A survey analysis of people's thoughts about 5G network

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Abstract— **Technology is very important for every aspects in our day to day life. When it is related to our physical and mental health, it is more important. Our future generation depends on how we use this technological power which is in the palm of our hands. As an enhancement of cellular networks, the future-generation 5G network can be considered an ultra-high-speed technology. The proposed 5G network might include all types of advanced dominant technologies to provide remarkable services. There are a lot of pros in 5G networking system. But like all other things, this coin also has two sides. Along with all the pros of this technology, there are also a lot of cons. A lot of people believe that 5G network is harmful for our physical and mental health. Some think it is also harmful for our nature. 5G is a lot faster and a lot more efficient than 4G. That's why it uses a higher frequency and radiation than all other networks. As we all know, radiations coming from our cell phone might do some damage to us, so of us are thinking 5G will only make it worse. So we collected data from students of different institutions and different ages in Bangladesh. We found 250 participants for our research work. We collected 250 student's data and we categorized them as per their thoughts about this matter. In this research work, we are trying to show the systematic way of collecting data of the thoughts of people about 5G. After collecting data, we tried to process, analyze and visualize the data. Therefore, our goal is to find out the opinions about 5G network on students. We made a clean dataset of those data. And Machine learning algorithms can easily classify and predict output from those data. We hope that our dataset will be helpful for the machine learning researcher. And they get appropriate output from our dataset.**

Keywords— 5G, network , technology.

1. INTRODUCTION

In telecommunications, 5G is the fifth generation technology standard for broadband cellular networks, which cellular phone companies began deploying worldwide in 2019, and is the planned successor to the 4G networks which provide connectivity to most current cellphones. 5G networks are predicted to have more than 1.7 billion subscribers worldwide by 2025, according to the GSM Association. Like its predecessors, 5G networks are cellular networks, in which the service area is divided into small geographical areas called cells. All 5G wireless devices in a cell are connected to the Internet and telephone network by radio waves through a local antenna in the cell. The main advantage of the new networks is that they will have greater bandwidth, giving higher download speeds, eventually up to 10 gigabits per second. Due to the increased bandwidth, it is expected the networks will increasingly be used as general internet service providers for laptops and desktop computers, competing with existing ISPs such as cable internet, and also will make possible new applications in internet-of-things and machine-to-machine areas. 4G cellphones are not able to use the new networks, which require 5G-enabled wireless devices. 5G is the latest network of wireless technology. It's used to transmit data between appliances, like mobile phones and Bluetooth devices. 5G works by producing a type of energy called electromagnetic radiation. It uses higher frequencies than previous wireless networks, making it faster and more efficient. Electromagnetic frequencies, like those produced by 5G, create an area called an electromagnetic field. Some people believe electromagnetic fields have negative health effects. As a result, there is concern about how 5G affects health. But there are currently no known health risks linked to 5G. According to the World Health Organization, there is limited research on the frequencies used in 5G. A study which took place in 2017 showed that mobile phones use frequencies of 1.8 to 2.2 GHz. These frequencies cause tissue heating, according to WHO. A 2021 study also found that people experience more EMF-related tissue heating as they get older. Plus, the higher the EMFs, the more they absorb. That's because older individuals tend to have reduced skin thickness and blood flow. There's some research involving EMFs from other sources. In a study of 2017, researchers examined how using a mobile phone affects cognitive function. The researchers found that using a mobile phone for at least 90 minutes a day is associated with attention difficulties. A 2018's research review found conflicting evidence. The

researchers examined 43 studies regarding EMFs and cognitive function. They concluded that there is no solid link between EMFs and cognitive concerns. In 2011, the International Agency for Research on Cancer stated EMFs are possibly carcinogenic to humans. The classification was determined by 30 scientists from 14 countries. To date, most studies have examined the potential link between EMFs and brain cancer. But the results have been inconsistent. For example, a 2017 research review found that EMF radiation from mobile phones are associated with glioma, a type of brain cancer. A 2018 study, on the other hand, did not find a clear association between high frequency EMFs and brain tumors. Since the release of 5G, many false claims about its health appeared on social media. Examples of these myths including COVID-19 vaccines contain 5G microchips, 5G release is used to cover up the COVID-19 pandemic, 5G causes headaches, migraines, and dizziness etc. There is no proof behind these claims. As we can see, there's a lot of controversy with 5G network. A lot of people believe that it's bad for both human and animal health. By doing this survey, we're trying to learn what others think about 5G network. For this data collecting we found 200 participants from different universities who shared their thoughts with us. We are doing this research in COVID-19 pandemic, so we can't collect data from a field survey. That's why we used online survey methods to collect data.

