

AN-NAJAH NATIONAL UNIVERSITY



FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR BACHELOR
DEGREE IN COMPUTER ENGINEERING

HARDWARE GRADUATION PROJECT

Happy Healthy Cat

Authors :

Saif Al-Dawla Watheq Abbas

Khalid Bassam Badawi

Supervisor:

Dr.Haya Samaneh

List of Figures

Figure 1:Arduino Mega 2560.....	4
Figure 2:ESP32.....	4
Figure 3:LDR module.....	5
Figure 4:Relay module	5
Figure 5:12volt-Lamp.....	6
Figure 6:DH11 sensor.....	6
Figure 7:IRF530N	7
Figure 8:12-volt Fan	7
Figure 9:SD card module.....	8
Figure 10:V-slot	8
Figure 11:timing built.....	9
Figure 12:Nema23	9
Figure 13:Nema17	10
Figure 14:Limit switch.....	10
Figure 15:A4899 driver	11
Figure 16:IR sensor	11
Figure 17:sg90 servo.....	12
Figure 18:Mg90 servo	12
Figure 19:ESPCam.....	13
Figure 20:Laser module	14
Figure 21:water pump	14
Figure 22:Ultrasonic sensor	15
Figure 23:Load cell.....	15
Figure 24:TB6600.....	16
Figure 25:YS-DIV268N-5A.....	16
Figure 26:HX711 module	17
Figure 27:Final Prdouct.....	18

Contents

List of Figures	i
1 Acknowledgments	
2 Disclaimer	
3 Abstract	
4 Introduction	1
5 Constraints Limitations and Earlier Coursework	2
5.1 Constraints Limitations.....	2
5.1.1 Lack of Resources	2
5.1.2 Time Limit	2
5.1.3 The Power	2
5.1.4 The Cost.....	2
5.2 Earlier Coursework	2
5.3 Standards and Protocols	3
5.3.1 HTTP	3
5.3.2 UART.....	3
6 Methodology	5
6.1 Equipment and Components.....	5

Table of Contents

6.1.1 Arduino Mega.....	3
6.1.2 ESP 32.....	4
6.1.3 LDR module	5
6.1.4 Relay module	5
6.1.5 Lamp.....	5
6.1.6 DH11 sensor	6
6.1.7 IRF530N.....	6
6.1.8 12 Volt Fan	7
6.1.9 External speaker:	7
6.1.10 SD card module	7
6.1.11 V-slot.....	8
6.1.12 Timing built.....	8
6.1.13 Nema23	9
6.1.14 Nema17.....	9
6.1.15 Limit switch.....	10
6.1.16 A4899 driver	10
6.1.17 IR sensor.....	11
6.1.18 Servo sg90.....	11
6.1.19 Wires.....	12
6.1.20 Servo Mg90.....	12
6.1.21 Breadboard	12
6.1.22 ESPCam.....	13
6.1.23 Laser module	13
6.1.24 Water bump	14
6.1.25 Solenoid.....	14
6.1.26 Ultrasonic	14
6.1.27 Load Sensor	15
6.1.28 TB6600 Stepper Motor Driver	15
6.1.29 YS-DIV268N-5A Stepper Motor Driver	16
6.1.30 HX711.....	17
6.2 The process	17
A GUI for the mobile application	18

Result and Analysis:	19
7 Discussion	19
8 Conclusions and Recommendation	20

1 Acknowledgments

“ We would like to extend our heartfelt gratitude and appreciation to our esteemed supervisor, Dr.Haya Samaaneh, for her unwavering guidance, invaluable support, and tireless dedication throughout the duration of our project, her profound expertise, insightful feedback, and willingness to share her knowledge have played a huge role in shaping the success of our project. We would also say a huge thanks to anyone tried to give a helping hand or contributed with any advice, our journey wouldn't have been the same without you”

2 Disclaimer

This report was written by students at the Computer Engineering Department, Faculty of Engineering, An-Najah National University. It has not been altered or corrected, other than editorial corrections, as a result of assessment and it may contain language as well as content errors.

The views expressed in it together with any outcomes and recommendations are solely those of the students. An-Najah National University accepts no responsibility or liability for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.

3 Abstract

Cats are very beloved pets that people like to raise and keep at home, but cats also need a lot of care and attention to stay healthy and comfortable, everyone has things to do other than raising a cat, you may be busy at work, studying or anything, how would you take care of your pet while being outside home? Not everyone can find someone to take care of their pet, so we decided to make an automated care system that allows any cat owner to keep an eye on his cat while not at home.

Our system covers many important needed aspects and luxury ones as well:

The first features of course are the Essential feeding and watering systems, food and water should be continuously provided, we also allow the user to choose between three types of food.

We also monitor the light status and allow the user to turn on/off the light.

Cooling system is applied using a fan depending on the current temperature of the room.

And of course, cats can leave a mess after they eat, so we provided a cleaning mechanism that helps the user avoid manual cleaning.

