



EDUTRONICS

Educational Electronics System

Authors:

Dareen Mohamed
David Youssef
Moataz Gad
Mohamed Azzam

Mohamed Khaled
Mohamed Tarek
Mostafa Saeed
Reem Own

Supervisors:

Dr. Alaa Hamdy
Dr. Amr Mahmoud
Dr. Dario Assante

Table of contents:

Abstract	I
Acknowledgement	II

Chapter One: Introduction:

1.1-Problem review:	3
1.1.2-What's Global Competitive Index (GCI)?	4
1.1.3-Egypt in the GCI regarding the main problem:	4
1.2.1-Proposed Solutions:	7
1.2.2-Our solution:	8

Chapter Two: Project Educational System:

2.1-General Education problems in Egypt:.....	10
2.2-Proposed Solutions:.....	13
2.3-Different learning styles:	14
2.3.1-Overview of learning styles:.....	14
2.3.2-Understanding the basis of learning styles:.....	15
2.3.2.1-Visual (Spatial) learning style:.....	16
2.3.2.2- The Aural (Auditory-Musical-Rhythmic) Learning Style:	18
2.3.2.3- The Verbal (Linguistic) Learning Style:.....	19
2.3.2.4- The Physical (Bodily-Kinesthetic) Learning Style:	20
2.3.2.5- The Logical (Mathematical) Learning Style:.....	22
2.3.2.6- The Social (Interpersonal) Learning Style:	24
2.3.2.7- The Solitary (Intrapersonal) Learning Style:	26
2.3.3-Four stages of learning:.....	29
2.4-Our project's Educational role:.....	31

Chapter Three: Project Hardware:

3.1-Hardware conceptual view:	33
3.2-Used Materials:	33
3.2.1-Electronic components:	33
3.2.2-Magnetic buttons:.....	34
3.2.3-Plastic blocks:.....	33
3.2.4-Solder wick:	35
3.2.5- Hardware components working together:	356
3.2.6-Arduino Uno R3 Module:	37
3.2.7-Bluetooth HC-06 module:	42

Chapter Four: Project Software:

4.1-Software concept:	45
4.2-Comparison between mobile operating systems:	45
4.2.1-Reason for choosing android:	47
4.3-Android Application:	49
4.3.1-Introduction about android:	49
4.3-MIT App Inventor 2:	50
4.3.1-Setting up App inventor:.....	50
4.3.2-MIT App Inventor 2 Designer and Blocks Editor:	59
4.3.3- Sharing and Packaging Apps:	60
4.3.4-Our project's application design:.....	62
4.4-Arduino software:	73
4.4.1-Arduino code:.....	75

Chapter Five: Hardware Software Integration:

5.1- Interaction between Hardware kit and mobile application:	80
5.2-UART Protocol:	81
5.3-Final Prototype working along with the mobile application:	82

Chapter Six: Conclusion and future work:

6.1-Conclusion:	86
6.2-Future work:	86
6.2.1-Replacing the Arduino and with a Printed Circuit Board:.....	86
6.2.2-Increasing the number of projects that can be implemented by the kit:	87
6.2.3-Using Augmented Reality technology in the mobile application:	91
6.2.3.1-What's Augmented Reality Technology?.....	92
6.2.3.2-Role of Augmented Reality in education:.....	93
6.2.3.3-Augmented Reality applications:.....	93
6.2.4-Develop the mobile applications on other platforms:	94
<hr/>	
Bibliography:	96

List of figures:

Figure 2.1.1: Illiteracy rates.....	11
Figure 2.3.2: Learning styles.....	15
Figure 2.3.2.1: Visual learning information	16
Figure 2.3.3.1: how students learn.....	29
Figure 2.3.3.2: Edgar Dale’s cone of learning	30
Figure 3.2.2.1: Magnetic Snaps front view	34
Figure 3.2.2.2: Magnetic Snaps back view.....	34
Figure 3.2.3: Plastic blocks	34
Figure 3.2.4.1: Solder wick pack.....	35
Figure 3.2.4.2: Wick usage in a primitive design	35
Figure 3.2.5.1: First protoype.....	36
Figure 3.2.5.2: First prototype	36
Figure 3.2.6.1: Arduino R3 Front view	38
Figure 3.2.6.2: Arduino R3 Back view	38
Figure 3.2.7.1: HC 06 Module front view	42
Figure 3.2.7.2: HC 06 Back view	42
Figure 4.2.1.1: Tweeting devices distribution across Egypt	47
Figure 4.2.1.2: Heatmap of the % of android users	48
Figure 4.3.1.1: Option one	50
Figure 4.3.1.2: Step 3-1	52
Figure 4.3.1.3: Step 3-2.....	52
Figure 4.3.1.4: Option two	53
Figure 4.3.1.5: Successful aiStarter launch	54
Figure 4.3.1.6: Selecting Emulator option	54
Figure 4.3.1.7: Emulator running checkup	55
Figure 4.3.1.8: Option three.....	56
Figure 4.3.2.1: Designer tab	59
Figure 4.3.2.2: Blocks tab.....	59
Figure 4.3.3.1: Exporting as aia file	60
Figure 4.3.3.2: Importing aia file	60
Figure 4.3.3.3: Saving as apk	61

Figure 4.3.3.4: Building process	61
Figure 4.3.4.1: App intro	63
Figure 4.3.4.2: App requesting bluetooth permission	64
Figure 4.3.4.3: Pairing button	64
Figure 4.3.4.5: Successful pairing	65
Figure 4.3.4.6: Project list	67
Figure 4.3.4.7: Pressing back button in projects menu.....	67
Figure 4.3.4.8: Ready to start connection between the app and the kit.....	70
Figure 4.3.4.9: Pressing back on ready screen.....	71
Figure 4.3.4.10: Pressing ready while the kit is disconnected	71
Figure 4.3.4.11: Project completion display	72
Figure 4.3.4.12: Timeout display	72
Figure 4.2.3.1.1: Arduino software.....	74
Figure 4.2.3.1.2: Selecting the arduino board version	74
Figure 5.1.1: Test Software	80
Figure 5.2.1: UART	81
Figure 5.3.1: Hardware kit final prototype front view	82
Figure 5.3.2: Hardware kit final prototype back view.....	83
Figure 5.3.3: Arduino and bluetooth module connection side view	83
Figure 5.3.4: Arduino and bluetooth module connection upper view	84
Figure 5.3.5: Hardware and mobile app functioning together	84
Figure 6.2.3.1.1: Augmented Reality technology example	92
Figure 6.2.4.1: Mobile device sales 2Q12.....	94

List of tables:

Table 1.1.3.1: Egypt and the net enrollment rate.....	5
Table 1.1.3.2: Egypt and primary education.....	6
Table 4.2.1: Mobile OS comparison	46
Table 6.2.2.1: Projects ideas list 1	87
Table 6.2.2.2: Projects ideas list 2	88
Table 6.2.2.3: Projects ideas list 3	88
Table 6.2.2.4: Projects ideas list 4	89
Table 6.2.2.5: Projects ideas list 5	89
Table 6.2.2.6: Projects ideas list 6	90
Table 6.2.2.7: Projects ideas list 7	90
Table 6.2.2.8: Projects ideas list 8	91
Table 6.2.2.9: Projects ideas list 9	91

Abstract

In this paper work, we'll be introducing Edutronics project, as a new creative solution to raise a whole new generation of kids and adolescents, who are be able to lead an industrial and technical revolution for our country, by mastering the field of electronics.

Moreover, we'll discuss the problems of education in Egypt, some purposed solutions to these problems, also we'll review all learning styles and stages which have guided us to prepare an educational plan for whoever will be using this project.

This document contains full details about how the hardware and software of this project have developed from scratch till they came to life, as a reliable prototype that proves our concept, and finally our future plans to improve its efficiency, and ensure that we provide a simple, safe and fun learning environment to our users.

ACKNOWLEDGEMENT

Praise Allah for his blessings which without, we wouldn't have been able to complete and finalize this project.

We would like to express our deepest appreciation for our dear professors who have the attitude and the substance of genius; where they have done their best and gave us from their time, knowledge and experience to begin, sustain and finalize our work with this project and make it to come to life.

Special thanks to Professor Dario Assante “Assistant Professor – Uninettuno University” who despite the large distance that separated us, provided us with some really genius and useful ideas for our project, and always kept asking about our progress; we were completely sure that if we needed anything he would have provided as much help as he could. We hope that we’ve lived up to his expectations.

Special thanks to Professor Alaa Hamdy “ Assistant Professor – Helwan University” who has helped us with all the available tools and resources to achieve the desired software output and to match the IEEE's International Standards for software mobile applications.

Special thanks to Professor Amr Elsayyed “Lecturer – Helwan University” who was very supportive to the project’s idea, endorsed us to work as a team, and helped us finalize the Hardware Educational Kits and ensured it matched the IEEE's Standards for the Electronics Education.

We would like to thank our families; Mothers, fathers, brothers and sisters who have helped us with all they could do by assisting us mentally, financially where they haven't slept the nights just to serve us in our gatherings and give us a great motivation.

We would like to thank our friends who have helped us with all their possibilities to search, buy the components needed and to make a full problem research on our society.

In addition we would like also to thank our dean and our department's management for their cooperation giving us all the facilities available from our faculty and the Egyptian government.

Chapter One: Introduction

1.1-Problem review:

The 118th out of 148 countries; again, Egypt retreats from the 107th out of 144 place in 2012-2013 to the 118th in 2013-2014 Global Competitiveness Index (GCI), issued by the World Economic Forum (WEF), keeping our country at the bottom of the report.

Lately there have been too many problems in Egypt, where we can say that most of them -if not all - are dependent on each other's such as poverty, health, traffic congestion and high population, lack of the Industrial levels, Education...etc.

As an example the health problems is dependent on poverty and education, traffic congestions is dependent on high population and education, the lack of the industrial level is dependent on the high salaries of the Egyptian market and the low quality obtained from the Egyptian technicians which is also dependent on the low quality of Education.

If we had a keen overview for these problems we would figure out that the most common problem resulting in other problems is the problem of the bad education.

Since the world's most common trend nowadays is about the new technologies and the electronic industries, a country with a bad education would hardly compete leading to another huge economic problem for this country.

Likewise most of the problems in Egypt is because of the bad education quality thus the absence of technical education; an electrical or an embedded systems Engineering student would know nothing about what he will be doing after he gets graduated before entering the faculty.

¹The duration of this Educational stage is so small for a student to cover the least information for having the bachelor's degree, or to have the job title of an Engineer or either a technician.

From the research made by the International Institute of Technology, the main reasons for keeping a country away from producing electronic devices or electronic components would be one of two different orientation reasons:

1. Business Oriented reasons (BOR)
2. Technical Oriented reasons (TOR)

If we came to the point of the TOR we would find that the main reason in the TOR is the lack of information and education of the Egyptians specially in the major of electronic production Which had a great Impact in the Global Competitiveness Index included (GCI) in the Global Competitiveness Report by World Economic Forum taking Egypt from coming 89th country in the index in the close past to be the to be the 118th over 148 country in 2013-2014's Report.

¹ The Global Competitiveness Report 2013 - 2014

1.1.2-What's Global Competitive Index (GCI)?

²It's a report that assesses the ability of countries to provide high levels of prosperity to their citizens. This in turn depends on how productively a country uses available resources. Therefore, the Global Competitiveness Index measures the set of institutions, policies, and factors that set the sustainable current and medium-term levels of economic prosperity.

1.1.3-Egypt in the GCI regarding the main problem:

³In the latest GCR (2013-2014) Egypt ranking was to be the last in the quality of primary education according to the latest Global Competitiveness Report issued by World Economic Forum. Shocked Arabic and English newspaper commentators drew particular attention to the embarrassingly low score on education, while online social network users wondered whether this figure is really true and Egypt did really rank the lowest among countries listed in this report.

While recognizing the significance of the figures cited and admitting that public education in Egypt is in a dismal state, it is problematic to be citing the Global Competitiveness Report on this matter, for a very simple reason:

There are two figures in the report that cover primary education in Egypt. One is the net enrollment rate, which means the percentage of children from a given age group enrolled in the academic year for that age group. So if we assume that 5th grade is for ten year-olds, then the net enrollment rate for 5th grade would be the number of ten year-old children enrolled divided by the number of ten year-olds in the country. It is the first, most basic indicator people use to get a sense of how big the education system is and how many kids are enrolled in schools. Access to education is by no means an indicator of the level of quality. Egypt has famously done fairly well on enrollment rates while doing very poorly on other quality indicators.

So Egypt's net enrollment rate for primary education is listed in the report as being 95.6%, with a ranking of 58/148. Generally not bad but also not good either. 95.6% sounds nice and high but it's important here to remember two things:

1. It is an average rate and the rates for girls and for children in rural, remote and economically marginalized areas are lower than the average
2. It is just an indicator of how many kids are going to school and mentions nothing about what type of education these children receive there.

² Wikipedia

³ The Global Competitiveness Report 2013 - 2014

RANK	COUNTRY/ECONOMY	VALUE	RANK	COUNTRY/ECONOMY	VALUE
1	Singapore	100.0	75	Malta ⁹	93.8
2	Japan ⁹	100.0	76	Uganda	93.8
3	Canada ¹	99.8	77	Montenegro ¹⁰	93.7
4	China	99.8	78	Cape Verde	93.5
5	Netherlands ⁹	99.8	79	Russian Federation ⁹	93.4
6	Iran, Islamic Rep.	99.8	80	India ⁹	93.3
7	Ireland	99.7	81	Chile	93.3
8	Spain	99.7	82	Serbia	93.2
9	Myanmar ⁵	99.6	83	Albania ⁹	93.0
10	Uruguay ⁹	99.5	84	Sri Lanka	92.9
11	United Kingdom ⁹	99.5	85	Suriname	92.8
12	Taiwan, China ¹⁰	99.5	86	Venezuela	92.7
13	Sweden	99.5	87	Hungary	92.5
14	Tunisia	99.4	88	Nicaragua ⁹	92.5
15	Vietnam	99.3	89	Hong Kong SAR	92.3
16	New Zealand ⁹	99.3	90	Luxembourg ⁹	92.1
17	Portugal ⁹	99.2	91	Kuwait ⁷	92.1
18	Norway ⁹	99.1	92	Benin ⁷	92.1
19	Argentina ⁴	99.1	93	Cameroon ⁹	91.9
20	Greece ⁹	99.0	94	Ukraine	91.7
21	Cyprus ⁹	99.0	95	Lithuania	91.1
22	Iceland ⁹	99.0	96	Jordan ⁹	90.7
23	Turkey ⁹	98.9	97	Timor-Leste	90.4
24	Belgium ⁹	98.9	98	Mozambique ¹⁰	90.4
25	Rwanda ⁹	98.7	99	Zimbabwe ⁵	90.0
26	Ecuador ⁸	98.6	100	Burundi ⁶	89.7
27	Mongolia	98.6	101	Thailand ⁸	89.7
28	Korea, Rep. ⁹	98.6	102	Czech Republic ⁵	89.6
29	France	98.5	103	Dominican Republic	89.4
30	Austria ⁹	98.4	104	Bhutan ¹⁰	89.0
31	Cambodia	98.2	105	Kyrgyz Republic	88.4
32	Georgia	98.1	106	United Arab Emirates ⁵	88.4
33	Tanzania ⁷	98.0	107	Bosnia and Herzegovina	88.4
34	Bulgaria ⁹	98.0	108	Philippines ⁵	88.3
35	Finland	97.9	109	Macedonia, FYR ⁹	88.0
36	Bahrain ⁵	97.8	110	Bolivia ⁹	88.0
37	Mexico	97.8	111	Moldova	87.8
38	Slovenia	97.7	112	Romania ⁹	87.6
39	Germany ⁹	97.7	113	Colombia	87.1
40	Italy ⁹	97.4	114	Botswana ⁸	87.1
41	Slovak Republic ⁵	97.4	115	Armenia ⁵	87.1
42	Lao PDR	97.4	116	Croatia ⁹	86.8
43	Honduras	97.3	117	Azerbaijan	86.6
44	Australia ⁹	97.1	118	Kazakhstan ¹⁰	86.5
45	Israel ⁹	97.1	119	Ethiopia	86.5
46	Mauritius	97.0	120	Angola ⁹	85.7
47	Brunei Darussalam ⁸	96.9	121	Namibia ⁹	85.1
48	Malawi ⁹	96.9	122	South Africa ⁸	85.1
49	Panama	96.9	123	Swaziland ⁶	84.8
50	Poland ⁹	96.6	124	Paraguay ⁹	83.6
51	Oman	96.6	125	Kenya ⁸	82.8
52	Saudi Arabia	96.5	126	Guyana	82.7
53	Algeria	96.2	127	Ghana ¹⁰	82.1
54	Morocco ¹⁰	96.0	128	Jamaica ⁹	82.0
55	Malaysia ⁴	95.9	129	Guinea ¹⁰	81.7
56	Indonesia	95.8	130	Gabon ²	80.0
57	Guatemala ⁹	95.8	131	Madagascar ³	79.2
58	Egypt	95.6	132	Puerto Rico	79.1
59	Zambia	95.5	133	Yemen	76.0
60	Denmark ⁹	95.4	134	Senegal	75.7
61	Seychelles ⁴	95.1	135	Mauritania	74.5
62	Latvia	95.1	136	Lesotho	74.5
63	Barbados ⁷	95.0	137	Pakistan	72.1
64	Estonia ⁹	95.0	138	Gambia, The	67.5
65	Lebanon	94.9	139	Sierra Leone	65.0
66	United States ⁹	94.6	140	Burkina Faso ¹⁰	64.1
67	Peru	94.5	141	Mali	62.9
68	Nepal ⁹	94.5	142	Chad ⁵	62.3
69	Brazil ⁴	94.4	143	Côte d'Ivoire ⁸	61.5
70	Bangladesh	94.4	144	Nigeria ⁹	57.6
71	El Salvador	94.3	145	Liberia	40.8
72	Qatar	94.0	n/a	Costa Rica	n/a
73	Trinidad and Tobago ⁹	93.9	n/a	Haiti	n/a
74	Switzerland	93.9	n/a	Libya	n/a

SOURCES: UNESCO Institute for Statistics (accessed June 21, 2013); The Asian Development Bank, *Key Indicators for Asia and the Pacific 2012*; The World Bank, *EdStats Database* (accessed June 27, 2012); Organisation for Economic Co-operation and Development (OECD), *UNICEF Education at a Glance 2011*; UNESCO Country Programming Document; national sources

¹ 2000 ² 2001 ³ 2003 ⁴ 2005 ⁵ 2006 ⁶ 2007 ⁷ 2008 ⁸ 2009 ⁹ 2010 ¹⁰ 2012

-Table 1.1.3.1: Egypt and the net enrollment rate-

The second Figure related to primary education, and the one that has everyone up in arms is listed as "Quality of Primary Education" and Figure 1.1.3.2 given in, which ranks Egypt at 148 out of the 148 countries covered in the report. According to the report itself, this Figure is the average score given by respondents to a question on the Executive Opinion Survey. The survey provides the bulk of the data the report is based on. The respondents of this survey, and here is the important part, are people from various sectors within the business community. For this year's report, the survey in Egypt (conducted by the Egyptian Center for Economic Studies) collected responses from 71 business people. The question they were asked about primary education was "How would you assess the quality of primary schools in your country?" (Or most likely something very close to it, as this was the question used for the same item in the 2009 survey and I doubt much has changed). Respondents were to give their answer as a rank, ranging from 1, indicating "Poor" to 7 indicating "Excellent—among the best in the world". So the average rank for the quality of primary education, from 71 executives from various sectors and business sizes, was 2/7. This was the lowest rank among all the countries.



-Table 1.1.3.2: Egypt and Primary education-

1.2.1-Proposed Solutions:

From the previous information, it all lies in increasing the country's production and industrial activities, and this will happen through:

1. The government creates a favorable framework for businesses activities.
2. Assisting the promotion of the diffusion of new technologies. Ultimately, it is new technologies that improve productivity.
3. Facilitating the inventions' patent process, as it takes years to be completed.
4. Facilitating the movement of the workforce from low to high productivity activities, both on an inter-regional and inter-industry basis.
5. Investment in post-secondary education, both in terms of the teaching and, of course, research and development.
6. Realizing the importance of research field, and encourage promising research institutes through awareness.
7. Converting researches from ideas to the real world and getting use of them in facing Egypt's problems.
8. Increasing the awareness of the importance of the technical education.
9. Using different approaches and learning from other cultures how they benefit from them and applying them in our educational systems.
10. The government should increase the budget of education and it should spend bigger percentage on the infrastructure.
11. Increasing the attention of the rural areas and building larger number of school according to the international standards.
12. Spending much money on advanced learning equipment.
13. Encouraging private companies and foundations to help Figurehting illiteracy.
14. Performing national projects to develop the education in Egypt.

1.2.2-Our solution:

Being engineers, we have a very effective role in developing this community and providing it with the tools, products and technologies that revive its economy.

Basically we provide a learning system that relates to the quote “Give a man a fish and he’ll eat for a day, teach a man how to fish and he’ll eat for a lifetime” I want you to imagine, a whole new generation that’s been learning electronics and implementing circuits since the age of 8, what would they capable to achieve?

We aim to prepare a generation that will lead a technological revolution for our country, through manufacturing educational kits and components that aim to develop the technical skills of our future generation in a safe, simple and fun learning environment based on learning by doing, which will be one of the main methods to place Egypt among the top countries in the Global Competitiveness Index on the long run.

Our main user is the child that we’ll reach through his/her parent, who’ll be an easy target once he/she knows the use of our product, by simply clarifying the function and operation of our project; Who won’t like the idea of making his kid play with something that will literally enhance his brain skills?

The children’s’ curiosity will be a great help, every child would wish to make his own game, imagine how will he/she react when he hears that he can make a circuit that performs a certain function, remember how your own kids or siblings reacted when they connected a lamp with a battery in school and it lit or when they created a magnetic field with a nail, they sure were interested; learning by doing, that’s the best and the most interesting learning method.

Chapter two: Project Educational System

2.1-General Education problems in Egypt:

We'll sum up all the problems in the upcoming points:

4

1. No clear governmental plans

- Instability, and no binding rules to maintain assurance in the schooling or the academic university systems.
- No long term plans for reforming education.
- Almost every year there is a new decision taken by a new prime minister or a minister concerning a new law that affects education.
- Every new minister of education comes and ignores the previous minister's efforts and start again.

2. Over population

- Statistics from Central Agency for Public Mobilization and Statistics shows that there are 16 million 101 thousand and 210 student in Egypt.
- Classes are so crowded so teachers can't give all what they have.
- No appropriate environment for education.
- Less attention to the instructor.
- Students can't use the education facilities like labs due to their number.
- Faster destruction for the infrastructure like classes, bathrooms, labs.
- Health problems may happen because of the crowd.

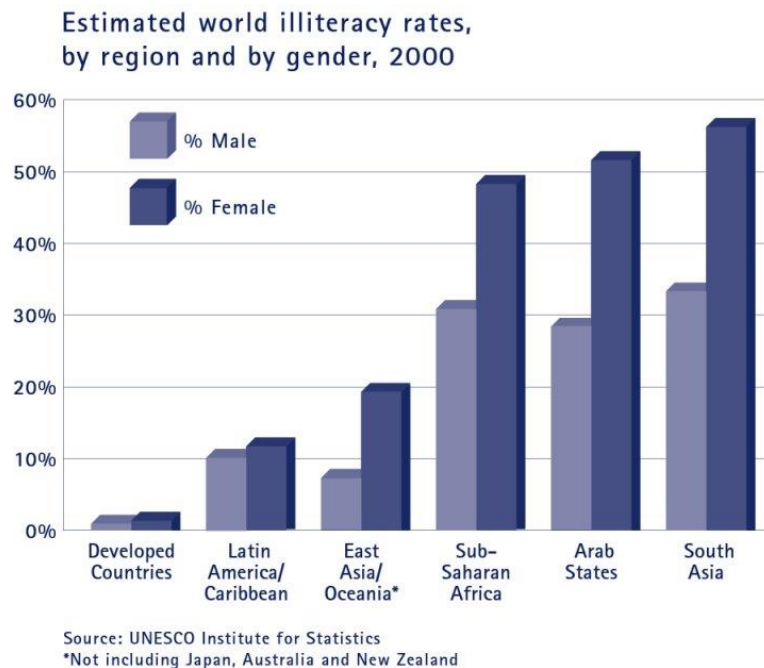
3. Unqualified instructors

- As a result of bad education systems there are many teachers who aren't well qualified to deal with the students.
- The inefficiency of the instructors and his inability to convey the information properly and also the inability to distinguish the differences between individual students.
- In each level of education student needs a specific kind of treatment from teachers but they don't understand this.
- Instructors lack how to deal with students psychologically and lack to having different ways of teaching.

⁴ Presentation about problems of education by Nile University 2013

4. Illiteracy

- Large number of illiterates in Egypt.
- There is a relation between poverty and illiteracy in Egypt.
- 45% of the workers in Egypt are illiterates.
- The Egyptian government doesn't spend enough money in fighting illiteracy.



-Figure 2.1.1: Illiteracy rates-

5. Private lessons

- Students are less interested in going to schools.
- Changing the nature of the relation between the student and the teacher.
- Creating type of dependency at the student.
- Teachers are not giving the required care to the students in schools.
- Teachers distinguish between students in treatment in classes.
- Private lessons creates miserable economic burden on families.

6. Old techniques of education

- The educational system didn't change since Mohamed Ali.
- The cramming system where the teacher provides everything, and students take notes, there is no participation.
- Moreover, each lesson has an enormous amount of data that has to be memorized by heart to be able to pass their finals at the end of the term.

- The grading scheme is unfair because the whole grade depends only on the finals so we find the phenomenon of students studying at home and they don't go to schools.

