MECT411 Capstone Team Project

Eastern Mediterranean University

Faculty of Engineering

Department of Mechanical Engineering

Ethernet Automated Pill Dispenser

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ABSTRACT

The automatic pill dispenser is increasingly becoming common in homes today because of the way diseases multiply day by day. To avoid diseases, it is important to take medication on time with the right dosage. Ethernet Automatic Pill Dispenser (e-APD) is specifically for patients who take their pill (medicine) without get any help from caregiver or other. It prevents the user from making the mistake of taking the wrong medicines at wrong time.

The main components of this pill dispenser are based on Arduino board as a microcontroller with Ethernet shield interfaced with a computer using C# programming. Arduino is controlling a LED flash light, an alarm system, motor controllers, water valves and a multiple pill container (3 containers). Basically, in our project we will use a new system that provides communication between the pill dispenser machine from the patient homes and computers in the doctors' offices which will allows the correct dose to be available at the correct time with the help of real time clock module. We are mainly concerned with the inside of the machine as a cylindrical system which consists of 3 separate containers that contain different sizes and types of pills. There will be an arm placed in the centre of container system and it will be picking the pill from inside of container to outside by using air vacuum. Current sensor will be used to check if the arm took pill or not. Additionally, a glass of water is given with the pill. The aim of this project is to design a medication dispenser system which gives feedback such as how many pills left inside the machine, checks if the user takes the pill or not. First of all doctors will program the machine like setting the time and how many times the patient will the patients will take in a day or over specification period of time. After doctor confirms the program, s/he send it into machine, the machine starts to work. Doctor can connect to machine any time again by using security password. When the time is came for the patient to use the pill, the correct container moves under the arm with help of the rotation of the step motor. Then the arm moves into the container to pick a pill by air vacuum pump. After picking a pill, at the same time water will be given and led display with alarm system start to work. The user is required to press a button to reset the alarm. The major objective is to keep the device simple, cost efficient and useful. The software used is reliable and stable. Elderly population can benefit from this device as it is not expensive in-home medical care.

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CHAPTER 1
INTRODUCTION

1.1 What is the Pill Dispenser?

The pill dispensers in the other words electronic pill organisers are developed to alert people about their medication. It is an easy way to use tablet dispenser which can assist in the management of medication and allows the correct dose to be available at the correct time of day or night. Their purpose is to help people who may suffer from impaired ability to adhere to their prescribed medication regime.

They are commonly used in medicine and some people can use individually as well such as elderly, chronically ills. These devices are evolved to care public health, the cost of medicine industry and waste of drugs. The advanced models of these dispensers can be available in the medicinal industry.

Figure 1.1 Pill Dispenser [1]

1.2 Advantages of the Pill Dispenser

Pill dispenser provides lots of benefits for us. First of all, this project will be useful for people who forget to take their medicine on time. Secondly, people who have many medicines to take and confused about which medicine at which time. So this project will help people to prevent from taking wrong medicines at wrong times thus this will be beneficial for healing.

1.3 Disadvantages of the Market Pill Dispenser

In the market, there are a few kinds of pill dispensers (See Appendix D) which are quite useful. Although these pill dispensers are useful, they need to be developed because of some lack of properties such as,

- They cannot be controlled remotely by doctor or expert
- Pills must be filled by hand one by one inside the cup
- Capacity is limited such as weekly or monthly
- Different pills must be in the same cup during the period of taking pills
- They haven't water storage to swallow pill
- They used by patient or someone so that patient might take the wrong pill
- They are quite expensive
- They don't suit all patient such as illiterate, weak-sighted and not having a person or relative to help

In our project, we will try to resolve these problems and try to make it better.

1.4 Functionality

When the time comes to take medicine, the machine will releases pills into a small cup and it gives a sounding signal and flashing led which mean that it is time to take the medicines. If the user doesn't take the cup which contains drugs then the machine will inform the doctor after a pre-considered time.

1.5 Scope of the work

We will design and manufacturing such a machine which will be used by doctor to control the amount of taking pill for patient for instance uneducated, elderly, physically disabled, forgetful people etc. This machine will have 3 different and independent pill tubes from each other. Doctor who is giving the medicine will control and adjust the machine from the internet like how many times patients will get in a day and which one will take? There will be software to communicate with machine, useable interface, three step/servo motors inside the machine and mechanical connection parts. This machine will be based on Arduino. On the taking of pill time, the machine will warn patient as warning tone. There will be a counter for the count how many pill is taking by patient and how many is left inside the machine. For the security of using machine, doctor will have a password to enter the system otherwise, someone who is from outside won't enter the system. Also this machine gives the one glass of water with pill to shallow.

1.6 Objective of the Project

Nowadays, the drug consumption increased with the increase of health problems and also waste of medicines has an important role on public health. However, the waste of drugs has huge cost for the world. If we consider just UK, unused prescription medicines cost over £300 million every year [2]. That situation may have many reasons.

One of these reasons is, people don't use medicines carefully, on the time. Maybe they can forget to take them, or elder people may have so many types of medicines that they can get confused and don't remember to take them on time.

The aim of this project, help to people who are elderly and always forget to take their pills on the time. This project is going to help them and make their life easier.

On the other hand, the cost is inexpensive and to get this machine will be economically easy. Consequently, we wanted to create such as machine which will be in every elderly people's home.

1.7 Develop ability of pill dispenser

Pill dispensers are already used in these days. In this project we developed as much as possible using today's technology. But it doesn't mean that that it is the final version of pill dispensers. In the future it may have connection with human using smart clocks, can measure blood pressure, heart beat changes for these patients. And for these emergency situations it can inform the patient to take drug urgently and prepare the dosages or tablets. Injection forms of this dispenser also can be developed by scientists.

Consequently the pill dispensers can be developed by the time and new forms of dispensers seems possible with the technology.

1.8 Organization of the Report

In chapter 1, the introduction is written and the pill dispenser need is discussed with variety of the pill dispenser processes .In Chapter 2 literate review of the pill dispenser process is discussed with reviewing previous works on the pill dispenser process while in

Chapter 3 design and analysis is discussed where design of the automatic pill dispenser is provided and explaining of the components involved in the machine. In Chapter 4, manufacturing, assembly and testing processing are explained. The Chapter 5 has result and discussion and the last chapter which is six and has conclusion with software and future work. The report also includes the Appendices as, Appendix-A Log books, Appendix-B Gantt chart, Appendix-C Drawing, Appendix-D Engineering Standards and Appendix-E Poster website of project and CD.

CHAPTER 2
LITERATURE REVIEW

2.1 Historical Background of Pill Dispenser

In this chapter, it will summarize respectively development of pill, making pill machine, shape of pill and development of pill dispenser with their efficiency.

The invention of the pill date is back to roughly 1500 BC as a liquid from. This date refers ancient Egyptian times and according to researches many recipes are found from ancient Egyptian living areas. After that, development of pill continued in ancient Greece because Roman scholar Pliny has found katapotia (meaning "something to be swallowed") and he lived from 23-79 AD. Also Roman's pill-making equipment is being on display in the British Museum. In 17th century England and thereafter, pill manufactures were granted special patent rights from the king. Then the compressed tablet was invented in the 1800s by a Brit named William Brockedon. He put powder in a tube and compressed it with a mallet, and thus a whole new type of pill was created [3]. After these developments, patient people have begun to choose this kind of treatment because this method has some advantages such as calibration of dose easily and pill is suitable to treatment a wide variety of diseases so that manufacturing of pill industry have begun to grow rapidly. A well-known fact that all, industries need a machine or machines to produce their products. Because of this reason, pharmaceutical manufacturers developed some devices to produce their pill. In 1867's August H. Wiez developed the first patented pill making machine [4]. (Appendix D). Most important development of making pill machines was in between interwar 1918 to 1939 so that many factories has been establish around the world to produce many types of pills[5].

After these developments, taking of pill has spread around the world and pill industry has evolved accordingly. At the same time, some problems began to appear. First problem is swallowing of pill because difficulty swallowing tablets and capsules can be a problem for many individuals and can lead to a variety of events and can show negative effect on the patient with treatment method. Then manufacturers have created many different types of pill. (Figure. 2.1)

Figure 2.1 Shapes of Pills [6]

Second problem is taking of pill on the right time so that manufacturers have put pills inside special packed to remove them by one by with hand and take on the time but it could be useless for some patients. Therefore, in 1964, David P. Wagner has invented the first patent pill dispenser to control oral contraceptive pills of his wife [7]. (Appendix D).

Significant development of pill dispenser has started to appear ın 1980s because of technological developments which have affected all devices because old devices were not enough to make life easier. Therefore, In the 1980s, automated dispensing devices appeared on the pill market. The invention and production of these devices brought hopes of reduced rates of medication errors, increased efficiency for pharmacy and nursing staff, ready availability of medications. The capacity of such systems increased patient safety and provided to control amount of taking pill on time. Efficiency of this system is seen in Table 1.

Table 1 :Six Studies Automated Drug Dispensing Systems [8]

Study	Study Design	Study Outcomes	Results
Barker, et al 1984	Prospective controlled clinical trial (Level 2)	Errors of omission and commission among number of ordered and unauthorized doses. (Level 2)	96 errors among 902 observations (10.6%) using the McLaughlin dispensing system vs. 139 errors among 873 observations (15.9%) using unit-dose dispensing (control)
Klein, et al 1994	Prospective comparison of two cohorts (Level 2)	Dispensing errors in unit-dose drawers to be delivered to nursing units (Level 2)	34 errors found among 4029 doses (0.84%) filled manually by technicians vs. 25 errors among 3813 doses (0.66%) filled by automated dispensing device
Borel, et al 1995	Prospective before-after study (Level 2)	Errors observed during medication administration in medications administered (Level 2)	148 errors among 873 observations (16.9%) before vs. 97 errors among 929 observations (10.4%) after Meditation Rx ($p<0.001$). Most errors were wrong time errors.
Schwarz, et al 1995	Prospective before-after study (Level 2)	Errors in medications administered (Level 2)	Medication errors decreased after automated dispensing on the cardiovascular surgery unit but increased on the cardiovascular intensive care unit.
Dean, et al 1995	Cross-sectional comparison (Level 3) of US and UK hospitals with different pharmacy distribution systems	Errors in medications administered (Level 2)	63 errors among 919 observations (6.9%, 95% CI: 5.2-8.5%) in the US hospital using unit doses and automated dispensing vs. 84 errors among 2756 observations (3.0%; 95% CI, 2.4-3.7%) in the UK hospital using ward stock. The absolute difference in error rates was 3.9% (95%CI: 2.1-5.7%).

Explanation of table 1, Level 2 outcome is to all studies measured rates of medication errors and Level 3 design is to determined errors by inspecting dispensed drugs. The Pyxis Medstation, Medstation Rx, and Medstation Rx 1000 are automated dispensing devices kept on the nursing unit. The Baxter ATC-212 dispensing system uses a microcomputer to pack unit-dose tablets and capsules for oral administration. The McLaughlin dispensing system includes a bedside dispenser, a programmable magnetic card, and a pharmacy computer.

The results of the study of the McLaughlin Dispensing System by Barker et al showed considerable nurse-to-nurse variability in the error rate. This error is between the automated system and usual unit dose.

The study by Klein et al showed little difference in the correctness of medication cart filling by the Baxter ATC-212 (0.65%) as opposed to filling by technicians (0.84%).

Borel and Rascati found that medication errors, mostly those related to the time of management, were fewer after application of the Pyxis Medstation Rx (10.4%) compared with the historical period (16.9%).

In the study by Schwarz, errors were greater after Medstation Rx and Brodowy, increasing on 6 of 7 nursing units by more than 30%.

Dean et al found half the errors in a ward-based system without automation in the United Kingdom (3.0%, 95% CI: 2.4-3.7%) compared with an automated unit-dose medication distribution system in the United States (6.9%, 95% CI: 5.2-8.5%).

To sum up, at the beginning, pill dispenser processes was just a packaging to conserve and take pill one by one. After that amount of taking different types of pill was increased in this way pill firms invented pill dispenser boxes but these boxes are not useful nowadays for all patient people. Therefore, new pill dispensers have started to appear on the market with the development of technology. The most widely used pill dispensers on the market is seen in Appendix D with their properties. In addition, before starting our project we investigated market pill dispensers and we found many disadvantages which are mentioned in Chapter 1 so that in the next chapter, we will design the project considering the disadvantages.

CHAPTER 3
DESIGN AND ANALYSIS

3.1 Components of Ethernet Automatic Pill Dispenser Machine

To occur a system, components should be combined and work in a synchronized way so that selection of components requires a lot of attention and preliminary studies. These studies can be classified that are calculations, specifications of materials, demands of system, manufacturing process, combining all components respectively and researching of suitable components. E-APD system can be considered one of the complex systems so that it has a lot of components. E-APD system contains seven main components which are Arduino, Arduino Mega Ethernet Shield, Real time clock module, Step Motor, DC Micro Vacuum Pump, several types of sensors and C# (C Sharp) is required to write software of Arduino. In the system of e-APD, Arduino will get software data from C# program and send signals to actuate motors and sensors. As seen in Figure 3 Arduino Mega Ethernet Shield is used to connect to the internet Arduino. Real time clock module will provide real time to control the taking of pill time. Step motor will turn the pill receptacle until correct position. Vacuum pump will create current of air inside movable arm to hold the pills. Lastly, sensors will check all components position and provide them to work safely such as current sensor has an adjustable operating rage. It means that, when the vacuum pump takes more current above of the operating range then sensor will send a signal to Arduino. After that, Arduino perceives the pill is kept by movable arm then Arduino will send a signal to step motor to have right position. In this chapter, properties of all components will be explained with documents, calculation and figure.

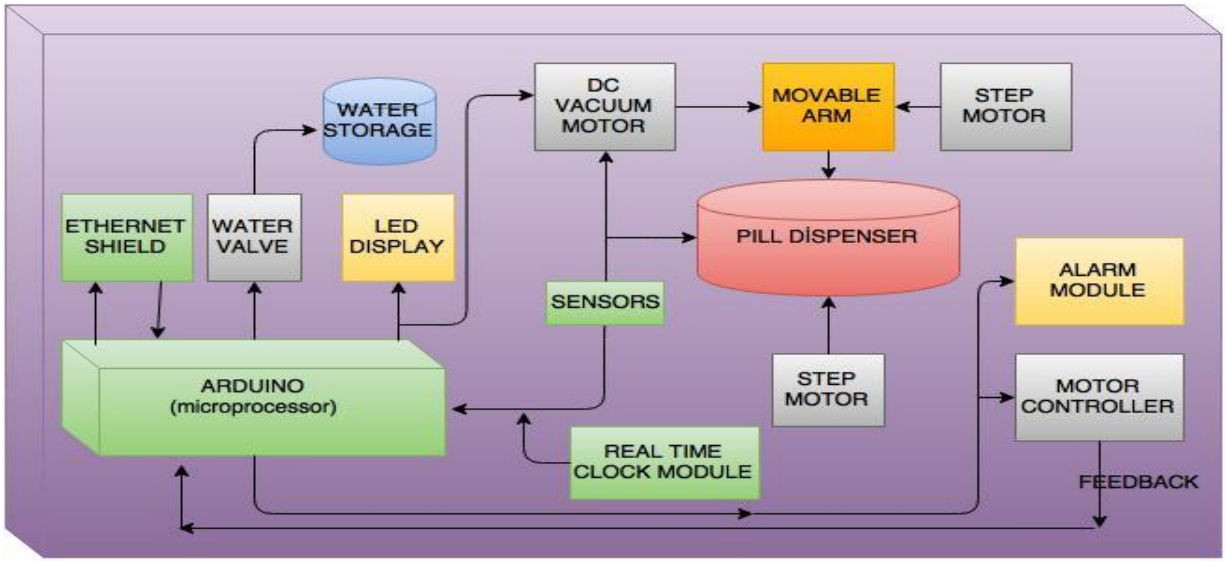

Figure 3. 1 Organization chart of Pill Dispenser

3.1.1 Arduino Mega R3 Board

Arduino is an open source microcontroller board and it's based on easy to use software and hardware. Arduino boards can used to read sensors and control anything like motors and lights. It has a big advantage which it is possible to upload programs to the Arduino board as shown in Figure 3.2 which communicate between real world and computers. In our project, it will be useful board because of it will connect computer to machine by sending a set of instructions to the Arduino (See Appendix D). Essentially, Arduino can deal with something that is controlled with electricity. An easy way to interface with does not controlled by the electricity, by using actuators.

Figure 3. 2 An Arduino Mega R3 Board

3.1.2 Arduino Ethernet Shield

The Arduino Ethernet Shield connects your Arduino to the internet which is based on the Wiznet W5100 (datasheet) Ethernet chip. Just plug Ethernet module onto Arduino board and connect it to network with RJ45 cable. The Wiznet W5100 Ethernet chip serves a network (IP) stack capable of TCP and UDP. It's simple to using the datasheet, by sending a set of instructions to start controlling to the Arduino from the internet. The Ethernet shield provides its power from the Arduino and there is a micro SD card slot on the shield as shown in Figure 3.3 which can be used to store files. Also the shield contains some informational LEDs as follow;

- PWR: indicates that the board and shield are powered
- LINK: indicates the presence of a network link and flashes when the shield transmits or receives data”
- FULLD: indicates that the network connection is full duplex
- 100M: indicates the presence of a 100 Mb/s network connection (as opposed to 10 Mb/s)
- RX: flashes when the shield receives data
- TX: flashes when the shield sends data
- COLL: flashes when network collisions are detected

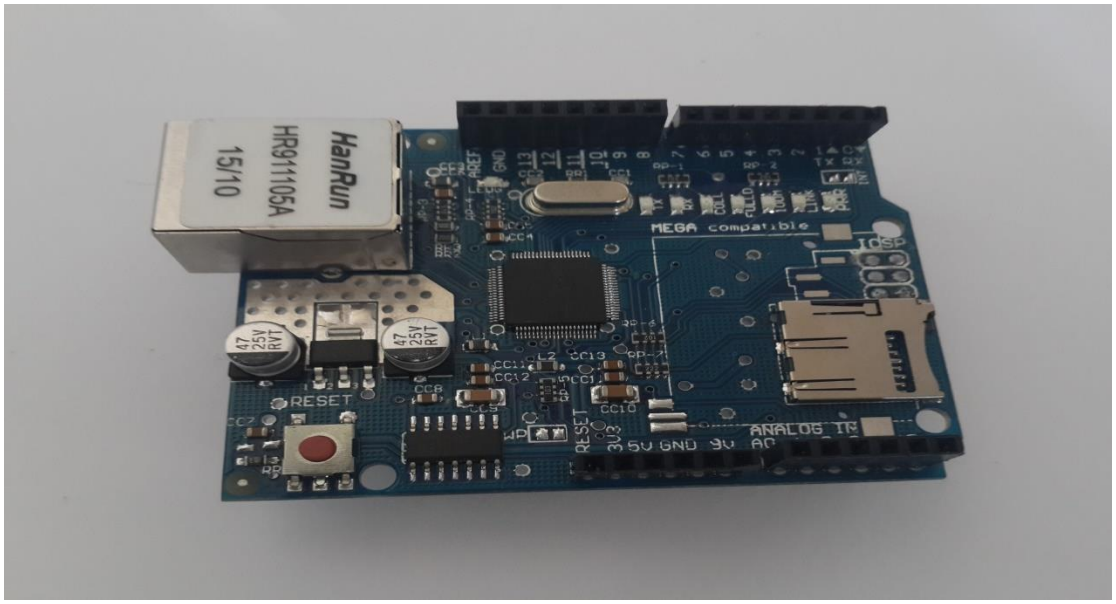

Figure 3. 3 An Ethernet shield for Arduino Mega

3.1.3 DS3231 Real Time Clock Module

DS3231 is a minimal effort, highly accurate I2C Real-Time Clock (RTC), with a combined temperature-compensated crystal oscillator (TCXO) and crystal in seen Figure 6. The module has a battery on it which is used for when the main power failure, the device can continue to provide accurate timing. So performance is not affected. That’s why we will use the RTC because of it is only solution for e-APD machine to prevents to power supply failure and improves accuracy of timing. Crystal oscillator is used for long-term accuracy of the device and reduces the number of components. RTC contains seconds, minutes, hours, day, date, month, and year information. If month is less than 31 days, the end date will be automatically adjusted, including corrections for leap year. It is possible to use the device as 24 hours or 12-hour format. Some important module parameters are given below.

Module parameters:

- Operating voltage :3.3 - 5 .5 V
- Clock Accuracy: 0-40 ℃ range, the accuracy 2ppm, the error was about 1 minute calendar alarm clock with two programmable square-wave output
- Real time clock generator seconds, minutes, hours, day, date, month and year timing and provide valid until the year 2100 leap year compensation
- with rechargeable battery LIR2032, to ensure the system after power failure, the clock move any natural normal

Arduino connection information:

SCL → Arduino

SDA → Arduino

VCC → 5V

GND → GND

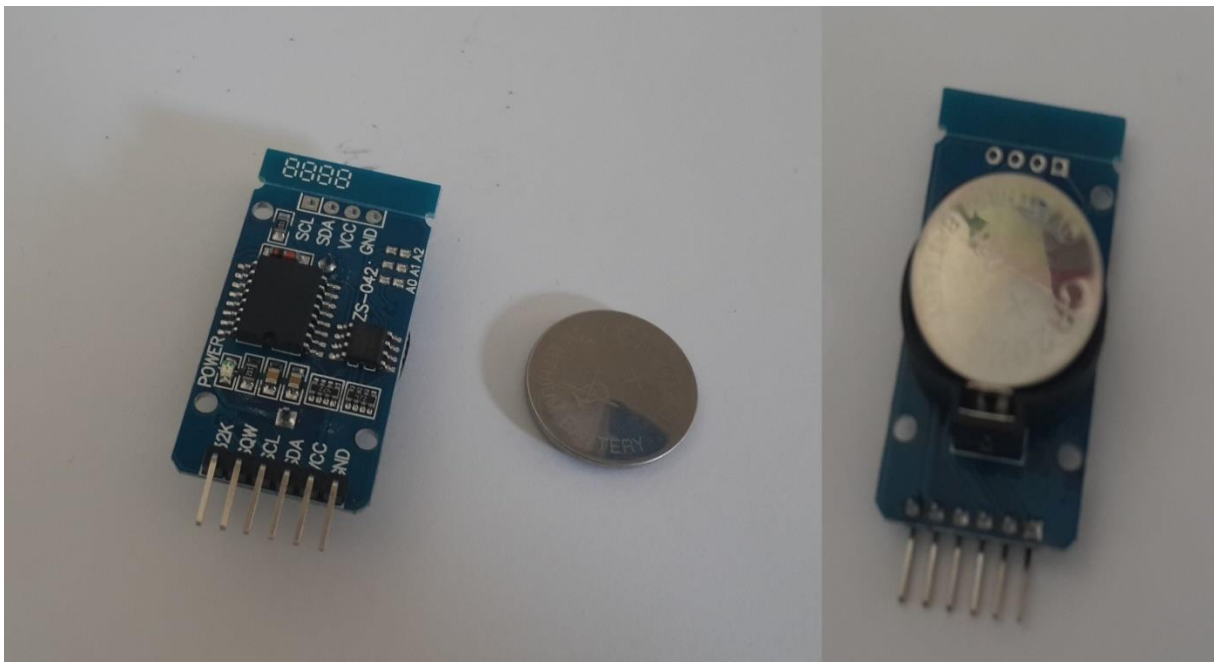

Figure 3. 4 Real time Clock Module

3.1.4 Step Motors

A stepper motor system (See Appendix D) consists of three basic elements, often combined with some type of user interface (host computer, PLC or dumb terminal):

- **Controller:** (Indexer) is a microprocessor capable of generating step pulses and direction signals for the driver [9].
- **Drivers:** The driver (or amplifier) converts the indexer command signals into the power necessary to energize the motor windings. There are numerous types of drivers, with different voltage and current ratings and construction technology. Not all drivers are suitable to run all motors, so when designing a motion control system the driver selection process is critical [9].
- **Stepper motors:** The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft rotation in shown Figure 3.5 . Advantages of step motors are low cost, high reliability, high torque at low speeds and a simple, rugged construction that operates in almost any environment. The main disadvantages in using a stepper motor is the Resonance effect often exhibited at low speeds and decreasing torque with increasing speed [9].

Table 2: Step Motor Properties [10]

Rated Voltage	12VDC
Number of Pole	4
Stride Angle	7.5°
Drive Mode	2-2 Single Pole
DC Resistance	4Ω/phase±10%(25℃)
Current	400mA
Max Start Frequency	≥650PPS
Max Idle Out-traction Frequency	≥1600PPS
In-traction Torque	≥100gf.cm(200PPS)
Self-positioning Torque	≤100gf.cmREF
Induction Resistance	3.5H/Phase±10%(1KHz 1Vrms)
Insulation Grade	A

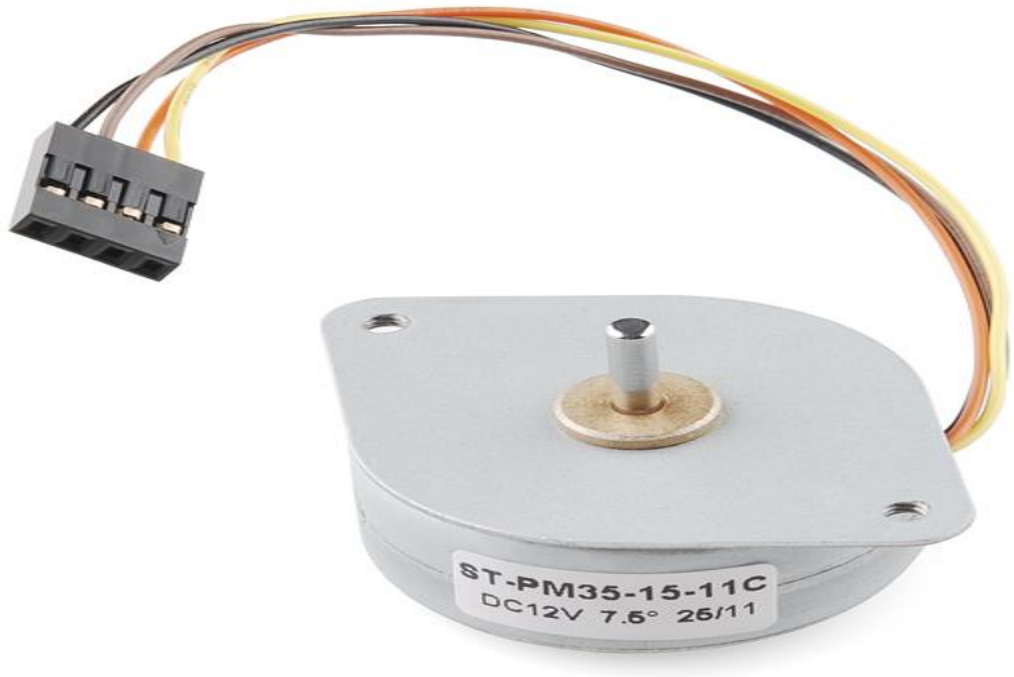

Figure 3. 5 Step Motor [10]

3.1.5 DC Micro Vacuum Pump

As seen in Figure 3.6, Air vacuum pumps are similar to compressors. Also it is even possible to generate vacuum from compressed air depending arrangement of the machine. In generally, a vacuum pump converts mechanical input energy to pneumatic energy. In our project, the air vacuum pump will be used to picking pill from inside of container to outside because sizes of pill are different and it is important give one pill to patient not more than one. Vacuum pump properties are shown in Table 3.

Table 3: Vacuum Pump Properties [11]

Rated voltage		12V
Power		7W
Current rating		< 500mA
Degree of vacuum		50KPA
Pressure	Gas	100Kpa
	Liquid	300kpa
Flow	Gas	3.2 LPM
	Liquid	320 LPM
Noise		< 55 dB

Figure 3. 6 A DC Micro Vacuum Pump [11]

3.1.6 C# Programming to Connect Arduino

Ethernet Shield is used for communication between the e- APD machine (Arduino board) and a computer. Also all Arduino boards have one serial port (also known as a UART or USART). It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB. Thus, Ethernet shield use these RX and TX, also it is not allowed to use pins 0 and 1 for digital input or output. In this Project, C# (C Sharp) will be used to communicate with an Arduino board as an interface program between Arduino and computer as shown in Figure 3.7

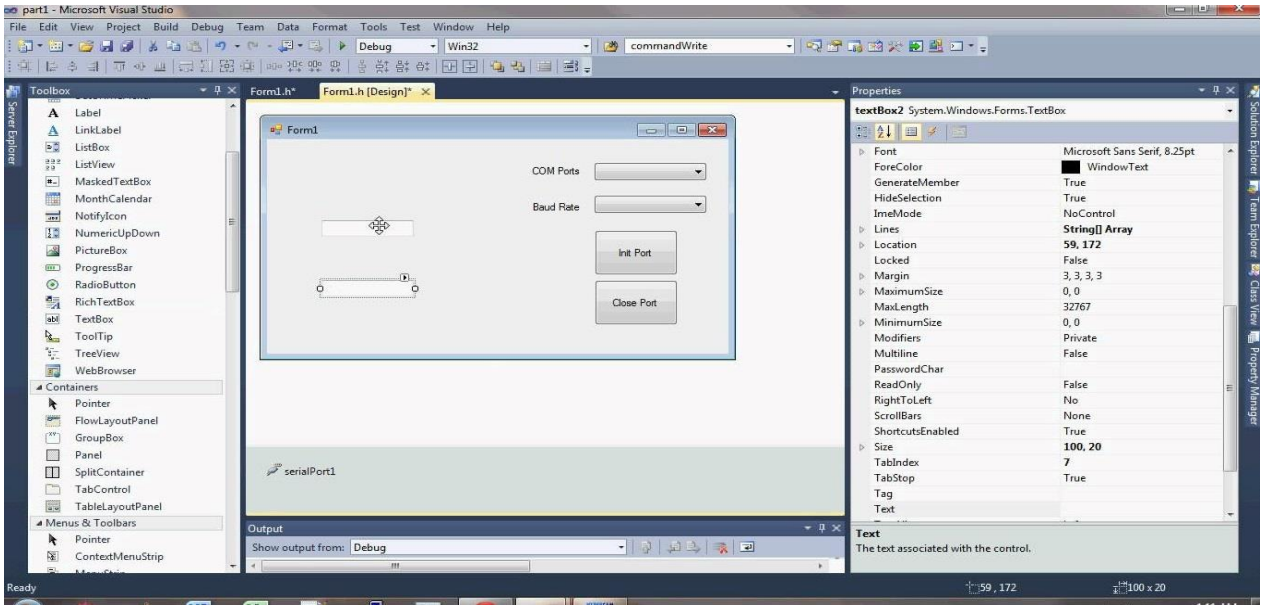

Figure 3. 7 Interface of C# Programming

3.2 Apply Engineering and Science to Select Suitable Materials

3.2.1 Material Selection for Material Design

In any project is designed by engineer, selection of materials must be impeccable so that selection principles should be consider. The selections principles can be classified such as machinability, cost of material, weight of material in unit cube, durability and mechanical performance data is also most significant which is obtainable with observation of other designed project. Also, these principles can help designer to increase efficiency of machine, decrease weight and cost of project and provide long life under the environmental effects. Environmental effects are different all over the world and under working condition so that it also must be investigated from the designer. In addition, designer also has to consider material properties under two principles which are general properties of the mechanical and electrical to prevent oxidation and check suitability each other. These properties are listed below.

- Density
- Strength
- Elasticity
- Ductility
- Hardness
- Conductivity
- Insulation

Designers should take into account the characteristics of the material while selection of materials. For example, each material has different density from each other so that materials light and stiff are different. Also composite and alloy material can be more useful instead of pure material because composite and alloy material are designed based on request. In addition, electrical properties should be considered by the designer because if the designer uses conductive material instead of insulator material there will be electrical risk and shock for project and machine user.

3.2.2 Material Criteria and Goals

All materials have a durability limit under working condition therefore the designer have to consider the limitation of materials. The limitation of material depends on material criteria such as vibration, strength and heat resistance. Another criterion is cost limitation that

is most significant for designer. Therefore designer should select suitable and correct material to control cost of project. In addition, design principles can be categorized as goals and restrictions. For instance, designed project must be suitable mass and size and not waste energy. Restriction can be about cost of material so that before the design project cost of materials should research by designer.

3.2.3 Some Factors for Material Selection

Material selection is also depended some factors. These are during the manufacturing period material must take appropriated form and can be designed. Sometimes very nice design is not enough itself so that an engineer should focus on product colour, aesthetic appearance and decoration to sell the many products. Therefore when the engineer chooses the materials, should be careful, see all possibilities and have an open mind. In the selection of material, to analyse factors some method can be used by engineer to selection that these are shown below.

- Examination of the necessary properties of materials.
- The selection of appropriate materials and apply some experiment and research than select suitable one.
- Developments of appropriate materials.

3.2.4 Main factors for material selection

- **Strength:** The strength of a material is its ability to withstand an applied load without failure or plastic deformation.
- **Ductility:** It is ability of a material to deform easily over the application of tensile force and ability of a material to withstand plastic deformation without rupture.
- **Design:** In engineering design process, design depends on systematic steps that engineers use convenient materials in processes. Engineering design process describes the following stages: research, applicability assessment, establishing design requirements, preliminary design, detailed design, production planning and tool design, and production.
- **Stability:** It is a property of system. It means existence at rest, not responsible to change. In mechanics and dynamics, a system has stability if it will not change motion of its own accord, and will resist small efforts to change its direction or position.

- **Availability:** Availability is a characteristic of a system, which aims to provide a decided level of operating performance. Also, availability has three main principles of system design in availability engineering:

  1. Elimination of single points of failure.
  2. Reliable crossover.
  3. Detection of failures as they occur.

- **Production Compliance:** An engineer cannot apply some method into materials to produce and give shape. Because of these reasons, Producer has to select suitable method to get accurate shape from material. Examples of applicable methods are forming, joining, turning, casting, bending, thermal processing etc.

- **Corrosion Resistance:** Environmental conditions always effects material and this effect decrease material working life thus to have long and enough working life from material engineer should research corrosion resistance of material. Other ways to increase corrosion resistance of materials, lubrication, painting and protection from sunlight.

- **Cost:** Cost must be analysed by designer but price of material is not enough to select material because after selection, material will to be processed by producer. The process type can be increase cost of project.

3.3 Materials Used in the System

3.3.1 Plexiglas (Polymathic Methacrylate)

Plexiglas is a plastic glass which has coloured and colourless varieties. It can be transparent and semi-transparent. It is easily processed and has a light plastic structure so can be cut and drill easily. It is generally sold as 1.5-2 mm flat sheets on the market. It can be softened by heating between 90°C – 115°C in the oven and it safe its shape after cooling thus; it can be given the desired shape by moulding. It is more durable and lighter than glass. The only disadvantage is it is a thermodynamic structure so it has low resistance to heat. Plexiglas does not leave users in the lurch during manufacturing and does not create problem like sheet extruders in the process of blow moulding and shaping. Its technical characteristics (expansion coefficient, density, softening point in see appendix A) are appropriate in standard and the number of polymer is high. Also it has high corrosion resistance under environmental condition [12].

Figure 3. 8 Plexiglas [13]

3.3.1.1 Why Plexiglas?

In the e-APD project, Plexiglas is chosen to cover around the machine because when compared with metal plates, Plexiglas has more advantages than metal plates such as easily manufacturing (machining, turning, drilling etc.), using Plexiglas decreases weight of devices, price of Plexiglas will cheapen cost of devices and provide easily mounting. Another significant reason, Plexiglas is transparent thus this property will help designer to see inside machine clearly and designer can explain all components of machine while presentation in front of jury members.

