



**Smart Litter Box**

**Embedded Systems Course**

**Supervisor: Dr. Belal Sababha / Dr. Anastassia Gharib**

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**Done by:**

**Saif Sakkijha – 20200135**

**Hasan Alrawashdeh – 20201048**

**Hazim Altoubasy - 20210425**

## **Abstract**

We provide an unusual method to make cleaning the cat litter box easier. An infrared sensor in our automated system tracks when the cat enters and exits the box. A servo motor that pushes the moving part upward through a filter to separate waste from clean litter starts working after the cat leaves. The litter box resets itself for the following usage once it finishes. This method guarantees a cleaner environment for cats and a more pleasant pet care experience by reducing the effort and frequency of cleaning required by cat owners.

## **Introduction**

This project explores the intersection of automation and pet care by developing a self-cleaning cat litter box that uses sensor technology and mechanical automation. Our system employs an infrared sensor to monitor when a cat enters and exits the litter box. Once the cat leaves, a servo motor activates, lifting and sifting the litter through a filter to separate waste from clean litter. The waste is then deposited into a designated compartment, and the litter box resets for the next use.

By integrating various technologies such as embedded systems, sensor technology, and mechanical design, this project aims to highlight the potential of automation in simplifying everyday tasks. The self-cleaning litter box reduces the effort and frequency of manual cleaning, ensuring a consistently hygienic environment for cats. The objective of this project is to demonstrate how these advanced technologies can be applied to create practical and efficient solutions that enhance the quality of pet care.

## 1.1 Hardware components

Components that were used in this project are:

### -PIC Microcontroller(16F877A)

The PIC 16F877A by Microchip is a widely-used 8-bit microcontroller known for its low power consumption and versatility in embedded systems.



Figure (1.1) PIC 16F877A

### -IR Infrared Sensor

An IR (Infrared) sensor detects infrared radiation, converting it into electrical signals. It's commonly used in motion detectors, proximity sensors, and remote controls for contactless detection in electronic systems.



Figure (1.2) IR Infrared Sensor

### - Light Dependent Resistor sensor.

An LDR is a light sensor that adjusts its resistance with changing light levels. It's used in applications like automatic lighting and light-sensitive alarms, often paired with microcontrollers for control.

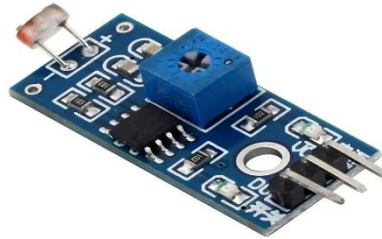


Figure (1.3) LDR sensor

### - Light-Emitting diode

A Light-Emitting Diode (LED) is a semiconductor device that emits light when an electric current passes through it. LEDs are widely used in various applications such as indicators, displays, and lighting due to their energy efficiency, long lifespan, and compact size.



Figure (1.4) LED

### - Servo motor

A servo motor can be used to move an arm from 0 to 180 degrees. The servo motor works based on PWM, this means that the angle that it rotates is controlled by the width of the pulse applied to its control pin. The MCU will output the angle via the control pin.



Figure (1.5) Servo motor

### - Power supply adapter

A power supply adapter converts AC from a wall outlet to a stable DC voltage suitable for electronic devices. It steps down the voltage, converts AC to DC, and regulates the output to ensure the device receives a steady voltage, typically 5V, 9V, or 12V.



Figure (1.5) Servo motor

## 2.1 Project Flow Chart & Design

Figure 2 depicts the flowchart that describes the designed project. The attached codes have all the detailed information and comments about the ports and functionality of the designed system