Every cat owner likes to interact with his cat and play with her, so we provided an interactive laser play using mobile application so the user can have fun with his pet while not at home, it also helps cat staying entertained and healthy.

Science has proved that music can help removing cats anxiety and stress, so we added audio playing module to allow the user to play specific relaxing music. The user has a mobile application that controls and navigates through the whole system.

We will build the house first, then we will work on the features mentioned above step by step, using Arduino, ESP and other needed modules for the work.

The project has been covered before, but covered just basic things, we are trying to improve the system and provide multiple new functionalities to it, it won't be perfect, but we will try to make it as efficient as possible.

4 Introduction

A Cat Care System, as the name suggests, tries to provide the needs of a cat without dedicating so much of your time, many people are reluctant to own a cat just because they don't have the time and energy for it, our system tries to help people save their time, and help cats have a good environment and care.

A cat can become hungry or thirsty at any point of time, so food and water should be present 24/7, a cat owner can be late to home, busy, so he might be worried about his cat, so the system took care of this aspect.

No one likes to clean by hand, so we provided a cleaning mechanism that includes shifting the garbage to the edge of the house, then a ready vacuum will take care of it.

Cats are very interactive with lasers, so we made a bit of fun implementing a laser play system controlled by mobile application joystick, combined with a Camera that follows the laser to keep track of it, this can release some of the stress the cat may have.

Although cats can live with darkness, we provided a lightening system, monitoring the environment status(dark/bright), and turning the bulb on/off accordingly.

A hot room requires cooling, even though cats can live with high temperatures, its better to keep it cool and give a suitable temperature, so we provided a fan that operates at certain temperature.

Music can release the stress of a cat, so we used SD card with external speakers module to play audio.

All of those features mentioned above, can be very helpful and save people's time, providing a remote control over your cat, can save you a lot of time, and should be a fun experience.

The report will explain the problem and how it could be solved. Then will show a methodology and the equipment to try and solve the problem. Then we will give an overview on how to improve the system and make the process of taking care of a cat a completely automated process.

5 Constraints Limitations and Earlier Coursework

5.1 Constraints Limitations

5.1.1 Lack of Resources

Unfortunately, as Palestinians, we don't have access to everything, some components that we needed were not available, making us move to worse alternatives to move on, even online shopping from amazon for example is very difficult, which adds some inaccuracy to the system.

5.1.2 Time Limit

Time is the most expensive constraint that costed us, not only on the amount of features that we add, but also on the depth of research and alternatives implementation.

Every task takes a lot of time, and with that time limit, its hard to accomplish perfect product.

5.1.3 The Power

Modules vary in their voltage/currents needs, which caused a bit of confusion, some of it needs 5Volt, some 12 Volt, some 220volt even. Motors also require high currents, so we had to deal with the lack of current that the Arduino provides.

5.1.4 The Cost

The project has multiple components, each will cost money, But the point of such project is to find an economic system with lower cost as possible to meet the financial level, not to mention that no one is willing to spend so much money on prototyping and something that won't be a final product.

5.2 Earlier Coursework

We learned a lot from the previous courses that we passed, such as microprocessors, micro controllers, digital design, critical thinking, electronics design and so on, which helped us learn the basics to go deeper into the tank and learn some other courses and tutorials such as:

1. Arduino Course
2. ESP32 Course

3. Blynk Tutorial

5.3 Standards and Protocols

5.3.1 HTTP

Hypertext Transfer Protocol (HTTP) is an application-layer protocol for transmitting hypermedia documents, such as HTML. The HTTP protocol was designed to communicate between web browsers and web servers, but it can also be used for other purposes. HTTP is a stateless protocol, this means that the server does not keep any data (state) between two requests.

5.3.2 UART

UART, which stands for Universal Asynchronous Receiver/Transmitter, is a hardware communication protocol widely used for serial data communication between electronic devices. It serves as a fundamental method for transmitting and receiving data in a bit-by-bit manner.

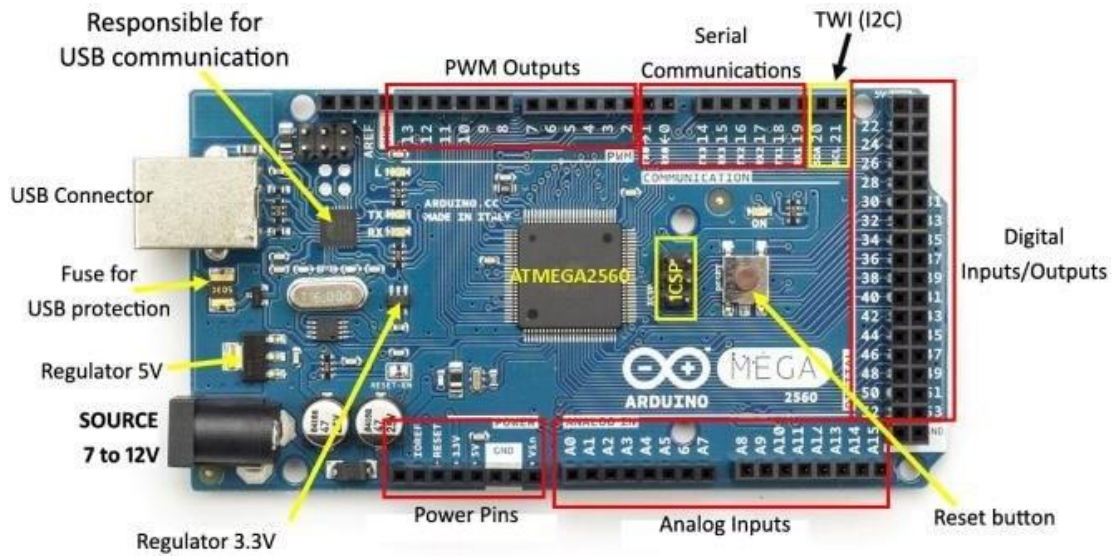
Key features are: Serial Communication, Asynchronous Communication, Start and Stop Bits, Full Duplex Communication