3.3.2 Stainless Steel

In metallurgy, stainless steel, also known as inox steel, is a steel alloy with a minimum of 10.5% chromium content by mass (See Appendix A). It is type of metal product and has more resistant to rust, staining and corrosion than regular steel. It is an alloy of iron and carbon. Stainless steel is often found in materials used in construction and tools. Because of these properties, stainless steel is used to create structure of machine in the project. Stainless steel surface contains chromium and chromium oxide film on it to prevent oxidation and corrosion so it is used in food industry [14]. Then water storage is made of stainless steel in the project.

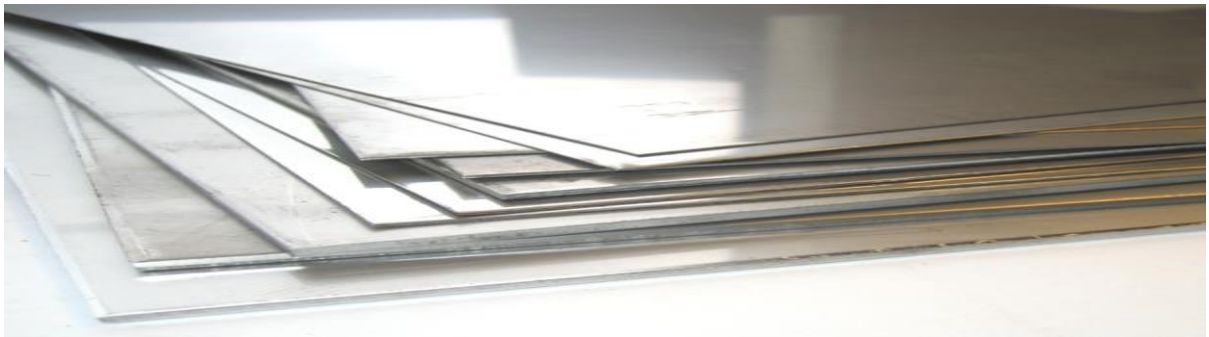

Figure 3. 9 Stainless Steel Sheet Metals [15]

3.3.3 Thermoplastic

Thermoplastics are in plastic group that when heated thermoplastic it become soft, again when cooled thermoplastic it become hard (See Appendix D). Thermoplastics have a high molecular weight. Thus, thermoplastics may be reshaped by heating and are typically used to produce parts by various polymer processing techniques such as injection moulding, compression moulding, easy machining, and extrusion. In e-APD project, there are two complex shapes which are pill containers and receptacle to carry pill containers [16-17].

Figure 3. 10 Thermoplastic [18]

3.3.4 Pneumatic Hose

It is usually used pneumatic system to propel cylindrical containers through networks of tubes by compressed air or by partial vacuum. It is very durable to water, mineral oil, grease, fuel, chemicals and various fluids, including solvents. In e-APD project, it will used to vacuum and water transform.

Figure 3. 11 Pneumatic Hose [19]

3.4 Design Calculation

3.4.1 Calculation of Stepper Motor Step Angle

The angle through which the motor shaft rotates for each command pulse is called the step angle β. Smaller step angle, greater the number of step per revolution and higher the resolution or accuracy of positioning obtained.

The number of step angle can be expressed in two equations.

$$\beta = \frac{(N_S - N_r)}{N_S * N_r} * 360^{\circ} \quad (1)$$

β : Step angle.

N_r : Number of poles (teeth) on rotor.

N_s : Number of poles (teeth) on stator.

m : Number of stator phases.

$$\beta = \frac{360^{\circ}}{m * N_r} \quad (2)$$

Resolution is given by the number of steps needed to complete one revolution of the rotor shaft. Higher the resolution, greater the accuracy of position of object by the motor

$$\therefore Resolution = \frac{Number\ of\ steps}{Revolution} = \frac{360^{\circ}}{\beta}\ [steps/revolution] \quad (3)$$

The actual speed of a stepper motor is dependent on the step angle and step rate and is found using the following equations:

$$n = \frac{\beta * S_S}{6}\ \ [rpm] \quad (4)$$

n: motor speed

S_S: number of speed per second

rpm: revolutions per minute

$$n = \frac{\beta * f}{360^{\circ}}\ [rps] \quad (5)$$

f: stepping frequency

rps: revolutions per second

3.4.2 Calculation of Vacuum Holding Force in Carrying System

For all subsequent calculations, it is important to know the mass of the workpiece to be handled. This can be calculated with the following formula:

$$m = L * B * H * \rho \quad (6)$$

m= mass [kg]

L = length [m]

B = width [m]

H = height [m]

ρ = density [kg/m3]

In order to determine the necessary holding forces, the above mass calculation is needed. In addition, the suction pads must be capable of handling the acceleration forces which, in a fully automatic system, are by no means negligible. In order to simplify the calculation, the three most important and most frequent load cases are shown graphically and described below.

1. The suction pads are placed on a horizontal workpiece which is to be moved

$$F_{TH} = m * (g + a) * S \quad (7)$$

F_{TH} = theoretical holding force [N]

m = mass [kg]

g = acceleration due to gravity [9, 81m/s^2]

a = system acceleration [m/s^2]

S = safety factor (minimum value 1.5; for critical inhomogeneous or porous materials or rough surfaces 2.0 or higher)

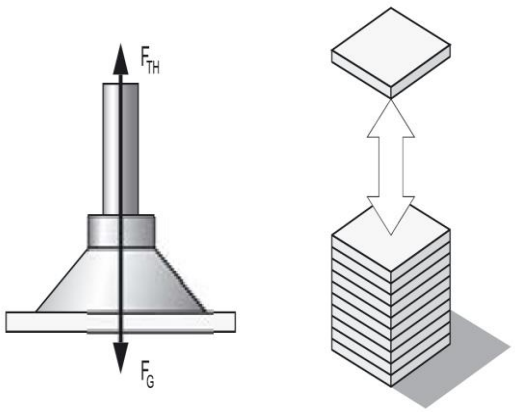

Figure 3. 12 Vertical Force -1

2. The suction pads are placed on a horizontal workpiece which is to be moved sideways.

$$F_{TH} = m * (g + a/\mu) * S \quad (8)$$

F_{TH} = theoretical holding force [N]

F_a = acceleration = $m * a$

m = mass [kg]
g = acceleration due to gravity [9, 81m/s^2]
a = system acceleration [m/s^2]
μ = coefficient of friction*
= 0.1 for oily surfaces
= 0.2 ...0.3 for wet surfaces
= 0.5 for wood, metal, glass, stones…
= 0.6 for rough surfaces

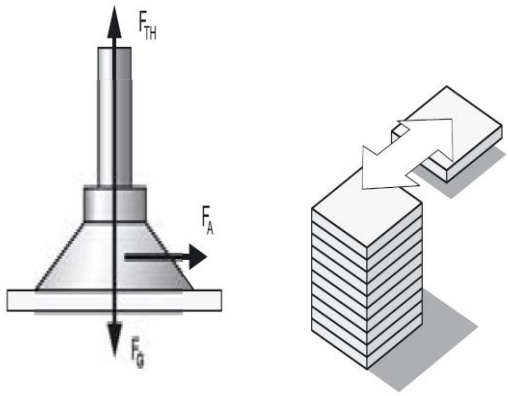

Figure 3. 13 Vertical and Horizontal Force

S = safety factor (minimum value 1.5; for critical inhomogeneous or porous materials or rough surfaces 2.0 or higher)

* Attention! The coefficients of friction shown above are average values. The actual values for the workpiece to be handled must be determined by testing.

3. The suction pads are placed on a vertical or horizontal workpiece which is to be moved vertically or turned to the other orientation.

$$F_{TH} = (m/\mu) * (g + a) * S \quad (9)$$

F_{TH} = theoretical holding force [N]

m = mass [kg]
g = acceleration due to gravity [9, 81m/s^2]
a = system acceleration [m/s^2]
μ = coefficient of friction*
= 0.1 for oily surfaces
= 0.2 ...0.3 for wet surfaces
= 0.5 for wood, metal, glass, stones…
= 0.6 for rough surfaces
S = safety factor (minimum value 2; higher for critical, inhomogeneous or porous materials or rough surfaces

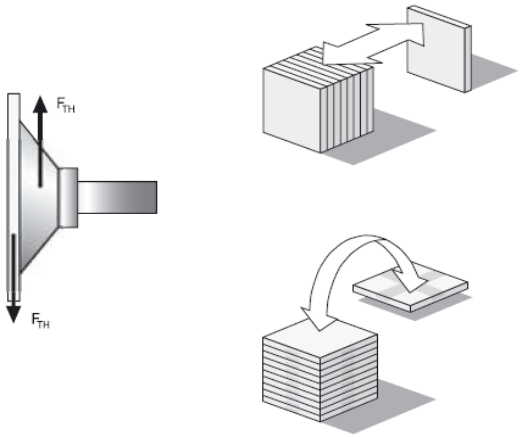

Figure 3. 14 Vertical Force -2

3.4.3 Water Discharge from Water Storage

To determine the water velocity at the outlet using Bernoulli equation:

(10)

$$\frac{P_1}{\rho * g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho * g} + \frac{V_2^2}{2g} + z_2$$

P_1=P_{atm} (open to the atmosphere) [kPa]

P_2=P_{atm} (Water discharge into the atmosphere) [kPa]

Velocities are $V_1^2 \ll V_2^2 \ and \ thus \ V_1 \cong 0 \ \ [m/s]$

Heights:

$z_1 \ is \ distance \ from \ the \ outlet \ tap \ [m]$
$z_2 = 0$ ($the \ reference \ level \ at \ the \ center \ of \ the \ outlet$)

g = gravity [9, 81m/s^2]

ρ = density of water [1 g/cm3]

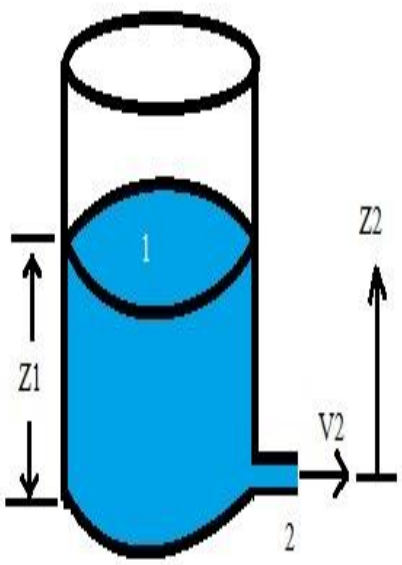

Figure 3. 15 Water Tank

Then the Bernoulli equation simplifies to

$$\frac{P_1}{\rho * g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho * g} + \frac{V_2^2}{2g} + z_2 \longrightarrow z_1 = \frac{V_2^2}{2g} \quad (11)$$

($\frac{V_1^2}{2g} \cong 0$, $z_2 = 0$)

$$V_2 = \sqrt{2gz_1}\,[m/s] \quad (12)$$

3.5 Cost Analysis of Project

Table 4: Cost Analysis of Project

# of products	Quantity	Company	Product Name	Price
1	1	ebay.com	Arduino ATmega2560-16AU CH340G MEGA R3 Board	30,92 ₺
2	1	ebay.com	Arduino Mega Ethernet Shield	16,42 ₺
3	1	gittigidiyor.com/	DS3231 AT24C32 IIC module	24,98 ₺
4	2	ebay.com	Step Motors	35,00 ₺
5	1	aliexpress.com	12V 50Kpa DC Micro Vacuum Pump	32,11 ₺
6	1	ebay.com	30A range Current Sensor Module ACS712	5,38 ₺
7	2	Alkaya Elektronik	L293d step motor driver	9,67 ₺
8	1	ebay.com	40pcs 20cm Male to Male Jumper Cable Wire	4,67 ₺
9	1	ebay.com	1-Channel 12V H/L Level Triger Optocoupler Relay Module	4,38 ₺
10	1	gittigidiyor.com/	power supply (24V 1.1A)	12,39 ₺
11	1	Lukas mobilya	wood	50,00 ₺
12	36	Sennaroğlu	M6 nut	50,00 ₺
13	4	Alkaya Elektronik	bearing	20,00 ₺
14	1	Alkaya Elektronik	belt	10,00 ₺
15	1	Alkaya Elektronik	gear	15,00 ₺
16	1	Alkaya Elektronik	M10 nut	0,50 ₺
17	2	Sennaroğlu	1m M6 threaded rod	30,00 ₺
18	1	Sennaroğlu	Motor joınt	20,00 ₺
19	1	Industrial Kitchen	Thermoplastıc material	50,00 ₺
20	1	Sennaroğlu	aluminium (0.5 mm^2)	10,00 ₺
21	1	Sennaroğlu	15cm M8 Threaded rod	15,00 ₺
21	36	Sennaroğlu	M6 washer	10,00 ₺
TOTAL				456,42 ₺

CHAPTER 4
MANUFACTURING, ASSEMBLY AND TESTING

Ethernet Automatic Pill Dispenser (e-APD) consists of two main mechanical parts. First part is The Pill Holder Mechanism (PHM) to hold pill from the pill container and second part is The Pill Container Mechanism (PCM) to carry pill to reach correct position for the pill holder. (Figure 4.1). In this chapter, it will explain and give details about manufacturing, assembly and testing. General technical drawing of all parts of project is in appendix-C and technical drawing number of PHM is one, PCM is two and main construction is three.

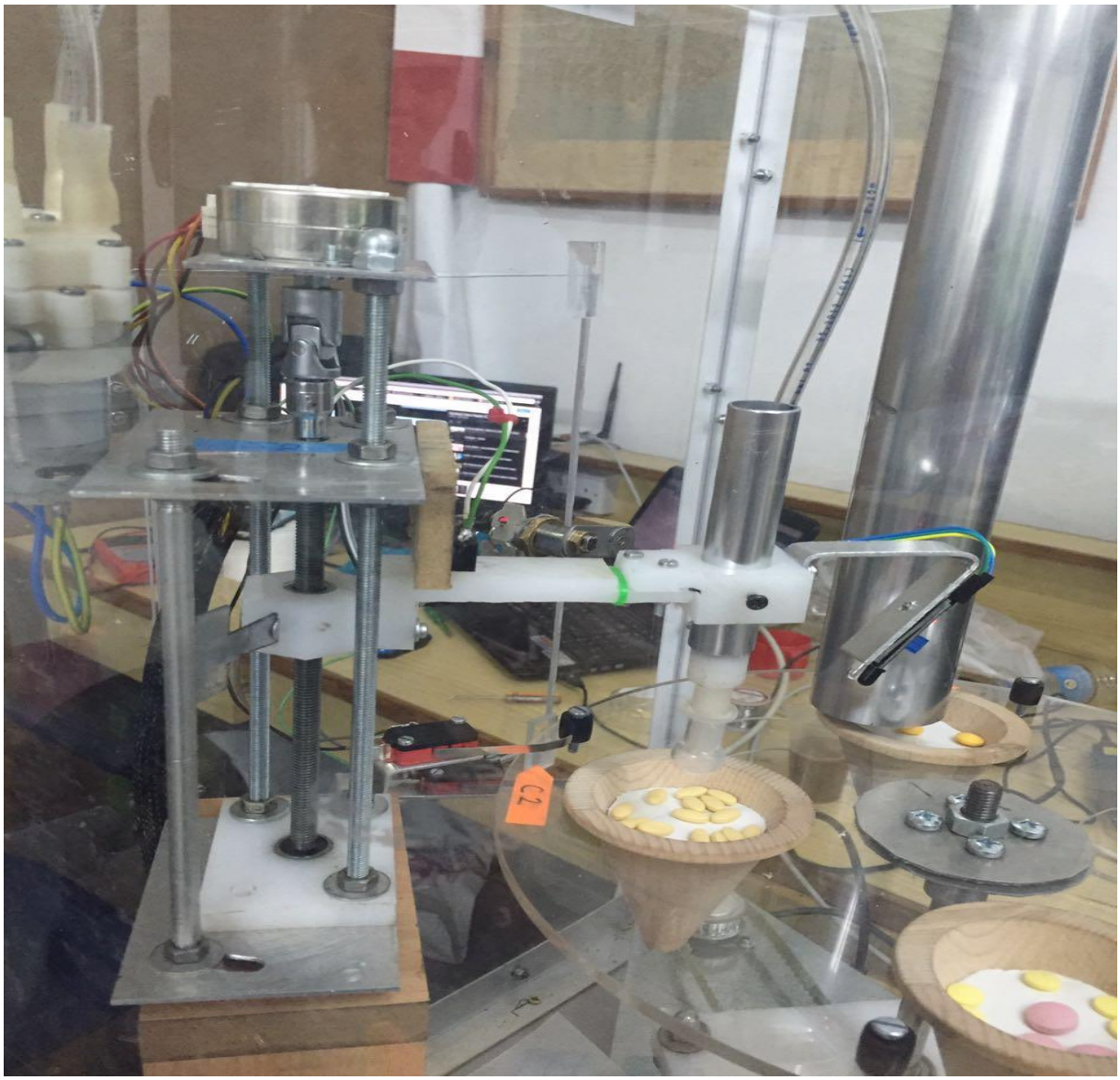

Figure 4. 1 General View of Ethernet Automatic Pill Dispenser (e-APD)

4.1 The Pill Holder Mechanism (PHM)

The PHM works like screw system which is can be explained briefly as a connection point. PHM system has two ball-bearings to fix two end points of gear shaft, two bearing beds and other mechanical parts. (Figure 4.2). Manufacturing and assembly procedure will explain under of this title.

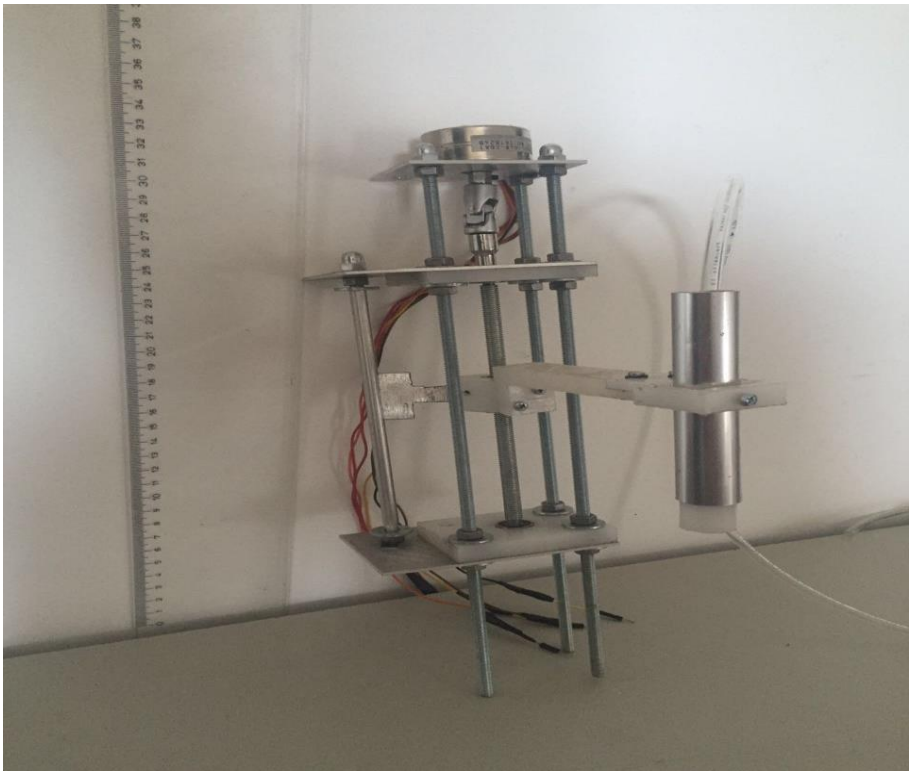

Figure 4. 2 General View of the Pill Holder Mechanism

4.1.1 Manufacturing of the PHM

After selection of materials which are thermoplastic plate and aluminium plate. Thermoplastic material is selected for bearing bed and all thermoplastic parts of the PHM drawings are drawn on simulated thermoplastic plate by using SolidWorks drawing programme (Figure 4.3) and this drawing is loaded on computer which is connected CNC (Computer Numerical Control) machine to get G codes (Appendix -C). Then this G codes are loaded on CNC to manufacture of all thermoplastic parts of PHM. (Fig.16).

In addition, thickness of thermoplastic material was 20 mm so that shaping machine is used to decrease thickness of material until the desired measurement (Appendix –C, No:1). After this processing, all parts (thermoplastic parts of PHM) were taken from machine. (Figure 4.4-4.5-.4.6). The aim of this operation is to have very good surface and correct outer dimension for ball-bearings.

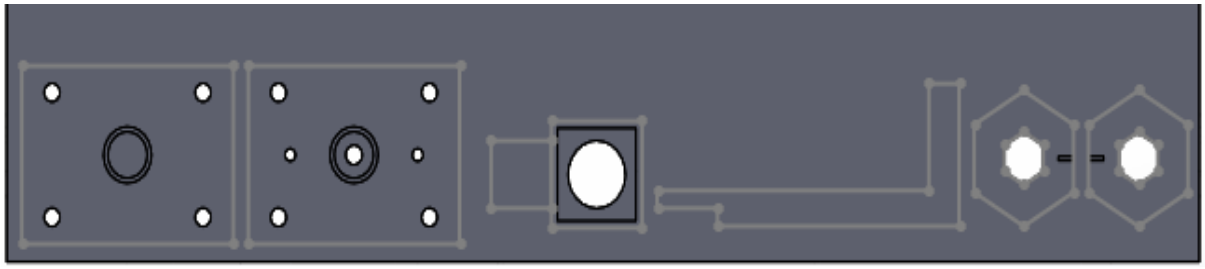

Figure 4. 3 SolidWorks Drawing for CNC Machine-1.

Figure 4. 4 Processing of Thermoplastic Material with Using CNC Machine.

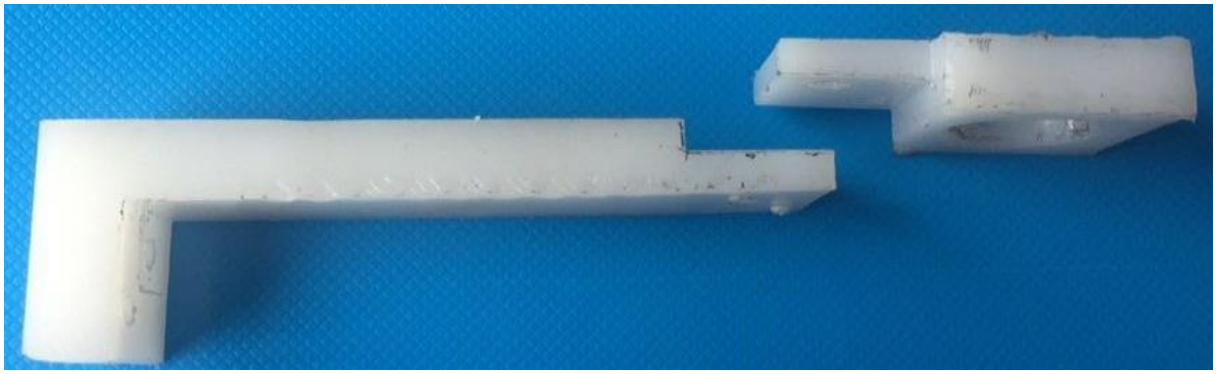

Figure 4. 5 Vacuum Aluminium Pie Holder Parts

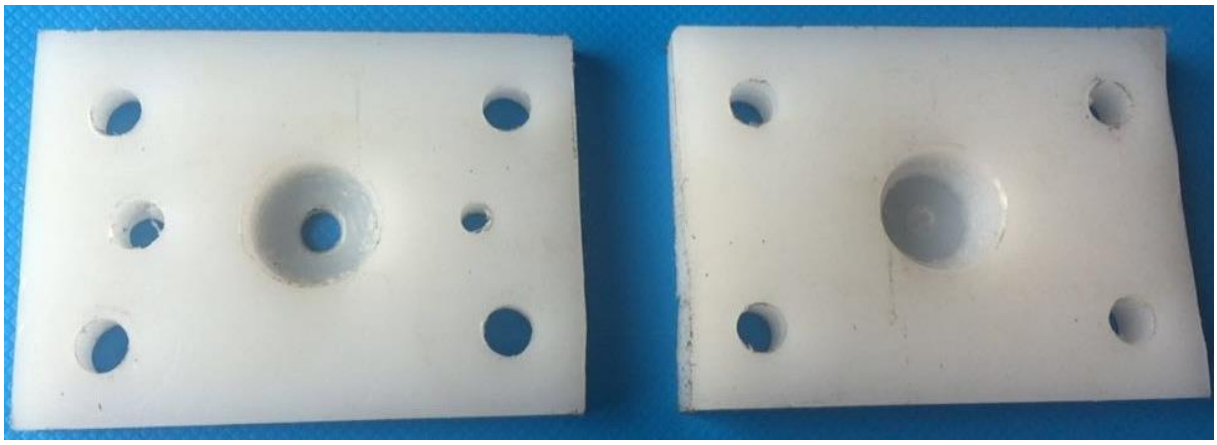

Figure 4. 6 Bearing Beds Parts (upper and lower)

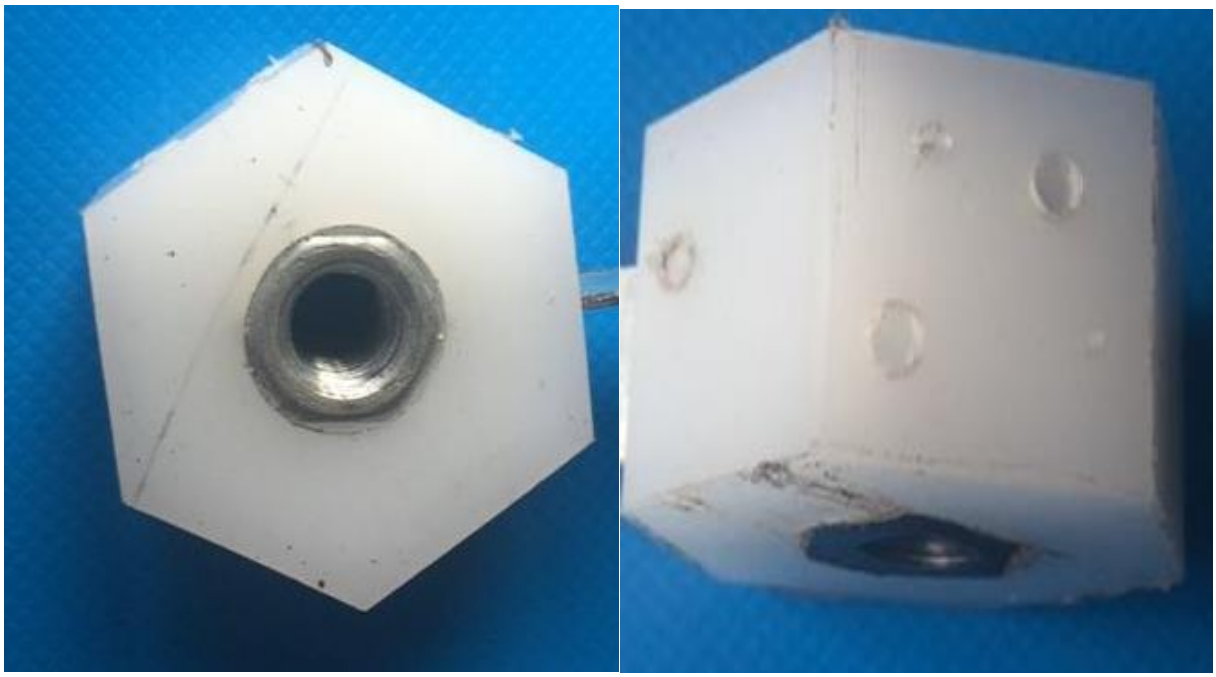

Figure 4. 7 Connection Part between Vacuum Aluminium Pie Holder and Gear Shaft.

Aluminium material is selected to support bearing bed and fix stepper motor. After that all aluminium parts of the PHM drawings are drawn on simulated aluminium plate by using SolidWorks drawing programme (Figure 4.8). This drawing is loaded on computer which is connected CNC machine to get G codes (Appendix-C). Then this G codes are loaded on CNC to manufacture of all aluminium parts of PHM. After this processing, all parts (aluminium parts of PHM) were taken from machine. (Figure 4.8-4.9). The aim of this operation is to have correct dimension of slot canal which is seen on the Figure 4.7.

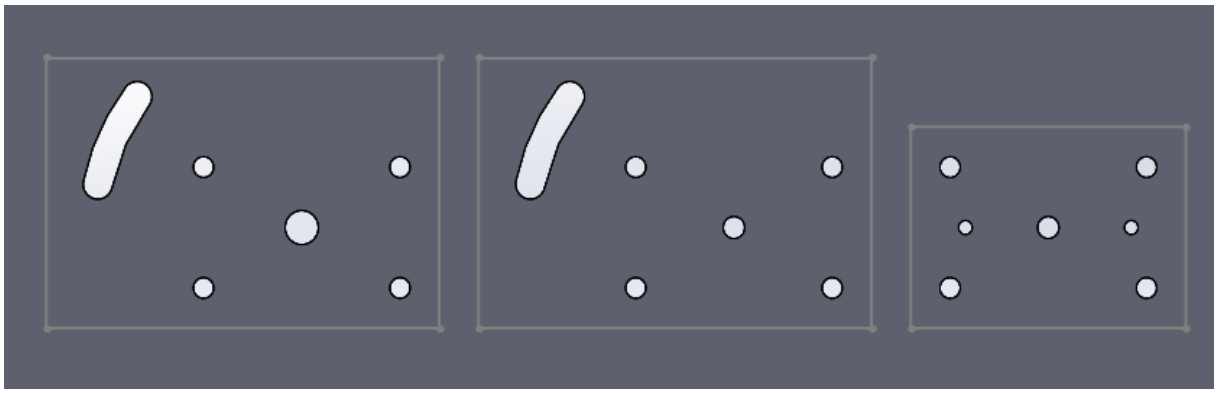

Figure 4. 8 SolidWorks Drawing for CNC Machine-2.

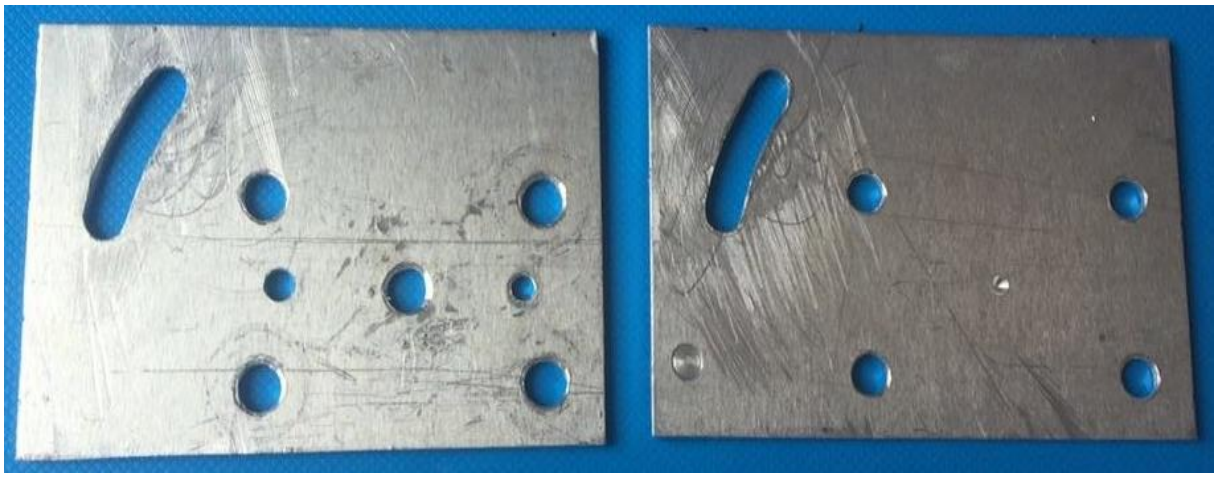

Figure 4. 9 Bearing Beds Support Parts (upper and lower)

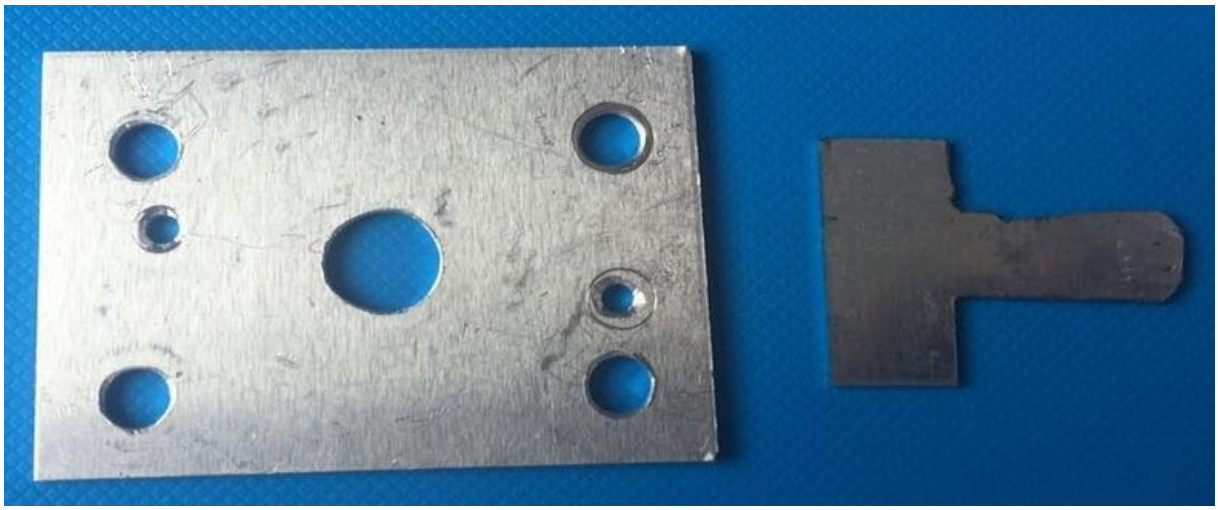

Figure 4. 10 Stepper Motor Support Part and T Part to fix Vacuum Pie Holder Part.

Other steps of PHM are preparing of gear shaft and support rods. For gear shaft, M8 rod is used and shaped by using turning machine to reach correct inner diameter of ball-bearings. (Figure 4.10) Then M6 rod is cut by using hacksaw and it is divided there pieces. (Figure 4.11)

Figure 4. 11 M8 Gear Shaft

Figure 4. 12 M6 Support Rods

The last step of manufacturing PHM is to make a small part to connect Pneumatic Hose and aluminium pipe. Thermoplastic rod material is used to prevent any air leak and manufactured by using turning machine (Figure 4.13). Then the part is taped for air hose connection part.

Figure 4. 13 Turning Machine is machining

4.1.2 Assembly of the PHM

The PHM has got two main part linear gear shaft and two ball bearing beds, all parts are connected each other by three stable rods and nuts, bolt, screw, washer, setsquare bolt are used to fix all parts each other. These connection parts of dimensions are given and assembly steps of the PHM are explained in drawing appendix-C and its drawing number is one.

Working principle of PHM is to get data from Arduino Mega R3 Board then the stepper motor is started rotation clockwise to reach deep of pill container and in this time DC vacuum motor is run so it created a vacuum inside Pneumatic Hose. When aluminium pipe reach inside the pill container the vacuum pulls the pill so that pill closes air inlet hole then DC vacuum motor takes more current from sources. Therefore overcurrent sensor which is connected to DC vacuum motor in this way overcurrent sensor sends a signal to Arduino. Arduino sends a data to PHM stepper motor thus it is started rotation anticlockwise to reach beginning position with taken pill and when the stepper motor reach the beginning position, the switch closes current source of DC vacuum motor and the pill fall inside patient pill cup.

4.2 The Pill Container Mechanism (PCM)

The PCM is a simple rotation system which has two ball-bearings with beds, a stepper motor and a strap – pulley system to transfer rotation from stepper motor to cup container. (Figure 4.14). Manufacturing and assembly procedure will explain under of this title.

