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# DESIGNING OF A CNC TRAINING SET

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**ABSTRACT:** Computer Numerical Control (CNC) is a system in where computer numerical control codes determine machining and sizing process of a work piece. Today, most of the products in manufacturing sector are produced by CNC lathes. Therefore, CNC lathes are indispensable parts of the manufacturing sector. In order to bring up operators who use CNC lathes, related courses are offered in our educational institutes. In different vocational high schools, faculties and vocational college, some knowledge such as basic lathe system, lathe usage, lathe programming, way of thinking three dimensional and work piece machining are offered to students who are candidates of being employed in this sector with the aim of reliable, effective and correct usage of these sensitive lathes that are so important for manufacturing. But, these learnings will be permanent and education will reach the target if and only if theoretical knowledge is followed by practical training session. In this study a training set that is low-cost, completely prepared in Turkish and educational has been designed and manufactured (produced) for the students who are getting CNC education. Training set consists of an electronics book that includes theoretical knowledge, a multimedia environment that includes usage, programming and structure of CNC, an editor that is used as programming environment, a simulation environment where written program‘s results can be viewed and a mini CNC lathe which has same functionality of original lathe and has the capability of processing work piece. Combination of all these materials made up training set and let the student to see the work piece from draft to production.

**Key words:** CNC, computer based numerical control, training set, cnc machine training

## INTRODUCTION

Metal parts of the many tools and machines we use in our daily life have been manufactured through metal cutting processes such as turning, milling and drilling. Producing manufactured products, which we use so frequently in every parts of our life, makes this sector one of the most important sectors operating in the industry. Because of its importance, this sector has to renew itself parallelly to other sectors and development of the technology.

Especially turning, milling and drilling are frequently used processes in manufacturing operations. These operations are performed by using turning, milling and drilling machines. Conventional machines which were used in past are still used in some areas, but today, in general, computer controlled machines have replaced them. The use of Numerical Control (NC) and Computer Numerical Control (CNC) machines has become fairly widespread parallelly to developments witnessed in 20th century.

Thanks to their some features such as high cutting and drilling capacities, high speed, precise and productive operating properties; CNC machines have become indispensable elements of the sector. These machines’ being so popular in the industry has brought a demand for qualified employee. Because, while a basic level of turning and milling training is enough for conventional machine operators, and it can be learnt through master-apprentice relationship, for CNC operators beside these basic skills; some higher level skills such as basic computer knowledge, CNC code reading, writing and interpreting skills are required. When the conditions such as diversity, size, sensitivity and the high cost of machines are considered qualified employees gain more importance.



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The most important places in which employees can acquire knowledge and skills to use these machines are; CNC departments of Anatolian Technical High Schools, Anatolian Vocational High Schools, Industrial Vocational High Schools and Technical High Schools in high school level, and graduate schools and vocational schools in higher education level.

With this study; a CNC training set will be introduced for institutions and organizations who aims to give in-service training to their employees to help them to enhance their knowledge and skills .For CNC training in training courses; CNC machines or costly foreign origin CNC training sets have been used. A minor mistake that an operator may do may cause great troubles, and this situation may put training institutions into trouble about repairment and replacement of the machines which are hard to be owned because of their high costs.

Within the scope of the designed CNC training set, there is an electronic book media by which theoretical information on use of the machines and their programming can be acquired, and there is an editorial environment in which tentative programme codes can be written and there is also a simulation media on which a simulation of a prepared simulation can be seen. Thanks to this training set; training institutions will have an opportunity to have a complete training set which is cheap, made in our own country, enables individual learning and covers all environments required all in one for CNC training.

## EDUCATION - TRAINING and TECHNOLOGY

Erturk, (1979) states that education is individual's practicing voluntary behavior process through his own life intentionally. With respect to this definition there are three main characteristics of education. First; behaviors of an individual must be modified in the intended direction, secondly, behavior modification occurs through individual's own experiences (as a result of coordinated knowledge and communication with the environment), and third, education is a planned and programmed process (Özdemir & Yalın, 1999). As it is clearly seen, the most emphasized point in education is behavior modification. If behavior modification takes place in the intended direction it means education is successful.

