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Face Detection–based Ergonomic Computer Workstation

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***Abstract*—This paper presents a approach on how to reduce stress and fatigability in the user's eyes, muscles and also backbone when the user is using a computer. The study uses image processing technique for the detection of the face of the user. The monitor of the desktop computer is connected with a DC motor that will auto align itself to the face of the user in order to make sure it is in front of the user's face. If the user moves its head sideward the monitor will align and this will help the user to have movements of the bone and also muscles on its back. The movement of the monitor through the microcontroller and also the face detection part was programmed on the python software.**

***Keywords*—Computer Workstation, Ergonomic, Face Detection, Image Processing**

I. Introduction

In present times, computers can be seen in all private places like houses, schools, offices, and many more. People spend many hours in front of the computer for so many reasons like gaining new knowledge, doing their tasks for their work and in school; some are increasing their social media life, while some are just playing computer games. Those times being spend in front of the computer causes trouble in the users body One of the hazards is the sitting position of the user, it is when the user is not comfortable in his or her sitting position or the user is in the wrong sitting posture and this will lead to back problems. Most likely the user will get an osteoporosis. Another hazard to the user is to have eye problems like having poor eyesight if the user stays in front of the monitor for a long time. The paper in [2] is a guide on how to sit in front of a computer properly, like for example how to position the monitor properly and to have regular small breaks during work day. Ergonomic chair is then invented for working people to provide optimum comfort and to avoid stress for the user. It also promotes good posture and it also helps alleviate back pains. According to [9], researchers often use an erect or forward leaning task posture, which is common when writing at desk or operating a desktop computer. This invention gives confidence to all computer users who need to stay in front of the computer for a long period of time because of the comfort it will provide to the body. It will just give comfort to the back of the user but not for the comfort of the eyes and this where this research paper comes in which is the ergonomic personal computer set, the computer screen will automatically align itself to the face of the user with an ergonomic chair specifically designed for the computer set. This research aims to make the computer experience of the user be more comfortable. As stated in [7], human face is prominent feature in machine learning and computer vision system. A face conveys various information including the gender, age, ethnicity etc. Face information is applicable in many sectors such as the biometric authentication and intelligent human computer interface. Spending too much time in front of the computer can lead people to osteoporosis diseases and eyesight problems. People don't know much what are the risk they can get by spending too much time in front of the computer. Some people know the proper posture in sitting in front of the computer but not knowing the improper placing of the computer monitor is also a factor for eyes, necks, upper bones problems. Due to circumstances that people can get diseases, the researchers inspire to conduct a research that is innovative and a new system of ergonomic computer workstation. As stated in [8], creating ergonomic working arrangement is important for protecting our health. This paper is organized as it follows: Section II briefly presents the methodology and conceptual framework used in this research paper. Section III is devoted to the experimental results, which are carried out in order to verify the effectiveness of proposed method by means of the prototype. Conclusion ends the paper at section IV.

II. Methodology

The block diagram as it was shown in figure 1 illustrates the methodology and procedural steps used in conducting this research study. The design phase refers to the actual planning for the hardware and software of the system. It includes the determination of the conceptual framework and materials used for the hardware design and implementation. It also refers to the determination of the algorithm, program flow, and type of microcontroller used for the software implementation. The implementation phase refers to the construction of the circuits based on the block diagram and schematic obtained from the design phase. In this phase, software coding was done for the python algorithm. The software and hardware are integrated in this phase for testing. The system test phase refers to the experimental testing of the system prototype. The performance of the hardware and software is tested. The analysis of result phase refers to the processing of data to yield a conclusion that is based on the set objectives. After the analysis a conclusion will be given.

