Menofia STEM School

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20218

Grade 11 Sem.2

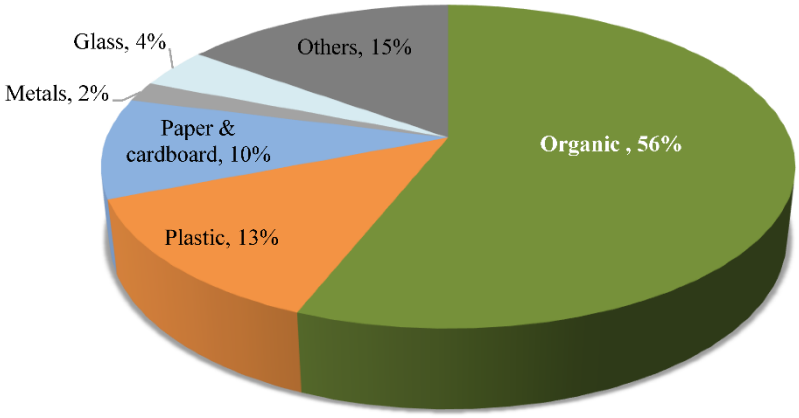
Abstract:

Egypt is dealing with several issues that are lowering its international standing and affecting future generations. The country's economy suffered as a result of the industrial base deterioration. One of the consequences of the situation is a drop in the value of the Egyptian pound on the international market. The demand for new industries and strict regulations to maintain the quality of manufactured goods had grown, as it is one of the forms of industrial and commercial corruption. The feedback system should be used to measure quality needs to raise the industry's profile. The feedback control system is used in many factories in many countries, and by implementing it in Egypt, it will be possible to cease the production of low-quality goods and raise the products' international worth. Because of its expanding use, the production of copper sheets has increased. Wasted materials are used to minimize pollution and manufacturing costs. Waste copper from cables was repurposed to create a high-efficiency copper sheet. After passing between two rolling axes, the copper sheet is manually placed on a template with specific dimensions. The copper sheet is then forwarded to the feedback system to see whether there are any issues with the product. the prototype had done by holding the two-axis with gears and connecting it to a motor then connecting the feedback system sensors to the Arduino nano to detect the error. The copper sheet reached the desired efficiency, heat proofing, and dimensions after going through the manufacturing process.

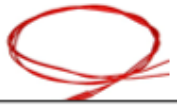
Introduction:

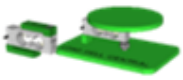
Egypt has been focused on industrial specialization for the past seven years, with the sectors involved including textiles, pharmaceuticals, and furniture. Specialized units and industrial zones targeting the development of small and medium-sized enterprises (SMEs) have been established in many governorates, with each finding the best industrial match for its resources. There are now 17 industrial complexes across 15 governorates, with these generating 84,000 direct job opportunities at a total cost of LE10 million. the manufacturing sector share has remained relatively low, not exceeding 30%. Indeed, this sector has faced several problems that affected its competitiveness. Indeed, Egypt (compared to other comparable economies is suffering from a lack of rule of law, low protection of property rights, a lack of market competition, and the relative absence of anti-

monopoly practices and laws. Moreover, the innovative capacity in Egypt is relatively low, which in turn affects its competitiveness and increases its specialization in traditional exports. Indeed, shows that Egypt has a low share of medium- and high-tech activities in its industrial sector. The currency crisis delayed important letters of credit for the imports of raw materials required for the industry. This led to a shortage of raw materials and an increase in prices. As we searched for prior solutions that wanted to find other ways to improve the industrial sectors by using green energy or wasted materials as an input for the industry. we found solutions like Recycled paper processing mills using paper as their feedstock. The recovered paper is combined with water in a large vessel called a pulper that acts like a blender to separate fibers in the paper sheets from each other. The resultant slurry then passes through screens and other separation processes to remove contaminants. Mechanical separation equipment includes coarse and fine screens, centrifugal cleaners, and dispersion or kneading units that break apart ink particles. Deinking processes use special systems aided by soaps or surfactants to wash or float ink and other particles away from the fiber, but it requires a lot of manpower which means that will spend more salaries. We tried to think out of the box to see what people need and can't dispatch, we found that the electronics industries will be satisfied for us. we decided to convert the expensive and traditional way of manufacturing copper sheets which is the base for any electronic board, smart screens, smart hand-band, etc. we will use the wasted copper from the wires industry and enter it into the rolling machine with some factors which will effect on it to meet our design requirement. then, it will be transferred to the feedback system to check the success of the product and detect its mistakes if found.



