

Hybrid Approach Used to Analyze the Sentiments of Romanized Text (Sindhi)

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Abstract—Sentiment analysis is an important part of natural language processing (NLP). This study evaluated the sentiment of Romanized Sindhi Text (RST) using a hybrid approach and ground truth values. The methodology of sentiment analysis involves three major steps: input data, process on tool, analysis of data and evaluation of results. One hundred RST sentences were used in this study's sentiment analysis, which can be positive, neutral, or negative. The statements in the corpus of this study are simple to understand and are used in everyday life. This research used an online Python tool to process a text and get results in the form of outcomes. The results showed that 86% of the sentences have neutral sentiments, 9% of the total results of sentiment analysis have negative sentiments, and only 5% of sentences of Romanized Sindhi Text have positive sentiments. The accuracy of the RST was measured on an online calculator and the value was 87.02% on the basis of ground truth values. An error ratio of 12.98% was calculated on the basis accuracy found on the online calculator of confusion matrix.

Keywords—Sentiment analysis; natural language processing; hybrid approach; python tool; Romanized Sindhi

I. INTRODUCTION

Sentiment analysis is the most important task of NLP, in which it analyses the community's opinions about social actions such as social media apps, academic activities, and technology [1, 2]. Sentiment analysis is the analysis of opinions about users [3, 4]. The principle part of artificial intelligence (AI) and man-made brainpower in NLP is to measure the content and investigate the importance of the content [5]. The information or text utilized for the Natural Language Processing looks like unstructured and organized information or text [6]. Text investigation is the cycle of changing unstructured content information over to organized content information as significant. Text examination utilized apparatuses for a few contents and measured factual information by utilizing artificial intelligence calculations [7]. Text investigation is additionally used to assess the client's assessment, and item audits with criticism are used to give a better reaction to future assignments. Text is utilized to recognize examples, and the fundamental thought of the examination comes from various wellsprings of data. Sentiment analysis is mostly used for the analysis of comments about any product or any other social activity [8, 9].

This research focused on the Romanization of Sindhi language by using hybrid model for the evaluation/analysis of sentiments. After the analysis of results on tool, author evaluates the results on the basis of ground truth / reality basis. The significance of this research study is to evaluate the results of tool and actual aim of the sentence in selected language.

Sentiment Analysis applied in this study project on 100 sentences of RST. Sentiment Analysis is done on the online Python tool and it may the result in Positive, Neutral and Negative Sentiments. After the task performed on tool, all sentiments were compared on ground truth values and accuracy was measured as 87.02%.

II. STRUCTURE OF ROMANIZED SINDHI TEXT

Structure of sentiment analysis of RST is same as English language [10]. The structure of Romanized Sindhi Text depend upon the three main attribute of grammar as like: subject à Verb à Object, same as like an English sentence [11]. The structure of Romanized Sindhi Text is easy to understand by the tool and it recognized the sentence by using above three attributes and it may give better output [12].

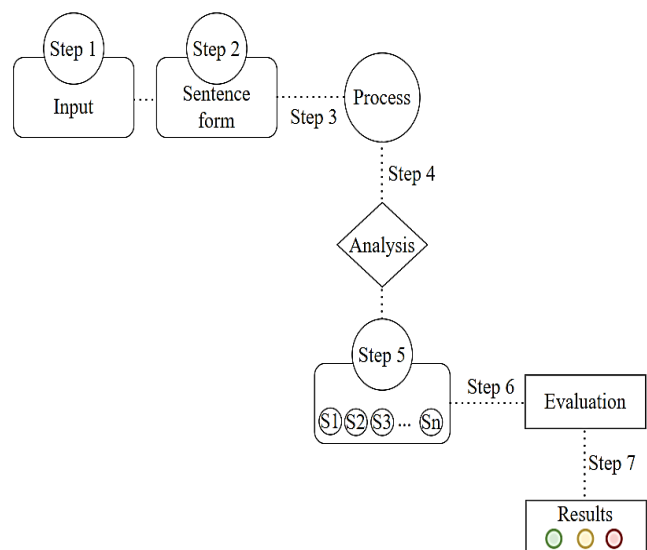


Fig. 1. Research methodology of sentiment analysis.