6 Methodology

6.1 Equipment and Components

6.1.1 Arduino Mega

The Arduino Mega 2560 is a microcontroller board that serves as an enhanced version of the popular Arduino platform. It's designed to provide a larger number of digital input/output pins, memory, and processing power compared to standard Arduino boards. Arduino mega powered by ATmega 2560 and it has three types of memory. Flash memory 256KB, SRAM 8KB and EEPROM 4KB. And also, it has 54 digital pins and 16 analog pins we can connect to them sensors and actuators and other modules, we can use 15 pins as PWM which we can control of speed pf motor and intensity of illumination. We can use the Arduino to make serial communication while it has I2C, SPI and UART so we can talk to another component like esp32 or other Arduino. And it has USB connection to upload our code to Arduino and take voltage to turn it on and also has power supply to start working and finally and the amazing thing Arduino mega 2560 offers enhanced capabilities, it maintains compatibility with the existing Arduino ecosystem. This means that code and libraries written for other Arduino boards can often be used with the Mega 2560 with minimal modifications.



6.1.3 LDR module

The LDR Sensor Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light. The sensitivity of the signal detection can be adjusted using a potentiometer. We use it to check the status of intensity light.



Figure 3:LDR module

6.1.4 Relay module

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit. We use more than one in our project. In 12volt Lamp, 230volt vacuum machine, 12volt solenoid and 12volt pump.



Figure 4:Relay module

6.1.5 Lamp

A 12-volt lamp is designed to operate using a 12-volt power supply. It's commonly used in automotive, marine, and low-voltage lighting applications. Its compatibility with 12-volt systems makes it suitable for various setups where standard household voltage isn't available or practical. We control it by LDR module and from mobile application.



Figure 5:12volt-Lamp

6.1.6 DH11 sensor

The DHT11 sensor is a basic and cost-effective digital temperature and humidity sensor module. It is commonly used in various projects and applications to measure ambient temperature and relative humidity. The sensor provides accurate and reliable data output through a digital signal, making it easy to integrate into microcontroller-based systems for environmental monitoring and control purposes. We use it to see the temperature only.



Figure 6:DH11 sensor

6.1.7 IRF530N

The IRF530N is an N-channel power MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) commonly used in electronic circuits for switching and amplification applications. It is known for its high voltage and current-handling capabilities, making it suitable for various power-related tasks. The IRF530N is often used in power amplifiers, voltage regulation circuits, motor control, and switching applications. Its low on-resistance and efficient performance make it a popular choice in electronics for controlling substantial currents and voltages. This transistor we use it to control of speed of fan by specify the voltage that will want to fan.

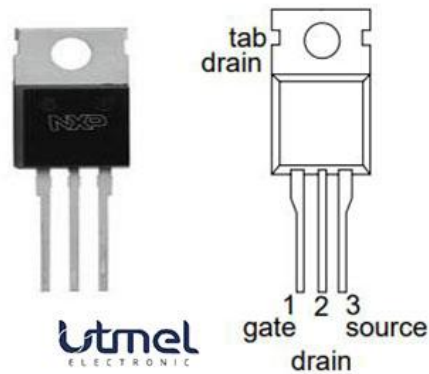


Figure 7:IRF530N

6.1.8 12 Volt Fan

A 12-volt fan is a cooling device designed to operate on a 12-volt power supply. These fans are commonly used in electronics, automotive, and various cooling applications where a lower voltage is preferred. They help dissipate heat by producing airflow, making them suitable for maintaining optimal operating temperatures in a variety of systems and environments. we are control of its speed according of temperature that reading from DH11.



Figure 8:12-volt Fan

6.1.9 External speaker:

We have an external speaker in our project to play the music that stored in SD card module, this speaker provides an audio an output and have a richer quality of sound this speaker is used to connect to laptop.

