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Test sheet Correction using microcontroller

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Abstract

The aim of the project is to build an embedded system to help teachers in correcting exam papers in a high accurate process. This system can be used in the elections and questionnaires to obtain information with high accuracy. This project will use the Nano Arduino microcontroller for correction of exams. The process will start by read shaded choices using a color sensor. After comparing the answer with the typical answer from the admin, the result will be displayed on PC monitor connected to the microcontroller with a notification if needed if there is any error.

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Chapter One

Introduction

1.1 Overview

1.2 Project idea description

1.3 Project object

1.4 System requirements

1.5 Motivations

1.6 Project scope

1.7 Problem statement

1.8 Methodology

1.9 Previous studies

Chapter 1

Introduction

This chapter presents an overview of the project, including the project idea description, the problem statement, project objectives, and system requirements, scope of the project, motivations, methodology, and project documentation outline.

1.1 Overview

Tests are an essential and integral part of the design education programs and represents one of the main elements of the curriculum, that the scientific method became seen as the basic part of the educational process contribute to reveal strengths and weaknesses in student achievement. They also provide feedback to the teacher about the quality of the education process, which helped them to develop teaching methods and tests.

The current testing system for teachers who are making great efforts in the preparation of school tests and correct and monitor the results, and no doubt these efforts represent economic and educational cost that take precious time of teachers can be invested better, especially that these efforts will be repeated every year because of preparation new tests each year with the lack of rules of information on the questions and tests show the variation in the difficulty of the test, as well as the increasing number of students in the classroom, which reflected negatively on the teacher in preparation of test questions as the biggest concern how to correct this huge number of exams on a short time.

Therefore there is a need to provide tests system which can be good for the exploitation of technical and scientific progress in the field of measurement and evaluation to raise the efficiency of the education system and increase its effectiveness and help teachers to diagnose many aspects of learning processes [1].

Electronic correction system is one of the most prominent of these techniques needed by the educational field in which errors decreases and increases confidence in the accuracy of the results; in addition, to the statistical reports that are extracted from it for testing the efficiency of its articles and information can be relied upon the decision-maker in guiding the teaching processes in the classroom, can also use this method in order to

accelerate the screening questionnaires used in the field of scientific research and sort the election papers.

1.2 Project idea description

Electronic correction system used to correct questionnaires and tests sheets (multiple choice, true / false) with high accuracy and speed. It is a practical application to micro controllers contains a sensor works on reading options shaded in pen whatever color of that pen on the answer form and then send them to the computer.

1.3 Project object

- The project is used to help teachers in correcting exams at speed and high accuracy.
- Also used for correcting the questionnaires and getting results with high accuracy and speed.
- It can be used in the elections so that the counting process easy and accurate.

1.4 System requirements

It consists of three main parts:

- **1:** The physical part is a device that holds the papers, and enters them one after the other into the device like a printer where sensor reads the answers, and sends them to the controller.
- **2:** The programming's part how to deal with receiving data from controller and how to display results. Programming using C# to easily handle this system and its interfaces and accurate program.
- **3:** A sample that demonstrates how to order questions to give the most accurate possible results (word file).

1.5 Motivations

- Components of the device are simple and cheap.
- Ease of use and speed of performance.
- Possibility to read all colors and this gives the ability to write in any pen.
- Give us a high accuracy in performance.
- The use of this mechanism reduces the fear of teachers correcting exams.
- Unify the question paper model to include all data.
- Easy handling with visual basic program
- Debugging and analysis.
- Works in any languages.
- Saving time and effort
- A file to save results and handle it.

1.6 Project scope

This project is a research and system based project since its purpose is to build an embedded system using a microcontroller, in an attempt to provide the correction process, and obtain accurate results at high speed, especially in schools and universities. It is also used to obtain information from the questionnaires at high speed and accuracy, and use it in the election process will lead to the vote count easily and high accuracy and also high credibility without any fraud.

1.7 Problem statement

To build a small and a cheap independent embedded system that can correct questionnaires and test sheets. Then display the result on computer screen or any smart device. These results could be stored in the system's database in a short time and good accuracy.

1.8 Methodology

The work will depend on few major steps:

First: Knowledge of the mechanism of sensor work and the nature of data transfer to the PC.

Second: made a default form, that sensor programming depends on it.

Third: along with the system implementation on hardware, visual basic will control the mechanism of displaying, and provide it to the user to deal with it.

1.9 Previous studies

New device of its kind widely used in schools, universities, and Statistics elections and has many advantages as we mentioned earlier. It has been produced in many countries such as United States, Saudi Arabia and Gaza-Palestine.

What differentiates our project from the previous projects?

Project results were presented on paper and thus the ink used in the same device has the ink seep into the scanner and spoil the results, and the student was forced to use a pencil and fill the vacuum until all the results are incorrect. Dependence on the scanner and print the results in the ink increases the weight and cost of the device is sold in Saudi Arabia at a price of 3,000 SAR.

Device that supports his work on color sensor and displays the results on the screen of PC and allows additional features such as finding rate and other features of that weight a little, the use of color sensor allow the user to use any pen.

Chapter 2

Component Background

2.1 Overview

2.2 Software Component

2.3 Hardware Component

Chapter 2

Component Background

2.1 Overview

The following subsections have a short description of the parts of our project, considering specification, justification and constraints.

2.2 Software Component

2.2.1 Windows Operating System and C# Applications

A PC will be used by users to read the final information and save them and deal with them as he/she like. We will build a C# application that is able to receive messages of grades of each sheet and the final grade of all the patched-sheets.

C#

- The structure of the Basic programming language is very simple, particularly as to the executable code.
- strong typing, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines
- *C# provides a windows form application easy to use from the user and to deal from the programmer.
- The graphical user interface provides intuitively appealing views for the management of the program structure in the large and the various types of entities (classes, modules, procedures, forms...).
- C# provides a comprehensive interactive and context-sensitive online help system.
- C# provides a simple ways to deal with resources files, database or connected to an internet.
- Can save data in word or excel sheet and deal with theme (reading/writing)[4].

2.3 Hardware Component

2.3.1 UNO R3 MEGA328P ATMEGA16U2 for Arduino Compatible

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world.

The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C, C++ and C# programming languages. Also can connect 2 or more Arduino in IC2 and have a cheap cost [8].

Arduino Uno we use in order to control the DC motor located in the printer in order to slow down the speed of the motor and the construction of a new Driver.



Figure 2.1 (Arduino Uno)

2.3.2 Nano Arduino

Used a small power 6-20v and give 2 power voltage 3v and 5v, ATmega328 has 32 KB, using `pinMode()`, `digitalWrite()`, and `digitalRead()` functions. About Programming the Arduino Nano can be programmed with the Arduino software which provided from Arduino

wesit, ATmega328 on the Arduino Nano comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer^[9].



Figure 2.2(Nano Arduino)

2.3.3 ISL29125 Sensor

The ISL29125 is a low power, high sensitivity, RED, GREEN and BLUE color light sensor (RGB) with an I2C (SMBus compatible) interface. Its state-of-the-art photodiode array provides an accurate RGB spectral response and excellent light source to light source variation (LS2LS). The ISL29125 is designed to reject IR in light sources allowing the device to operate in environments from sunlight to dark rooms. The integrating ADC rejects 50Hz and 60Hz flicker caused by artificial light sources. A selectable range allows the user to optimize sensitivity suitable for the specific application. In normal operation mode the device consumes 56 μ A, which reduces to 0.5 μ A in power-down mode. The ISL29125 supports hardware and software user programmable interrupt thresholds. The Interrupt persistency feature reduces false trigger notification. The device operates on supplies (VDD) from 2.25V to 3.63V, I2Csupply from 1.7V to 3.63V, and operating temperature across the -40°C to +85°C range ,easy accesses to arduino and easy for programmed ,have a height of read more than 1cm and space more than 1.5cm*1.5cm^[10] .