Materials:

Name	Price	Photo
Axis	20 L·E	
Heater	36 L·E	
Metal gears	10 L·E	
Wood	10 L·E	
Wood fibre	50 L·E	
DC Motor	300 L·E	
TMP Sensor	10 L·E	
Relay Module	16 L·E	

Name	Price	Photo
Arduino Nano	95 L·E	
Battery 3·7 V	75 L·E	
Battery holder	6 L·E	
Battery 9 v	15 L·E	
Motor	40 L·E	
Ultrasonic Sensor	90 L·E	
Load Cell	86 L·E	
3D printed shape	0 L·E	
Total	869 L·E	

Methods:

In our capstone project, we seek to solve the problem of manufacturing in Egypt. we should solve the problem by using green energy or wasted materials to solve the problem. we identified the problem which was the improvement of manufacturing copper sheets. We use the copper sheet in our daily life in smartphones and electronic materials. To achieve our design requirements, we set our prototype design and then followed some specific steps to build it which are:

Manufacturing process:

- We get the two-axis and sand the two sides of each one to make them have a smaller radius. Decreasing the radius makes the two-axis able to be closer to each other as the copper sheet will pass from it.
- We get the two-metal gears and put them on each side of one of the two axes.
- The other axis was pierced from the middle on one side to put the motor which is held by a nail. By connecting the electricity, the motor will power the two-axis to roll in reverse.
- We put the heater on an aluminum plate and connect it to a relay module to control the heat degree.
- The heater is connected to a battery.
- A heat sensor was put on the axis keeping a small space between them to capable the two-axis moving.
- A template was designed with specific dimensions and printed using a 3D printer to put the copper sheet into it manually to make it shape with the required dimensions.
- A mold was designed on the computer to put the two-axis and the whole manufacturing process on it to organize it.
- the fiber wood (heat proofing) had cut by laser cutter depending on the designed mold and the axis is installed on it.

Feedback system:

- A conveyer belt was built by using wood fixed on two rolls to transfer the product from the manufacturing process to the feedback system.
- The ultrasonic sensor was connected to the breadboard to detect the dimensions of the copper sheet.
- The load cell (weight sensor) was connected to the breadboard to measure the weight of the sheet copper.
- The Arduino Nano was connected to the breadboard. The ultrasonic sensor, the relay module, and the load cell were connected to the Arduino Nano using jumpers.
- The code of the Arduino was written to give orders to the sensors and the heater with specific values.

Safety

- Using the fab lab sharp equipment under the teacher's supervision.
- Wearing safety goggles and masks while cutting the wood to avoid the wood fragments.
- Connect any electricity source to the prototype under the teacher's supervision.

Test Plan

After we finish our project, we want to detect that it meets the design requirements. So, we will do some tests on our prototype that would detect that.

Efficiency test:

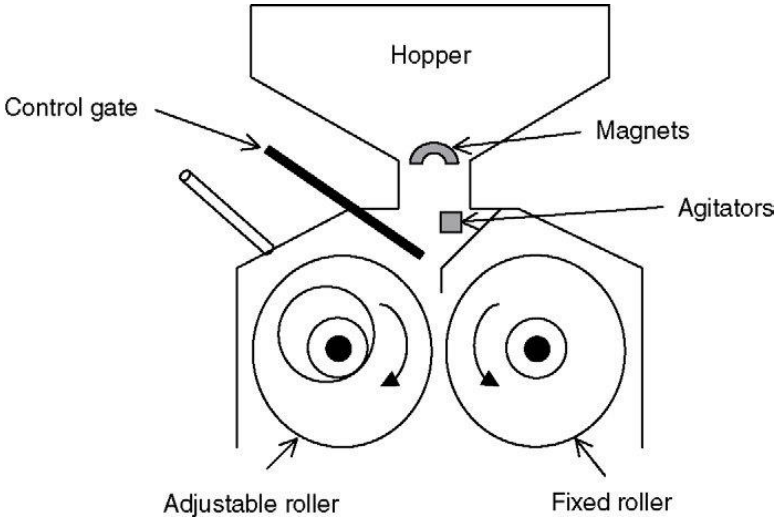
The stripboard sometimes has high-handling components connected to it. These components need special characteristics of its stripboard to be able to handle the high pressure on it. the normal thickness of the breadboard is approximately 1.2 cm, this value should be raised to 1.6 to be used in the high handling. 2 Ultrasonic sensors were put to measure the thickness from two sides.

