



USE OF LOW COST INDUSTRIAL TECHNOLOGY IN SPORTS ACTIVITIES

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ABSTRACT

The use of hitting machines with low cost industrial technology with control systems is very important to learn to play sports as baseball or softball, thus increasing the ability to obtain the best results to make contact of the bat with the ball and generate a good play that supports a team to win. These practice systems are manufactured for different levels of capacity and abilities of people, including the basic ones at low speeds with which care must be taken even being at this type of capacity, later those of intermediate level are had at a moderate speed that also the safety of the batter should be recommended and those of high capacity with which extreme security for the people who practice is had, in order to have the ability to dodge if necessary that the ball has the direction towards the body and has speeds sometimes higher from 60 km / hour to 100 km / hour.

Keywords Industrial Technology, Low Cost, Control Systems, Sport Activities

INTRODUCTION

The batting practice teams are indispensable in improving the capabilities of hitters. Since baseball is a sport of great interest in our country in conjunction with soccer, and in Baja California it is considered to be what is most practiced by young people and adults, a project is being carried out with which the automated and specialized systems are replaced, and an average cost greater than \$ 1,000. The project includes motion control equipment with a detection system with lamps and a small electronic device to control the ignition of the batting machine. In addition, an adaptation of a piston was developed with the aim of having the balls on a rail and each one of them are delayed, so that when a batter wants to be ready in the right position, he receives a ball to be part of the practice process (George F et al, 2011). The equipment consists of a base with three supports to have the adequate support that helps to send the balls in the correct direction and not to the body of the batter

that can cause an accident. In addition, there are two types of levelers in the motion detector and lights, one of them being a turning one where the sensitivity of the movements to be detected is controlled. The other control device is the ignition time of the motor that contains the batting machine to indicate when it is in operation and achieve the maximum necessary energy savings, which is so much sought by companies in the Mexicali region, which is where it is generate high costs for the use of electricity. Another control system that is electrically connected to the batting machine is the ignition of a piston where it is contemplated that the batter can control the moment in which he is going to receive the ball to be connected and have the most suitable position for good contact and with it, go achieving the necessary goals of being an excellent hitter (Narum G et al, 2016).

Relationship of batting practice with industrial operations

The process of batting practice, related to the manufacturing processes, is part of the development of activities that lead to being more efficient day by day and thus having the maximum performance for companies. Having the appropriate positions at the operational levels, in the professionalization and managerial functions, in addition to having the organization and work methods, which indicate the appropriate strategies, leads to having the required capacities that always obtain the best results. in industrial plants that are part of the success of the companies and the personnel who work in them (Szymanski D, 2012). This is part of the project that is presented where knowledge of batting practice was required, as well as control systems with detection devices and indicators that show the desired operations, mainly motion sensors, in addition to the strategies involved. to improve at all times both in batting practice and in the functions of the companies. The way to connect the ball depends on each player and the style they take in the position to connect the hit, being known as hitting techniques, as shown by the two fundamental principles of the following figures (Hendrickson A et al, 2013):

a) Principle 1. It is known as the transfer of weight, which does not mean that it is a way of how to hit the bat, but a factor to properly connect the ball. The main aspect is the movement from back to front in order to have consistency and power (Figure 1).



Figure 1 Generation of the batter's back-to-front movement

Source <https://steemit.com/spanish/@maikelsoto/practica-de-bateo-aprendamos-un-poquito-mas-del-beisbol>

b) Principle 2. It refers to the position of the hips and the center of the body, where the rotation of the hip is an important part to be able to connect properly to the ball (Figure 2).



Figure 2 Position and movement of the hips and the center of the body

Source https://www.amazon.com/-/es/dp/B07741S7Y8?pd_rd_w=m9ui1&pf_rd_p=7b8af918-324e-4300-8643-71f9cef54439&pf_rd_r=KDWF5Y663SS8CCQWTQV9&pd_rd_r=cc5e6867-5ddf-4725-a9b2-73adecdb1741&pd_rd_wg=mBzBxni

The initial position and movements of arms, hips and body; was evaluated by industrial techniques as time and movements to improve the yielding of batters.