Figure 2.3 (ISL29125 Sensor)

2.3.4 DC Motor

Electronic device that convert the current to mechanical power (movement).



Figure 2.4 (DC Motor)

2.3.5H bridge L293D

Run four solenoids, two DC motors or one bi-polar or uni-polar stepper with up to 600mA per channel using the L293D. If you accidentally damaged the drivers in a shield, you can use one of these puppies to replace it. Or you can breadboard something on your own!

Each chip contains two full H-bridges (four half H-bridges). That means you can drive four solenoids, two DC motors bi-directionally, or one stepper motor. Just make sure they're good for under 600 mA since that's the limit of this chip. They do handle a peak of 1.2A but that's just for a short amount of time.

There's a PWM input per driver so you can control motor speed. Runs at 5V logic. Good for motor voltages from 4.5V up to 36V! This won't work well for 3V motors. The motor voltage is separate from the logic voltage.

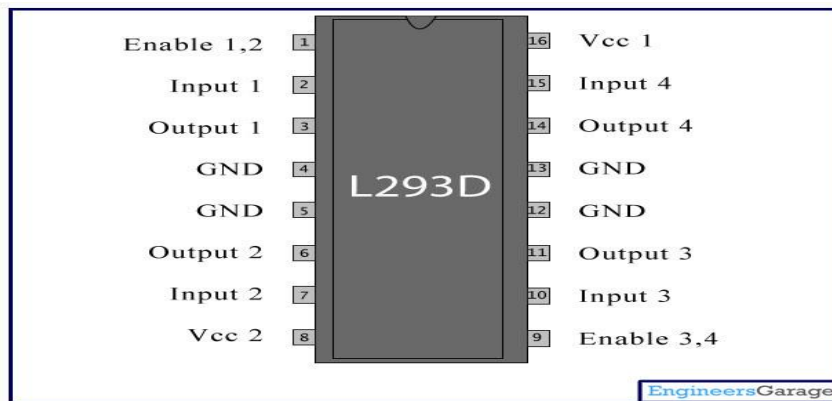


Figure 2.5 (L293D)

2.3.6 Outer body

The outer body is seems like a printer and working like printer , It's easier to deal with sheets In terms of Pull the paper at a time so we choose to using the printer body as a form.

1- Paper support: Load paper in the device.

2- Protection tool Paper feed: Prevent sliding the paper in the paper slot.

3-Not used.

4- The control panel buttons.

5- Paper exit tray: Carried paper when it exits the printer.

6- Screen: displays the results of the work

7- Access cover: Slot for installation of sensors or replace.

8- Mover Paper: carried the paper to be fed properly.

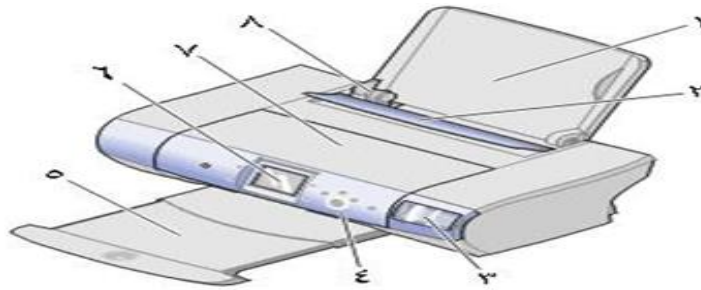


Figure 2.6 (Outer Body)

Ports

I- Power supply port:

Providing power to the printer using the power supply and power cord.

II- USB port:

Connect the printer to the computer using the USB cable [12]

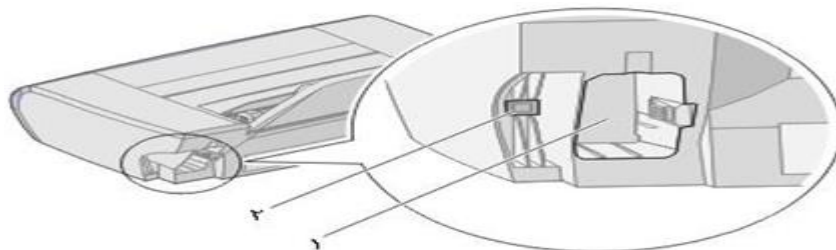


Figure 2.7 (Port)

Chapter 3

System Analysis and Design

3.1 Overview

3.2 System Analysis

3.3 System Diagrams

3.4 Color Sensor

3.5 Motor

Chapter 3

System Analysis and Design

3.1 Overview

This chapter discusses the conceptual design of the system, brief description of the system, a block diagram of its hardware components, software and hardware requirements.

3.2 System Analysis

In this section and the following sections of this chapter the whole processing that happens inside the device, processor, algorithms and techniques will be covered clearly.

Our system will be designed to work on correcting the multiple-choice examinations and questionnaires and elections and then show results accurately at high speed.

To do this, we will put the sheets on the paper support, then the system pull them one by one, each paper will have a number, while pulling the paper color sensor reads the selected choices and sends the answers to Arduino which sends the answer to file that compares them with the typical answers and find the result, then display the result on the screen of our system also sends the result to the computer. Then take out the corrected sheet to the paper exit tray, and this process will be for all the sheets, as shown in figure 3.2.

The number and the mark of each sheet will appear on the PC monitor, as shown in figure 3.2.

The description diagram of the system, it shows the hardware components of the system, and how they are communicate with each other, as shown in figure 3.3.