7. The gap between the family and the school

- The family and the school are the main factors in building the student's background and habits.
- These two factors must work together in the right way to improve the student's performance and to solve the problems that the student might face.
- The absence of any factor of them leads to:
- Bad habits like drugs, Alcohol, disrespecting.
- Poor academic performance.
- Bad behavior regards teachers.

8. Infrastructure

- The educational infrastructure in Egypt isn't strong or developed at all.
- The number of schools isn't proportional to the number of students especially in the countryside.
- Many children have to walk for kilometers to reach their schools.
- Schools don't contain advanced labs and modern technology means.

9. Neglecting Technical Education, which is the main problem that we're concerned about as it's related to our field as engineers; caused by the following:

- **Reasons:**
 - i. The society's view of technical education is always negative.
 - ii. The poor condition of buildings and equipment of the schools because the government doesn't develop them.
 - iii. The number of students in classes is huge so classes are overcrowded.
 - iv. Concentrating on the theoretical side and ignoring the practical one.
- **Which led to:**
 - i. Students don't have enough abilities.
 - ii. Graduates don't find work which increases the problem of unemployment

10. Subjects aren't related to the labor market

2.2-Proposed Solutions:

1. Technical Education

- Increasing the awareness of the importance of the technical education to change the people's look to it by making campaigns in the media.
- Developing the equipment and the constructions and coping with the modern techniques.
- Taking the students to attend international conferences to recognize what the world reached.
- Finding jobs for graduates with good salaries.
- Making final projects like engineering faculties.

2. Old techniques of education

- Provide students with creative, fun, syllabuses to ensure that they learn while having fun.
- Using different approaches and learning from other cultures how they benefit from them and applying them in our educational systems.
- Project based learning.
- Task based learning.
- Language communicative skills.

3. Infrastructure

- The budget of education in Egypt in 2011 is 36.3 Billion LE. Which represents 3.4% from Egypt's budget.
- Statistics show that 94% from the education budget goes for salaries.
- The government should increase the budget of education and it should spend bigger percentage on the infrastructure.
- Increasing the attention of the rural areas and building larger number of school according to the international standards.
- Spending much money on advanced equipment like labs and computer.
- Maintenance is the most important thing to save the money spent.

4. Performing national projects to develop the education in Egypt like Zewail's city for sciences and technology.

5. Increasing the attention of scientific research which is really ignored in Egypt and increasing its budget.

6. Converting researches from ideas to the real world and getting use of them in facing Egypt's problems

7. Overcome the problem if bureaucracy that faces any ambitious project in Egypt.

2.3-Different learning styles:

⁵2.3.1-Overview of learning styles:

Many people recognize that each person prefers different learning styles and techniques. Learning styles group common ways that people learn. Everyone has a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles. Others may find that they use different styles in different circumstances. There is no right mix. Nor are your styles fixed. You can develop ability in less dominant styles, as well as further develop styles that you already use well.

Many people recognize that each person prefers different learning styles and techniques. Learning styles group common ways that people learn. Everyone has a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles. Others may find that they use different styles in different circumstances. There is no right mix. Nor are your styles fixed. You can develop ability in less dominant styles, as well as further develop styles that you already use well.

Using multiple learning styles and multiple intelligences for learning is a relatively new approach. This approach is one that educators have only recently started to recognize. Traditional schooling used (and continues to use) mainly linguistic and logical teaching methods. It also uses a limited range of learning and teaching techniques. Many schools still rely on classroom and book-based teaching, much repetition, and pressured exams for reinforcement and review. A result is that we often label those who use these learning styles and techniques as bright. Those who use less favored learning styles often find themselves in lower classes, with various not-so-complimentary labels and sometimes lower quality teaching. This can create positive and negative spirals that reinforce the belief that one is "smart" or "dumb".

By recognizing and understanding your own learning styles, you can use techniques better suited to you. This improves the speed and quality of your learning.

⁵ learning-styles-online.com

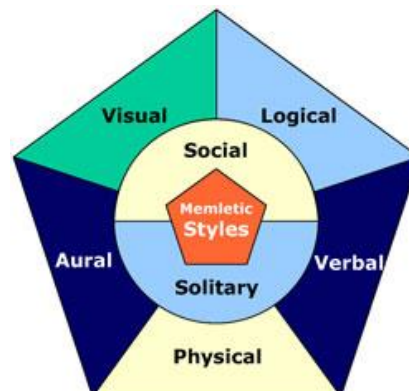
2.3.2-Understanding the basis of learning styles:

Learning styles have more influence than you may realize. Your preferred styles guide the way you learn. They also change the way you internally represent experiences, the way you recall information, and even the words you choose. We explore more of these features in this chapter.

Research shows us that each learning style uses different parts of the brain. By involving more of the brain during learning, we remember more of what we learn. Researchers using brain-imaging technologies have been able to find out the key areas of the brain responsible for each learning style.

For example:

- **Visual:** The occipital lobes at the back of the brain manage the visual sense. Both the occipital and parietal lobes manage spatial orientation.
- **Aural:** The temporal lobes handle aural content. The right temporal lobe is especially important for music.
- **Verbal:** The temporal and frontal lobes, especially two specialized areas called Broca's and Wernicke's areas (in the left hemisphere of these two lobes).
- **Physical:** The cerebellum and the motor cortex (at the back of the frontal lobe) handle much of our physical movement.
- **Logical:** The parietal lobes, especially the left side, drive our logical thinking.
- **Social:** The frontal and temporal lobes handle much of our social activities. The limbic system (not shown apart from the hippocampus) also influences both the social and solitary styles. The limbic system has a lot to do with emotions, moods and aggression.
- **Solitary:** The frontal and parietal lobes, and the limbic system, are also active with this style.



-Figure 2.3.2: Learning styles-

2.3.2.1-Visual (Spatial) learning style:

If you use the visual style, you prefer using images, pictures, colors, and maps to organize information and communicate with others. You can easily visualize objects, plans and outcomes in your mind's eye. You also have a good spatial sense, which gives you a good sense of direction. You can easily find your way around using maps, and you rarely get lost. When you walk out of an elevator, you instinctively know which way to turn.

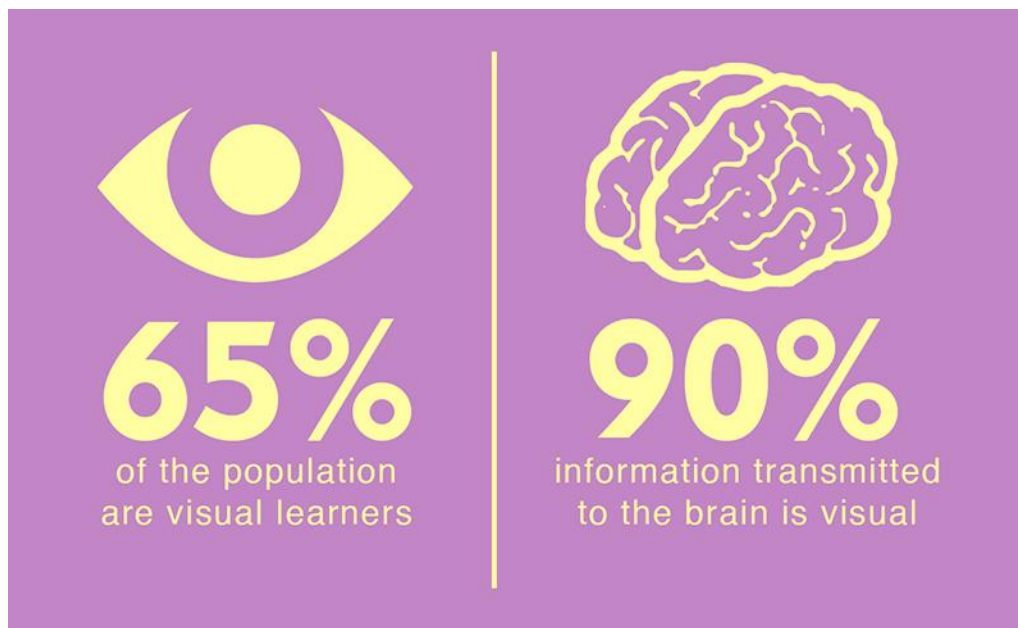
The whiteboard is a best friend (or would be if you had access to one). You love drawing, scribbling and doodling, especially with colors. You typically have a good dress sense and color balance (although not always!).

Common pursuits and phrases

Some pursuits that make the most use of the visual style are visual art, architecture, photography, video or film, design, planning (especially strategic), and navigation.

You may tend to use phrases like these:

- Let's look at it differently.
- See how this works for you.
- I can't quite picture it.
- Let's draw a diagram or map.
- I'd like to get a different perspective.
- I never forget a face.



-Figure 2.3.2.1: Visual learning information-

Learning and techniques:

If you are a visual learner, use images, pictures, color and other visual media to help you learn. Incorporate much imagery into your visualizations.

You may find that visualization comes easily to you. This also means that you may have to make your visualizations stand out more. This makes sure new material is obvious among all the other visual images you have floating around inside your head.

- Use color, layout, and spatial organization in your associations, and use many 'visual words' in your assertions. Examples include see, picture, perspective, visual, and map.
- Use mind maps. Use color and pictures in place of text, wherever possible. If you don't use the computer, make sure you have at least four different color pens.
- Systems diagrams can help you visualize the links between parts of a system, for example major engine parts or the principle of sailing in equilibrium. Replace words with pictures, and use color to highlight major and minor links.
- The visual journey or story technique helps you memorize content that isn't easy to 'see.' The visual story approach for memorizing procedures is a good example of this.
- Peg words and events come easily to you, however you need to spend some time learning at least the first ten peg words. Afterwards, your ability to visualize helps you peg content quickly.
- The swish technique for changing behaviors also works well for you, as it relies on visualization.

2.3.2.2- The Aural (Auditory-Musical-Rhythmic) Learning Style:

If you use the aural style, you like to work with sound and music. You have a good sense of pitch and rhythm. You typically can sing, play a musical instrument, or identify the sounds of different instruments. Certain music invokes strong emotions. You notice the music playing in the background of movies, TV shows and other media. You often find yourself humming or tapping a song or jingle, or a theme or jingle pops into your head without prompting.

Common Pursuits and Phrases

Some pursuits that use the aural style are playing, conducting, or composing music, and sound engineering (mixing and audiovisual work).

You may tend to use phrases like these:

- That sounds about right.
- That rings a bell.
- It's coming through loud and clear.
- Tune in to what I'm saying
- Clear as a bell.
- That's music to my ears.

Learning and Techniques

- If you are an aural learner, use sound, rhyme, and music in your learning. Focus on using aural content in your association and visualization.
- Use sound recordings to provide a background and help you get into visualizations. For example, use a recording of an aircraft engine running normally, playing loudly via a headset, to practice flight procedures. Use a recording of the sound of wind and water when visualizing sailing maneuvers. If you don't have these recordings, consider creating them while next out training.
- When creating mnemonics or acrostics, make the most of rhythm and rhyme, or set them to a jingle or part of a song.
- Use the anchoring technique to recall various states that music invokes in you. If you have some particular music or song that makes you want to 'take on the world,' play it back and anchor your emotions and state. When you need the boost, you can easily recall the state without needing the music.

2.3.2.3- The Verbal (Linguistic) Learning Style:

The verbal style involves both the written and spoken word. If you use this style, you find it easy to express yourself, both in writing and verbally. You love reading and writing. You like playing on the meaning or sound of words, such as in tongue twisters, rhymes, limericks and the like. You know the meaning of many words, and regularly make an effort to find the meaning of new words. You use these words, as well as phrases you have picked up recently, when talking to others.

Common pursuits and phrases

Pursuits that use the verbal style include public speaking, debating, politics, writing and journalism.

You may tend to use phrases like these:

- Tell me word for word
- Let's talk later.
- The word you're looking for is
- I hear you but I'm not sure I agree.
- Let me spell it out for you.
- In other words

Learning and techniques

- If you are a verbal learner, try the techniques that involve speaking and writing. Find ways to incorporate more speaking and writing in techniques. For example, talk yourself through procedures in the simulator, or use recordings of your content for repetition.
- Make the most of the word-based techniques such as assertions and scripting. Use rhyme and rhythm in your assertions where you can, and be sure to read important ones aloud. Set some key points to a familiar song, jingle or theme.
- Mnemonics are your friends for recalling lists of information. Acronym mnemonics use words, focusing on the first letter of the word to make up another word or memorable sequence. You can also make up phrases using the items you want to memorize.
- Scripting is also powerful for you. You don't just have to write them down. Record your scripts using a tape or digital audio recorder (such as an MP3 player), and use it later for reviews.
- When you read content aloud, make it dramatic and varied. Instead of using a monotone voice to go over a procedure, turn it into a lively and energetic speech

worthy of the theatre. Not only does this help your recall, you get to practice your dramatic presence!

- Try working with others and using role-playing to learn verbal exchanges such as negotiations, sales or radio calls.

2.3.2.4- The Physical (Bodily-Kinesthetic) Learning Style:

If the physical style is more like you, it's likely that you use your body and sense of touch to learn about the world around you. It's likely you like sports and exercise, and other physical activities such as gardening or woodworking. You like to think out issues, ideas and problems while you exercise. You would rather go for a run or walk if something is bothering you, rather than sitting at home.

You are more sensitive to the physical world around you. You notice and appreciate textures, for example in clothes or furniture. You like 'getting your hands dirty,' or making models, or working out jigsaws.

You typically use larger hand gestures and other body language to communicate. You probably don't mind getting up and dancing either, at least when the time is right. You either love the physical action of theme park rides, or they upset your inner body sense too much and so you avoid them altogether.

When you are learning a new skill or topic, you would prefer to 'jump in' and play with the physical parts as soon as possible. You would prefer to pull an engine apart and put it back together, rather than reading or looking at diagrams about how it works.

The thought of sitting in a lecture listening to someone else talk is repulsive. In those circumstances, you fidget or can't sit still for long. You want to get up and move around.

Common Pursuits and Phrases

Pursuits that involve the physical style include general physical work, mechanical, construction and repair work, sports and athletics, drama and dancing.

You may tend to use phrases like these:

- That feels right to me.
- I can't get a grip on this'
- Stay in touch.
- Get in touch with'
- That doesn't sit right with me.
- I have good feelings about this.

- My gut is telling me'
- I follow your drift.

Learning and techniques

- If you use a physical style, use touch, action, movement and hands-on work in your learning activities. For visualization, focus on the sensations you would expect in each scenario. For example, if you are visualizing a tack (turn) on a sailboat, focus on physical sensations. Feel the pressure against your hand as you turn the rudder, and the tension lessening on the ropes. Feel the wind change to the other side, feel the thud as the sail swaps with the wind, and feel the boat speed up as you start the new leg.
- For assertions and scripting, describe the physical feelings of your actions. For example, a pilot might script as follows: 'I feel the friction as I push the throttle forward to start my takeoff run. The controls start to feel more responsive as I check the airspeed, oil pressure and temperature. At takeoff speed, I pull back slightly, and I feel the vibrations of the wheels stop as the plane leaves the ground. After a few moments, I reach down and set the gear selector to up. I feel the satisfying bump as the gear stops fully up.'
- Use physical objects as much as possible. Physically touch objects as you learn about what they do. Flashcards can help you memorize information because you can touch and move them around.
- Keep in mind as well that writing and drawing diagrams are physical activities, so don't neglect these techniques. Perhaps use big sheets of paper and large color markers for your diagrams. You then get more action from the drawing.
- Use breathing and relaxation to focus your state while you learn and perform. Focus on staying calm, centered, relaxed and aware. If you want to gain more control over your physical state, look up some references on Autogenics. This was a secret behind the Great Russian athletic performances over the past few decades.
- Use role-playing, either singularly or with someone else, to practice skills and behaviors. Find ways to act out or simulate what you are learning.

2.3.2.5- The Logical (Mathematical) Learning Style:

If you use the logical style, you like using your brain for logical and mathematical reasoning. You can recognize patterns easily, as well as connections between seemingly meaningless content. This also leads you to classify and group information to help you learn or understand it.

You work well with numbers and you can perform complex calculations. You remember the basics of trigonometry and algebra, and you can do moderately complex calculations in your head.

You typically work through problems and issues in a systematic way, and you like to create procedures for future use. You are happy setting numerical targets and budgets, and you track your progress towards these. You like creating agendas, itineraries, and to-do lists, and you typically number and rank them before putting them into action.

Your scientific approach to thinking means you often support your points with logical examples or statistics. You pick up logic flaws in other peoples words, writing or actions, and you may point these out to people (not always to everyone's amusement).

You like working out strategies and using simulation. You may like games such as brainteasers, backgammon, and chess. You may also like PC games such as Dune II, Starcraft, Age of Empires, Sid Meier games and others.

Common Pursuits and Phrases

People with a strong logical style are likely to follow such pursuits as the sciences, mathematics, accounting, detective work, law and computer programming.

You are more likely to use phrases that reflect you're most dominant style out of the visual, aural or physical styles, however you may also use phrases like these:

- That's logical.
- Follow the process, procedure, or rules.
- There's no pattern to this.
- Let's make a list.
- We can work it out.
- Quantify it, or prove it!

Learning and techniques

- If you are a logical learner, aim to understand the reasons behind your content and skills. Don't just rote learn. Understanding more detail behind your compulsory content helps you memorize and learn the material that you need to know. Explore the links between various systems, and note them down.
- While you study, create and use lists by extracting key points from your material. You may also want to use statistics and other analysis to help you identify areas you may want to concentrate on.
- Pay attention to your physical state, for example you're breathing and stress level. It's possible that you isolate your own body from your rational thought. Remember that you are just as much a part of the 'system' as any equipment you may be using.
- Also remember that association often works well when it is illogical and irrational. It doesn't matter how logical two items are together. You have a better chance of recalling them later if you have make the association illogical. Your brain may protest at first!
- In your scripting though, highlight logical thoughts and behaviors. Highlight your ability to pick up systems and procedures easily, and that you can detect when you need to change a set procedure.
- Make use of 'systems thinking' to help understand the links between various parts of a system. An important point here is that systems thinking helps you understand the bigger picture. Often the whole is greater than the sum of the parts. For example, you may understand the individual aircraft systems and flight surfaces, but you may not have a view of how all those systems support flight in equilibrium. Systems diagrams can help you gain that understanding.
- You may find it challenging to change existing behaviors or habits. You can rationalize all you want to about why you should change a behavior, but you may find it persists. Try the shunt technique to understand what behavior you currently have and what behavior you want to have. When you understand those behaviors, use the technique to divert from the old behavior to the new.
- You may sometimes overanalyze certain parts of your learning or training. This can lead to analysis paralysis. You may be busy, but not moving towards your goal. If you find you are overanalyzing which school to start with, or you are over-planning your course maps, stop and refocus on activities that move you forward. Consider how much 'bang for buck' you get from spending more time than necessary. Measure your activities by your speed towards your goal. Planning exactly how much time to spend on each chapter of theory doesn't help learn it anywhere near as fast as starting on the theory!

- If you often focus from analysis paralysis, write 'Do It Now' in big letters on some signs or post-it notes. Place them in strategic places around your work or study area.

2.3.2.6- The Social (Interpersonal) Learning Style:

If you have a strong social style, you communicate well with people, both verbally and non-verbally. People listen to you or come to you for advice, and you are sensitive to their motivations, feelings or moods. You listen well and understand other's views. You may enjoy mentoring or counseling others.

You typically prefer learning in groups or classes, or you like to spend much one-on-one time with a teacher or an instructor. You heighten your learning by bouncing your thoughts off other people and listening to how they respond. You prefer to work through issues, ideas and problems with a group. You thoroughly enjoy working with a 'clicking' or synergistic group of people.

You prefer to stay around after class and talk with others. You prefer social activities, rather than doing your own thing. You typically like games that involve other people, such as card games and board games. The same applies to team sports such as football or soccer, basketball, baseball, volleyball, baseball and hockey.

Common pursuits and phrases

Some examples of pursuits that people with a strong social style may follow include counseling, teaching, training and coaching, sales, politics, human resources, and others.

As with people with the logical style, you are more likely to use phrases that reflect your dominant style out of physical, aural and visual styles. Here are some other phrases you may also use:

- Let's work together on this.
- We can work it out.
- Tell me what you are thinking.
- Help me understand this.
- Let's pull some people together to discuss.
- Let's explore our options.

Learning and techniques

- If you are a social learner, aim to work with others as much as possible. Try to study with a class. If this is not available then consider forming your own study group with others at a similar level. They don't have to be from the same school or class. If you like, introduce them to some of the techniques from this book. It may be easier for you to try some of the Memletric Techniques in a social setting, and work with the feedback from others.
- Role-playing is a technique that works well with others, whether it's one on one or with a group of people. For example, in aviation training, role-play the aerodrome area. Have people walking around in 'circuits' making the right radio calls with the tower coordinating everyone. Another example might be to role-play with one person being the instructor and the other being the student.
- Work on some of your associations and visualizations with other people. Make sure they understand the principles of what you are doing though, otherwise you may get some interesting responses! Others often have different perspectives and creative styles, and so the group may come up with more varied and imaginative associations compared to the ones you might create yourself.
- Rather than reciting assertions to yourself, try sharing your key assertions with others. By doing so, you are almost signing a social contract that your assertion is what you do. This strengthens your assertions.
- Share your reviews, review checklists and 'perfect performance' scripts with those in your group as well. By listening to how others solve their issues, you may get further ideas on how to solve your own issues. Try sharing the work of creating a 'perfect performance' script. Each person writes the script for the areas they want to work on the most, and then the group brings all the scripts together.
- Mind maps and systems diagrams are great to work on in class. Have one person be the appointed drawer, while the rest of the class works through material and suggests ideas. The group may have varied views on how to represent some ideas, however this is a positive part of learning in groups. If you can't agree on something, just take a copy of what the group has worked on and add your own thoughts. Often there is no right answer for everyone, so agree to disagree!
- Working in groups to practice behaviors or procedures help you understand how to deal with variations. Seeing the mistakes or errors that others make can help you avoid them later. As well, the errors you make are helpful to others! Whether it's via role-playing, a simulator or other technique doesn't matter too much. Be imaginative. Two chairs in the middle of a classroom to simulate an aircraft cockpit can be just as good as computer simulation and the real activity.

- Lastly, if you are working in groups it may help to have everyone do the learning styles questionnaire. This may help everyone understand why each person has different viewpoints. It can also help with assigning activities to people. Individuals may volunteer for activities based on either the styles they currently have, or the styles they want to learn.

2.3.2.7- The Solitary (Intrapersonal) Learning Style:

If you have a solitary style, you are more private, introspective and independent. You can concentrate well, focusing your thoughts and feelings on your current topic. You are aware of your own thinking, and you may analyze the different ways you think and feel.

You spend time on self-analysis, and often reflect on past events and the way you approached them. You take time to ponder and assess your own accomplishments or challenges. You may keep a journal, diary or personal log to record your personal thoughts and events.

You like to spend time alone. You may have a personal hobby. You prefer traveling or holidaying in remote or places, away from crowds.

You feel that you know yourself. You think independently, and you know your mind. You may have attended self-development workshops, read self-help books or used other methods to develop a deeper understanding of yourself.

You prefer to work on problems by retreating to somewhere quiet and working through possible solutions. You may sometimes spend too much time trying to solve a problem that you could more easily solve by talking to someone.

You like to make plans and set goals. You know your direction in life and work. You prefer to work for yourself, or have thought a lot about it. If you don't know your current direction in life, you feel a deep sense of dissatisfaction.

Common pursuits and phrases

Those that have a strong solitary style include authors, researchers, park rangers and security guards. Peak performers in any field often have a good solitary style behind other more dominant styles.

You are more likely to use phrases that reflect your other dominant styles. Here are some other phrases you may also use:

- I'd like some time to think it over.
- This is what I think or feel about that.
- I'd like to get away from everyone for a while.
- I'll get back to you on that.

Learning and techniques

You prefer to learn alone using self-study. When you spend time with an instructor or a teacher, you often only clarify information you haven't be able to clarify yourself. You may dislike learning in groups.

Don't be afraid to ask questions like 'What's in this for me?' 'Why does this matter?', 'How can I use this idea?' Be aware of your inner thoughts and feeling towards various topics. This is because these inner thoughts have more of an impact on your motivation and ability to learn than they do in the other styles. Here are a few ideas to help this along:

- **Spend more time on the 'Target' step of the Memletic Approach.** Set your goals, objectives and plans. Define ultra-clear visualizations or scripts of what life is like once you've achieved your goals. Understand your reasons for undertaking each objective, and ensure that you are happy with your learning goals.
- Align your goals and objectives with personal beliefs and values. If there is misalignment, you may run into issues with motivation or confidence. It's not always obvious what the underlying cause is. If you suspect a misalignment, try some of the techniques like 'five whys' and 'seventy by seven' to flush these issues out. Scripting and assertions also help highlight issues. If you script your goal and you find you don't like certain parts of it, that's probably a hint that you have some misalignment.
- **Create a personal interest in your topics.** An example for pilots might be to learn more about other aviators, both current and past. Why do others find aviation interesting? What is in it for them? What keeps them motivated? Why do they work in the field? You may also want to look at the people behind your books or material. What was their motivation to create it? Why do you think they organized the material in the way they did? Can you ask them?
- **Keep a log or journal.** You may want to keep one separate from your normal journal or training log. Include extra information about your thoughts and feelings. Outline your challenges, ideas on how to overcome them, and what worked. Write down what works well and doesn't work well for you. While you are studying, be aware of thoughts or concerns that arise. Write them down and come back to them. Discuss with others later if needed. Bear in mind it may be more efficient to put something that confuses you aside, and ask others later. This is often better than spending too much time trying to work it out yourself.
- When you associate and visualize, highlight what you would be thinking and feeling at the time. You may want to do most of your visualization and association in private. I suggest you also try talking to others with more experience to get some idea of what thoughts and feelings they have in various circumstances.

