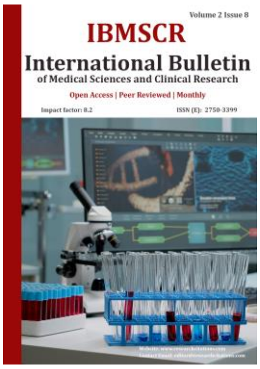

DIRECT APPLICATION OF IMPLICATION AND EQUIVALENCE

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Annotation. Discrete mathematics, which is increasingly gaining popularity, has also been able to find its own application thanks to the introduction of new information sciences using the binary number system, both in the face of classical and quantum computer science. In this paper, the question of finding not only the indirect, but also the direct direct application of implication and equivalence operations known since the 60s of the XX century, the search for which has continued to the present time, is considered.
Keywords: discrete mathematics, implication, equivalence, direct application, practical application, technical understanding, electrical circuit.

At the moment, a variety of operations are actively used in discrete mathematics and logic to describe the conduct of actions on judgments. So the main operations are conjunction, disjunction and negation, so known as logical multiplication, logical addition and logical negation, respectively. They allowed to operate on various judgments that accept the result either "true" - 1, or "false" - 0.

Each of the operations at the same time had its own truth table. For conjunction it is (Table 1), for disjunction – (Table 2) and logical negation – (Table 3).

Table 1. Table of truth of conjunction (logical multiplication)

A	B	A∧B
0	0	0
1	0	0
0	1	0
1	1	1

Table 2. Table of truth of disjunction (logical addition)

A	B	A∨B
0	0	0
1	0	1
0	1	1
1	1	1

Table 3. Table of truth of logical negation

A	]A
1	0
0	1

At the same time, for the conjunction (logical "And"), a serial connection scheme takes place in the practical description (Fig. 1), described in the following cases:

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1. If there is no current through "A" and through "B", as a result there is no current;
2. If there is a current in "A", but in the absence through "B", as a result there is no current;
3. If there is no current in "A", but in the presence of "B", as a result there is no current;
4. If there is a current in "A" and in the presence of "B", as a result, there is a current.

Fig. 1. Serial connection

For a disjunction (logical "OR"), a similar representation can be seen in the face of a parallel connection (Fig. 2), described already in the following cases:

1. If there is no current through "A" and through "B", as a result there is no current;
2. In the presence of current in "A", but in the absence through "B", as a result, the current is;
3. If there is no current in "A", but in the presence of "B", as a result, there is a current;
4. If there is a current in "A" and in the presence of "B", as a result, there is a current.

Fig. 2. Parallel connection

For logical negation (logical "NOT"), everything is even simpler, because it can be represented as an ordinary reverse button (Fig. 3), describing the actions as follows:

1. 1. If there is a current in "A", as a result there is no current;
2. 2. If there is no current in "A", as a result, there is a current.

Fig. 3. "Button" - logical negation in the circuit

But along with these operations, there were also implication and equivalence operations, where implication is a logical consequence or statement "Follows from here", and equivalence is logical equivalence and or the statement "Then and only then" had the following truth table (Table 4), and equivalence – (Table 5).

Table 4. The truth table of the

Table 5. Table of truth of logical

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logical consequence (implication)

A	B	A⇒B
0	0	1
1	0	1
0	1	0
1	1	1

equivalence (equivalence)

A	B	A⇔B
0	0	1
1	0	0
0	1	0
1	1	1

At the same time, both operations have not yet been applied in practice in direct form, as it looked for conjunction and disjunction. To date, the transformation is used for implication (1) and for equivalence (2).

$$(A \Rightarrow \mathrm{B}) \sim (\bar{\mathrm{A}} \vee \mathrm{B}) \quad (1)$$

$$(A \Leftrightarrow \mathrm{B}) \sim \big((\bar{A} \wedge \bar{B}) \vee (\mathrm{A} \wedge \mathrm{B})\big) \sim \big((\bar{A} \vee \mathrm{B}) \wedge (\bar{B} \vee \mathrm{A})\big) \quad (2)$$

That is, the implication can be represented as a negation of the first and a disjunction with the second statement, and the equivalence as a conjunction of the negations of both judgments on the disjunction of the conjunction of both judgments. If we check the truth of (1) and (2) on the table, then the result will be valid (Table 6-7).

Table 6. Checking the truth table to (1)

A	B	A⇒B	⌉A	⌉A∨B
0	0	1	1	1
0	1	1	1	1
1	0	0	0	0
1	1	1	0	1

Table 7. Checking the truth table to (2)

A	B	A⇔B	⌉A	⌉B	⌉A∧⌉B	A∧B	(⌉A∧⌉B) ∨(A∧B)
0	0	1	1	1	1	0	1
0	1	1	1	0	0	0	0
1	0	0	0	1	0	0	0
1	1	1	0	0	0	1	1

And the methods presented were considered the only possible ones to this day, until finally an electric element was created, a kind of connection in which implication and equivalence would be performed in the direct case.

The first device, the implicator, consists of a vacuum flask 7 with a cathode 3 and an anode 1, between which an anode grid 2 is placed. The distance between the cathode and the anode l is verified with the accuracy that it is less than or equal to the free path of electrons that have flown from the cathode to the anode. There is also an isolated electrode 6, connected from the outside (behind the bulb) to the cathode pin 3, but not connected to it (Fig. 4).