1.A. MOBILE NETWORKS EVOLUTION

It seems that telecommunication technology advances every decade or so, as 1G started around 1980, 2G by 1992, 3G by 2001, 4G or Long-Term Evolution (LTE) by 2011 and the new 5G network expectantly by 2020 [2]. 4G nowadays supports 1 Gb/s for low mobility and 100 Mb/s for high mobility. For the new upcoming 5G they estimate 10 Gb/s for low mobility and 1Gb/s for high mobility [3]. The latency in 4G is 15 ms while in 5G it is expected to be 1 ms or so [1]. So how could all of that happen? The answer lies in the new architecture of the 5G network.

1.B. 5G NETWORK ARCHITECTURE

The architecture of the new network will be changed, many aspects will try to utilize and get the most out of the existing technology and add new ones to form much faster network capable to deliver the rich content of the multimedia (High Definition streaming/none streaming video and High Resolution images) and the data flood produced from mobile phones and social media apps. One proposed idea is software-defined network architecture. The 5G mobile network needs to deal with some of the challenges facing the 4G network nowadays such as high energy consumption, spectrum crisis, bad interconnectivity, poor coverage, flexibility, and poor Quality of Service (QoS) [4].

1.C. INTERNET OF THINGS (IOT) FOR 5G

IoT Definition. IoT is a dynamic network of connected devices. The idea is to connect not only things but also people any time, any place, with anything and anyone, and so on. The definition of IoT has crossed the boundaries of traditional network. The International Telecommunications Union (ITU) has codified the concept of IoT [5] as the *IoT* is a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies". However, IoT has become hugely popular over the last decade. The dimensions and the scopes of IoT can be any Thing, any Place, any Time, any Body, and so on. Consequently, standardization is being demanded to establish interoperability among things with a view of transforming the world into a global village.

Standardization Effort. Standards control any system to operate under fixed rules and regulation. Interoperability among the disciplines of any reference system depends on standards. Worldwide, numerous standardization authorities have initiated the creation of relevant standards during the last decade. Nevertheless, these efforts have had no impact in terms of unifying the standards into a single framework because IoT has become the storehouse of anything. The list of different organizations, institutions, and groups engaged in IoT standardization is given in Table 2 [6].

IoT Architecture. The future is approaching a new paradigm of networks with huge numbers of devices. The idea of 5G (beyond 4G) refers to networks with improved QoS, huge capacity, enhanced data rate, and, overall, a feasible architecture to sustain the aforementioned features. The influential parts of 5G networks include D2D communication, which can be interpreted as the idea of IoT. IoT comprises the technologies of smart sensors, RFID, machineto-machine (M2M), IP, communication systems, and so on. This part of the paper focuses on the different emerging IoT architectures suitable for future-generation 5G networks. IoT architecture has evolved with the evolution of the Internet. The first phase of IoT evolution entailed communication among several

computers through a computer network. However, the World Wide Web (WWW) was launched in 1991 to connect all computers worldwide [8, 9]. Further technological advances have connected the users of various types of electronic devices with computers under the same platform by connecting to the cloud network [10]. Finally, the idea of IoT was conceived to give shape to the world by connecting everything. IoT is the network that can adopt and connect anything that anyone can imagine [11].

2. LITERATURE REVIEWS

This is a survey-based research. is an important topic for researchers. There are so many papers about this topic. So, we reviewed some survey related papers and some satisfaction and dissatisfaction related paper. Some paper descriptions are given below.

