Automatic Score Measuring Archery Target Board

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ABSTRACT

There are several challenges in developing an automatic electronic archery score measuring system. Many attempts have been done in last several years to develops such system but these always face certain limitations regarding accuracy, affordability, accessibility and power consumption. In this paper we present an attempt to develop such a system using pressure sensors, microprocessor and display device. This system has targeted to minimize the above limitations and to present a better performance.

Keywords
Archery,Scoring,pressure sensor,microproccessor

1.INTRODUCTION

Archery, an ancient and captivating sport, combines precision, focus, and strength into a beautiful display of skill and concentration. Dating back thousands of years, archery has played a significant role in human history, serving as a tool for hunting, warfare, and now, a thrilling competitive sport. Archery has transcended its historical roots and has become a globally recognized Olympic sport with captivating audiences. However this sport has faced any challenges regarding the process of score calculation. These days the process of observing and validating the results(Scores) by the judges, coaches and archers at Olympics level and international level is usually carried out with the help of electronics scoring system which have good precision and accuracy, and then the results are displayed on a digital scoring board[1]. Recently, Archery Analytics developed RyngDyng© to support archers and their coaches through measuring their performance, documenting and analyzing all recorded arrows and tracing improvements. But its use is only limited at Olympic. Unfortunately, this process of validating scores in Archery is quite expansive and such electronics scoring setup are not easily affordable and accessible to everyone. While In a lower scale competition for amateur and junior levels, such schools, colleges, and university events, judges, trainers and archers usually only use binoculars or approach the target board, to directly observe and validate where the arrow is stuck, to determine the point obtained . Moreover, until presently, this has certainly resulted in several disadvantages, such as time wastage in the observation and validation process, therefore interfering with the concentration of archers and affecting their next performance, or creating the possibility of debate between judges, coaches and players when determining the points obtained. To counter these problems several more approaches has been done including electronic scoring system[2] using image processing techniques and sensors [4].However affordability, accuracy and power consumption always remain as major challenges.

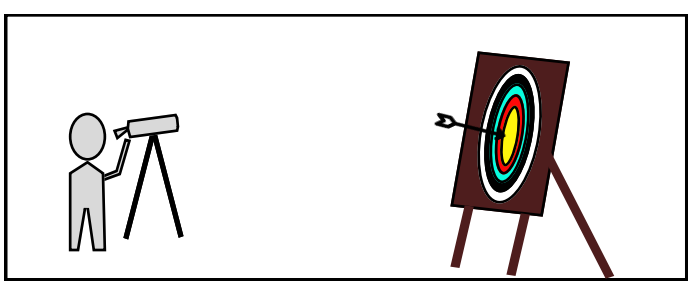

Figure 1.Binocular approach for score measuring.

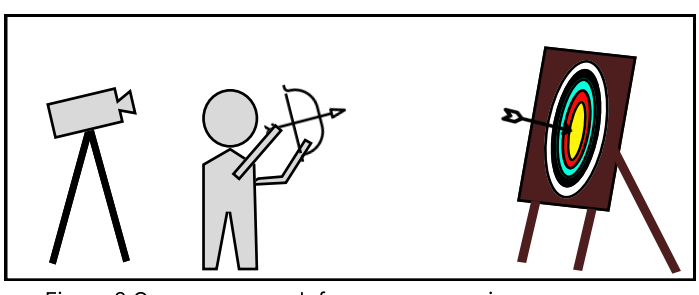

Figure 2.Camera approach for score measuring.

Our design 'Automatic Score measuring Archery target board' has tried to minimize the above challenges and to produce a better performance with low power consumption. The functionalities of different parts of our design is discussed in below sections.

2.BACKGROUND WORK

The design consists of four layers represented in the figure below.

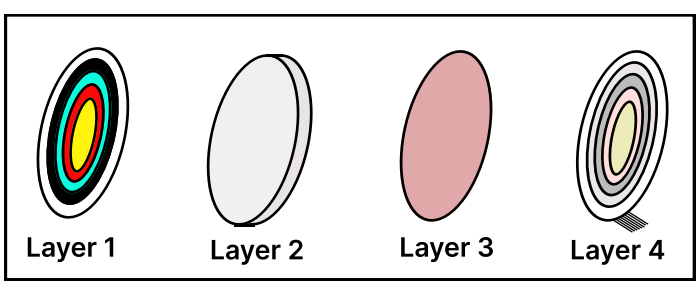

Figure 4.Layers of our Archery target board design for automatic score measuring.

Layer 1

Layer 1 consists of target marked sheet as shown in fig.3.The target marked sheet is pasted on the styrofoam.

Layer 2

Layer 2 consists of styrofoam as shown in fig3.It allow penetration so the the arrow get fix on the target board after striking.