3.3 System Diagrams

3.3.1 Flow chart

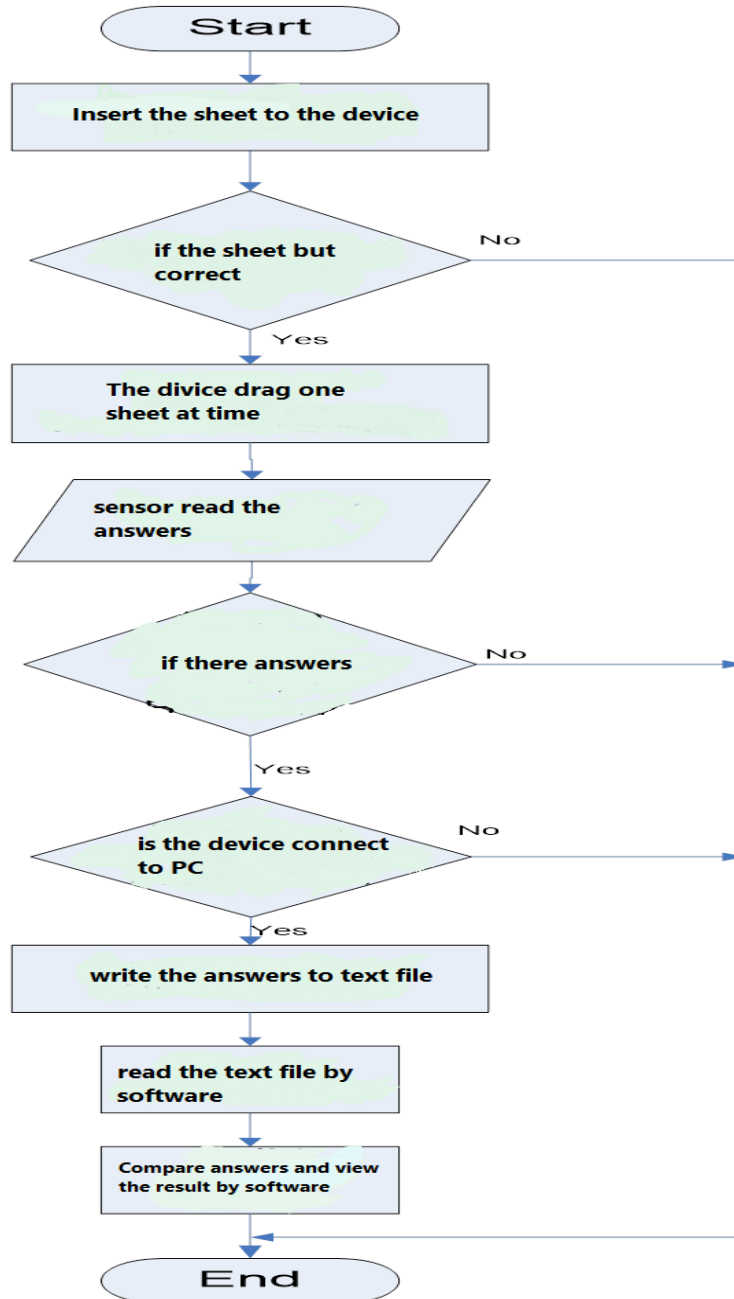


Figure 3.1 (Flow chart of the system)

3.3.2 Block diagram

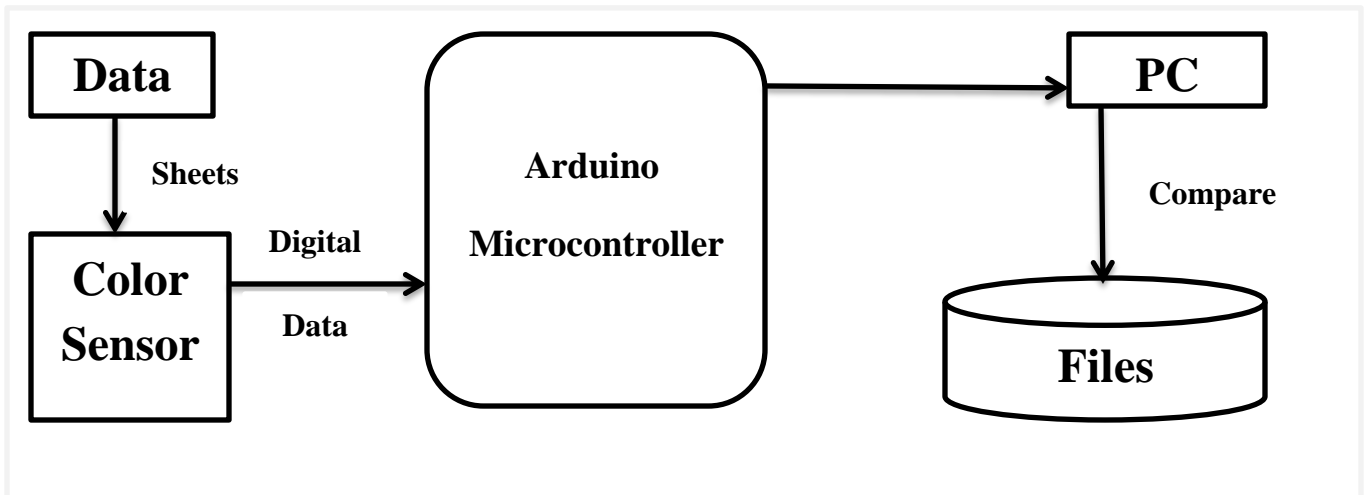


Figure 3.2 (Block diagram of the system)

3.3.3 Description diagram

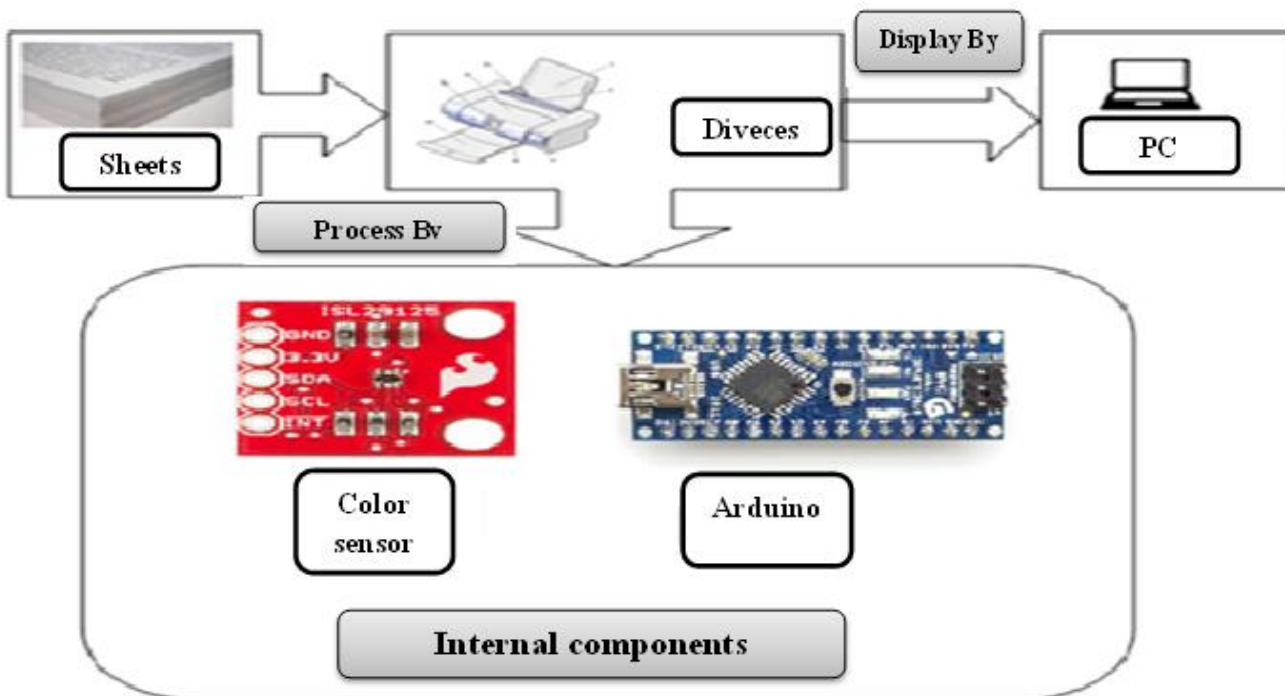


Figure 3.3 (Description diagram of the system)

3.3.4 Schematic diagram

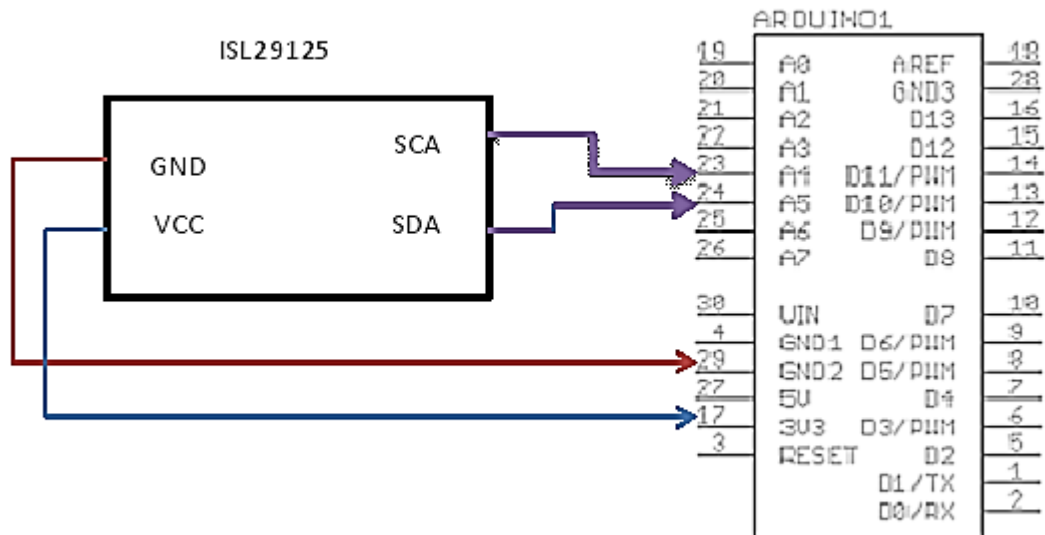


Figure 3.4 (Schematic diagram of the system)

3.4 Color Sensor

We need to connect the Nano Arduino with ISL29125 sensor module to the SDA, SCL ports, and enable the ISL29125 sensor software. Then, test the ISL29125 sensor, as shown in Figure 3.3.