Fig. 1 show the methodology of sentiment analysis of RST depends on three major steps such as: Input data, Process on tool, analysis of data and evaluation of results. According to the first step of the methodology, input data is collected. The data in the RST is the input data in the form of sentences. After this step, the data is processed on a tool in the shape of sentences, but the sentences may be single or multiple. After the second step of processing, tool is to analyze the data and it may the output results in the shape of sentiments. These sentiments are positive, neutral and negative.

III. ANALYSIS OF ROMANIZED SINDHI TEXT ANALYSIS

One Hundred RST sentences were used in this study's sentiment analysis. A text's sentiment can be positive, neutral, or negative [13-15]. The statements in the corpus of this study are simple to understand. These sentences are used in everyday life. A data set is a fundamental element of research and is used as input towards the online Python tool (as shown in Fig. 2), which then processes a text and gets results in the form of outcomes. Sentiment analysis results, on the basis of ground truth value Data set of this research, is shown in below Table I.

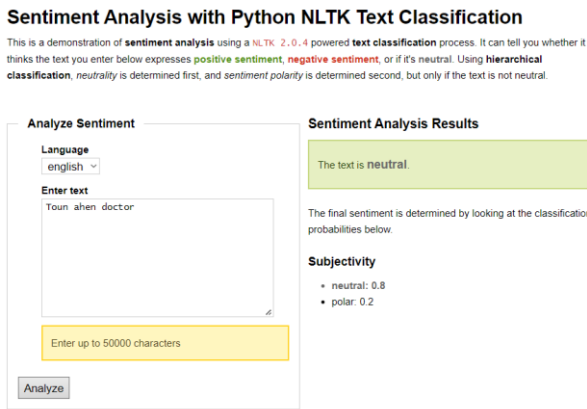


Fig. 2. Input/output view of online Python tool.

TABLE I. SENTIMENT ANALYSIS OF ROMANIZED SINDHI SENTENCE

#	Sindhi Sentence	Romanized Sindhi Sentence	Sentiment Analysis	Ground through value
1	تون آهين ڊاڪٽر	Toun ahen doctor	The text is neutral.	Neutral
2	مان آهيان شاگرد	Maa'n ahiyan shagrid	The text is neutral.	Neutral
3	مان ڪيڏان راند	Maa'n khedan rand	The text is neutral.	Neutral
4	مان پيان پاڻي	Maa'n piyan pani	The text is neutral.	Neutral
5	علي ماريو نانگ	Ali maryo nang	The text is neutral.	Neutral
6	ڊاڪٽر سڏيو مريض ڪي	Doctor sadiyo mariz khe	The text is neutral.	Neutral
7	هي آهي بدسورت	He ahy bad surat	The text is neg.	Negative
8	مان لکيو خط	Maa'n likhyo khat	The text is neutral.	Neutral
9	مان پڙهيو ڪتاب	Maa'n parhyo kitab	The text is neutral.	Neutral
10	تو ساڙيو گهر	Toun sadyo ghar	The text is neutral.	Negative