Relevant aspects

In the Mexican Republic, baseball stands out as one of the sports that is most practiced in conjunction with soccer and Mexico has stood out in international competitions with considerable results. Having ball throwing machines for batting practice is of great importance, to avoid first of all a hit to a person who would be throwing the balls to be hit by a batter. And secondly, the importance of being able to practice alone is considered, to obtain a better concentration in practice (Eben W, 2011).

The strategies in baseball

The development of sports activities requires methods with specific activities to obtain the desired goals. One of the sports of great relevance is baseball where operations such as batting practice are presented. To carry out this activity, the different types of speed of the ball to hit, shape and place where the person is who will hit the ball are analyzed, in order to obtain a good result in the process of hitting the ball (Narum G et al, 2016). This is part of the efficiency that a baseball player must have when hitting the ball, because based on this, the appropriate plays are presented for the teams. The situation that occurs in the batting process of a player is a fundamental part and similar to the activities carried out in industrial plants, where the efficiency of the personnel who work in them, as well as the working methods, are essential to be able to obtain the desired goals (Hendrickson A et al, 2013).

Skills and abilities in sport

There are important aspects in any activity, where both the capacities and the abilities of each person represent operational performance both at the sports level and for industrial operations. Experience is also part of the development of any activity and can be used to make complex plays, the same happening for industry functions. The way of taking the object (bat) with which the ball is hit is a factor that indicates the force with which the hit is made and with it the type of objective in each play (Szymanski D, 2012). This is shown in the same way in companies where it is necessary to take the necessary tools and with the appropriate position in any operation. Another aspect of interest is the way to carry out operations based on strategies to make plays in a baseball game and the same can happen in a company where there are various proposals for solutions and improvement of development opportunities that are presented and have the skills and abilities to solve them. Each player has his style from how to take the bat to the way to hit the ball, as well as the activities carried out by workers from the operational to managerial level. One of the objectives of a batter is to feel how he hits the ball to be able to send the ball as far as possible and if possible beyond the field of play indicating that he has achieved a home run (home run), which represents a run and if there were others in the game on the bases more runs are achieved process (George F et al, 2011). Any player likes to have feelings by having good contact with the ball and being able to cooperate so that they serve so that the team with which he participates wins. But the most basic skill since the beginning of baseball is what we know as a single, which is a simple connection somewhere on the field that served to get to first base. There are different types of systems with which you can practice hitting a ball with a bat with automated equipment; only they have a high cost, one of them being the one shown in figure 3.



Figure 3 Ball launch system for batting practice.
Source. <https://beisbol.store/maquinas-de-bateo/>

Batting Practice Machine Operation

At present, there are great hitters from the amateur to the professional field, being athletes, with abilities that exceed the extraordinary when making contact with the ball, while their style is concentrated in their own world, where discipline and honor for the physical activity are the basics (Romero E., et al, 2013). This is achieved with batting practice through the specialized teams for this activity. To learn more about the batting process, an explanation of the system that operates as follows is shown (Romero-Samaniego E et al, 2019):

1. The balls are introduced into a rail where they remain until the machine is turned on, where there are different levels of speed to throw the balls and different times to throw one and the other ball.
2. There is an engine that is turned on by means of a switch and once it is turned on it has a speed leveler and another as a waiting time.
3. The switches on the batting machine generate electrical conductivity and are connected to 12 volt direct current power levels from 120 volt alternating current.
4. The machine must be installed on either a three-post or a four-post base and orient it towards where the batter will be.
5. Once the machine is turned on and finishes its work, specialized electronic control systems that have a high cost or sometimes one person or several people collect the balls and feed them back to the batting machine.

This is the most essential of a machine for batting practice, in order to have the right skills and abilities to be an excellent hitter, being supported by the coaches based on their experience and strategies. The relationship of the previously explained of the batting machine with activities that are carried out in industrial plants, in such a way that there are different types of specialized equipment, as well as courses for the training of the personnel who will elaborate the operations, being indicated by experts from the functions to be carried out, the appropriate methods and strategies to always obtain the desired objectives (Karl J et al, 2018).