Heat Proof Test:

The stripboard can be developed to be qualified to use in these machines. We can test the ability of this stripboard to withstand the heat using the TMP sensor which will be connected to the Arduino in the feedback system.

Dimensions test:

Hence, in our feedback system we put ultrasonic sensor which ordered with specific dimensions; it can be changed according to required product to check its availability. In our test plan, we selected specific template to reshape the copper sheet with length= 5 cm and width= 2 cm. 2 Ultrasonic Sensors were put in each side of copper sheet to measure the width and length. Each one will measure the dimensions.



Weight test:

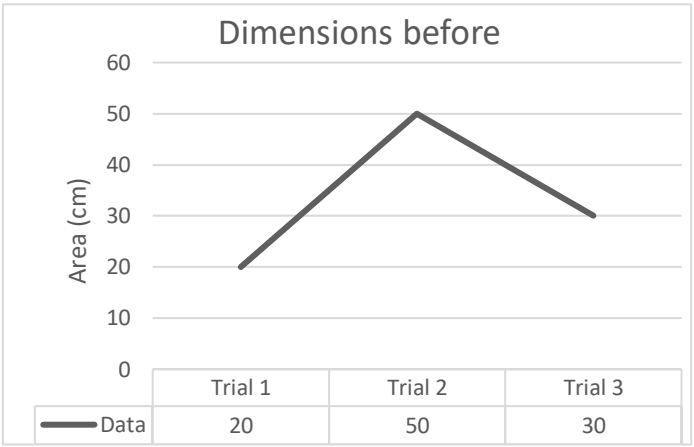
Copper sheets may use in large touch screens ad same as smart hand-band. For that, it is not the same weight in all products but whatever this product is, it mustn't reach more than 25-gram. Load cell was put in the end of the feedback system to measure the wight and 3D shape was printed to help the load cell to endure the wight and measure it.

Results:

When we started to test our prototype according to the plan that we set. Also, calculate the results and measures that are required to prove to design requirements to measure the success of the prototype in three different trials to check the precision and accuracy.

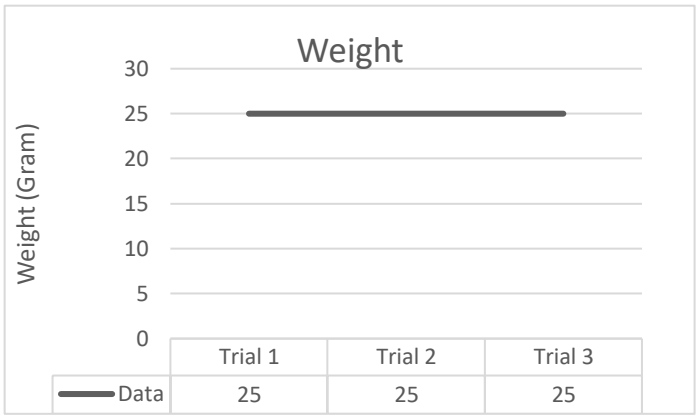
Dimensions:

According to the importance of the dimensions of the copper sheet, we tested its dimensions in three trials by repeating the process three times. We observed the diversity of the copper sheet's dimensions in every trial in addition to the ultrasonic sensors that detect the measures of copper sheets in every trial with a big difference. Subsequently, we add a manual step which is making templates with the required dimensions to press it on the copper sheet before reaching the feedback system then, we compared the three trials before adding the dimensions template and after; the two following graphs are illustrating this.