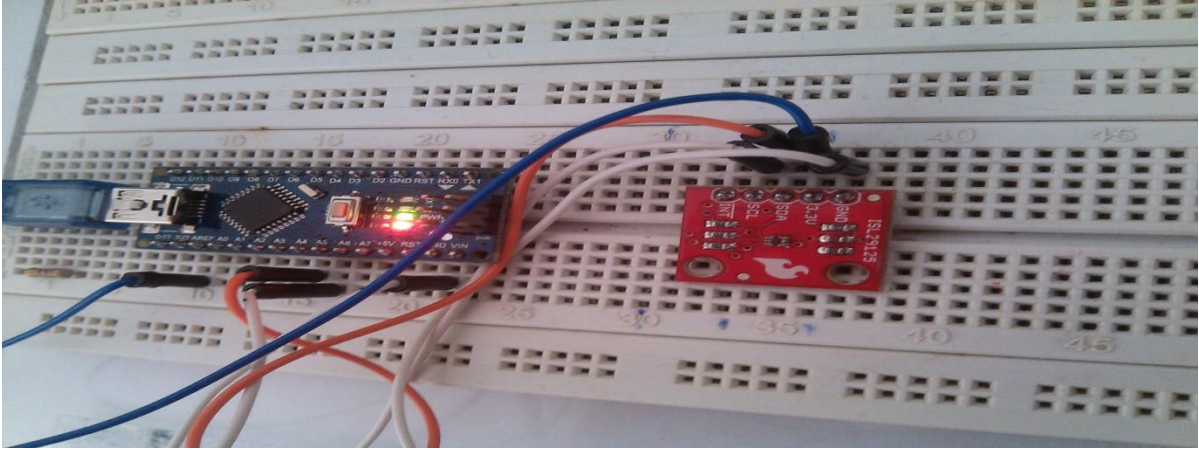


Figure 3.5 (connect the Nano arduino with ISL29125 sensor)

3.5 Motor

We need to connect the enable pins of H-bridge to pins 10 and 11 of Arduino. This is because pins 10 and 11 are PWM pins as shown in figure 3.4.

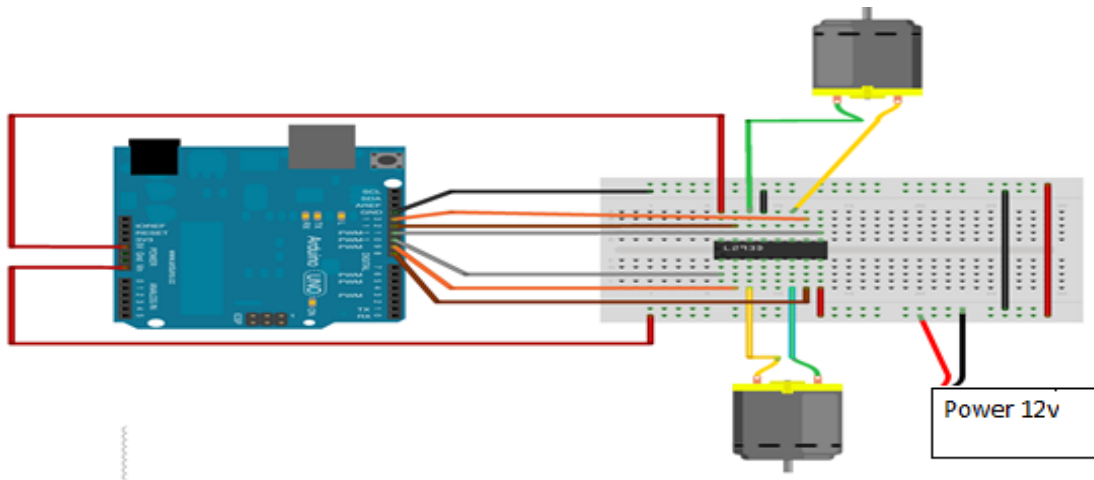


Figure 3.6 (DC Motor connection)

Chapter 4

Software

4.1 Overview

4.2 System Software

Chapter 4

Software Implementation

4.1 Overview

The following subsections describe the software to control and drive the system.

4.2 System Software

4.2.1 User Interface

The user interface program contains a main screen containing an insert data button, display results and start buttons. By pressing the insert data button, Screen appears allowing the user to enter data as in Figure (4.2). This screen allows the user to enter answers to multiple-choice questions; this screen contains the back, saves and true/false buttons. By pressing the true/false button, Screen appears allowing the user to enter the answer as in Figure (4.3).

When you press the display results button in the main screen, it will appear another screen as shown in Figure (4.4). This screen contains back and show buttons where it is view the full outcome of this screen and also allows me to see the results of a multiple-choice questions, as in Figure (4.5) and also know the results of true/false questions as in Figure (4.6).



Figure 4.1 (Main Screens)

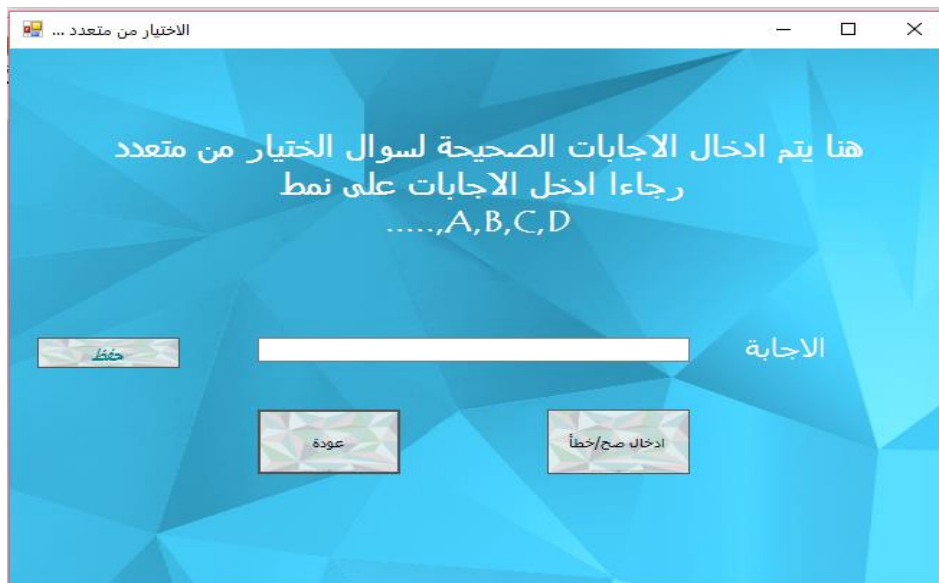


Figure 4.2 (multiple-choice questions screen)