Education is not only limited to school and school periods, it continues at any time and every aspects of life. Everything a human being does in his life brings him knowledge, experience, change in attitude and behavior, and this makes some changes on him. In short, as some behavioral changes can be achieved through education process, in order to educate people in the direction of desirable qualifications people are required to have experiences that provide desired properties them, and by this way some behavioral changes must be achieved.

A society which consists of educated people means a society with high workforce level and a better society. In the society formed on which education is applied in various areas almost all sections of the society need for education in order to step forward. For institutions and organizations which aim to get into competition technically, economically, socially and commercially, and want to be the best providing adequate and high quality education has become a necessity.

Every individual, institution and organization who comprehends the importance of education minds not only how technical knowledge or product is important but also how education on these products and the profit they will have are important. Today, in purchasing process of the best machines, programs and technical devices that are produced, people don't only search for their uses and functions; they also search if they can make use of it with its educative way and the technical support that will be taken in the use of these products. All of these mentioned above present the importance education.

Technology that brings great conveniences to all areas of our lives and that serves as a bridge between practice and science also brings great conveniences in the area of education. The educational technology including all aspects of human learning case, systematically analyze problems, all the relevant elements to develop their solutions (manpower, information, methods, techniques, tools, editing, etc.) is the work that is developed by running the appropriate designs, implements, evaluates and manages a complex process (Yalın, 2004).

One of the largest reflections in educational technology is also the use of computers. The computer, due to the high initial cost of purchasing, even though it seems a little expensive for education to keep the students active, to provide student-centered education, to present the information in the required format, when all of these are taken into account is an affordable training tool in the long term. Thanks to computers and educational software

specially designed for educational purposes in education, in order to make an effective education the required principles can be applied more easily.

## MACHINE TOOLS and CNC

Obtaining as raw material in a desired shape, form and appearances to obtain a suitable material in the means of production used is called machine tools. By machine tools especially metal, wood, plastic and other materials and marble can be processed. Raw materials that are fastened to the machine tools for the purpose of the counter, task, and the function and thanks to the moves of transactions in certain parts of the machine tools pass through a series of operations. The manufacturing that will be made through these lathes is divided into two as with sawdust and without sawdust. Manufacturing with sawdust from the work piece surface gets its name it's being made through lifting. The process of turning, milling, drilling, shaping, broaching, grinding, honing, lapping is made in the sawdust manufacturing process, on the other hand casting, forging, pressing, rolling, drawing, extrusion, bending, welding, gluing, soldering is made in without sawdust manufacturing process. The common feature of all these processes is based on the trio of team piece and the process. Generally, in the past the without sawdust manufacturing process was used but today mostly the sawdust manufacturing process has been used.

For Soysal (1991), the first appearance of the machine tools goes back to the 16th century. In 1540, an Italian called Torriano, in the manufacture of a clock that would be presented to the Spanish King Charles V, has used the first sample of milling machine. This machine consisted of an adjustable cutting rotary index table with a hole cutter. The ancestor of modern machines is taught to be used in 1775 by John Wilkinson as a horizontal boring machine. The first turning machine was made around 1780s by Henry Maudstay (Özdeveci, 2001).

In line with technological developments to improve the quality of machines, to ensure easier reproducibility, low cost and in order to replace easier working conditions, it was automated. Thus, the part of the processing of the information data after they were operated given by the human made conventional lathes, was found out that the data were composed of the numerical program code that the lathes can understand.

The Numerical Control (NC) can be named such: to control a movement of numerically, to control a movement numerically or in other words, according to a particular number system to control a system of coded input signal and the implementation to the appropriate logic and finally the desired output is achieved according to the commands within a tolerance (Koçlu, 2002). NC is written to the control unit according to the features of the desired part to be produced and the shape of the piece. In line with the data on the lathe the move command is sent to the active pieces and making the parts that are needed active the pieces are processed. Again, in line with technological developments, with the introduction of computers in our lives, as a result of the integration with the computer program code storage on NC lathes, CNC came into being (Computer Numerical Control). The CNC lathe is a machine that composes certain letters, numbers, symbols and that is connected to the counter depending on the encoded commands to a particular logic. Working with the CNC lathes in the various stages of the metalworking methods has great advantages. In parallel with the development of technology, the structure of the CNC lathes has increasingly developed and begun to be used in different areas. Generally, today the CNC lathes are manufactured and being used. Even in small numbers, the conventional lathes have been used and manufactured.