- Assertions are important for you. You drive yourself by the way you see yourself internally. Assertions are a good way to ensure your internal self-image matches your learning objectives. This also applies to the scripting techniques, so include your internal thinking and feelings in your scripts.
- Modeling is a powerful technique for you. Don't just model behaviors and appearance. Try to get 'inside their heads' and model the thought patterns and feelings you believe they have in various circumstances. You can gain ideas by talking to people or reading biographies. Remember you don't have to find a single perfect model. Create a model that combines several people.
- Be creative with role-playing. You don't always need other people to role-play with, because you can create plenty of people using visualization! For example, you can visualize your instructor beside you, or a colleague and you practicing a procedure or skill. Work with them and talk to them while you visualize. An advantage of this form of role-playing is that you can control their behavior!
- When changing behaviors and habits, you need to have a strong desire to make the changes you want. Explore the benefits of making a change, and visualize scenarios in which you've already made the change. If you don't believe strongly in the benefits, you may find it difficult to change the behavior.
- Your thoughts have a large influence on your performance and often safety. Your thoughts are just as much part of a system as is the physical equipment you are using, such as an aircraft, car or boat. In addition, other people are also part of those systems, so be aware that their thoughts and feelings can affect the overall system.
- Years of refinement have made physical equipment, such as aircraft and boats, safe and reliable. For example, aircraft failure causes less than ten percent of all aircraft accidents. The largest percentage is pilot error, more than seventy percent. This is likely the case in many other fields. It's just not as visible when accidents happen. It's well worthwhile spending some time refining the reliability of your own systems.

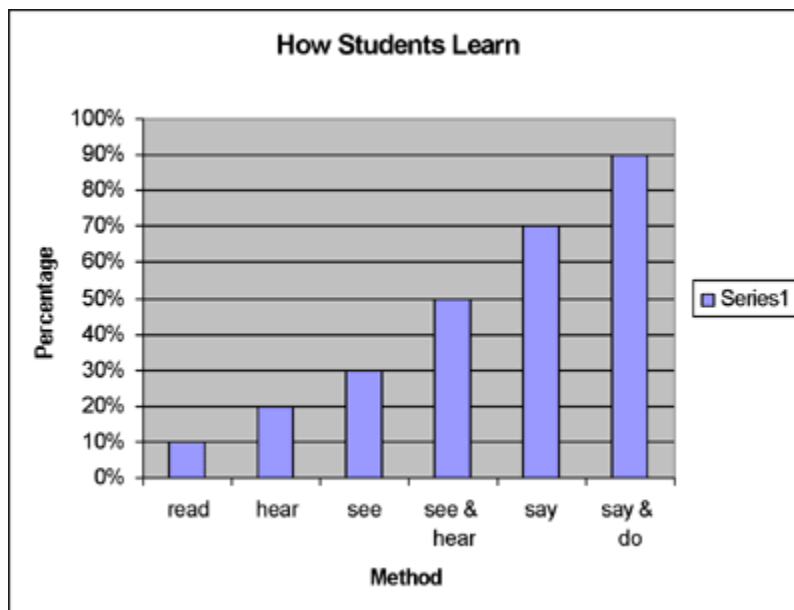
2.3.3-Four stages of learning:

⁶There is a wealth of information, both on the shelves of libraries and on the Internet, which addresses the different learning theories that have been suggested over the past three or four decades. Those most often quoted are Kolb and Gardner. While most theorists disagree, or come from a different approach about learning styles, it is generally accepted that there are basically four stages of learning.

1. *Exposure Stage*—the first time a concept (such as long division) is new to us.
2. *Guided Learning Stage*—when we still can't do the problems without help. This is where most people get stuck.
3. *Independent Stage*—with review, guidance, and hard work, we reach stage 3.
4. *Mastery Stage*—comes with more practice, final goal of education.

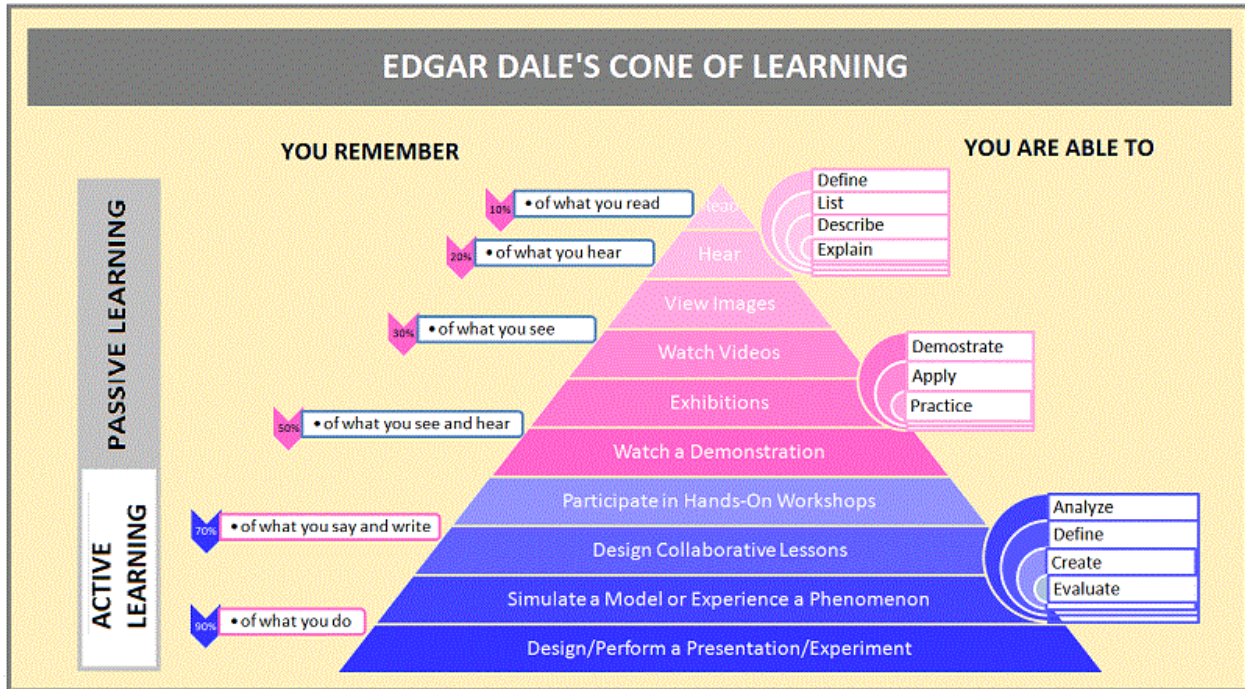
Regardless of how a student learns, the stages remain the same. It is up to the instructor and the curriculum content developer to assist a student in getting past the guided learning stage to become an independent learner, thus building on newly gained learning concepts or skills.

It has also been shown through repeated studies that students learn in different ways, or through a combination of different ways, thus supporting Smith and Kolb's learning cycle concept.



-Figure 2.3.3.1: how students learn-

⁶ phschool.com



-Figure 2.3.3.1: Edgar Dale's cone of learning-

2.4-Our project's Educational role:

As we've previously reviewed in this chapter, Egypt is suffering from a lot of problems in its educational system, which strongly encouraged us to think of a solution that's related to our field, that helps solving the previous stated problems; that's when the idea of creating an educational system using our kits came to our mind.

Our project's educational system will support the following:

1. Provide a technical skill directly related to the labor market.
2. Provide an automated step by step learning system that will guide the user in implementing the circuits from scratch.
3. It strongly supports technical education, it might be a start to other similar technical educational projects.
4. It supports visual and aural learning styles by the step by step guide through the mobile application.
5. It supports physical and logical learning styles, through the hardware circuit implementation kit.
6. It supports solitary learning style, as the user can work alone with the aid of the mobile application only.
7. It supports social learning style, due to the score calculation system in the mobile application, as users can gather up and compete with each other's for achieving the highest scores for implementing the circuits.
8. It supports the four learning stages, as the user will be **exposed** to the real world circuit components, **guided** from scratch into implementing a real functioning circuit, being **independent** as the user will be able to implement whichever circuit he desires using the hardware kit, and **master** the implementation of any circuit after he/she completes all the available levels.
9. Supports all the stages of Edgar's cone of learning, especially learning by doing

Chapter Three: Project Hardware

3.1-Hardware conceptual view:

We aim to use the currently available electronic components and materials, put them in customized cases that appear more simple and attractive to the kids; simplify the way they're put together and ensure maximum safety that can be provided to the user.

These are the points that should be covered in the hardware as a whole:

- Colorful attractive components' casings
- Simple way to connect the components together
- Insulated casings to ensure maximum safety of the user
- Variety of interactive circuits to be implemented

3.2-Used Materials:

3.2.1-Electronic components:

1. Resistors
2. Capacitors
3. Light Emitting Diodes (LEDs)
4. Relays
5. Integrated Circuits (ICs)
6. Batteries
7. Copper wires

3.2.2-Magnetic buttons:

⁷Also known as Magnetic Snap 18mm, these are relatively large 18mm diameter snaps (all three pieces come as shown in Figure 3.2.2.1 and Figure 3.2.2.2). They couple together very strongly (must be pried apart), rotate freely on the axis, and are electrically conductive. We've seen snaps like these soldered onto PCBs and batteries to form a strong, but quick disconnect mechanism. Overall connection resistance is less than 200 miliOhm. Snaps will couple when closer than 10mm.



-Figure 3.2.2.1: Magnetic snaps front view-



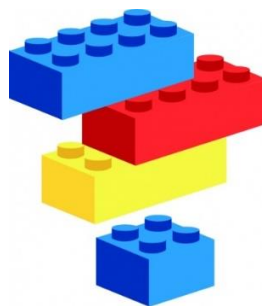
-Figure 3.2.2.2: Magnetic snaps back view-

These snaps will be the core of our hardware kit, as the female part of the snap will be lined in a matrix form to be used as the ordinary existing board that we know about, while the male parts will be attached to the electronic components, this is the easiest and most efficient way to connect the components together in a safe, convenient form to the kids.

3.2.3-Plastic toy blocks:

Toy blocks (also building bricks, building blocks, or simply blocks), are wooden, plastic or foam pieces of various shapes (square, cylinder, arch, triangle, etc.) and colors that are used as construction toys.

We've picked the plastic ones due to its availability and the easy of manipulating its shape.



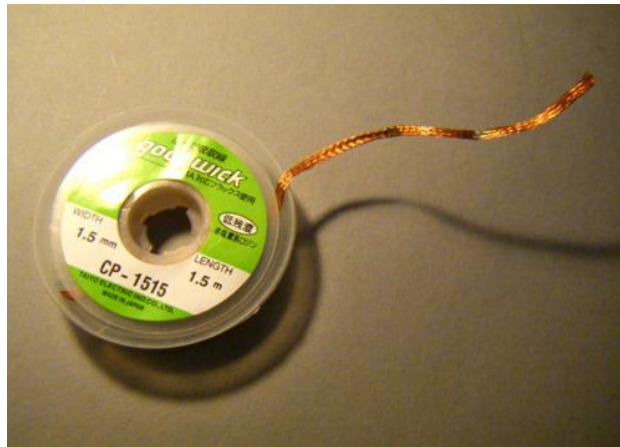
-Figure 3.2.3: Plastic blocks-

⁷ SparkFun electronics

3.2.4-Solder wick:

Which is commonly used in the desoldering process, which refers to the removal of solder and components from a circuit board for troubleshooting, repair, replacement, and salvage.

In our project, we've used it to connect the female magnetic snap parts together in a matrix form, the wick is highly conductive and has a thick diameter, which will ensure the connectivity between them. Figure 2.2.4.2 shows how we connected them in the first prototype.



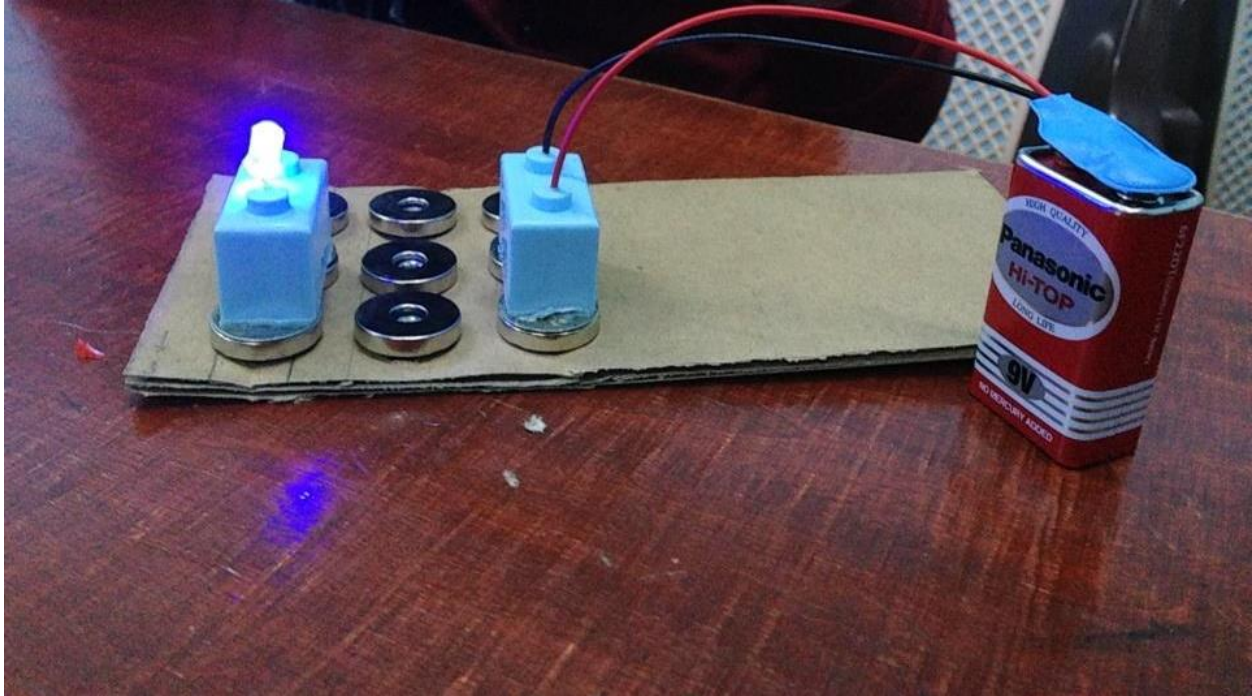
-Figure 3.2.4.1: Solder wick pack-



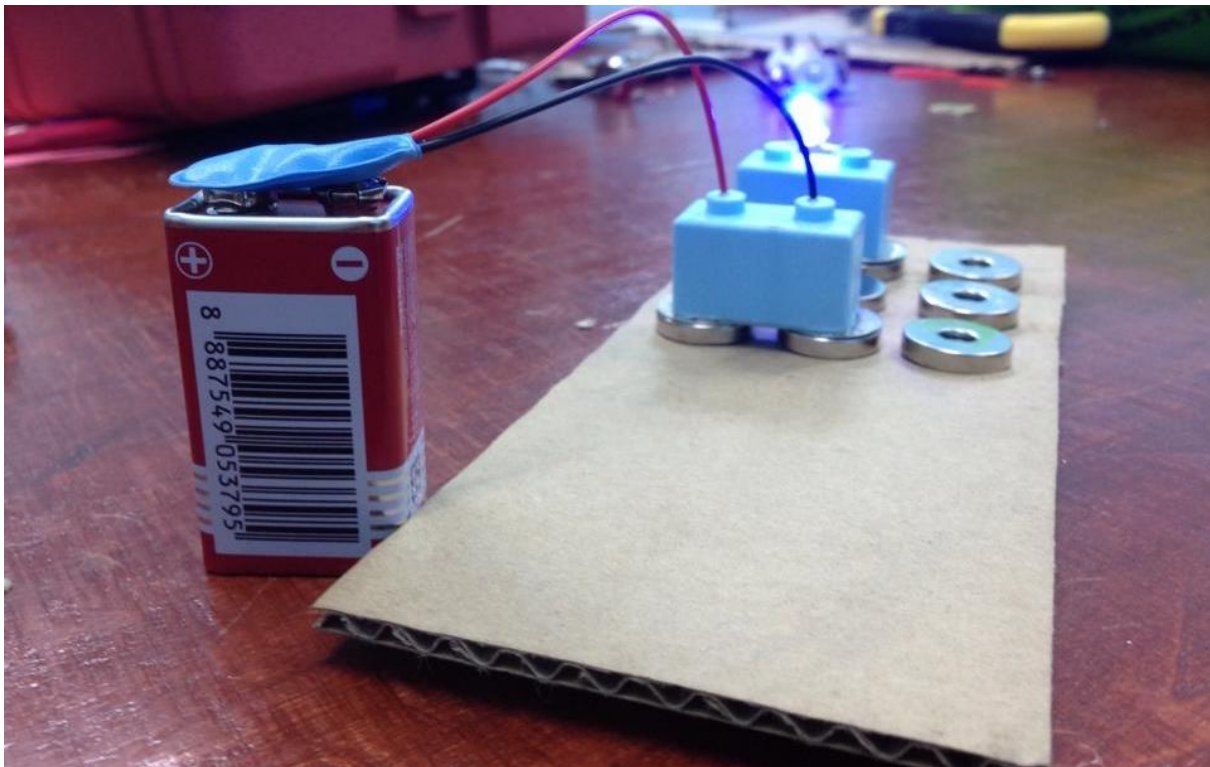
-Figure 3.2.4.2: wick usage in a primitive prototype-

3.2.5-Hardware components working together:

To make it clearer, here's our first trial in using all the previous components together:



-Figure 3.2.5.1: First prototype-



-Figure 3.2.5.2: First prototype-

3.2.6-Arduino Uno R3 Module:

⁸Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board, also it can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing, MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50

Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

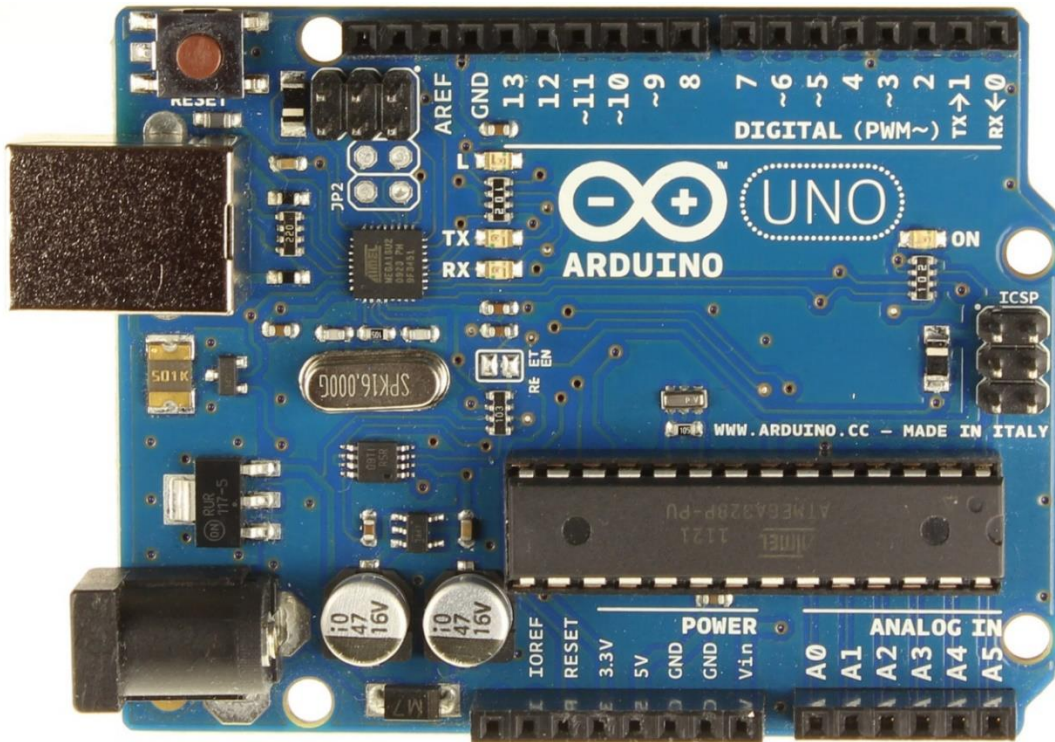
Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino

Open source and extensible software- The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

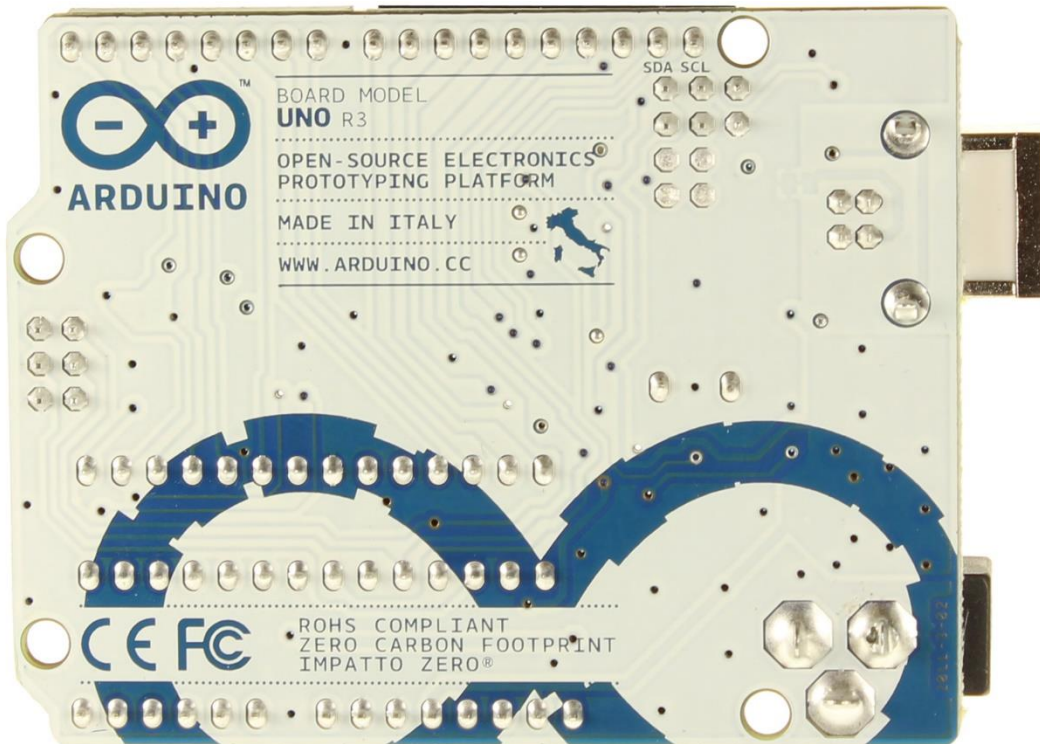
Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard

⁸ arduino.cc

version of the module in order to understand how it works and save money.



-Figure 3.2.6.1: Arduino R3 Front view-



-Figure 3.2.6.2: Arduino R3 Back view-

Revision 3 “R3” has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using `pinMode()`, `digitalWrite()`, and `digitalRead()` functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

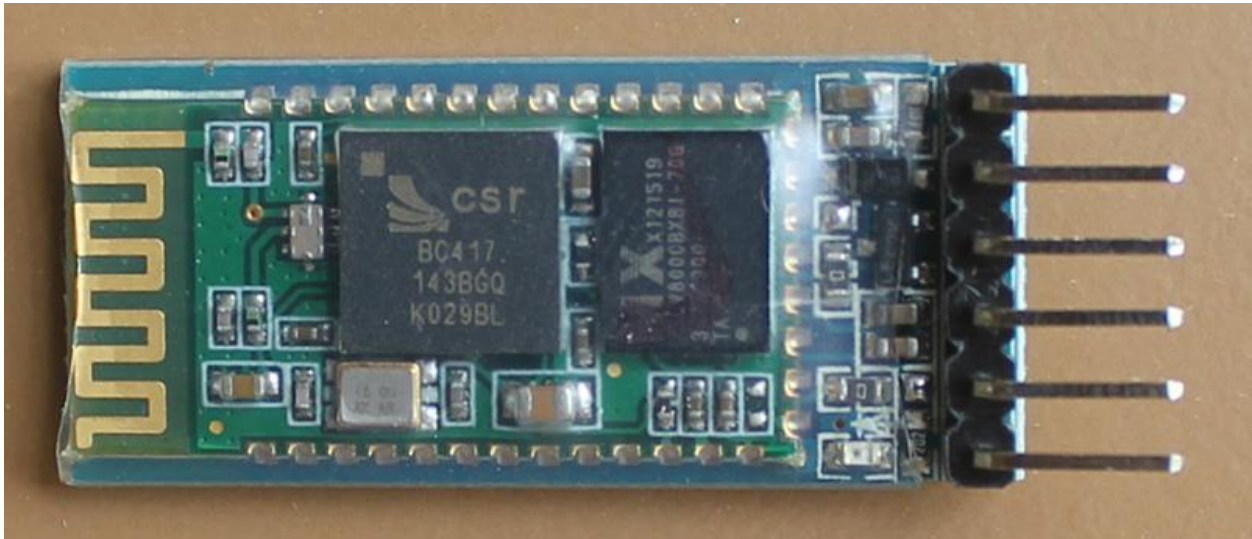
- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the `attachInterrupt()` function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the `analogWrite()` function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin and the `analogReference()` function. Additionally, some pins have specialized functionality:
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- There are a couple of other pins on the board: AREF. Reference voltage for the analog inputs. Used with `analogReference()`.
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Power pins:

- VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V. This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND. Ground pins.
- IOREF. This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

3.2.7-Bluetooth HC-06 module:

⁹HC-06 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm.