6.1.10 SD card module

An SD card module is a convenient and compact device that enables microcontrollers and other electronics to interface with SD (Secure Digital) memory cards. These modules typically include an SD card slot, voltage level shifting circuitry, and often a SPI (Serial Peripheral Interface) communication interface. By connecting an SD card module to a microcontroller, users can read from and write to SD cards, allowing for data storage and retrieval in various projects such as data logging, multimedia playback, and data backup applications. We use it to store the music of cat.



Figure 9:SD card module

6.1.11 V-slot

V-Slot is a versatile and modular aluminum extrusion system commonly used in DIY projects, particularly in the maker and 3D printing communities. Its profile is shaped like a "V," featuring a V-shaped groove along one or more sides. This groove serves as a guide for compatible wheels or bearings, allowing smooth and precise linear motion.

V-Slot extrusions are designed to create rigid and customizable structures, making them suitable for building frames, gantries, and other mechanical components. These extrusions can be easily connected using brackets, nuts, and bolts, offering flexibility in creating various configurations. V-Slot's adaptability and ease of assembly make it a popular choice for constructing accurate and stable machines and frameworks in the maker, CNC (Computer Numerical Control), and robotics domains. We use it in shifting mechanism.



Figure 10:V-slot

6.1.12 Timing built

In a piston engine, either a timing belt (also called a *cambelt*) or timing chain or set of timing gears is used to synchronize the rotation of the crankshaft and the camshaft. This synchronization ensures that the engine's valves open and close at the correct times in relation to the position of the pistons. But we are use it to hold our component that used in shifting mechanism and let it to walk.



Figure 11: timing belt

6.1.13 Nema23

The NEMA 23 is a standardized stepper motor size often used in various mechanical and automation applications. It derives its name from the National Electrical Manufacturers Association (NEMA) classification system. NEMA 23 stepper motors are known for their medium size and power, offering a balance between torque output and physical dimensions. They are widely used in CNC machines, 3D printers, robotics, and automation systems where precise and controlled motion are required. The NEMA 23 designation indicates the physical dimensions and mounting specifications of the motor, making it easier to select and integrate into different projects. We use it more than position in V-slot to run shifting mechanism and in food module to move from type to type.

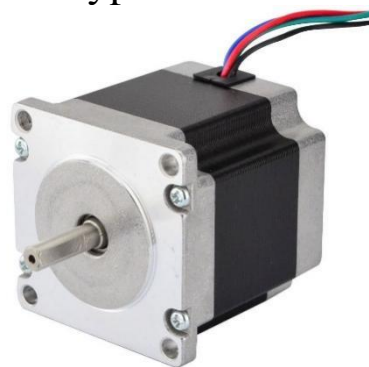


Figure 12: Nema23

6.1.14 Nema17

The NEMA 17 is a standard stepper motor size defined by the National Electrical Manufacturers Association (NEMA). It's a popular choice in the world of automation, robotics, and 3D printing due to its compact size and versatile performance. NEMA 17 stepper motors offer a good balance between torque and

physical dimensions, making them suitable for applications that require precise control and positioning. Their standardized dimensions and mounting specifications make them easy to integrate into various projects, ranging from DIY machines to industrial automation systems. We use it to move the vacuum in linear way when shifting mechanism finished.



Figure 13:Nema17

6.1.15 Limit switch

A limit switch is a mechanical or electrical device designed to detect the presence or absence of an object, limit the movement of a machine or mechanism, or trigger an action when a specified physical limit is reached. These switches are commonly used in industrial automation, robotics, and machinery to ensure safe and precise operation. Limit switches typically consist of an actuator (a lever, roller, or button), a switch body, and electrical contacts. When the actuator comes into contact with an object or reaches a predefined position, it triggers the switch to open or close, which, in turn, initiates specific actions or halts the movement of equipment. Limit switches play a critical role in safeguarding machinery and ensuring accurate positioning, making them essential components in various industries. We use stop the stepper to move when the shift mechanism is reach to the end.



Figure 14:Limit switch

6.1.16 A4899 driver

The A4988 is a widely used motor driver integrated circuit (IC) designed to control stepper motors in various applications. It's commonly used in 3D printers, CNC machines, and robotics projects. The A4988 driver provides micro stepping capabilities, allowing for smoother and more precise control of stepper motor movements. It can handle relatively high current levels and supports step and direction control signals. The A4988's popularity stems from its simplicity, reliability, and affordability, making it a go-to choice for hobbyists and professionals seeking to control stepper motors efficiently. We

use it for nema17.



Figure 15:A4899 driver

6.1.17 IR sensor

An Infrared (IR) sensor is a device that detects and measures infrared radiation, which is a type of electromagnetic radiation with longer wavelengths than visible light. IR sensors are commonly used in a wide range of applications for detecting the presence or movement of objects, measuring temperature, and facilitating communication between devices. We used it to avoid the dish of food and water to collide to shifting mechanism.