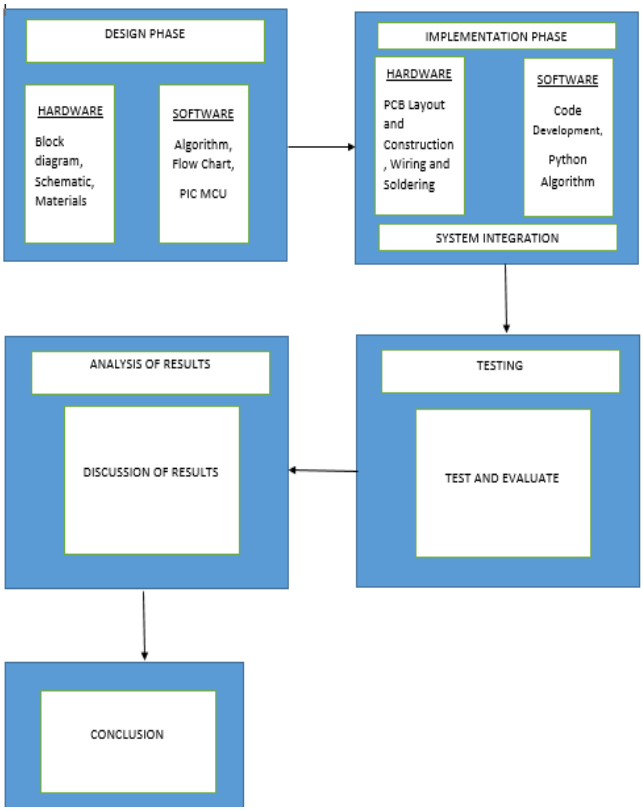

Fig. 1. Methodology of the study.

To be able to implement the idea, below is the block diagram of the concept that the researchers used the achieved desired movement of the computer screen.

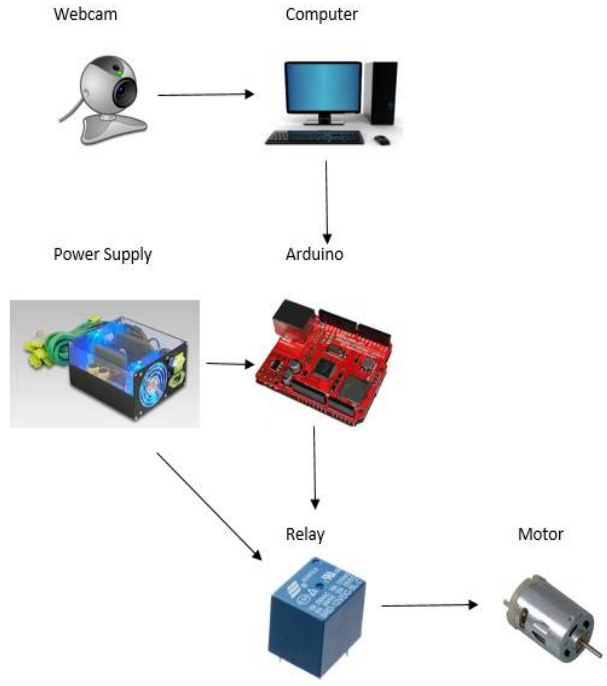

Fig. 2. General block diagram of the system.

Figure 2 shows the process on how the system will work. A power supply is connected to the Arduino [1] and also in the relay. The input will be coming from the webcam to the computer then it will send to the microcontroller and next to the relay and last to the motor itself, which will make the monitor to move and align to the face of the user. The diagram shows below represents the component and their connection as it is used for the research project circuit development.

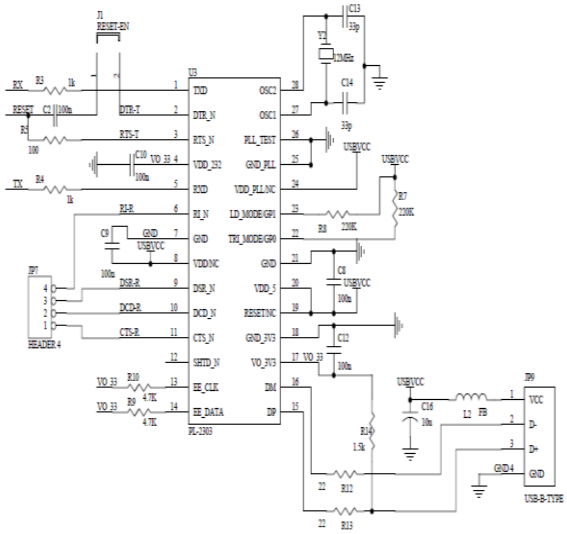

Fig. 3. ATmega328 schematic circuit [1].