-Figure 3.2.7.1: HC 06 Module front view-



-Figure 3.2.7.2: HC 06 Module back view-

⁹ ITead Studio

Specifications

Hardware features:

- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector

Software features:

- Default Baud rate: 38400, Data bits: 8, Stop bit: 1, Parity:No parity, Data control: hasSupported baud rate: 9600,19200,38400,57600,115200,230400,460800.
- Given a rising pulse in PIO0, device will be disconnected.
- Status instruction port PIO1: low-disconnected, high-connected;
- PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:"0000" as default
- Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

Chapter Four: Project Software

4.1-Software concept:

We aim to lead a revolution in the field of learning electronics, and in the field of learning in general which can be achieved by “learning by doing” technique, this is what made us think of developing a game that’s linked to a change done in reality, we decided to develop an android game, linked to our hardware kits, in other words, the changes done to the hardware kits like a circuit implementation, can be sensed by the android application through the Bluetooth module and a certain score will be calculated according to the time of circuit completion for example, aside of unlocking a new circuit after the user is able to implement the current one.

The software application should contain the following:

1. Full guide to every project that can be done with the current kit
2. Leveling system
3. Score calculation system
4. Bluetooth connection protocol
5. Ability to sense changes done to the hardware

4.2-Comparison between mobile operating systems:

¹⁰Microsoft's Windows Phone was met with rave reviews from day one of its launch back in late 2010, but despite its beautiful and smooth UI it hasn't caught up with users. One way or another, part of the blame for this was some immaturity of the platform - multitasking arrived later and it was very limited, the apps weren't there, customization was somewhat limited, and the list just went on and on, depending on how much you want to pick the nits.

But it was clear Windows Phone 7 wasn't as mature as iOS or Android. It was damn close, but not on par. Now, with the announcement of Windows Phone 8 Microsoft is making one giant leap towards the market leading platforms, and matches them in a lot of aspects. We'd say it even outpaces iOS and possibly Android with its new stunning Start Screen which makes us feel we won't miss widgets too much.

The real change happens under the hood, though. Windows Phone 8 now runs on the Windows NT kernel, the same kernel Windows 8 runs on. This means that you get support for multi-core chips and you'd get faster ports of apps and easier overall development across platforms. This will strengthen Microsoft's ecosystem. And with the addition of offline maps by Nokia, it's one step ahead of the competition there as well.

¹⁰ phonearena.com

Here's a quick comparison between mobile operating systems:

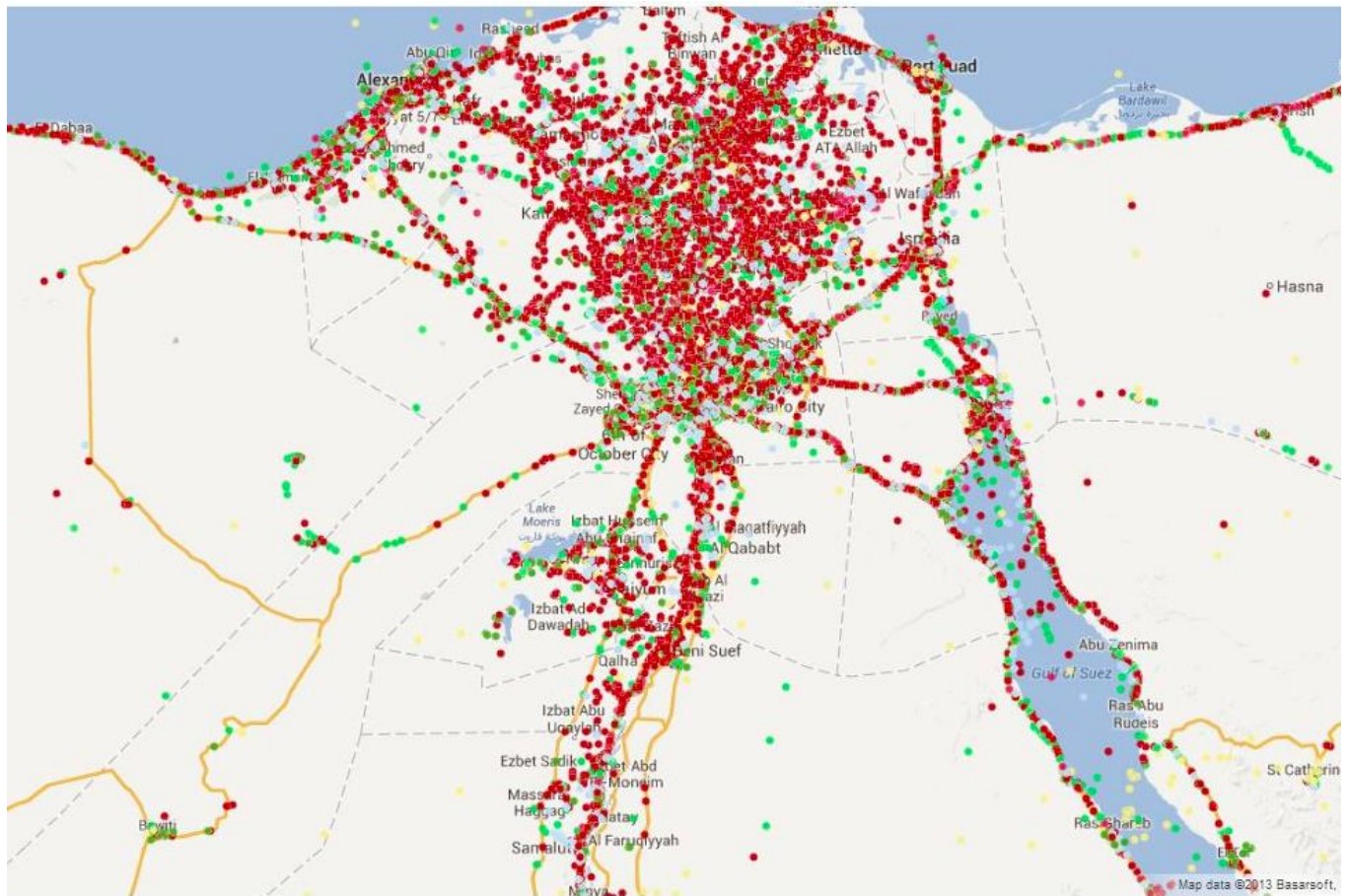
	IOS 6.0	Android 4.1	Windows Phone 8	Windows Phone 7.8
Apps	650,000+	600,000+	100,000+	100,000+
Multitasking	yes limited	yes	yes limited	yes limited
Widgets	no	yes	expandable Live Tiles	expandable Live Tiles
Expandable storage	no	yes	yes	yes
Multi-core processors	yes	yes	yes	yes
High-res displays	yes	yes	yes	yes
File manager	no	yes	no	no
Drag and drop file management	no requires iTunes	yes	no requires Zune	no requires Zune
Intelligent voice assistant	yes	yes with Google Now	no	no
Sideloaded apps	Cydia	yes many outlets	no	no
Centralized notifications	yes drop-down pane	yes drop-down pane	no	no
Flash support	no	yes	?	?
Native screenshots	yes	yes	no	no
Offline maps	no paid apps	yes	yes	no only Lumias
Core	Darwin	Linux	Windows NT	Windows CE 7
USB Host	limited via Camera Connection Kit	yes	?	?

-Table 4.2.1 mobile OS comparison-

4.2.1-Reason for choosing android:

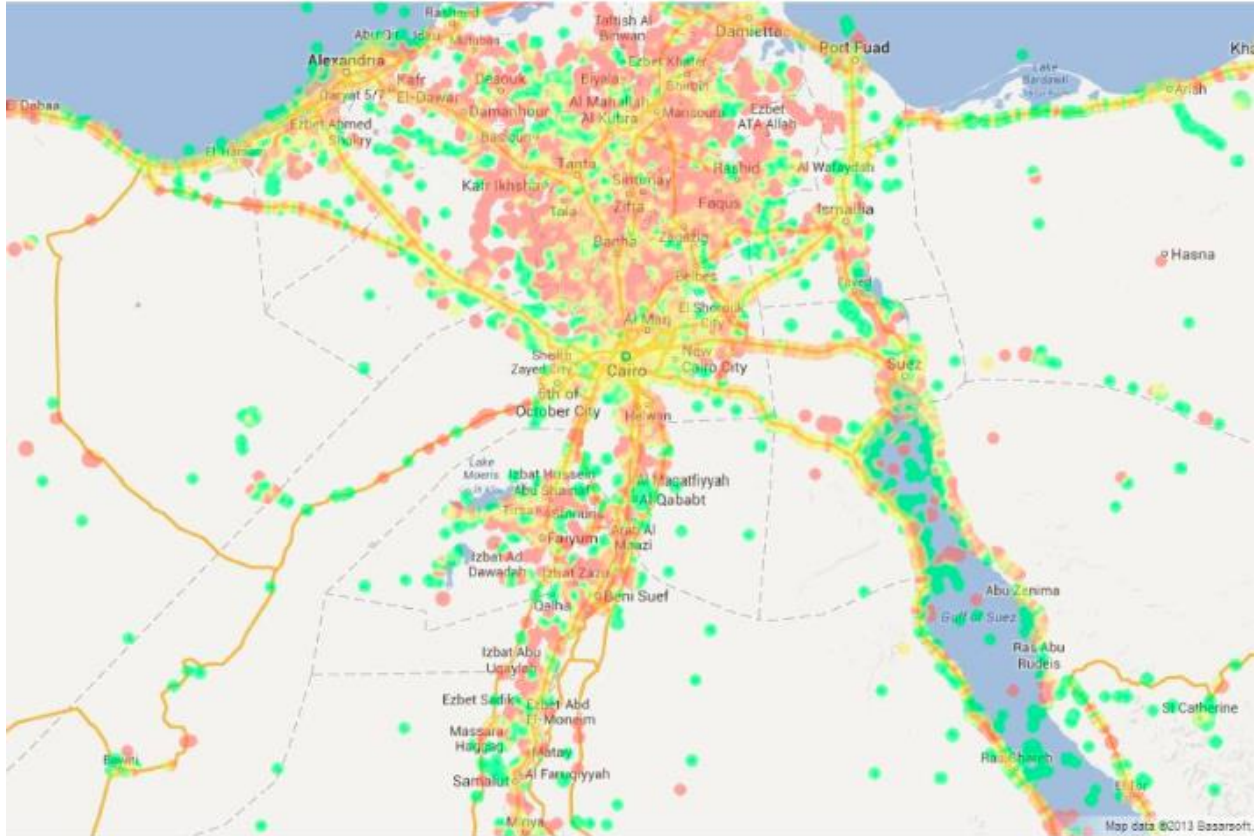
1. It's open source
2. It's widely spread in Egypt, and available to the kids
3. As it's installed on a mobile, which will make it highly mobile and portable

¹¹The following information was collected by MIT, through monitoring the number of tweets that were tweeted from all over Egypt, and the type of OS that was used to tweet it, whether it was Android, IOS, or Blackberry, through 3.5 million geolocated tweets from October 2012 to June 2013. **Red dots represent the location of tweets posted by Android users;** Green dots – iPhone; Purple – Blackberry.



-Figure 4.2.1.1: Tweeting devices distribution across Egypt-

¹¹ Irevolution.net



-Figure 4.2.1.2: Heatmap of the % of Android users-

From the previous information we can conclude that Android is the most widely common OS used by Egyptians.

4.3-Android Application:

4.3.1-Introduction about android:

¹²Android is an operating system based on the Linux kernel with a user interface based on direct manipulation, designed primarily for touchscreen mobile devices such as smartphones and tablet computers. The operating system uses touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching, and reverse pinching to manipulate on-screen objects, and a virtual keyboard. Despite being primarily designed for touchscreen input, it also has been used in televisions, games consoles, digital cameras, and other electronics.

As of 2011, Android has the largest installed base of any mobile OS and as of 2013, its devices also sell more than Windows, iOS and Mac OS devices combined. As of July 2013 the Google Play store has had over 1 million Android apps published, and over 50 billion apps downloaded. A developer survey conducted in April–May 2013 found that 71% of mobile developers develop for Android.

Android's source code is released by Google under open source licenses, although most Android devices ultimately ship with a combination of open source and proprietary software. Initially developed by Android, Inc., which Google backed financially and later bought in 2005, Android was unveiled in 2007 along with the founding of the Open Handset Alliance—a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices

¹² Wikipedia

4.3-MIT App Inventor 2:

¹³We've used this tool to develop the android application, App Inventor is a cloud-based tool, which means that you can build apps right in your web browser. This website offers all of the support that you'll need as you learn how to build your own apps. **The App Inventor software, or "service" is at ai2.appinventor.mit.edu.** You can get there by clicking the orange "Create" button from any page on this website.

4.3.1-Setting up App inventor:

You can set up App Inventor and start building apps in minutes. The Designer and Blocks Editor now run completely in the browser (aka the cloud). To see your app on a device while you build it (also called "Live Testing"), you'll need to follow the steps below:

- **If you are using an Android device and you have a wireless internet connection**, you can start building apps without downloading any software to your computer. You will need to install the App Inventor Companion App for your device. Choose *Option One* below. This option is STRONGLY RECOMMENDED
- **If you do not have an Android device**, you'll need to install software on your computer so that you can use the on-screen Android emulator. Choose *Option Two* below.
- **If you do not have a wireless internet connection**, you'll need to install software on your computer so that you can connect to your Android device over USB. Choose *Option Three* below. ***The USB Connection option can be tricky, especially on Windows. Use this as a last resort.***

Option one - Connect your Phone or Tablet over WiFi:

You can use App Inventor without downloading anything to your computer! You'll develop apps on website: ai2.appinventor.mit.edu. To do live testing on your Android device just install the MIT App Inventor Companion app on your Android phone or tablet. Then open your project in App Inventor on the web, open the companion on your device, and you can test your apps as you build them:



-Figure 4.3.1.1 option one-

¹³ appinventor.mit.edu

The following steps will guide you through the process:

Step 1: Download and install the MIT AI2 Companion App on your phone.

Open your device's QR code scanner and scan the QR code on the left below to download the Companion App from the Play Store. If you can't use the Play Store, use the QR code on the right to download the Companion App directly to your phone.

Play Store Recommended: Automatic updates

Scan this QR code
to get the app from the Play Store



APK File
Scan this QR code
to download the app directly



Note: If you need a QR code scanner, you can get one at the Play Store (e.g., ZXing).

After downloading, step through the instructions to install the Companion app on your device. You need to install the MIT AI2 Companion only once, and then leave it on your phone or tablet for whenever you use App Inventor.

Note 1: If you are unable to use the QR code, you can still install MIT AI2 Companion on your phone or tablet. Use the Web browser on your device to go to the Google Play Store; look for MIT AI2 Companion in the store. Once you find Companion, click the INSTALL button for the Companion app.

Note 2: If you choose not to go through the Play store and instead load the app directly (aka "side load"), you will need to enable an option in your device's settings to allow installation of apps from "unknown sources". To find this setting on versions of Android prior to 4.0, go to "Settings > Applications" and then check the box next to "Unknown Sources". For devices running Android 4.0 or above, go to "Settings > Security" or "Settings > Security & Screen Lock" and then check the box next to "Unknown Sources" and confirm your choice.

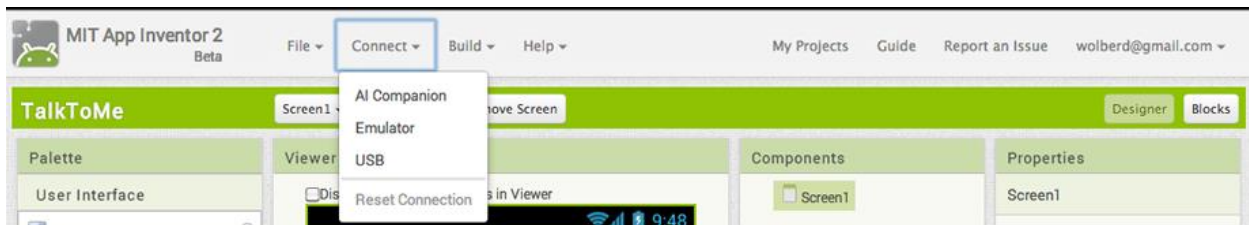
Step 2: Connect both your computer and your device to the SAME WiFi Network.

App Inventor will automatically show you the app you are building, but only if your computer (running App Inventor) and your Android device (running the Companion) are connected to the same WiFi Network.

Step 3: Open an App Inventor project and connect it to your device.

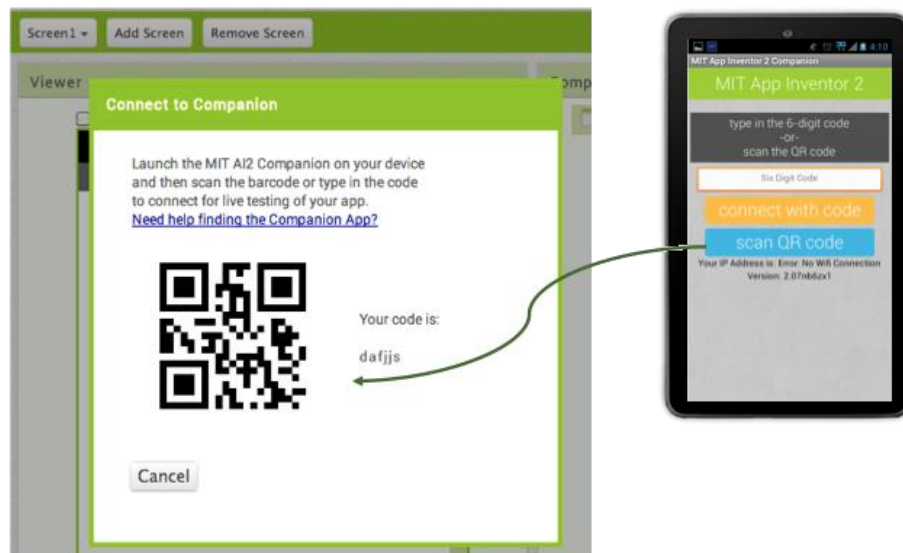
Go to App Inventor and open a project (or create a new one -- use *Project > Start New Project* and give your project a name).

Then Choose "Connect" and "AI Companion" from the top menu in the AI2 browser:



-Figure 4.3.1.2 step 3-1-

A dialog with a QR code will appear on your PC screen. On your device, launch the MIT App Companion app just as you would do any app. Then click the "Scan QR code" button on the Companion, and scan the code in the App Inventor window:



-Figure 4.3.1.3: step 3-2-

Within a few seconds, you should see the app you are building on your device. It will update as you make changes to your design and blocks, a feature called "live testing".

If you have trouble scanning the QR code or your device does not have a scanner, type the code shown on the computer into the Companion's text area on your Android device exactly as shown. The code is directly below where the screen on your PC shows "Your code is" and

consists of six characters. Type the six characters and choose the orange "Connect with code". Do not type an Enter or carriage return: type just the six characters followed by pressing the orange button.

Option - 2 Installing and Running the Emulator in AI2:

If you do not have an Android phone or tablet, you can still build apps with App Inventor. App Inventor provides an Android emulator, which works just like an Android but appears on your computer screen. So you can test your apps on an emulator and still distribute the app to others, even through the Play Store. Some schools and after-school programs develop primarily on emulators and provide a few Androids for final testing.



**Build your project on
your computer** **Test it in real-time on
your computer with
the onscreen
emulator**

-Figure 4.3.1.4: Option two-

To use the emulator, you will first need to first install some software on your computer (this is not required for the wifi solution). Follow the instructions below for your operating system, then come back to this page to move on to starting the emulator.

Step 1. Install the App Inventor Setup Software

Installing App Inventor 2 Setup on Windows

Installing the Windows software for App Inventor Setup has two parts:

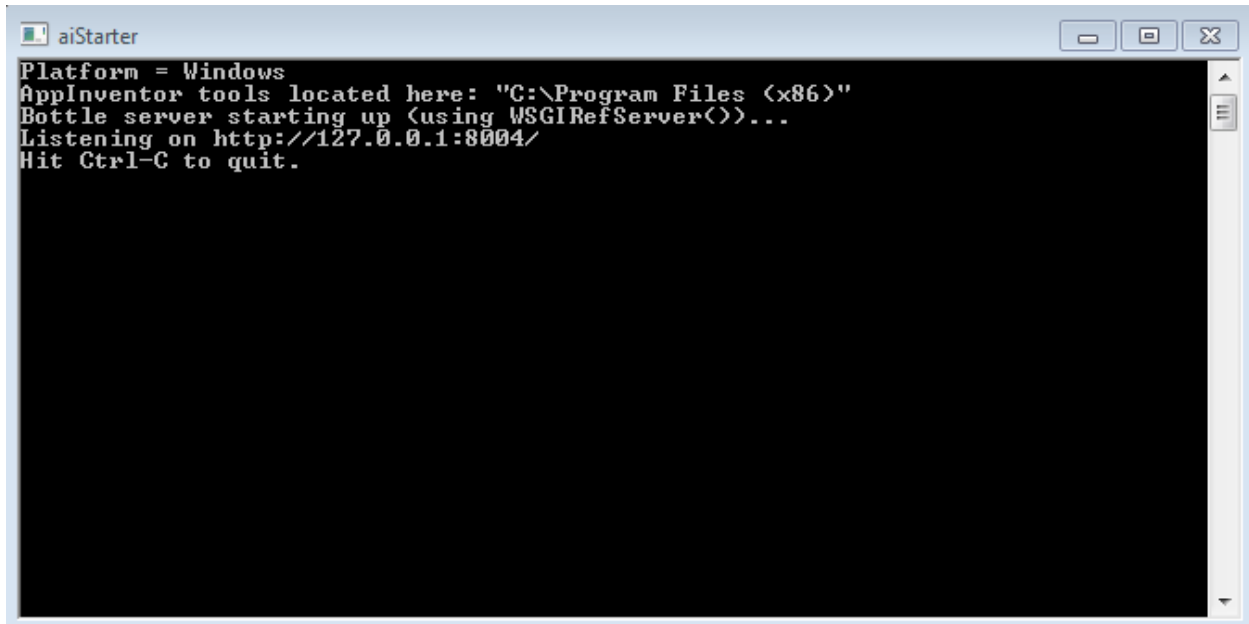
1. Installing the App Inventor Setup software package. This step is the same for all Android devices, and the same for Windows XP, Vista, and 7.
2. If you choose to use the USB cable to connect to a device, then you'll need to install Windows drivers for your Android phone.

NOTE: App Inventor 2 does not work with Internet Explorer. For Windows users, we recommend using either Chrome or Firefox as your browser for use with App Inventor.

Step 2. Launch aiStarter (Windows & Linux only)

The emulator requires the use of a program named *aiStarter*. This program is the helper that permits the browser to communicate with the emulator. The aiStarter program was installed when you installed the App Inventor Setup package. There will be shortcuts to aiStarter from your Desktop, Start menu, All Programs and from Stratup Folder (Windows only).

To launch aiStarter, double click on its icon. You'll know that you've successfully launched aiStarter when you see a window like the following:



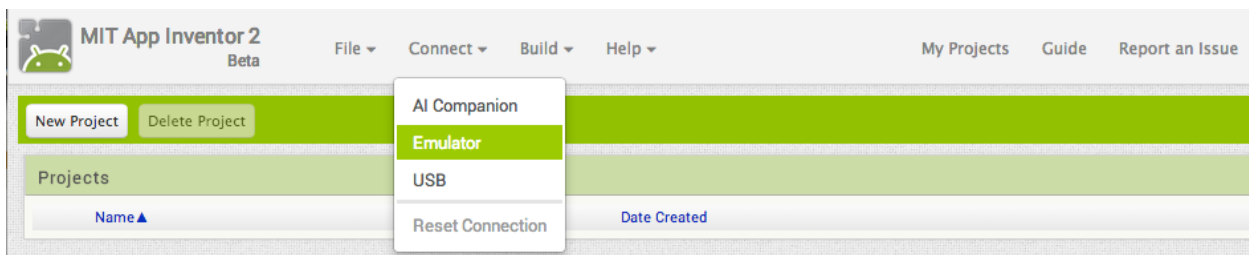
```

aiStarter
Platform = Windows
Appinventor tools located here: "C:\Program Files (x86)"
Bottle server starting up (using WSGIRefServer())...
Listening on http://127.0.0.1:8004/
Hit Ctrl-C to quit.
  
```

-Figure 4.3.1.5: Successful aiStarter launch-

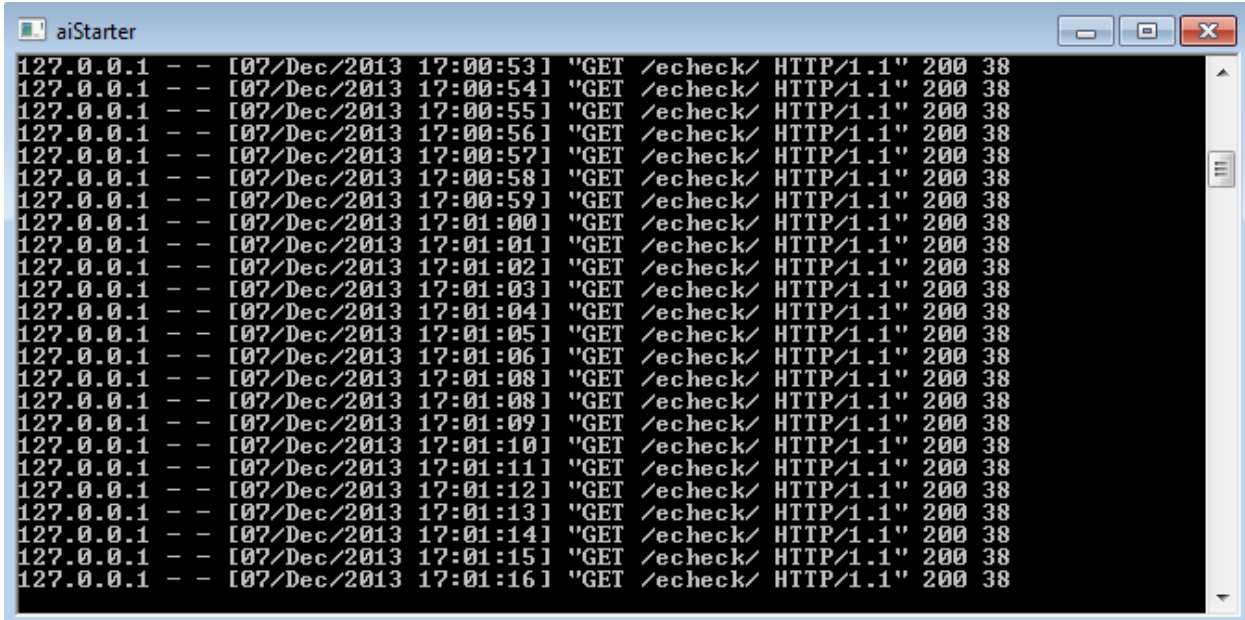
Step 3. Connect to Emulator

From App Inventor's menu (on the App Inventor cloud-based software at ai2.appinventor.mit.edu), go to the **Connect Menu** and click the **Emulator** option.