Figure 16:IR sensor

6.1.18 Servo sg90

The SG90 is a small, lightweight servo motor that's commonly used in hobbyist electronics and robotics projects. It's known for its affordability, compact size, and relatively good performance. The SG90 servo motor can rotate within a range of approximately 180 degrees and is controlled by sending PWM (Pulse Width Modulation) signals. It's often used to control the movement of small mechanical components, such as robotic arms, remote-controlled vehicles, and miniature aircraft. While it may not be as powerful as larger servo motors, its ease of use and availability make it a popular choice for beginners and small-scale projects requiring precise motion control. We use it in laser module to move the laser in y-axis, for open and close the food carries and in shifting mechanism to avoid the dish of food and water while shifting mechanism operating.



Figure 17:sg90 servo

6.1.19 Wires

Wires used to connect the component

6.1.20 Servo Mg90

The MG90 is a versatile and compact servo motor commonly utilized in electronics, robotics, and RC (radio-controlled) hobbyist projects. Known for its reliability and accuracy, the MG90 offers a good balance between size and performance. It operates using PWM (Pulse Width Modulation) signals to achieve controlled movement within a range of around 180 degrees. The MG90 servo motor is suitable for tasks requiring precise angular positioning, such as controlling robot limbs, steering mechanisms in remote-controlled vehicles, and various other mechanical motions. Its durability, affordability, and ease of integration make it a popular choice for both beginners and experienced enthusiasts seeking precise motion control solutions. We use it to move the laser in x-axis.



Figure 18:Mg90 servo

6.1.21 Breadboard

Breadboard used to ease wiring some parts and to supply power for multiple parts using 1 wire from the source.

6.1.22 ESPCam

The ESPCam is a compact and versatile camera module based on the ESP8266 or ESP32 microcontroller platform. It integrates both a microcontroller and a camera sensor into a single module, allowing developers to easily add image and video capture capabilities to their projects. The ESPCam typically comes with features like Wi-Fi connectivity, making it suitable for applications such as live streaming, surveillance, remote monitoring, and image recognition. With appropriate firmware and software libraries, users can control the camera, capture images and videos, and transmit them over the internet. The ESPCam's compact form factor and integration with microcontrollers make it a popular choice for IoT (Internet of Things) projects requiring visual data acquisition and communication. We use it to see the laser and while the user playing with cat from mobile application.



Figure 19:ESPCam

6.1.23 Laser module

A laser module is a compact device that emits a concentrated and coherent beam of light through the process of stimulated emission. These modules utilize various laser technologies, such as diode lasers or semiconductor lasers, to produce a narrow and focused light beam. Laser modules find applications in a wide range of fields, including communication, measurement, alignment, projection, engraving, and medical procedures. They offer precision and accuracy due to their ability to produce a highly directional and concentrated light source. Laser modules are available in different power levels and wavelengths, each suited for specific tasks, making them a versatile tool in both industrial and consumer settings. However, it's important to note that lasers can be hazardous if not used properly, so proper safety precautions should always be observed when working with laser modules. We use it to interactive with cat because the cat love to play with something like that.



Figure 20:Laser module

6.1.24 Water bump

A 12-volt water pump is an electrical device designed to move water using a 12-volt power supply. These pumps are commonly used in various applications such as RVs, boats, off-grid systems, and outdoor setups where standard AC power sources are not available or practical. They come in various types, including submersible, centrifugal, and diaphragm pumps, each with specific capabilities and purposes. 12-volt water pumps are favored for their portability, flexibility, and ability to operate in remote locations. They are widely used for water transfer, irrigation, fluid circulation, and other water-related tasks in both recreational and practical settings. We use it to get the water and we turn it when the ultrasonic give us distance less than 3cm.



Figure 21:water pump

6.1.25 Solenoid

A 12-volt water solenoid is an electromechanical valve designed to control the flow of water using a 12-volt power supply. These solenoids are commonly used in irrigation systems, water automation, and various industrial applications where remote or automated control of water flow is required. When a 12-volt electrical signal is applied, the solenoid's coil generates a magnetic field that opens or closes the valve, allowing or stopping the water flow. 12-volt water solenoids offer precise and efficient control, making them suitable for tasks such as filling tanks, controlling water distribution, and managing fluid flows in various setups. They are a crucial component in systems where fluid management needs to be coordinated with other electrical processes. We are also turn it on if the ultrasonic give us less than 3cm distance, it connects to water pump.

6.1.26 Ultrasonic

An ultrasonic sensor is a versatile technology used to measure distances or detect objects using ultrasonic sound waves. These sensors emit ultrasonic pulses and measure the time it takes for the sound waves to bounce back after hitting an object or surface. By analyzing the time delay, the sensor can calculate the distance between itself and the target. We use it to see the level of water.



Figure 22:Ultrasonic sensor

6.1.27 Load Sensor

A load sensor, also known as a load cell, is a transducer designed to measure force or weight by converting mechanical force into an electrical signal. Load sensors are used in a wide range of applications where the measurement of force, tension, compression, or weight is essential. They consist of a strain gauge or a series of strain gauges bonded to a structure that deforms when subjected to force.