The CNC lathes, through the integration of control unit of the lathe with the computer, along with the programs stored in memory it is possible that the software stops at every stage of piece manufacturing, may be necessary to make changes in the program, to continue the program again from thick, and it is also possible to be able to keep the program in memory with the final form. Thus, once installed the program control unit is sufficient. The transfer of the program to the lathes can be in two ways, one is via the vertical panels and the other is the codes can be produced on the computer and the digitized data through a cable (Dinçel, 1999).

In today's world the CNC is being used in the area of industrial manufacturing sawdust. Today's CNC was emerged as a result of the problems that are encountered in this field mentioned above. When three-axis milling lathe was first operated in 1952, it was perfect as providing the solution of that day's some manufacturing problems. Those systems applied to the lathes was later also applied to turning and grinding lathes. Today, CNC has been used in almost every field of manufacturing facilities (Dinçel, 1999). CNC technology has been used in some areas such as; lathes, milling machines, drilling and grinding machine tools, measuring machines and tools,

bending-bending machines, pipe bending machines, shaping machines, welding machines, dyeing machines, woodworking machines, drawing machines.

The primary and the biggest benefit of CNC lathe is its allowing automation. By the use of CNC machines, the intervention of the operator during the manufacture of the work pieces can be minimized or eliminated completely. During machining process, most CNC machine tools can operate without of any outside intervention, so that the operator has a chance to find time to deal with other works. This enables CNC operator to minimize his errors, and minimize errors caused by human being, machining time to be determined in advance and completely. Since the machine will be running under program control, when compared with the operator of a conventional machine who made the same parts, the level of basic skill experience of CNC operators are considerably reduced (Mamur, 2005).

The second major benefit of CNC technology, sensitive parts of the business come out equally and are constantly. Today's CNC lathes have incredible positioning and repeat capacities. This case, after the program has been checked; enables two, or ten thousand in the work piece to work in the same precision and dimensional accuracy (Mamur, 2005). Moreover, when compared with other lathes it can save the data and consistently write programs (even if the electricity goes off, will not be affected) can be stored in lathes' memory, later can be used at any time was called back. Adjusting these lathes in the program and adding new information process is very easy. Thanks to the sub programs, the programs used mostly are always with you. The calculation process of compensation values is made automatically by the lathe, and this provides a number of advantages. Thanks to the simulation appears on the screen of the program, the operator is able to have information momentarily about the operations performed. Being able to find out the faults of the lathes can be found out in the control is another advantage of the lathe. Automatic changing cutters provide users with great amenities. Thanks to the memory of the lathe can be accessed by an external computer, the users are able to send the programs directly to the lathe, and use the program in a different computer.

## CNC TRAINING

The CNC training in Turkey in high school level has been taught in Anatolian Technical High School, Anatolian Vocational High School, the Vocational and Technical High School and the School at tertiary level and in vocational schools. The CNC departments of these schools have CNC courses and on the other hand it has been also taught in other departments.

The CNC courses taught in high school level to vocational and technical schools are such in the following due to small difference.