-Figure 4.3.1.6: Selecting Emulator option-

You'll get a notice saying that the emulator is connecting. Starting the emulator can take a couple of minutes. You may see update screens like the following as the emulator starts up:



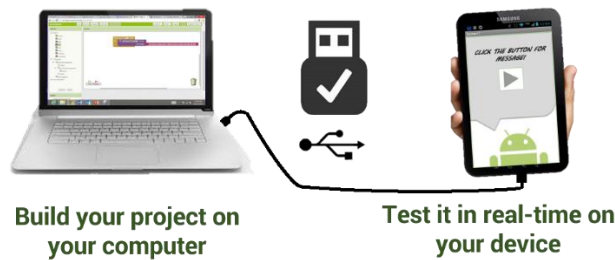
```

aiStarter
127.0.0.1 - - [07/Dec/2013 17:00:53] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:00:54] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:00:55] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:00:56] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:00:57] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:00:58] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:00:59] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:00] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:01] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:02] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:03] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:04] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:05] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:06] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:08] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:08] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:09] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:10] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:11] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:12] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:13] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:14] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:15] "GET /echeck/ HTTP/1.1" 200 38
127.0.0.1 - - [07/Dec/2013 17:01:16] "GET /echeck/ HTTP/1.1" 200 38

```

-Figure 4.3.1.7: Emulator running checkup-

The emulator will initially appear with an empty black screen. Wait until the emulator is ready, with a colored screen background. Even after the background appears, you should wait until the emulated phone has finished preparing its SD card: there will be a notice at the top of the phone screen while the card is being prepared. When connected, the emulator will launch and show the app you have open in App Inventor.

Option - three Connecting to a phone or tablet with a USB cable:*-Figure 4.3.1.8: Option three-*

When you use App Inventor with a phone or tablet, that device communicates with the App Inventor software running in your computer's browser window. This communication is managed by the AI2 Companion App running on the device. The instructions below (step 2) explain how to install the companion. The Companion can communicate with your computer over a wireless connection.

This is the method strongly recommended by the App Inventor team. It does not require any additional software to be installed on your computer. (See Option 1, under Setting up App Inventor.)

There are, however, some environments where wireless connections won't work. These include some hotels, conference centers, and schools that configure their wireless networks to prohibit two devices on the network from communicating with each other. See [How Does my Android Device Connect Over Wifi?](#) For a short explanation. Some App Inventor users have solved this problem by purchasing a wireless router and setting up their own local network. (Also, most Macs and some PC can serve as WiFi routers that can handle a small number of machines.) But where even this is impossible, you can still use App Inventor with a phone or tablet if you connect it to the computer with a USB cable.

Setting up a USB connection can be awkward, especially on Windows machines, which need special *driver* software to connect to Android devices. (This is not the case with Mac or Linux, which do not need special drivers.) Unfortunately, different devices may require different drivers, and, outside of a few standard models, Microsoft and Google have left it to the device manufacturers to create and supply the drivers. As a consequence, that you may have to search on the Web to find the appropriate driver for your phone. App Inventor provides a test program that checks if your USB-connected device can communicate with the computer. You should run this test and resolve any connection issues before trying to use App Inventor with USB on that device.

Here are the steps for beginning to use App Inventor with the USB cable:

Step 1: Install the App Inventor Setup Software

On windows:

Installing the Windows software for App Inventor Setup has two parts:

1. Installing the App Inventor Setup software package. This step is the same for all Android devices, and the same for Windows XP, Vista, and 7.
2. If you choose to use the USB cable to connect to a device, then you'll need to install Windows drivers for your Android phone.

NOTE: App Inventor 2 does not work with Internet Explorer. For Windows users, we recommend using either Chrome or Firefox as your browser for use with App Inventor.

Step 2: Download and install the MIT AI2 Companion App on your phone.

Open your device's QR code scanner and scan the QR code on the left below to download the Companion App from the Play Store. If you can't use the Play Store, use the QR code on the right to download the Companion App directly to your phone.

For more details: Review Step 2 on Option one.

Step 3. Launch aiStarter (Windows & GNU/Linux only)

Communicating between the computer and the phone or table requires a program named aiStarter. The aiStarter program was installed when you installed the App Inventor Setup package. There will be shortcuts to aiStarter from your Start menu, from the Desktop, and from All Programs (Windows only). Windows and Linux: Every time you want to use USB with App Inventor, you will need to manually launch the aiStarter on your computer.

Step 4: Set up your device for USB (Turn USB Debugging ON)

On your Android device, go to System Settings, Developer Options, turn them on, and be sure that "USB Debugging" is allowed.

On most devices running Android 3.2 or older, you can find this option under Settings > Applications > Development.

On Android 4.0 and newer, it's in Settings > Developer options.

Note: On Android 4.2 and newer, Developer options is hidden by default. To make it available, go to Settings > About phone and tap Build number seven times. Return to the previous screen to find Developer options, including "USB Debugging".

Step 5: Connect your computer and device, and authenticate if necessary.

Connect your Android device to the computer using the USB cable - be sure that the device connects as a "mass storage device" (not "media device") and that it is not mounted as a drive on your computer. This may mean that you have to go to the Finder (on a Mac) or My Computer (on Windows) and disconnect any drive(s) that were mounted when you connected your Android device.

On Android 4.2.2 and newer, your device will pop up a screen with the message *Allow USB Debugging?* the first time you connect it to new computer. Press "OK". This authenticates the computer to the device, allowing the computer to communicate with it. You'll need to do this for each computer you want to connect to the device, but only once per computer.

Step 6: Test the connection.

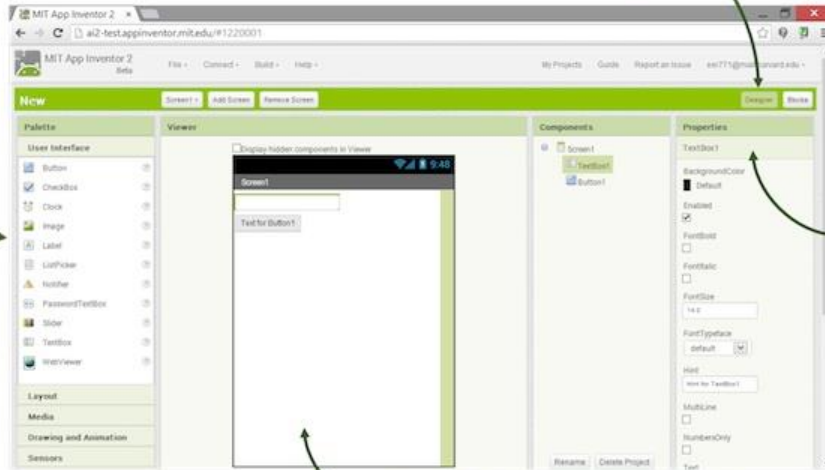
Check if your computer has detected the connection.

4.3.2-MIT App Inventor 2 Designer and Blocks Editor:

Design the App's User Interface by arranging both on and off-screen components.

Palette: Find your components and drag them to the Viewer to add them to your app.

Designer Button: Click from any tab to go to the Designer tab.



Properties: Select a Component in the Components List to change its properties (color, size, behavior) here.

Viewer: Drag components from the Palette to the Viewer to see what your app will look like.

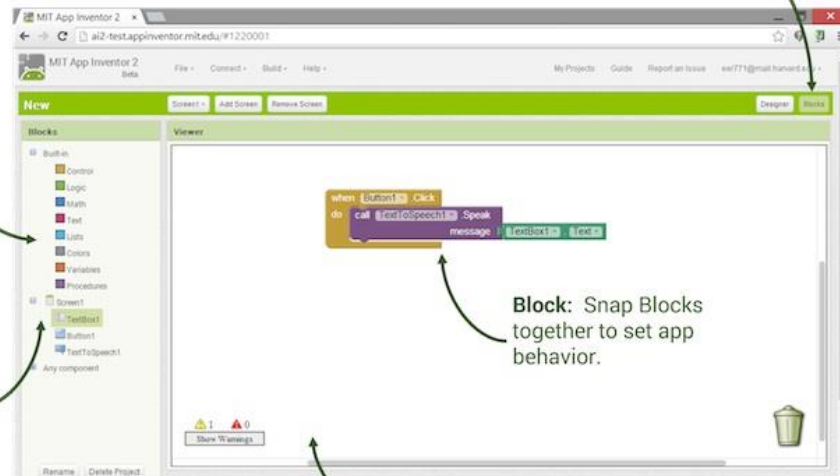
-Figure 4.3.2.1: Designer tab-

Program the app's behavior by putting blocks together.

Built-In Drawers: Find Blocks for general behaviors you may want to add to your app and drag them to the Blocks Viewer.

Blocks Button: Click from any tab to go to the Blocks tab.

Component-Specific Drawers: Find Blocks for behaviors for specific Components and drag them to the Blocks Viewer.



Block: Snap Blocks together to set app behavior.

Viewer: Drag Blocks from the Drawers to the Blocks Viewer to build relationships and behavior.

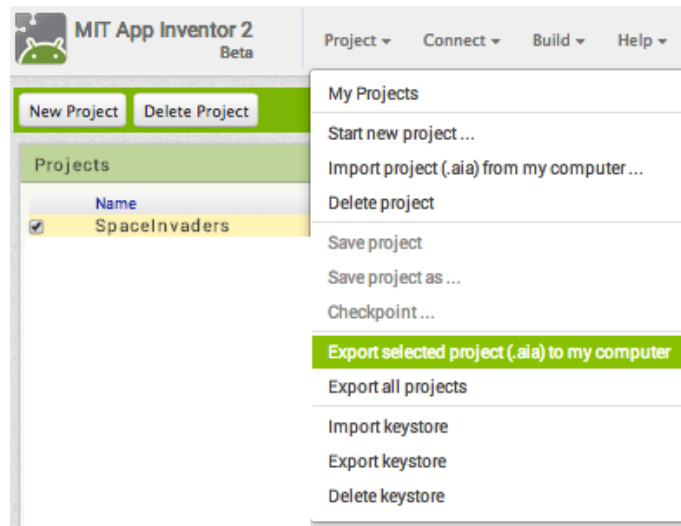
-Figure 4.3.2.2: Blocks tab-

4.3.3- Sharing and Packaging Apps:

You can share the app in an executable form (.apk) that can be installed on a device, or in source code form (.aia) that can be loaded into App Inventor and remixed. You can also distribute your app on the Google Play Store.

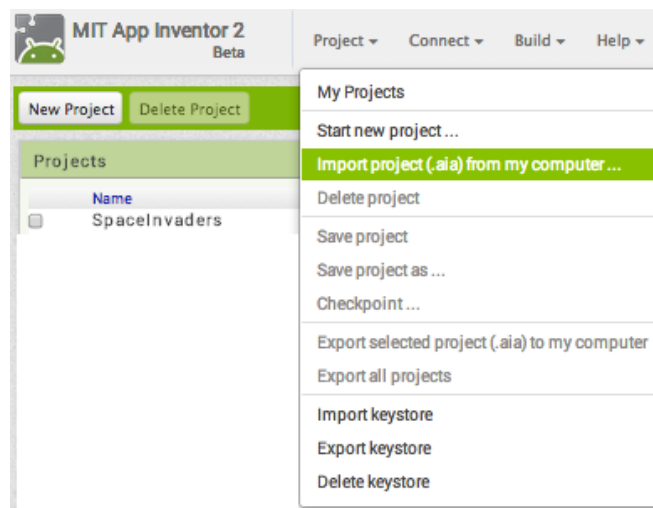
Sharing your app so that others can remix (.aia file)

Make sure you are viewing the list of all of your projects (if you are not, choose Projects | My Projects). Select the project you wish to share by checking the box next to it. Choose **Project | Export selected project (.aia) to my computer** to export the source code (blocks) for your project. The source code is downloaded in a .aia file.



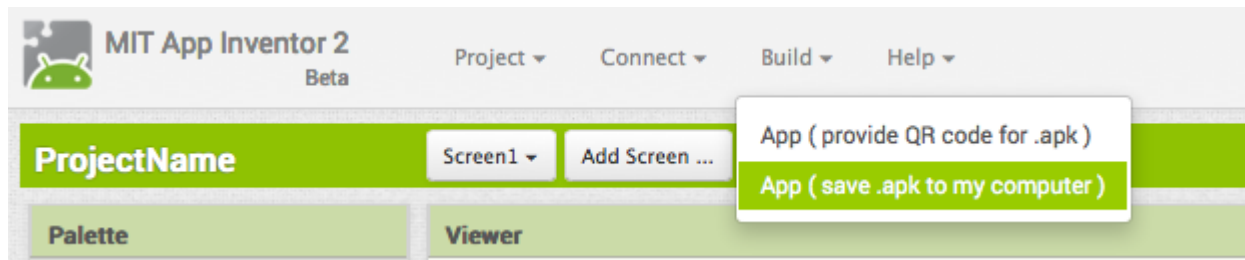
-Figure 4.3.3.1: Exporting as aia file-

If you send it to a friend, they can open it with Project | Import project (.aia) from my computer.



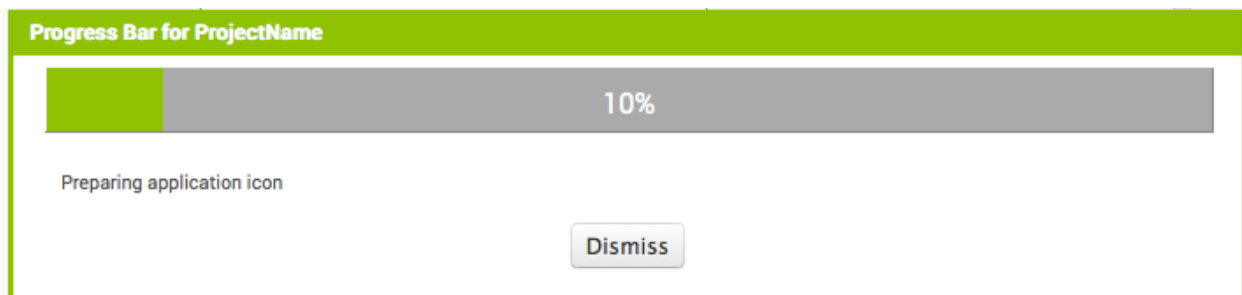
-Figure 4.3.3.2: Importing aia file-

Sharing the app for others to install on their phone/tablet (.apk file), package the app (.apk file) by going to the "Build" menu on the App Inventor toolbar.



-Figure 4.3.3.3: Saving as .apk-

Select "App (save .apk to my computer)." A pop-up box should alert you that your download has begun. Note: The other option (provide QR code for .apk) produces a scannable QR code that will download the app ONLY for the person who owns the project in App Inventor. Do not distribute the QR code to others because it will not work for them.



-Figure 4.3.3.4: Building process-

Once the build completes, you can email the app (".apk" file) to your friends who can install it by opening the email from their phone. If you want to distribute it more widely, you can upload it to a website that both you and your friend can access. You can also distribute your app on the [Google Play Store](#).

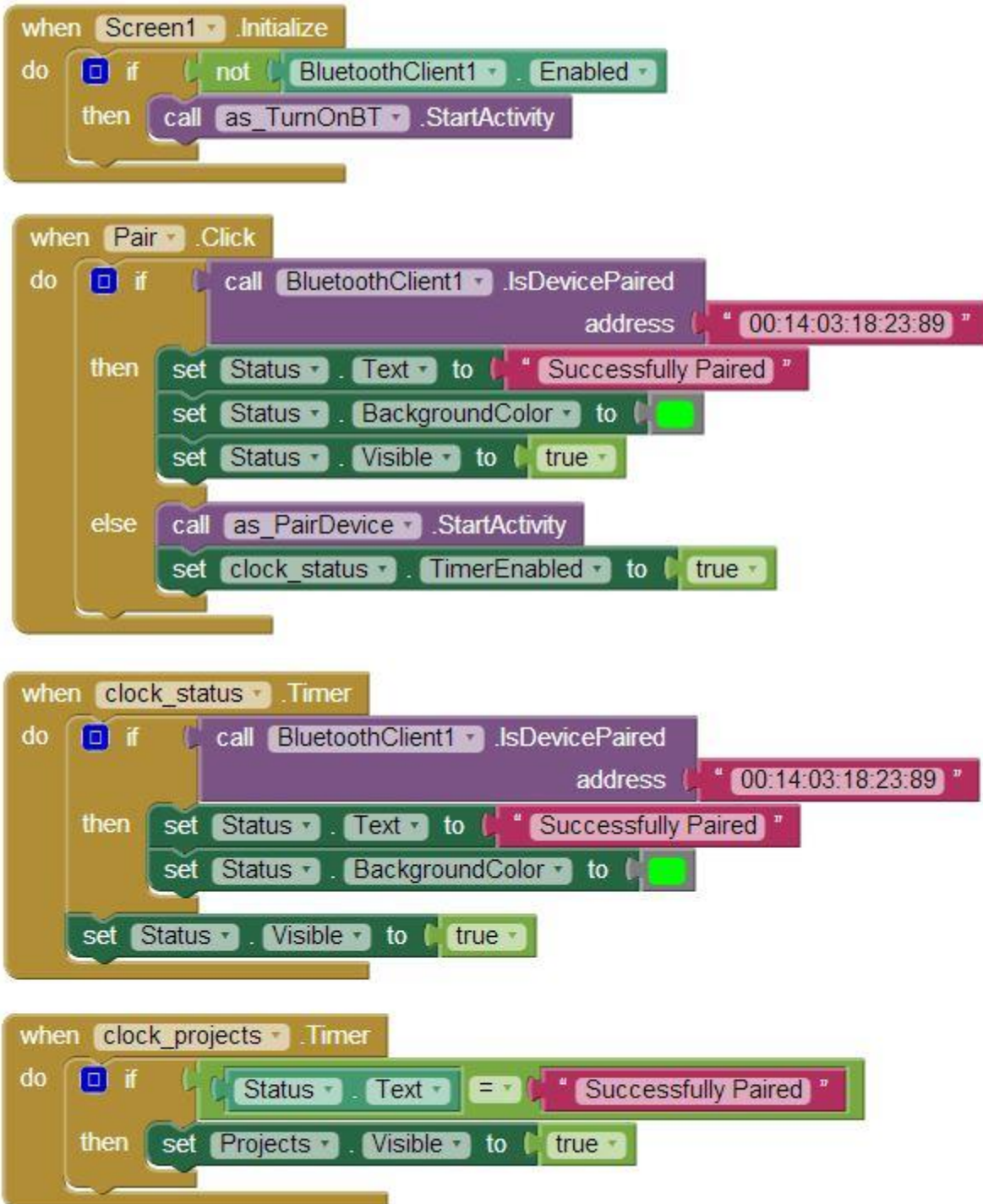
NOTE: Anyone installing your app (which is an ".apk" file) will need to change the setting on their phone to allow installation of non-market applications:

To find this setting on versions of Android prior to 4.0, go to "Settings > Applications" and then check the box next to "Unknown Sources". For devices running Android 4.0 or above, go to "Settings > Security" or "Settings > Security & Screen Lock" and then check the box next to "Unknown Sources" and confirm your choice.

Note: The source code (.aia) files are not executable Android programs -- those are .apk files. The source code is also not Java SDK code -- it can only be loaded into App Inventor.

4.3.4-Our project's application design:

Stage 1 – Getting started



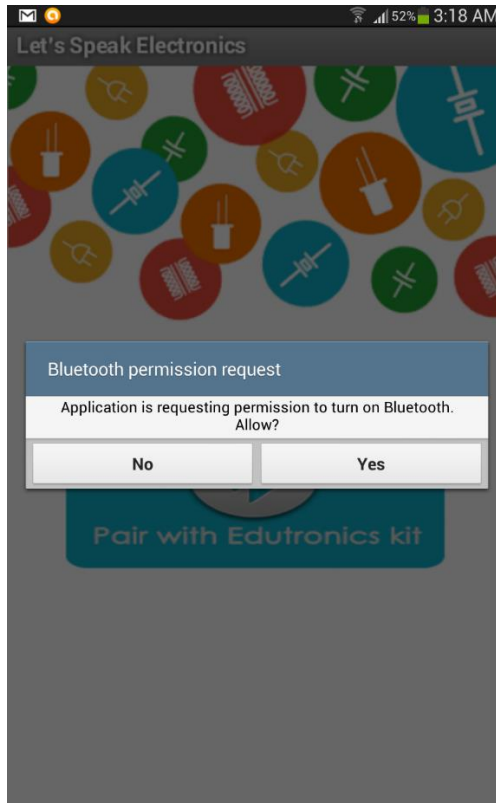
```
when Projects .Click  
do open another screen screenName "Projects"
```

```
when Intro .Timer  
do set Logo .Visible to false  
set Header .Visible to true  
set welcome .Visible to true  
set Pair .Visible to true
```

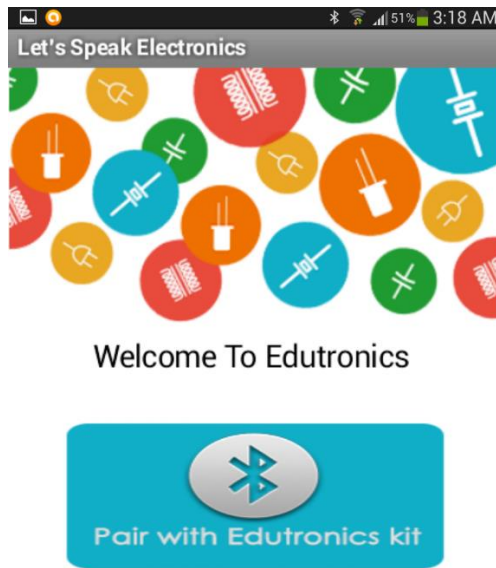
This is what'll appear and how the application will behave:



-Figure 4.3.4.1: App intro-



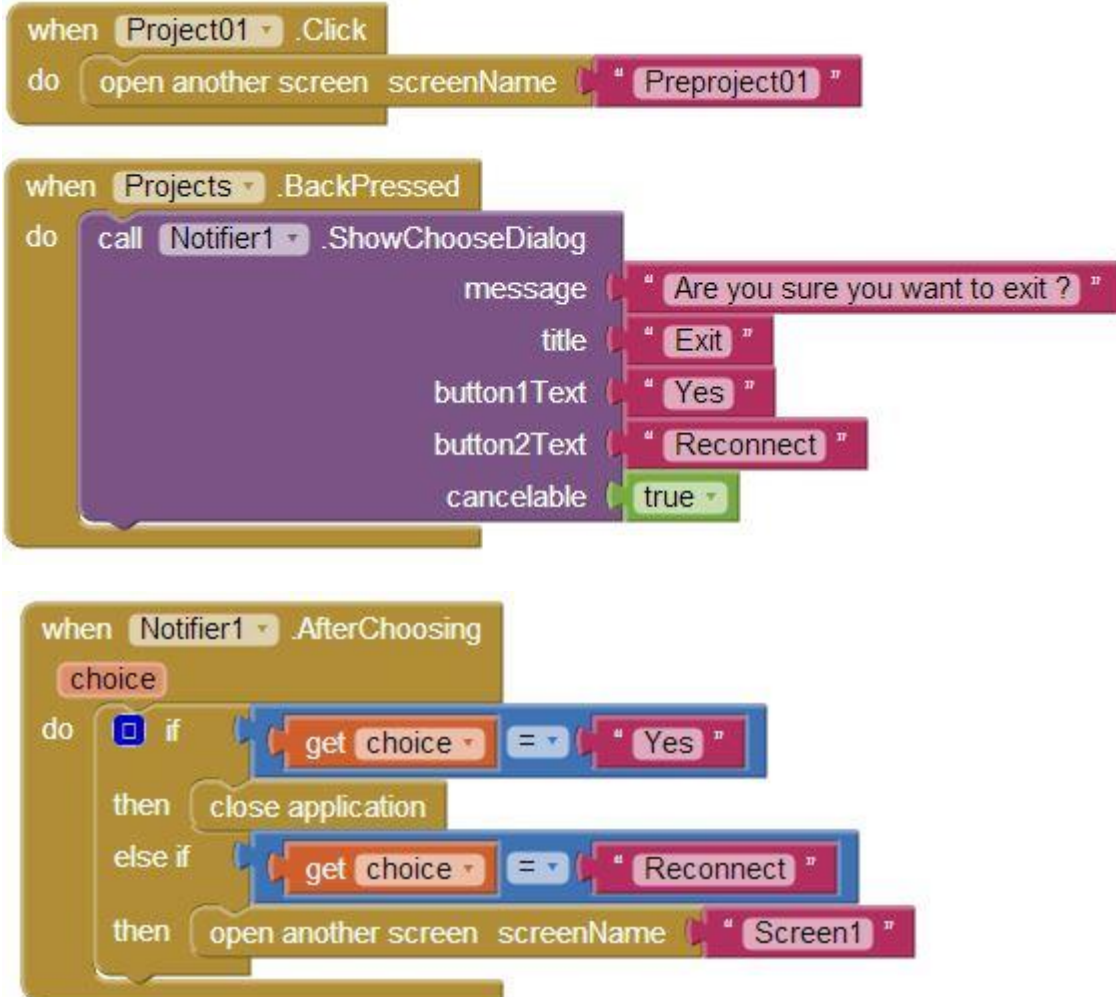
-Figure 4.3.4.2: App requesting Bluetooth permission-