When force is applied to the load sensor, the strain gauges change their resistance, which leads to a change in electrical output. This change in electrical signal is then calibrated and converted into a measurable force or weight reading. Load sensors come in various capacities, sizes, and configurations, allowing them to be used in different contexts such as industrial machinery, weighing scales, material testing, automotive systems, and medical equipment and it connect to HX711 module to amplify the signal come from load cell.

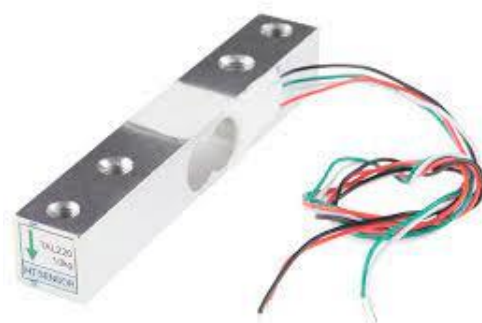


Figure 23:Load cell

6.1.28 TB6600 Stepper Motor Driver

The TB6600 is a popular stepper motor driver module widely used in various applications that require precise control of stepper motors. It is designed to convert low-level control signals from a micro controller or other control systems into high-level current and voltage signals required to drive stepper motors effectively.

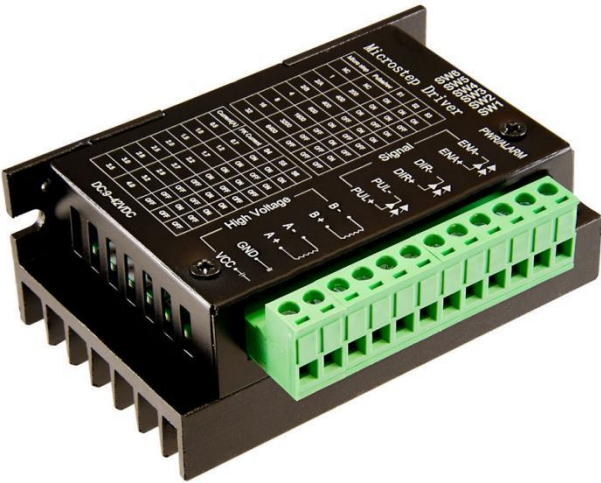


Figure 24:TB6600

6.1.29 YS-DIV268N-5A Stepper Motor Driver

Same as the TB6600 driver but with higher current ability.

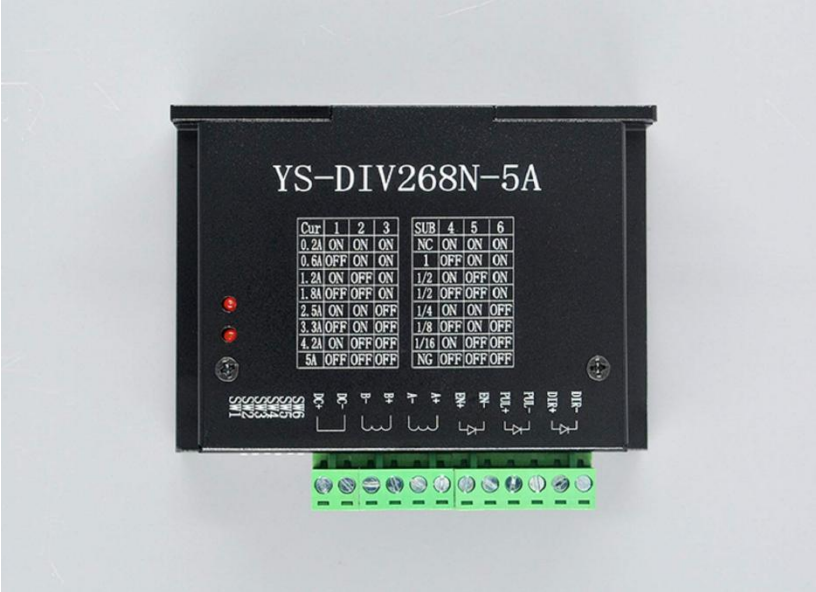


Figure 25:YS-DIV268N-5A

6.1.30 HX711

The HX711 amplifier is a breakout board that allows you to easily read load cells to measure weight. You wire the load cell wires on one side, and the microcontroller on the other side. The HX711 communicates with the microcontroller using two-wire interface (Clock and Data), and we should connect header pins to the GND, DT, SCK and VCC to Arduino and E+, E-, A- and A+ should connect to load cell.

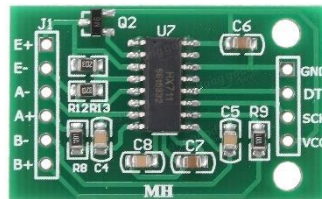


Figure 26:HX711 module

6.2 The process

1. The user is allowed to choose between two modes, Automated Mode and Manual Mode, the auto mode takes care of lightening system, feeding system, watering system, cooling system.
2. First module is the feeding system, where we allow the user to choose auto mode, in which the food is filled by turn, so first meal will be type1, the next time the food can is empty, the food can will be filled by type2, and so on, in the manual mode, we allow the user to fill the food can as he wants, he can mix the types as well.
3. Third module is the watering system, where we measure the water level and send the level to the mobile application, the water will only be filled when the water can is empty, when its empty, a water pump and a valve will be opened for a certain amount of time.
4. The cleaning module, which consists of two phases, the first phase is the shifting mechanism from the start to end of the house, then a vacuum machine will be waiting to clean the shifted garbage.
5. The laser play Mode, where the user can interact with his pet whenever he wants, attached with a live cam to see what is happening.
6. Finally, a relaxing music module can be used to release the stress if the cat is anxious or uncomfortable.