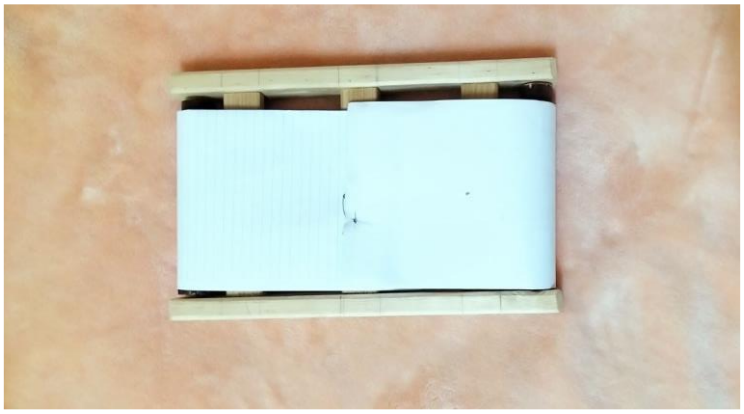
Weight:

After modifying the manufacturing process with the metal template, we got the stability and balancing results in our measurements that have been observed and detected by the feedback system. We got precise results with the required weight with accuracy ± 0.02 gram.



High handling:

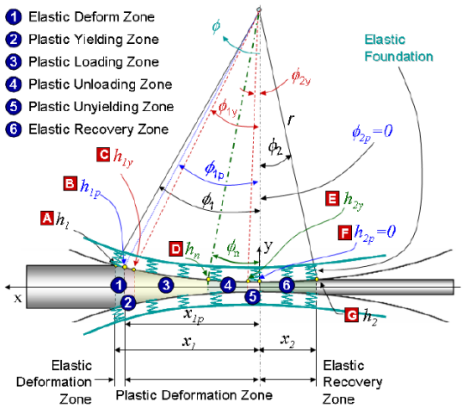
According to depending material of the copper sheet. We tested high handling by checking the nature of inserted wasted material. We checked the conductivity of wasted material by measuring resistivity and we found it = 1.7 x 10^-8 ohm.



Heatproof:

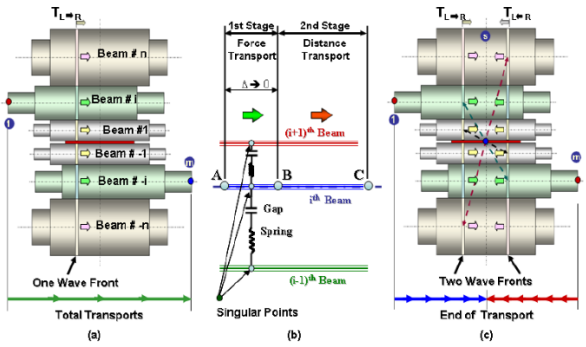
we confirmed the heat proofing from previous checking the nature of copper and its conductivity. Also, when it passed through a heater of 350 Celsius.

Analysis:



Recycling achieves the objective of keeping materials out of the landfill by turning them back into raw materials that will be used again to manufacture new products or items. In Egypt solid waste currently disposed of in dumpsites has an indispensable potential for recycling, processing, or reuse. We have been asked to solve the challenge of recycling and sectors of agriculture and industry for the sake of raising the income of our country and making a peak in the Egyptian economy. We search for the most usable products for the new generations as same as the old ones. After that, we must contrast a feedback system which is responsible for checking the quality of the final product that had been given orders. We found many examples like recycling the wastes of PCBs for the sake of manufacturing

concrete; any change in this industry is a major risk for the product's quality. Also, there is the industry that revolves around the production of glass transition to renewable fuels, moreover, of being sophisticated to implement as a prototype, the hydrogen gas nowadays is so expensive to use, thus there will not be a balance between the total cost and the efficiency.