Piston operation

A piston is a component of engines, piston pumps, gas compressors, and pneumatic cylinders, among other similar mechanisms. It is the mobile component that is contained in a cylinder and has movements up and down. In an engine, its purpose is to transfer the gas expansion force in the cylinder to the crankshaft through a piston rod and / or the connecting rod. In a pump, the function is reversed and force is transferred from the crankshaft to the piston in order to compress or expel the fluid in the cylinder. In some engines, the piston also acts as a valve by covering and uncovering the ports in the cylinder wall (Christophe B., 2012).

Electronic control systems

In the area of electronics applied to any type of activity, there are electronic control systems (ECS) that greatly support low and high-power operations. The control systems can be of the electrical and electronic type where low or high-power levels are applied according to the type of control systems, they have their operating characteristics and they generate the energy necessary for the operation of mechanisms mainly with high levels of alternating current. These control devices are part of control engineering or engineering control systems, which is the engineering discipline that applies control theory to design systems with desired behaviors. The practice uses sensors to measure the output performance of the controlled device (of any operation) and the measurements can be used to give feedback to the input actuators that can make corrections towards the desired performance. When a device is designed to perform without the need for human input for correction it is called automatic control, as the cruise control for regulating the speed of a car). Control systems engineering activities can focus on the application of control systems, mainly derived from the mathematical modeling of systems of a great variety (Liu J et al, 2010).

MATERIALS AND METHODS

The project contemplates the performance of analysis, electrical connection and testing operations of

the electronic control devices in conjunction with the high-power activation systems that generate the required functions (Christophe B., 2012). The development of the activities was carried out with the adequate requirements to activate the mechanisms that operate in the batting machine. The electronic diagrams of the low power activation systems are shown below in figures 4 and 5, both for the activation of the hitting machine and for the control of the balls to be connected:

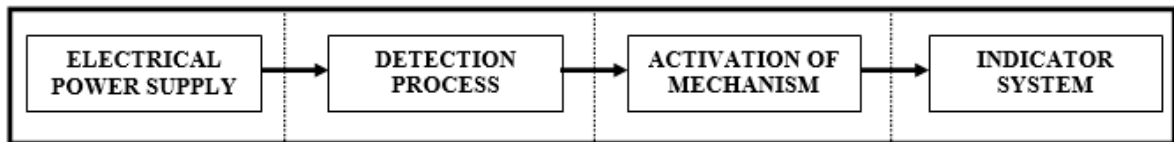


Figure 4 Electrical control system for automated piston activations installed in the batting machine

Source Investigation analysis

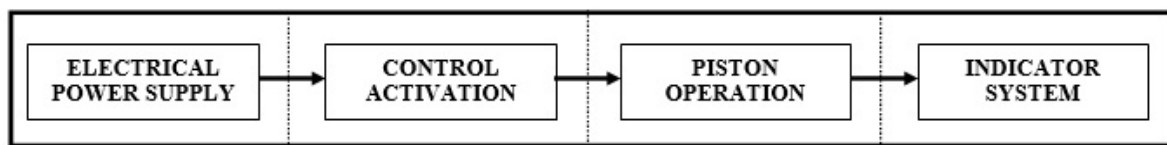


Figure 5 Electronic control system for automated hitting machine activations

Source Investigation analysis

The assembly process of the tamping machine consisted of several stages, as shown and explained below (Karl J et al, 2018):

Step 1 The assembly of the machine with its supports is carried out according to the orientation of the batter who will have batting practice. This is developed according to the distance the batter will be, the type of ball (soft or hard), the angle at which the balls are required to be thrown, as well as the speed at which the machine is to be used. All these factors are key to achieving the main objective, which is to connect with consistency and power to the ball and be a good hitter. In addition; it includes the assembly of a protective mesh for the batting process and prevent damage to the ball someone (Figure 6).