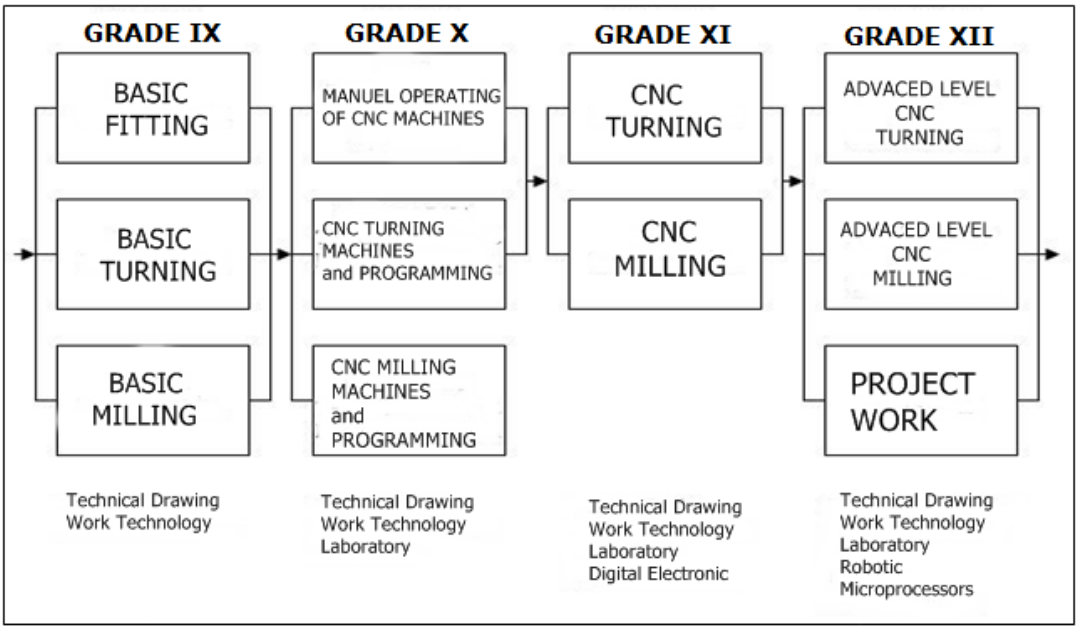



**Figure 1: Numerical Control (CNC) Course Modular Program Structure (MEB, 1996)**

Moreover, in the following departments the CNC courses have been taught: Hydraulic and Pneumatic Technology Department, Mold Division, Department of Mechanical, Micro technology Department of Mechanical Model Department, Furniture-Interior Department, Wooden Boat Building Division, Department of Plastic Arts, Shoes Department of Computer Aided Industrial Modeling Department, Industrial Casting Department and Leveling Department of Plastic Processing Department. In the table below there is given the name of the courses that are related with the CNC course which are taught in vocational and technical education in high schools connected to the Ministry of Education.

The CNC training, as seen in our country has been given in many educational institutions. To make the training more qualified given in this course, each step that will be taken concerns thousands of students studying in these schools and the teachers. So, thousands of students and teachers are affected by the CNC training. In order to get a better quality education of the students, the self-supporting and facilitating the work of teachers with training materials, and by using the modern teaching methods, in terms of quality personnel it is important train graduates that it will serve the country's industry.

To be able to remain standing today and create employment is only possible with competitive strength. One of the main economic indicators of competitiveness is efficiency. The most important factor that increases the productivity undoubtedly is the educated workforce. Education is an important need to be there today. Education, industry and service sector increases the efficiency and effectiveness; increases the employability of the workforce. The industrial organizations who are aware of this situation, they organize courses to improve the efficiency and effectiveness of the employees such training in various courses.

The CNC lathes can be used in many different sector of industry such as, aerospace, automotive, bottle and glass, molding, modeling, shoes, jewelry, souvenirs, coins and badges, health, rapid prototyping, billboards, white goods and toys. And there are thousands of personnel working in these sectors. Number of people are earning thanks to CNC machines. Every business that operates in this sector has lower costs compared to the others, is in the efforts to provide better service. For this reason, every business needs a more knowledgeable and experienced staff on the CNC or is willing to provide training to staff on hand.

For example, there are only about 10,000 CNC machines in Konya. The staffs using these lathes and business owners who have these lathes are affected by the related facilities. Therefore, the development of new methods for the training of CNC machines the search of opportunity is important for many people working in the industry.