The ATmega328 is a microcontroller chip with 32k bytes of the flash program memory and 2Kbytes of SRAM with system clock speed of up to 20 MHz and has 23 programmable I/O pins. The flash based program memory is where the program sketch is stored after an upload. The SRAM act as the main memory where the program variables are temporarily stored as the sketch program executes. The system clock synchronizes the internal operation of the CPU and other peripherals as well.

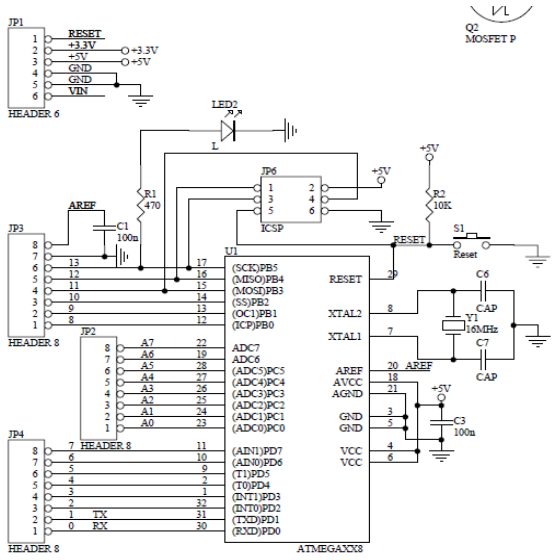

Fig. 4. ATmega168 schematic circuit [1].

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The ATmega168 has 16k bytes of FPM and 1k bytes of SRAM. It has 23 programmable I/O and having a system clock speed up to 20 MHz; it is connected to the oscillator circuit. The system clock circuitry of the ATmega generates clean square wave signal that is used to synchronize the operation of the CPU and peripherals inside the microcontroller. The ATmega normally requires an external oscillator circuit where it derives the base clock. The oscillator circuit connected consists of 16 MHz crystal oscillator and two loading capacitors.

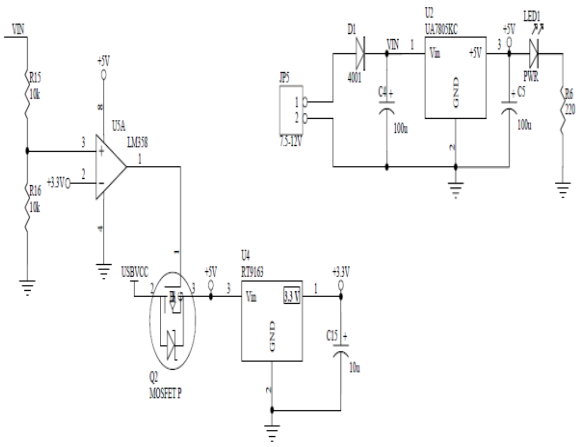

Fig. 5. Power supply.

The power supply module is the components that supplies power to the system. It receives power from an electrical outlet and converts the current from AC into DC, which is what the system requires. It also regulates the voltage to an adequate amount that allows the system to run smoothly without overheating. The power supply must function correctly for the rest of the components to work.