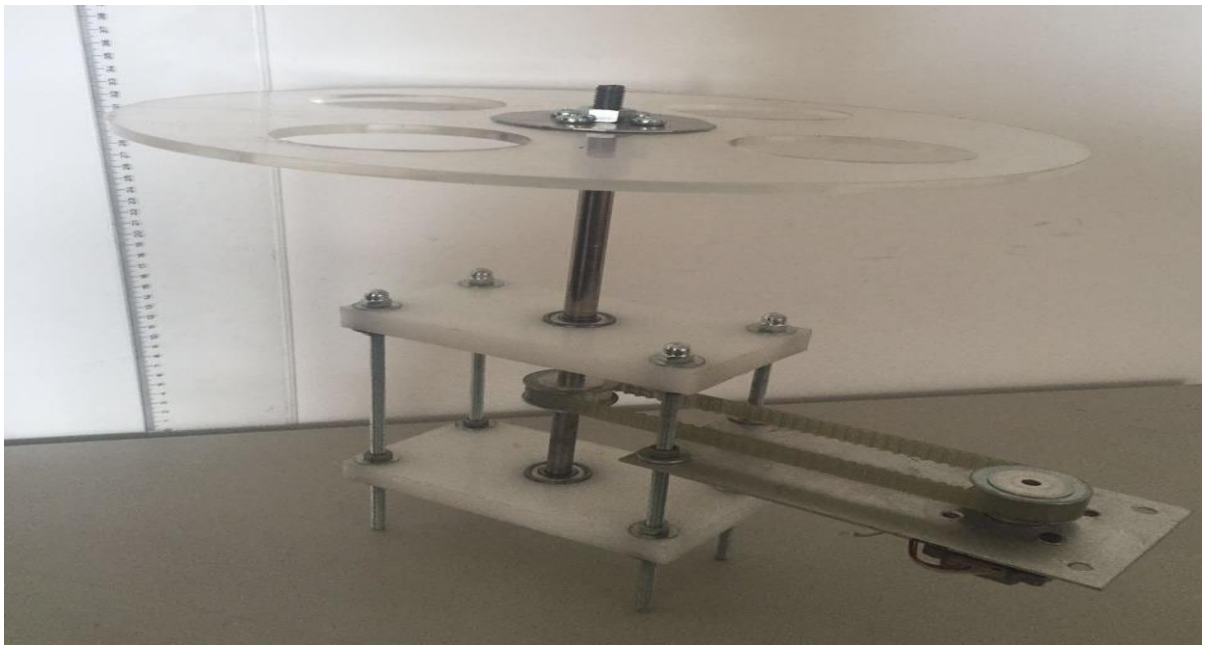

Figure 4. 14 General view of the Pill Container Mechanism

4.2.1 Manufacturing of the PCM

After selection of materials which are thermoplastic plate and aluminium plate. Thermoplastic material is selected to manufacture bearing beds. The bearing beds parts drawing are drawn on simulated thermoplastic plate by using SolidWorks drawing programme and this drawing is loaded on computer which is connected CNC machine to get G codes (Appendix -C). Then this G codes are loaded on CNC to manufacture of bearing beds parts of PCM. In addition, thickness of thermoplastic material was 20 mm so that shaping machine is used to decrease thickness of material until the desired measurement (Appendix – C, No:2). After this processing, bearing beds parts of PCM were taken from CNC machine. (Figure 4.15). The aim of this operation is to have very good surface and correct outer dimension for ball-bearings.

Figure 4. 15 Bearing Bed Part Lower

Aluminium material is selected to connect and fix stepper motor into PCM. Guillotine is used for cutting of aluminium material and drilling machine is also used to drill the holes. Steel rod used in the PCM and shaped by turning machine. (Figure 4.16)

Figure 4. 16 Steel Rod Machining in Lathe

The last operation of PCM is cutting of pill container holder. Plexiglas material is selected for pill container and drawing of pill container holder is drawn by using AutoCAD drawing programme. This drawing is load on Laser cutting machine to cut Plexiglas easily and to get exact dimensions. (Figure 4.17)

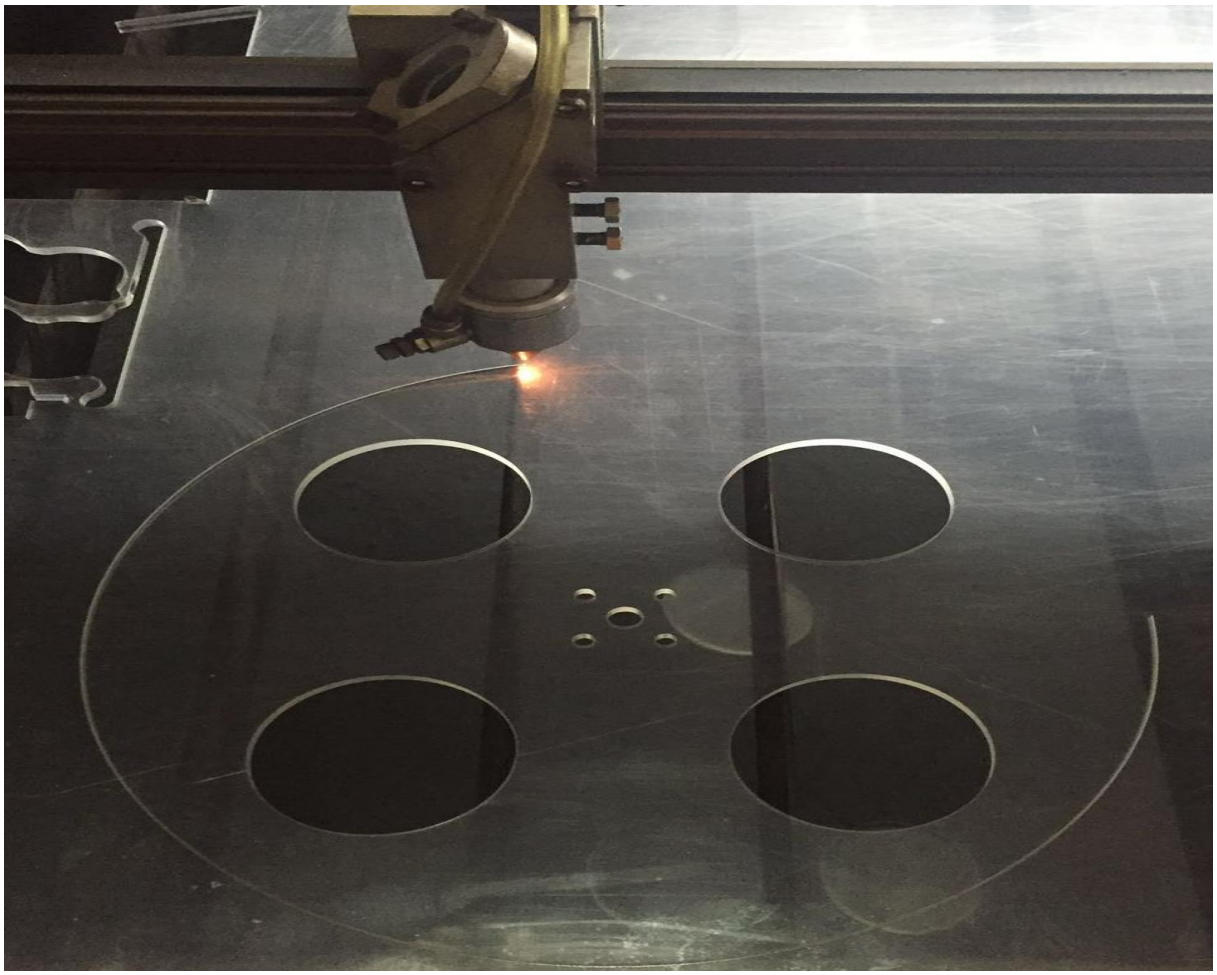

Figure 4. 17 Laser cutting machine

4.2.2 Assembly of the PCM

The PCM has got two ball bearing beds and a pill container all parts are connected each other by four stable rods and nuts, bolt, screw, washer, setsquare bolt are used to fix all parts each other. These connection parts of dimensions are given and assembly steps of the PCM are explained in drawing appendix-C and its drawing number is two.

Working principle of PCM is to get data from Arduino Mega R3 Board then the stepper motor is started rotation clockwise to put correct pill cup under the PHM thus PHM starts to hold a pill from pill cup after that Arduino sends a data to PCM stepper motor then it is started rotation anticlockwise to bring pill container in unloading position.

4.3 Testing of PCM and PHM

In PCM system, the stepper motor rod was inside the upper side of gear shaft hole and connected directly with setsquare bolt. However after testing PCM this connection was not useful to transfer rotation of the steeper into gear shaft because their rods are not in the same axis thus this operation created unusable balance that it affects the speed of the motor. As a solution, to prevent this unusable joint is used. (Figure 4.18)

Figure 4. 18 Joint

In PHM system, the pill container holder and pill container had complex shape. However to manufacture of these shape was very hard because the forming process must be applied to prepared mould to get these complex shape. This operation was too expensive and it takes more time. As a solution, Plexiglas material is used instead of pill container holder and Beech wood (Figure 4.19) is used to manufacture pill container because Beech wood is very useful turning machine operation.

Figure 4. 19 Beech wood

4.4 Ironmongery Engineering Standard for Assembly

In assembly of Ethernet Automatic Pill Dispenser (e-APD), much kind of ironmongeries are used to fix and support all part of machine and also a nut is used to convert rotation movement into linear movement. Engineering Standard of these ironmongeries is described below.

4.4.1 Nut-Bolt

Nut and bolt are part of a machine element that makes the task of tightening the connection. Nuts are made according to bolt measurements. They are usually made of steel and nut is a type of fastener with a threaded hole. Nuts are almost always used opposite a mating bolt to fasten a stack of parts together as seen in Figure 4.20.Standarts of the nut shown in the Appendix D.

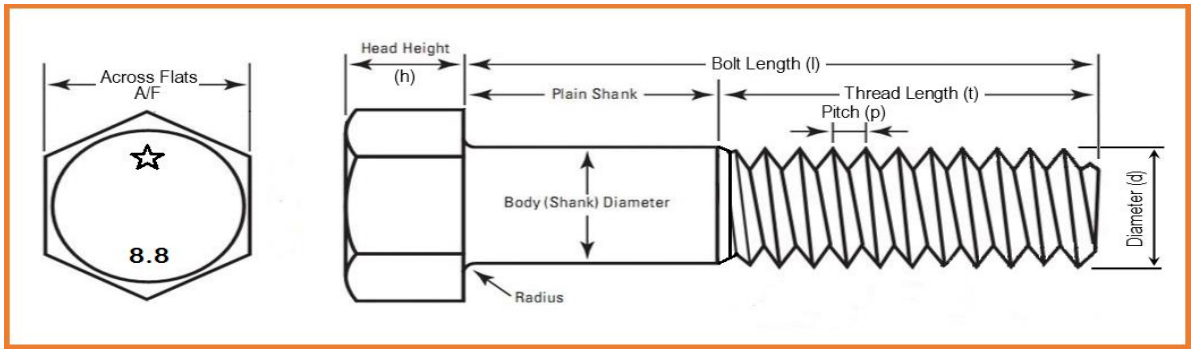

Figure 4. 20 Part of Name Nut and Bolt [20]

4.4.2 Steel Threaded Rod

Standard threaded rods are pre-threaded bars used with standard nuts, couplers and washers. It is very useful to connect machine part each other whatever the distance between them. In PHM and PCM system, M8 steel threaded rod is used to convert rotation movement into linear movement with M8 nut and M6 steel threaded rod is used to connect and fix all parts each other.(See in Appendix D.) [24]. Some steel threaded rods are shown in Figure 4.21.

Figure 4. 21 Steel Threaded Rod [22]

4.4.3 Setsquare Bolt

A Setsquare Bolt is a type of screw or bolt generally used to safe an object within or against another object,(see in Figure 4.22) normally not using like a nut. The most common examples are connecting a pulley or gear to a shaft. In the project, each motor rod and pulley and joint are fixed each other by using setsquare bolt. There are many types of setsquare bolt in the market.(See in the Appendix D).[25]

Figure 4. 22 Setsquare Bolt [23]

CHAPTER 5
RESULT AND DISCUSSION

Ethernet Automatic Pill Dispenser e-APD is very useful machine in daily life for elderly people and people who have Alzheimer disease. It has specific software which communicates with the Arduino via Internet. This software provides facility for a doctor to determine the pills which will be taken by the patient on the time.

Although the linear mill was connected to the stepper motor in the system, balance problem was occurred at the top of e-APD then the mill was tried to fix but problem was continued. After some research on the Internet, specific joint was used to overcome this problem. Another problem was occurred in the different motor which rotates the middle mechanism. In order to solve this problem belt was used to transmit the rotation of the stepper motor.

Beginning of the project, it was decided to use plastic container which contains the pills. Because of the disadvantages of plastic such as low melting temperature during process, decided to use wood for containers. Being organic and low decomposition are some of several advantages of the wood. Another issue was some measurement that had to be changed during manufacturing.

Considerable innovation is in the software part. Before start the mechanical part, software part was done but the problem was on the design. Interface was redesigned. Another problem was in the Arduino programing. After mechanical part became palpable, problem was occurred. After research on the Internet some specific codes were used and problem was solved.

CHAPTER 6
CONCLUSION AND FUTURE WORK

6.1 Conclusion

Basic pill dispenser is widely used in medicine. However it has been tried to develop as much as possible using today's technology. For example, some mechanical parts and electronic kits which are Arduino and sensors. This project was undertaken with an objective learn how to program an Arduino and design mechanical parts and the importance of proper selection of materials for the project.

During the procedure of the project, we have gained knowledge about design, calculation, theories, production some material and Arduino programming. For example Plexiglas was used in the project. It was used because it is inexpensive, lightweight and easy machinable. And some materials that used in the Capstone Project were brought from Turkey and China such as current sensor, Arduino etc.

On the other hand, software for the Automatic Pill Dispenser was designed and developed with members of capstone team. During this period, some specific software's were used such as C# (C Sharp), Photoshop (for editing logos and images), Microsoft Access (for database). And software design is described below step by step. The purpose of using software design in the project to provide ease of use and controlling the machine in this way the software design helps us to reach our main aim which is to help elderly people who forget to take their pill on time and will make life of patients and their relatives easier.

6.1.1 Software Design

6.1.1.1 Username and Password Control

Automated Pill Dispenser (APD) is occurring from forms or windows. Firstly to use Automated Pill Dispenser (APD), user has to enter own username and password as shown in Figure 6.1. After this dialog, main menu will be open. If user enters wrong password and username, one warning dialog gives warning as shown in Figure 6.2 and if enters more than 3 times, program close itself because of security as shown in Figure 6.3. Microsoft Access Database is used to hide Login information as shown in Figure 6.4 . It is possible to change username and password after the login dialog.

Figure 6. 1 Username and Password Control

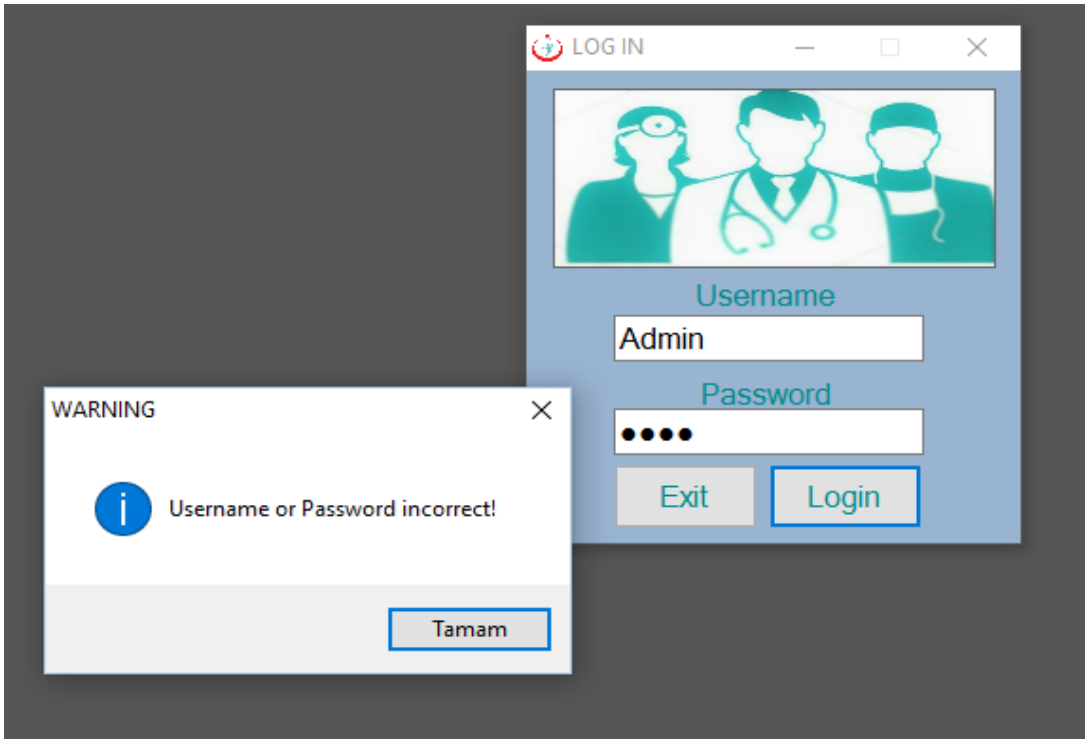

Figure 6. 2 Wrong Username and Password Control

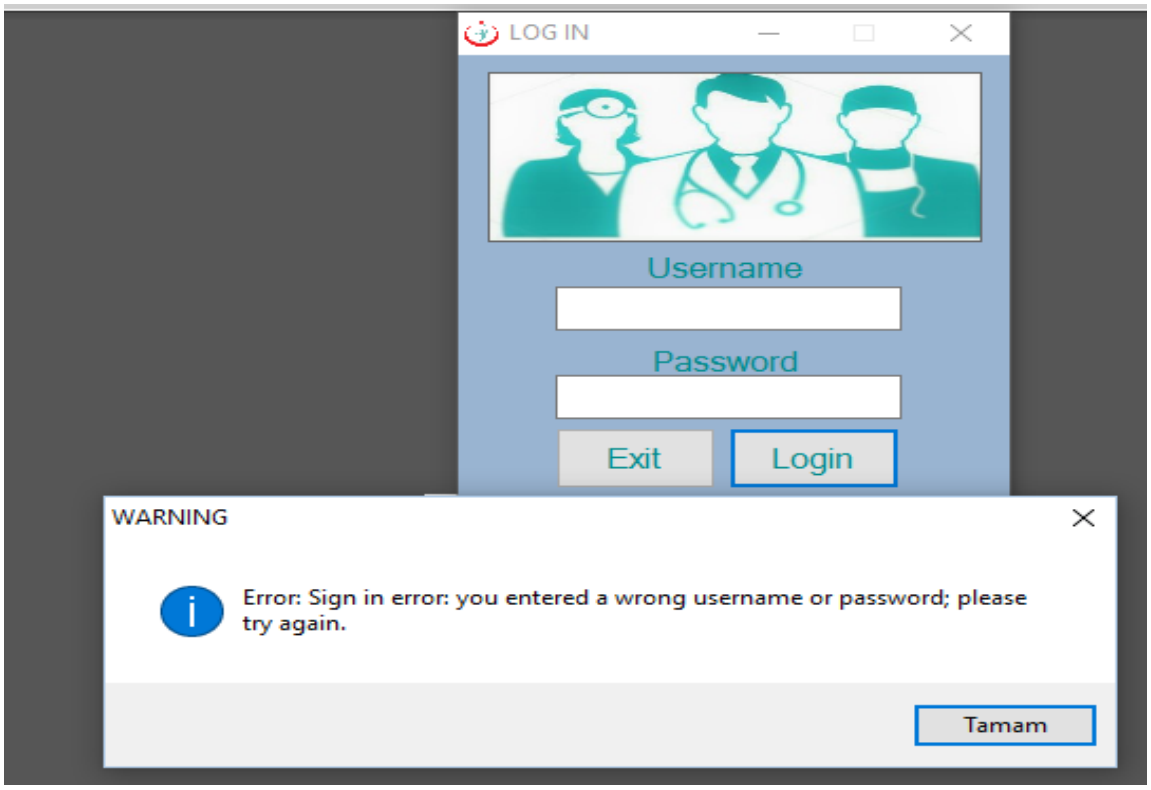

Figure 6. 3 Warning When More than Three Times Entering Wrong Information

.

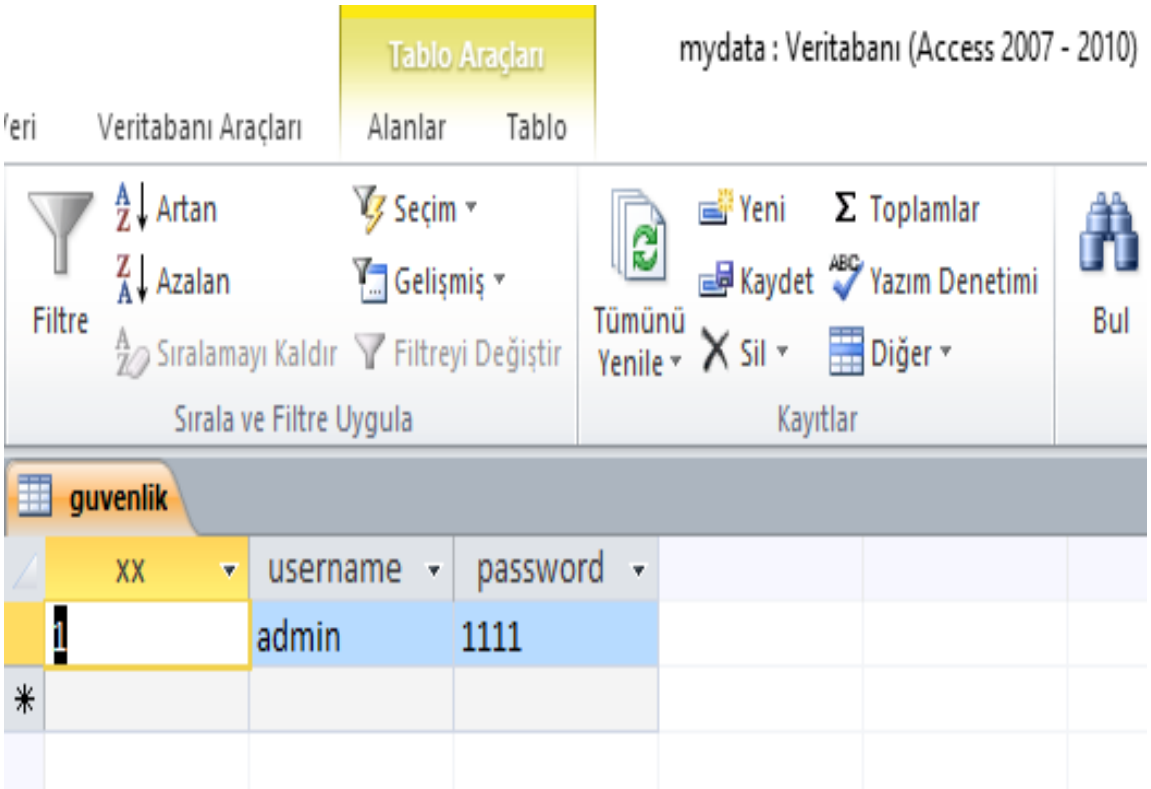

Figure 6. 4 Saving LOGIN Information to Database

After the successfully entering login information, main menu will be open as shown in Figure 6.5 and main menu has a two option

a- Shows existing patient
b- Add new patient

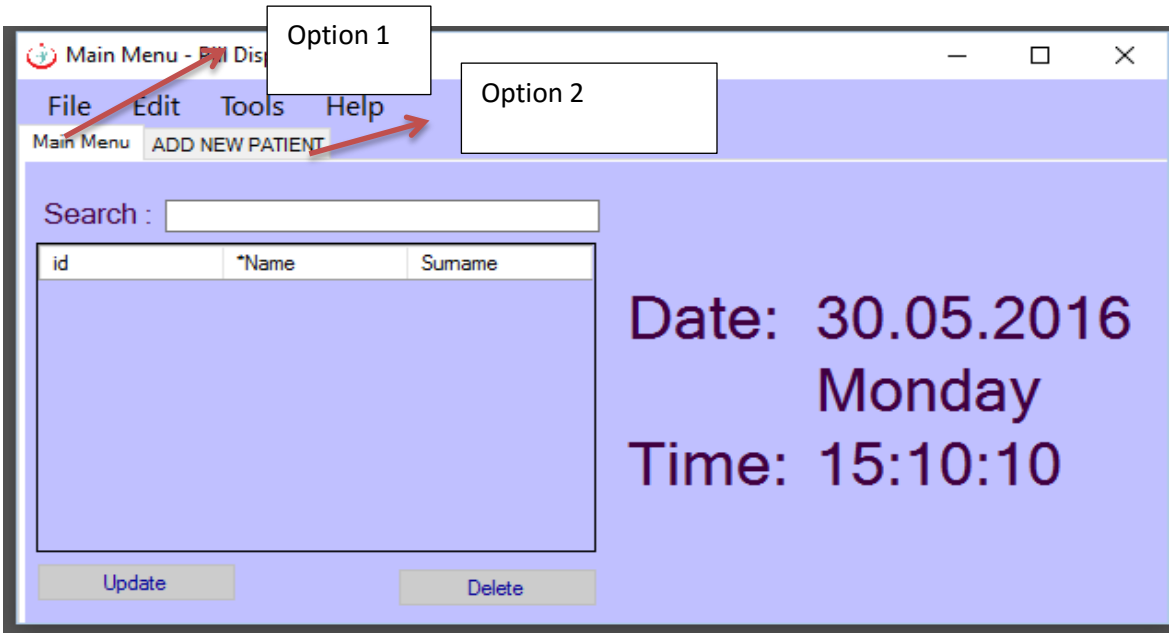

Figure 6. 5 Main Menu

a- Shows Existing Patient

In this window, it is requires to search patient ID. If patient ID exists on the Database then shows on the list view as shown in Figure 6.6. In here, there are three options. One of the options is deleting the patient information as permanently from the database. Second option is updating patient information as shown in Figure 6.7 . And third option is connection and settings with machine.

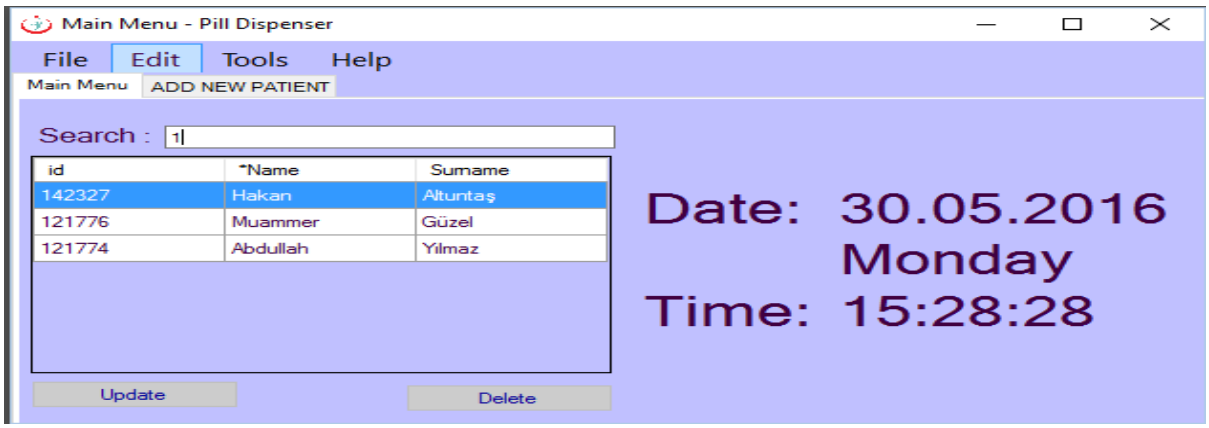

Figure 6. 6 Searching Existing Patient by ID

In here Muammer is selected and updating patient information option clicked and then new form shows all information of Muammer. This information is hiding in the Database. In here only ID can't change because of the security and every person has a unique ID number.

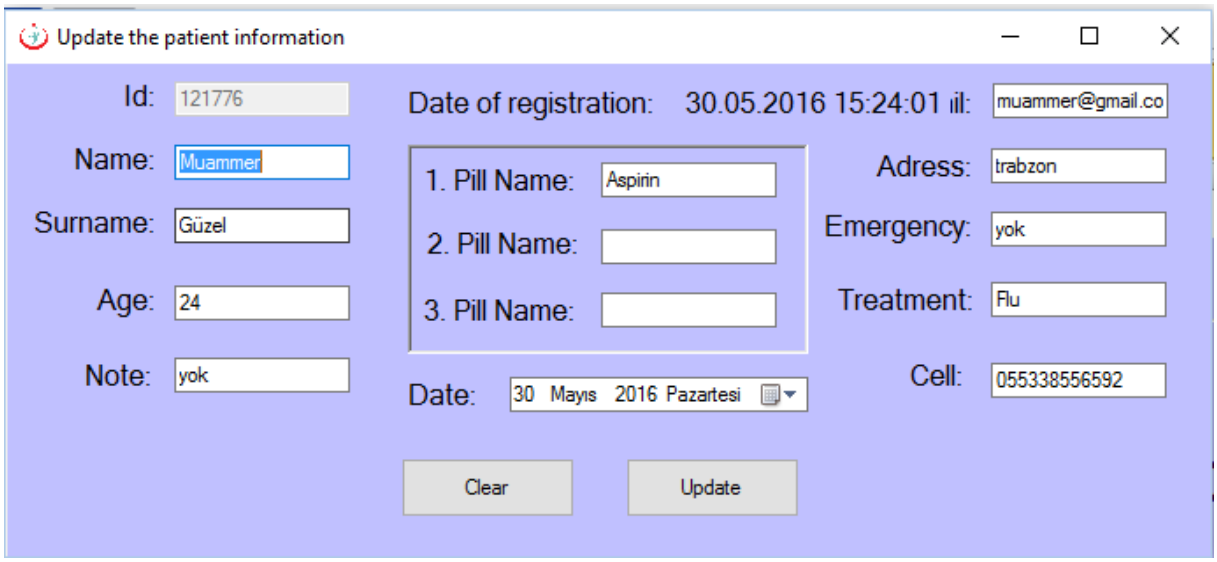

Figure 6. 7 Update Patient Information

If user double clicks selected patient information thus machine connection page will be open. In here, it's necessary to enter machine IP address and port name according to the machine. In this project, IP address is 192.168.2.17 and port number is 23. (Figure 6.8)

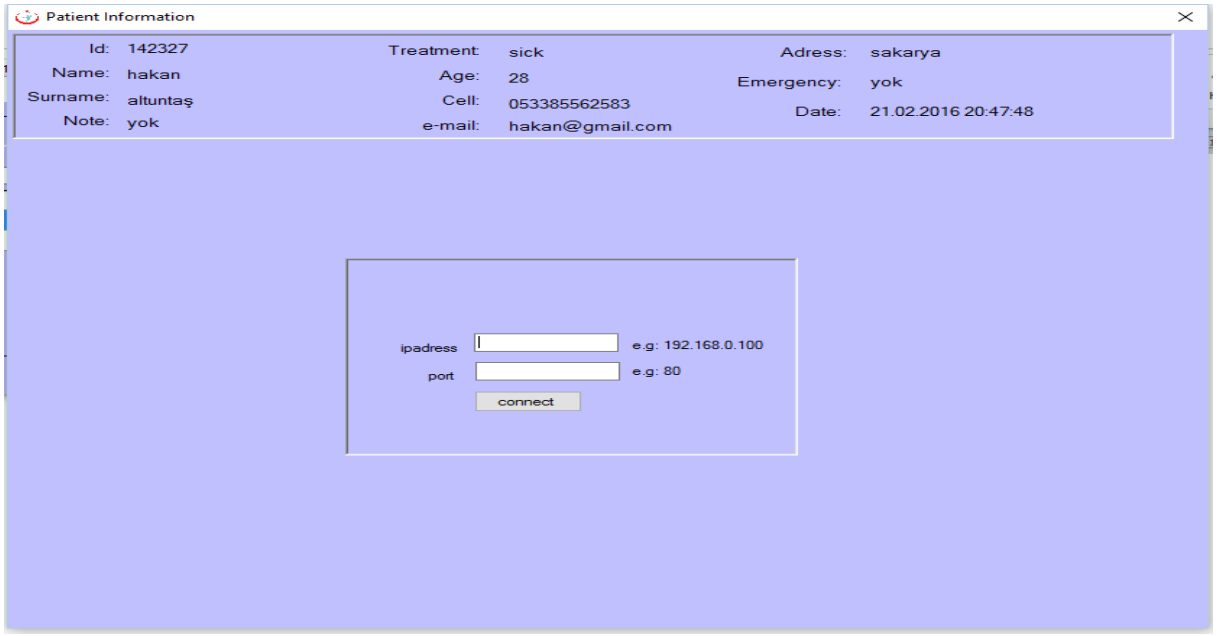

Figure 6. 8 Machine Connection

After connecting to the machine there will be open new form which contains 3 different settings. It is necessary to choose medicine taking hours and need to send to the machine. If there is no medicine, selecting to taking medicine hours is not possible as shown in Figure 6.9. Also data will be saved on the database and when data transfer complete, bottom of the form there will be message to show data transfer situation which is shown in bottom of Figure 6.8 and Figure 6.10.

