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Design and Application of a New Warp Stop Motion by using a Laser Beam

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ABSTRACT

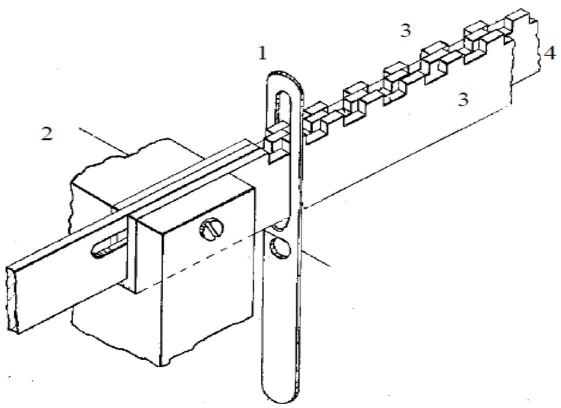
This paper presents the first report on design, construction and application of a genuine and new method of warp stop motion using a laser beam .It is based on the phenomenon of light dependant resistance (LDR). The Latter acquires very low resistance in light falls on it and very high resistance in the absence of the light. An electronic circuit was used with two resistances one of them was an LDR. When there is no yarn breakage, the light falls on the LDR, so its resistance becomes very low and the current in the circuit passes through the LDR and back to the source. In the case of yarn breakage the dropper falls crossing the laser beam preventing it from reaching the LDR, so the latter resistance remains very high and the current passes through the other resistance, to the transistor and then to the relay connected to the loom stopping mechanism Ten droppers were dropped by hand, one at a time, simulating yarn breakage and the result was that the loom stopped at the same moment a dropper was crossing the laser beam.

INTRODUCTION:

Since early times man has tried hard to improve the style of life he is leading by using different methods and tools and making use of the most recent innovations. At present and with the great development in science and technology, a great advancement has taken place in all aspects of life, especially in industry. The textile industry, as one of the most ancient industries, practiced by man is a good example of this advancement, The time (hours) needed to produce 100 m of fabric was reduced from 20 to 0.3 hours during the last 125 years (Ormerod, 1995).

Fabrics are produced by looms which consist of a number of mechanisms having different roles and motions, but work synchronously to give ultimately the required product. They also include other devices and control systems of which the warp stop motion system is of paramount importance. Warp stop motion systems are the mechanisms that stop the loom when a warp yarn breaks (ruptures), and it has to be remedied immediately by the loom attendant, otherwise the loom remains idle and a bad quality product may result. The currently used warp stop motions are either mechanical or electrical devices.

The Mechanical warp stop motion comprises of a number of different makes of this type of warp stop motion, of which the most commingled widely used is shown schematically in Figure 1.



1. Dropper.
2. Warp thread.
3. Outer fixed toothed bars.
4. Middle reciprocating toothed bar

Figure 1: Parts of the mechanical warp stop motion

When the dropper (1) freely falls between two teeth due to warp yarn (2) breakage, the reciprocation of the middle bar (4) which is connected to the stopping mechanism of the loom halts, It is important that the middle bar is adjusted in such a way to prevent the dropper falling on the top of a tooth, a situation which has no effect on triggering the action of the loom stopping mechanism.

Electrical warp stop motion is based on the fact that when the yarn holding the dropper breaks, the latter falls freely on two bars separated by an insulator, one of them is electrically active, thus connecting them and closing the electrical circuit of the loom stopping mechanism. Two such mechanisms are used in practice, one with a frictional clutch and the other with an electromagnetic clutch.

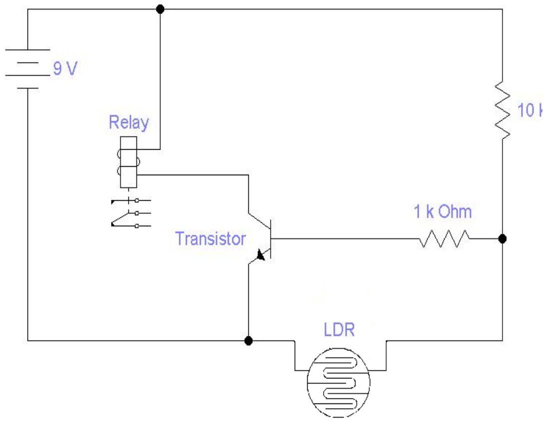
The objective of the present research was to develop a new warp stop motion using a laser beam. Similar to the former methods of warp stop motion, this method also uses a dropper to cross the laser beam thus preventing it from reaching a built in LDR receiver.