## MATERIAL and METHOD

Taking the benefits CNC provides to the industry and the present situation of CNC Trainings in our country into consideration, it was concluded that design and production of a CNC Training Set will be a profitable endeavor. The design and production logic of the CNC Training Set is based on the fact that the learning process of CNC usage is similar to that of driving an automobile. Just like a person who wishes to learn to drive first receives theoretical (structure and working process of the engine, units that constitute the automobile, systems of the vehicle, etc.) and practical information (rules to be followed at traffic, meanings of traffic warning signs, necessary deeds to ensure a safe drive etc.) and then proceeds to practice at an appropriate field with an accompanying driving trainer; a person who wishes to be knowledgeable of CNC usage should first receive theory and then exercise it. Note that a driver candidate is due to trainer's control during the practice; if s/he happens to make a mistake the mentor is there to intervene. The intervention gradually lifts as the driver candidate progresses at practice. After a certain amount of time taken for exercise, the driver candidate becomes an actual driver; able to use the automobile by him/herself. Teaching on another hand, is neither an easy job. Teaching how to use a CNC is moreover a hard work since a CNC machine is a mechanism formed of various systems, some of which are interconnected while some others are totally independent. Each of these systems, the 'metabolism' of the machine in operation, how it can be controlled, how a workpiece should be put into process, how the programming should be made are all to be taught to the learner. In order for the information to permanently settle in student's mind and become applicable, theory should be supported by practice. Let alone the rest of the education, teaching how to write a compatible program is quite a difficult work itself since a dense crowd of resembling codes are due to creating contradiction in terms. Writing the program therefore holds a specific part in the training; bearing a particularly complicated character, program writing requires a distinct amount of time to practice. The teaching model at driving courses is taken as basis in preparation of the CNC Training Set since the learning process of CNC usage is similar to that of driving. Taking these necessities of the particular learning process of CNC Usage into consideration, the Set was developed on the base of respective educational principles. A teaching method in which practical lessons are in correspondence with basic learning rules was followed.

CNC Training Set is designed as a desktop training package that aims to ensure a more efficient CNC training and enables all CNC-related processes to be exercised on the same media. The Set is made up of two main sections, software and hardware section. The hardware section constitutes of a mini-CNC machine. Set up in Turkish, this mini-machine is an ordinary CNC, only with smaller dimensions. The software part meanwhile, consists of programs that are meant to operate in a specific computer which will be placed in the hardware part. The software body includes an interface that lets the user to reach any information regarding the CNC and the production process. The interface also enables access to sub-sections. By clicking the links or buttons on this interface; the user can reach various sections such as the e-book, the multimedia-supported narration or the simulation; each of which are rich in content. Below is a list of features that are ready to function at the CNC Training Set:

**1.** The screen enables the user to study CNC programming commands. User can summon detailed information pertaining to these commands and see relevant examples. Therefore, any time the user wishes to review or consolidate his knowledge on programming commands, he will have ready service with this Set.

**2.** The user can follow audio and video records where machine components, working principles and general information on CNC usage are explained in detail by a professional.

**3.** Programming codes can be entered through the panel. A real-time simulation of the production can be summoned to the screen. All changing values, the process that will operate on basis of the entered codes and the eventual shape that the workpiece will take can all be watched at the simulation.

As soon as the hardware section is added to the Set, which is set to happen in a short period, below functions will also be applicable:

**1.** The user will be able to connect a real workpiece to the machine. In other words, an actual production will be possible. Witnessing the production stages, seeing the functions of the machine throughout the process and observing the mechanical movements conducted by these functions will all be achieved with the joining of the hardware section.

**2.** The machine's user-friendly ergonomy will enable the user to easily control the CNC process through a control panel which will be right next to him. The user will have the chance to intervene from where he sits.

Learning how to use a CNC Machine is a multi-staged process. Theoretical information on the machine should first be obtained. Then programming should be learned and the learner should write programs. This is essential because in this stage the learner receives the chance to see the mistakes he is inclined to make during formatting the machine. The corrected program should then be entered to instruct the CNC. Eventually, the workpiece should be connected to the machine and the program should start to run for the candidate operator to watch and learn. This particular CNC Training Set does contain sections which sequentially follow these stages. The learner first receives theoretical information from the information screen; that is general information on the CNC and the command structures. He then proceeds to program writing; this stage is accompanied by simulation. The simulation helps him to see if he has made any mistakes and if any, to correct them. As mentioned before however, the hardware section through which a real application on the workpiece can be made is not materialized and added in the Training Set yet, due to high costs. Subsections of the software section are shown and explained below.


**Figure 2: Interface of the Software**

**Electronic Book Section:** This part of the software is prepared as an e-book where the user can reach theoretical information. From machine programming commands to utilization types, all sorts of information regarding CNC usage can be found in this part. As a topic is selected from the list on the left hand side, its content displays on the right. The menu is prepared in shape of a concept map with a tree-like appearance, this enables easy access to the requested topic from anywhere in the media. CNC Machines, Basic CNC Codes, Operational Codes, Computer Supported Piece Programming and Direct Numeric Control are the topics that are explained in this section.