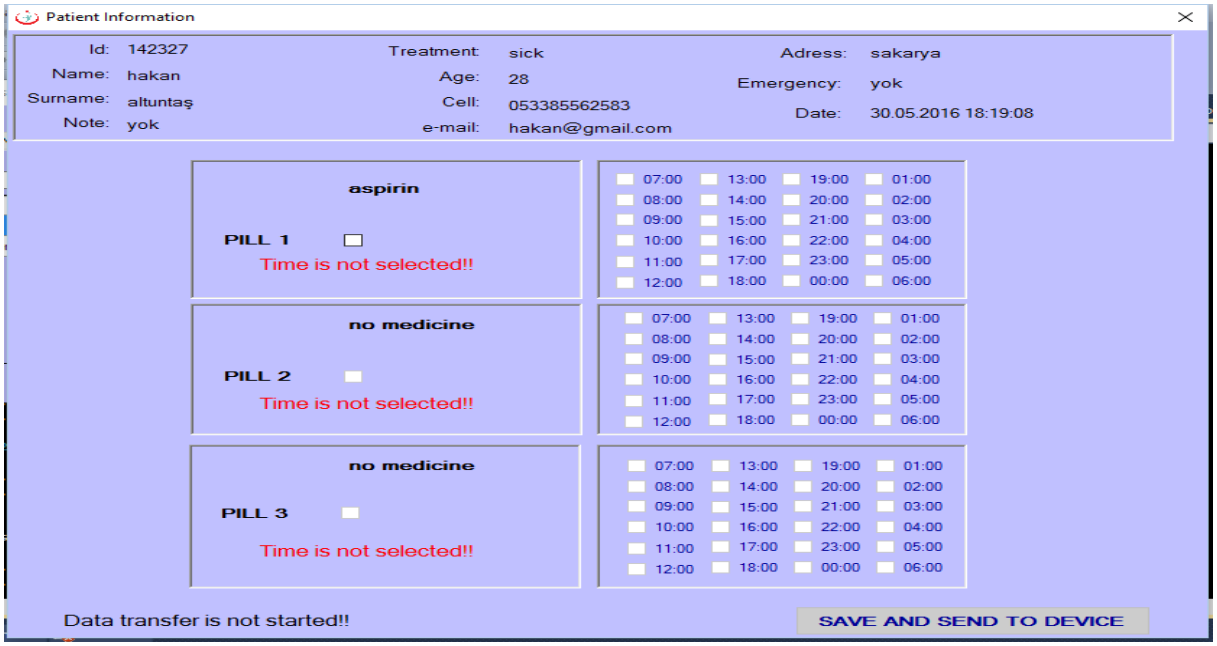

Figure 6. 9 Machine Settings

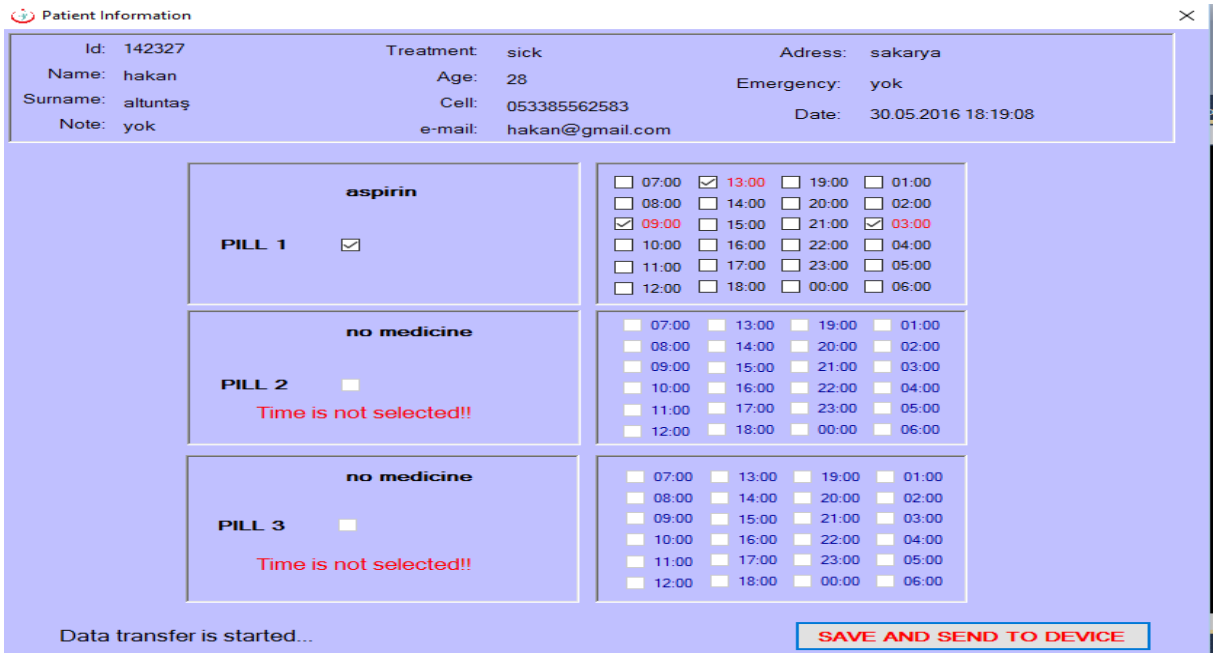

Figure 6. 10 Selecting to the Taking to Medicine Time

b- Add new patient

This option is for add new patient. The form is shown as an option 2 in Figure 6.5. In here it's necessary to fill all empty space. Otherwise adding new patient is not possible. It is also saving the registration date and time automatically.

6.1.1.2 File Option

Under the file there is an option which is exit. It is used for closing the program as shown in Figure 6.11.

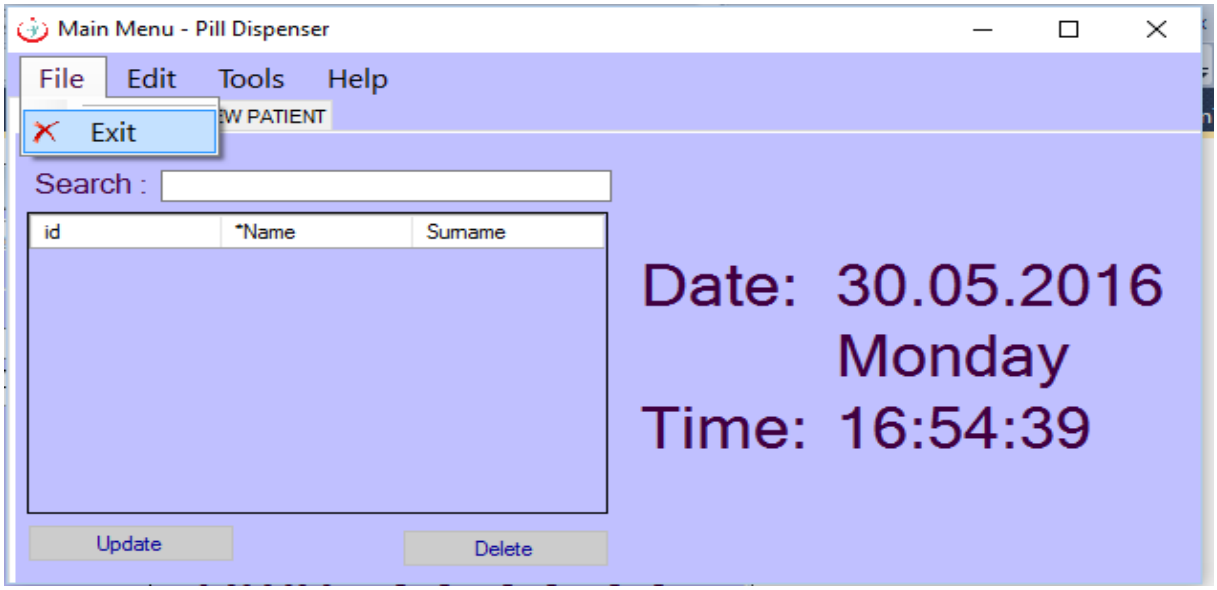

Figure 6. 11 File Menu and Exiting from the Program

6.1.1.3 Edit Option

Under the edit option, Doctor Information can be open and edit the information as shown in Figure 6.12 and Figure 6.13.

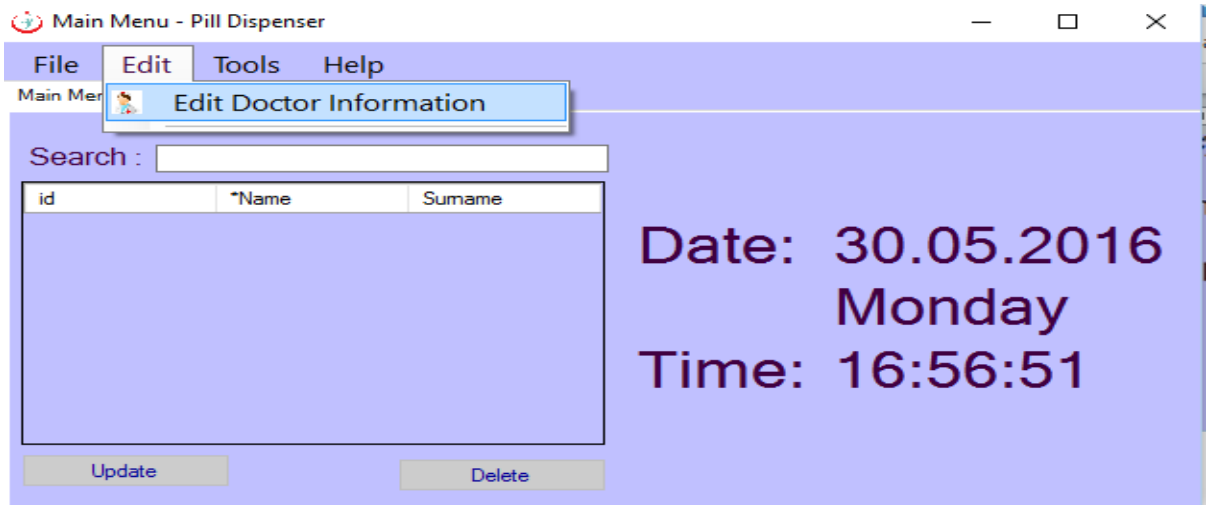

Figure 6. 12 Edit Doctor Information

Figure 6. 13 Edit Doctor Information

6.1.1.4 Tools Option

Under the tools option, username and password can be change as shown in Figure 6.14 and Figure 6.15.

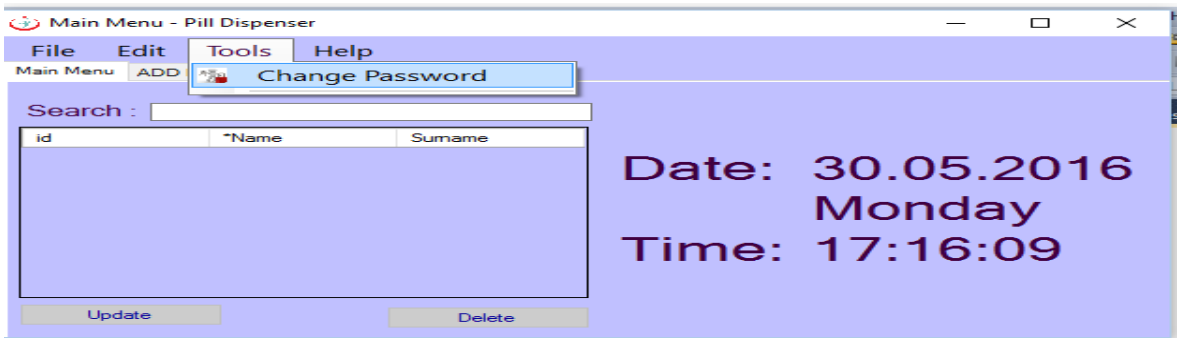

Figure 6. 14 Changing the password 1

Figure 6. 15 Changing the password 2

6.1.1.5 Help Option

There are two options under the help option as shown in Figure 6.16 and Figure 6.17.

a- Support

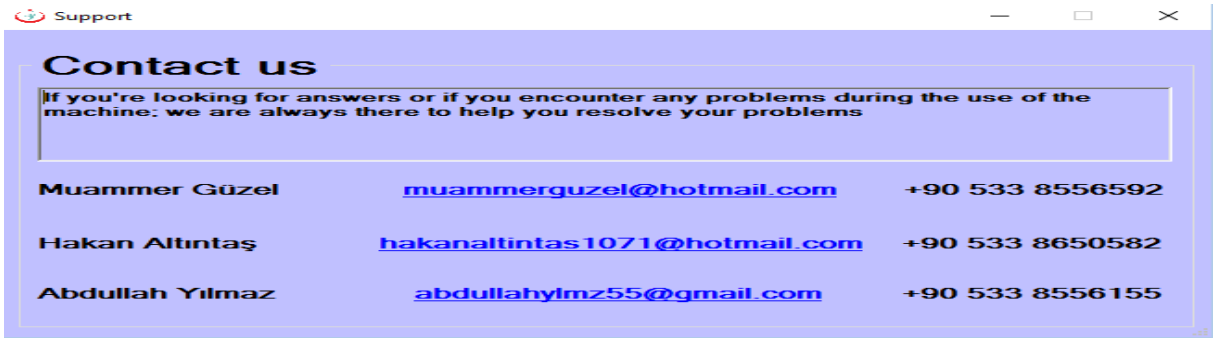

Figure 6. 16 Contact us

b- About Automated Pill Dispenser

Figure 6. 17 About Automated Pill Dispenser

6.2 Future Works

Ethernet Automatic Pill Dispenser (e-APD) is compound of mechanical structure, electronic materials and Arduino. e-APD communicates with Arduino using interface that on the doctors' computer. APD has 3 different containers which contain 3 different pills. Applicability of pill dispenser is promising for future works. In addition, it can be developed easily.

As known that, e-APD has software in the PC. One of these developments is using it in the mobile application for android or iOS. Another development can be feedback. For example using some specific sensors in the e-APD, program can detect whether patient takes the pills or not and patient relatives or the doctor can be informed via SMS or e-mail.

Another way of developing of e-APD is that using smart clock that can be used for blood pressure measurement and heart beat changes and inform the relatives of patient and doctor. Also there can be an emergency button on the machine. When press it, doctors may be informed and ambulance can be called. For interface, a button can be added which reset the password. These innovations or developments are limited by human imagination.

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APPENDICES

APPENDIX A
LOGBOOKS

Hakan's Logbook

12.10.2015	First of all, we search the some Project and we discuss together with our friends.
19.10.2015	This week we decided to Pill Dispenser Project with our friends and our advisor Assist. Prof. Dr. Davut SOLYALI
26.10.2015	I find the some information about the Project and also I start to prepare the Gantt chart.
02.11.2015	We start to research of our project that Automated Pill Dispenser Systems we collect the general information
09.11.2015	We visit the our advisor and we give the information what we are doing for the project
16.11.2015	We visited our advisor to get information about the Project and we distribute the duty in our group.
23.11.2015	I search the information about the Project what we use in this Project, how we can develop this project.

24.11.2015	I learn lots of thinks about the e-APD system like working principle
30.11.2015	I prepared appendix, Gantt chart and my logbooks for the final report. Also I did some calculation
02.12.2015	I did some calculation about the Project. I discuss with my friend how we can fix the part. Also I collect the information for the final report.
07.12.2015	I continue the collect the information and I prepare the proposal with my friends. Also I start to write Chapter 2.
14.12.2015	I finished the proposal with my friends and I continue the write the Chapter 2 and I help to somewhere in chapter 1 to my friends.
21.12.2015	I finished the Chapter 2 and also we finished the writing formula and calculation.
28.12.2015	I prepared appendix, Gantt chart and my logbooks for the final report.
10.02.2016	Plexiglas design and measurements are discussed with team members.
11.02.2016	Plexiglas was machined according to the design in Turkey.

23.02.2016	New design assembled on the SolidWorks.
01.03.2016	Project raw materials were bought.
02.03.2016	C# interface was discussed with Assist. Prof. Dr. Davut SOLYALI and new ideas and new design were found out.
08.03.2016	Assembly was discussed with Hamed POURASL for the machine on CNC machine.
15.03.2016	Step motor drivers problem solved with Ayhan ÖZGÜR.
29.03.2016	Step motor connection mil machined and mil ball bearing bed machined according the drawings
01.04.2016	Ball bearing bed machined and tested.
25.04.2016	Some parts machined on the CNC machine with Hamed POURASL
04.05.2016	After the CNC machine, parts machined on the workshop and tested.
11.05.2016	Mill, bearing and step motor were assembled.

18.05.2016	Step motor was tested on the assembled and requires adjustment (balance) was made
20.05.2016	Step motor platform was failed and new ideas was found with technician Servet UYANIK
21.05.2016	Middle platform was assembled and step motor mechanics were machined
27.05.2016	Middle platform assembled is finished and tested.

Muammer's Logbook

12.10.2015	First of all, we search the some Project and we discuss together with our friends.
19.10.2015	This week we decided to Pill Dispenser Project with our friends and our advisor Assist. Prof. Dr. Davut SOLYALI
26.10.2015	I start to prepare the Gantt chart.
02.11.2015	We start to research of our project that Automated Pill Dispenser Systems we collect the general information
09.11.2015	I continue the collect the information about the ASRS and I try to learn Automated Pill Dispenser systems. Also we visit our advisor and we give the information what we are doing.
16.11.2015	We visited our advisor to get information about the Project and we distribute the duty in our group.
23.11.2015	We search the information about the Project what we use in this Project like sensors, design, etc.
24.11.2015	I prepared appendix, Gantt chart and my logbooks for the final report.
30.11.2015	I draw the design of ASRS system with my Project member from SolidWorks.

02.12.2015	I did some calculation about the Project. I discuss with my friend How we can fix the part. Also I collect the information for the final report.
07.12.2015	I continue the collect the information and I prepare the proposal with my friends. Also I start to write Chapter 3.
14.12.2015	I finished the proposal with my friends and I continue the write the Abstract.
21.12.2015	I finished the Chapter 3 and also we finished the writing formula and calculation.
28.12.2015	I prepared appendix, Gantt chart and my logbooks for the final report.
10.02.2016	Plexiglass design and measurements are discussed with team members.
11.02.2016	Electronic material was bought.
23.02.2016	New design assembled on the SolidWorks.
01.03.2016	C sharp and Arduino connection was tested.
02.03.2016	C# interface was discussed with Assist. Prof. Dr. Davut SOLYALI and new ideas and new design were found out.

08.03.2016	Real time clock module was tested.
15.03.16	Step motor drivers were chanced and tested.
29.03.2016	Step motors were assembled on the machine and tested.
01.04.2016	Arduino sensors were tested.
04.04.2016	Ethernet module problem was solved.
11.05.2016	Step motors adjustment was done on the mechanical part
20.05.2016	Step motor platform was failed and new ideas was found with technician Servet UYANIK
27.05.2016	Middle platform assembled is finished and tested.

Abdullah's Logbook

12.10.2015	First of all, we search the some Project and we discuss together with our friends.
19.10.2015	This week we decided to Pill Dispenser Project with our friends and our advisor Assist. Prof. Dr. Davut SOLYALI
26.10.2015	I start to prepare the Gantt chart.
02.11.2015	We start to research of our project that Automated Pill Dispenser Systems we collect the general information
09.11.2015	We visit our advisor and we give the information what we are doing. Also I search the information about the Project material.
16.11.2015	We visited our advisor to get information about the Project and we distribute the duty in our group.
23.11.2015	I search the information about the Project what we use in this Project like sensors, design, etc.
12.10.2015	I learn lots of thinks about the e-APD system like working principle. I draw the concept design.
19.10.2015	I prepared appendix, Gantt chart and my logbooks for the final report.

24.11.2015	I draw the design of e-APD system with my Project member from SolidWorks.
30.11.2015	I did some calculation about the Project. I discuss with my friend what we will use for the design. Also I collect the information for the final report.
02.12.2015	I continue the collect the information and I prepare the proposal with my friends. Also I start to write Chapter 1.
07.12.2015	I finished the proposal with my friends and I continue the write the Chapter 1.
14.12.2015	I finished the Chapter 1 and also I finished the writing formula and calculation.
21.12.2015	I prepared appendix, Gantt chart and my logbooks for the final report.
28.12.2015	Working on assembling and resulting the final report for the submission,
10.02.2016	Plexiglas design and measurements are discussed with team members.
20.02.2016	C sharp menu designed was searched.

21.02.2016	Electronic material was bought
23.02.2016	New design assembled on the SolidWorks
01.03.2016	C sharp and Arduino connection was tested.
02.03.2016	C# interface was discussed with Assist. Prof. Dr. Davut SOLYALI and new ideas and new design were found out.
05.03.2016	New c sharp menu designed.
08.03.2016	Arduino Ethernet module tested and data transfer successfully done.
17.03.2016	C sharp menu discussed with team members
01.04.2016	C sharp database was created

10.05.2016	Doctor password and username was add in the database
11.05.2016	Step motor control was done
15.05.2016	Patient information were saved on the database
27.05.2016	Middle platform assembled is finished and tested.

APPENDIX B
GANTT CHART

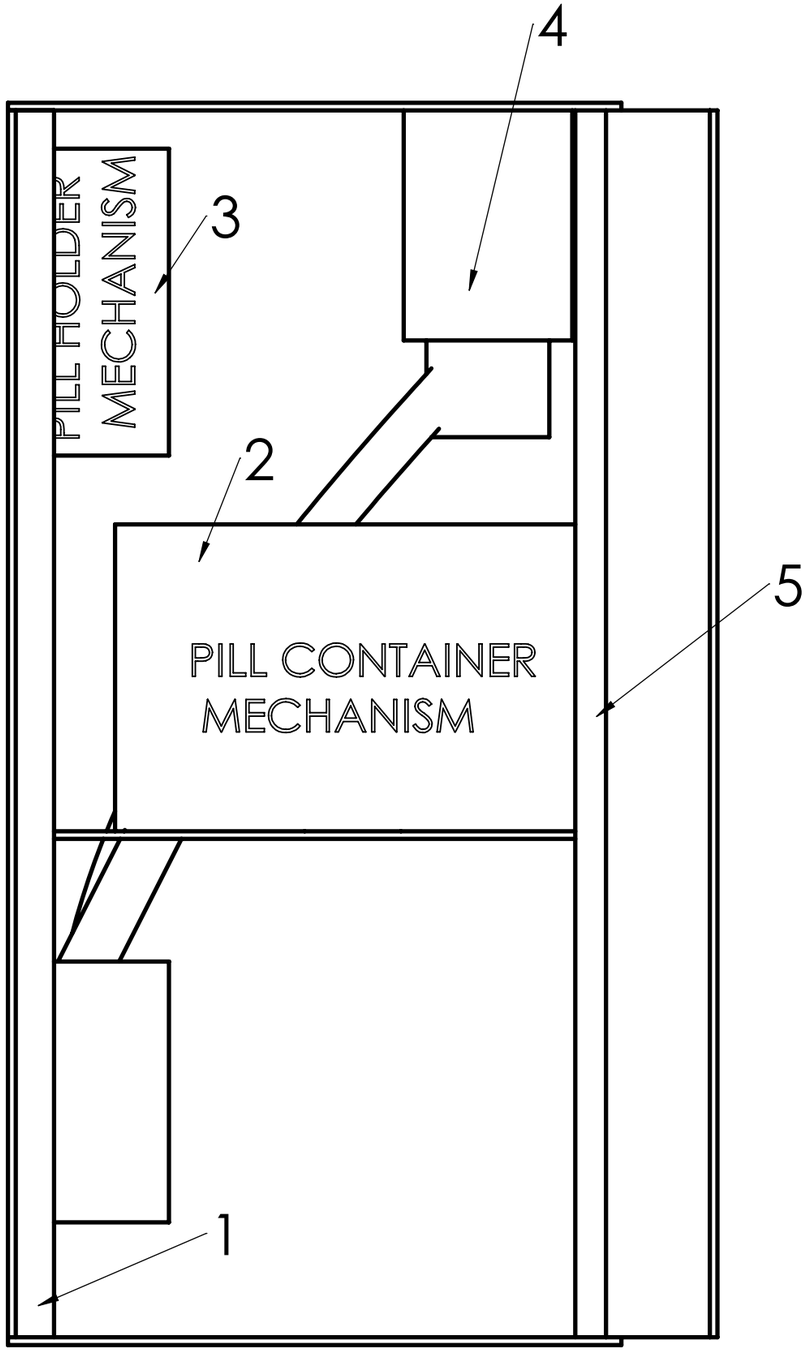
	12.09.2015	19.09.2015	26.09.2015	02.11.2015	09.11.2015	16.11.2015	23.11.2015	30.11.2015	07.12.2015	14.12.2015	21.12.2015	28.12.2015
Selecting project												
Start to preparing Gantt chart												
Searching information about the project												
Learning to Pill dispenser system												
Distribution of duty												
Design and calculation												
Collecting information												
Preparing to proposal												
Preparing to report writing												
Writing chapter 1, 2 and 3												
Writing formula and calculation												
Resulting the final report												

	10.02.2016	17.02.2016	24.02.2016	02.03.2016	09.03.2016	16.03.2016	23.03.2016	30.03.2016	06.04.2016	13.04.2016	20.04.2016	27.04.2016	04.05.2016	11.05.2016	18.05.2016	25.05.2016
Design of Plexiglas and cutting																
Electronic material search																
Searching information about the vacuum																
Searching Arduino and C sharp connection																
Step Motor driver and sensor delivery																
Designing main structure																
Adding stepper motor and testing																
Bearing beds machined																
material cutting on the CNC machine																
Program writing in Arduino and C sharp																
Preparing control box																

Table 5: Distribution of Tasks

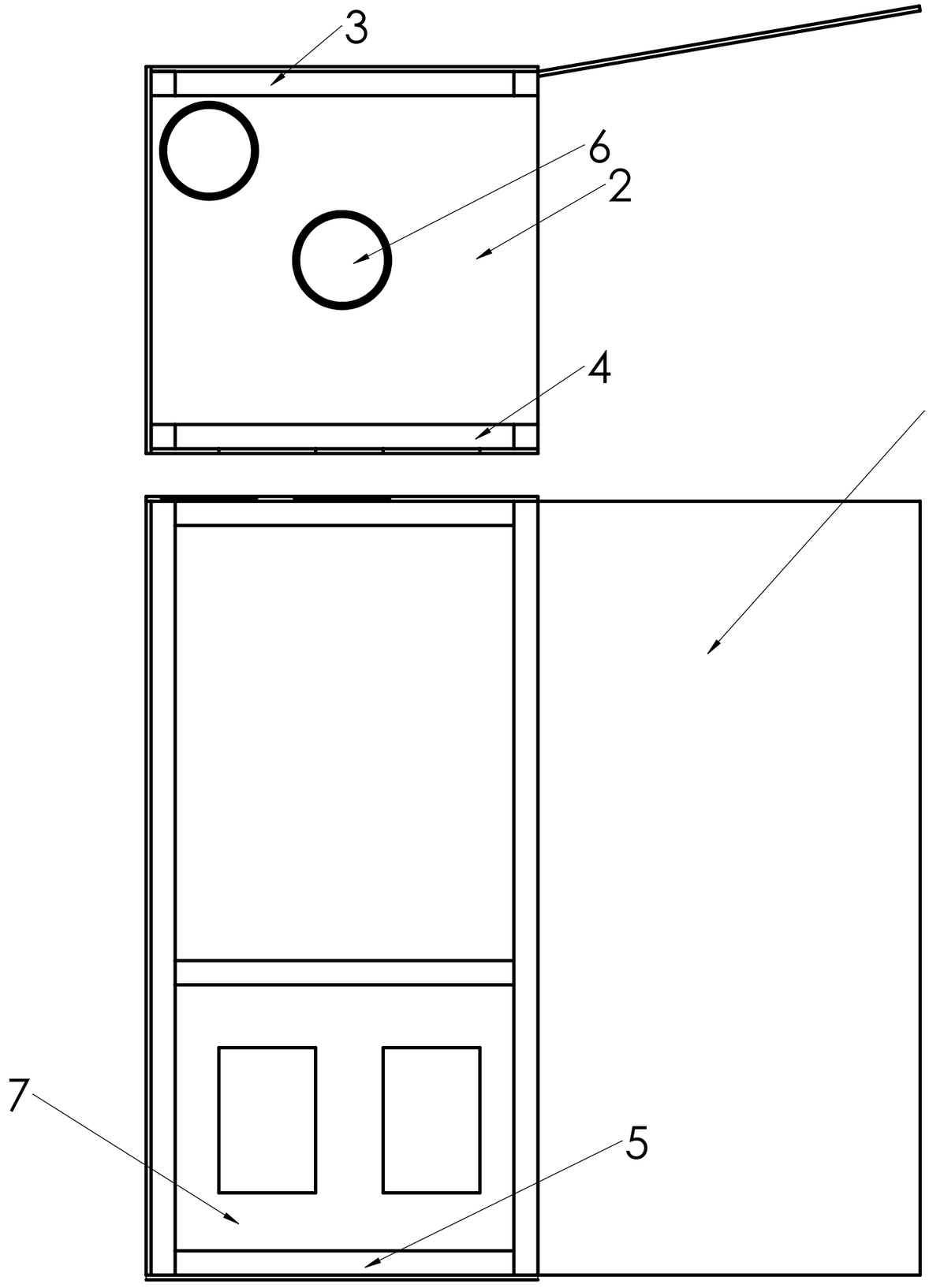
DISTRIBUTION OF TASKS	HAKAN	MUAMMER	ABDULLAH
PLEXIGLASS DECISION	X	X	X
PLEXIGLASS PURCHASING	X		
MATERIAL SELECTION	X	X	X
MOTOR SELECTION	X	X	X
MILL SELECTION AND PURCHASING	X		X
PLEXIGLASS ASSEMBLY	X	X	X
C SHARP MENU IDEA	X	X	
PILL HOLDER MECHANISM IDEA	X		
MIDDLE MECHANISM IDEA	X	X	
MIDDLE SYSTEM DESIGN	X	X	X
CUTTING PLASTIC MATERIAL ON CNC		X	
VACUUM PUMP IDEA	X	X	X
SOLIDWORK DESIGN		X	
STEPPER MOTOR ASSEMBLY	X	X	X
STEPPER MOTOR ASSEMBLY		X	X
MIDDLE MECHANISM ASSEMBLY	X	X	
CHAIN AND MOTOR MIL IDEA	X		
ELECTRONICS AND CABLE CONNECTIONS		X	
ARDUINO		X	
C SHARP			X
REPORT WRITING	X	X	X
SOLIDWORKS DESIGN	X	X	X
SOLVING MECHANICAL PROBLEMS	X	X	X
CONTROLLER BOX	X	X	X

APPENDIX C
DRAWING



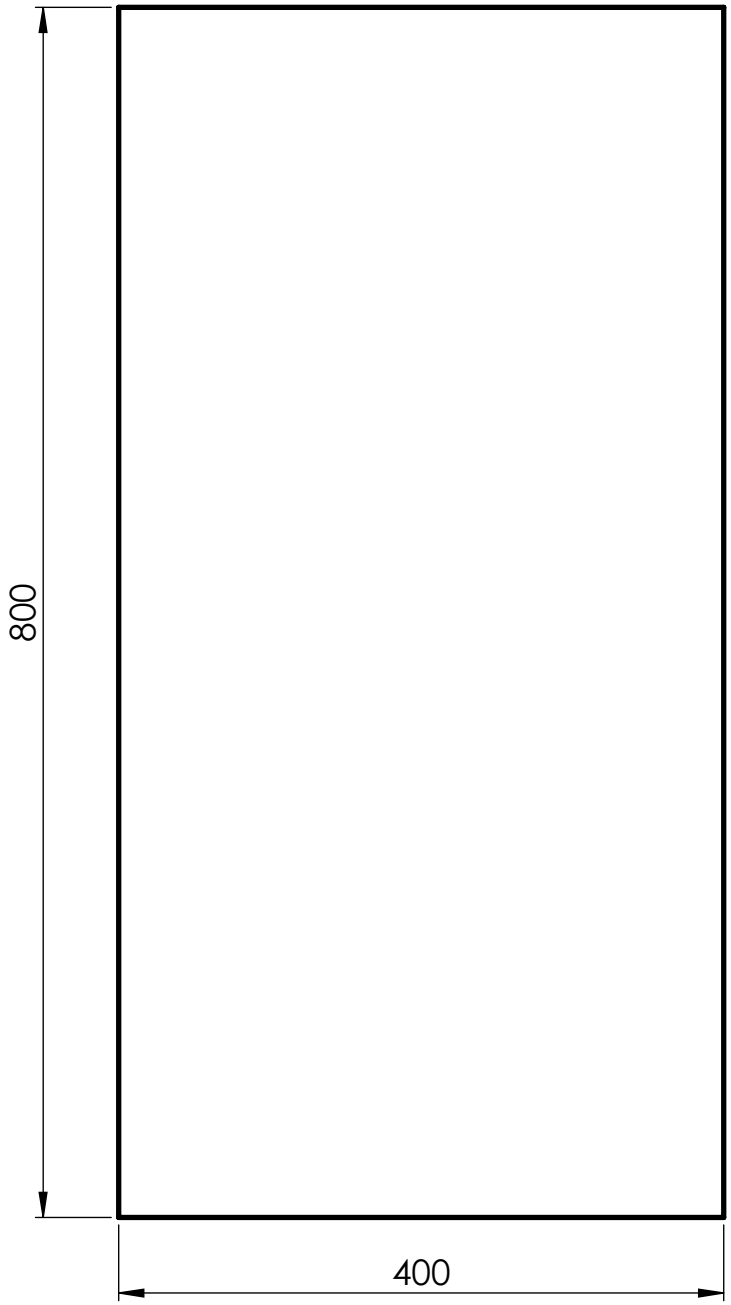
NO	NAME	AMOUNT	DESCRIPTION
5	M3 NUTS AND BOLTS	52	TS 1026-1
4	WATER TANK	1	PLASTICS
3	PILL HOLDER MECHANISM	1	PLEXIGLASS
2	PILL CONTAINER MECHANISM	1	PLEXIGLASS
1	BODY OF MACHINE	1	PLEXIGLASS

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:4	PILL DISPENSER ASSEMBLY			DRAWING NO 1



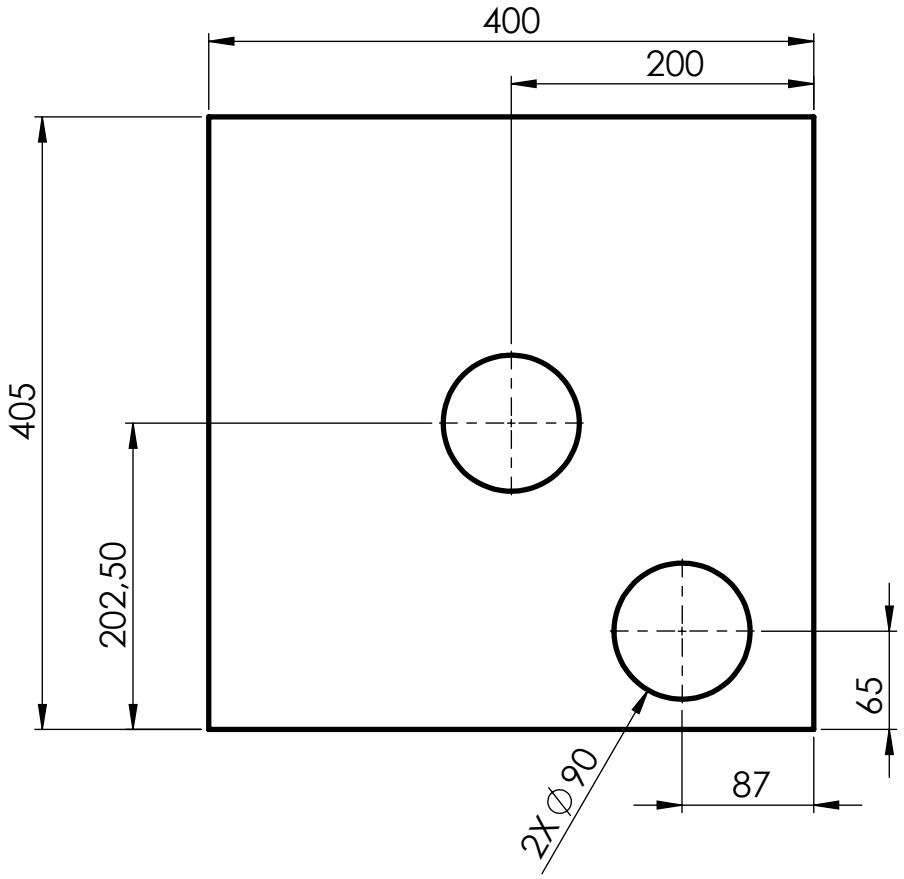
7	FRONT SIDE OF THE MACHINE	3	PLEXIGLASS
6	COVER OF THE WATER AND PILL TANK	2	PLEXIGLASS
5	BOTTOM SUPPORT OF THE PLEXIGLASS	4	ALUMINUM
4	LOWER SUPPORT OF THE PLEXIGLASS	4	PLEXIGLASS
3	UPPER SUPPORT OF THE PLEXIGLASS	4	ALUMINUM
2	TOP OF THE MACHINE	1	PLEXIGLASS
1	DOOR	1	PLEXIGLASS
NO	NAME	AMOUNT	DESCRIPTION

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	BODY OF MACHINE			DRAWING NO 1-1



