "Initiated" in the database.
5. **Track Payment Status:**Continuously check the payment gateway for updates on the transaction status.Update the status in the system as it progresses through stages:Processing: Payment is being handled by the gateway.Completed: Payment has been successfully made.Failed: Payment could not be completed; further action is required.
6. **Notify Farmer:**Once the payment is completed, trigger a notification (using Firebase Cloud Messaging or SMS) to inform the farmer.The notification includes details like the payment amount, date, and transaction ID.
7. **Update Transaction History:**Log the completed transaction in the farmer's account history with details:Transaction ID, Payment amount, Payment date

Advantages:

1. **Increased Transparency:**Farmers receive real-time notifications about payment statuses (e.g., initiated, processing, completed), which fosters trust and reduces the need for manual follow-ups on payments.

2. **Efficient Payment Processing:**By automating the payment calculation based on crop weight, rate per ton, and applicable deductions, the algorithm minimizes errors and speeds up payment processing.

3. **Reduced Administrative Load:**Automating payment calculations and updates lessens the administrative workload, allowing staff to focus on other critical tasks.

4. **Real-Time Updates and Notifications:**With immediate updates to farmers via SMS or push notifications, the algorithm ensures that farmers stay informed, improving user satisfaction and reducing queries.

5. **Scalability:**The algorithm can handle a high volume of transactions as it scales with Firebase or other backend services, making it suitable for sugar factories of various sizes.

Disadvantages:

1. Dependency on Reliable Connectivity: Farmers in remote areas might have limited access to consistent internet or cellular service, which could delay notifications and payment updates.

2. Complexity in Handling Deductions and Rate Fluctuations: The algorithm requires accurate and up-to-date data on rates and deductions, which can be complex to maintain, especially if rates vary by crop quality or season.

3. High Initial Setup and Maintenance Costs: Implementing and maintaining the system can be costly, particularly for smaller factories or those with limited digital infrastructure.

4. Integration with Payment Gateways: If the payment gateway fails or has technical issues, the payment process could be disrupted, which may delay transactions and affect farmer satisfaction.

Limitations:

1. Limited Customization for Diverse Payment Structures: The algorithm may not accommodate complex or customized payment structures, such as varied rates based on crop quality or location-specific incentives, without significant modifications.

2. Offline Access Limitations: Although data can be saved offline temporarily, full functionality and real-time notifications require an active internet connection, potentially affecting accessibility for farmers in remote areas.

3. Data Security and Privacy Concerns: As the system involves sensitive payment and personal data, ensuring secure storage and compliance with privacy regulations is essential, which may increase development and maintenance costs.

4. Potential for Human Error in Data Entry: If crop delivery details or rates are entered manually, there is a risk of human error, which could affect payment accuracy. Automating data capture could help but may require additional infrastructure.

5. System Downtime and Reliability: The algorithm relies on consistent uptime for real-time notifications and payment processing. Any server downtime or technical issues could lead to delayed payments and farmer dissatisfaction.

2. Shareholder Analytics & Reporting Algorithm:

This algorithm gathers and analyses data related to crop yields, payment records, and shareholder investments, creating a comprehensive view of the factory’s production and financial metrics. It aggregates data to generate insights on production trends (such as peak production times), payment summaries, and financial performance metrics. These insights are presented to shareholders and administrators through visual reports on a dashboard, helping them track the progress of their investments and make data driven decisions.

Key performance indicators (KPIs) like production efficiency, payment status, and investment growth are calculated and visualized on dashboards in various formats, such as graphs, tables, and charts.

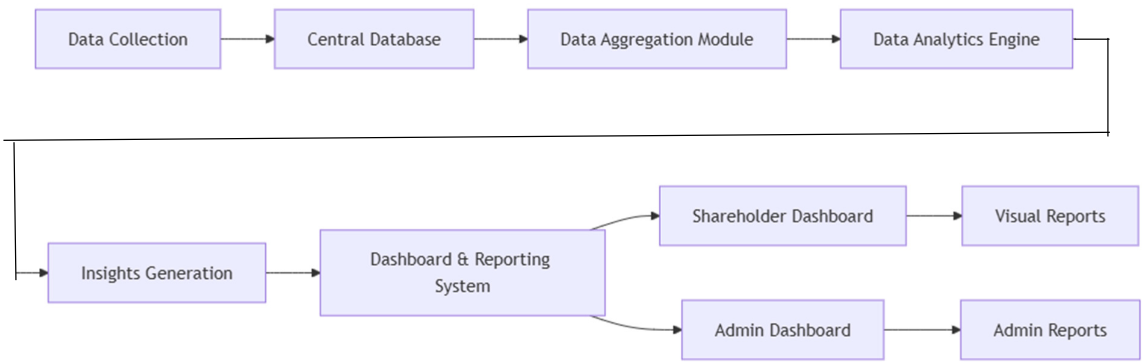

Fig. 02 Architecture of Shareholder Analytics and Reporting Algorithm

Working and Process:

1. **Aggregate Relevant Data:**Gather data from the database, including: Crop yields from each farmer over time, Payment history of farmers, Investment records of shareholders (e.g., share value, dividends).
2. **Calculate Key Metrics:**For each metric, calculate relevant indicators to summarize performance: (Total Crop Production; Payment Summaries; Investment Growth3; Generate Insights and Trends)
3. **Use data analytics techniques to analyze the aggregated data:**Identify patterns, such as highest production periods or months with increased revenue.For financials, determine ROI and payment trends that show how shareholder investments are performing.
4. **Visualize Data for Dashboard:**Create visual representations (graphs, charts, tables) of the analysed data:Farmers: Display crop production over time, payment statuses, and pending payments.Shareholders: Show financial summaries, share performance, and dividends.Organize this information in a user-friendly dashboard layout for easy access and interpretation.
5. **Display Reports and Enable Data Export:**Present the insights and trends on the dashboard, accessible to shareholders and administrators.Allow users to export reports (e.g., PDF, CSV) for offline viewing or record-keeping.
6. **Update Insights Regularly:**Schedule regular updates to ensure that the data on the dashboard reflects the latest trends and transactions.Automatically refresh data and regenerate visualizations for shareholders and administrators to access the most up-to-date information.

Advantages:

1. **Improved Decision-Making:**The algorithm provides real-time data and insights, allowing shareholders to make informed investment decisions.

2. **Enhanced Transparency:**Shareholders get a clear view of the performance of the sugar factory, ensuring transparency in operations and dividend distribution.

3. **Automated Reporting:**It can automate the generation of reports (e.g., financial statements, profit/loss), reducing manual efforts and errors.

4. **Better Risk Management:**With data-driven insights, shareholders can assess risks associated with investments and plan accordingly.

5. **Personalized Dashboards:**Custom dashboards can be created to track key metrics such as yield, investments, and profits, tailored to each shareholder's interests.

Disadvantages:

1. **Complexity of Implementation:**Developing an algorithm that can accurately handle multiple variables (e.g., investment amounts, yield, market fluctuations) can be complex.

2. Data Dependency: The accuracy and quality of the output depend heavily on the input data. Incorrect or incomplete data can lead to misleading reports.

3. Over-reliance on Automated Insights: Shareholders might rely too much on the algorithm's recommendations and ignore other important factors, such as market conditions or human judgment.

4. Technical Issues: Bugs or errors in the algorithm might cause incorrect reporting, affecting shareholder confidence and decision-making.

Limitations:

1. Limited by Historical Data: The algorithm's predictions and insights may be based on historical data, which might not always reflect future trends, especially in volatile markets.

2. Lack of Flexibility: Standard algorithms may not fully accommodate the unique goals or preferences of individual shareholders.

3. Difficulty Handling Uncertainty: Predicting performance in agriculture-based industries like sugar production can be challenging due to factors like weather and crop health, which are outside the scope of the algorithm's analysis.

4. Inability to Account for External Factors: The algorithm may not consider all external factors such as global sugar market prices or political influences that could affect shareholder investments.

5. High Maintenance: Continuous updates and modifications might be required to account for changes in business processes, external variables, or shareholder needs.

IV. APPLICATIONS

Farmer Payment Management Algorithm:

1. Real-Time Payment Calculation: The algorithm can calculate real-time payments for farmers based on the quantity of sugarcane supplied, current market prices, and contractual agreements. This ensures that payments are automatically updated as the data is received.

2. Instant Payment Transfers: Once the payment is calculated, the system can initiate instant bank transfers to the farmer's registered bank account using APIs integrated with banking services. This provides farmers with immediate payment access.

3. Payment Status Updates: Farmers can receive real-time updates regarding their payment status, such as payment confirmation, pending payment, or payment errors. Notifications can be sent via SMS, email, or in-app alerts.

4. Real-Time Adjustment for Discounts/Bonuses: The algorithm can dynamically adjust payments based on real-time factors, like quality of the sugarcane, seasonal bonuses, or discounts on late deliveries. For example, a farmer's payment could be adjusted based on how fresh or high-quality the crop is.

5. Transaction History Tracking: The system can maintain a real-time, detailed history of all transactions, including past payments, deductions, bonuses, and any corrections. Farmers can track their payment history via the app.

6. Dynamic Reporting: Shareholders and factory managers can access real-time reports showing the total amount paid to farmers, outstanding payments, and overall payment distribution, helping in decision-making and financial planning.