Figure 6. Manual assembly process of the machine and mesh

Source Investigation analysis

Step 2 A variety of electronic devices and systems were analyzed to determine which of them could be indicated for the batting machine, where the on and off can be controlled, in addition to the launch process with a piston that is activated and allows that he passes only one ball at the moment he wishes and then allows the launch of another ball (Figure7).

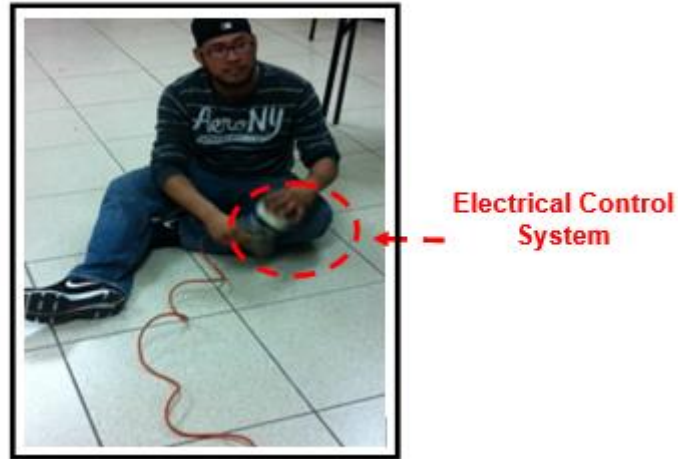


Figure 7 Control system used for turning it on and off before connecting it to the batting machine
Source Investigation analysis

Step 3 Once the control systems had been determined, the assembly process was carried out where the operation of the control that activates the two mechanisms was observed, such as the off and on process and the piston controller, which is the one that allows a ball to pass and be thrown by the machine (Figures 8 and 9).



Figure 8 Control system used for switching on and off once connected to the batting machine
Source Investigation analysis

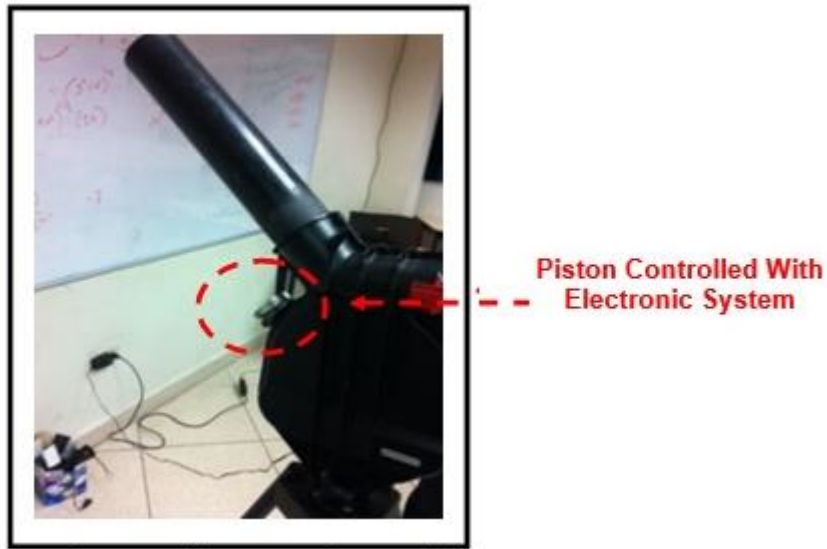


Figure 9 Control system used to activate and deactivate the piston when it is connected to the batting machine

Source Investigation analysis

This investigation contemplated the use of low-cost electrical and electronic control systems where a great diversity of designs was developed and different electrical and electronic devices were evaluated, such as resistors, capacitors, coils, relays, integrated circuits, diodes, transistors and others of low and high power where both direct and alternating current are used. The electrical conductivity devices were analyzed based on their properties, where their power capabilities and response speed were observed that is showed in figure 10.