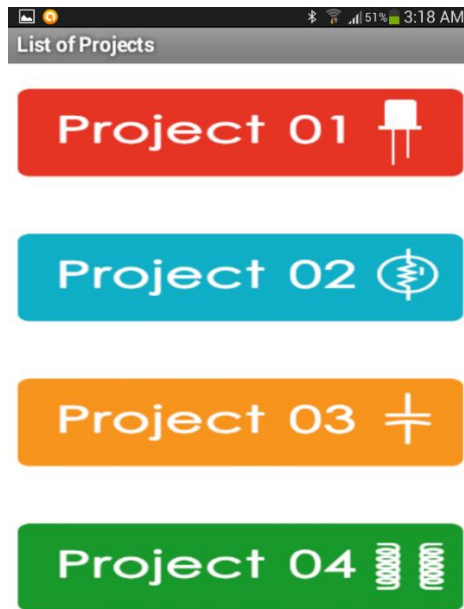
-Figure 4.3.4.3: Pairing button-



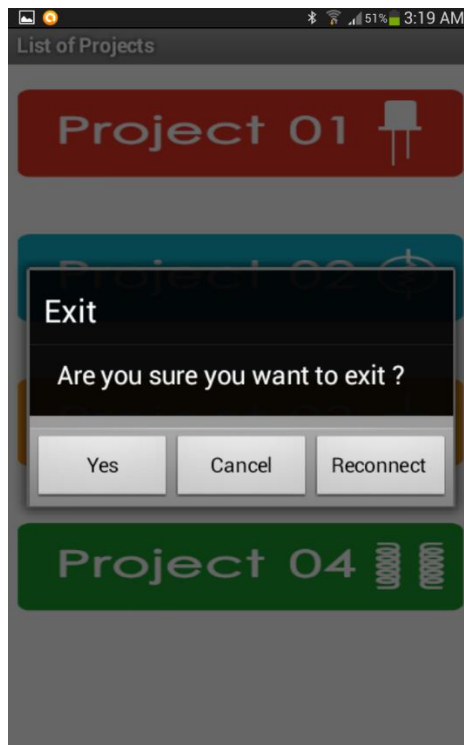
-Figure 4.3.4.5: Successful pairing-

Stage 2 – Choosing a project**Projects list design blocks:**

This is what'll appear and how the application will behave:



-Figure 4.3.4.6: Projects list-



-Figure 4.3.4.7: Pressing back button in projects menu-

Stage 3 – Getting Ready

Design blocks:

```

when Project01.Initialize
do
  if not BluetoothClient1.Enabled
  then
    call as_TurnOnBT.StartActivity
    set Connect.Elements to BluetoothClient1.AddressesAndNames
  
```

```

when Connect.BeforePicking
do
  set Connect.Elements to BluetoothClient1.AddressesAndNames

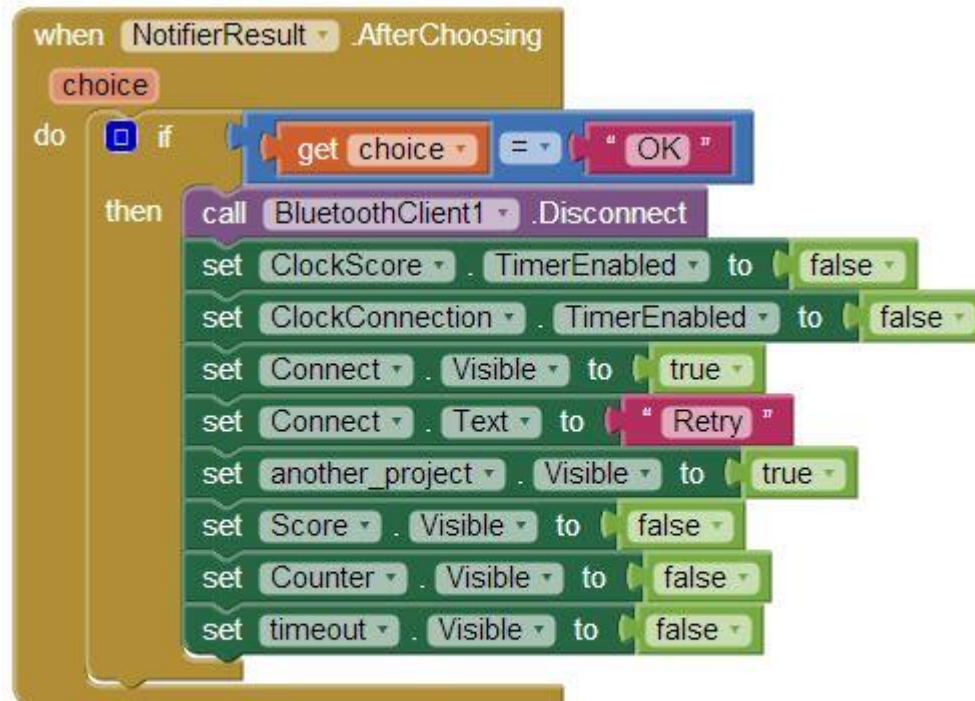
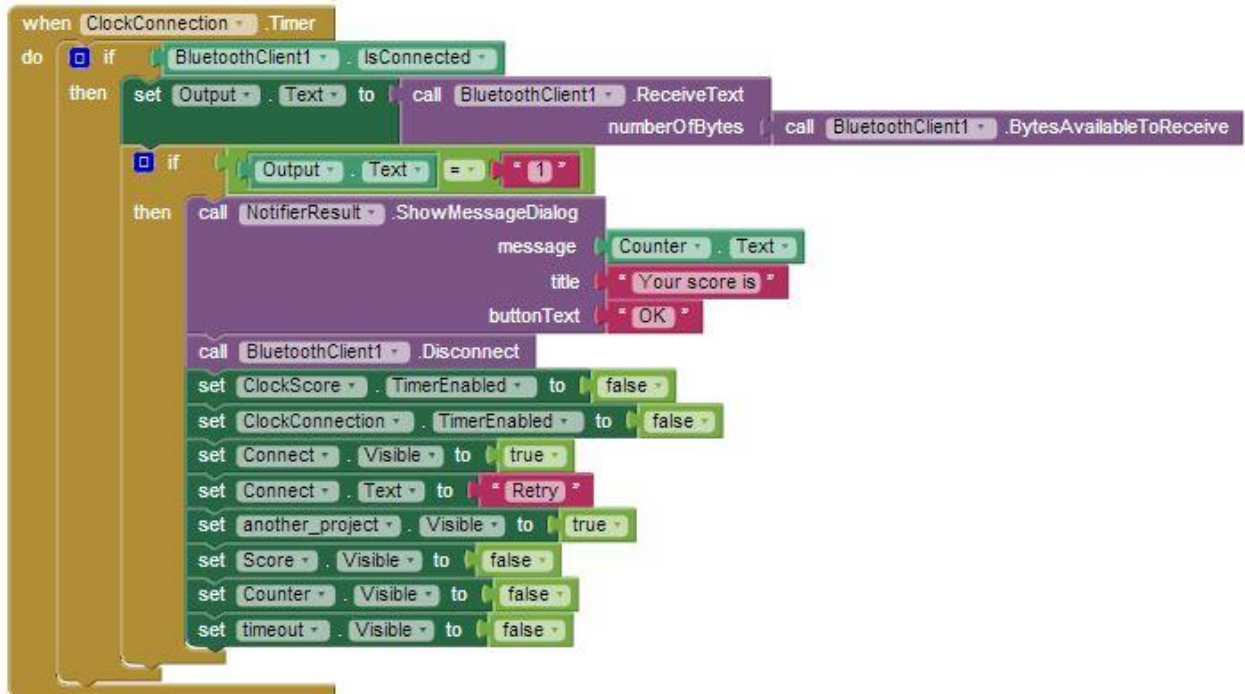
```

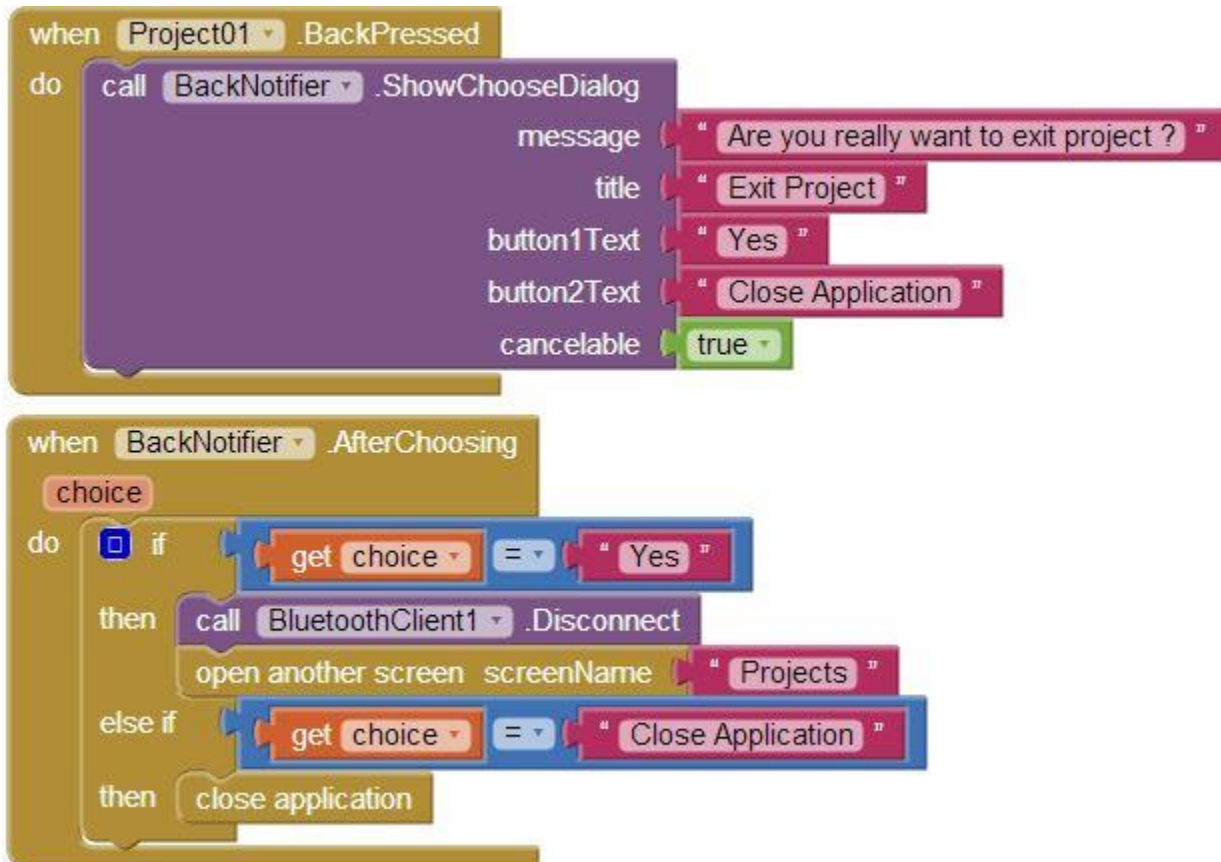
```

when Connect.AfterPicking
do
  set Connect.Selection to call BluetoothClient1.Connect
  address "00:14:03:18:23:89"
  if BluetoothClient1.IsConnected = true
  then
    set Connect.Visible to false
    set Label1.Visible to true
    set Label2.Visible to true
    set Score.Visible to true
    set Counter.Visible to true
    set Counter.Text to "100"
    set Image1.Visible to true
    set ClockScore.TimerEnabled to true
    set ClockConnection.TimerEnabled to true
  
```

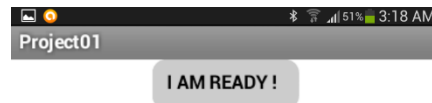
```

when ClockScore.Timer
do
  set Counter.Text to Counter.Text - 1
  if Counter.Text = 0
  then
    set ClockScore.TimerEnabled to false
    set timeout.Visible to true
    set Counter.Text to "0"
  
```

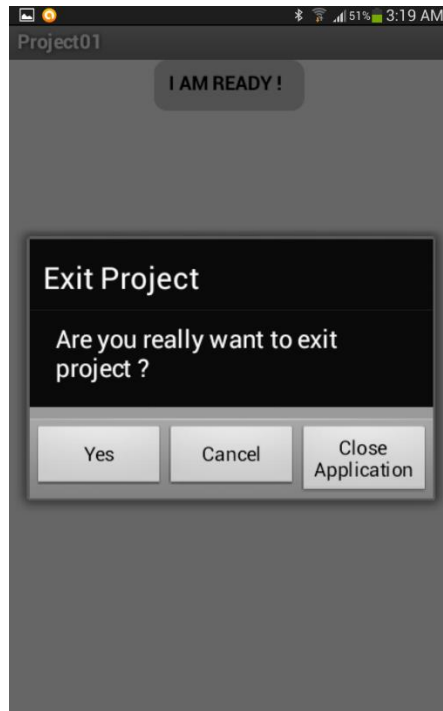




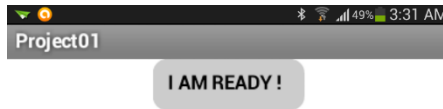
This is how the application will behave:



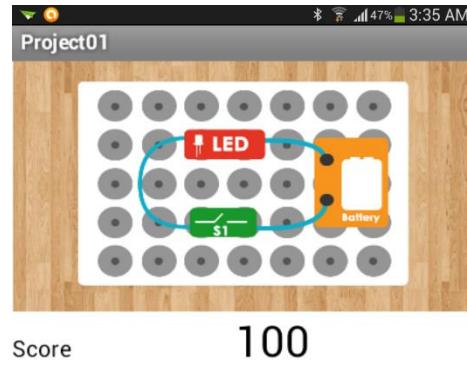
-Figure 4.3.4.8: Ready to start connection between the app and the kit-



-Figure 4.3.4.9: Pressing back on ready screen-

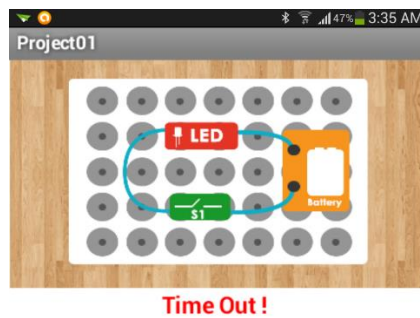


-Figure 4.3.4.10: Pressing ready while the kit is disconnected-



-Figure 4.3.4.11: Project completion display-

The displayed circuit in Figure above is the circuit the user is currently implementing, once it's completed the hardware kit senses the correct output and the application returns a calculated score based on the time of completion.



-Figure 4.3.4.12: Time out display-

4.4-Arduino software:

¹⁴The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a "sketch".

Arduino programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a runnable cyclic executive program:

setup(): a function run once at the start of a program that can initialize settings

loop(): a function called repeatedly until the board powers off

A typical first program for a microcontroller simply blinks an LED on and off. In the Arduino environment, the user might write a program like this

```
#define LED_PIN 13

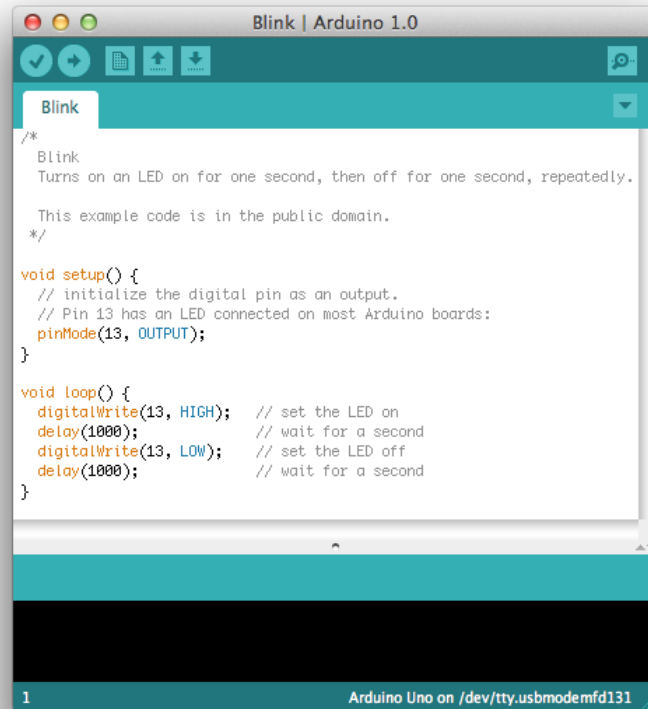
void setup () {
  pinMode (LED_PIN, OUTPUT); // Enable pin 13 for digital output
}

void loop () {
  digitalWrite (LED_PIN, HIGH); // Turn on the LED
  delay (1000); // Wait one second (1000 milliseconds)
  digitalWrite (LED_PIN, LOW); // Turn off the LED
  delay (1000); // Wait one second
}
```

It is a feature of most Arduino boards that they have an LED and load resistor connected between pin 13 and ground; a convenient feature for many simple tests. The previous code

¹⁴ Arduinio.cc

would not be seen by a standard C++ compiler as a valid program, so when the user clicks the "Upload to I/O board" button in the IDE, a copy of the code is written to a temporary file with an extra include header at the top and a very simple main() function at the bottom, to make it a valid C++ program.



```

Blink | Arduino 1.0
Blink
/*
 * Blink
 * Turns on an LED on for one second, then off for one second, repeatedly.
 *
 * This example code is in the public domain.
 */

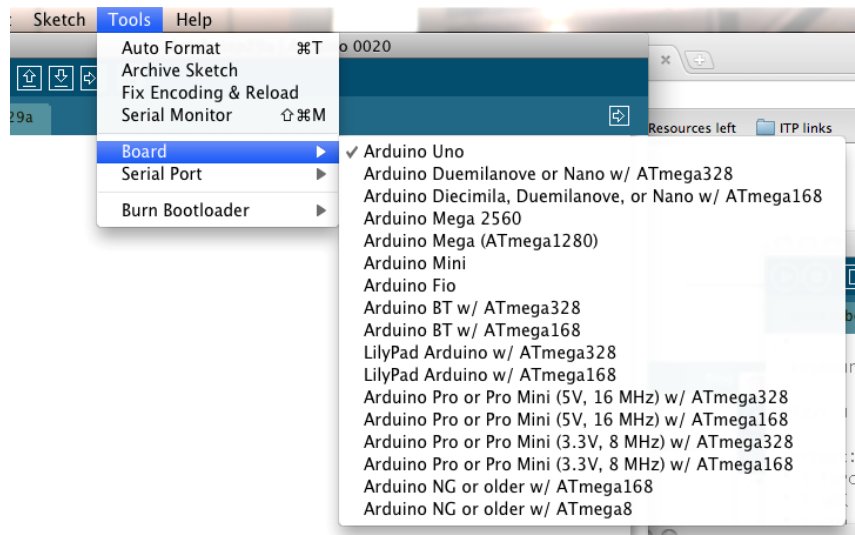
void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH); // set the LED on
  delay(1000);           // wait for a second
  digitalWrite(13, LOW); // set the LED off
  delay(1000);          // wait for a second
}

1 Arduino Uno on /dev/tty.usbmodemfd131

```

-Figure 4.2.3.1.1: Arduino software-



-Figure 4.2.3.1.2: Selecting the Arduino board version-

4.4.1-Arduino code:

```

// This module work as Slave
// Upload this sketch into Arduino and press reset

#include <SoftwareSerial.h> //Software Serial Port
#define RxD 6
#define TxD 7

SoftwareSerialblueToothSerial (RxD,TxD);

void setup()
{
  Serial.begin(9600);
  pinMode(RxD, INPUT);
  pinMode(TxD, OUTPUT);
  setupBlueToothConnection();
}

void loop()
{
  charrecvChar;
  while(1){
    //check if there's any data sent from the remote bluetooth shield
    if(blueToothSerial.available()){
      recvChar =blueToothSerial.read();
      Serial.print(recvChar);
    }
    /*check if there's any data sent from the local serial terminal,
    you can add the other applications here*/
    if(Serial.available()){
      recvChar = Serial.read();
      blueToothSerial.print(recvChar);
    }
  }
}

voidsetupBlueToothConnection()
{
  blueToothSerial.begin(38400); //Set BluetoothBee BaudRate to default baud rate 38400
  blueToothSerial.print("\r\n+STWMOD=0\r\n"); //set the bluetooth work in slave mode
  ueToothSerial.print("\r\n+STOAUT=1\r\n"); // Permit Paired device to connect me
  blueToothSerial.print("\r\n+STAUTO=0\r\n"); // Autoconnection should be forbidden here
  delay(2000);
  blueToothSerial.print("\r\n+INQ=1\r\n"); //make the slave bluetooth inquirable
  Serial.println("The slave bluetooth is inquirable!");
  delay(2000);
  blueToothSerial.flush();
}

```

```

////////////////////////////////////
////////////////////////////////////
//This module work as Master
#include <SoftwareSerial.h> //Software Serial Port
#define RxD 6
#define TxD 7
String retSymb = "+RTINQ="; //start symbol when there's any return
String slaveName = ";SeedBTSlave";
//Set the Slave name ,caution that ';' must be included
intnameIndex = 0;
intaddrIndex = 0;

String recvBuf;
String slaveAddr;

String connectCmd = "\r\n+CONN=";

SoftwareSerialblueToothSerial (RxD,TxD) ;

void setup()
{
  Serial.begin(9600);
  pinMode(RxD, INPUT);
  pinMode(TxD, OUTPUT);
  setupBlueToothConnection();
  //wait 1s and flush the serial buffer
  delay(1000);
  Serial.flush();
  blueToothSerial.flush();
}

void loop()
{
  charrecvChar;
  while(1){
    if(blueToothSerial.available()){
      //check if there's any data sent from the remote bluetooth shield
      recvChar =blueToothSerial.read();
      Serial.print(recvChar);
    }
    if(Serial.available()){
      /*check if there's any data sent from the local serial terminal,
      you can add the other applications here*/
      recvChar = Serial.read();
      blueToothSerial.print(recvChar);
    }
  }
}

```

```

void setupBluetoothConnection()
{
  blueToothSerial.begin(38400); //Set BluetoothBee BaudRate to default baud rate 38400
  blueToothSerial.print("\r\n+STWMOD=1\r\n"); //set the bluetooth work in master mode
  blueToothSerial.print("\r\n+STAUTO=0\r\n"); // Auto-connection is forbidden here
  delay(2000);
  blueToothSerial.flush();
  blueToothSerial.print("\r\n+INQ=1\r\n"); //make the master inquire
  Serial.println("Master is inquiring!");
  delay(2000);

  //find the target slave
  char recvChar;
  while(1) {
    if(blueToothSerial.available()) {
      recvChar = blueToothSerial.read();
      recvBuf += recvChar;
      nameIndex = recvBuf.indexOf(slaveName); //get the position of slave name
      //nameIndex -= 1;
      /*decrease the ';' in front of the slave name,
      to get the position of the end of the slave address*/
      if (nameIndex != -1) {
        Serial.print(recvBuf);
        //get the start position of slave address"
        addrIndex = (recvBuf.indexOf(retSymb, (nameIndex - retSymb.length() - 18) ) + retSymb.length());
        slaveAddr = recvBuf.substring(addrIndex, nameIndex); //get the string of slave address
        break;
      }
    }
  }

  //form the full connection command
  connectCmd += slaveAddr;
  connectCmd += "\r\n";
  int connectOK = 0;
  Serial.print("Connecting to slave:");
  Serial.print(slaveAddr);
  Serial.println(slaveName);
  //connecting the slave till they are connected
  do {
    blueToothSerial.print(connectCmd); //send connection comma
    recvBuf = "";
    while(1) {
      if(blueToothSerial.available()) {
        recvChar = blueToothSerial.read();
        recvBuf += recvChar;

```

```
if(recvBuf.indexOf("CONNECT:OK") != -1){
connectOK = 1;
Serial.println("Connected!");
blueToothSerial.print("Connected!");
break;
}else if(recvBuf.indexOf("CONNECT:FAIL") != -1){
Serial.println("Connect again!");
break;
}})
while(0 == connectOK);}
```

Chapter Five: Hardware Software Integration

5.1- Interaction between Hardware kit and mobile application:

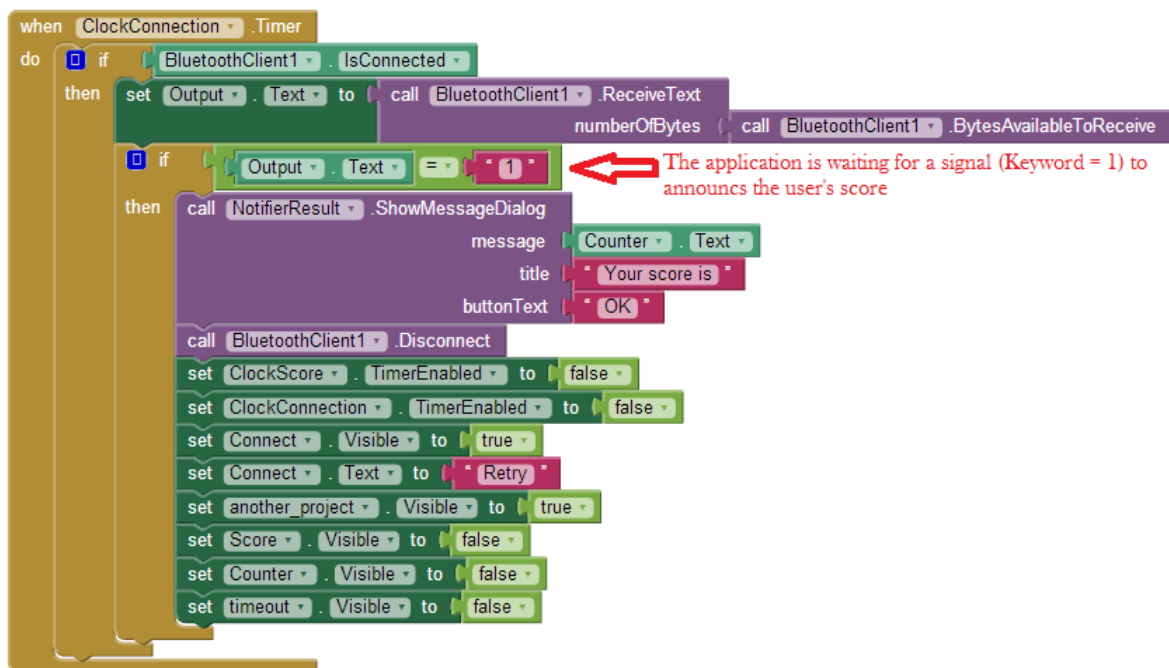
Scenario:

While starting the mobile application is forced to turn on the Bluetooth connectivity of the mobile device, then it asks the user to pair with the Kit, after pairing the user continues to use the application until he/she reaches the requested project.