**Multimedia-Supported Explanatory Section:** This is a multimedia (vocal and visual) supported environment where various titles such as parts, systems or segments of the CNC Machine or usage of the control panel are lectured by a professional operator. The narration can both be listened and watched through a video that displays on the screen. The multimedia environment consists of ten episodes, namely “CNC Machines from Programmer's View”, “Information on Writing Basic CNC Programs”, “Movement Types”, “Compensation Types”, “Structure of a CNC Program”, “Features to Contribute Programming”, “CNC Machines from Operator's View”, “Machine Process Modes”, “Procedures” and “Principles of Writing a Safe Program”.

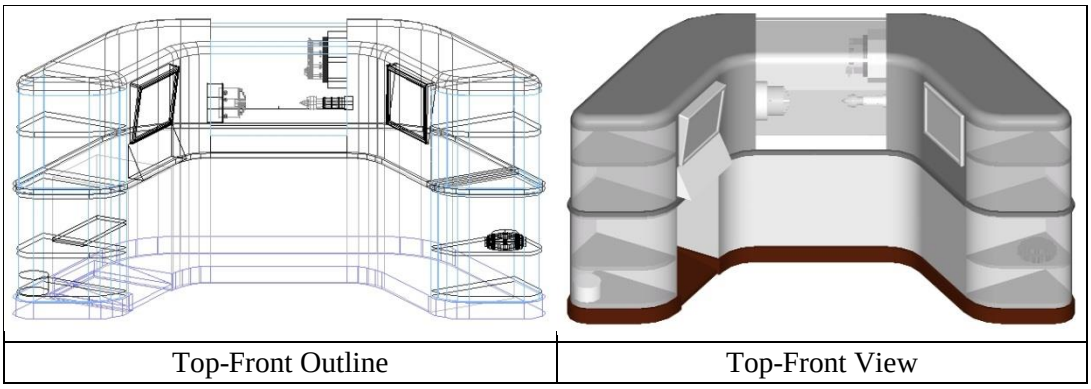
**Simulation Section:** This is the part where the written program codes can be simulated into a virtual manufacturing process. The user is therefore able to see how the process will look like once he passes on to actual production. This environment includes an editor program with which the user writes program codes. A simulation of the production is displayed on the screen, enabling the user to observe the phases of the operation through which the workpiece is processed towards its planned shape. At this section, a new program can be written, the written ones can be saved to computer's memory, and if any, previously saved programs can be

summoned and edited. Program codes are written with an on-screen keyboard. Use of an external keyboard has been avoided deliberately with respect to the goal of ensuring the simulation to be wholly realistic.

As "Show Simulation" button is clicked after the completion of coding, a particular simulation program initializes. The written program shall then open within this simulation program. Clicking on "Show Simulation" enables the user to review various values of the planned production before the actual commencement of the process: What form shall the workpiece take on basis of the written program codes, which tools shall be used, how the workpiece shall be processed, which steps will be followed during processing. These will all be available to reviewing at the simulation. If a mistake that sources from the written programme is noticed during the simulation, the software warns the user on the type of the error. The user will have the means to see the error of the written program and correct it before writing the code on an actual CNC Machine.

It has not been deemed necessary to write an original program for the simulation part since several simulation programs are available and accessible on the internet. A free software called CNC Simulator 4.44f from Microtech company is used in this project. The software simulates the workpiece according to the commands that are written in pursuance with the standard ISO (International Organization for Standardization) codes.

**Mini CNC Lathe Section:** Due to cost-related reasons, all designed sections of the CNC Training Set are yet to complete. It is planned to complete the rest of the design by conceptualizing the unfinished sections and obtaining financial support for those. The Mini CNC Lathe will take Fanuc Machine system as basis and work with the codes given in pursuance with ISO (International Organization for Standardization) Standards.