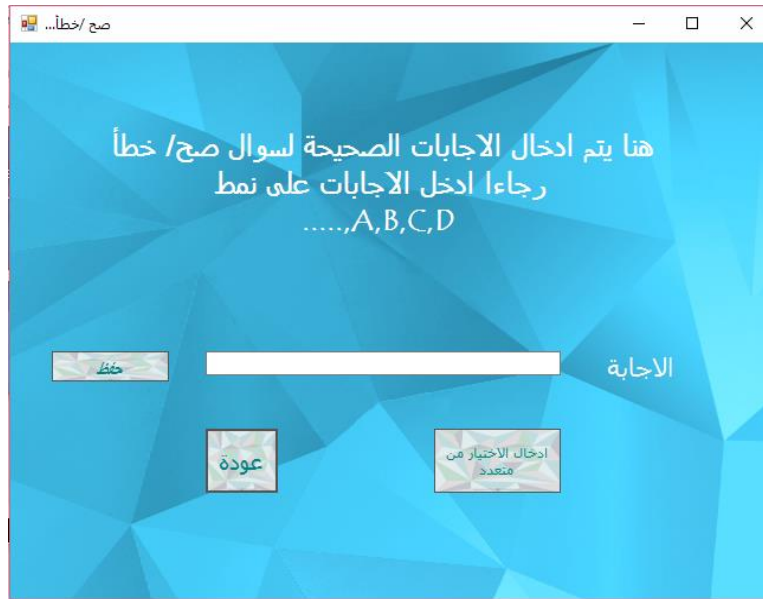


Figure 4.3 (True/False questions screen.)



Figure 4.4 (Full result screen.)

العلامة	رقم الطالب
5	121789
4	118956
4	156334
4	066370
1	125896

Figure 4.5 (Results of multiple-choice questions.)

العلامة	رقم الطالب
2	121789
3	118956
1	156334
0	066370
0	125896

Figure 4.6 (Results of True/False questions)

4.2.2 Color sensor Function

The color sensor will be controlled using a function that reads the data from sensor; then sends data to Arduino, these data show us what color reading.

4.2.3 DC Motor

DC motor used to pass the paper inside the device is also used to move the sensor over the paper in order to read data.

Chapter 5

System Implementation and Testing

5.1 Overview

5.2 Hardware connections and Interfaces

5.3 Software methods and interface

5.4 Steps of Implementation

Chapter 5

System Implementation and Testing

5.1 Overview

This chapter introduces and explains the implementation and testing of each apparatus in the system. The whole implementation stages are shown also.

5.2 Hardware connections and Interfaces

5.2.1 Color sensor connections

The color sensors is connected to Nano arduino using four lines, the first line connects with the ground at the pin2, the second line connects with the VCC at the pin14, the third line SDA connects to pinA5 and the fourth line SCL connects to pin A4. After we connect the circuit in the board the connection such as in the Figure (5.1).

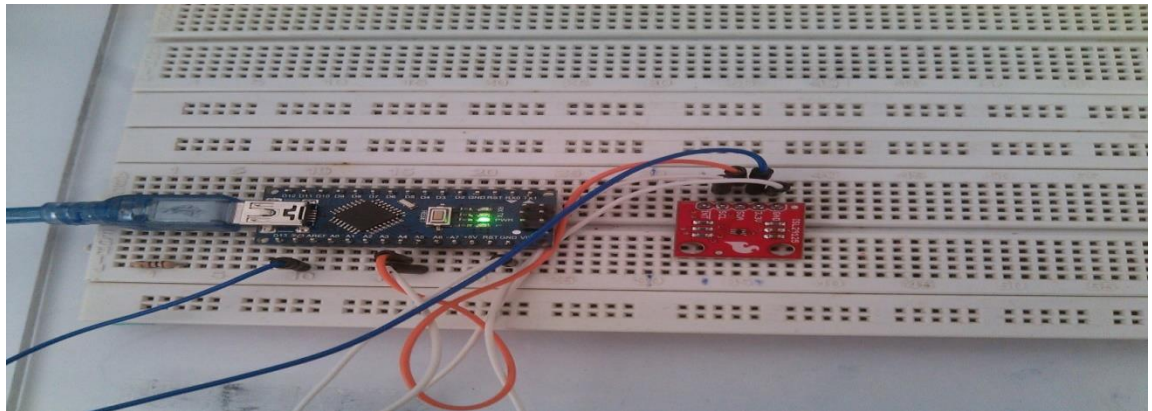


Figure 5.1 (Color sensor connections)

5.2.2 DC motor

To control the speed of the motor, all we need is to replace digitalWrite function on L293D enable pins to analogWrite. The speed of the motor depends on value that was passed to the analogWrite function. The value can be between 0 and 255. If 0, then the motor will stop and if 255 then it will run at full speed, if the value between 1 and 254, then the speed of the motor will vary accordingly. as shown in Figure (5.2) .

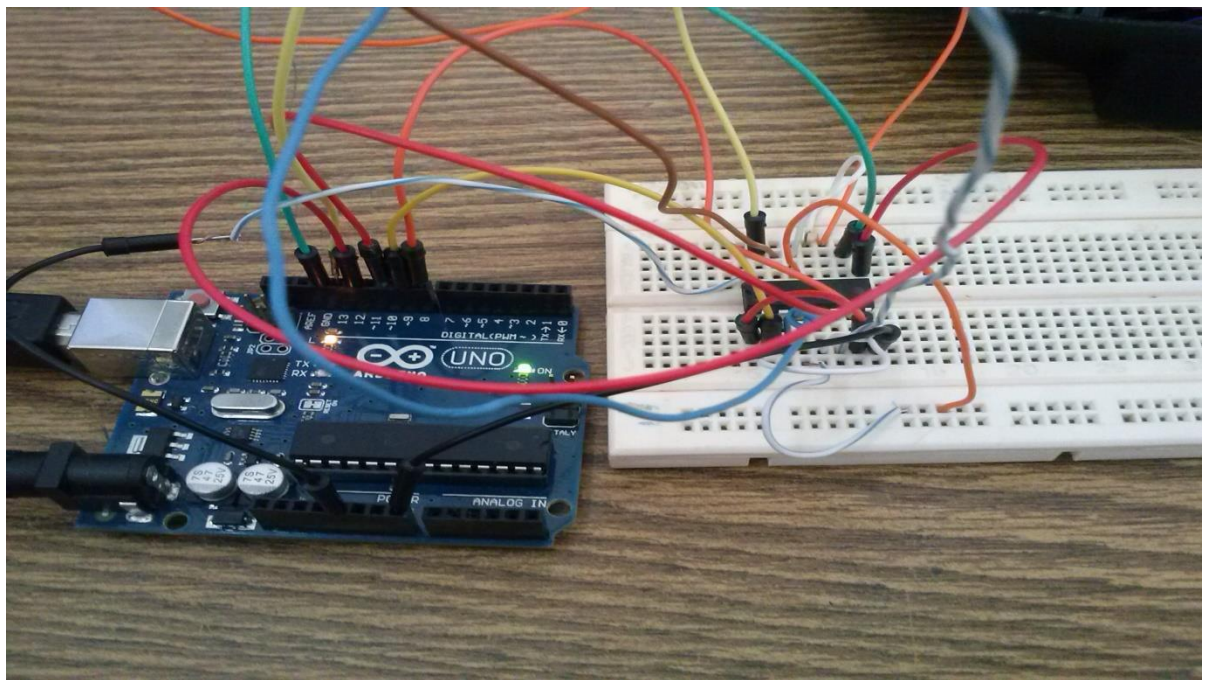


Figure 5.2(DC motor and L293D connections)

5.3 Software methods and interface

5.3.1 User interface application

We made our system to be reliable for users, so in our system there is a user interface application that allows user's easily inserting data, as shown in Figure (5.3).