The rolling force model is the foundation of other rolling models. The related parameters include the work roll diameter, the friction coefficient, the entry/exit gages, the entry/exit tensile stresses, the material work hardening stress curve, and the mechanical and thermal properties of the roll and the strip. The force model can predict the feasibility of rolling, the rolling force, the rolling torque, the rolling energy, the normal, shear, and compressive stress distribution curves in the roll bite, the neutral point, and many other rolling parameters. As shown in Figure the roll bite is divided into the entry elastic deformation zone, the core plastic zone, and the exit elastic recovery zone. The rolling equation was proposed by von Karman in 1925 considering the force equilibrium condition of an infinitesimal element in the roll bite. The first one is the relationship between the shear stress and the normal stress, which was formulated by Coulomb's law of friction for the slip friction zone and assumed to be the constant shear yield stress for the stick friction zone. The roll gap thickness is the second equation using a partial circular arc of an equivalent roll diameter calculated by Hitchcock ™ or Hertzian equation *¥. The material deformation criteria elastically and/or plastically came to the third equation. The elastic zones obeyed Hooke’s law while the plastic zones were dominated by the von Mises yield criterion.

This matrix is derived based on the equilibrium condition of the parameters. The 2* stage transport matrix derived from the beam deflection theory “*is a distance transport matrix from node B to node C. This matrix is used to consider the beam deflection between nodes B and C without any singular points (nodes with the spring and gap elements). The transport process starts from the left corner of the model (point 1) and stops at point m. The global transport matrix is then formed to correlate the parameter vectors of nodes 1 and m on only the rollability (achievable gage), but also the productivity and the marketability

(achievable crown and shape). The determination of the roll size must consider not only the rollability (achievable gage) but also the productivity and the marketability (achievable crown and shape). The strip crown is calculated by the roll stack deflection model. There are many factors influencing the exit strip crown including the natural crown, the crown effects due to roll benders, the crown effects due to roll crowns, and the crown effect due to the entry crown. The basic crown/shape control concept is that the strip shape will not change if the crown ratio difference is within the shape dead-band ds. Hence, the target exit crown should be controlled within the following range: The work roll diameter determines the rolling feasibility. The achievable minimum gage has a very strong relationship with the work roll diameter. The small work roll diameter can roll down to the thin gage. The general rule used in the industry for the minimum gage and the maximum pass reduction is also based on the work roll diameter. Besides the work roll diameter, other factors, such as the entry/exit tension, the friction coefficient, and the material property, have their contribution as well.

Learning outcomes:

SUBJECT	CONNECTION
PHYSICS	In (PH.2.10): The DC motor and how it works help in understanding the motor mechanism of the manufacturing process. In (PH.2.09): RL, RC, and RLC circuits to understand the components and how the circuits in the electronic materials are connected, to calculate its current and voltage, and to be able to connect the circuits of the feedback system correctly.
MATH	In (MA.2.08): The DC motor and how it works help in understanding the motor mechanism of the manufacturing process.
MECHANICS	In (ME.2.06): Power and its law which is w/t and how to calculate the power of the motor to know its efficiency.
BIOLOGY	In (BI.2.08): The positive and negative feedback systems of the reproductive hormones in the male and female which helped in the feedback mechanism.

Conclusion:

In the way of Solving the manufacturing problem which is one of Egypt's grand challenges, we get great results. We were required to solve the problem using green energy or wasted materials. The wasted materials were our choice. It was to use the wasted copper on the wire to make the copper sheet used in electronics. everything starts well and ends well. After searching and finding the solution. We followed specific methods to build the prototype. the test plan is done. we found that our prototype would help to solve the most important grand challenge. Our prototype was made from two parts which are the manufacturing process and the feedback system. The feedback system was the tool to measure our design requirements for the copper sheet which is our product resulting from the manufacturing process. It allows us to check the design requirements. Our prototype achieved the design requirements which we set to get the base we had required. This base is appropriate for most boards.

Recommendations:

After making our prototype we recommended points for the new researchers who would work on developing our project to put them into consideration:

- We recommend increasing the thickness or the diameter of the axes to make the sheet thinner.
- We recommend using a piston to make all the copper sheets with the same dimensions.
- On large scale: increase the power of the torque to endure 360 Newton of weight and increase the heat to liquidate copper more quickly.
- Applying electrolysis on the wasted copper from the wires to release any impurities as some wires are not one hundred percent pure copper. These wires can have high resistance but they can exist within the wasted wires. To avoid reducing the efficiency of the copper sheet the electrolysis could be applied.
- Using the two-granite axis. The granite is heavy and can withstand high temperatures. Using the granite would make the copper sheet thinner and lighter.

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