MATERIALS and METHODS:

The loom LOEPF SW10 present in Dr. Khalil Osman's hall for weaving, in the northern campus of SUST – Khartoum North was used in these experiments. The loom was operated with disabled electrical warp stop motion. A metallic bar across the width of the loom, perpendicular to the warp yarns was fixed. Ten droppers were used hanging slightly over the metallic bar on a small piece of paper. The droppers were dropped manually by pulling the piece of a paper thus simulating a warp yarn breakage. Driven by was used, a laser source A pointer and a 4.5v dry battery. The pointer was chosen because of two reasons: it provides non-scattering liplut in a form of a bundle of parallel rays of uniform diameter less than the width of the dropper and, it is cheap and available in the market.

The LDR circuit, which triggers the action of the loom stopping mechanism, consists of i)Power source in the form of 9V dry battery,

ii).Two resistances (a) 10 K ohm (b) 1 K ohm, iii).Transistor LDR (fixed to the right side of the loom) and IV). A Relay (connected also to the loom stopping The above components are connected as shown in figure (2) and picture (2.1)



mechanism) (Figure 2-Plate1).

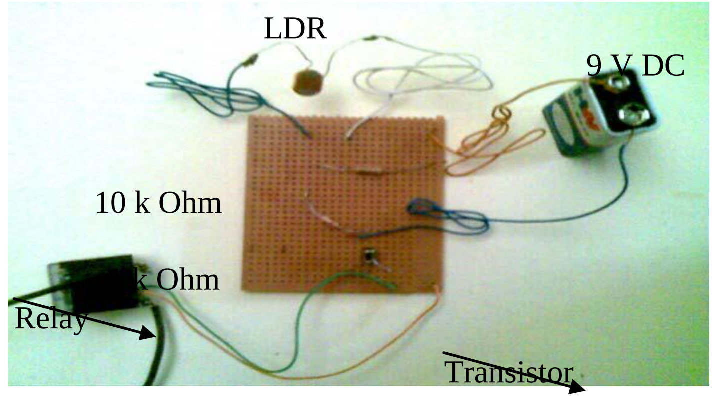


Figure2.The electronic circuit connection

Fig 2.1: Connection of the electronic circuit components

The components used in the experiment were connected to the loom. Metallic bar was fixed across the width of the loom

Perpendicular to the warp yarns, The 10 droppers were raised slightly from the bar by a piece of paper.

Figure 3. The middle bar across the width of the loom

The LDR was fixed to the right side of the loom while the light source was fixed to

The Left side (Fig 4and 4-1)

Picture 4: fixation of the light source

Picture 4.1: fixation of the LDR

Care was taken to ensure passage of the laser beam at a reasonable fixed distance below the lower tip of the droppers, to avoid disturbances due to the dropper's side movement (Figure 5).

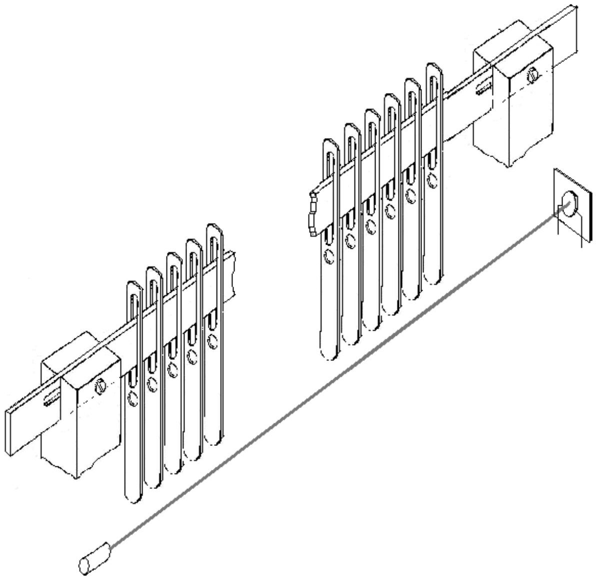


Figure 5: Arrangement of fixing the source of the laser beam

However, due to the high level of vibrations of the loom causing unsteady fall of the light on the LDR, it was necessary to fix the light source rigidly to the ground using a separate metallic frame. The relay was connected to the circuit of the loom stopping mechanism.

Methodology:

The theory behind this method resides on phenomenon light dependent resistance briefly when the loom is normally working and no yarn breakage occurs the light reaches the LDR. Hence its resistance is lower than 1 K ohm the current passes through it and then back to the power source closing the circuit. But when the light does not reach the LDR, due to yarn breakage and fall of the dropper, the resistance of the LDR becomes higher than 1 K ohm.

And as a result the current from the power source passes through the 1 K ohm resistance and then through the transistor to the relay. The relay closes the circuit of the loom stopping mechanism, which is then actuated to stop the loom.