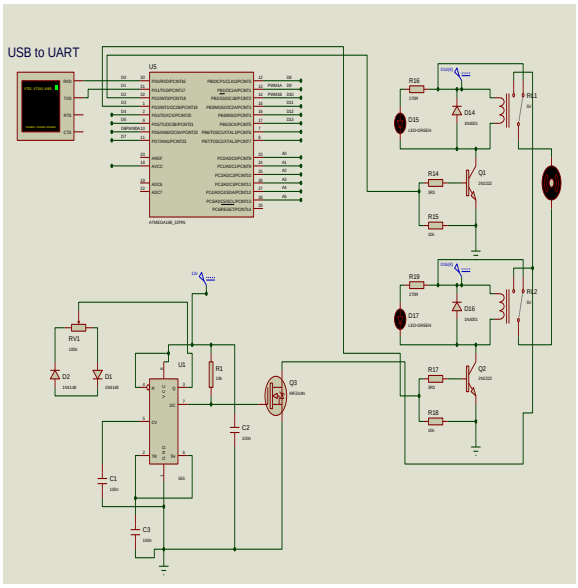

Fig. 6. Schematic diagram of the system.

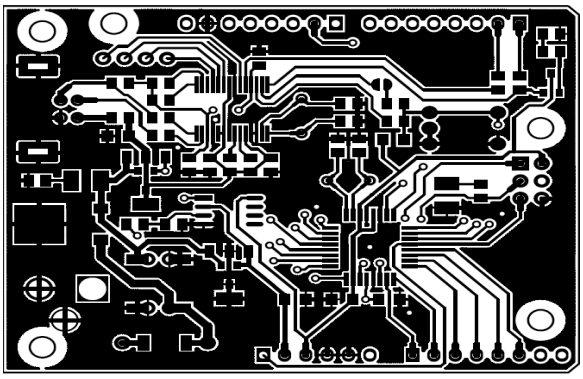

Fig. 7. PCB top layer [1].

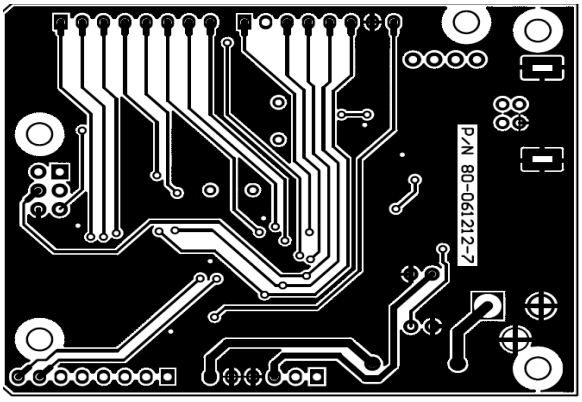

Fig. 8. PCB bottom layer [1].

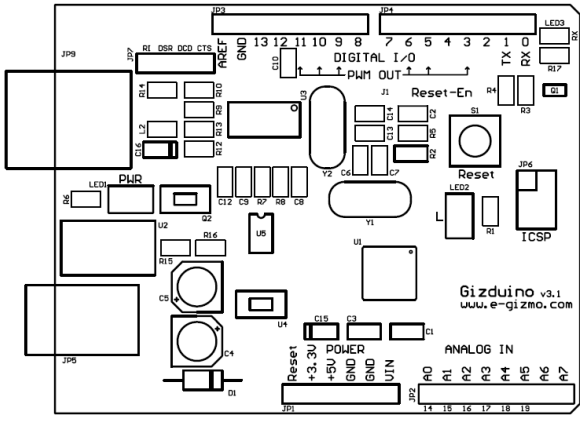

Fig. 9. Component parts placement [1].

The system will start by the detection of the face of the user and capture it with a rectangle around the face to get the value of X, Y, W, and H. The X parameter is the important one since it only moves horizontally. When the value of X is less than 150 the screen will move to the right and if X is more than 200 then it will go the other way. As it moves to the left or to the right the value of the X is constantly changing and if X will come-in to the range of 150 to 200 then the monitor will stop, it means that it is already aligned to the face of the user. This is shown in Figure 10.