7. Payment Dispute Resolution: The algorithm can also flag any discrepancies between expected and actual payments. In case of disputes, farmers can raise queries in real-time, and the system can generate automatic audit trails to resolve issues efficiently.

Shareholder Analytics & Reporting Algorithm:

1. Live Financial Reporting: The algorithm can provide shareholders with real-time financial reports such as revenue, expenses, profits, and other key financial metrics. These reports can be updated automatically based on incoming data from transactions, production, and sales.

2. Real-Time Dividend Calculation: Shareholders can view real-time calculations of their dividends based on the factory's performance. The algorithm can calculate how much each shareholder is entitled to based on their shareholding percentage, current profits, and other factors like bonus distributions.

3. Stock Performance Monitoring: If your platform includes a stock or share trading element, the algorithm can track the real-time value of shares and display current stock prices, historical price trends, and performance comparisons, helping shareholders make informed decisions.

4. Real-Time Production & Sales Data: Shareholders can access real-time data on sugarcane production, the amount of raw material processed, and the amount of sugar produced. This data helps shareholders gauge the company's performance and its impact on their returns.

5. Real-Time Market Analysis: The algorithm can fetch market trends and global sugar prices, providing shareholders with insights into how external factors are influencing the factory's performance. This helps in adjusting expectations and making data-driven decisions.

6. Profit and Loss Dashboard: Shareholders can have a real-time, interactive dashboard that visualizes profits, losses, and operational efficiency metrics. Graphs, charts, and alerts can provide instant insights into how the factory is performing financially at any given moment.

7. Shareholder Activity and Engagement Reports: The algorithm can track and report on shareholder activities, including voting on important issues, meetings attended, and the number of shares held. This helps ensure transparency and keeps shareholders informed about their involvement in company governance.

V. CONCLUSION

The Farmer Payment Management and Shareholder Analytics & Reporting algorithms have proven instrumental in advancing transparency, efficiency, and user satisfaction within the sugar factory's ecosystem. By automating payment calculations and tracking, the Farmer Payment Management Algorithm ensures that farmers receive accurate, timely payments while reducing administrative overhead. The integration of real-time notifications and tracking significantly strengthens trust between farmers and the factory, as farmers now have clear visibility into payment processes and statuses.The Shareholder Analytics & Reporting Algorithm empowers shareholders and administrators with detailed insights into production trends, financial metrics, and investment performance. By presenting data through visual, easy-to-interpret dashboards, the algorithm supports informed decision-making, thereby fostering more strategic investments and a deeper understanding of factory operations.Together, these algorithms not only streamline complex financial and operational workflows but also enhance stakeholder engagement and trust. Their design supports scalability, making the system adaptable for future expansion with advanced data analytics, predictive tools, or security features. In conclusion, these algorithms represent a transformative step toward a modernized, data driven approach in the agricultural sector, providing a replicable model that enhances efficiency, transparency, and connectivity in traditional industries.

REFERENCES

[1] R. Khara, D. Pomendkar, R. Gupta, I. Hingorani and D. Kalbande "Micro Loans for Farmers," 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Kharagpur, India, 2020, pp. 1-5, doi: 10.1109/ICCCNT49239.2020.9225577.

[2] Sai, P. K., Gupta, P., & Fernandes, S. F. (2019). Analysing Performance of Company through Annual reports using Text Analytics. 2019 International Conference on Digitization (ICD). doi:10.1109/icd47981.2019.9105673

[3] Piangor Loahavilai, Nopasit Chakpitak, Thunyaporn Jaimung (2017) Human Asset Management at the End-of-Life Phase" 11th International Conference on Software, Knowledge, Information Management and Applications (SKIMA)

[4] Zhang, Y. (2011). The Analysis of Shareholder Theory and Stakeholder Theory. 2011 Fourth International Conference on Business Intelligence and Financial Engineering. doi:10.1109/bife.2011.117

[5] C. Xu, Z. Jiang and C. Ma, "Research on Measuring Method of Farmers' Bearing Capacity to Agricultural Water Price," 2010 3rd International Conference on Information Management, Innovation Management and Industrial Engineering, Kunming, China, 2010, pp. 567-570, doi: 10.1109/ICIII.2010.616

[6] L. -a. Wang, F. -l. Zhong and X. -d. Guo, "A Research Framework of the Relationship between Payments for Environmental Services and Poverty Alleviation in China," 2009 First International Conference on Information Science and Engineering, Nanjing, China, 2009, pp. 4140-4144, doi: 10.1109/ICISE.2009.149

[8] "Kisan Suvidha" App for farmers: https://play.google.com/store/apps/details?id=com.dac.kisan

[9] Zerodha: https://zerodha.com