With an exponential increase in the demand of the users, 4G will now be easily replaced with 5G with an advanced access technology named Beam Division Multiple Access (BDMA) and Non- and quasi-orthogonal or Filter Bank multi carrier (FBMC) multiple access. The concept behind BDMA technique is explained by considering the case of the base station communicating with the mobile stations. In this communication, an orthogonal beam is allocated to each mobile station and BDMA technique will divide that antenna beam according to locations of the mobile stations for giving multiple accesses to the mobile stations, which correspondingly increase the capacity of the system [12]. An idea to shift towards 5G is based on current drifts, it is commonly assumed that 5G cellular networks must address six challenges that are not effectively addressed by 4G i.e. higher capacity, higher data rate, lower End to End latency, massive device connectivity, reduced cost and consistent Quality of Experience provisioning [16], [17]. These challenges are concisely shown in Fig. 2 along with some potential facilitators to address them. An overview of the challenges, facilitators, and corresponding design fundamentals for 5G is shown in Fig. 1 [15]. Recently introduced IEEE 802.11ac, 802.11ad and 802.11af standards are very helpful and act as a building blocks in the road towards 5G [13]–[14].
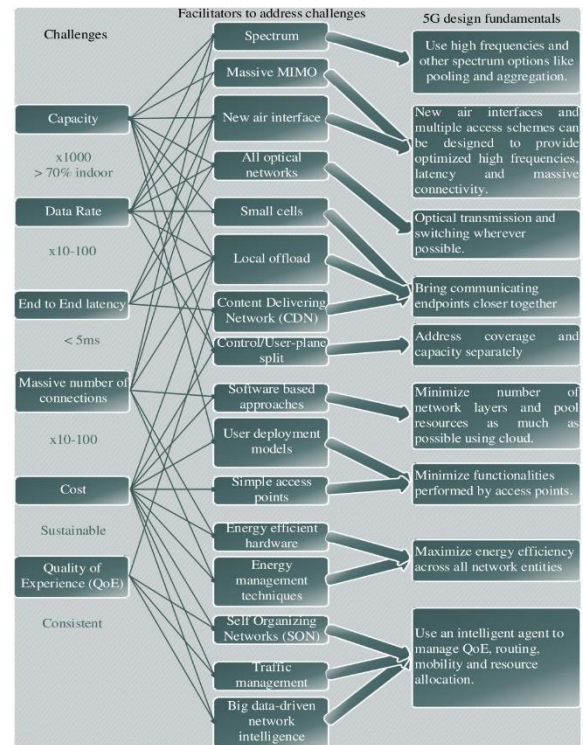
FIGURE 1. 5G challenge, facilitators, and design fundamental [15].

II.A. Millimeter-Wave (mmWave): The distinctive feature of 5G is its intrinsic flexibility, which will allow it to support several use cases in an optimized way, either using low-band spectrum below 1 GHz, mid-band frequencies from 1 GHz to 6 GHz, or high-band spectrum above 6 GHz. Although the decision on globally harmonized 5G millimeter wave bands will only take place at WRC-2019, the regulatory bodies of the countries with strong 5G initiatives are already trying to influence the final decision:

In the USA, the Federal Communications Commission (FCC) selected 3.85 GHz of the licensed spectrum in the 27.5–28.35 GHz and 37–40 GHz bands (37–37.6 GHz is allocated to 5G on a shared basis), along with 7 GHz of the unlicensed spectrum in the 64–71 GHz band [21]. Although these choices are not fully aligned with ITU plans, FCC is analyzing the possibility to open up to 18 GHz of additional spectrum in all ITU candidate bands, except 42.5–47.2 GHz [21].

The European Union followed ITU guidelines and designated 3.25 GHz of spectrum in the 24.25 27.5 GHz band as a pioneer 5G band. Europe also considers the bands 31.8–33.4 GHz and 40.5–43.5 GHz as promising bands in the future [18,19].

South Korea intends to offer 5G in time for the 2018 Winter Olympics, for which they have decided to

use the 27.5–28.35 GHz and 37.5–40 GHz bands, i.e., very similar choices to those of the USA [20].

Japan intends to commercially roll out 5G in time for the 2020 Summer Olympics, using the spectrum from 27.5 to 29.5 GHz [20].

China is adopting 24.25–27.5 GHz, which ensures compatibility with Europe, and 27.5–29.5 GHz, which also ensures compatibility with USA, South Korea, and Japan [20].

These high-band frequencies have higher path losses, and therefore, the coverage will be limited. This drawback can be mitigated by the use of high power gain antennas or antenna arrays.

3. PROPOSED METHODOLOGY

To implement this research, we need to make a workflow diagram. We divided our workflow into so many parts. The flow diagram and methodology show in the following diagram 1.

A. Selecting the parameters for collecting data

For research, we need to fix our parameters for collecting data. First, we did some study and discussed our research work and which parameters we need to accurate the dataset. Finally, we set some parameters.

B. Selecting the target people

There are a lot of people of different mindset. So, collecting different types of data is quite easy work but analyzing those data is not easy. So, we decided to work with only students who are currently studying in college or undergraduate level. We didn't target this survey for a specific group of people, so we collected data from students from different public and private universities in Bangladesh. We also tried to collect data from some school and college students to see how they feel about this technology. Because nowadays kids start using smartphone and internet from their childhood so their knowledge about this is also quite good.