Layer 3

Layer 3 consists of resilient knotted mesh material[5].It cannot be penetrated by the arrow and also absorbs the energy of the arrow to bring it into rest. It is pasted on the embedded pressure sensor concentric layers to prevent the direct attack of arrowhead on these embedded pressure sensors.

Layer 4

concentric layers of pressure sensor corresponding to each concentric circles marked on the target marked sheet are embedded in proper fashion to form a layer. These pressure sensors can easily be developed using piezoresistive material [6].

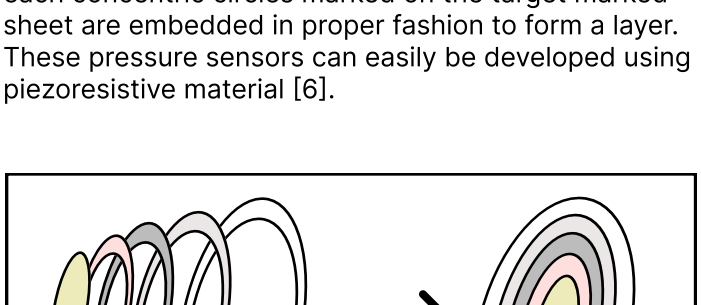

Figure 5.concentric pressure sensitive sensors forming pressure sensitive plate shown in fig.(b).

2.1. Further all these sensors have connectivity with a microprocessor(Arduino Mega) coded in C++ programming language. As the arrow strikes the variation in the resistance of the pressure sensors is detected and processed in the microprocessor and ultimately the result is displayed on the digital screen.

2.2. Score Detection.

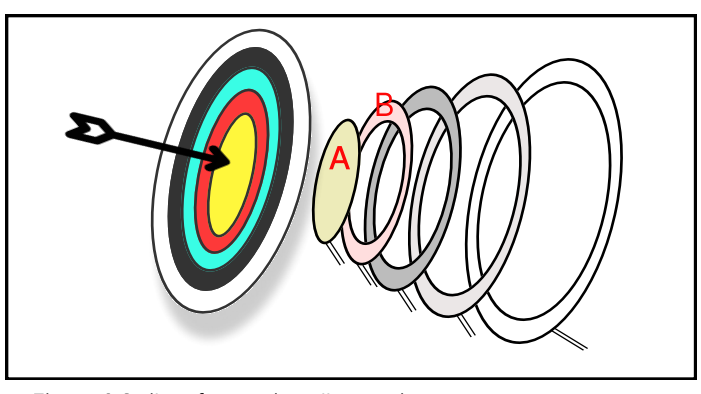

Figure 6.Strike of arrow in yellow region.

Let the arrow strikes the yellow region of the board then the pressure sensor A just behind the yellow region will experience a pressure and the remaining sensors will experience little or no pressure. The signal of pressure experience by sensor A will further processed in the microcontroller and ultimately corresponding score will be displayed on the digital screen.
Similar process will be there if the arrow strikes at the red region, here sensor B will come in role.
Now, if the arrow strikes just between the red and the yellow region, in this case three possibilities may be there.
Case 1:-Unequal pressure experienced by the pressure sensors 'A' & 'B'.
sensor experiencing more pressure will decide the score correspondingly.
Case 2:-Equal pressure experienced by both the sensors 'A' & 'B'.
Score will be decided as per the rule in archery and will be displayed on digital screen.

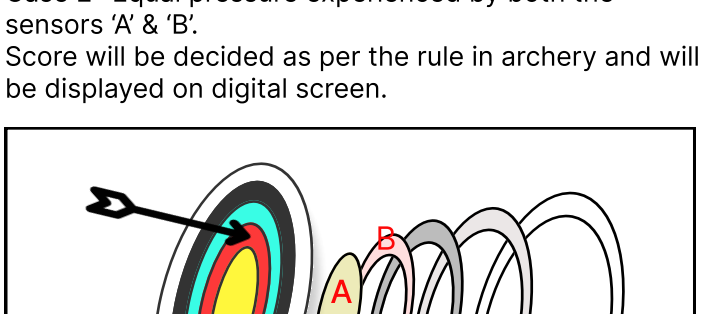

Figure 7.Arrow striking in the red region.

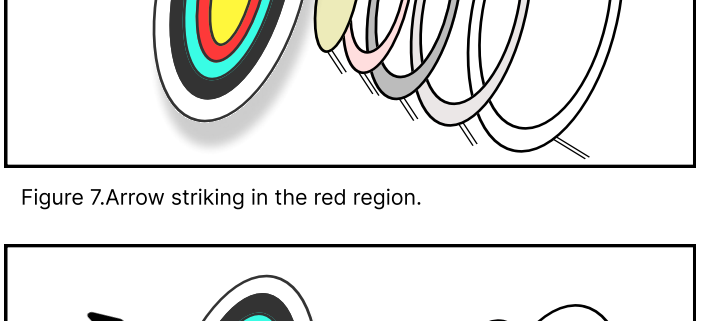

Figure 8.Arrow striking just at the interface of red and yellow region.