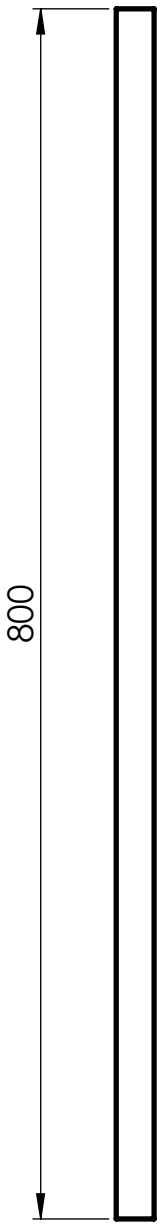
NOTES
1. REMOVE ALL SHARP EDGES
2. TICKNESS IS 5MM
3. MATERIAL IS PLEXIGLASS

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	DOOR			DRAWING NO 1-1-1



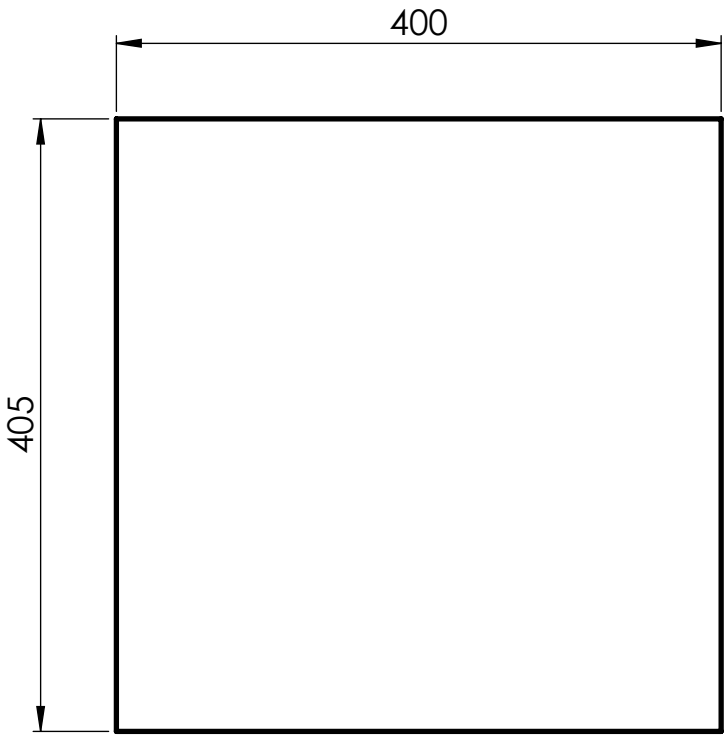
NOTES
1. REMOVE ALL SHARP EDGES
2. TICKNESS IS 5MM
3. MATERIAL IS PLEXIGLASS

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	TOP OF THE MACHINE			DRAWING NO 1-1-2



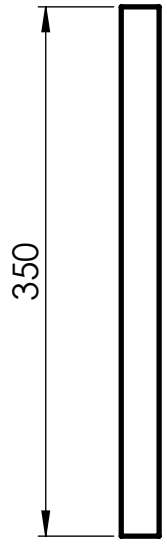
NOTES
1. REMOVE ALL SHARP EDGES
2. 25X25 SQUARE PROFILE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	UPPER SUPPORT OF THE PLEXIGLASS			DRAWING NO 1-1-3



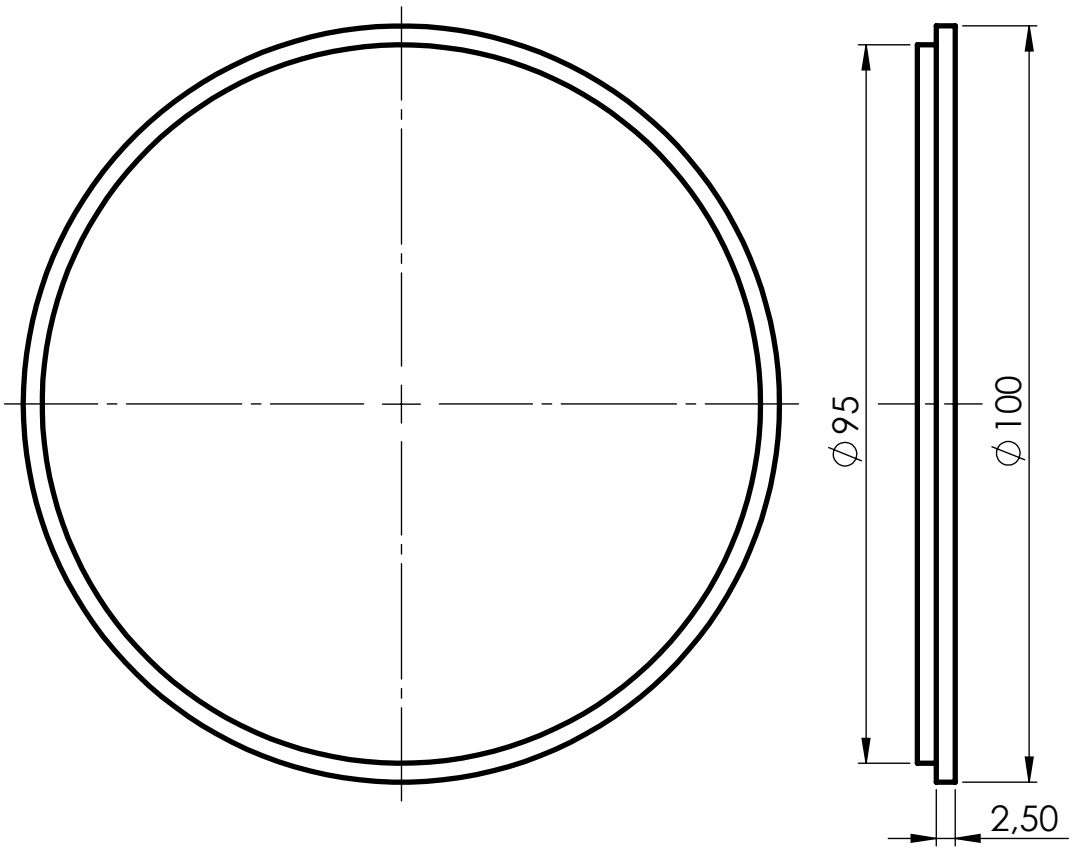
NOTES
1. REMOVE ALL SHARP EDGES
2. TICKNESS IS 5MM

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	LOWER SUPPORT OF THE MACHINE			DRAWING NO 1-1-4



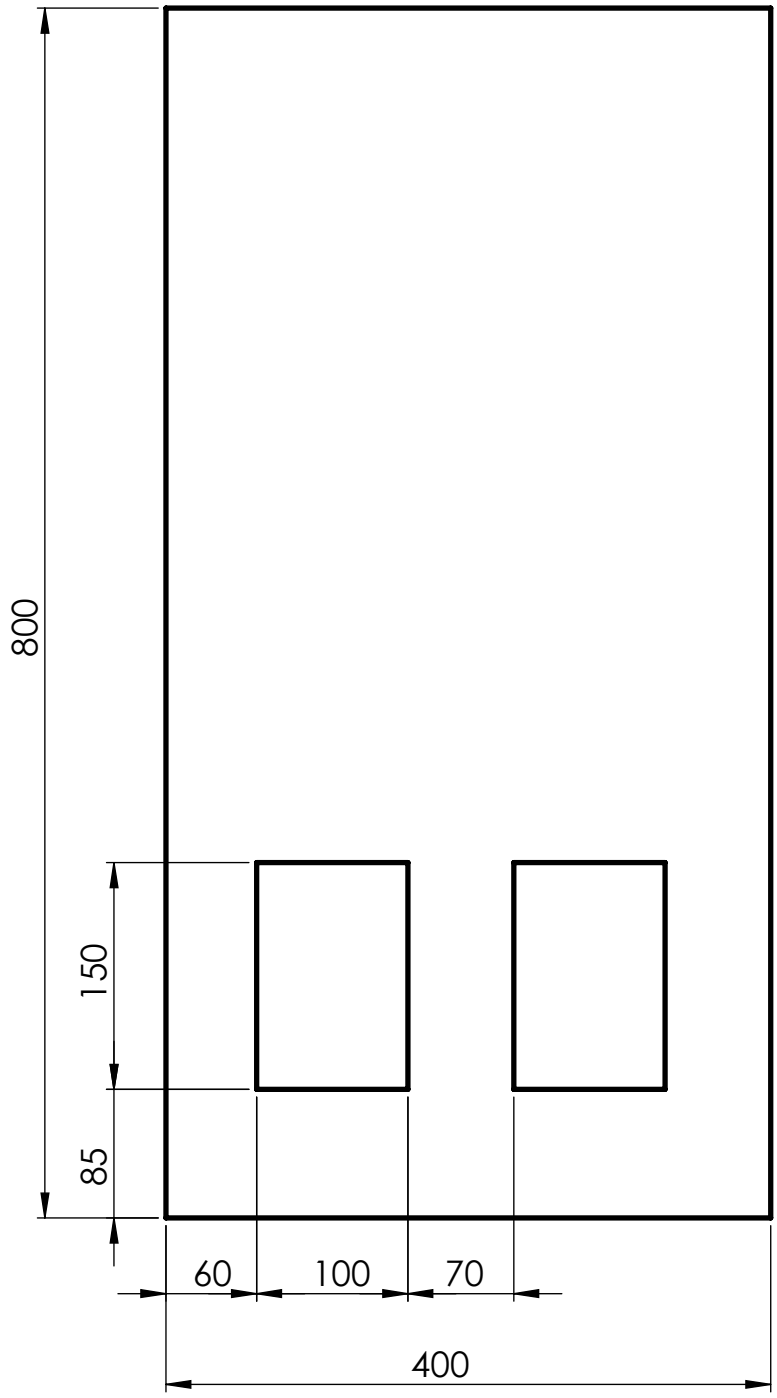
NOTES
1. REMOVE ALL SHARP EDGES
2. 25X25 SQUARE PROFILE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	BOTTOM SUPPORT OF THE PLEXIGLASS			DRAWING NO 1-1-5



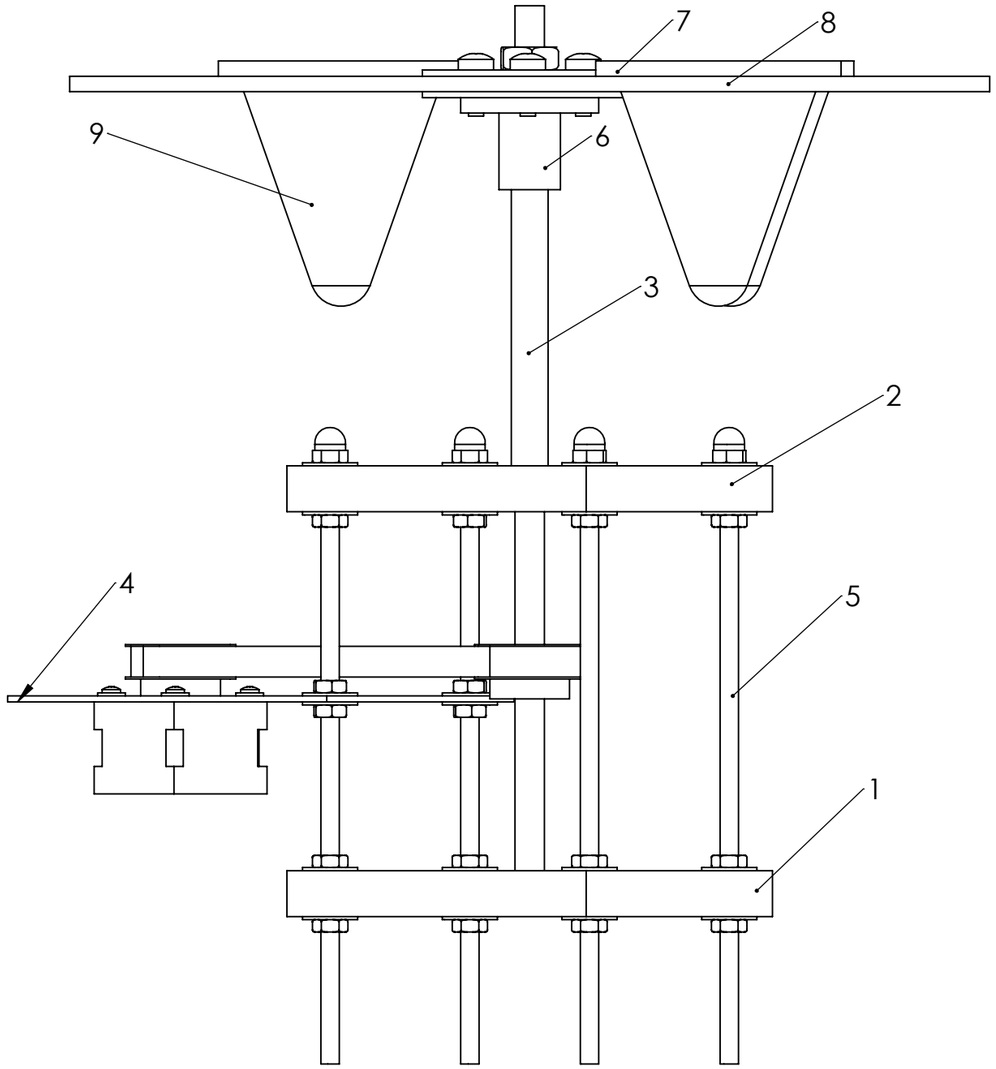
NOTES
1. REMOVE ALL SHARP EDGES
2. TICKNESS IS 5MM
3. MATERIAL IS PLEXIGLASS

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	COVER OF THE WATER AND PILL TANK			DRAWING NO 1-1-6



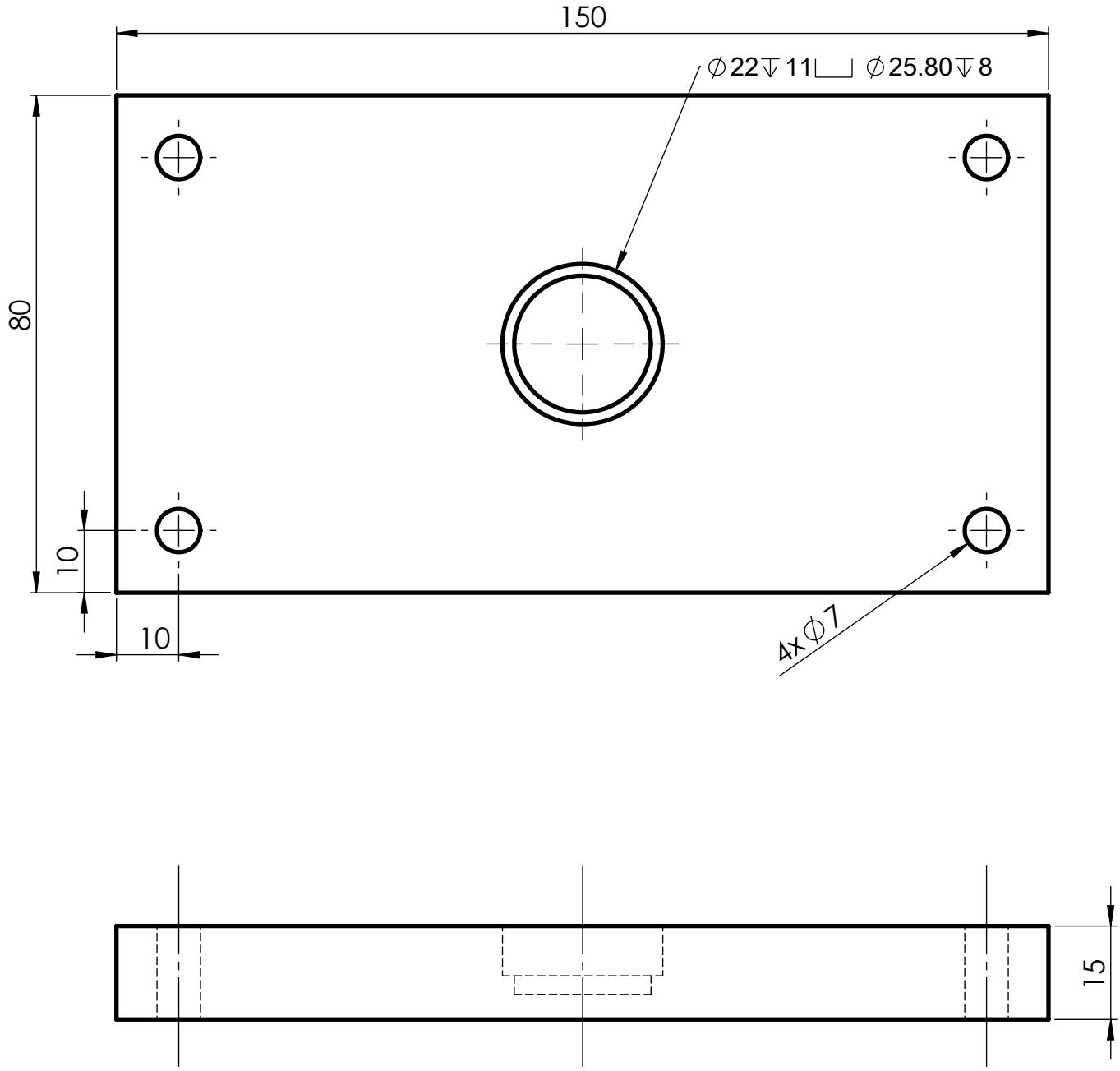
NOTES
1. REMOVE ALL SHARP EDGES
2. TICKNESS IS 5MM
3. MATERIAL IS PLEXIGLASS

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/16		EMU
CHK. BY	D. SOLYALI	22/06/16		
SCALE 1:5	FRONT SIDE OF THE MACHINE			DRAWING NO 1-1-7



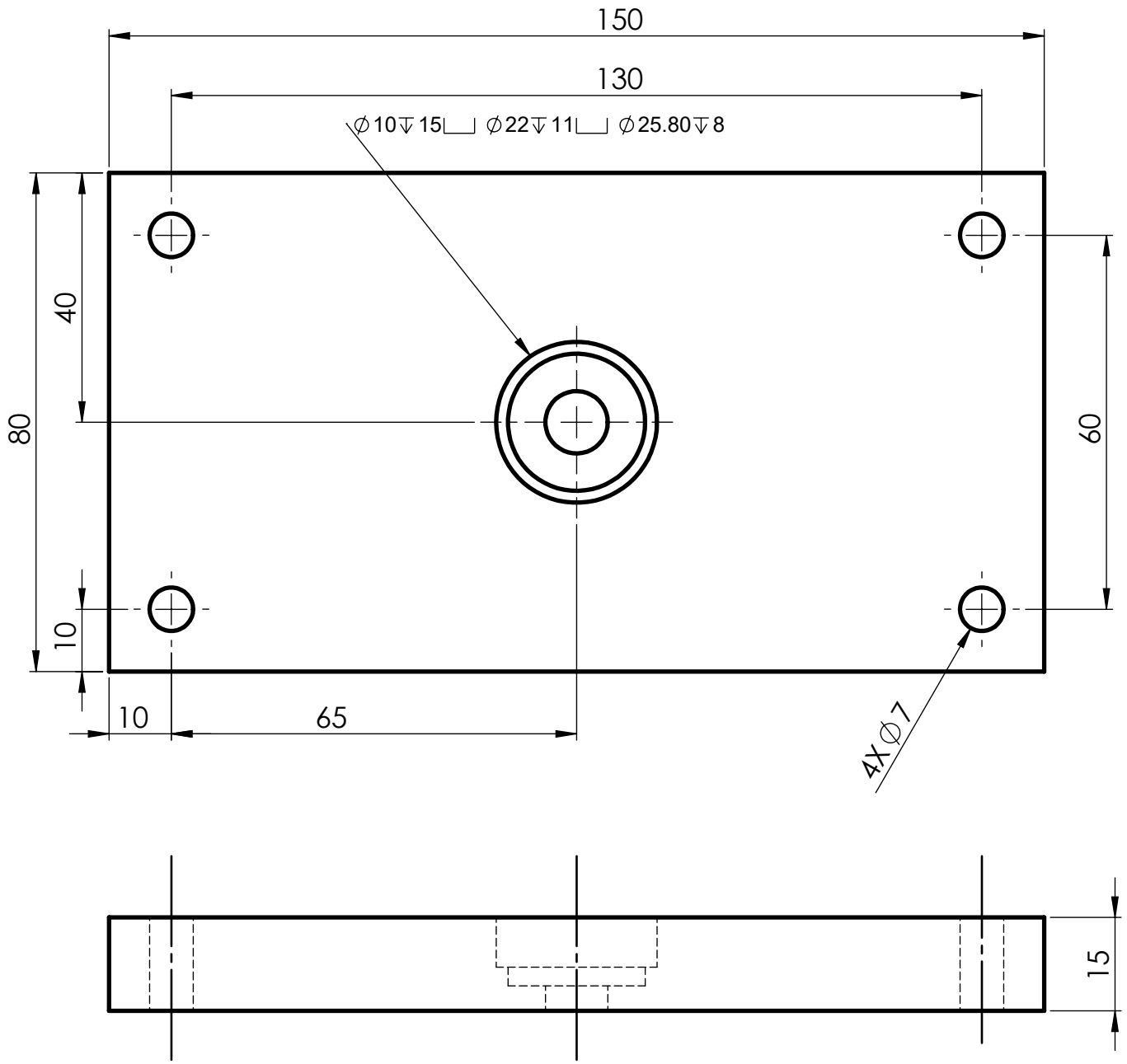
NO	NAME	AMOUNT	DESCRIPTION
9	PILL CUP	3	HORNBEAM WOOD
8	PLEXIGLASS	1	PLEXIGLASS
7	ALUMINUM SHEET PLATE	2	ALUMINUM
6	PLEXIGLASS HOLDER	1	LOW CARBON STEEL
5	M6 THREADED ROD	4	LOW CARBON STEEL
4	STEPPER MOTOR HOLDER	1	STAINLESS STEEL
3	THREADED ROD	1	LOW CARBON STEEL
2	BEARING BED UPPER PART	1	PLASTIC
1	BEARING BED LOWER PART	1	PLASTIC

	NAME	DATE	SIGN	
DRW. BY	121776	22/062016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:2	PILL CONTAINER ASSEMBLY			DRAWING NO 1-2



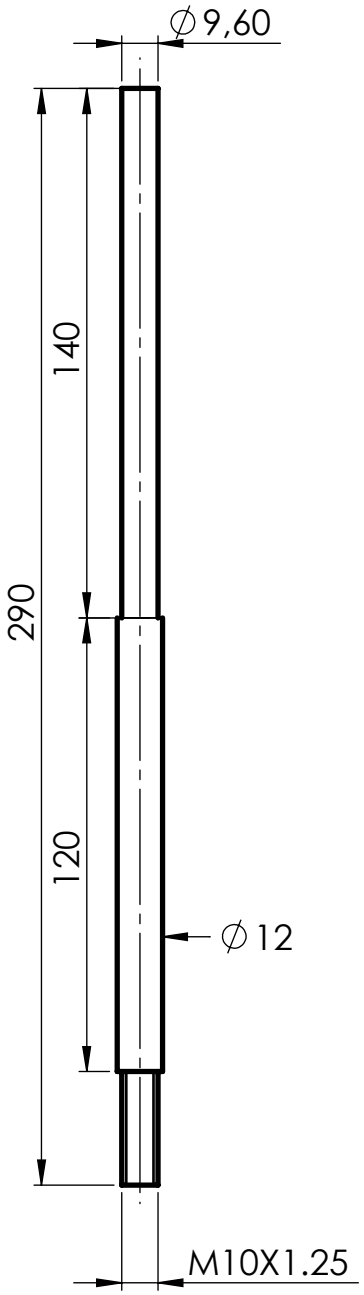
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED LOWER PART			DRAWING NO 1-2-1



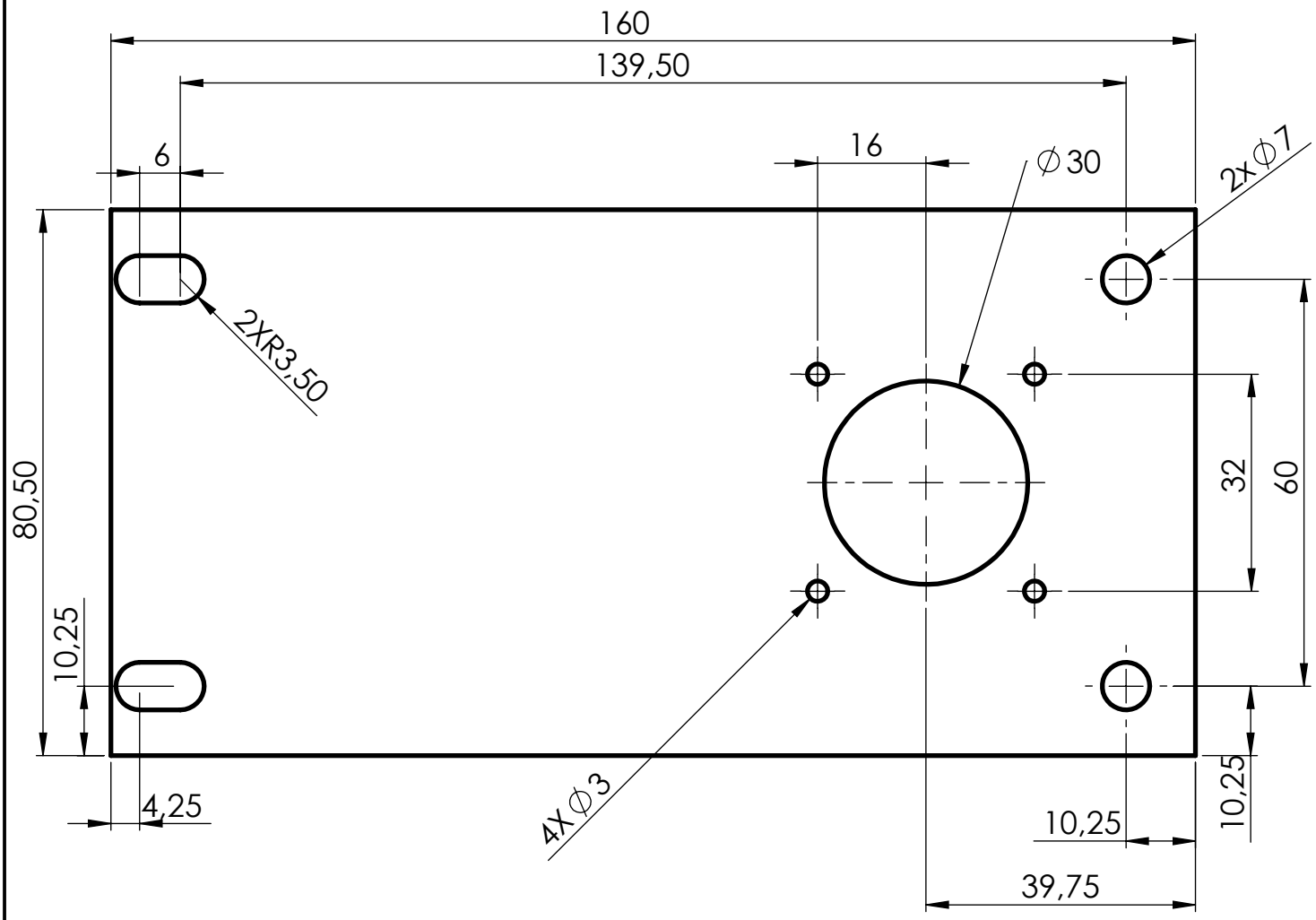
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED UPPER PART			DRAWING NO 1-2-2



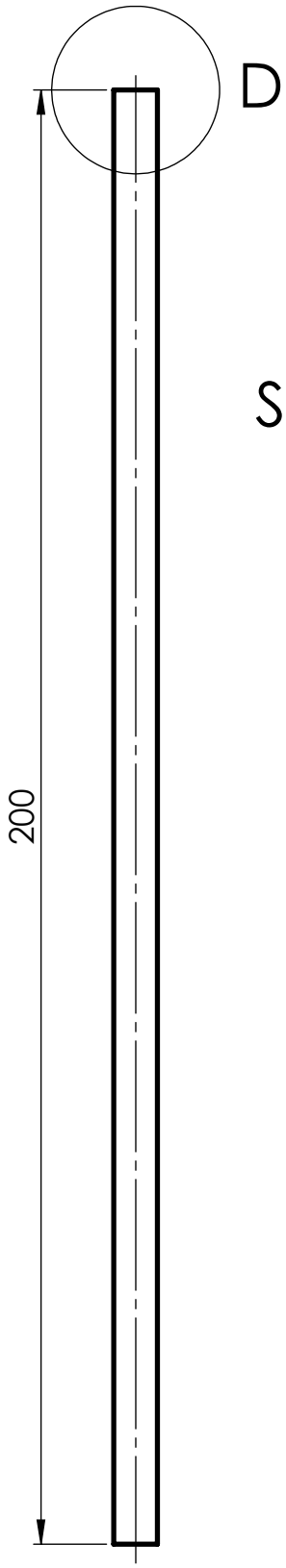
NOTES
1. REMOVE ALL SHARP EDGES

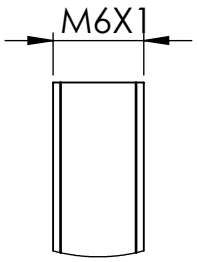
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:2	TREATED ROD			DRAWING NO 1-2-3



NOTES
1. REMOVE ALL SHARP EDGES
2. THICKNESS IS 2 MM
3. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	STEPPER MOTOR HOLDER			DRAWING NO 1-2-4

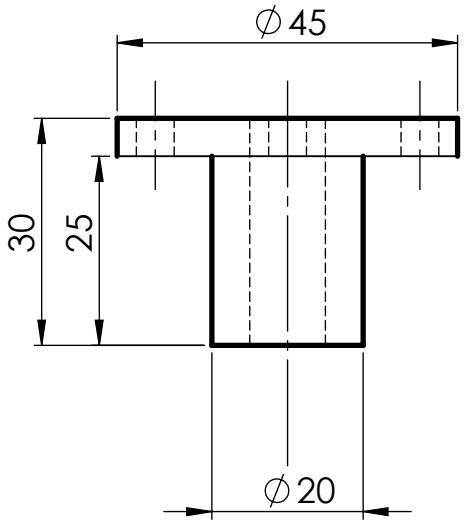


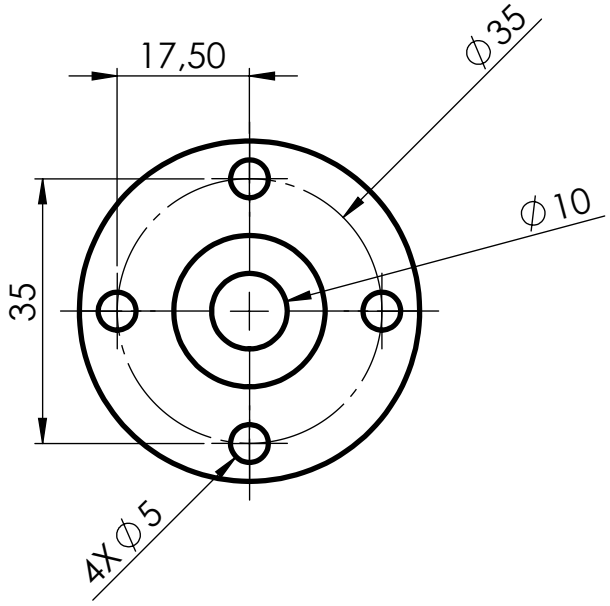


DETAIL D
SCALE 2 : 1

NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

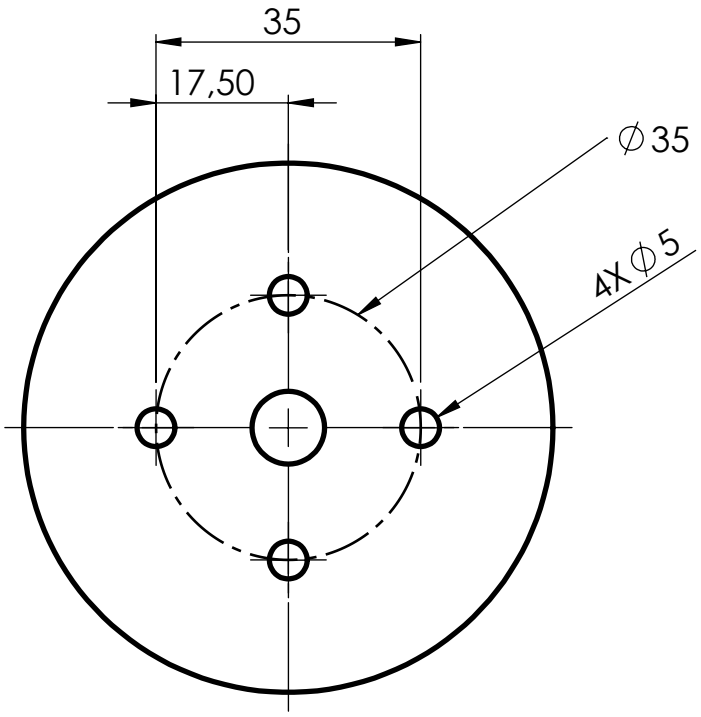
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	M6 THREATED ROD			DRAWING NO 1-2-5

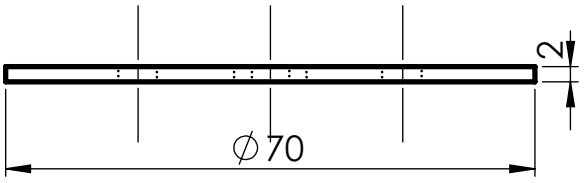




NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

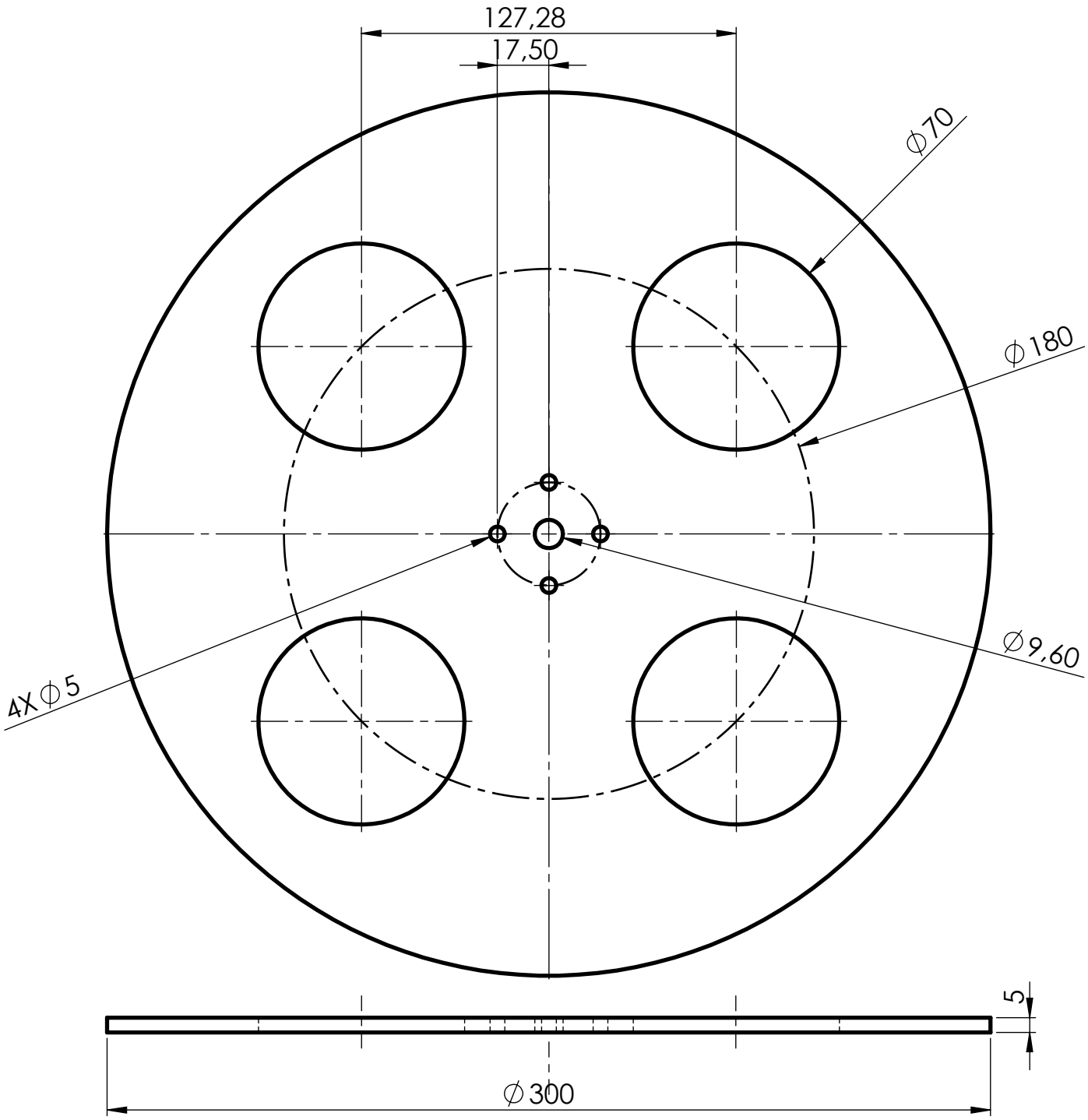
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	PLEXIGLASS HOLDER			DRAWING NO 1-2-6