#	Sindhi Sentence	Romanized Sindhi Sentence	Sentiment Analysis	Ground through value
11	مان ڪيو ڪم	Maa'n kayo kam	The text is neutral.	Neutral
12	تو ٻڌو گانو	Toun budho gano	The text is neutral.	Neutral
13	حنا ٿوريو ڪلاس	Hina tourdyo glass	The text is neutral.	Negative
14	مان ڪوليو دروازو	Maa'n kholiyo darwazo	The text is neutral.	Neutral
15	مان سڪي انگلش	Maa'n sikhi English	The text is neutral.	Neutral
16	تو ٺاهي چانهين	Toun thai chanhe	The text is neutral.	Neutral
17	تون آهين خوبصورت	Toun ahen khoubSORat	The text is neutral.	Neutral
18	تون آهين ڪنو	Toun ahen kino	The text is neutral.	Negative
19	آهين تون نيڪ	Ahen toun thek	The text is neutral.	Neutral
20	ڪتو پونڪي ٿو	Kuto bhonke tho	The text is neutral.	Neutral
21	مان لکيو آرٽيڪل	Maa'n likhyo article	The text is neutral.	Neutral
22	هن تي ارام ويهه	Irum waihu hite	The text is neutral.	Neutral
23	مون کي آهي ڏک	Moun khe ahe dukh	The text is neutral.	Neutral
24	مان آهيان خوش	Maa'n ahiyan khush	The text is neutral.	Neutral
25	هن تي سارا آهي بيهه	Sara uthee beehu hite	The text is neutral.	Neutral
26	تون آهين استاد	Toun ahen ustad	The text is neutral.	Neutral
27	مان سڪان ٿي سنڌي	Maa'n sikhian thi Sindhi	The text is neutral.	Neutral
28	مان سڪان ٿي ميٺ	Maa'n sikhian thi math	The text is neutral.	Neutral
29	علي ماريو واڳون	Ali maryo wagoon	The text is neutral.	Negative
30	ڪرسي علي ويهه تي	Ali waihu kursi te	The text is neutral.	Neutral
31	انعم اچ	Anam achu	The text is neutral.	Neutral
32	ڏاڍو خراب آهي بيد	Dadho kharab ahy bad	The text is neg.	Negative
33	گندگي آهي بيد تي	Gandagi ahy bad te	The text is neg.	Negative
34	مان آهيان استاد	Maa'n ahiyan ustad	The text is neutral.	Neutral
35	چا آهين تون ڊاڪٽر	Cha ahin toun doctor	The text is neutral.	Neutral
36	مان هلائي مشين	Maa'n halai machine	The text is neutral.	Neutral
37	انعم اچ ويهه هن تي	Anam ach hite waihu	The text is neutral.	Neutral

#	Sindhi Sentence	Romanized Sindhi Sentence	Sentiment Analysis	Ground through value
38	مان وچان ٿو اسڪول	Maa'n wanjan tho school	The text is neutral	Neutral
39	آهين تونشاگرد	Ahin toun shagrid	The text is neutral	Neutral
40	آهيان مان ڊاڪٽر	Ahyan Maa'n doctor	The text is neutral	Neutral
41	هوءَ آهي استاد	Huoaa ahe ustad	The text is neutral	Neutral
42	مون کي آهي ڪم لندن ۾	Moun khe ahe kam London maen	The text is neutral	Neutral
43	تون رهين ٿو نواب شاهه ۾	Toun rahen tho Nawabshah maen	The text is neutral	Neutral
44	تو ڪاڏو انب	Toun khado amb	The text is neutral	Neutral
45	هوءَ ٻوڙي ٿي روڊ تي	Huoaa dore thi road te	The text is neutral	Neutral
46	مان ڪيان ٿي پسند پيزا	Maa'n kayan thi pasand pizza	The text is neutral	Neutral
47	هي ڪري ٿو نظر انداز مون کي	He kre tho nazarandaz moun khe	The text is neutral	Negative
48	هي آهي هوشيار	He ahy hushiyar	The text is neutral	Positive
49	مان ڪيان ٿي پسند ڪيلا	Maa'n kayan thi pasand kela	The text is neutral	Neutral
50	ڪيان ٿي مان پسند ڪيلا	Kayan thi Maa'n pasand kela	The text is neutral	Neutral
51	مان ڪيڏان ٿي فٽ بال	Maa'n khedan thi football	The text is neutral	Neutral
52	مان ڪيڏان ٿي ڪرڪيٽ	Maa'n khedan thi circket	The text is neutral	Neutral
53	مان پڙهان ٿو ڪتاب	Maa'n parhan tho kitab	The text is neutral	Neutral
54	تون مدد ڪندي منهنجي	Toun madad kande mounhje	The text is neutral	Positive
55	تون هليو وڃ هاڻي	Toun halyo wanj hanne	The text is neutral	Neutral
56	۽ گهر ۾ بيد تي ڪچرو آهي	Kichro ahy bad te aen ghar mean	The text is neg.	Negative
57	بيد کي ٽوڙين ٿو	Torin tho bad khe	The text is neg.	Negative
58	تون پنهنجي گهر وارن جي لاءِ پارٽي سوچيندو آهين	Toun pahinje ghar waran je parhae je lae Positive sochindo ahin	The text is pos.	Positive
59	علم حاصل ڪرڻ هڪ پارٽي رستو آهي	Ilim hasil karan hik Positive rasto ahy zindagi guzarin jow	The text is pos.	Positive
60	علم سکي ڪري بين کي سيکارڻ پارٽي ڳالهه آهي	Ilim sikhi kry biyan khe saikharinn Positive galh ahy	The text is pos.	Positive
61	توهان جو بيد ڪرسي پڳل آهي	Tawha jow ahy bhaghal bad aen kursi	The text is neg.	Negative
62	تون هليو وڃ هاڻي مهرباني ڪري	Toun halyo wanj hanne maerhani kre	The text is neutral	Neutral
63	علي سمهي ٿو	Ali sumhe tho	The text is neutral	Neutral

