JOURNAL-

For my part of the project, I worked on how technology helps deliver real-time exchange rates to our phones. It was quite a struggle at first because the information available online was not very clear. After going through several sources(Google Finance, sheets, etc,- which were quite complicated to understand), I got to know about APIs, WebSockets, and polling. Later, I began to understand how these technologies work together to provide the most recent data on exchange rates and how they come on our screen. It was more complicated than I expected it to be, but it was very interesting to know the process.

MY PART-

BRETTON WOODS AND THE CURRENT SYSTEM-

In the past, people used barter systems as a medium of exchange. However, in the barter system, as we know, it was difficult to find people who were willing to exchange goods, and storage was almost impossible. So, trading was limited, especially if it was a large trade. Another big problem was that some goods used to get spoiled in a short time and lose their value. To solve the issues with the barter system, people started to shift from the barter system to metals(more specifically coins). These coins were made of many different valuable metals like gold, silver, copper, etc. and they didn't spoil and can easily hold value. This worked fine for some time but later when trade got bigger and bigger a new problem emerged. This was because carrying large amounts of metal was difficult during traveling. Furthermore, the most trusted medium of exchange was gold so it became a common medium of exchange, but using it required a high level of trust and had many risks.

To deal with this problem, China introduced a gold banking system. In this banking system people could deposit their gold in banks and receive paper notes in return. This made trade much easier, as these notes took the place of coins. In the 13th century, Europe adopted this Chinese banking system. With the adoption in Europe it became popular worldwide. Every country had its currency, and to trade internationally they adopted this system. To make it work some rules were defined such as currency printing was directly related to the amount of gold one country had. This was known as the **Gold Standard**. So, if a country is exporting more, its gold reserves will thrive and vice versa.

Gold became the symbol of economic strength. For example- the UK at that time was able to make its currency Pound Sterling, the most powerful.

However, the situation changed after World War I and World War II, as the UK lost many of its resources, and the U.S. became the dominant economic power in the world by holding nearly 70% of the world's gold. Other war-affected countries lacked gold and had difficulty importing grains to feed their population. To address this, 44 countries met in 1944 at Bretton Woods, USA. They agreed to establish a new system for exchange rates and connect their currency with the U.S. dollar. This connection was that now countries could trade in dollars and the U.S. promised to exchange dollars for gold(35$= one-ounce gold). This system did stabilize the global economy till the 1970s. However, in the 1960s, the U.S. ended up printing too much money(printing>gold reserve). This led to a fall in trust for dollars. Furthermore, in 1971, President Nixon ended the dollar-gold convertibility, and by 1973, countries stopped trading only in dollars. And changed to a **floating exchange rate system**. Now, currency values are no longer fixed to dollars or any other things but are changing according to demand and supply in the global market. This is the system we still use today.

TECHNOLOGY IN PROVIDING REAL-TIME EXCHANGE RATES-

- Well in this part we are looking at how exchange rate tools work and provide us with the information-
- We can take an example of yuan to INR rates. When we ask this question from the internet it gives us the rates and also a chart showing past and present exchange rates through a graph. How does this happen?
- There is a whole process behind it. And at the core of it is the foreign exchange market (forex). Different traders buy and sell currencies like USD, Yuan, Won, INR, Euro, etc. across global trading platforms. These transactions create changes in the demand and supply of the currencies. This leads to fluctuation in their values every minute. This raw data from the transactions gets recorded on financial platforms. But to get this data from there, there is a need for financial data providers who work as intermediaries between these exchange platforms and service providers like Google.
- There are many financial data providers(for example- central banks, Refinitiv, Morningstar, etc.). Financial systems use different approaches for forex data transmission- like WebSockets and polling. Many of them use WebSocket

connections to maintain persistent, low-latency connections with trading platforms.

- These WebSockets help in enabling real-time data streaming, allowing instant transmission of price changes. In some cases, they use polling(providing data at regular intervals to check for new exchange rates). This method of data transmission is less frequent than WebSockets. However, it works well as this is only used for currencies with fewer fluctuations.
- Now comes the Services provider like Google Finance- in this case Google is not directly connected to trading floors. They use APIs (Application Programming Interfaces) to connect with data providers(with this they request and receive data). When Google needs data its servers send a specific request to a data provider's API. This requests the exchange rate. The API responds with data on the current rate. For example- 1 Yuan = 11.70 INR.
- When Google receives this data, its servers process it to make it suitable for the next step - this means adjusting timestamps according to time zones, removing vague values, etc.
- After Google gets the data, it checks both current and past values(compares it to figure out the change). Based on that all the ups and downs are shown. With all the rates it draws a chart for you to see. Well, all of this is done by your own browser(it is handled by smart codes on the browser).
- This chart keeps changing. This is created by using JavaScript and some libraries. These libraries use technologies like Canvas or SVG (Scalable Vector Graphics) to help in the visual representation of exchange rate trends. The real-time updates are done with the help of WebSockets and AJAX (Asynchronous JavaScript and XML)(helps update the page without reloading).

Links-

- https://www.google.com/finance/quote/CNY-INR?sa=X&ved=2ahUKEwjt1tKl4d-MAxXtma8BHVGwEeAQmY0JegQIGRAu
- https://www.google.com/googlefinance/disclaimer/#:~:text=Associated%20Disclaimers-,Exchanges,provided%20by%20ICE%20Data%20Services.
- https://cloud.google.com/blog/topics/financial-services/building-real-time-streaming-pipelines-for-market-data
- https://support.google.com/docs/answer/3093281?hl=en

- https://coefficient.io/google-sheets-tutorials/convert-currency-in-google-sheets#:~:text=Using%20GOOGLEFINANCE%20to%20Get%20Real%2DTime%20Exchange%20Rates&text=The%20GOOGLEFINANCE%20function%20can%20fetch,using%20the%20latest%20exchange%20rate.
- https://www.w3schools.com/graphics/plot_google_chart.asp?utm_source=chatgpt.com
- https://www.ibm.com/think/topics/api
- https://exchangeratesapi.io/
- https://docs.openexchangerates.org/reference/api-introduction
- https://developer.mozilla.org/en-US/docs/Learn_web_development/Howto/Web_mechanics/How_does_the_Internet_work
- https://developer.mozilla.org/en-US/docs/Web/API/WebSockets_API
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- https://www.pubnub.com/guides/realtime-api/