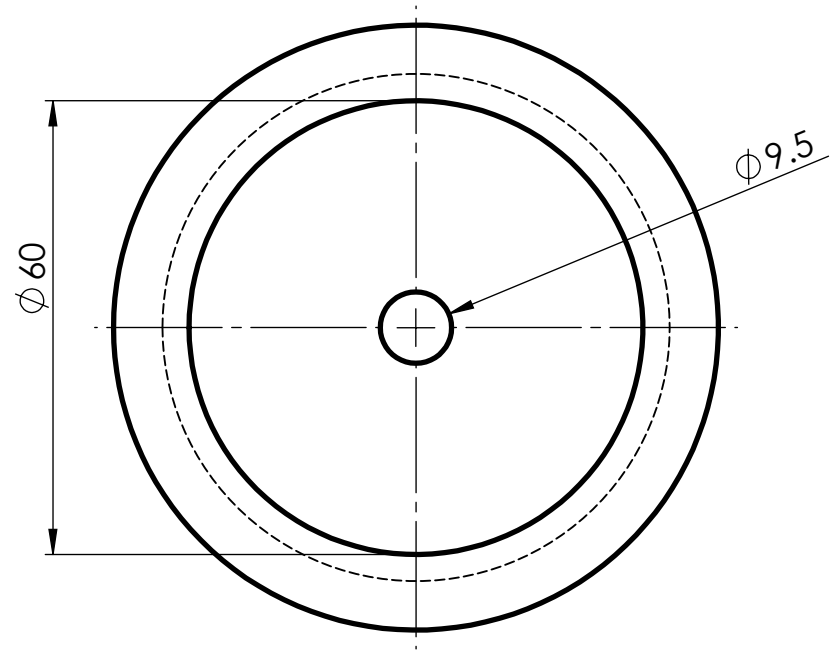
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

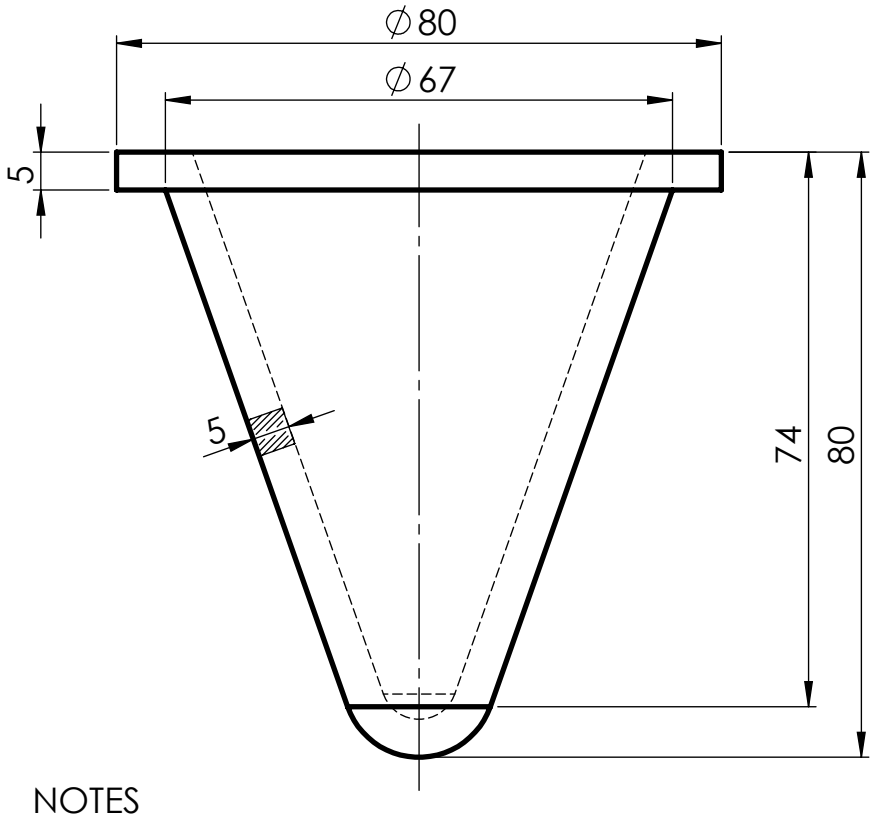
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	ALUMINUM SHEET PLATE			DRAWING NO 1-2-7



NOTES
1. REMOVE ALL SHARP EDGES

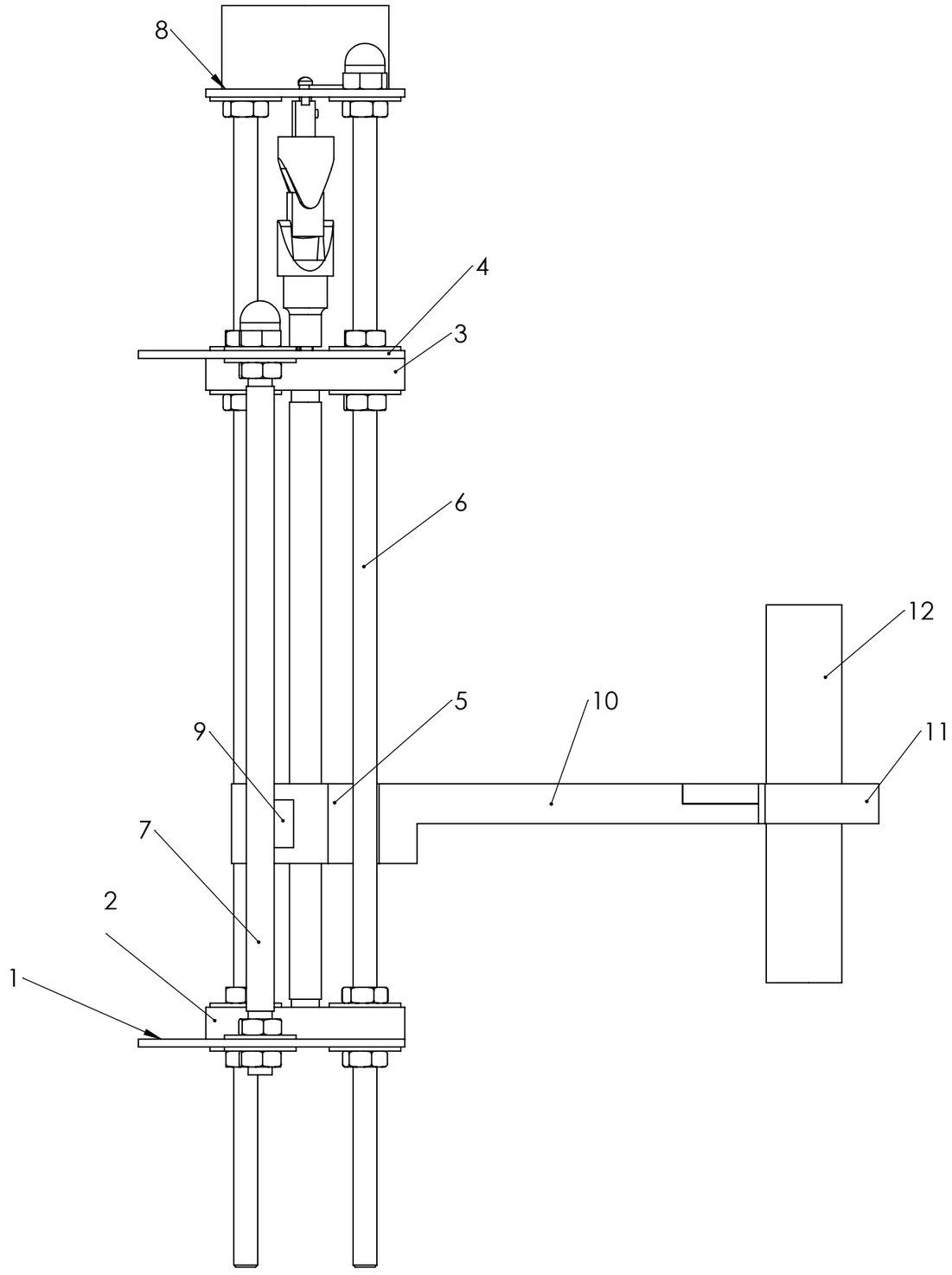
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:2	PLEXISIGLASS			DRAWING NO 1-2-8





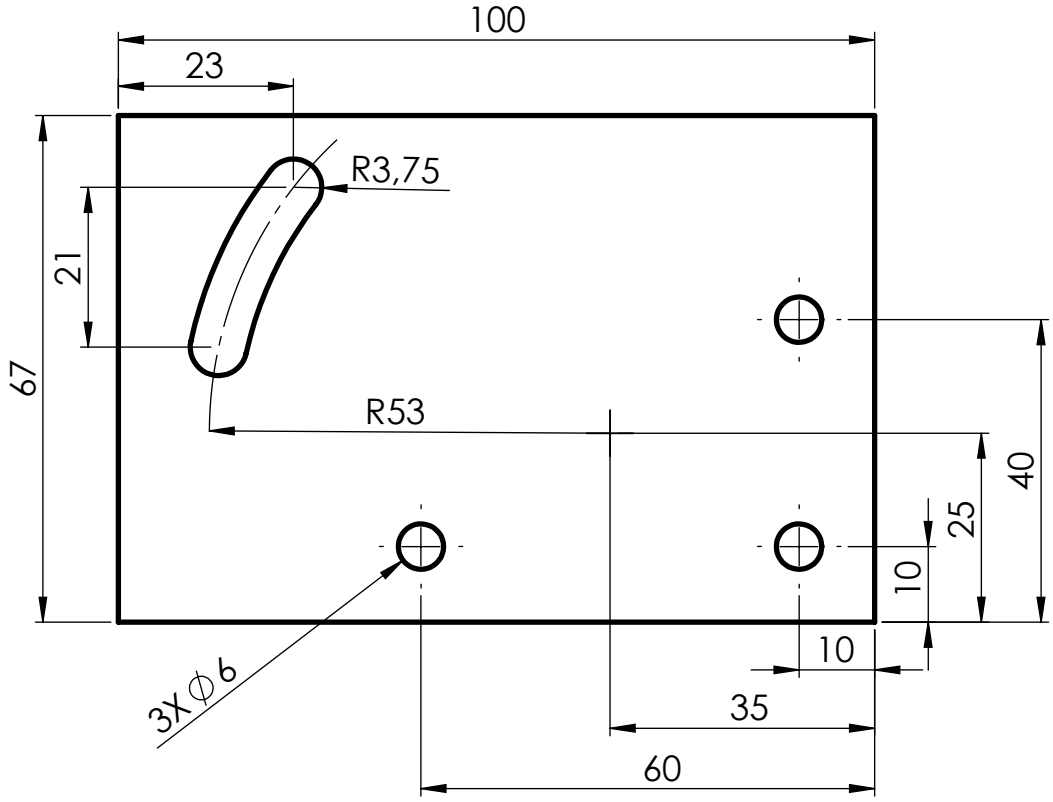
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	PILL CUP			DRAWING NO 1-2-9



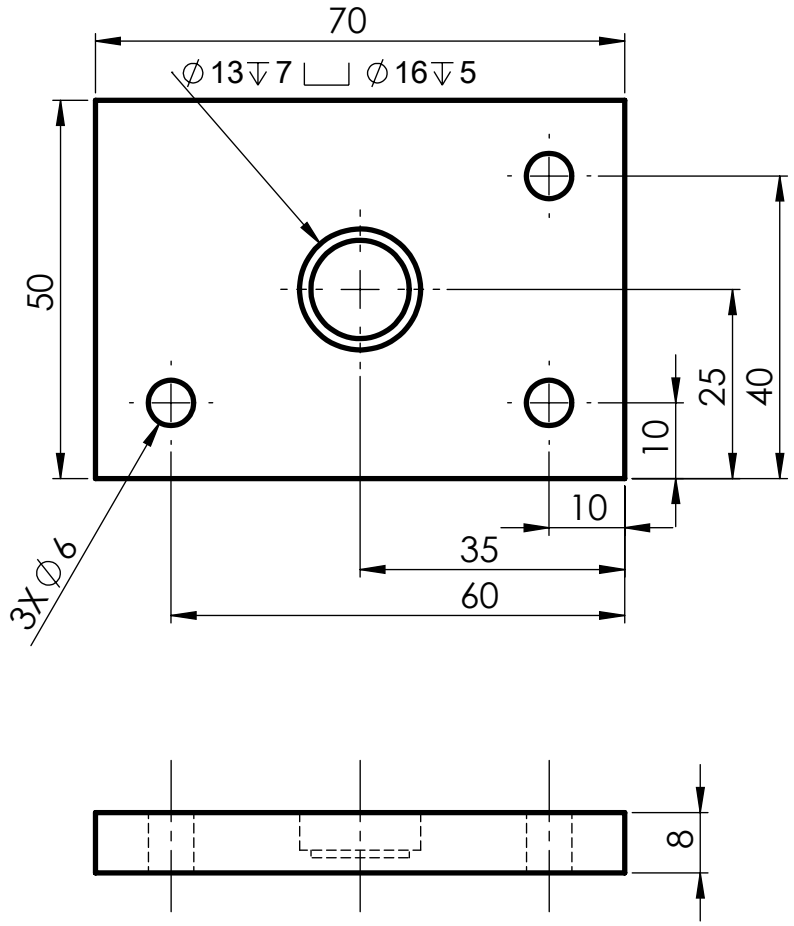
NO	NAME	AMOUNT	DESCRIPTION
12	ALUMINIUM PIPE	1	ALUMINIUM
11	PIE HOLDER	1	PLASTIC
10	VACUUM AL. PIE HOLDER	1	PLASTIC
9	T PART	1	ALUMINIUM
8	STEPPER MOTOR SUPPORT PART	1	LOW CARBON STEEL
7	SUPPORT ROD	1	LOW CARBON STEEL
6	M6 THREADED ROD	3	LOW CARBON STEEL
5	CONNECTION PART	1	PLASTIC
4	BEARING BED UPPER SUPPORT PART	1	LOW CARBON STEEL
3	BEARING BED UPPER PART	1	PLASTIC
2	BEARING BED LOWER PART	1	PLASTIC
1	BEARING BED LOWER SUPPORT PART	1	LOW CARBON STEEL

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:0.75	PILL HOLDER MECHANSIM			DRAWING NO 1-3



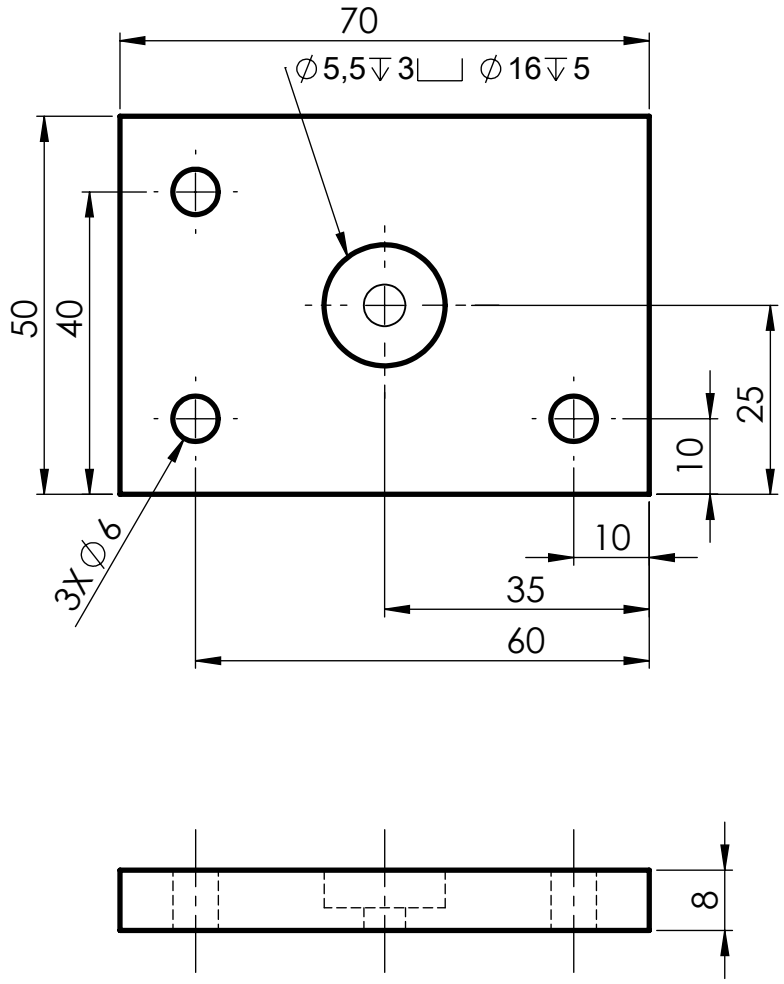
NOTES
1. REMOVE ALL SHARP EDGES
2. THICKNESS IS 2MM
3. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED LOWER SUPPORT PART			DRAWING NO 1-3-1



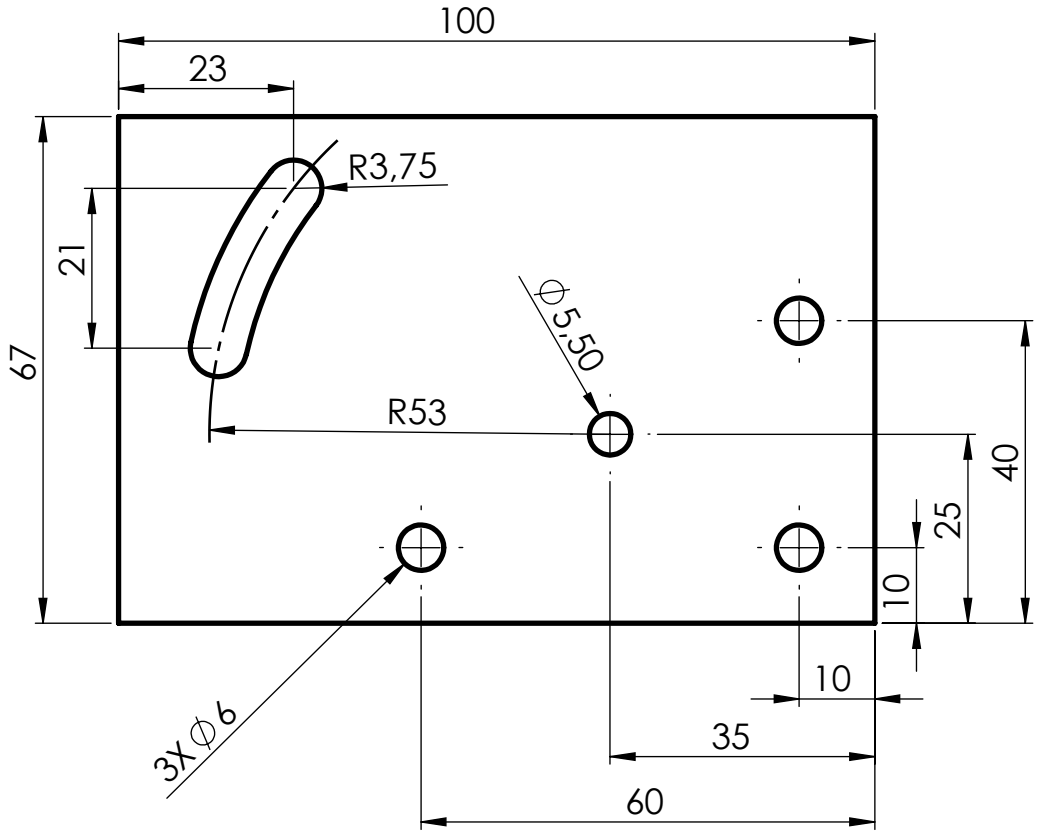
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED LOWER PART			DRAWING NO 1-3-2



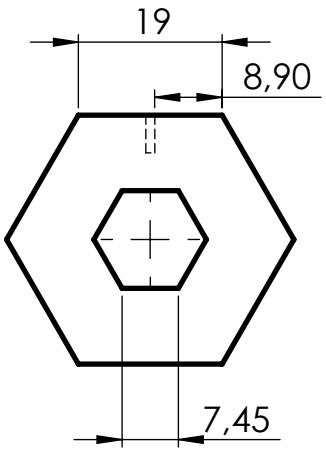
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

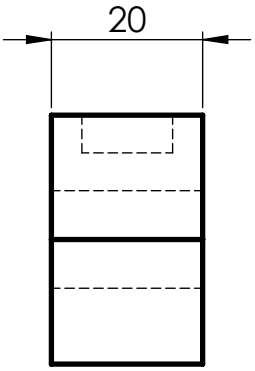
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED UPPER PART			DRAWING NO 1-3-3

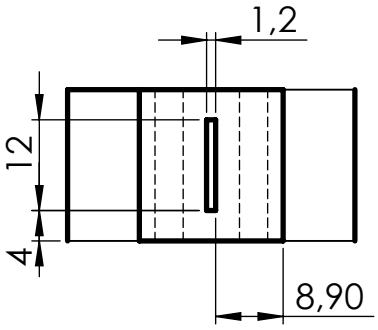


NOTES
1. REMOVE ALL SHARP EDGES
2. THICKNESS IS 2MM
3. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED UPPER SUPPORT PART			DRAWING NO 1-3-4

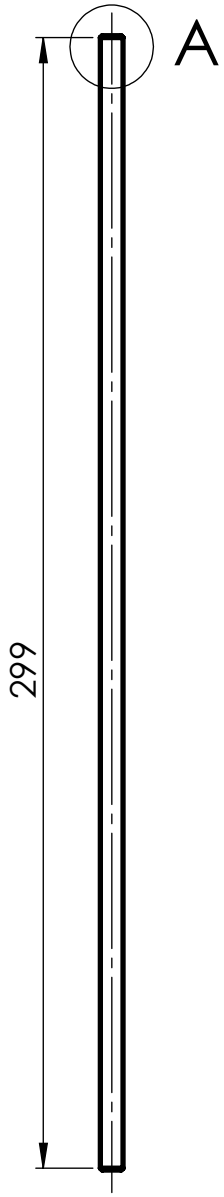


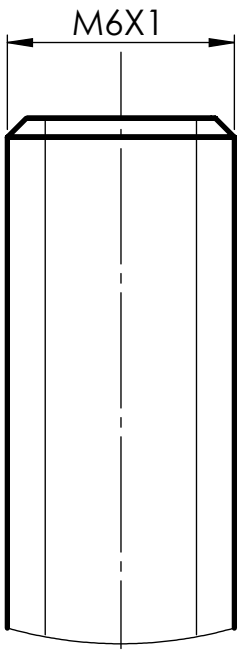




NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	CONNECTION PART			DRAWING NO 1-3-5

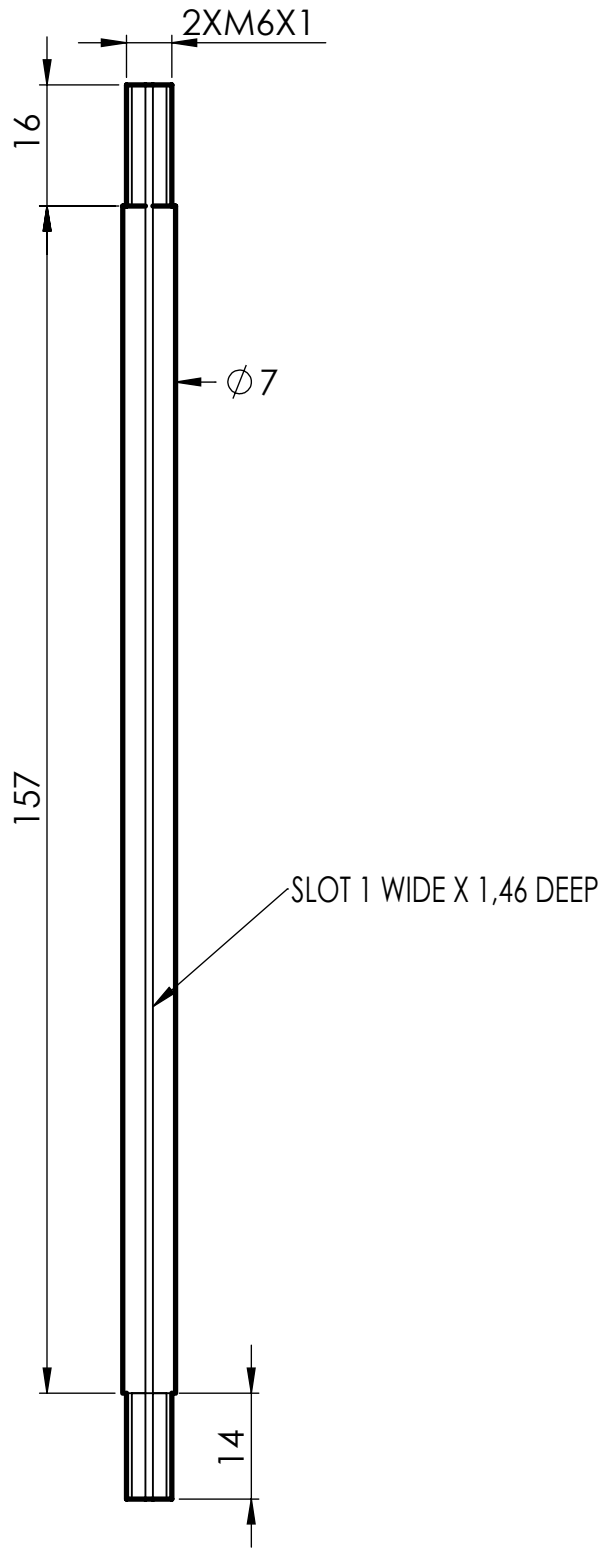




DETAIL A
SCALE 5 : 1

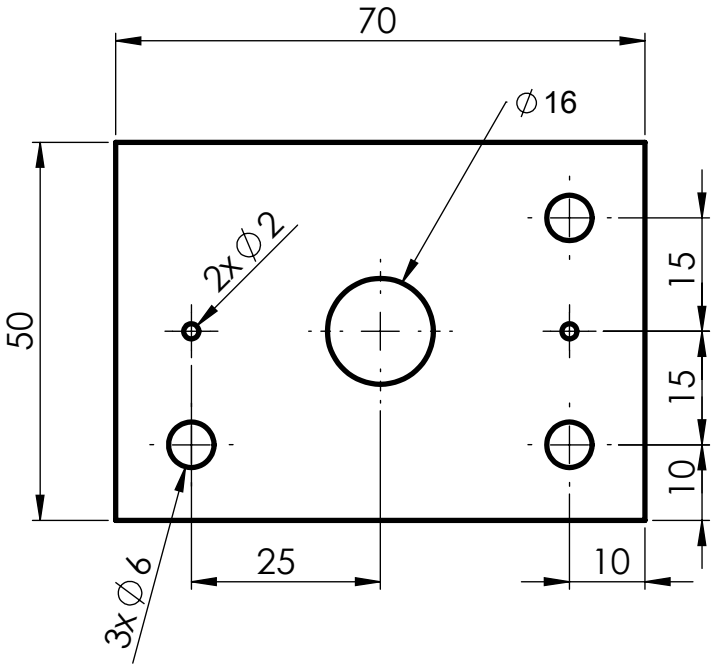
NOTES
1. REMOVE ALL SHARP EDGES

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 2:1	M6 TREADED ROD			DRAWING NO 1-3-6



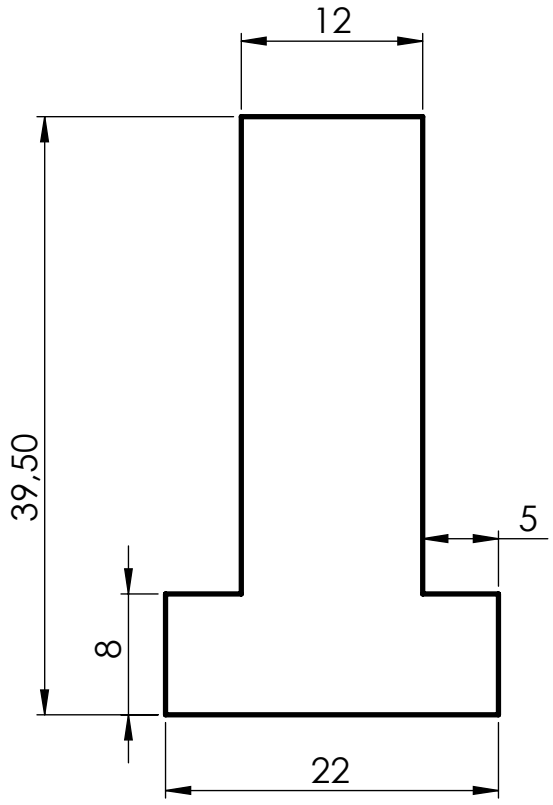
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	BEARING BED UPPER PART			DRAWING NO 1-3-7



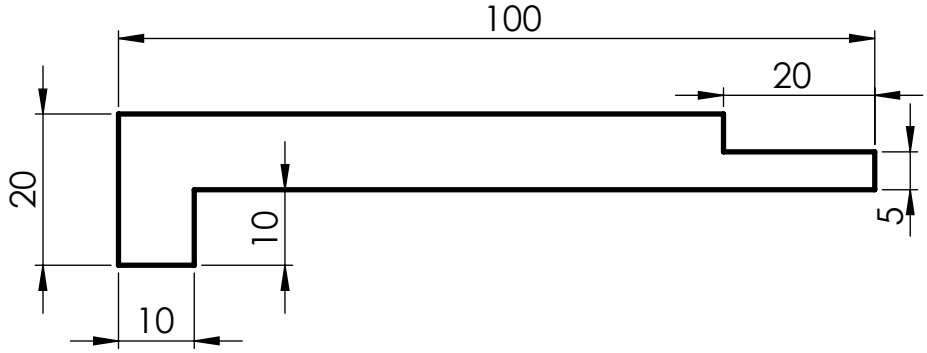
NOTES
1. REMOVE ALL SHARP EDGES
2. THICKNESS IS 2MM
3. DO NOT MEASURE

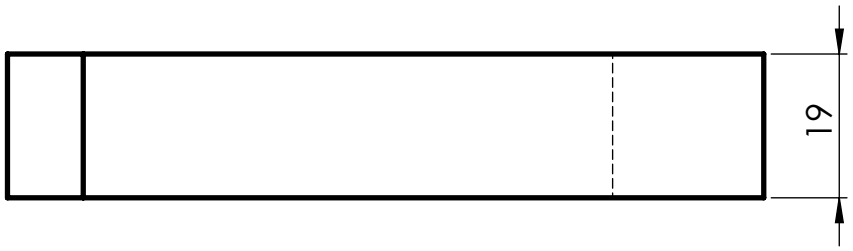
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	STEPPER MOTOR SUPPORT PART			DRAWING NO 1-3-8



NOTES
1. REMOVE ALL SHARP EDGES
2. THICKNESS IS 1MM

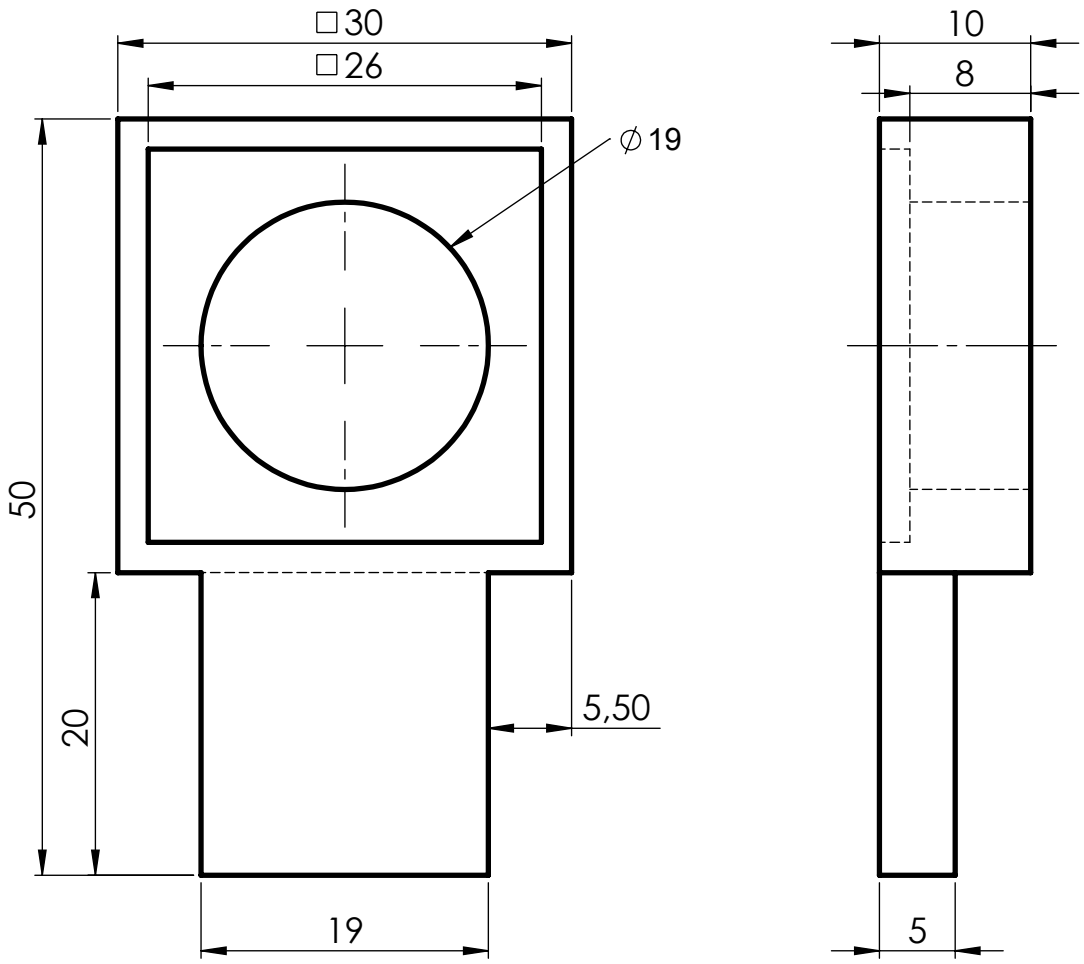
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 2:1	T-PART			DRAWING NO 1-3-9





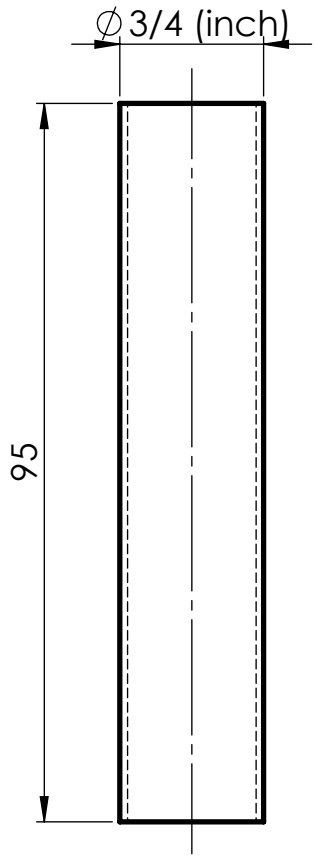
NOTES
1. REMOVE ALL SHARP EDGES
2. DO NOT MEASURE

	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	VACUUM ALUMINIUM PIE HOLDER			DRAWING NO 1-3-10