C. Creating Google Form

After selecting the parameters and audience, we created a form full of some questions and input fields. For online surveys we used google form. We created a google form with those selected parameters. The google form is given in figure 2.
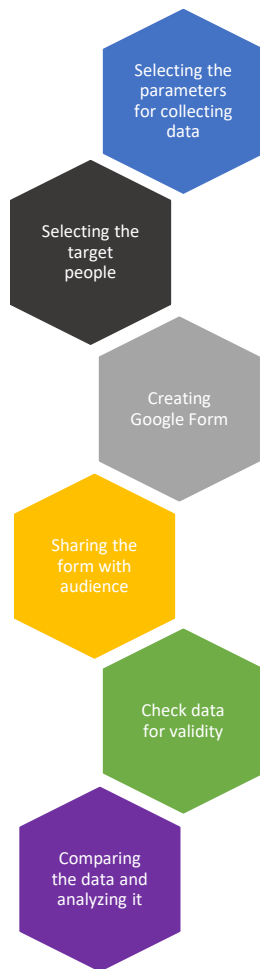
D. Sharing the form with audience

For an accurate dataset we need to be careful about data collection. Collecting data using google form is kind of a risk because there are so many people who doesn't have enough knowledge about this technology. If anyone of them found this google form link, they could try to input data. This fake data could make our dataset messy. To avoid this circumstance, we needed to be very careful about sharing this google form link. To avoid this, we shared our google form link within our friends and university and college level student related Facebook groups.

E. Check data for validity

After finishing the data collection part, we were able to collect 250 student's data. But a problem arose when we looked at the data. There were some students who filled up the google form in an irrelevant way. And some students filled up the form in an inaccurate way. Such as, some students didn't input their name, a lot of them didn't put their mail id as we didn't keep them as compulsory. If we used this data for analysis, we couldn't find the accurate result. For this reason, we carefully worked with data validation. Only in case of valid data, we kept them in the dataset. And if we were able to pre-processed and clean the invalid data, we cleaned and pre-processed those data. But if we are not able to do so, we remove those data. After preprocessing and cleaning, our dataset contains 200 student's accurate data.

F. Comparing the data and analyzing it

For comparing satisfied and dissatisfied student's data, we separate the data from our dataset. We analyzed the options they chose using different parameters and we plotted those data in graphs for understanding how people are taking these technology.

Figure 2: Flow Diagram

Figure 2: Google Form

Do you think the frequency used for the 5G network might harm us? (আপনি কি মনে করেন 5G তে ব্যাবহারকৃত ফ্রিকুয়েন্সি আমাদের ক্ষতি করতে পারে?) *

○ Yes

○ Maybe

○ No

Do you now have a new 5G network/pole/antenna and/or a "smart" meter program in your neighborhood? (আপনার এলাকায় কি কোনো নতুন 5G নেটওয়ার্ক/ পোল/ এন্টেনা অথবা স্মার্ট মিটার প্রোগ্রাম আছে?) *

○ "Smart" Meter only

○ Digital radiation emitting electric meters like iTron, but no "smart" meters

○ Analog looking radiation producing electric meters

○ No 5G but radiation producing meters

○ Both "smart" meter and 5G poles

Do you keep any wireless devices on at night (cordless phone, cell phone, Wi-Fi modem/router, wireless security system, printers or other wireless system)? (আপনি কি রাতে মোবাইল, ওয়াইফাই রাউটার, তারবিহীন প্রিন্টার, ইত্যাদি তারবিহীন যন্ত্র চালু রাখেন?) *

○ Always

○ Sometimes

○ Never

How do you feel when you are near any wireless radiation, dirty electricity, magnetic fields, body voltage/current, EMF? (রেডিয়েশন, শক্তিশালী চৌম্বকক্ষেত্র, ইত্যাদির আশেপাশে আপনি কেমন বোধ করেন? *

	1	2	3	4	5	
Good	○	○	○	○	○	Bad

Select the best benefit of 5G in order of which one you believe will have the most positive impact on your life? (5G আপনার জীবনে কোন বিষয়ে সবচেয়ে বেশি অবদান রাখবে বলে মনে করেন?) *