| Top-Front Outline | Top-Front View |
|---|---|

**Figure 3: Views of the designed CNC Training Set**

Various electrical/electronical circuits will be used at the production of this section's electronic components. Elements such as engine, drivers, and sledges will be used for the mechanical division that processes the parts. Control panel and control unit elements will be used for machine control. After all parts are compiled together on a metal plain, a base software which is prepared in Turkish language shall be uploaded to function as the operating system. Latter to the production of the Mini CNC Machine, the software section of the training set will be incorporated to the machine in a form that it shall be available to be viewed and controlled from another monitor on the machine. The schematic structure of the CNC Training Set is as follows:

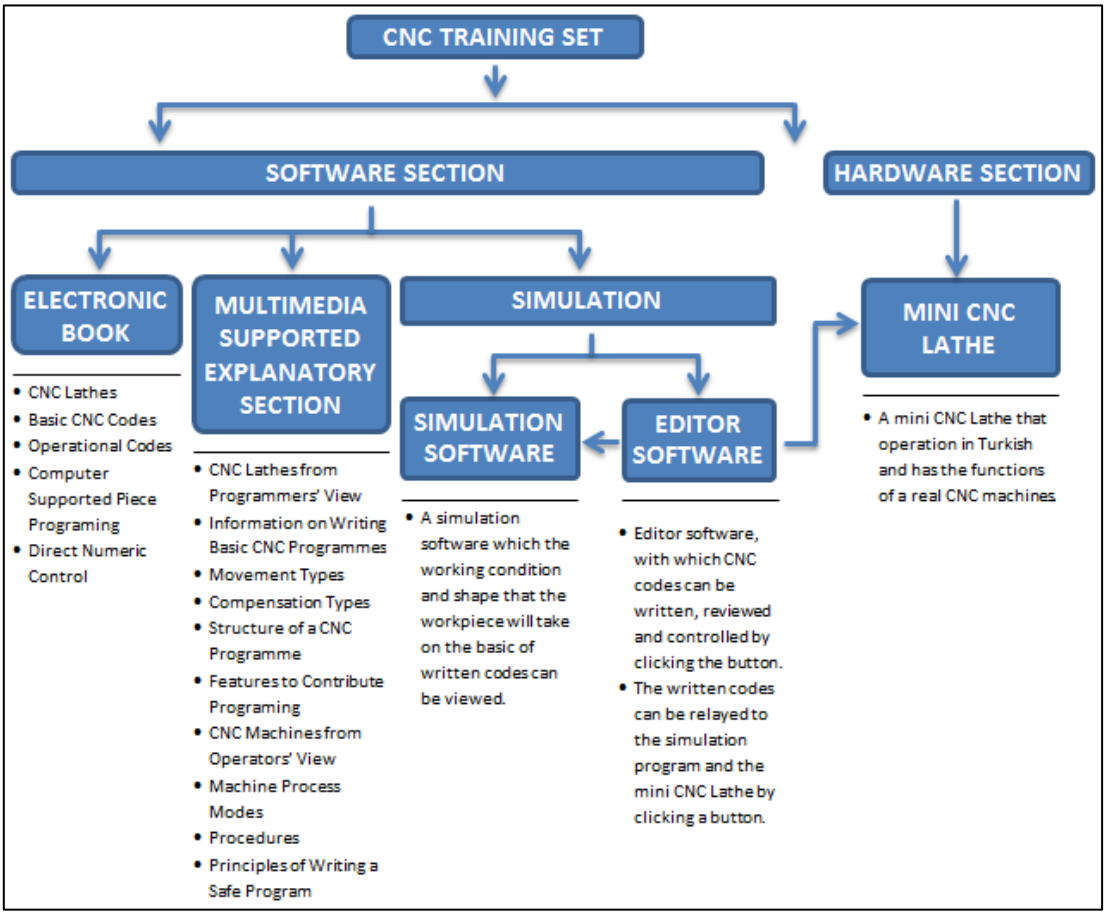



**Figure 4: CNC Training Set Design Scheme**

Borland Delphi 7.0 Programming Language from Borland Company was used at the development of the software part. The editor program at the simulation section and the e-book section are prepared with this software. This specific program was especially preferred as it is a very elastic and easy-to-use programming language that is eligible to work at various computer types without requiring an additional file. Multimedia Builder 4.9.7 from MediaChance Company is used at the interface of the software part and the multimedia supported narration part to ensure easier visualization. This program is particularly used in developing multimedia supported interfaces and has a simple script language. In addition to those, Adobe Photoshop CS2 for image programming; Macromedia Flash 8.0 for animations, Sony Vegas 6.0 for video editing and Techsmith Snagit 8.0 for screenshots were used. Benefits that can be expected from the CNC Training Set are;

• **A Faster and More Qualified Training:** In comparison with the present classic training types, the training with the CNC Training Set provides a more qualified education with its vivacious and practice-based structure. Lecturing is far easier since the trainer is able to show the machine parts, functions and results of the written codes on the machine. The trainee has the means to receive training with a maximum level of comprehensiveness instead of a training that remains in theory and is tendentious to be forgotten in time.