Figure 5.3(Grafical User Interface)

5.3.1.1 Insert Data function

Function used to input data so that answers of multiple-choice and True/False questions will be inserted.

The Pseudo code for the insert data process:-

- 1- Insert the answers of multiple-choice questions.
- 2- Save the answers.
- 3- Insert the answers of True/False questions.
- 4- Save the answers.

5.3.1.2 Display results function

Function used to display the results of the exam so that number of student and his mark, also display mark of multiple-choice question and mark of True/False question alone.

The Pseudo code for the display results process:-

- 1- View student numbers and grades.
- 2- View student numbers and grades of multiple-choice questions.
- 3- View student numbers and grades of True/False questions.

5.3.1.3 Start buttons function

Function used to start the machine working that makes the printer operates and starts to pull the papers, the color sensor begins to take data, and the Nano Aurdino computes the results.

5.4 Steps of Implementation

5.4.1 TCS3200 Testing

At the beginning TCS3200 sensor connection as shown in Figure(5.4) it works on measuring the intensity of the colors, but its results inaccurate and inadequate. Because of that we used another one , but we will discuss briefly our testing of the first one.

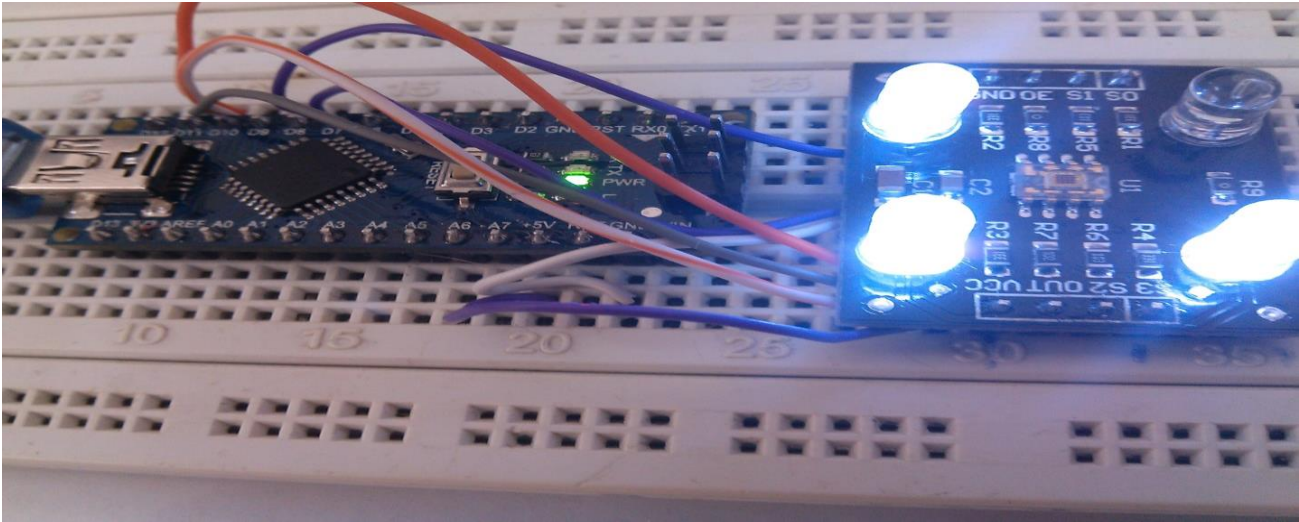


Figure 5.4 (TCS3200 connect)

Testing To make sure of the results we connect Oscilloscope to measure the frequency of the colors as in the Figure (5.5).

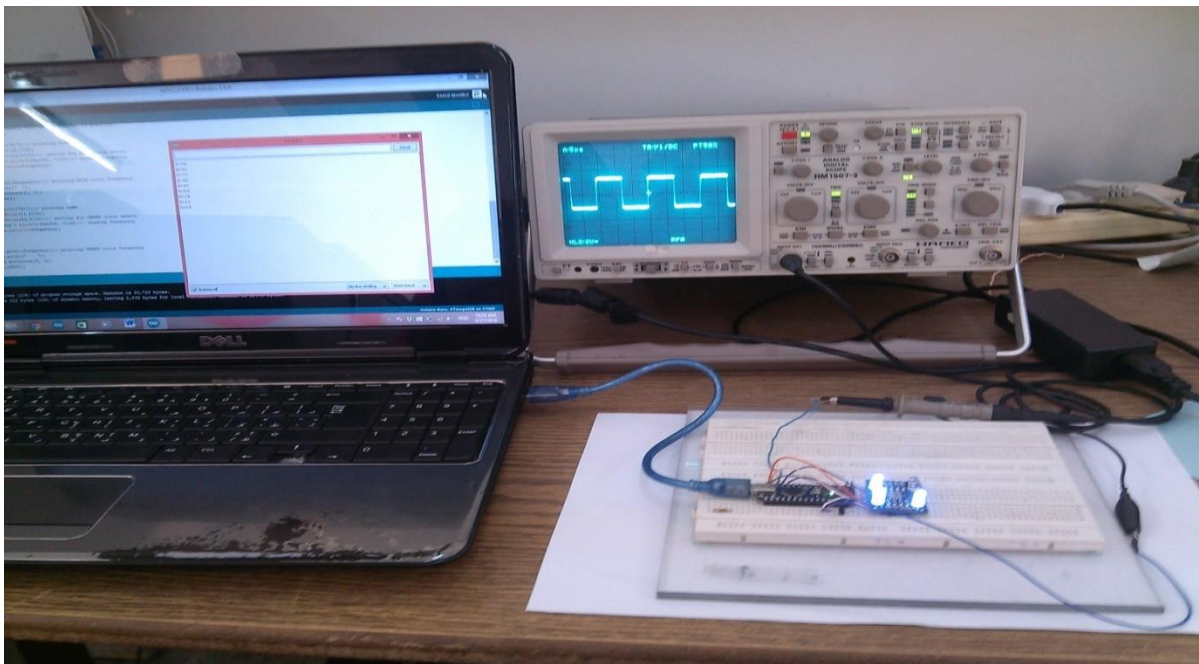


Figure 5.5 (Oscilscope connection)

5.4.2 ISL29125 Testing

ISL29125 connection as in Figure(5.6), we use it for more accuracy, we test it by many experiments, the experiments proved that is the sensor in a perfect situation and it is suitable for our project.