NOTES
1. REMOVE ALL SHARP EDGES

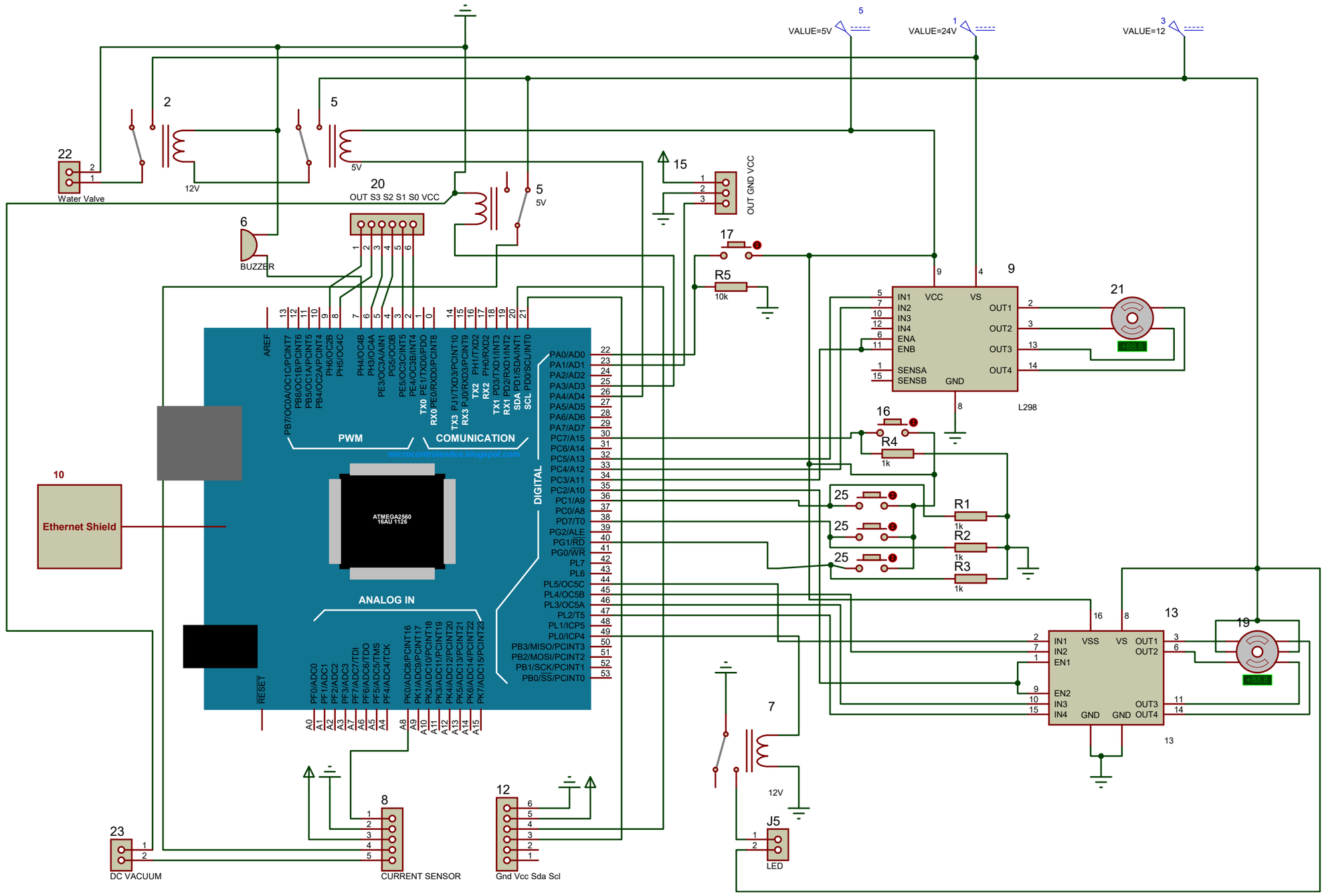
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 2:1	PIE HOLDER			DRAWING NO 1-3-11

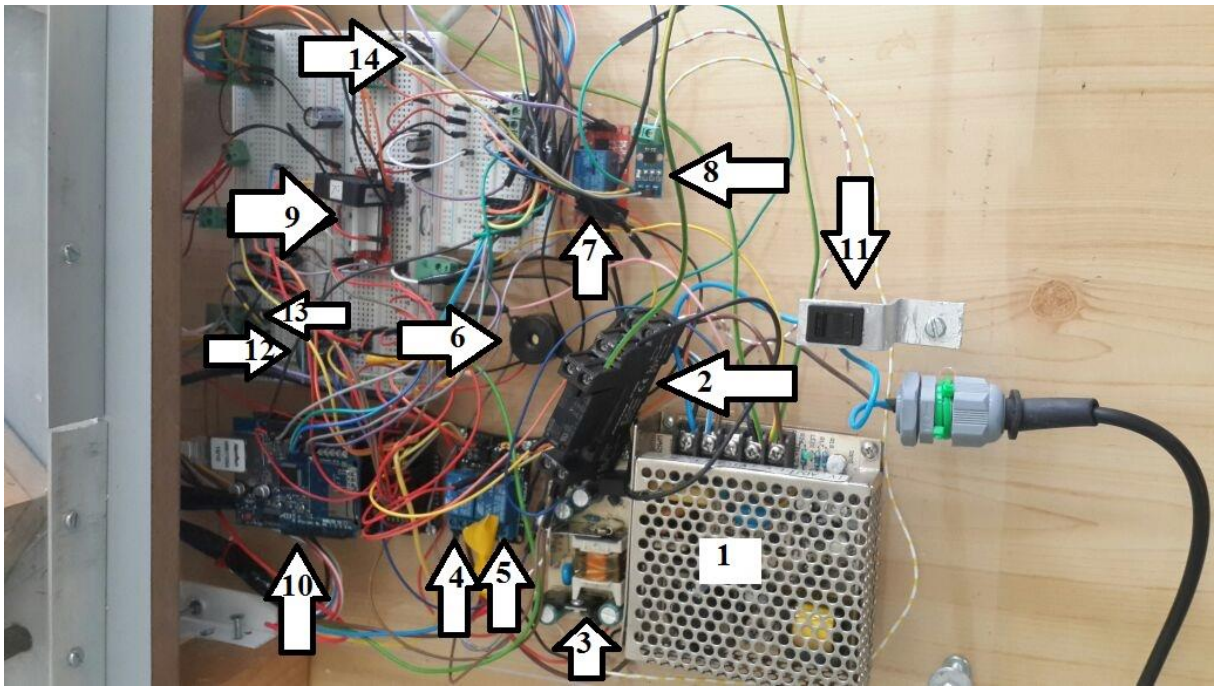


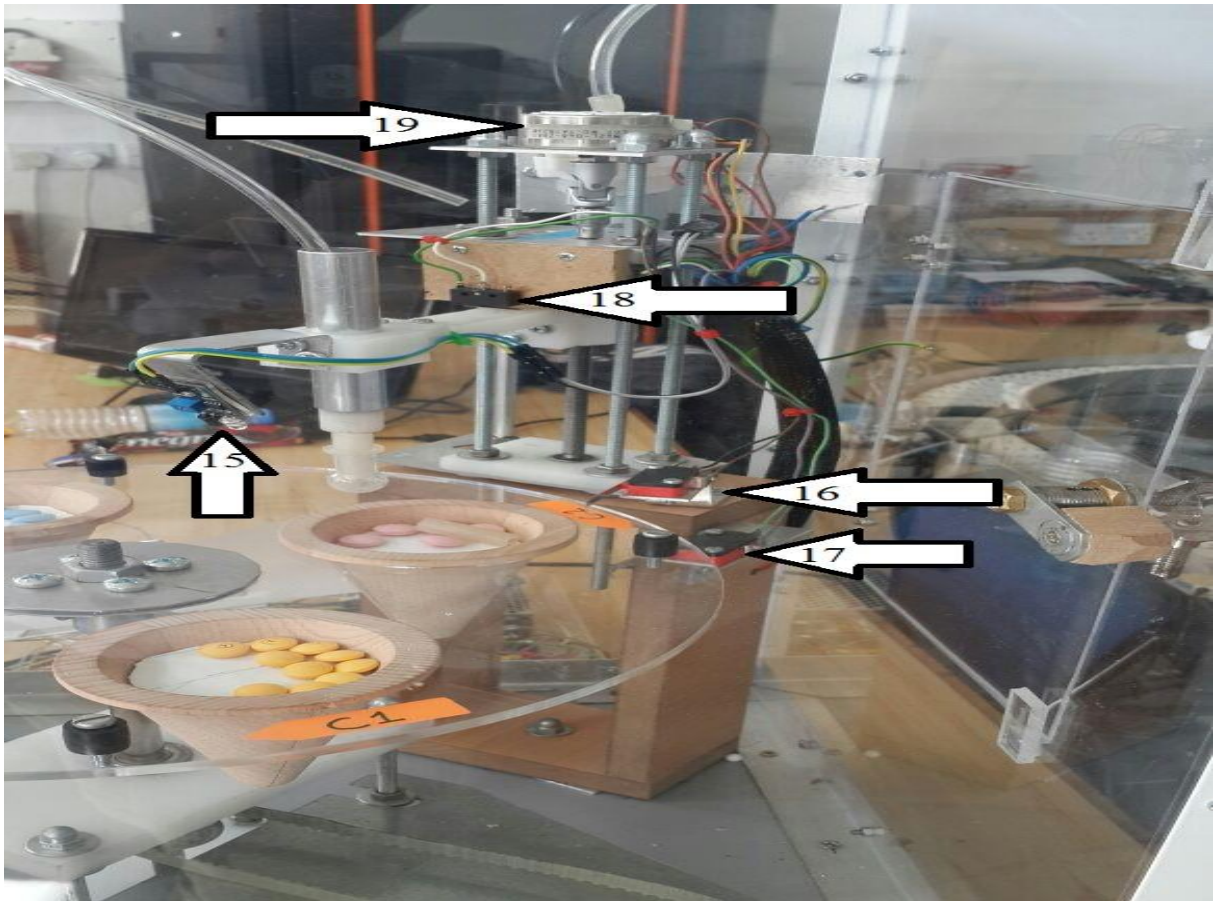
NOTES
1. REMOVE ALL SHARP EDGES
2. MATERIAL IS ALUMINIUM
3. DO NOT MEASURE

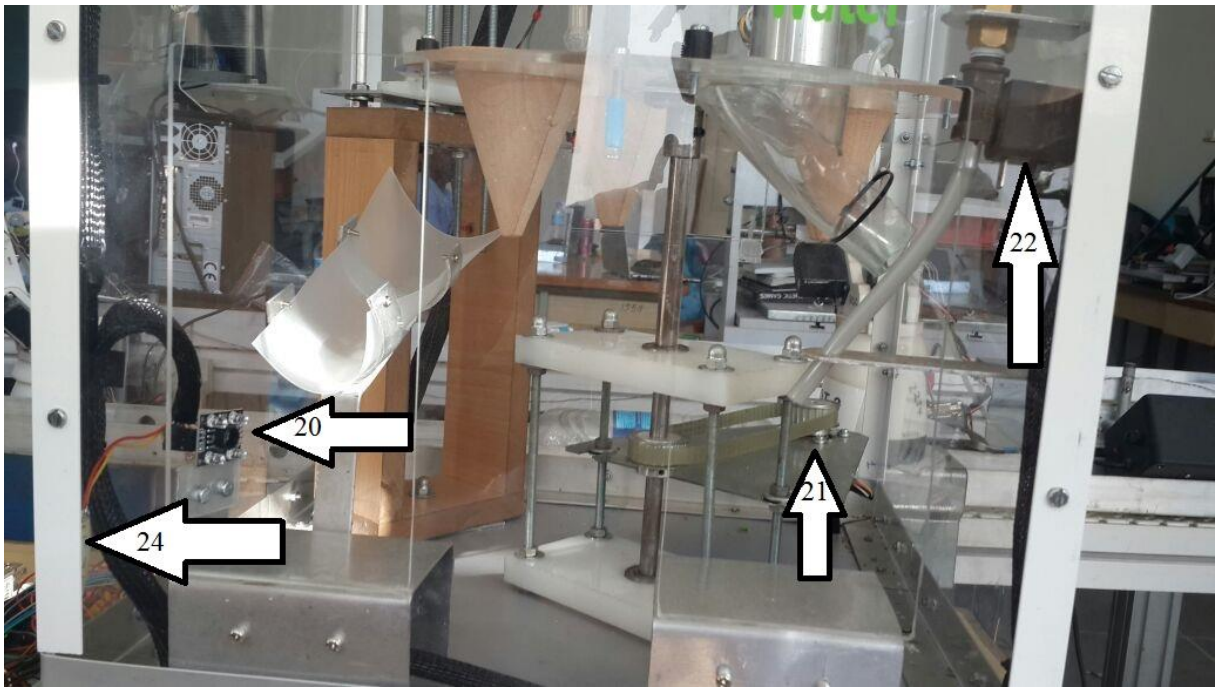
	NAME	DATE	SIGN	
DRW. BY	121776	22/06/2016		EMU
CHK. BY	D. SOLYALI	22/06/2016		
SCALE 1:1	ALUMINIUM PIPE			DRAWING NO 1-3-12

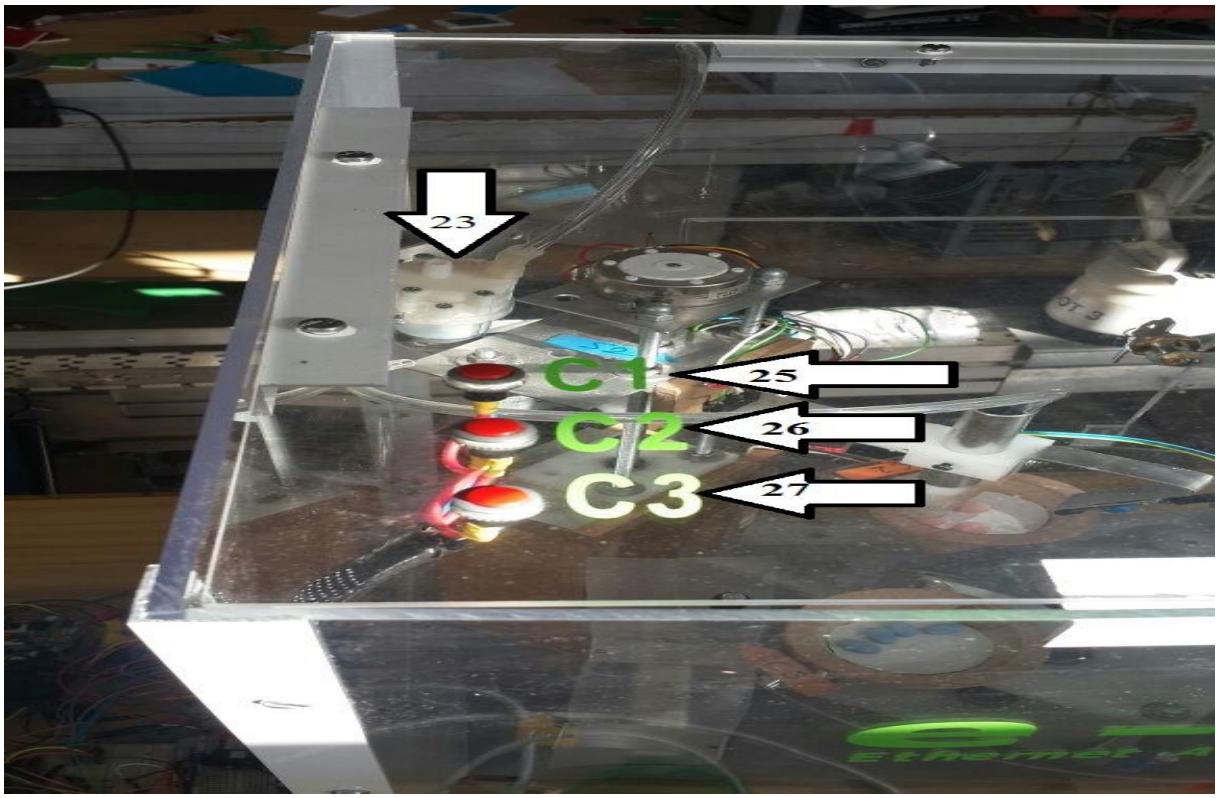
Shematic of The Machine




14
8
9
7
11
13
12
6
2
1
10
4
5
3


19
18
15
16
17
C1


22
20
21
24


23
C1
25
C2
26
C3
27

Electronic components

1. 24V DC Power supply. It is used to feed step motor (21) and water valve (22).
2. 24V DC relay. It used to control water valve (23).
3. 12V DC Power supply. It is used to feed step motor (19), Arduino DC Vacuum pump (23).
4. 5V DC relay. It is used to control vacuum pump (23).
5. 5V DC relay. It is used to control 24V DC relay.
6. Buzzer. It is controlled by Arduino
7. 5V DC relay. It is used to control LED (24).
8. Current Sensor. It is used to measure current of DC vacuum pump (23).
9. Easy driver. It is used drive step motor (21).
10. Arduino Ethernet shield and Arduino Mega. Shield mounted it on top of an Arduino board.
11. Power switch. It is for the cutting power.
12. Real Time Clock Module. It is used for the keep real time.
13. L293D. It is used to drive step motor (19).
14. 5C DC power supply. It is coming from Arduino. Red is shows + and blue is -.
15. IR Sensor. It used to control step motor (19) speed.
16. Limit switch. It is used to control pill container mechanism.
17. Limit switch. It is used to set home position of pill container mechanism.
18. Limit switch. It is used to control pill holder mechanism.
19. Step motor. It is used to rotate to pill holder mechanism.
20. Color sensor. It is detecting glass and controlling buzzer (6).
21. Step motor. It is used to rotate pill container mechanism.
22. Water valve. It is used to control water.
23. DC Vacuum Pump. It is used to take pill.
24. LED. It ıs used for the light.
25. Push buttons. These are 3 push button is used to control pill container mechanism.
26. Push buttons. These are 3 push button is used to control pill container mechanism
27. Push buttons. These are 3 push button is used to control pill container mechanism

Electronic components

1. 24V DC Power supply. It is used to feed step motor (21) and water valve (22).
2. 24V DC relay. It used to control water valve (23).
3. 12V DC Power supply. It is used to feed step motor (19), Arduino DC Vacuum pump (23).
4. 5V DC relay. It is used to control vacuum pump (23).
5. 5V DC relay. It is used to control 24V DC relay.
6. Buzzer. It is controlled by Arduino
7. 5V DC relay. It is used to control LED (24).
8. Current Sensor. It is used to measure current of DC vacuum pump (23).
9. Easy driver. It is used drive step motor (21).
10. Arduino Ethernet shield and Arduino Mega. Shield mounted it on top of an Arduino board.
11. Power switch. It is for the cutting power.
12. Real Time Clock Module. It is used for the keep real time.
13. L293D. It is used to drive step motor (19).
14. 5C DC power supply. It is coming from Arduino. Red is shows + and blue is -.
15. IR Sensor. It used to control step motor (19) speed.
16. Limit switch. It is used to control pill container mechanism.
17. Limit switch. It is used to set home position of pill container mechanism.
18. Limit switch. It is used to control pill holder mechanism.
19. Step motor. It is used to rotate to pill holder mechanism.
20. Color sensor. It is detecting glass and controlling buzzer (6).
21. Step motor. It is used to rotate pill container mechanism.
22. Water valve. It is used to control water.
23. DC Vacuum Pump. It is used to take pill.
24. LED. It is used for the light.
25. Push buttons. These are 3 push button is used to control pill container mechanism.

G-Codes of PHM Parts

%	X74.451Y30.159	X82.844Y45.972	X66.41Y44.886
G90	X76.624Y30.253	X82.055Y46.876	X65.761Y43.496
T1	X78.501Y30.765	X80.969Y47.846	X65.258Y41.627
S1500M3	X79.883Y31.407	X79.883Y48.592	X65.159Y40.541
Toolpath Name: 1	X80.969Y32.154	X78.512Y49.231	X65.259Y38.369
Output:	X81.869Y32.937	X76.624Y49.747	X65.761Y36.504
Units: MM	X82.841Y34.023	X75.538Y49.841	X66.412Y35.11
Tool Coordinates: Tip	X83.587Y35.11	X73.365Y49.741	X67.109Y34.096
Tool Number: 1	X84.228Y36.482	X71.487Y49.231	G0Z10.
Tool Id: 1	X84.746Y38.369	X70.106Y48.577	X68.128Y36.024
Coolant: Standard	X84.841Y39.455	X69.02Y47.838	Z5.
Gauge Length: 30.000	X84.745Y41.627	X68.127Y47.059	G1Z-10.925F500.
Block:	X84.228Y43.52	X67.156Y45.972	X81.872F500.
MIN X: 0.000	X83.582Y44.886	X66.409Y44.886	X81.99Y36.196
MIN Y: -0.000	X82.844Y45.972	X65.761Y43.496	X82.495Y37.282
MIN Z: -2.000	X82.055Y46.876	X65.258Y41.627	X82.804Y38.369
MAX X: 500.000	X80.969Y47.846	X65.159Y40.541	X82.937Y39.455
MAX Y: 121.000	X79.883Y48.592	X65.259Y38.369	Y40.
MAX Z: 0.000	X78.512Y49.231	X65.761Y36.503	X67.063
COORDINATE SYSTEM:	X76.624Y49.747	X66.412Y35.11	Y40.541
Workplane	X75.538Y49.841	X67.109Y34.096	X67.194Y41.627
Datum - Tool Tip:	X73.365Y49.741	G0Z10.	X67.504Y42.714
X: 250.000	X71.487Y49.231	Z5.	X68.008Y43.8
Y: 60.500	X70.106Y48.578	G1Z-7.925F500.	X68.129Y43.977
Z: 10.000	X69.02Y47.838	X82.891F500.	X81.871
Number of Flutes: 1	X68.127Y47.059	X83.586Y35.11	G0Z10.
Tool: End Mill	X67.156Y45.972	X84.228Y36.483	X68.128Y36.024
DIAMETER: 6.000	X66.409Y44.886	X84.653Y38.032	Z5.
Safety:	X65.761Y43.496	X65.349	G1Z-10.925F500.
Tool Cutting Moves: Safe No	X65.258Y41.627	X65.259Y38.369	X69.02Y34.722F500.
Gouges	X65.159Y40.541	X65.159Y40.541	X70.106Y33.7
Tool Leads: Safe No Gouges	X65.258Y38.369	X65.258Y41.627	X71.299Y32.937
Tool Links: Safe No Gouges	X65.761Y36.503	X65.35Y41.968	X72.279Y32.525
Holder Cutting Moves: Collisions	X66.412Y35.11	X84.651	X73.365Y32.215
Not Checked	X67.109Y34.096	X84.228Y43.52	X74.451Y32.047
Holder Leads: Collisions Not	G0Z10.	X83.582Y44.886	X75.538
Checked	Z5.	X82.89Y45.905	X76.624Y32.213
Holder Links: Collisions Not	G1Z-5.283F500.	X67.11	X77.71Y32.521
Checked	X82.891F500.	G0Z10.	X78.7Y32.937
Toolpath: Profile Area Clearance	X83.586Y35.11	X67.109Y34.096	X79.883Y33.693
STEPOVER: 3.000	X84.228Y36.482	Z5.	X80.969Y34.707
TOLERANCE:0.100	X84.653Y38.032	G1Z-7.925F500.	X81.99Y36.196
THICKNESS:0.000	X65.349	X67.159Y34.023F500.	X82.495Y37.282
Toolpath Stats:	X65.259Y38.369	X67.934Y33.135	X82.804Y38.369
LENGTH: 503.098	X65.159Y40.541	X69.02Y32.162	X82.937Y39.455
TIME: 0/00/15	X65.258Y41.627	X70.106Y31.423	Y40.541
LIFTS: 2	X65.35Y41.969	X71.496Y30.765	X82.805Y41.627
G0X75.Y40.Z10.	X84.652	X73.365Y30.259	X82.496Y42.714
X67.109Y34.096	X84.228Y43.52	X74.451Y30.16	X81.992Y43.8
Z5.	X83.582Y44.886	X76.624Y30.254	X80.969Y45.29
G1Z-2.642F500.	X82.89Y45.905	X78.501Y30.765	X79.883Y46.311
X82.891F500.	X67.11	X79.883Y31.408	X78.707Y47.059
X83.587Y35.11	G0Z10.	X80.969Y32.154	X77.71Y47.479
X84.228Y36.482	X67.109Y34.096	X81.868Y32.937	X76.624Y47.787
X84.653Y38.032	Z5.	X82.841Y34.023	X75.538Y47.953
X65.349	G1Z-5.283F500.	X83.586Y35.11	X74.451
X65.258Y38.369	X67.159Y34.023F500.	X84.228Y36.483	X73.365Y47.785
X65.159Y40.541	X67.934Y33.135	X84.746Y38.369	X72.279Y47.475
X65.258Y41.627	X69.02Y32.161	X84.841Y39.455	X71.293Y47.059
X65.35Y41.969	X70.106Y31.422	X84.745Y41.627	X70.106Y46.301
X84.652	X71.496Y30.765	X84.228Y43.52	X69.02Y45.278
X84.228Y43.52	X73.365Y30.259	X83.582Y44.886	X68.008Y43.8
X83.582Y44.886	X74.451Y30.16	X82.844Y45.972	X67.504Y42.714
X82.89Y45.905	X76.624Y30.253	X82.055Y46.876	X67.194Y41.627
X67.11	X78.501Y30.765	X80.969Y47.846	X67.063Y40.541
G0Z10.	X79.883Y31.408	X79.883Y48.592	X67.064Y39.455
X67.109Y34.096	X80.969Y32.154	X78.512Y49.231	X67.196Y38.369
Z5.	X81.868Y32.937	X76.624Y49.746	X67.505Y37.282
G1Z-2.642F500.	X82.841Y34.023	X75.538Y49.841	X68.01Y36.196
X67.159Y34.023F500.	X83.586Y35.11	X73.365Y49.74	X68.128Y36.024
X67.934Y33.135	X84.228Y36.482	X71.487Y49.231	G0Z10.
X69.02Y32.161	X84.746Y38.369	X70.106Y48.577	M2
X70.106Y31.422	X84.841Y39.455	X70.091Y48.567	
X71.496Y30.765	X84.745Y41.627	X69.392Y48.092	
X73.365Y30.259	X84.228Y43.52	X68.127Y47.059	
	X83.582Y44.886	X67.157Y45.972	

G-Codes of PCM Parts

%
G90
T1
S1500M3
Toolpath Name: 1
Output:
Units: MM
Tool Coordinates: Tip
Tool Number: 1
Tool Id: 1
Coolant: Standard
Gauge Length: 30.000
Block:
MIN X: 0.000
MIN Y: -0.000
MIN Z: -2.000
MAX X: 500.000
MAX Y: 121.000
MAX Z: 0.000
COORDINATE SYSTEM:
Workplane
Datum - Tool Tip:
X: 250.000
Y: 60.500
Z: 10.000
Number of Flutes: 1
Tool: End Mill
DIAMETER: 6.000
Safety:
Tool Cutting Moves: Safe No Gouges
Tool Leads: Safe No Gouges
Tool Links: Safe No Gouges
Holder Cutting Moves: Collisions Not Checked
Holder Leads: Collisions Not Checked
Holder Links: Collisions Not Checked
Toolpath: Profile Area Clearance
STEPOVER: 3.000
TOLERANCE:0.100
THICKNESS:0.000
Toolpath Stats:
LENGTH: 503.098
TIME: 0/00/15
LIFTS: 2
G0X75.Y40.Z10
X67.109Y34.096
Z5.
G1Z-3.962F500.
X82.891F1000.
X83.586Y35.11
X84.228Y36.482
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X65.258Y41.627
X65.35Y41.969
X84.652
X84.228Y43.52
X83.582Y44.886
X82.89Y45.905
X67.11
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Z5.
G1Z-3.962F500.
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X69.02Y32.161
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X83.586Y35.11
X84.228Y36.482
X84.746Y38.369
X84.841Y39.455
X84.745Y41.627
X84.228Y43.52
X83.582Y44.886
X82.844Y45.972
X82.055Y46.876
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Y40.541
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X68.008Y43.8
X68.129Y43.977
X81.871
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X68.128Y36.024
Z5.
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Y40.541
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X82.496Y42.714
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X78.707Y47.059
X77.71Y47.479
X76.624Y47.787
X75.538Y47.953
X74.451
X73.365Y47.785
X72.279Y47.475
X71.293Y47.059
X70.106Y46.301
X69.02Y45.278
X68.008Y43.8
X67.504Y42.714
X67.194Y41.627
X67.063Y40.541
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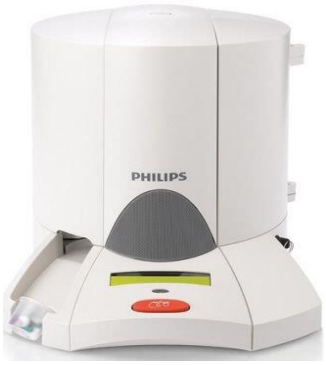
G0Z10.
M2

APPENDIX D
ENGINEERING STANDARDS

1. **Kinds of pill dispensers in the market**

1.1 The Philips Medication Dispensing Service



Properties

- Independent living possible by automating the pill-taking process
- Load the machine with single-dose cups of medication
- Sound a reminder and dispense the right medication at the right time
- Enrolled with the 24-hr. monitoring service, subscribers dispensed their medications
- Price is $895.00

1.2 MD3 e-Pill Automatic Pill disperser Tamperproof

Properties

- Tamper Proof Pill Dispenser
- Automatic e-pill Medication Dispenser
- Locked Pill Box with Strong Alarm and Robust Lock (2 keys are included)
- Load Medicine Weekly. Dispense up to 4 times per Day
- Used for Pain Medications and Class II Narcotics
- Price is $844.95.

1.3 MD1 MedTime XL

Properties

- Automatic Pill Dispenser - Dispense up to 28 times/day
- Never Forget or Double Dose again!
- Simple to Use - great for Early Alzheimer's patients
- Locked medication dispenser - 2 KEYS, 2 MED Tray, and Pill Sorting and Filling Tray to help organize and fill your e-pill automatic pill dispenser.
- Most Popular e-pill Medication Reminder
- Price is $289.95.

2. **Fisrt Pill Making Machine Disgn by August H. Wiez**

A. H. WIRZ.
PILL MACHINE.

No. 69,379. Patented Oct. 1, 1867.

Fig. 1.

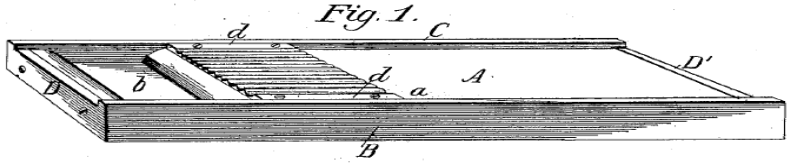


Fig. 2.

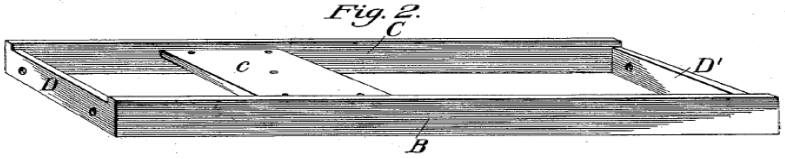
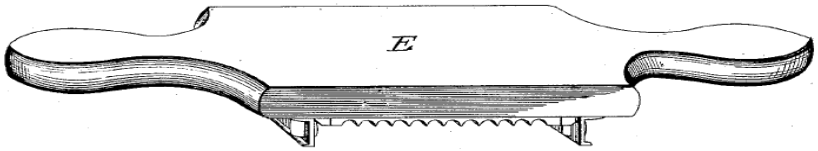


Fig. 3.



Witnesses.
John G. Wirz
George Hofstetter.