○ Faster downloads

○ Eliminate network issues in crowded areas

○ increased capacity for devices

○ better work from home experience

Do you have any Concerns around 5G ? (5G নিয়ে আপনার মনে কোনো উদ্বেগ আছে?) *

☐ No concerns

☐ Too expensive

☐ Draining too much battery life

☐ Health concerns

☐ Won't be secure

☐ Other:

Do you think 5G will be positive for the economy? (আপনি কি মনে করেন 5G দেশের অর্থনীতির জন্যে পজিটিভ হবে?) *

○ Positive

○ Negative

○ Neutral

○ Don't know

Submit

4. EXPERIMENTS AND RESULT

After working with our own dataset, we were able to find out the thoughts of different people. When we analyzed the data, we found that most of our audience are 21-25 year olds (Figure:3). Between total 200
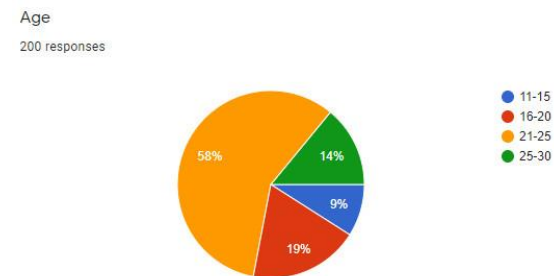

Figure: 3

responses, 116 are between that age. Normally they are undergraduate students. The second highest age group is 16-20 year old. They are from the college which is 19% of the total audience. Followed by 14% 25-30 year old which are post graduates or graduates along with 9% school students. In the next
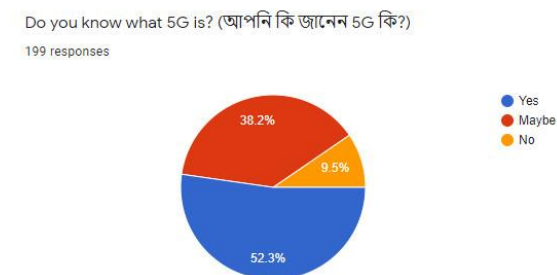
Figure: 4

question(Figure:4), we asked them if they knew well about 5G. 104 of them answered yes. 38.2% said they were not fully sure that they knew about 5G well. And 19 of them said they didn't know which is 9.5%. After that we wanted to know how they feel
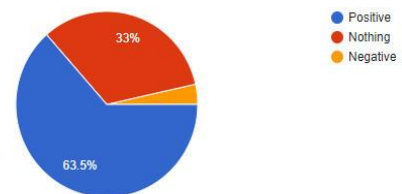
Figure: 5

about this technology(Figure:5). 63.5% of them said they were positive about it. Which is 127 people. 33% said they didn't feel anything and only 7 people said negative which is 3.5% of the total audience. The next question was about how much excited they
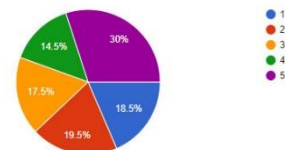

Figure: 6

are for 5G network. As we know, Bangladesh is a developing country. Because of that, the 5G network hasn't reach here yet. But in the chart we can see that most of the students in our country are excited to use 5G experience from their own device(Figure:6).
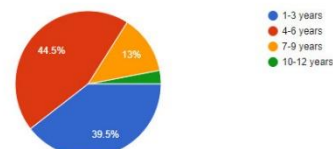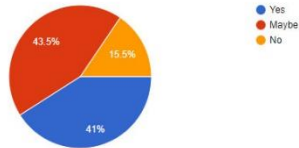

Figure: 7

Total 89 out of 100 people said they were 80/100% excited about 5G. 17.5% people voted for 3 and 19.5 and 13.5 are the non-excited audience. Though a lot of countries now own a 5G network, Bangladesh is

lacking behind them. But as we have already seen, most of the students take it as a positive thing and

Figure: 8

most of them are very excited about it. And some of us are waiting for it to coming to Bangladesh (Figure:7). Majority of them said it'll take 4-5 years. A lot of people also said it could come in 1-3 years. 39.5% people chose that option. Which is 79 in number. The rest of them thinks it'll take 7-12 years. In the next chart, we can see that a lot of people are not happy with our current 4G network (Figure:8). 43.5% people answered may be and 15.5% people answered no in this question. Which is more than
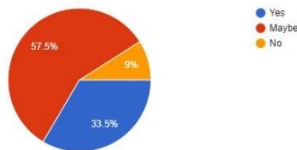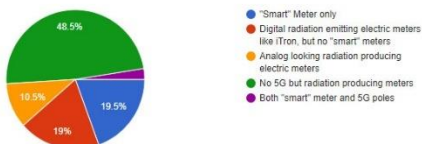

Figure: 9

half of the people who responded in this survey. 82 of them said they were good with the current 4G network. Then we asked them if they thought 5G network frequency could harm them any how and the results were surprising that most of them couldn't even decide what they will choose (Figure:9). 57.5% of the responders chose "may be"
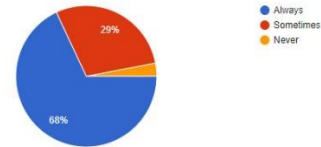

Figure: 10

this time. That's 115 people. 33.5% people think it'll harm them and 9% people think it won't hurt them.