After opening the required project, pressing “I am ready” button let the application be synchronized with the Bluetooth module of the kit and the counter starts to count for the process of calculation of the user’s score.

During the life of the project, the application is waiting for an interrupt signal (A pre-specified keyword known between the module and the application for this project) from the Bluetooth module to stop the counter and to show a message for the user announcing his/her final score.

Design blocks:



```

sketch_jul05b $
void setup() {
  // Open serial communications and wait for port to open:
  Serial.begin(9600);
}
void loop(){
  Serial.println(1);
}

```

-Figure 5.1.1: Test app-

5.2-UART Protocol:

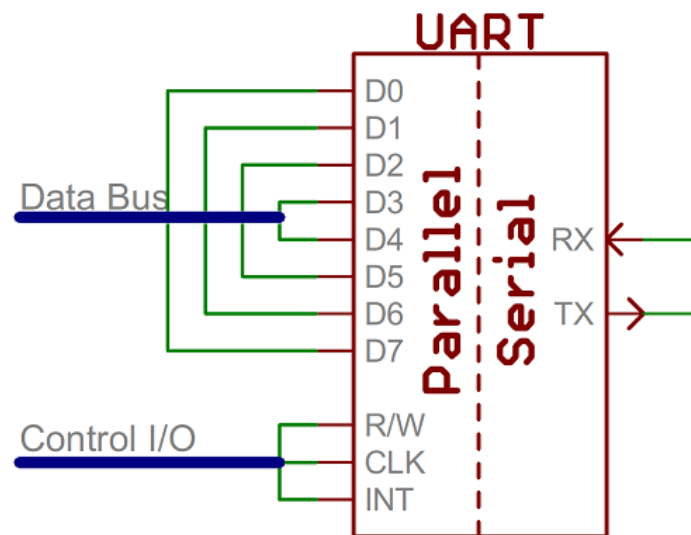
The mobile equipment (Application) is connected to the hardware (Kit) through a continuous Bluetooth connection using UART protocol

¹⁵A universal asynchronous receive-transmitter, is a piece of computer hardware that translates data between parallel and serial forms.

The main features:

- Full Duplex Operation
- Master or slave clocked Synchronous operation
- High Resolution Baud Rate Generator
- Data Over run Detection

The UART takes bytes of data and transmits the individual bits from the source (kit) in a sequential fashion .at the destination (Mobile), a second UART re-assembles the bits into complete bytes. Each UART contains a shift register, which is the fundamental method of conversion between serial and parallel forms.



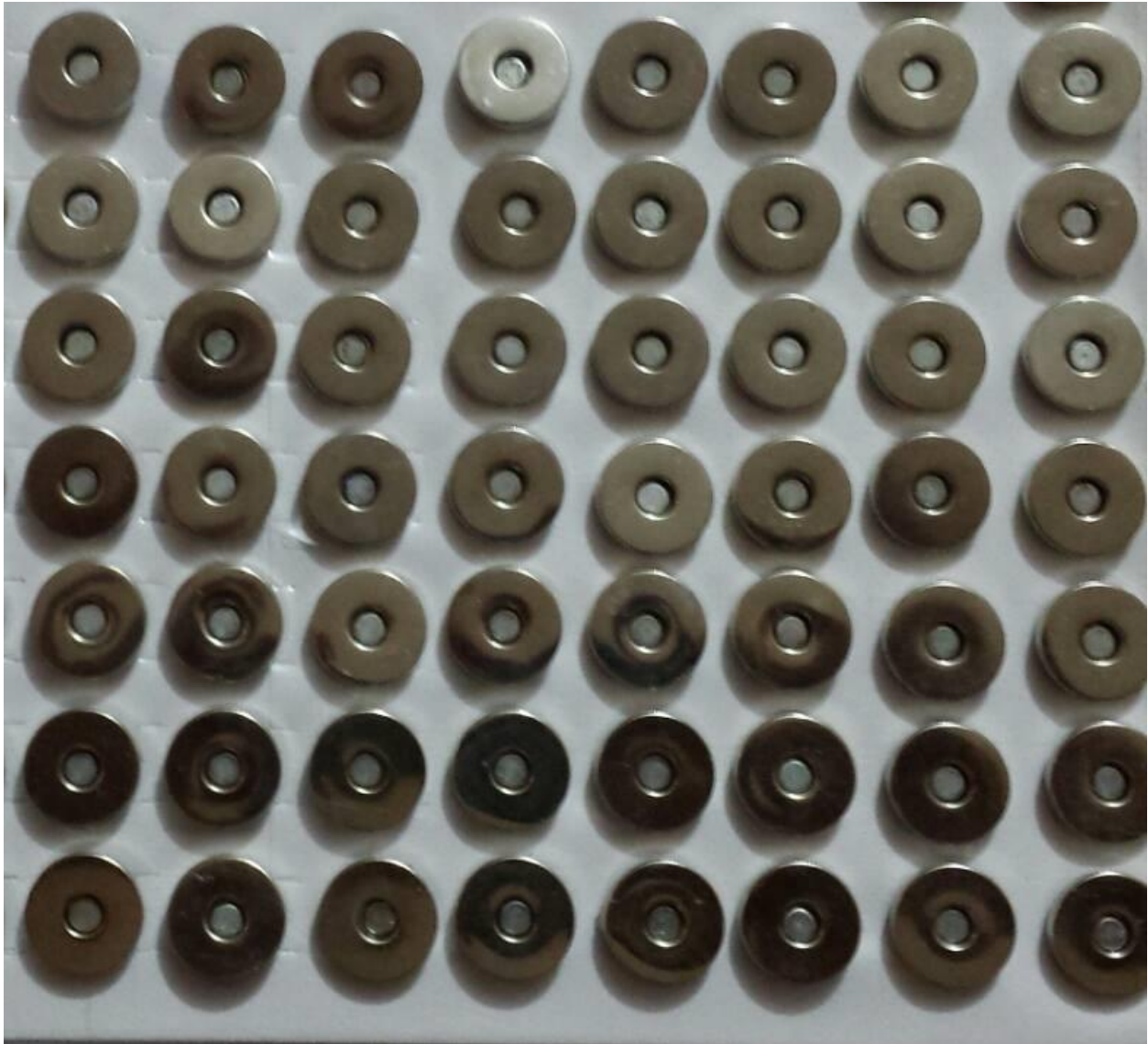
-Figure 5.2.1: UART-

The UART Used for communication between the Arduino board (Kit) and the mobile device. All Arduino boards have at least one serial port (also known as a UART or USART): Serial. It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB. Thus, if you use these functions, you cannot also use pins 0 and 1 for digital input or output.

¹⁵ Wikipedia

5.3-Final Prototype working along with the mobile application:

This is the final shape of the hardware kit

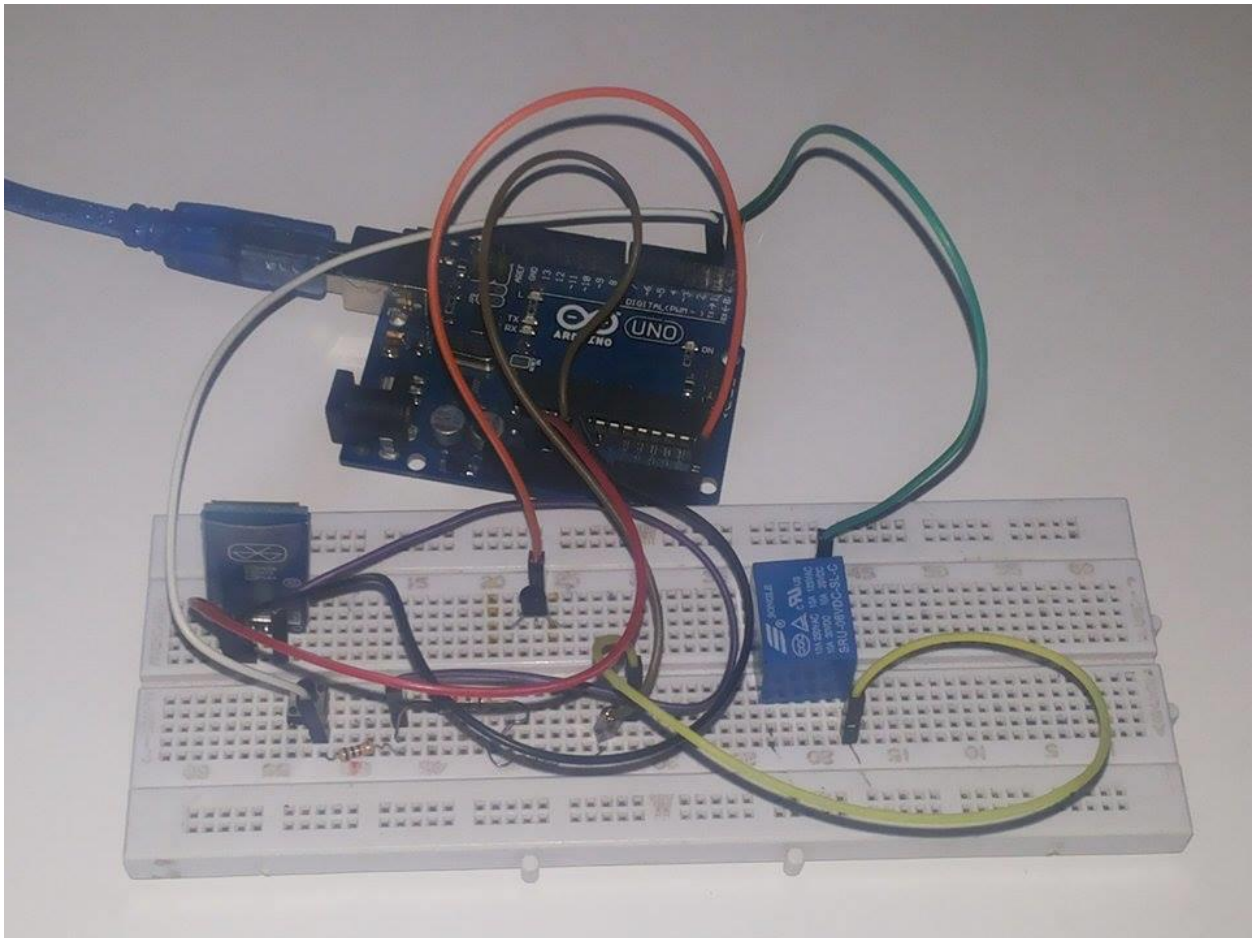


-Figure 5.3.1: Hardware kit final prototype front view-

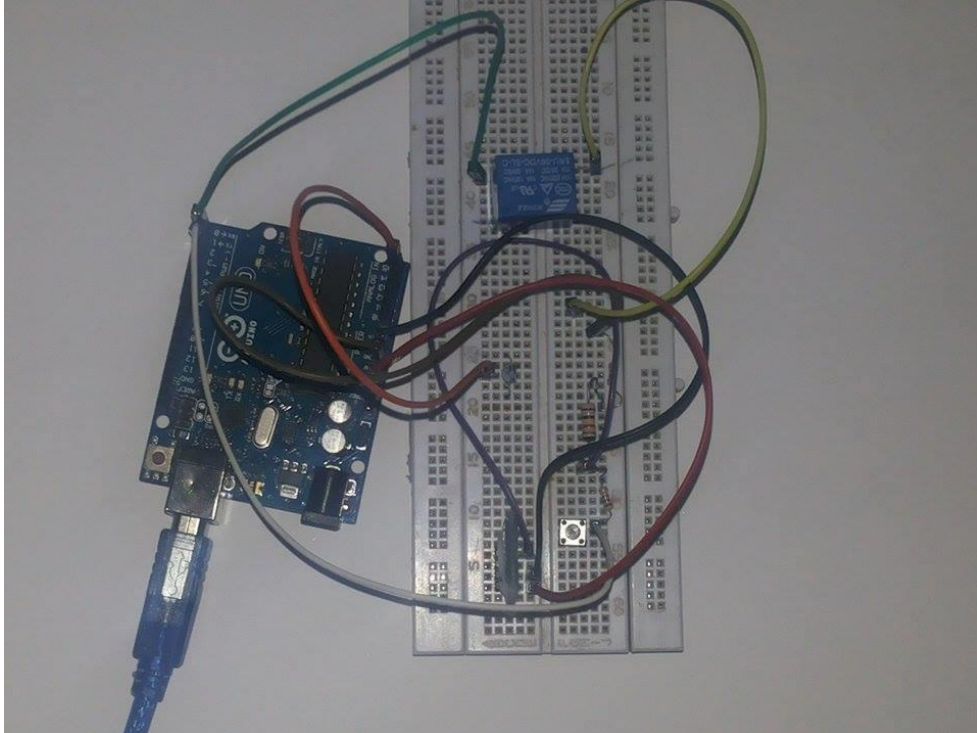


-Figure 5.3.2: Hardware kit final prototype back view-

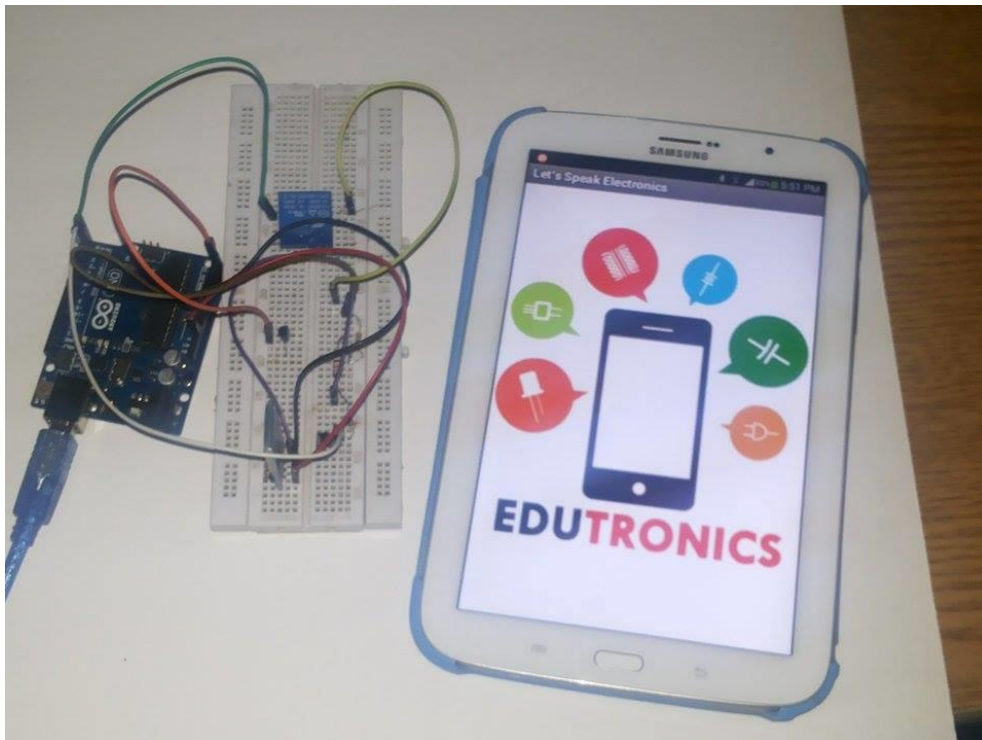
Note that the back of the kit will be cased with an insulating material, to ensure the safety of the user.



-Figure 5.3.3: Arduino and Bluetooth module connection Side view-



-Figure 5.3.4: Arduino and Bluetooth module connection Upper view-



-Figure 5.3.5: Hardware and Mobile app functioning together-

Chapter 6 Conclusion and future work

6.1-Conclusion:

After weeks, days and hours of hard work, we were able to create a unique product with a new idea that didn't exist before, an interactive educational game, that teaches kids the basics and concepts of electronics at an early life stage, based on learning by doing as the user will be able to implement fully functional circuits, guided by the listed instructions and figures in the mobile application.

We were able to finalize a reliable prototype that will be a base to our future work, to us this is not just a graduation project, we see a great business potential in this project, the idea is brand new, and no such product exist in Egypt, so we have new competitors, its new, it's educational, it's a service to the whole community and it has a real value to the customers, surely sponsors will be interested to hear about it, and maybe interested in claiming the advantage of being the first company that supports such an idea.

Conclusion, we aim to prepare a generation that will lead a technological revolution for our country.

6.2-Future work:

6.2.1-Replacing the Arduino and with a Printed Circuit Board:

The main use of this will be reducing the size of the hardware kit and ensuring its sustainability and reliability as every component will be properly fixed, hence it won't be affected by sudden movements or impact, there will be other advantages such as:

1. The circuit board fabrication cost is lower with mass quantity production.
2. Electronic circuit characteristics will be maintained without introducing parasite capacitance with a proper circuit board design.
3. Component wiring and assembly can be mechanized in a circuit board manufacturing facility.
4. PCBs offer uniformity of electrical characteristics from assembly to assembly.
5. The location of electronic parts is fixed and so it simplifies components identification and maintenance of equipment.
6. Inspection time is reduced because printed circuitry eliminates the probability of error.

6.2.2-Increasing the number of projects that can be implemented by the kit:

¹⁶Here are some project ideas that we picked from elenco, a company that manufactures educational toys.

Project #	Description	Project #	Description	Project #	Description
1	Electric Light & Switch	35	Motor Space Light	69	Space War Siren
2	DC Motor & Switch	36	Space Battle (II)	70	Quiet Water Alarm
3	Sound Activated Switch	37	Silent Space Battle	71	Light-Controlled Lamp
4	Adjusting Sound Level	38	Periodic Sounds	72	Voice-Controlled Lamp
5	Lamp & Fan in Series	39	Blinking Double Flashlight	73	Motor-Controlled Lamp
6	Lamp & Fan in Parallel	40	Motor-Controlled Sounds	74	Light-Controlled LED
7	Light Emitting Diode	41	More Motor Sounds	75	Sound-Controlled Time Delay LED
8	One Direction for LED	42	More Motor Sounds (II)	76	Motor-Controlled Time Delay LED
9	Conduction Detector	43	More Motor Sounds (III)	77	Space War Flicker LED
10	Space War Alarm Combo	44	More Motor Sounds (IV)	78	Music AND Gate
11	Flying Saucer	45	Light-Controlled Flicker	79	Flash and Tone
12	Decreasing Saucer Lift	46	More Sound Effects	80	Lamp, Speaker & Fan in Parallel
13	Two-Speed Fan	47	This OR That	81	Pencil Alarm
14	The Fuse	48	This AND That	82	Pencil Alarm Variants
15	Musical Doorbell	49	Neither This NOR That	83	Fun with the Alarm IC
16	Momentary Alarm	50	NOT This AND That	84	Motor Sounds Combo
17	Alarm Circuit	51	Reflection Detector	85	Motor Sounds Combo (II)
18	Laser Gun	52	Quieter Reflection Detector	86	Music Alarm Combo
19	Space War	53	Flashing Laser Light with Sound	87	Bomb Sound
20	Light Switch	54	Space War Flicker	88	Bomb Sound (II)
21	Paper Space War	55	Spinning Rings	89	Light-Controlled LED (II)
22	Light Police Siren	56	Strobe the House Lights	90	Touch Light
23	More Loud Sounds	57	Race Game	91	Touch Sound
24	More Loud Sounds (II)	58	Using Parts as Conductors	92	Wacky Sounds
25	More Loud Sounds (III)	59	Spin Draw	93	Wackier Sounds
26	More Loud Sounds (IV)	60	Space War Flicker Motor	94	Really Wacky Sounds
27	Clap Sounds	61	Light-Controlled Sounds	95	Noisier Water Space War
28	More Clap Sounds	62	Light-Controlled Sounds (II)	96	Light/Water Space War
29	More Clap Sounds (II)	63	Light-Controlled Sounds (III)	97	OR/AND Space War Light
30	More Clap Sounds (III)	64	Light-Controlled Sounds (IV)	98	Simple Water Alarm
31	More Clap Sounds (IV)	65	Light-Controlled Sounds (V)	99	Simple Salt Water Alarm
32	Voice Light Diode	66	Electronic Bombing Game	100	Ambulance Water Alarm
33	Voice Control	67	Quiet Zone Game	101	Ambulance Contact Alarm
34	Motor Space Sounds	68	Space War Music Combo		

-Table 6.2.2.1: Project ideas list 1-

¹⁶ Elenco® Electronics

Project #	Description	Project #	Description	Page #	Project #	Description
102	Batteries in Series	136	High Frequency Touch Buzzer		170	PNP Light Control
103	Ticking Screecher	137	High Frequency Water Buzzer		171	PNP Dark Control
104	Spacey Fan	138	Mosquito		172	Red & Green Control
105	Two-Transistor Light Alarm	139	High Sensitivity Voice Doorbell		173	Current Controllers
106	Light-Controlled Alarm	140	Louder Doorbell		174	Current Equalizing
107	Automatic Street Lamp	141	Very Loud Doorbell		175	Battery Polarity Tester
108	Voice-Controlled Rays of Light	142	Doorbell with Button		176	Blow Off a Doorbell
109	Blowing Off the Electric Light	143	Darkness Announcer		177	Blow Off a Candle
110	Adjustable Tone Generator	144	Musical Motion Detector		178	Blow On a Doorbell
111	Photosensitive Electronic Organ	145	Radio Music Alarm		179	Blow On a Candle
112	Electronic Cicada	146	Daylight Music Radio		180	Screaming Fan
113	Light & Sounds	147	Night Music Radio		181	Whining Fan
114	More Light & Sounds	148	Night Gun Radio		182	Light Whining
115	More Light & Sounds (II)	149	Radio Gun Alarm		183	More Light Whining
116	More Light & Sounds (III)	150	Daylight Gun Radio		184	Motor Than Won't Start
117	More Light & Sounds (IV)	151	Blow Off a Space War		185	Whiner
118	Motor Speed Detector	152	Series Lamps		186	Lower Pitch Whiner
119	Old-Style Typewriter	153	Parallel Lamps		187	Hummer
120	Optical Transmitter & Receiver	154	Fire Fan Symphony		188	Adjustable Metronome
121	Space War Sounds Controlled by Light	155	Fire Fan Symphony (II)		189	Quiet Flasher
122	Space War Radio	156	Fan Symphony		190	Hissing Foghorn
123	The Lie Detector	157	Fan Symphony (II)		191	Hissing & Clicking
124	NPN Amplifier	158	Police Car Symphony		192	Video Game Engine Sound
125	PNP Amplifier	159	Police Car Symphony (II)		193	Light Alarm
126	Sucking Fan	160	Ambulance Symphony		194	Brighter Light Alarm
127	Blowing Fan	161	Ambulance Symphony (II)		195	Lazy Fan
128	PNP Collector	162	Static Symphony		196	Laser Light
129	PNP Emitter	163	Static Symphony (II)		197	Water Alarm
130	NPN Collector	164	Capacitors in Series		198	Radio Announcer
131	NPN Emitter	165	Capacitors in Parallel		199	Pitch
132	NPN Collector - Motor	166	Water Detector		200	Pitch (II)
133	NPN Emitter - Motor	167	Salt Water Detector		201	Pitch (III)
134	Buzzing in the Dark	168	NPN Light Control		202	Flooding Alarm
135	Touch Buzzer	169	NPN Dark Control		203	Make Your Own Battery