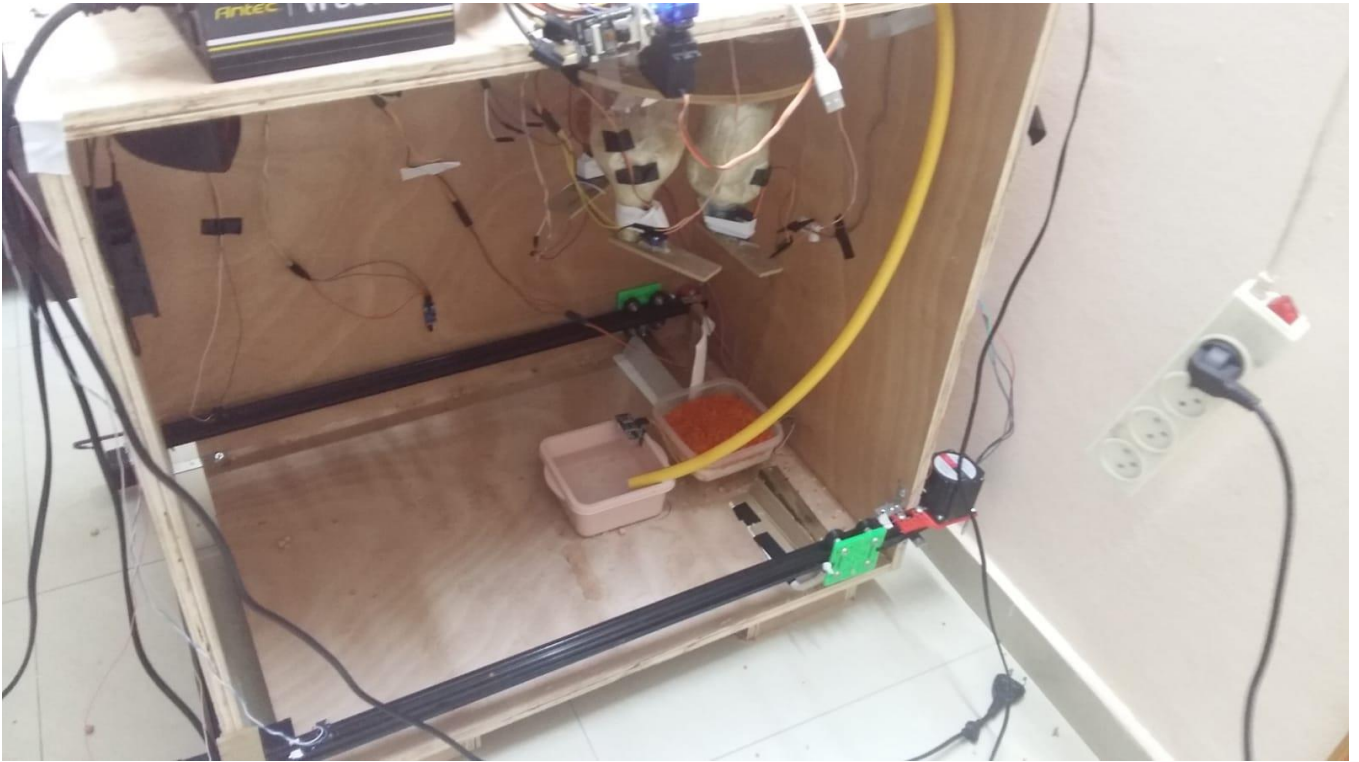
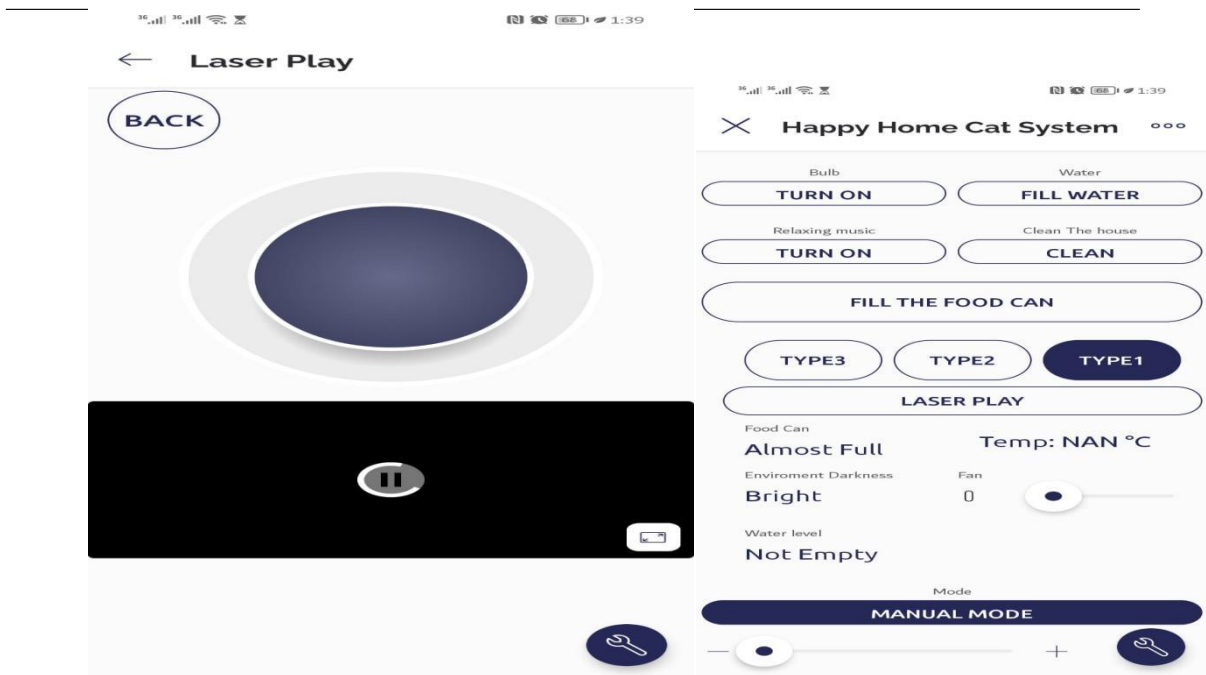