Most of these people who chose to answer yes, doesn't really know about it. Because there is no legal proof that 5G harms us. In figure 10, we wanted to know from our audience if they have

Figure: 11

anything in their neighborhood that releases radiations. Almost half of their neighborhood has meters that releases radiation. About 20% have smart meters and the rest 30% have analog meters. Then we asked them if they keep their cordless phone, cell phone, Wi-Fi modem/router, wireless security system, printers or other wireless system
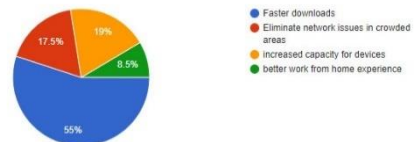

Figure: 12

keeps on at night. About 70% of them answered that they always keep those on at night. Only 3% said they don't keep these things on all night. And the rest of them replied "sometimes". In figure 12 we collected information about how they feel while being near any wireless radiation, dirty electricity, magnetic fields, body voltage/current or EMF.
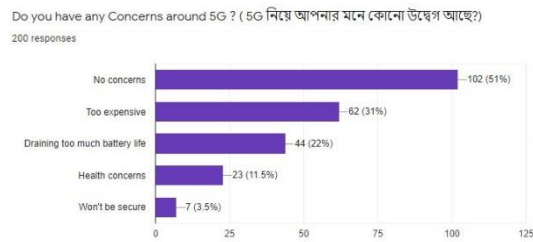

Figure: 13

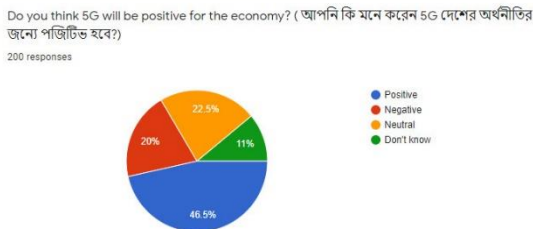In the figure number 13 we wanted to know what's their biggest interest in 5G. More than half of them

replied faster downloads. Increased capacity for devices and Eliminate network issues in crowded areas are in the 2nd and 3rd places with 19% and 17.5%. The next question was if they had any

Do you have any Concerns around 5G ? (5G নিয়ে আপনার মনে কোনো উদ্বেগ আছে?)
200 responses

- No concerns — 102 (51%)
- Too expensive — 62 (31%)
- Draining too much battery life — 44 (22%)
- Health concerns — 23 (11.5%)
- Won't be secure — 7 (3.5%)

Figure: 14

concerns around 5G. more than half of them submitted that they have no concern. Then Too expensive, Draining too much battery life and Health concerns come one after another. Surprisingly security is the least of majority's concern. In this last question, we have asked what

Do you think 5G will be positive for the economy? (আপনি কি মনে করেন 5G দেশের অর্থনীতির জন্যে পজিটিভ হবে?)
200 responses

- Positive
- Negative
- Neutral
- Don't know

22.5% / 11% / 20% / 46.5%

Figure: 15

They think will happen to the country's economy when 5G comes to Bangladesh. Almost half of them said it'll be positive. 20% of them answered negative and the rest is either unaware or neutral about this matter.

5.CONCLUSION AND FUTURE WORK

In this survey paper, we discussed some evolving networking technologies related to the 5G network. We focused on the main approaches and did not go deeply into the algorithms which controls the power consumption in the 5G network or any machine learning techniques which could help optimizing the network. This survey could be an beginners entrance knowledge to the new 5G mobile network technology. . For this pandemic situation we had some limitations, we only could collect a really few number of data using an online form. Because of these limitations, our maximum data came from our friends and classmates. After finishing our work, we found that most of the people filling the form see 5G as positive. Although there's also some people who see it negatively, but in this survey we can clearly see that there are more pros than cons in 5G network.

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