-Table 6.2.2.2: Project ideas list 2-

Project #	Description	Project #	Description	Project #	Description
204	Make Your Own Battery (II)	238	Trombone	272	Photoresistor Control
205	Make Your Own Battery (III)	239	Race Car Engine	273	Microphone Control
206	Tone Generator	240	Power Amplifier	274	Pressure Alarm
207	Tone Generator (II)	241	Feedback Kazoo	275	Power Microphone
208	Tone Generator (III)	242	AM Radio	276	LED Fan Rotation Indicator
209	Tone Generator (IV)	243	Fire Engine Symphony	277	Space War Sounds with LED
210	More Tone Generator	244	Fire Engine Symphony (II)	278	Sound Mixer
211	More Tone Generator (II)	245	Vibration or Sound Indicator	279	Sound Mixer Fan Driver
212	More Tone Generator (III)	246	Two-Finger Touch Lamp	280	Electric Fan Stopped by Light
213	Music Radio Station	247	One-Finger Touch Lamp	281	Motor & Lamp
214	Alarm Radio Station	248	Space Battle	282	Start-Stop Delay
215	Standard Transistor Circuit	249	Space Battle (II)	283	Mail Notifying System
216	Motor & Lamp by Sound	250	Multi-Speed Light Fan	284	Mail Notifying Electronic Bell
217	Fading Siren	251	Light & Finger Light	285	Mail Notifying Electronic Lamp
218	Fast Fade Siren	252	Storing Electricity	286	Twice-Amplified Oscillator
219	Laser Gun with Limited Shots	253	Lamp Brightness Control	287	Quick Flicking LED
220	Symphony of Sounds	254	Electric Fan	288	AM Radio with Transistors
221	Symphony of Sounds (II)	255	Radio Music Burglar Alarm	289	AM Radio (II)
222	Transistor Amplifiers	256	Light Dimmer	290	Music Amplifier
223	Pressure Meter	257	Motion Detector	291	Delayed Action Lamp
224	Resistance Meter	258	Fan Modulator	292	Delayed Action Fan
225	Auto-Off Night-Light	259	Oscillator 0.5 - 30Hz	293	Police Siren Amplifier
226	Discharging Caps	260	Sound Pulse Oscillator	294	Lasting Doorbell
227	Changing Delay Time	261	Motion Detector (II)	295	Lasting Clicking
228	Morse Code Generator	262	Motor Rotation	296	Quieting a Motor
229	LED Code Teacher	263	Motor Delay Fan	297	Transistor Fading Siren
230	Ghost Shriek Machine	264	Motor Delay Fan (II)	298	Fading Doorbell
231	LED & Speaker	265	High Pitch Bell	299	Blowing Space War Sounds
232	Dog Whistle	266	Steamboat Whistle	300	Adjustable Time Delay Lamp
233	Mind Reading Game	267	Steamship	301	Adjustable Time Delay Fan
234	Enhanced Quiet Zone Game	268	Light NOR Gate	302	Adjustable Time Delay Lamp (II)
235	Capacitor Charge & Discharge	269	Noise-Activated Burglar Alarm	303	Adjustable Time Delay Fan (II)
236	Sound Wave Magic	270	Motor-Activated Burglar Alarm	304	Watch Light
237	Space War Amplifier	271	Light-Activated Burglar Alarm	305	Delayed Bedside Fan

-Table 6.2.2.3: Project ideas list 3-

Project #	Description	Project #	Description	Project #	Description
408	Oscillator Sound (V)	443	Flashing "A & J"	478	Variable Oscillator (II)
409	Transistor Tester	444	Alarm Timer	479	Variable Oscillator (III)
410	Adjustable Voltage Divider	445	Alarm Timer (II)	480	Variable Oscillator (IV)
411	Automatic Display Capital Letter "C"	446	Alarm Timer (III)	481	Photo Variable Resistor
412	Automatic Display Capital Letter "E"	447	Bird Sounds	482	Variable Whistle Chip Oscillator
413	Automatic Display Capital Letter "F"	448	Bird Sounds (II)	483	Slow Adjusting Tone
414	Automatic Display Capital Letter "H"	449	Bird Sounds (III)	484	Slow Adjusting Tone (II)
415	Automatic Display Capital Letter "P"	450	Bird Sounds (IV)	485	Fixed-Current Path
416	Automatic Display Capital Letter "S"	451	Bird Sounds (V)	486	Simple Illumination Meter
417	Automatic Display Capital Letter "U"	452	Touch-Control Bird Sound	487	LED Voltage Drop
418	Automatic Display Capital Letter "L"	453	Motor Sound Recording	488	Open/Closed Door Indicator
419	Whistle Chip Sounds	454	Motor Sound Indicator	489	Hand-Control Meter
420	Whistle Chip Sounds (II)	455	Relay & Buzzer	490	Light-Control Meter
421	Whistle Chip Sounds (III)	456	Relay & Speaker	491	Electric-Control Meter
422	Whistle Chip Sounds (IV)	457	Electronic Playground	492	Sound-Control Meter
423	Whistle Chip Sounds (V)	458	Electronic Cat	493	Fixed-Voltage Divider
424	Whistle Chip Sounds (VI)	459	Electronic Cat (II)	494	Resistor Measurement
425	LED Music	460	Electronic Cat (III)	495	Automatic Display Letter "b"
426	Light-Controlled LED Time Delay	461	Electronic Cat (IV)	496	Automatic Display Letter "c"
427	Touch-Controlled LED Time Delay	462	Buzzer Cat	497	Automatic Display Letter "d"
428	Alarm Recorder	463	Buzzer Cat (II)	498	Automatic Display Letter "e"
429	Alarm Recorder (II)	464	Buzzer Cat (III)	499	Automatic Display Letter "h"
430	Machine Gun Recorder	465	Lazy Cat	500	Automatic Display Letter "o"
431	Time Delay 1-7 Seconds	466	Meter Deflection (II)	501	Hand-Control Display 1 & 4
432	Time Delay	467	Automatic Display #1	502	Hand-Control Display 1 & 0
433	Manual 7 Second Timer (II)	468	Automatic Display #2	503	Hand-Control Display 1 & 7
434	15 Second Alarm	469	Automatic Display #3	504	Hand-Control Display 1 & 8
435	Flashing "1 & 2"	470	Automatic Display #4	505	Hand-Control Display 1 & 9
436	Flashing "3 & 4"	471	Automatic Display #5	506	Monitor Capacitor Charging & Discharging
437	Flashing "5 & 6"	472	Automatic Display #6	507	Hand-Control Space Meter
438	Flashing "7 & 8"	473	Automatic Display #7	508	Rhythm Swinging Meter
439	Flashing "9 & 0"	474	Automatic Display #8	509	Police Car Sound with Whistle Chip
440	Flashing "b & c"	475	Automatic Display #9	510	Fire Engine Sound with Whistle Chip
441	Flashing "d & e"	476	Automatic Display #0	511	Ambulance Sound with Whistle Chip
442	Flashing "h & o"	477	Variable Oscillator		

-Table 6.2.2.4 Project ideas list 4-

Project #	Description	Project #	Description	Project #	Description
408	Oscillator Sound (V)	443	Flashing "A & J"	478	Variable Oscillator (II)
409	Transistor Tester	444	Alarm Timer	479	Variable Oscillator (III)
410	Adjustable Voltage Divider	445	Alarm Timer (II)	480	Variable Oscillator (IV)
411	Automatic Display Capital Letter "C"	446	Alarm Timer (III)	481	Photo Variable Resistor
412	Automatic Display Capital Letter "E"	447	Bird Sounds	482	Variable Whistle Chip Oscillator
413	Automatic Display Capital Letter "F"	448	Bird Sounds (II)	483	Slow Adjusting Tone
414	Automatic Display Capital Letter "H"	449	Bird Sounds (III)	484	Slow Adjusting Tone (II)
415	Automatic Display Capital Letter "P"	450	Bird Sounds (IV)	485	Fixed-Current Path
416	Automatic Display Capital Letter "S"	451	Bird Sounds (V)	486	Simple Illumination Meter
417	Automatic Display Capital Letter "U"	452	Touch-Control Bird Sound	487	LED Voltage Drop
418	Automatic Display Capital Letter "L"	453	Motor Sound Recording	488	Open/Closed Door Indicator
419	Whistle Chip Sounds	454	Motor Sound Indicator	489	Hand-Control Meter
420	Whistle Chip Sounds (II)	455	Relay & Buzzer	490	Light-Control Meter
421	Whistle Chip Sounds (III)	456	Relay & Speaker	491	Electric-Control Meter
422	Whistle Chip Sounds (IV)	457	Electronic Playground	492	Sound-Control Meter
423	Whistle Chip Sounds (V)	458	Electronic Cat	493	Fixed-Voltage Divider
424	Whistle Chip Sounds (VI)	459	Electronic Cat (II)	494	Resistor Measurement
425	LED Music	460	Electronic Cat (III)	495	Automatic Display Letter "b"
426	Light-Controlled LED Time Delay	461	Electronic Cat (IV)	496	Automatic Display Letter "c"
427	Touch-Controlled LED Time Delay	462	Buzzer Cat	497	Automatic Display Letter "d"
428	Alarm Recorder	463	Buzzer Cat (II)	498	Automatic Display Letter "e"
429	Alarm Recorder (II)	464	Buzzer Cat (III)	499	Automatic Display Letter "h"
430	Machine Gun Recorder	465	Lazy Cat	500	Automatic Display Letter "o"
431	Time Delay 1-7 Seconds	466	Meter Deflection (II)	501	Hand-Control Display 1 & 4
432	Time Delay	467	Automatic Display #1	502	Hand-Control Display 1 & 0
433	Manual 7 Second Timer (II)	468	Automatic Display #2	503	Hand-Control Display 1 & 7
434	15 Second Alarm	469	Automatic Display #3	504	Hand-Control Display 1 & 8
435	Flashing "1 & 2"	470	Automatic Display #4	505	Hand-Control Display 1 & 9
436	Flashing "3 & 4"	471	Automatic Display #5	506	Monitor Capacitor Charging & Discharging
437	Flashing "5 & 6"	472	Automatic Display #6	507	Hand-Control Space Meter
438	Flashing "7 & 8"	473	Automatic Display #7	508	Rhythm Swinging Meter
439	Flashing "9 & 0"	474	Automatic Display #8	509	Police Car Sound with Whistle Chip
440	Flashing "b & c"	475	Automatic Display #9	510	Fire Engine Sound with Whistle Chip
441	Flashing "d & e"	476	Automatic Display #0	511	Ambulance Sound with Whistle Chip
442	Flashing "h & o"	477	Variable Oscillator		

-Table 6.2.2.5: Project Ideas list 5-

Project #	Description	Project #	Description	Project #	Description
512	Siren	546	6V Lamp Current	580	U2 with Transistor Amplifier (II)
513	Electronic Rain	547	Combined Lamp Circuits	581	U1 with Transistor Amplifier
514	Leaky Faucet	548	Rechargeable Battery	582	Loud Sounds
515	Lamp & Fan Independent	549	Solar Batteries	583	Swinging Meter with Sound
516	Drawing Resistors	550	Solar Control	584	Motor Sound Using Transformer
517	Electronic Kazoo	551	Solar Resistance Meter	585	Motor Sound with LED
518	Electronic Kazoo (II)	552	Solar Diode Tester	586	Motor Sound with LED (II)
519	Water Resistor	553	Solar NPN Transistor Tester	587	AC & DC Current
520	Two-Transistor Oscillator	554	Solar PNP Transistor Tester	588	Noisemaker
521	Diode	555	Solar Cell vs. Battery	589	AC Voltage
522	Rectifier	556	Solar Cell vs. Battery (II)	590	AC Voltage (II)
523	Motor Rectifier	557	Solar Music	591	AC Voltage (III)
524	SCR Shutdown	558	Solar Sounds Combo	592	Noisemaker (II)
525	SCR Motor Control	559	Solar Alarm	593	Noisemaker (III)
526	Output Forms	560	Better Solar Alarm	594	Pulsing Motor
527	Transistor AM Radio	561	Photo Solar Alarm	595	Noisemaker (IV)
528	Adjustable Solar Power Meter	562	Solar Space War	596	Noisemaker (V)
529	Fan Blade Storing Energy	563	Solar Music Alarm Combo	597	Noisemaker (VI)
530	Antenna Storing Energy	564	Solar Music Space War Combo	598	Noisemaker (VII)
531	Electromagnet Storing Energy	565	Solar Music Space War Combo (II)	599	Noisemaker (VIII)
532	Transformer Storing Energy	566	Solar Periodic Lights	600	Noisemaker (IX)
533	Relay Storing Energy	567	Solar Periodic Lights (II)	601	Alarm Power
534	Transformer Lights	568	Solar AM Radio Transmitter	602	Alarm Power (II)
535	Machine Siren	569	Low Light Noisemaker	603	Night Sounds
536	Hear the Motor	570	Low Light Noisemaker (II)	604	Mega Pulsar and Flasher
537	Back EMF	571	Low Light Noisemaker (III)	605	"E" & "S" Blinker
538	Back EMF (II)	572	Solar Oscillator	606	"2" & "3" Blinker
539	Electronic Sound	573	Solar Oscillator (II)	607	"9" & "0" Blinker
540	Electronic Sound (II)	574	Daylight SCR Lamp	608	"3" & "6" Blinker
541	Lighthouse	575	Solar Bird Sounds	609	"c" & "C" Blinker
542	Diode Wonderland	576	Solar Bird Sounds (II)	610	"O" & "o" Blinker
543	Meter Ranges	577	SCR Solar Bomb Sounds	611	"b" & "d" Blinker
544	Motor Current	578	Flashing Laser LED's with Sound	612	"H" & "L" Blinker
545	2.5V Lamp Current	579	U2 with Transistor Amplifier	613	"A" & "o" Blinker

-Table 6.2.2.6: Project ideas list 6-

Project #	Description	Project #	Description	Project #	Description
614	Open & Closed Indicator	648	Low Pitch Oscillator (II)	679	Machine Gun Paperclip Vibrator
615	Open & Closed Indicator (II)	649	Low Pitch Oscillator (III)	680	Alarm Vibrator w/ LED
616	Vibration Indicator	650	Segment Jumper	681	Alarm Vibrator w/ LED (II)
617	Vibration Sounder	651	DP & Zero Flasher	682	Relay-Whistle Vibrator
618	SCR Noise Circuit	652	Stepper Motor with Lamp & LED's	683	Relay-Whistle Photo Vibrator
619	SCR & Transistor Switch	653	IC Start & Stop	684	Vibration LED
620	Two-speed Motor	654	IC Motor Speed	685	Vibration Speaker
621	Two-speed Motor (II)	655	Sound & Light Flasher	686	Measure the Vibration as You Tap the Switch
622	Current Flow	656	Electromagnet Delayer	687	Shaky Birthday Song
623	AM Radio with Power LED's	657	Electromagnet Delayer (II)	688	Vibration Detector
624	Space War IC Recording	658	Two-Lamp Electromagnet Delayer	689	Out of Balance
625	LED Flasher	659	Electromagnet Current	690	Vibration Alarm
626	LED Flasher with Sound	660	Electromagnetism	691	Vibration Space War
627	LED Flasher with Sound (II)	661	Electromagnetism & Compass	692	Vibration Light
628	Stepper Motor	662	Electromagnetism & Paperclips		
629	Crazy Music IC	663	Electromagnet Suction		
630	Stepper Motor w/ Sound	664	Electromagnet Tower		
631	Stepper Motor w/ Light	665	Paperclip Compass		
632	Police Siren with Display	666	Adjustable Paperclip Suspension		
633	Oscillator Alarm	667	Adjustable Paperclip w/ Delay		
634	Oscillator Alarm (II)	668	Photoresistor Paperclip Suspension		
635	Tapping U3	669	Paperclip Oscillator		
636	Tapping U3 (II)	670	Paperclip Oscillator (II)		
637	Adjustable Beeper	671	Paperclip Oscillator (III)		
638	Electronic Meow	672	Paperclip Oscillator (IV)		
639	Electronic Meow (II)	673	Paperclip Oscillator (V)		
640	Strobe Light	674	Oscillating Compass		
641	AND Gate	675	High Frequency Vibrator		
642	NAND Gate	676	High Frequency Vibrator (II)		
643	OR Gate	677	Siren Paperclip Vibrator		
644	NOR Gate	678	Alarm Paperclip Vibrator		
645	XOR Gate				
646	High Pitch Oscillator				
647	Low Pitch Oscillator				

-Table 6.2.2.7: Project ideas list 7-

Project #	Description	Project #	Description	Project #	Description
Welcome to Electronics		27	Triple Switching Voltmeter (Voltages in a series circuit)	Motor Circuits	
1	Electronic Playground	28	Triple Switching Ammeter (Currents in a series circuit)	53	Motor
2	Parallel Play	29	Current Divider (Currents in parallel circuits)	54	Propeller and Fan
3	Wicked Switches	30	Ohm's Law (Measuring resistance of parts)	55	Back EMF (Motor characteristics)
4	Spinning Cylinder Suspender	31	Ohm's Law - Cold Lamp	56	Generator (Make a current with the motor)
Static Electricity		Putting Electricity to Use		57	Make Your Own Generator (Make current with the motor)
5	Electricity You Can Wear	32	2-Way Switch (Switching for lights in home)	58	String Generator (Use string to spin the motor faster)
6	Electricity In Your Hair	33	Another 2-Way Switch	59	Motion Enhancer
7	Bending Water	34	3-Speed Motor (Regulating motor speed with lamps)	60	Holding Down (Overloading batteries)
8	More Static Tricks	35	3-Speed Motor (II)	Advanced Magnetic Circuits	
Electrical Materials		36	3-Speed Motor (III)	61	Make Your Own Electromagnet
9	Light the Way (Lamp circuit)	37	3-Position Switch (Simulate more complex switch)	62	Relay (Build a relay)
10	Flip It (2-position switch)	38	3-Position Switch (II)	63	Relay (II)
11	Pushing Electricity (Voltage across lamp)	39	4-Position Switch	64	Relay (III)
12	Pushing a Lot of Electricity (Voltage across motor)	40	AND (Simulate an AND gate with switches)	65	Buzzer (Build a buzzer with the electromagnet)
13	What's An Ohm? (Find lamp resistance)	41	AND NOT (Simulate a NAND gate with switches)	66	Buzzer (II)
14	Be a Scientist (Conductors and insulators)	42	OR (Simulate an OR gate with switches)	67	Reed Switch (Magnetically controlled switch)
15	Make Your Own Parts (Resistance of graphite in pencils)	Magnetism		68	Reed Switch (II)
16	Hydro-Resistors (Resistance of water)	43	Compass	Electrochemistry	
Basic Electrical Circuits		44	Magnetic Fields	69	Cola Power (Use soda as a battery)
17	One Way Around (Lamps in series)	45	Iron Extension (Extending a magnet with an iron bar)	70	Fruit Power (Use fruit as a battery)
18	Many Paths (Lamps in parallel)	46	Electronic Magnet	71	Water Impurity Detector (Current from water)
19	Parallel Swapping	47	Electromagnet Magnetic Field	Fun with Electricity and Magnetism	
20	Series Swapping	48	Electromagnet Tower (Suspending iron rod in air)	72	Indian Rope Trick (Suspend objects in air)
21	Light Bulb (Incandescent light bulbs)	49	Electromagnetic Suspender	73	Hypnotic Discs (Spinning patterns)
22	Batteries in Series	50	Electromagnet Direction (Reversing current)	74	Spin Draw
23	Batteries in Parallel	51	Wire Magnet (Magnetic field from wire)	75	Morse Code
24	Voltage Divider (Voltages in a series circuit)	52	Magnetic Induction (Induce a current in a coil)	76	Flying Saucer (Launch the fan)
25	Voltage Shifter (Currents in a series circuit)			77	Power Light Regulator (Regulate lamp brightness)
26	Triple Voltage Divider (Voltages in a series circuit)			78	Raising the Bar
				79	Electromagnetic Playground

-Table 6.2.2.8: Project ideas list 8-

Project #	Title	Project #	Title
A1	Electric Light	A30	One Shot
A2	Controlling Electricity	B1	Blinker (Programming the Microcontroller)
A3	Dancing Motor	B2	Blinkers
A4	Electronic Counter	B3	Four Outputs
A5	Adding Sound to the Counter	B4	Play a Tune
A6	Daylight Alarm Clock	B5	Computer Music Box
A7	Intruder Alarm	B6	Random Sounds
A8	Jukebox	B7	Sloppy Switches
A9	Counting to the Stars	B8	Bounceless Switches
A10	Angles and Distance	B9	Jukebox with Terminal
A11	Flip-Flop	B10	Launch Pad
A12	Adjustable Light Timer	B11	Adjustable Blinker
A13	Light Sensitive Timer	B12	Basic Light Meter
A14	Shot in the Dark	B13	Capacitor Discharge
A15	Microphone Control	B14	Sunrise Alarm
A16	Adjustable Brightness	B15	Photon Counter
A17	Conduction Detector	B16	Photon Kazoo
A18	Slider	B17	Click Counter
A19	Parallel Resistors	B18	Super Click Counter
A20	Series Resistors	B19	Data Logger
A21	Flying Saucer	B20	Data Logger with Cost
A22	Transistor	B21	24 Hour Data Logger
A23	Capacitor Battery	B22	Digital Voltmeter
A24	Blow Off Sound	B23	Battery Tester (4V or less)
A25	Capacitor Photo Control	B24	Battery Tester (20V or less)
A26	Capacitor Photo Control with Slow Shut-off	B25	Clap Light
A27	Photo Switcher	B26	Clap Music
A28	Blow On Sound	B27	Test the Microcontroller
A29	Scratchy Amplifier		

-Table 6.2.2.9: Projects ideas list 9-

6.2.3-Using Augmented Reality technology in the mobile application:

This will make the implementation guidance much easier for the user, as it will provide a 3D display of the project while being implemented.

6.2.3.1-What's Augmented Reality Technology?

¹⁷**Augmented reality (AR)** is a live direct or indirect view of a physical, real-world environment whose elements are *augmented* (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented) by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one. Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable. Artificial information about the environment and its objects can be overlaid on the real world.



-Figure 6.2.3.1.1: Augmented Reality technology example-

To use augmented reality technology, our own 3D shapes should be designed using Unity; Unity is a powerful engine with a variety of tools that can be utilized to meet your specific needs. The editor is intuitive and customizable allowing you a greater freedom in your workflow.

¹⁷ Wikipedia

6.2.3.2-Role of Augmented Reality in education:

¹⁸Johnson, et al. (2010) stated, “AR has strong potential to provide both powerful contextual, on-site learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world.”

AR has been experimentally applied to both school and business environments, although not as much as classic methods of education and training during the last two decades. In addition to that, now that the technologies that make AR possible are much more powerful than ever before and compact enough to deliver AR experiences to not only corporate settings but also academic venues through personal computers and mobile devices, several educational approaches with AR technology are more feasible. Also, wireless mobile devices, such as smart phones, tablet PCs, and other electronic innovations, are increasingly ushering AR into the mobile space where applications offer a great deal of promise, especially in education and training.

6.2.3.3-Augmented Reality applications:

¹⁹The most common use of AR can be seen through mobile apps. And there is a growing batch of these available from your Mobile App Store. Popular Apps such as Aurasma, Fetch and Layar are now being implemented in educational and commercial settings.

Basically you point your device’s camera at something that the app recognizes, and it will generate a 3D animation or video superimposed over whatever is on your camera’s screen. The effect makes the computer-generated item appear like it’s really there.

Perhaps you’ve already seen this television advertisement for IKEA that enables you to Place IKEA furniture in your home with augmented reality.

Currently the use of augmented reality in an enterprise context across government and non-government includes strategic defense, business process and logistics control.

AR can be integrated across a wide variety of employee roles particularly useful where simulation, training and skills development are required. Of particular interest is rapid take-up of mobile wearable technologies that complement or build upon information systems supporting augmented reality such as Google Glass.

Take a look at this short YouTube video which focusses on Google Glass and Augmented Reality’s Future.

AR is of interest in an enterprise and industrial context given the ability to connect a user or wearer with information to enhance:

¹⁸ Augmented Reality in Education and Training By Kangdon Lee University of Northern Colorado

¹⁹ Augmented Reality in Education and Training By Catriona Ward

Instruction – character (OCR), image, object or location recognition combined with other triggers such as RFID or Beacon that prompt the system to provide the user with instructions to undertake tasks or provide alerts to the user about that object or location

Operations – hands-free information transmission while an operator is otherwise occupied undertaking tasks requiring hands on operations

Engagement – provision of a range of feedback to the AR user enhancing that person’s engagement with a task such as a reward, result or other feedback

Enjoyment – an AR user will often report that they are better engaged with a process if information that is specific and useful is presented to them for consideration.

6.2.4-Develop the mobile applications on other platforms:

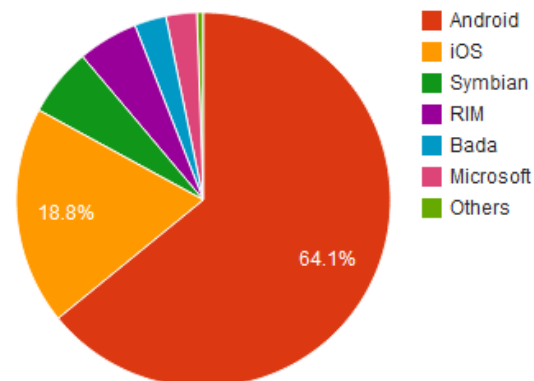
This will be very useful to us as we’ll tremendously increase the number of users who’ll be able to use our products, as we’ll develop the application to work with other OS such as:

- IOS
- Unix/Mac OS
- Windows
- Windows phone

Our priorities will be set according to the following chart:

20

Worldwide Mobile Device Sales to End Users by Operating System in 2Q12 (Source: Gartner)



-Figure 6.2.4.1: Mobile device sales 2Q12-

²⁰ Gartner report “Market Share: Mobile Devices, Worldwide, 2Q12”

Bibliography:

1. The Global Competitiveness Report 2013 - 2014
2. Wikipedia
3. The Global Competitiveness Report 2013 - 2014
4. Presentation about problems of education by Nile University 2013
5. learning-styles-online.com
6. Phschool.com
7. SparkFun electronics
8. arduino.cc
9. ITead Studio
10. phonearena.com
11. Irevolution.net
12. Wikipedia
13. appinventor.mit.edu
14. arduino.cc
15. Wikipedia
16. Elenco® Electronics
17. Wikipedia
18. Augmented Reality in Education and Training By Kangdon Lee University of Northern Colorado
19. Augmented Reality in Education and Training By Catriona Ward
20. Gartner report "Market Share: Mobile Devices, Worldwide, 2Q12"