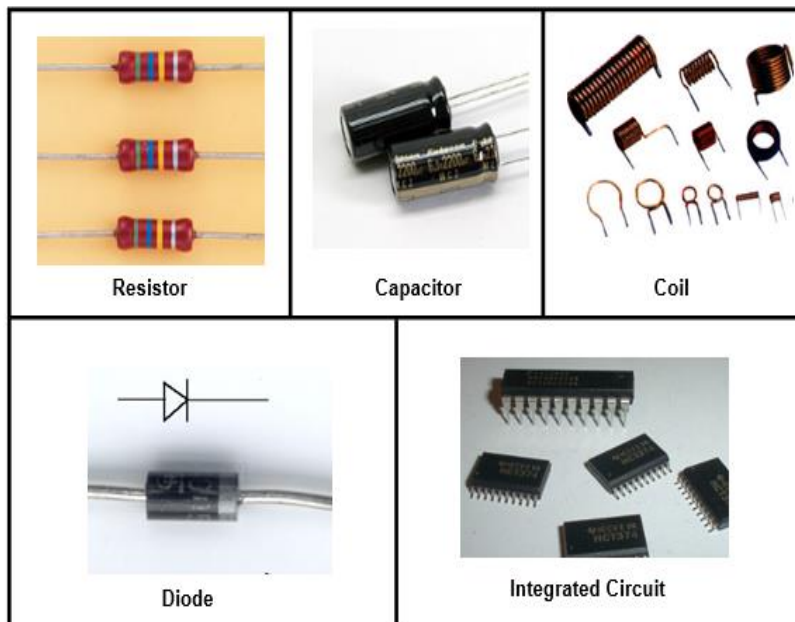


Figure 10 Electrical and electronic devices used in the control system
Source Investigation analysis

RESULT AND DISCUSSION

This section is a fundamental part where the objectives achieved in the investigation are shown. It is here where the achievements of the operation tests of each stage mentioned above are indicated and an evaluation of its operation is made (Figure 12). It is worth mentioning that the cost of the shutdown system was adapted from a movement detector equipment and with a low cost of around 200 Mexican pesos, which is installed in homes, shops and industries, with the appropriate requirements, for the research project. In addition, the piston control system has a cost of less than 100 pesos, being specifically designed for this activity. Batting practice lasts 1 minute for each ball that is thrown, and according to the tests carried out, some strategies were taken into account to be able to connect with consistency and power, to have great connections with the balls. In a proper training process, it is necessary for the hitter to be between half and an hour, making the necessary attempts to have the appropriate capacity, according to the abilities of each person. The placement of the hands and arms were factors that supported better contact. The batter's height is also essential as a base of support for a good hitting operation.



Figure 11 Evaluation of batting tests with automated control systems
Source Investigation analysis

In the evaluations, several types of strategies were observed, where the players who participated in the test, thought that batting practice improved not only the sports field but also the coordination of their movements. Several test players showed their gazes focused on the hitting machine and mainly where the ball was thrown from. An important aspect that the players indicated that a batting practice does not make them one hundred percent proficient in the game, because the pitchers sometimes throw the balls with some movement called curves, which the batting machine does not, it only throws. at low, medium and high speed in a straight line. As with any other sport and activity, it is necessary to always be a part of the game or operation to be aware of the requirements to continually practice to improve batting technique styles. Experts in hitting consider that it is of great importance to have this type of test, but also being in the game gives the experience to be the best hitter. Also hitting experts, it can affect the way the ball is hit in a game, because you do not have the idea of what the game is going to show, but if it supports a lot for people who do not, they have the experience and confidence to be able to have the best contact with the ball. Different opinions from what is commented in the previous paragraphs, the evaluated players showed great interest as to have better orientation in the game and others as part of a relaxation process that supported being part of their normal life such as sports activities considerably like the being with family. The players showed that having good contact made them have good feelings where the confidence to perform any type of

activity was mainly shown. This research represents the use of prototypes of this type of functions as part of recreational and family activities. In batting practice, usually a coach stands behind an L-shaped screen located midway between the mound and home plate. The objective is to throw consecutive pitches and be able to hit, simulating speed fields as the theoretical analyzes. The real work for hitters is done on and off batting practice machines, and against low, medium and high-speed pitches. When the players did not have adequate batting practice, it was observed that they lost their fear of various situations of lack of concentration. Among the many things that divide pitchers and hitters, there are few sources of friction more contentious than batting practice.