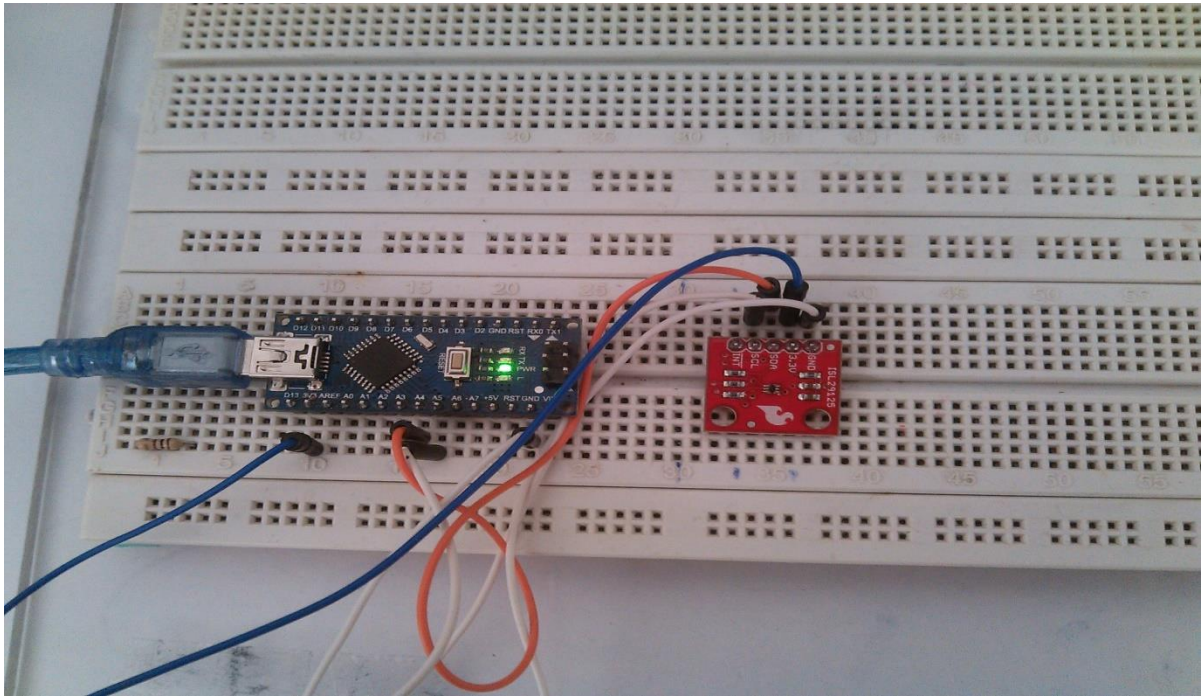


Figure 5.6(ISL29125 connect)

Testing: To make sure of the results we connect Oscilloscope to measure the frequency of the colors and the results were very accurate. So that it is examining the frequency of black color as in Figure (5.7).Green color frequency as in Figure (5.8) and Orange frequency as in Figure (5.9)

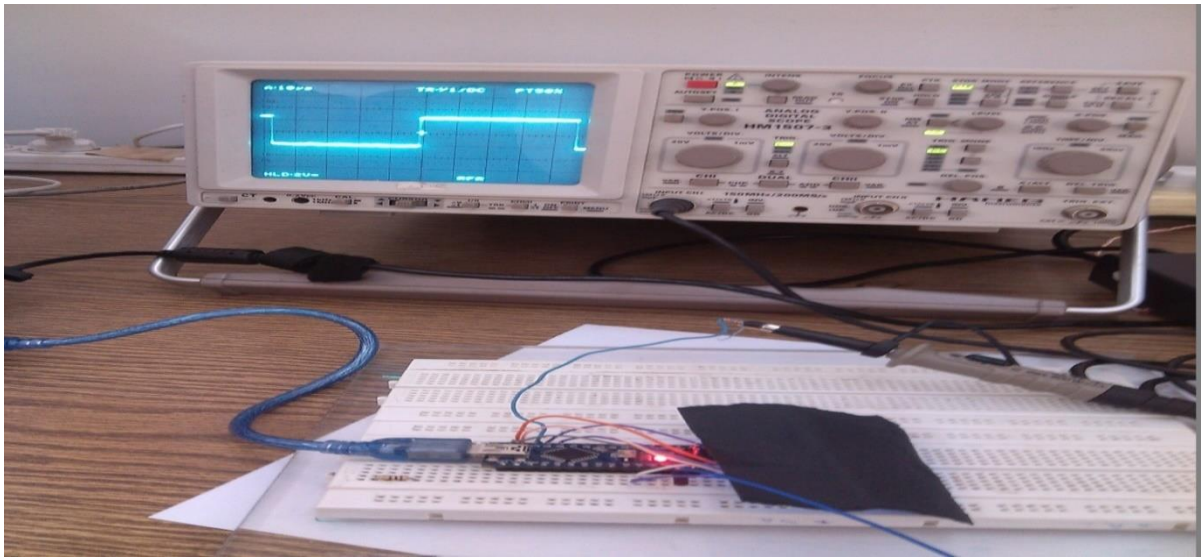


Figure 5.7 (Black color frequency)

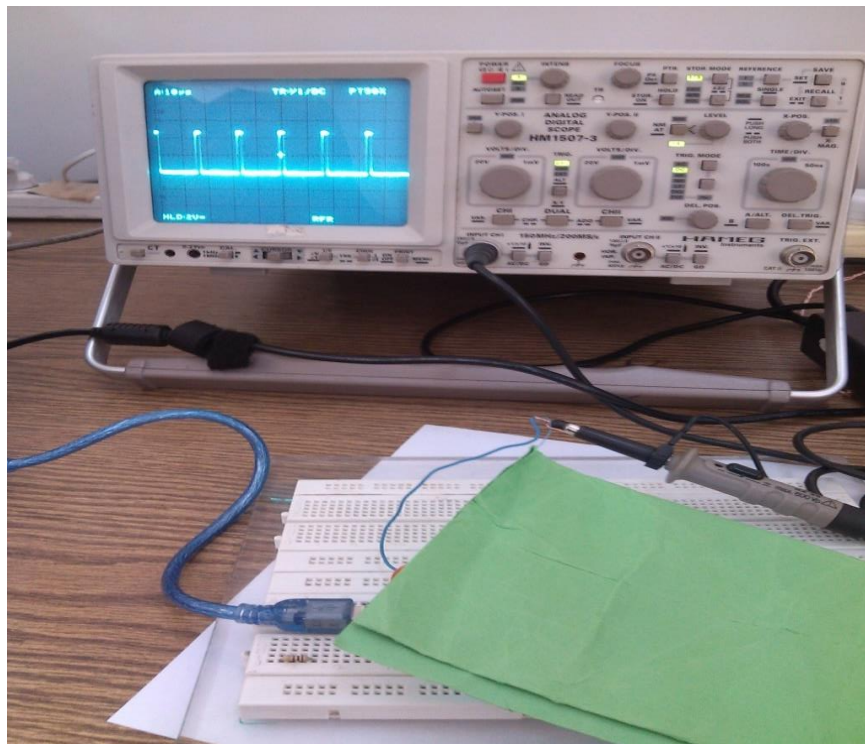


Figure 5.8 (Green frequency)