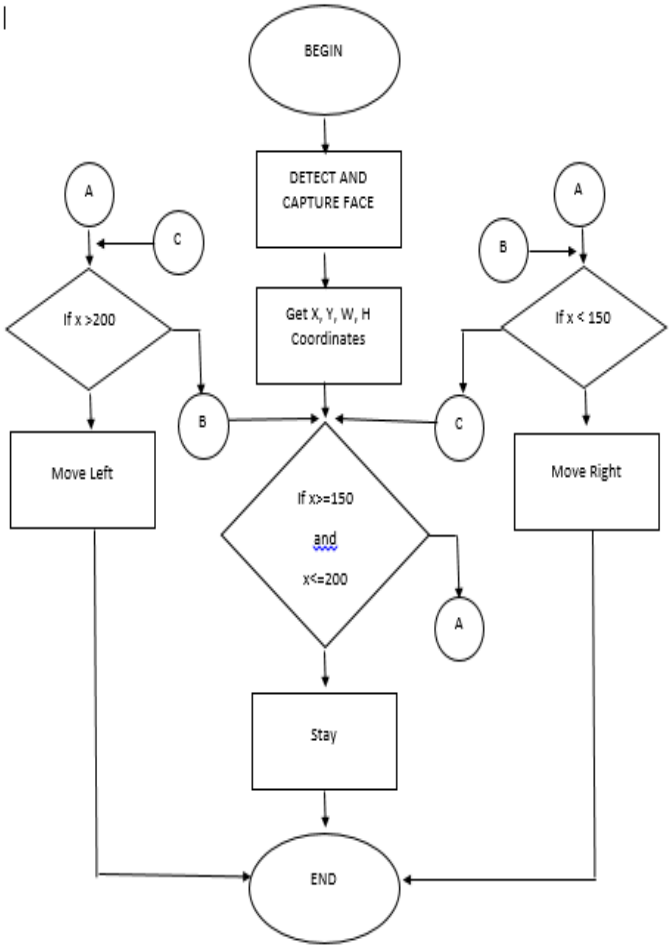

Fig. 10. Flowchart of the software program.

III. Experimental Results

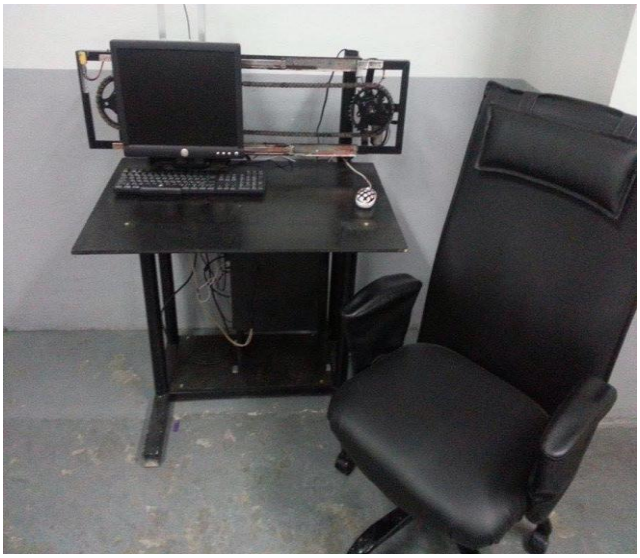

Fig. 11. Prototype design project.

Fig. 12. Actual test of the prototype.

Fig. 13. Close-up view during actual prototype test.

The operation of the study was evaluated in terms of its accuracy in following the head of the user and how many heads needed to make it operational. Below is the result of evaluation.

Table 1. Operational Evaluation.

Area of Testing	Findings	Comment
Accuracy	Position of the monitor is aligned with the head.	Alignment is accurate.
No. of Face	The monitor will not move if it detects greater than one face.	Only one face is applicable.
Stability	Movement is fine.	The movement of the monitor is stable.

IV. Conclusion

Creating a good ergonomic working arrangement is important for protecting our health. Working in front of the computer without knowing anything may cause problems in our health in the future particularly the backbone problem. A good working arrangement may help to reduce fatigability in the bones, muscles and eyes. It is suggested that the users of the project will not only rely on the project for its comfort ability in using the computer but to have a knowledge also on how to sit properly to be more comfortable in using the computer and to know what are the consequences if the user will not have enough knowledge on how to properly seat in front of a computer. We also like to recommend the project to use another technique such as artificial intelligence like ANN, GA, FL, etc.

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