#	Sindhi Sentence	Romanized Sindhi Sentence	Sentiment Analysis	Ground through value
64	سارا ڪائي ٿي انب	Sara khae thi amb	The text is neutral	Neutral
65	ڪير آهين تون	Kair ahen Toun	The text is neutral	Neutral
66	بيءُ جو نالو	Peeu joww nalo	The text is neutral	Neutral
67	ماءُ جو نالو	Maau joww nalo	The text is neutral	Neutral
68	پيءُ جو نالو	Bhau joww nalo	The text is neutral	Neutral
69	پيڻ جو نالو	Bheen joww nalo	The text is neutral	Neutral
70	مان ڪيان ٿي پسند چانور	Mai kayan thi pasand chanwar	The text is neutral	Neutral
71	صنم آهي هتي	Sanam ahe hete	The text is neutral	Neutral
72	هي آهي منهنجي ماءُ	He ahy mounhje maau	The text is neutral	Neutral
73	هي آهي منهنجو پيءُ	He ahy mounjoww peeu	The text is neutral	Neutral
74	علي آهي هتي	Ali ahe hete	The text is neutral	Neutral
75	سارا آهي استاد	Sara ahe ustad	The text is neutral	Neutral
76	اقرا آهي ڊاڪٽر	Iqra ahy doctor	The text is neutral	Neutral
77	ماڻهو پسندڪن ٿاچانور	Mannho pasand Kan tha chanwar	The text is neutral	Neutral
78	ماڻهو پسند ڪن ٿا اباريل چانور	Mannho pasand kan tha umarial chanwar	The text is neutral	Neutral
79	ماڻهو پسند ڪن ٿا چانهين	Mannho pasand kan tha chanhe	The text is neutral	Neutral
80	توهان پڳل بيد تي ويٺا آهيو	Tawha waitha ahiyo bhaghal bad te	The text is neg.	Negative
81	توهان بدسورت آهيو	Tawha bad sourat aahiyo	The text is neg.	Negative
82	اسان سڀني کي هڪ ٻئي جي لاءِ پارٽي سوچ رکڻ گهرجي	Asan sabhni khy hik biay je lae Positive soach rakhan ghurjy	The text is pos.	Positive
83	توهان جو ننڍو پاءُ ڏاڍو بدڪردار آهي	Tawha jow nandho bhau dadho bad kirdar ahy	The text is neg.	Negative
84	مسجد ۽ گهر کي ساف رکڻ پارٽي ڳالهه آهي	Masjid aen ghar khy saff rakhan Positive soach ahy	The text is pos.	Positive
85	تون ڪيڏين ٿي مون سان	Toun kheden thi moun san	The text is neutral	Neutral
86	ڊبو آهي ڳاڙهو	Dabho ahy gahro	The text is neutral	Neutral
87	مان ڏيئي ٻلي	Maa'n detho bhli khe	The text is neutral	Neutral
88	ڪٿو آهي هتي	Kuto ahe hete	The text is neutral	Neutral
89	تون ڳالهين ٿو انگلش	Toun galhaeen tho English	The text is neutral	Neutral
90	اسان کي نه وساريو	Naa wesaryo asann khe	The text is neutral	Neutral