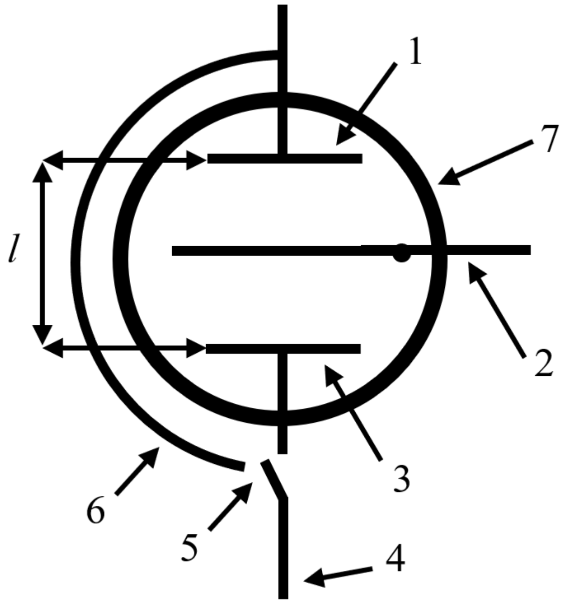

Fig. 4. Implicature scheme

Thus, let the anode grid 2 act as the second statement, the cathode 3 as the first, and the anode 1 as the result. At the same time, a condition is introduced that before the current 4 arrives at the cathode 3, a divider 5 is supplied, which reacts to the amount of the incoming current, if the current is greater than or equal to a certain value taken as the truth of the first judgment, then it is connected to the cathode 3, otherwise to the electrode 6 coming out of the anode. In this case, the exception is the case when there is a current on the anode grid 2, while it is assumed that the current does not go to the cathode and to the cathode circuit at all.

So, in this scheme, we can consider four situations:

1. If there is no current at the cathode and there is no current on the anode grid, then the current flows through the electrode to the anode, as a result there is a current;
2. If there is current at the cathode, but there is no current on the anode grid, then the electrons reach the anode, as a result there is current;
3. If there is no current at the cathode, but there is no current on the anode grid, there are also no electrons in the bulb, which is why there is no current as a result;
4. If there is current at the cathode and there is current on the anode grid, then the electrons receive additional acceleration, which means that there is also current as a result.

This device, as you can see, although with a couple of conventions, which can be completely replaced by reducing elements, a kind of sensors or switches, fully performs the function of implication. But it is also interesting to mention here that neither conjunction nor disjunction was used, nor even negation, unless of course the "switch" is considered an extremely distant relative of negation, which would be inappropriate. Moreover, this system acts as a single element that fully fulfills the task.

Speaking of this type of connection, it should be called a "close mixed" connection, or a "Promichtovoe" connection, from the Latin prore – "close" and mixta – "mixed", since both parallel and serial connection are involved here, but more figuratively, because of which this connection acts new – the third kind.

The situation with equivalence is similar, but the difference is that the distance between the cathode 3 and the anode 1 – L (for the equivalentor) must be strictly greater than the electron path length so that they cannot reach it without the help of an anode grid, which, however, explains why the implicator is connected "close-mixed" connection. When using the same equivalentor (Fig. 5) – a device that performs the function of equivalence, there are also 4 cases:

1. If there is no current at the cathode and there is no current on the anode grid, then the current flows through the electrode to the anode, as a result there is a current;
2. If there is current at the cathode, but there is no current on the anode grid, then the electrons do not reach the anode, as a result there is no current;
3. If there is no current at the cathode, but there is no current on the anode grid, there are also no electrons in the bulb, which is why there is no current as a result;
4. If there is a current at the cathode and there is a current on the anode grid, then the electrons receive additional acceleration, which means that there is a current as a result.

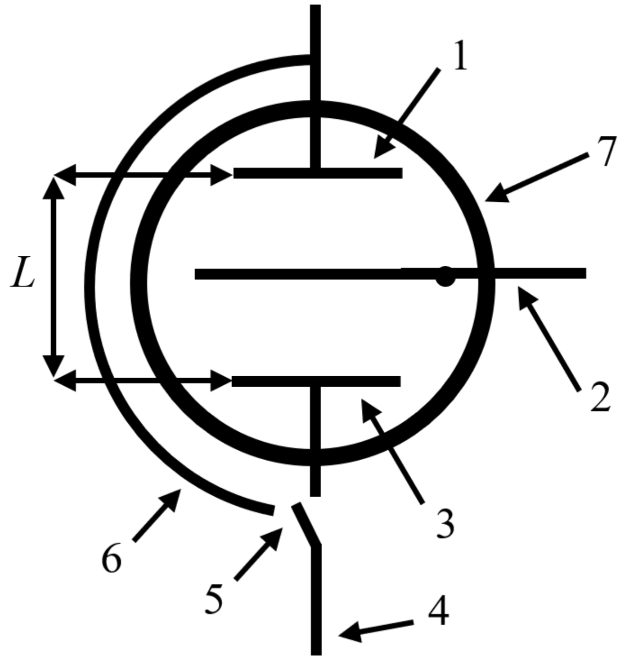

Fig. 5. The scheme is equivalent to

The equivalentor is similarly connected by the type of connection in this case by a "far-mixed" or "long–distance" connection, from the Latin longe – "far away" and mixta - "mixed".

Thus, it is possible to demonstrate two elements – an implicator and an equivalentor that fully perform the functions of implication and equivalence in modern electronics, finding perfect application, allowing to reduce space at times, because these circuits can be made in an arbitrarily small size, along with replacing the "diode-lamp" part with the presence of vacuum with modern triodes with the usual additional switchable connection for the implicator and more upgraded triodes with the same switches and connection for the equivalentator.

Presenting this scheme, we can hope that it will bring its benefits, contributing to the development of modern science and technology, improving and bringing new things to science, as well as opening up new even more grandiose horizons to the entire human civilization!

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