Inventor.
A. H. Wirz

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

3. The First Patent Pill Dispenser by David P. Wagner

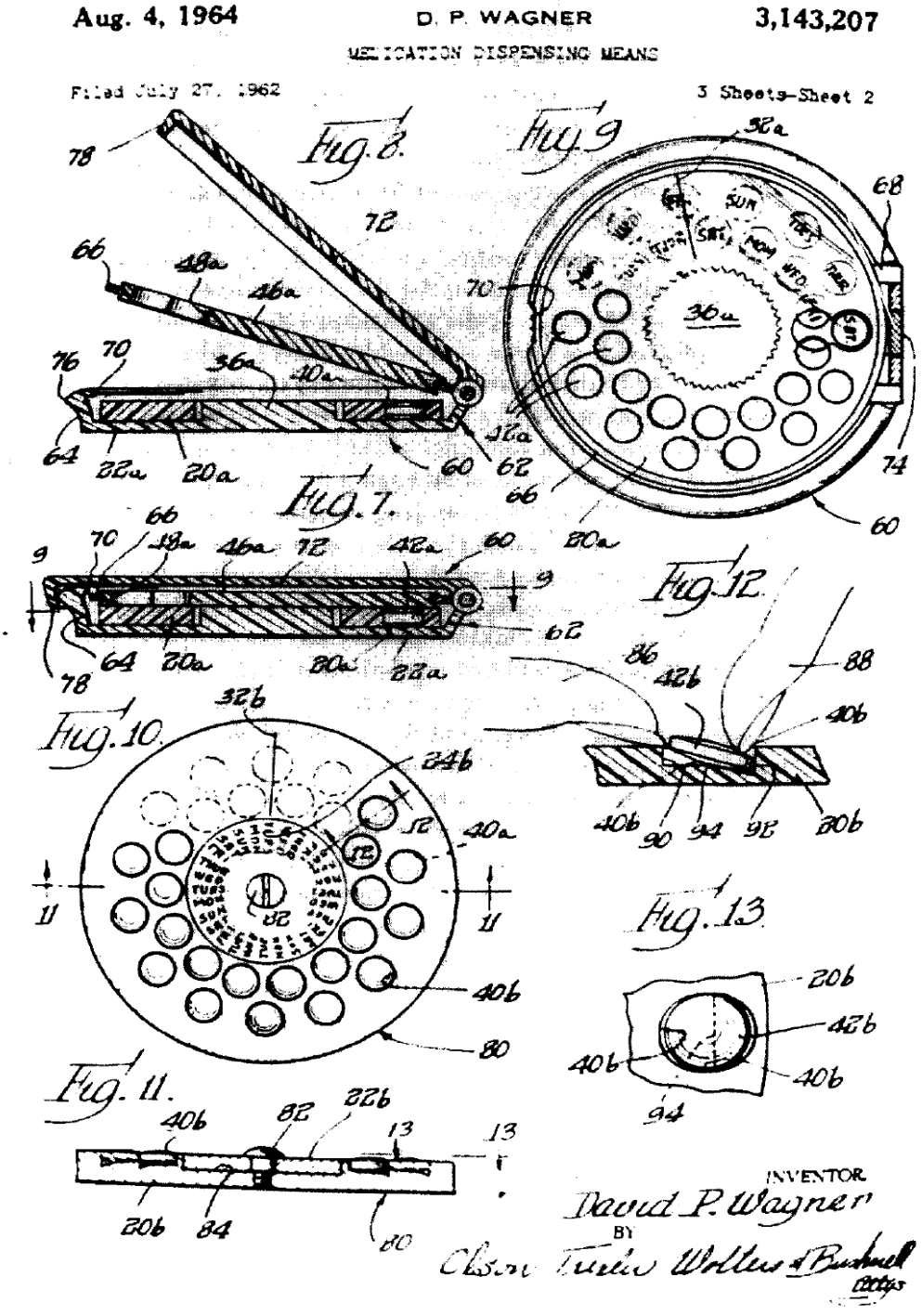
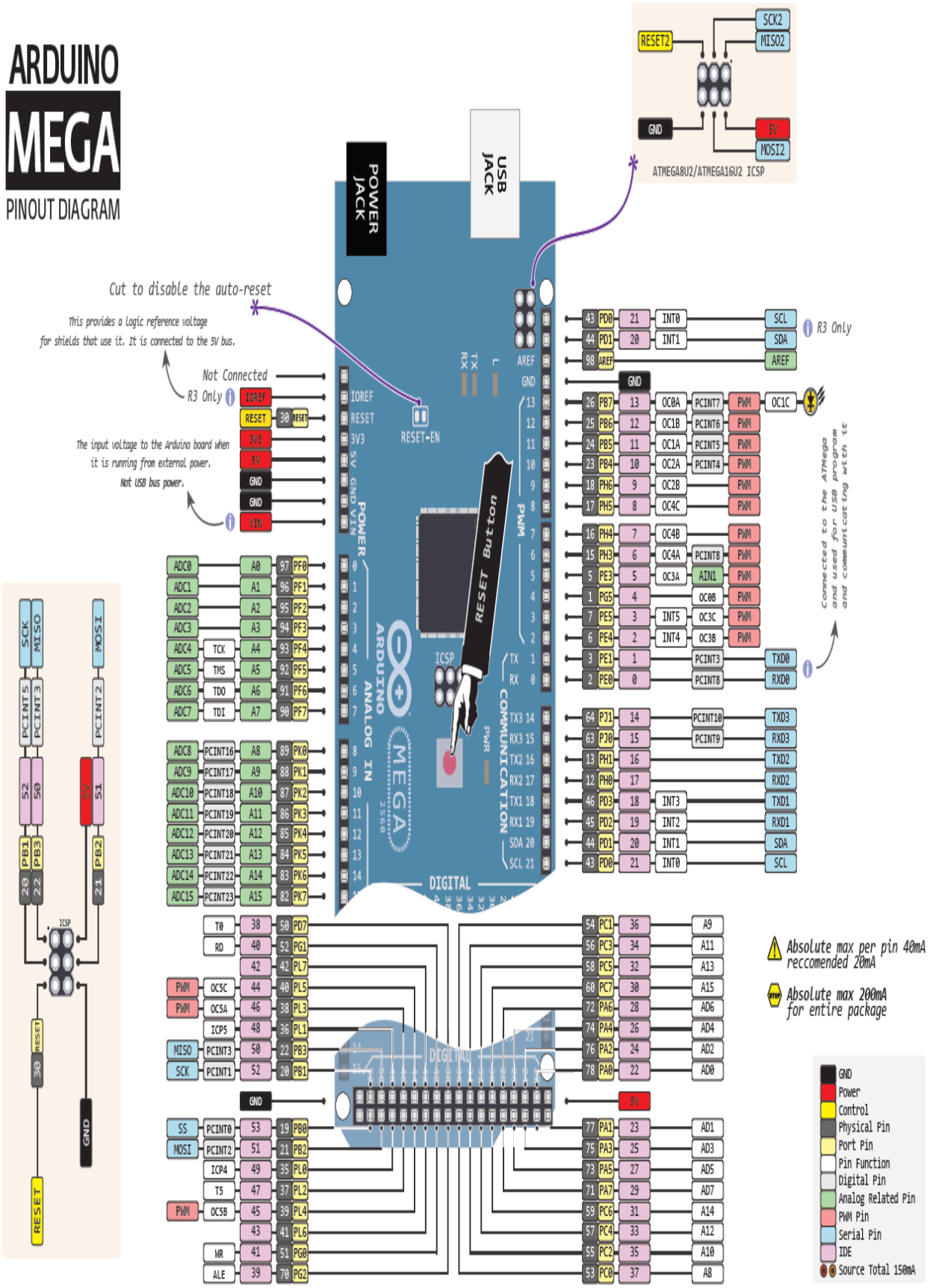
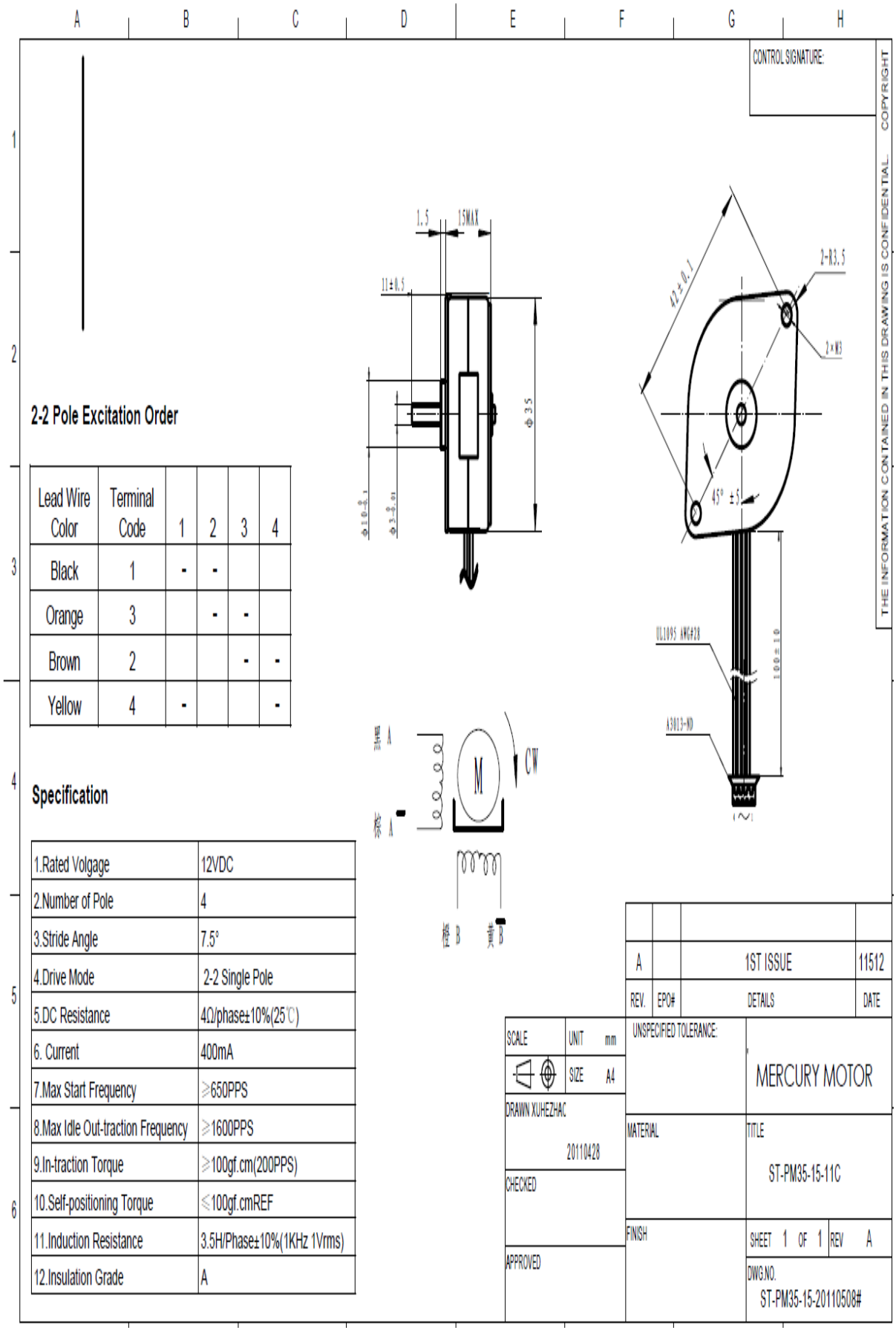


Figure 4. An illustration of the compact version of David P. Wagner's pill dispenser from US Patent # 3,143,207.

4. **Arduino Wiring Diagram**



5. Step Motors



2-2 Pole Excitation Order

Lead Wire Color	Terminal Code	1	2	3	4
Black	1	-	-		
Orange	3		-	-	
Brown	2			-	-
Yellow	4	-			-

Specification

1.Rated Volgage	12VDC
2.Number of Pole	4
3.Stride Angle	7.5°
4.Drive Mode	2-2 Single Pole
5.DC Resistance	4Ω/phase±10%(25℃)
6. Current	400mA
7.Max Start Frequency	⩾650PPS
8.Max Idle Out-traction Frequency	⩾1600PPS
9.In-traction Torque	⩾100gf.cm(200PPS)
10.Self-positioning Torque	⩽100gf.cmREF
11.Induction Resistance	3.5H/Phase±10%(1KHz 1Vrms)
12.Insulation Grade	A

6.Average Physical Properties of PLEXIGLAS Sheet

Property	ASTM Method (2)	Units	Type of Acrylic sheet PLEXIGLAS G	PLEXIGLAS MC
Thickness, nominal		**in**	**0.236**	**0.236**
Specific gravity	D792	N.A.	1.19	1.19
OPTICAL				
Refractive index	D542	N.A.	1.49	1.49
Light transmittance and haze "as received"	D1003			
Parallel		%	91*	91*
Total		%	92*	92*
Haze		%	1*	2*
After 5 years' outdoor exposure, Bristol, Pa., 45° angle, facing south				
Parallel		%	90*	90*
Total		%	92*	92*
Haze		%	2*	3*
After 240 hours' artificial exposure, Carbon Arc Type, per ASTM G-23				
Parallel		%	90*	—
Haze		%	2*	—
Artificial weathering, fluorescent sunlamp with dew, 10 cycles, 240 hours' exposure	D1501 or Fed. Std. 6024			
Crazing			none	none
Warping			none	none
Instrumental measurement change in Yellowness Index after	D1925	N.A.	1.0	0.8
Ultraviolet transmission, 320 nm	Beckman DU-	%	0	0
MECHANICAL				
Tensile strength (0.25" specimen-0.2"/min)	D638			
Maximum		psi	10,500	10,200
Rupture		psi	10,500	10,200
Elongation, maximum		%	4.9	4.5
Elongation, rupture		%	4.9	4.5
Modulus of elasticity		psi	450,00	450,000
Poisson's ratio			0.35	—
Flexural strength (span depth ratio 16, 0.1"/min)	D790			
Maximum		psi	16,000	15,000
Rupture		psi	16,000	15,000
Deflection, maximum		in	0.6	0.5
Deflection, rupture		in	0.6	0.5
Modulus of elasticity		psi	450,00	450,000

Property	ASTM Method[2]	Units	Type of acrylic sheet PLEXIGLAS G	PLEXIGLAS MC
Thickness, nominal		**in**	**0.236**	**0.236**
Compressive strength (0.05"/ min)	D695			
Maximum		psi	18,000	16,000
Modulus of elasticity		psi	450,000	430,000
Compressive deformation under load	D621			
2,000 psi at 122° F,24 hrs	Method A	%	0.2	0.3
4,000 psi at 122° F,24 hrs		%	0.5	0.9
(Conditioned 48 hrs at 122°F)				
Shear strength	D732	psi	9,000*	—
Shear modulus		psi	167,000	—
Impact strength				
Charpy unnotched @ 73°F	D256	ft-lb/ 1/2" X 1" sect.	7.0	7.0
Izod milled notch @ 73°F		ft-lb/ in. of notch	0.3	0.3
Rockwell hardness	D785	—	M-100*	M-90*
Barcol number	D2583	—	49	—
Resistance to stress				
Critical crazing stress	ARTC Mod.			
Isopropyl alcohol	of	psi	2,100[3]	1,300
Toluene	MIL-P-6997	psi	1,700[3]	1,200
THERMAL				
Hot forming temperature		°F	290-360	275-350
Deflection temperature under				
(flexural) load	D648			
3.6° F/ min-264 psi		°F	205*	200*
Maximum recommended				
continuous service temperature		°F	180-200	170-190
Coefficient of thermal expansion	E831	in/ in/ °F X10^{-5}		
-40°F			2.8	2.7
-20			2.9	2.9
0			3.1	3.1
20			3.3	3.2
40			3.6	3.4
60			3.9	3.6
80			4.2	3.9
100			4.6	4.3
Coefficient of thermal conductivity	Cenco-Fitch	BTU / (hr)/(sq ft)/(°F/ in)	1.3	1.3
Specific heat at 77°F		BTU / (lb)(°F)	0.35	0.35
ELECTRICAL				
Dielectric strength, short time test	D149	volts/mil	500	500
Dielectric constant	D150		3.7	3.7
60 Hz			3.7	3.7
1,000 Hz			3.3	3.3
1,000,000 Hz			2.5	2.2

Property	ASTM Method[2]	Units	Type of acrylic sheet PLEXIGLAS G	PLEXIGLAS MC
Thickness, nominal		**in**	**0.236**	**0.236**
Power factor	D150			
60 Hz			0.05	0.05
1,000 Hz			0.04	0.04
1,000,000 Hz			0.03	0.03
Loss factor	D150			
60 Hz			0.19	0.19
1,000 Hz			0.13	0.13
1,000,000 Hz			0.08	0.07
Arc resistance	D495		No Tracking	No Tracking
Volume resistivity	D257	ohm-cm	6 X 10^{17}	1 X 10^{18}
Surface resistivity	D257	ohm/sq cm	2 X 10^{18}	1 X 10^{17}
MISCELLANEOUS				
Horizontal burning test avg. Burning rate	D635	cm/ min (in/min)	2.8 (1.1*)	2.5 (1.0*)
Smoke density	D2843	%	4-10	4-10
Flammability classification		UL 94	94HB	94HB
Water absorption, 24 hrs at 73° F	D570			
Weight loss on drying		%	0.1*	0.1*
Weight gain on immersion		%	0.2*	0.3*
Soluble matter lost		%	0.0*	0.0
Water absorbed		%	0.2*	0.3*
Dimensional changes on immersion		%	0.0*	0.0*
Water absorption (weight gain) after immersion for:				
1 day	D229	%	0.2*	—
2 days	and	%	0.3*	—
7 days	D570	%	0.4*	—
28 days		%	0.8*	—
56 days		%	1.1*	—
84 days		%	1.3*	—
Humidity expansion, change in length on going from 20% to 90% relative humidity at equilibrium, 74°F		mils/in	3	—
Odor			None	None
Taste			None	None

* This value will change with thickness. The value given is for the thickness indicated in the column heading.

(1) Values reported are averages and should not be used for specification purposes.

(2) Samples conditioned per ASTM D618, Procedure B, except where noted.

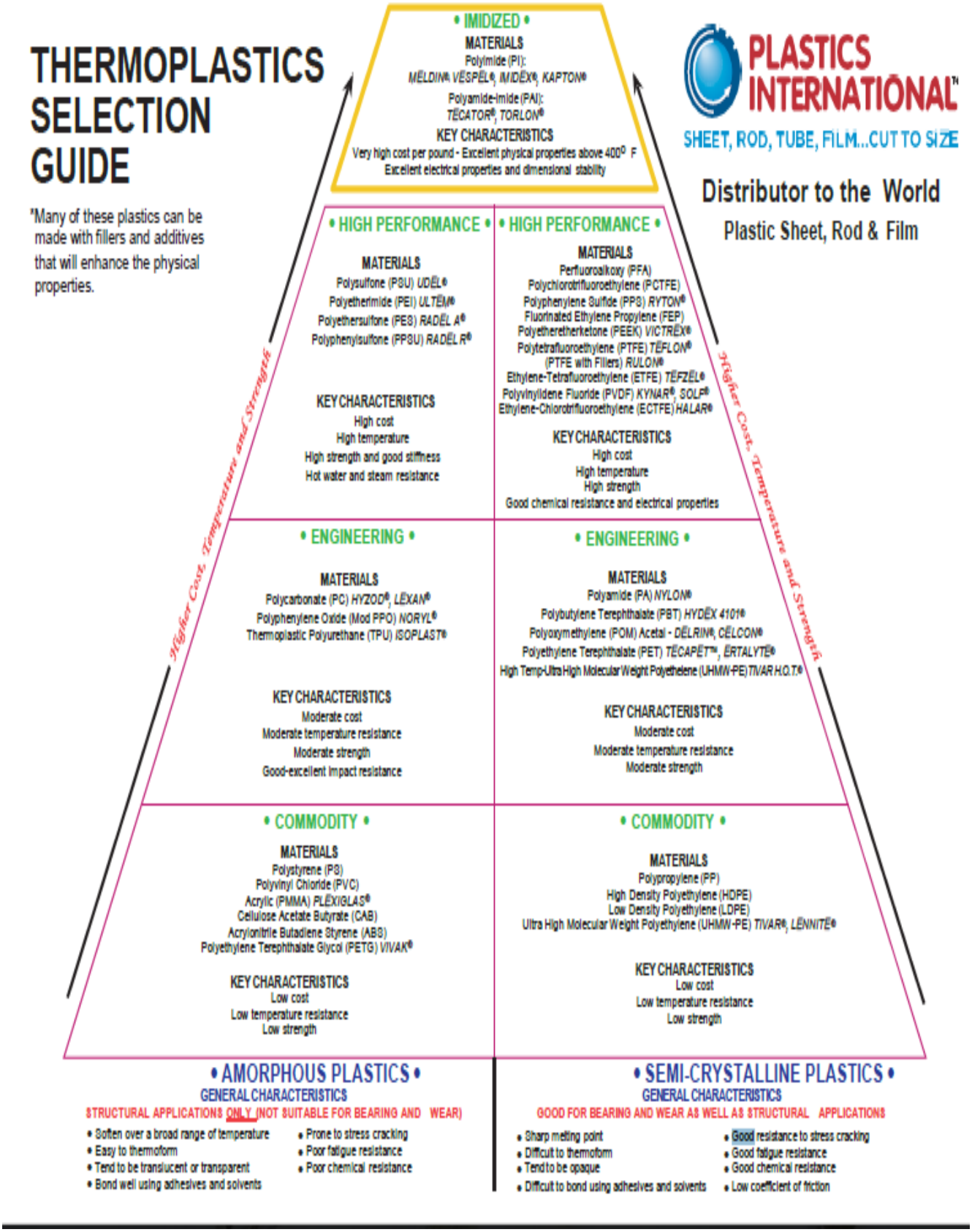
(3) The values are after the material has been heated for forming.

N.A. = Not Applicable.

7. Properties of Stainless Steel Alloys Stated

Alloy	UNS number	Ultimate strength, psi	Yield strength, psi	Elongation, % minimum	Modulus of elasticity	Hardness typical
Austenitic Stainless Steels						
Type 304	S30400	75,000	30,000	35	29,000,000	80 RB
Type 304L	S30403	70,000	25,000	35	29,000,000	75 RB
Type 316	S31600	75,000	30,000	30	28,000,000	80 RB
Type 316L	S31603	70,000	25,000	35	28,000,000	80RB
AL-6XN	N08367	112,000	53,000	50	27,000,000	90 RB
Ferritic Stainless Steels						
Type 430	S43000	60,000	30,000	20	29,000,000	85 RB
Type 439	S43035	60,000	30,000	20	29,000,000	90 RB
Type 409	S40900	55,000	30,000	20	29,000,000	85 RB
SEA-CURE	S44660	90,000	75,000	25	31,500,000	95 RB
Duplex Stainless Steels						
Alloy 2205	S31803	90,000	65,000	25	29,000,000	30 RC
7Mo PLUS	S32950	90,000	70,000	20	29,000,000	30 RC
Alloy 255	S32550	110,000	80,000	15	30,500,000	32 RC
Martensitic Stainless Steels, Maximum Strength						
Type 410	S41000	190,000	150,000	15	29,000,000	41 RC
Type 420	S42000	240,000	200,000	5	29,000,000	55 RC
Type 440C	S44050	280,000	270,000	2	29,000,000	60 RC
Precipitation Stainless Steels						
17-7 PH	S17700	210,000	190,000	5	32,500,000	48 RC
17-4 PH	S17400	190,000	170,000	8	28,500,000	45 RC
Custom 455	S45500	230,000	220,000	10	29,000,000	48 RC

8. Thermoplastic Selection Guide



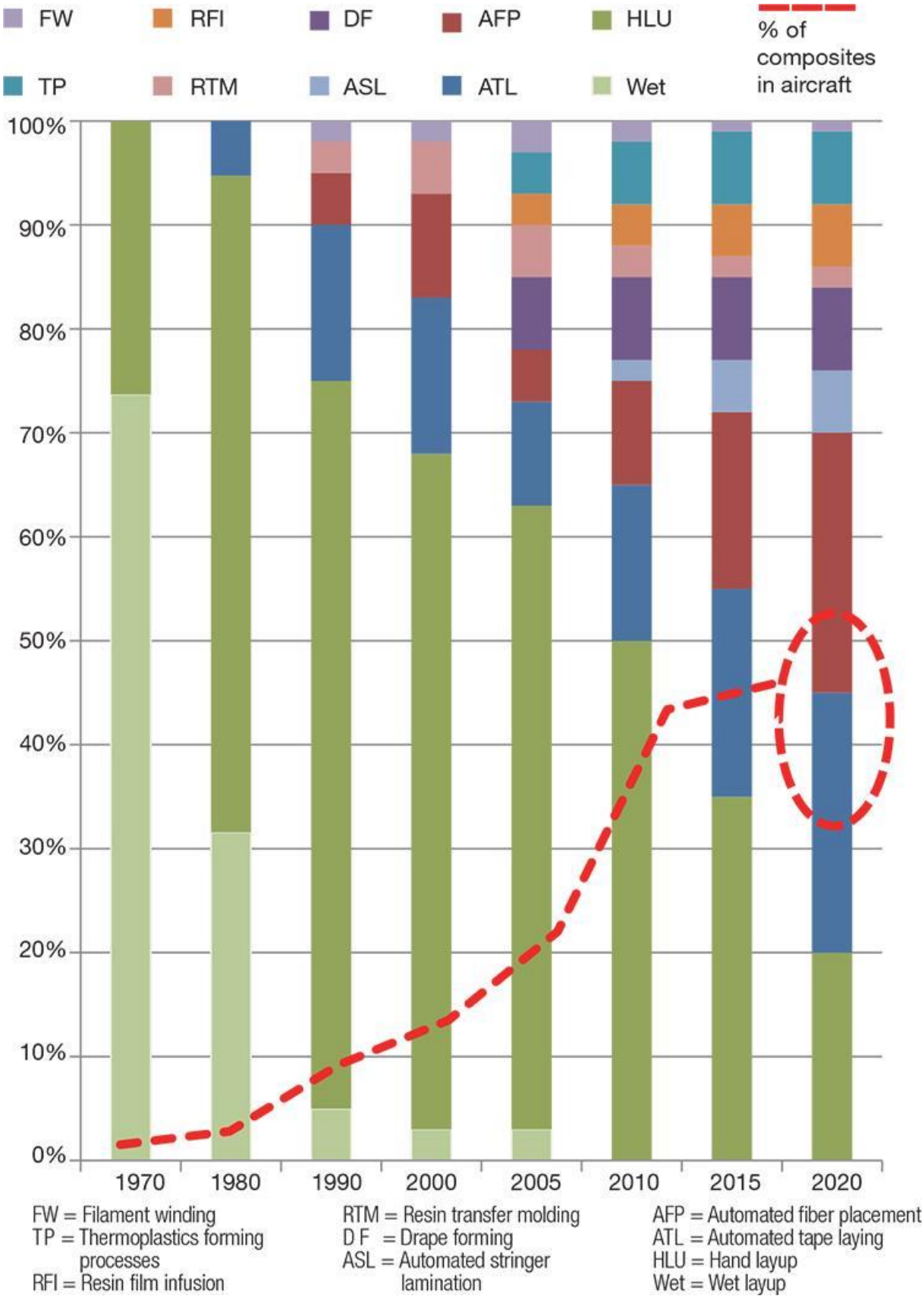


Fig. 1: Change in Composite Manufacturing Process vs. Airframe Content. Source: Composites Forecasts & Consulting LLC

Resin Family	Continuous Service Temp. (°C / °F)	Cure Time (min)	Tensile Strength (ksi)	Tensile Modulus (Msi)
Thermoset Resins				
Phenolic (PH)	170 / 340	60+	6.9	0.55
Epoxy (E)	180 / 350	60-240	9.7	0.34
Cyanate ester (CE)	180 / 350	60-180	7.4 - 13.2	0.38 - 0.45
Bismaleimide (BMI)	230 / 450	120 - 240+	10.5	3.9
Polyimide (PI)	370 / 700	120+	16.6	-
Thermoplastic Resins				
Polycarbonate (PC)	120 / 250	< 20	9.4	0.33
Polyphenylene sulfide (PPS)	240 / 464		13.5	0.5
Polyetherimide (PEI)	200 / 390		6	0.8
Polyetheretherketone (PEEK)	250 / 480		14 - 33	0.58 - 3.4

Table: Comparison of Selected Aerospace Thermoset and Thermoplastic Resin Matrices. Source: Composites Forecasts & Consulting LLC

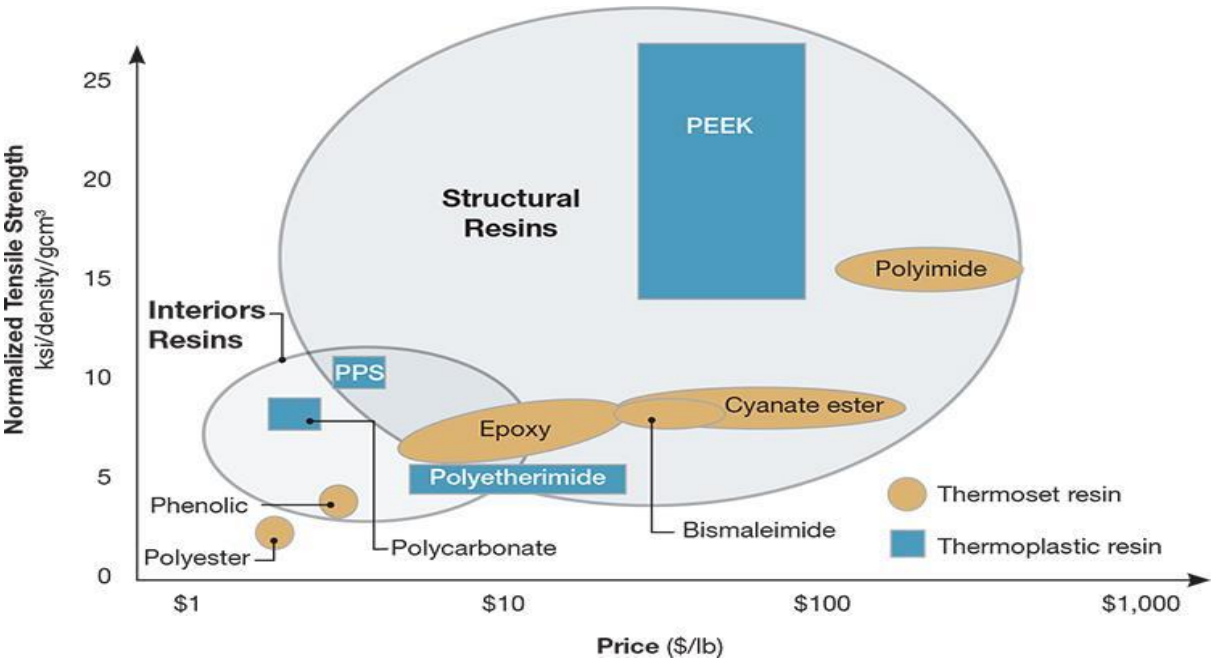
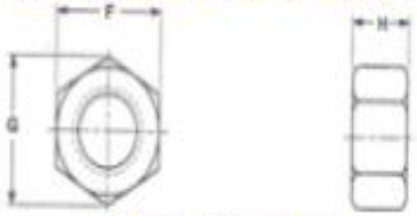


Fig. 2: Normalized Tensile Strength vs. Raw Material Price for Aerospace Thermoset and Thermoplastic Polymers. Source: Composites Forecasts & Consulting LLC

9. Dimensions of Metric Nuts

Dimensions of Metric Hex Nuts



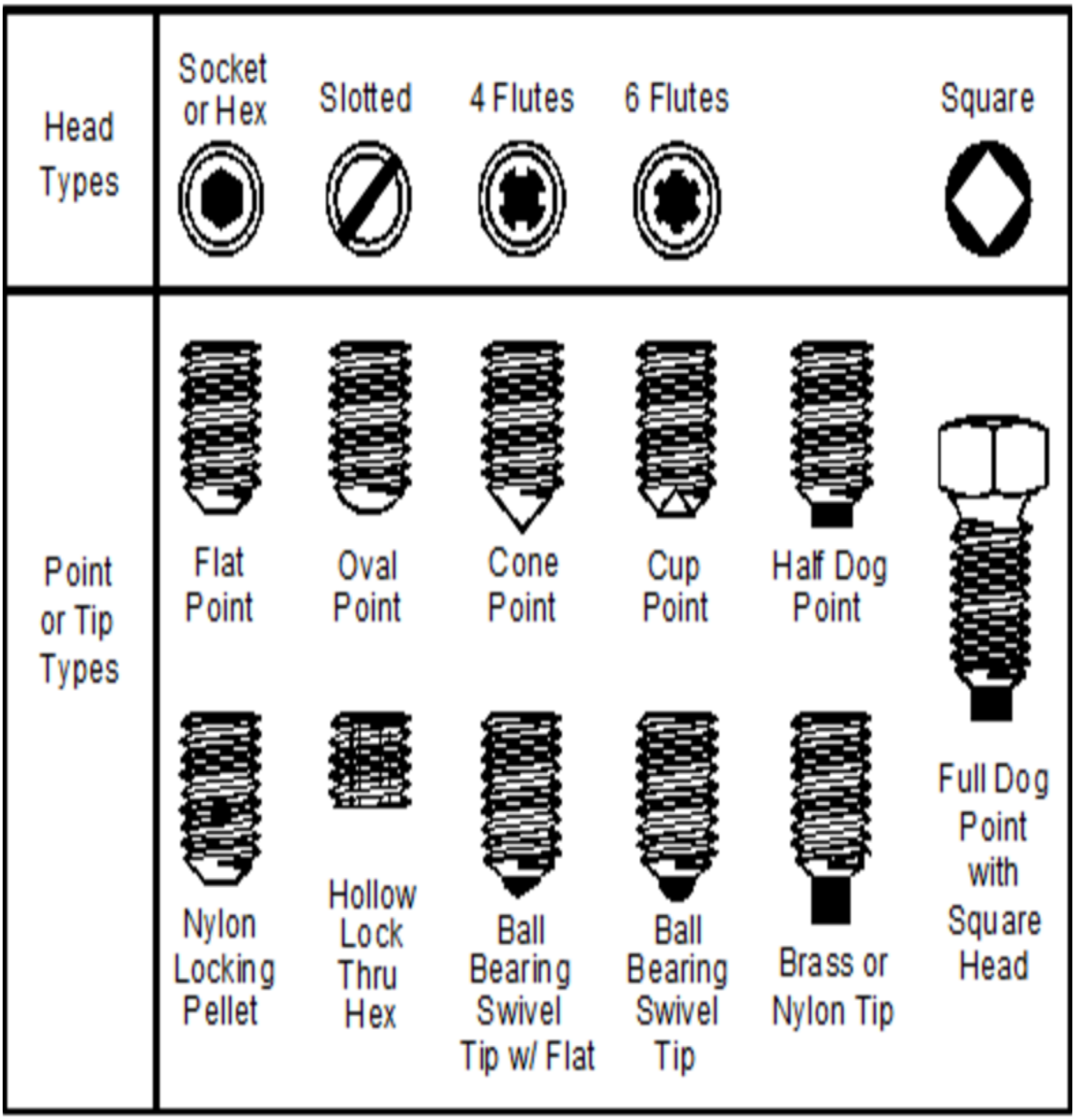
Metric Hex Nuts

Nominal Size	Thread Pitch	F		G	H	
		Width Across Flats (Wrench Size)		Width Across Corners	Thickness	
		Max	Min	Min	Max	Min
M1.6	0.35	3.2	3.02	3.41	1.3	1.05
M2	0.4	4	3.82	4.32	1.6	1.35
M2.5	0.45	5	4.82	5.45	2	1.75
M3	0.5	5.5	5.32	6.01	2.4	2.15
M4	0.7	7	6.78	7.66	3.2	2.9
M5	0.8	8	7.78	8.79	4.7	4.4
M6	1	10	9.78	11.05	5.2	4.9
M8	1.25	13	12.73	14.38	6.8	6.44
M10	1.5	16	15.73	17.77	8.4	8.04
M12	1.75	18	17.73	20.03	10.8	10.37
M14	2	21	20.67	23.35	12.8	12.1
M16	2	24	23.67	26.75	14.8	14.1
M20	2.5	30	29.16	32.95	18	16.9
M24	3	36	35	39.55	21.5	20.2
M30	3.5	46	45	50.85	25.6	24.3
M36	4	55	53.8	60.78	31	29.4
M42	4.5	65	63.1	71.3	34	32.4
M48	5	75	73.1	82.6	38	36.4
M56	5.5	85	82.8	93.56	45	43.4
M64	6	95	92.8	104.86	51	49.1

10. Rod Sizes

ROD SIZE	MAX. REC. LOAD LBS., 650 F	MAX. REC. LOAD LBS., 750 F	Wt PER FT.
1/4	240	215	0.12
3/8	610	540	0.29
1/2	1130	1010	0.53
5/8	1810	1610	0.85
3/4	2710	2420	1.22
7/8	3770	3360	1.65
1	4960	4420	2.21
1 1/8	6230	5560	2.80
1 1/4	8000	7140	3.55
1 1/2	11630	10370	5.10
1 3/4	15700	14000	8.16
2	20700	18460	10.68
2 1/4	28200	24260	13.32
2 1/2	3350	29880	16.68
2 3/4	41580	37066	20.88
3	50580	45085	26.04

11. Types of Setsquare



APPENDIX E

Website of the Project: http://students.emu.edu.tr/142327/

Poster:

EASTERN MEDITERRANEAN UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
ETHERNET AUTOMATIC PILL DISPENSER (e-APD)

PROJECT SUPERVISOR: Assist. Prof. Dr. DAVUT SOLYALI

DATE SPRING 2015-2016

GROUP NAME
I DON'T KNOW

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142327

MUAMMER GÜZEL
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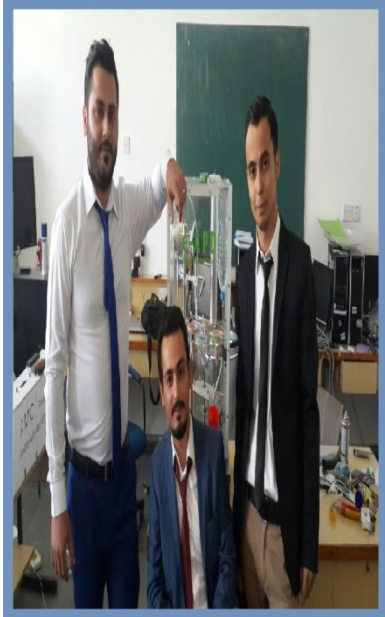

AIM OF PROJECT

The aim of this project, help to people who are elderly and always forget to take their pills on the time and this project is to design a medication dispenser system which gives feedback such as how many pills left inside the machine, and checks if the user takes the pill or not. Therefore , this project will make life of patients and their relatives easier.

INTRODUCTION

Ehernet Automatic Pill Dispenser is such a machine which will be used by doctor to control the amount of taking pill for patient for instance uneducated, elderly, physically disabled, forgetful people etc. This machine will have different and independent pill tubes from each other. Doctor who is giving the medicine will control and adjust the machine from the internet like how many times patients will get in a day and which one will take? There will be software to communicate with machine, useable interface.

CONCLUSION

Ethernet Automatic Pill Dispenser is compound of mechanical structure, electronic materials and arduino. e-APD communicates with arduino using interface that on the doctors' computer. e-APD has three different type of pills containers. The project can be developed related to needs such as controlling the machine with using the mobile application for Android or iOS and adding camerasystem to watch patient or using some specific sensors in the machine, program can detect whether patient takes the pills or not and patient relatives or the doctor can be informed via SMS or e-mail.