#	Sindhi Sentence	Romanized Sindhi Sentence	Sentiment Analysis	Ground through value
91	نه ڊرجو	Naa drejow	The text is neutral.	Neutral
92	تون ڳالهايو ڪوڙ	Toun galhayo koor	The text is neutral.	Negative
93	ڪٿو چانهن	Khanno chahen	The text is neutral.	Neutral
94	نه اچو هتي	Naa acho hete	The text is neutral.	Negative
95	بلي ڊورڙي ٿي	Bilii dorhe thi	The text is neutral.	Neutral
96	هي آهي ٿوم	He ahy tom	The text is neutral.	Neutral
97	وڻ آهي وڻو	Wanu ahe wadho	The text is neutral.	Neutral
98	سج آهي گرم	Sijh ahy garam	The text is neutral.	Neutral
99	مان ڪاڻو ڪيڪ	Maa'n khado cake	The text is neutral.	Neutral
100	مان استاد کان نه ٿو ڊرجان	Maa'n Naa tho drjan tho ustad khan	The text is neutral.	Negative

Table I shows the data set of the research, which depends on one hundred sentences of RST. The data was obtained from the RST, which was obtained from different sources. Sentiment Analysis RST was done on the online Python tool. The obtained results of sentiment analysis are in the form of positive text, neutral text, and negative text. From the output results of the Python tool, 573 sentences have neutral sentiments, 8 sentences have positive sentiments, and 12 sentences have negative sentiments. After the task was performed on the tool, all sentiments were compared based on ground truth values.

IV. ALGORITHM FOR THE SENTIMENT ANALYSIS OF ROMANIZED TEXT (SINDHI)

Start

Take input: In sentence form of RST

Apply: apply one by one sentence till 100 sentences.

Analysis on tool: Analysis on the tool results (Neu, Neg and Positive) based on input sentence.

Evaluation: based on the ground truth values.

Process: Sentence run on tool Repeat steps 2 to 6 when get appropriate

End

V. EVALUATION OF ROMANIZED SINDHI TEXT

Results are evaluated based on RST's sentiment analysis, which is carried out using a web-based Python tool and ground truth values. The one hundred sentences in the RST are subjected to a sentiment analysis examination. The evaluation of RST is based on two key elements of the research, the first being the ground truth values and the second being the online Python tool. The results came from tool are in three categories of the sentiments positive, neutral and negative as shown in

Table II and Fig. 3. According to the results of the Python tool, 573 sentences had neutral, 12 sentences had negative, and 8 sentences had positive sentiments on the sentences of RST. According to the results of ground truth values 323 sentences had neutral meaning, 64 sentences had negative meaning, and 208 sentences had positive meaning in the RST.

TABLE II. SENTIMENTS ANALYSIS OF RST PYTHON VS GROUND TRUTH VALUES.

S. No.	Sentiment	Analysis By Python	Ground Truth Values
1	Neutral	86	76
2	Negative	9	17
3	Positive	5	7
Total		100	100

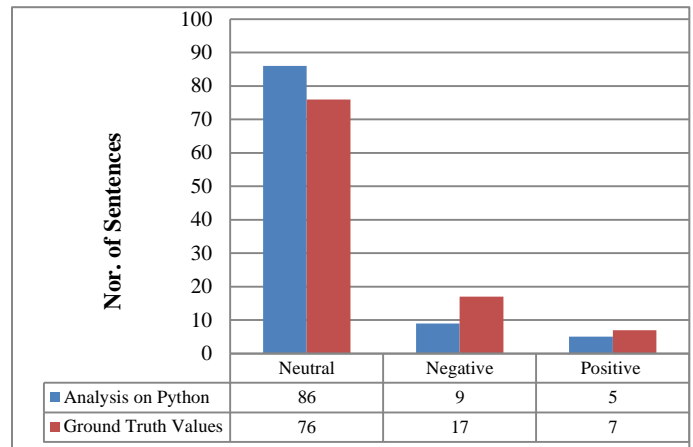


Fig. 3. Comparison of sentiment analysis (python tool and ground truth values).