2.2. Preparation of pressure sensitive sensor.

The pressure sensors can easily be developed using piezoresistive material [6].These are the material whose resistance varies upon change in applied pressure. This variation is treated as signal in microprocessor.

3.WORKING OF TARGET BOARD

All the above layers are pasted over each other in order to form the required Archery target board.The block diagram for the board is described below.

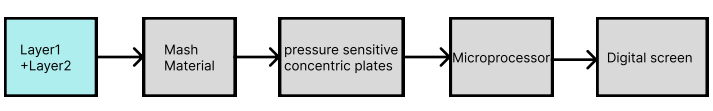

Figure 10.Block diagram for the our archery target board design.

3.1.The marked target sheet(fig.11.) is pasted over the styrofoam as shown in figure 6.This facilitates the easy penetration of the arrow so that it remain stuck into the board.

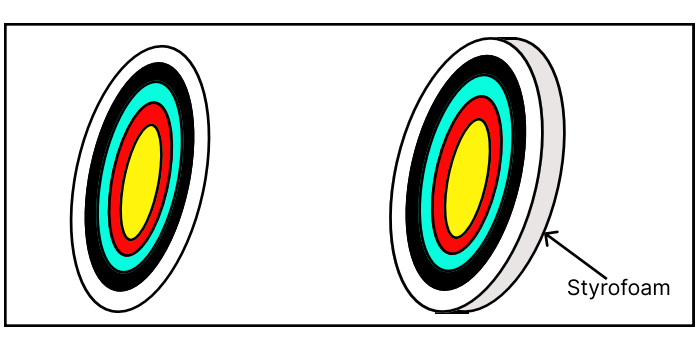

Figure 11.Archery marked target sheet.it is pasted on the styrofoam.

3.2.Just behind the styrofoam there is a layer of resilient knotted mesh material[5].It absorbs the energy of the arrow and can't be penetrated and thus protect the sensor layers from direct attack, which can damage the sensors.

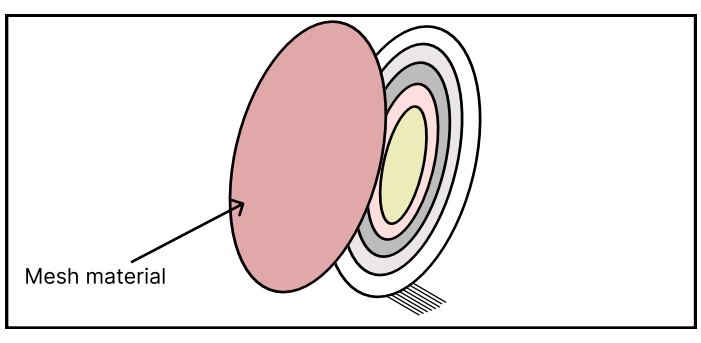

Figure 12.Mesh material and concentric pressure sensor layers.

As the arrow strikes the target board the impulse experienced by the mesh material is transferred to the pressure sensor just behind that. As result of this there occurs the variation in the resistance and this variation is transmitted in the form of signal to the micro controller. The microprocessor processes the signal and ultimately present the corresponding score on the digital screen.

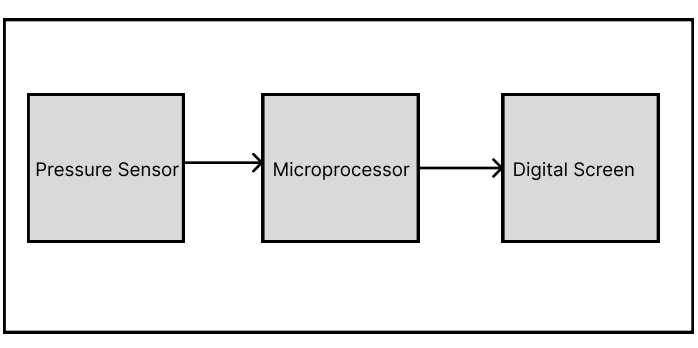

Figure 13.Work flow of the design.

4.CONCLUSION

This system can be efficiently implemented in archery tournaments to increase interaction between the competitors and spectators.It facilitates higher accuracy and it is easily affordable so that it can be used in even low level competition like in Universities, schools,colleges and locally.Although this system is developed for archery competitions, it can also be extended to gun competitions. A more simplistic version of this scoring system can also be used for any game that can be translated into a 2D scoring plane.

6.REFERANCES

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