CONCLUSION

Being, baseball is a sport defined by routines and traditions, and few are those who have more ingrained batting practices, a pre-game ritual is always performed which is one of the main ancient traditions that most teams they develop so that their players better day by day. For two hours before almost every game, each team dutifully extends the batting cage and slowly hits balls pitched outside the baseball fields. In this research project, it was observed that skills were coordinated in certain cases and the opportunity to obtain the necessary qualities and skills was much greater. Unless they are working in the pitchers' practice place (bullpen), pitchers wait for the moment to challenge the batters. The project developed is of great interest to the sports field, since it can be applied to other types of sports activities such as tennis. The main objective of the study was to evaluate the various types of electrical and electronic devices and systems that support having control operations in the hitting machine, indicating that these areas of engineering are widely applied in the sports field. The use of safety cage nets is of great importance to avoid any harm to people who observe the batting practice process and to be able to take photographs that are part of the choreographic operation of how batting techniques are evaluated. This is why the use of low-cost electronic and electrical devices can perform the functions in any type of activity. The analysis of the batting practice has a great relationship with the operations carried out in companies and therefore, they can be correlated in such a way that similar strategies are generated with which great objectives are achieved in the manufacturing processes. For many people, batting practice is just for hitters to see how far they can hit the ball to hit home runs. However, for baseball strategists, this activity is an integral part of pre-game preparation that - when done right - increases the odds of achieving the goal of always winning. In most batting practice processes, groups are generated according to the capabilities and skills of the batters, where at times, there are competencies to know the batters with greater consistency and power. This is done for if they participate in a professional way to obtain better performance and that leads to better economic benefits, as they sometimes receive extra bonuses.

REFERENCE

- [1] Christophe B. (2012). *Designing Control Loops for Linear and Switching Power Supplies*, A Tutorial Guide of Control of Systems, Artech House Ed., pp 125.
- [2] Eben, W. (2011). Multimode Resistance Training to Improve Baseball Batting Power, *Journal of Strength and Conditioning Research* Vol. 28, No. 3, pp 32–36.
- [3] George F., Young H., DeJong A. (2011). Analysis of Time and Movements in the Baseball Activities, *Multidisciplinary Research Topics*, Vol. 7, No. 3, pp 39-56.
- [4] Hendrickson A., Russell L. (2013). Techniques to Play Baseball, *International Sports Journal*, Vol. 3, No. 1, pp 23-31.
- [5] Karl J., Richard, M. (2018). *Feedback Systems: An Introduction for Scientists and Engineers*, Princeton University Press Ed., pp 89.

- [6] Romero E., Toledo S., Garduno R., Márquez C., Hinojosa J. (2013). Corrosion in Control Systems Decrease the Lifetime of the Electronic Devices of the Industrial Plants of Mexicali, BC, Mexico, January 2013, *Open Journal of Air Pollution*, Vol. 2, No. 2, pp 29-35.
- [7] Liu, J., Wilson W., Farid G., Eric K. (2010). A novel fuzzy framework for nonlinear system control, *Fuzzy Sets and Systems Journal*, Vol. 161, No. 21, pp 2746–2759.
- [8] Narum G., Sorensen M., Andersen C. (2016). Baseball Batting Techniques and Engineering Tools, *Research Engineering*, Vol. 5, No. 2, pp 88-99.
- [9] Romero-Samaniego, E., Toledo-Perea S., Lopez-Rodríguez, R. (2019). Dispositivo automatizado para control de micro corrosión generada en convertidor de ozono instalado en área de producción de industria aeroespacial de Mexicali, Vol. 3, No. 9, pp 24-32.
- [10] Szymanski, D. (2012). Effect of Various Warm-up Devices on Bat Velocity of Intercollegiate Softball Players, *Journal of Strength and Conditioning Research*, Vol. 26, No. 1, pp 45-62.