According to the results of RST on Python, 86% of the sentences have neutral sentiments, 9% of the total results of sentiment analysis have negative sentiments, and only 5% of the total sentences of Romanized Sindhi Text have positive sentiments, as shown in Fig. 4.

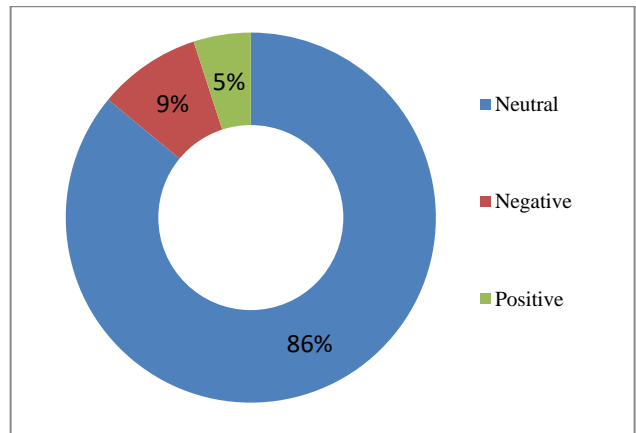


Fig. 4. Analysis of sentiments on online python tool.

As the results of RST on Ground Truth Values of sentiment analysis show, 76% of the sentences have neutral sentiments, 17% of the total results of sentiment analysis have negative

sentiments, and only 7% of the total sentences of RST have positive sentiments. Analysis of sentiments for RST on Python Tool is shown in Fig. 5.

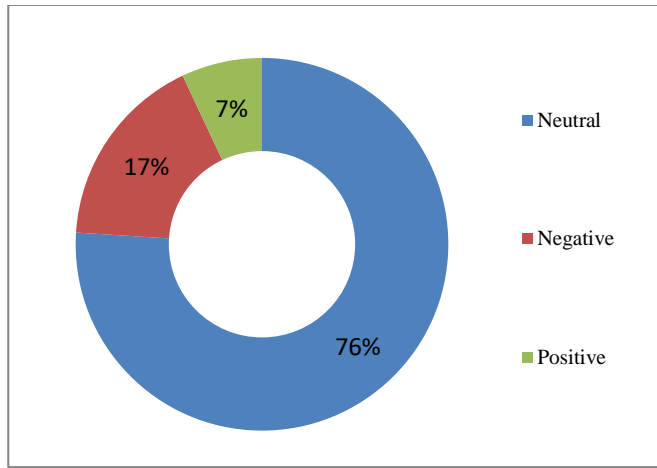


Fig. 5. Analysis of sentiments on ground truth values.

VI. ACCURACY OF SENTIMENT ANALYSIS OF ROMANIZED SINDHI TEXT

Sentiment analysis of RST has been done using the online Python tool for 100 sentences. In sentiment analysis, positive, negative, and neutral sentiments were measured. Output results of the sentiment from tool were compared with the Ground Truth Value of the sentences. After performing the task of sentiment analysis, the accuracy of the output results from the tool was measured on the basis of the ground truth values of the sentences [16, 17].

For the accuracy evaluation, a confusion matrix has been created on the basis of ground truth values, as shown in Table III, True Negative (TNeg), True Positive (TP), True Neutral (TNeu), False Neutral (FNeu), False Positive (FP), and False Negative (FNeg) [16]. After calculating the values of the parameters from the confusion matrix, the accuracy of the RST was measured on an online calculator, and the value is 87.02% on the basis of ground truth values as shown in Fig. 6. Also, error ratio of 12.98% was calculated on the basis of accuracy found on online calculator of confusion matrix.