• **Reduction of Accidents and Malfunctions at CNC Machines:** With the CNC Training Set, the student is able to write the codes on the information screen and see the simulation of the process before forming the part. With this technology, accidents like crashing that would occur as a result of false coding can be foreseen and correction becomes possible. Furthermore, the training made with this set is easier to learn in comparison with a theory-based course as this one provides means to practice. Given the chance to see his mistakes, correct them and re-exercise; the student will naturally make less mistakes during the actual operation.

• **Means to Re-train the Learner:** This set appeals to students from various levels of knowledge. Any student from any level, from a beginner level learner to an actual CNC operator can be trained with this set. A person who has previously received a CNC training or a user who actively operates CNC Machines can take advantage of this training as they can study the topics which they feel they should develop themselves at. In other words, this set provides means to be trained over again on any needed topic whenever deemed necessary. All students, regardless of their knowledge level, can obtain benefits from this designed Set.

• **Positive Approach of the Student and Therefore Easier Concentration on the Lesson:** There will be an actual machine at the lessons with the CNC Training Set. This practice-based methodology, by which a real machine is ready to serve to the learning process, increases the attention towards the lesson. This is a remarkable difference that reinforces the quality of the overall training. The student furthermore, will have a mindset that he will better comprehend the lesson when he first sees the set. A positive approach towards the lesson will develop by itself, enabling the learner to better concentrate on the course.
• **Cost Saving:** This desktop type CNC Training Set with smaller dimensions naturally has a lower cost in comparison with an industry-type CNC. Purchase of one industrial CNC Machine that will serve educational purposes at schools can be replaced by purchase of several CNC Training Sets.. The training set furthermore shall provide more benefits in comparison with an industrial CNC as it is specifically designed for training.

## CONCLUSION and SUGGESTIONS

Aiming to render CNC trainings more influential and efficient, a specific CNC Training Set was designed in this study to meet educational needs at institutions that provide CNC Training and at industrial establishments that wish to bring in-service training to their employees. The Set is produced except for a few specific sections. Due to cost-related reasons, certain sections of the CNC Training Set could not yet be manufactured. This deficiency will be remedied by project conceptualizing on these sections. As soon as the project proposals presented to particular establishments are accepted and support is obtained, the incomplete parts will also be produced and added to the training set. Presently, the software part that will run on the computer is wholly produced and ready to serve.

Production of the hardware section will further increase the efficiency of the education. At the moment, operation is applicable with simulation. Even though the current simulation media is very similar to the actual production environment, joining of the hardware part shall render the training set quite more efficient as means to sustain a real production will materialize.

With this training set, the overall understanding on CNC Usage Education will upgrade to a more qualified level. Qualified CNC Operators needed by the production industry shall be raised through a practice-based methodology. This designed CNC Training Set is open to further development. Being formed of a modular system, the Set is formed of different and independent sections, enabling third party professionals to add to it or upgrade its current sections. Copyrights of other books can be obtained for e-book section and their electronic versions can be added to this part, for instance. To the multimedia environment on the other hand; vocal, animation or graphic containing features from various sources can be added to achieve a more efficient narration.

Current CNC Training Sources bear various disadvantages such as excluding Turkish language options, being sold at high prices or having other purposes than training. In this study, a low-cost Training Set in Turkish language, designed only for educational purposes is developed throughout which educational principles have been taken into account.

With its advantages mentioned above, the presence of the CNC Training Set at the learning environment will bring remarkable benefits to the educational process in means of reaching its goals. Educational institutions that provide CNC Training and corporations that aim to train their employees on CNC usage will earn significant advantages by using this Training Set.

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