Since the loom used in this experiment was working on commercial basis, intentional yarn breakage was not allowed and it had to be substituted by some means closely resembling the actual situation. This was achieved by hanging 10 droppers over the metallic bar fixed across the loom, by means of a small piece of paper. By pulling the piece of paper, the dropper fell to rest on the metallic bar, thus cutting the flow of the laser beam to the LDR, as shown in fig (6).

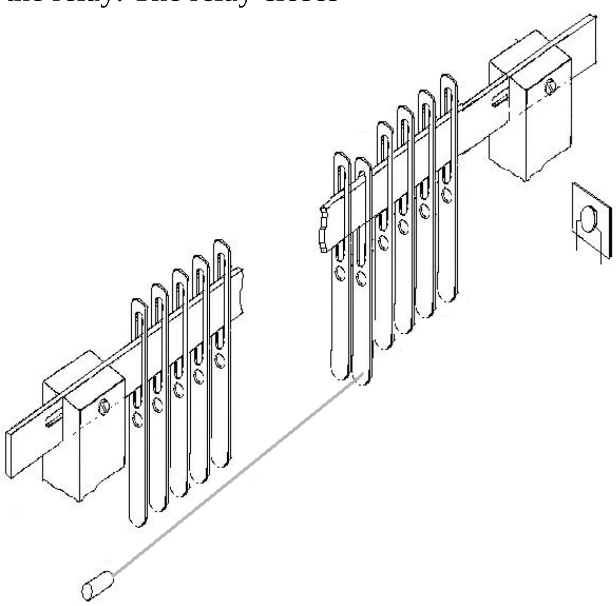


Figure 6: the falling of the dropper cutting the flow of the laser beam.

RESULTS and DISCUSSION:

The experiment was repeated using the 10 droppers one at a time and in all the 10 trials the loom stopped almost at the same instant the dropper crossed the laser beam.

The results obtained applying this new method of warp stop motion and under the conditions of the experiment using the materials mentioned earlier, seem very successful and encouraging. However certain limitations and short comings including vibrations in the loom and power sources have to be pointed out.

Vibrations in the loom affect adversely the performance of the device, since it causes unsteady fall of laser beam on the receiver. These vibrations were inevitable in our case, because the loom used was not rigidly fixed to the ground. This was remedied by fixing the laser source rigidly to the ground separated from the loom by means of a metallic frame. The situation may be different with looms having low vibrations, so further investigation is required in this respect. However using a laser source separate from the loom may be a privilege and a positive sign added to this method which may lead to further development in this field.

The power sources used in this experiment were dry batteries. These usually have short lives and their use in commercial production is not practicable, since they have to be frequently changed, which means increased downtime and so less production. Using AC to DC converters and lowering the voltage to the required levels represent a sound solution to this problem.

A general comparison of the wrap stop motion methods mentioned earlier is given below to show their shortcomings and at the same time to show how our new technique got rid of these disadvantages.

The mechanical warp stop motion is the oldest method used and it is becoming undesirable by the users for a number of reasons: It needs a relatively longer time from the moment of yarn breakage to the resumption of loom re-start. Sometimes the worker has to turn back the lower shaft of the loom a complete turn before fixing the broken yarn. In case of the dropper falling and resting on top of a tooth, the loom needs another turn to allow the dropper fall between the two teeth. As well the loom needs two turns before it stops. It is composed of various components which need regular cleaning, greasing and maintenance in addition to spare parts.

The droppers are subject to high shear stress when they fall between the teeth and so a special material for their manufacture is needed. In addition they have to be changed frequently.

Higher power of the loom motor is needed to cater for the additional movement of the mechanical components of the warp stop motion.

The electrical warp stop motion is generally preferred to the mechanical one since it gives almost immediate stop of the loom, when the dropper makes thorough contact between the two isolated bars. However, the main drawback is the hazard of fire outbreak which may be caused by the spark generated by the dropper fall on the active bar having 12 – 24 volts especially in the presence of the fly fibers in the production hall.

In addition there is the probability that the dropper, falling on the two bars, does not make a perfect contact between them and so the electric circuit will not be closed, The electrical warp stop motion devices having no mechanical components, are preferred at present, provided that spark generation is avoided and this may be achieved by, i) lowering the voltage of the active bar, ii) increasing the relative humidity in the production hall and iii) using slow igniting yarn.

CONCLUSION:

The new method designed, constructed and applied and described in this pepper very successful under the conditions stated earlier. But further work is needed to verify and confirm technical and economic feasibility of true new method for commercial productive.

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