TNeg = Both values (Ground truth value and tool (Python) are negative.

TP = Both values (Ground truth value and tool (Python) are positive.

FP = Ground truth values are negative or neutral and values from tool (Python) are positive.

FNeg = Ground truth values are positive or neutral and values from tool (Python) are negative.

TABLE III. CONFUSION MATRIX ON THE BASIS OF GROUND TRUTH VALUES

S. No.	FNeg	FP	TP	TNeg
1	0	0	1	0
2	0	0	1	0
3	0	0	1	0
4	0	0	1	0
5	0	0	1	0
6	0	0	1	0
7	0	0	0	1
8	0	0	1	0
9	0	0	1	0
10	0	1	0	0
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.
.
Total	2	8	81	9

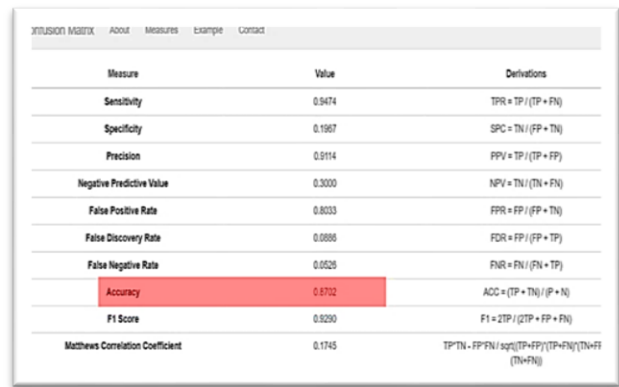


Fig. 6. Accuracy of confusion matrix on online calculator.

VII. ISSUES OF SENTIMENT ANALYSIS OF ROMANIZED SINDHI TEXT

Sentiment analysis of RST has been done on the online Python tool for 100 sentences. But during, before, and after performing the task of sentiment analysis on RST, faced issues with the completion of this task [18, 19]. While performing the task of sentiment analysis on RST, positive sentences were not identified by the tool (Python), but after the characters of the Romanized text were changed, and then the results came. Other issues are discussed below:

- 1) Even when a single word (positive or negative) is used for sentiment analysis on tool, output result was a neutral sentiment.
- 2) Input sentences were interrogative used for sentiment analysis, but the results were neutral sentiment.
- 3) When Punctuation was used as input in sentences, the results were mostly neutral sentiment.

4) Input sentences were used as Negative, but the results were neutral sentiments. But for the negative sentences of English word, bad is used in Romanized Sindhi sentences, the result was negative.

5) Input sentences were used as Positive, but the results were neutral sentiments. But for the positive sentences of English word, positive were used in Romanized Sindhi sentences, the result was positive.

6) When country name comes in any sentences output comes as neutral.

7) When (ignore) word of English comes in sentences with subject+verb+Object of Romanized Sindhi text used on tool and the result came neutral.

8) Neutral output comes when sentences without subject are used on tool.

VIII. CONCLUSION

In this research, sentiment analysis has been done on Romanized Sindhi text using a machine learning tool (a hybrid approach) and ground truth values. The machine learning tool is a Python online tool that is freely available to perform different tasks of NLP by using input text. In this task, we used a data set of RST. Sentiment Analysis of RST has been done on 593 sentences, and the sentiments of the sentences are positive, negative, and neutral. According to the results for the sentences of RST on the Python tool of sentiment analysis, 86% of the total sentences have neutral sentiments and as per Ground Truth Values of Sentiment Analysis 76% of the sentences have neutral sentiments. The overall accuracy of the sentiment analysis was measured from the confusion matrix, and the accuracy is 87.02%. Sentiment analysis of RST has been done using the online Python tool for the one hundred sentences. In sentiment analysis, positive, negative, and neutral sentiments were measured. Output results of the sentiment from tool were compared with the Ground Truth Value of the sentences. After performing the task of sentiment analysis, the accuracy of the output results from the tool was measured on the basis of the ground truth values of the sentences [16, 17].

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