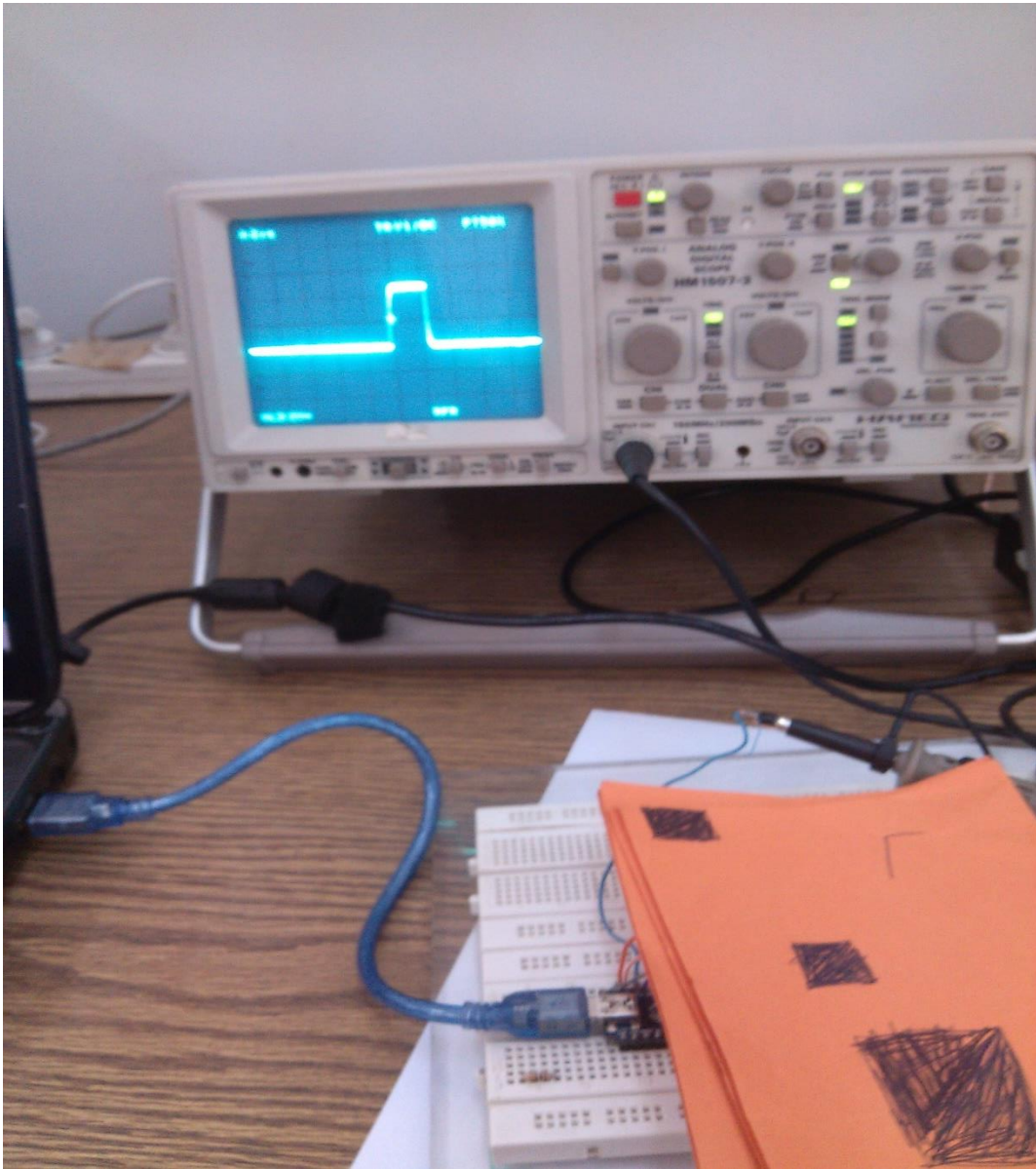


Figure 5.9 (Orange frequency)

5.4.3 Implementation

When we put the answered exam papers in the printer as shown in Figure (5.10), so this gives an command for printer to pull a paper, and when it is dragged ISL29125 sensor passes over it, then it reads the student number and the answers of the questions, and sends them to the Nano Arduino which works on comparing the shaded answers by the student with the typical answers (saved in a word file) which entered by the teacher , at the end displaying the number of each student with his total mark and mark for each question alone.

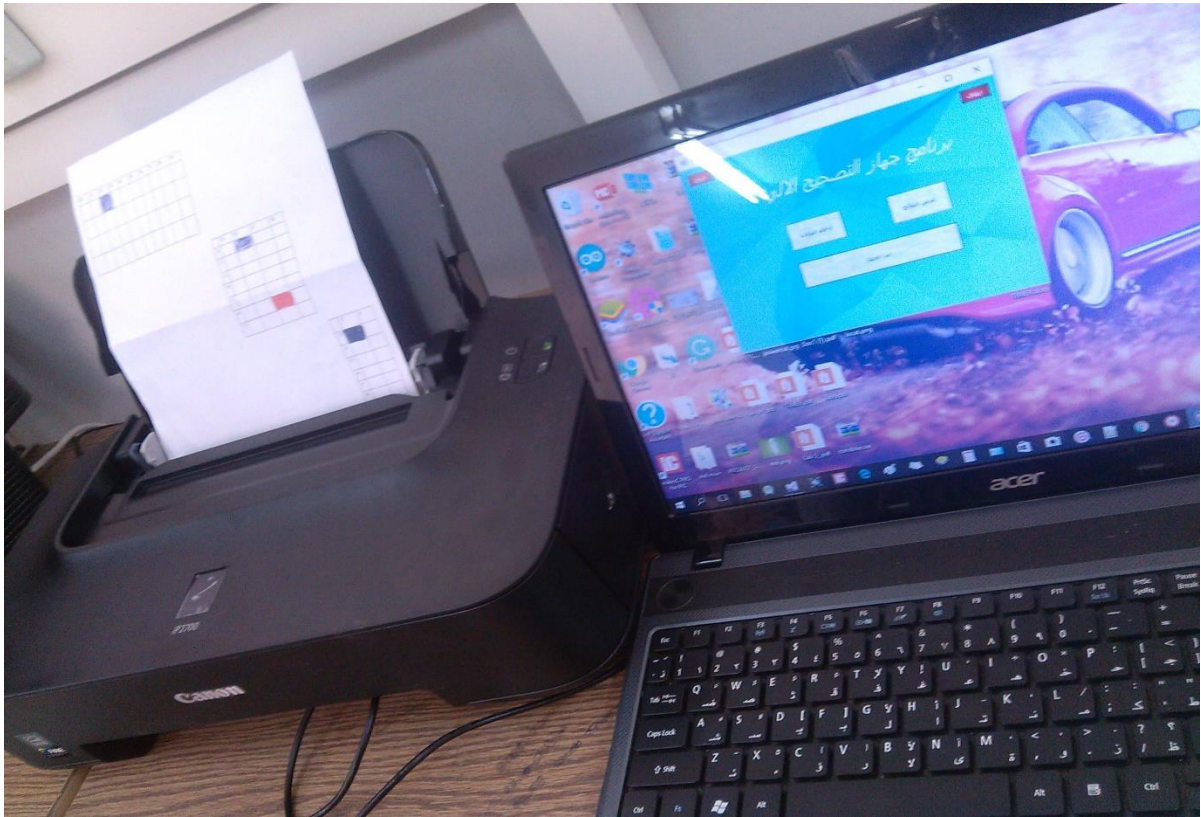


Figure 5.10(Correct device)

Chapter 6

Conclusion and Future Work

6.1 Overview

6.2 Conclusion

6.3 Future Work

Chapter 6

Conclusion and Future Work

6.1 Overview

This chapter introduces the conclusion of remarks, in addition to the future work, and recommended points for further work and research.

6.2 Conclusion

The main purpose of this project was to build an embedded system to help the teachers in correcting exams. This system consists of Atmega328 microcontroller which is connected with RGB color sensor which reads shaded choices and compares them with the typical answers, then displays results on the screen also sends it to computer for storage and another options. The project will be used in schools, universities, elections, and questionnaires to make the correction process easier and faster.

6.3 Future Work

After our hard work on this project, and facing many problems during the implementation; we, as a project team, see that the following points may be a good improvement in the future. Make it more reliable, and suitable for real life applications as dynamic exam forms and elections.

Appendix

Test Sheet

0	1	2	3	4	5	6	7	8	9

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				

	T	F
1		
2		
3		
4		
5		
6		
7		

Download Operating System

We can download the operating system by the CD that came with your device. This CD contains programmable Nano Arduino, Visual Basic programming and Motor driver; these software's are linked with each ready for use.

You may download software's through the following steps:-

- 1- Insert CD in the computer.
- 2- Download software of Motor driver in Uno arduino.
- 3- Download software of color sensor in Nano arduino.
- 4- Download software of C# programing.

After these step you can use the system successfully.

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