Figure 27:Final Prdouct

A GUI for the mobile application



Result and Analysis:

The final Result was close to what we expected, a decent System that takes care of the cat needs but with flaws that are related to the limitations that we faced.

The design that we had in mind would've worked better had we used CNC instead of simple prototyping wood, like the movement of the cleaning system and the feeding mechanism.

The prototyping fact caused us to limit our focus on how much we spend on the project, both financially and energy wise.

But of course, it could've been better and future work could make it a better system.

7 Discussion

The problem was that people couldn't take care of their cats all the time, so there has to be a system that help these people.

We solved this problem by implemented an automated/user-controlled system that allows the user to interact and take care of his cat wherever he is.

The first problem that we solved was the Feeding process, imagine being outside and the cat is starving and there is no food in the can, how would u feed it? Our system solved that by allowing the user to set an auto mode where the system continuously checks if there is food or not.

Similarly, water is the most essential thing in life, so same like feeding system, the system checks if the water can is empty so it fills it.

Also cleaning may be an annoying thing to a pet owner, so we contributed by implementing a cleaning mechanism that is not perfect, but decent enough to release some of the work needed manually from the user.

Not only that we covered essential living things, we also contributed by adding fun features like relaxing music and laser play, that are scientifically proved to be

helpful for cats' mental health.

Naturally, as more systems like this exist, the more people will own cats and pets in general, just think of how many people that love raising cats but always say "I don't have time for it" or "I don't think I will take care of it".

8 Conclusions and Recommendation

- ❖ The results show that these types of systems can be very useful, its very important to keep creating systems and machines that save people's time and energy, and this system does exactly that.
 - ❖ We saw how feeding can release a headache for the cat owner, providing cat's full day food and water can be very satisfying.
 - ❖ We noticed the importance of a cleaning system that does most of the cleaning job for the user, of course its not perfect but it did the job.
 - ❖ Implementing fun and Interactive methods like laser play could encourage people to lean towards these systems, as cat owners tend to care so much about cat's mental health and how the cat behaves throughout the day.
 - ❖ Improving the work can be done in several ways, the first one is providing a completely accurate feeding system, using better measuring system than the load sensor, since food weights can vary.
 - ❖ Watering could be done in a slightly different approach, as the ultrasonic sensor is not that accurate, but we tried some water level sensor that turned out to be a problematic sensor, using better watering system will definitely be an improvement.
 - ❖ Cleaning should be done in CNC, accurate movement is required in such systems, especially if it's a final product not a prototype.
-
- ❖ We learned how to build embedded systems, and that nothing is impossible to implement, but accuracy needs better equipment, seriousness about producing a final product.
 - ❖ We also learned how to deal with electrical problems facing us throughout the project.
 - ❖ For the future work we could do a lot of things, such as a GPS Tracking system for the cat, keeping track of cat's health, improving the cleaning mechanism to cover everything and be a complete operation and more features that of course will need time and money.

References

- 1-<https://docs.arduino.cc/hardware/mega-2560>
- 2-<https://docs.espressif.com/projects/esp-idf/en/latest/esp32/>
- 3-<https://docs.blynk.io/en/>