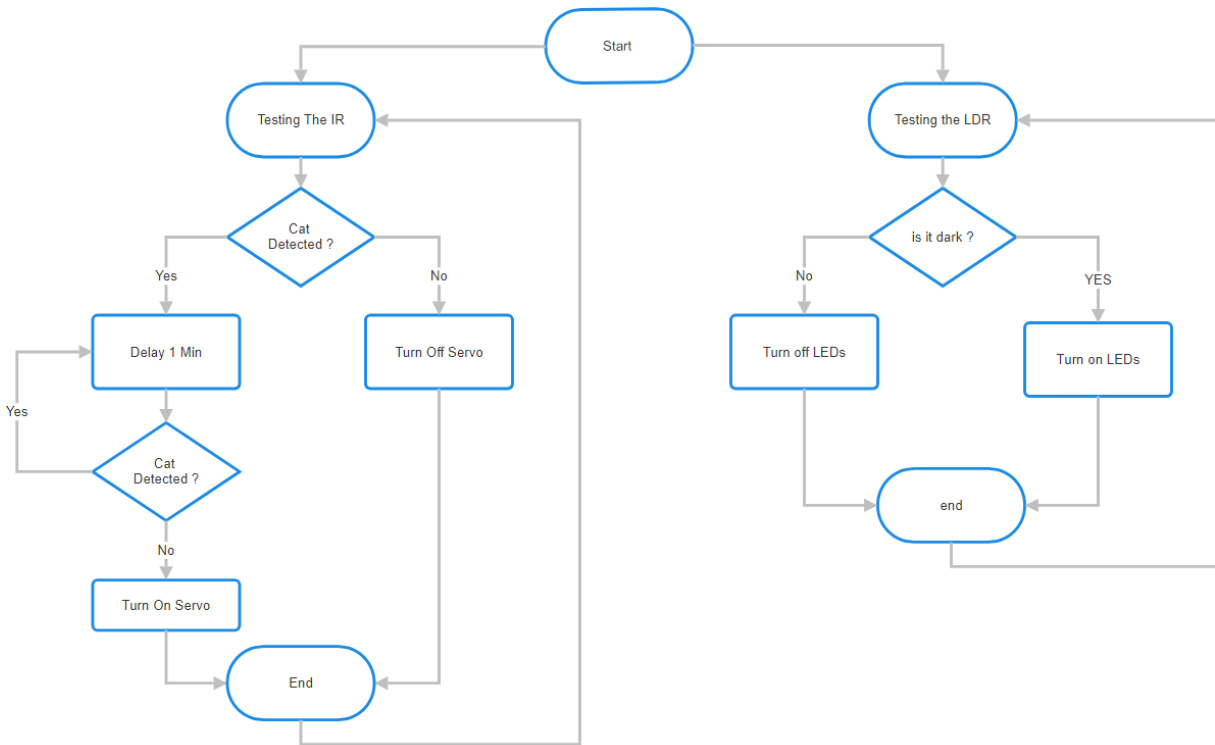
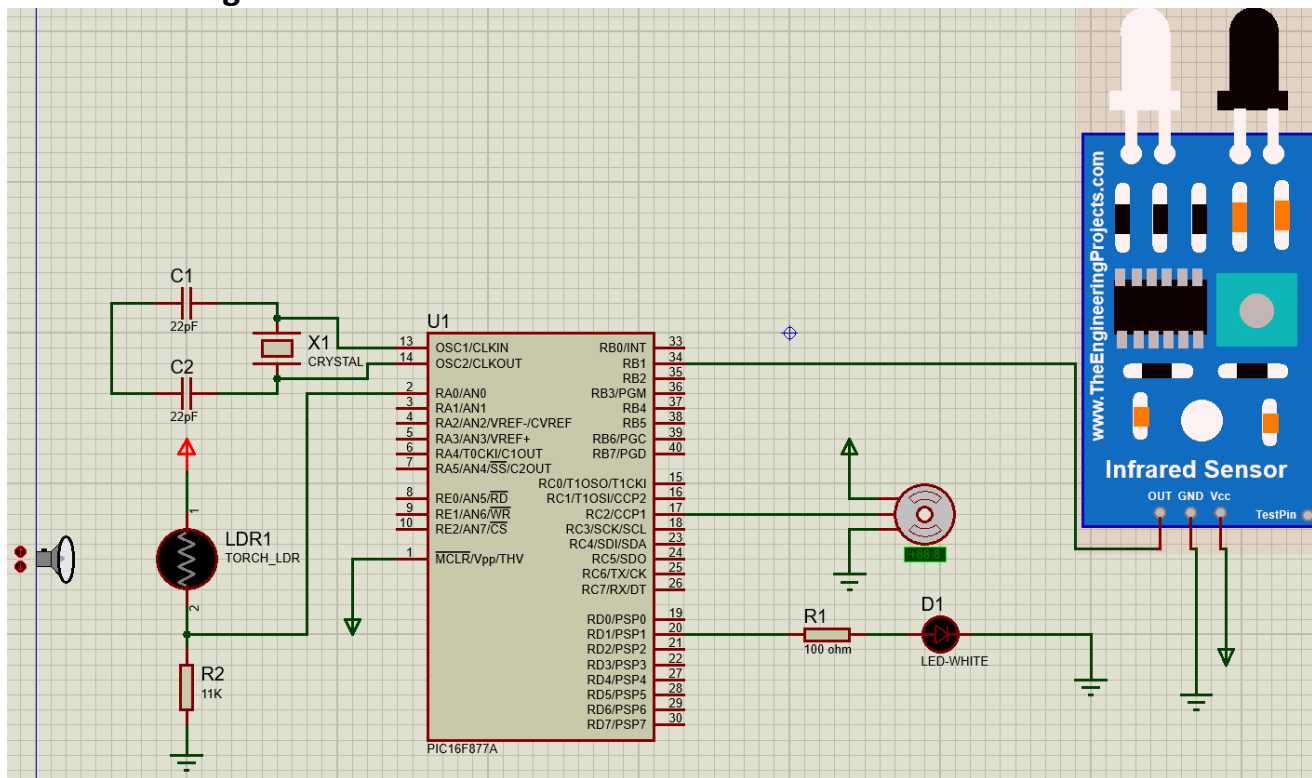


Figure (2): software design

## -Circuit Design



Port	Pin	Connected TO
Port A	RA0	LDR (Analog input)
Port B	RB1	IR sensor (Digital input)
Port C	RC2	Servo motor (PWM)
Port D	RD1	LED (Digital output)
	VDD	Power
	VSS	Ground
	OSC1	Crystal Oscillator
	OSC2	Crystal Oscillator

## -Mechanical Design









## Problems and Recommendations

While working on this project we faced few problems that we should mention:

- The continuous malfunction while working on the hardware parts, as they are cheap and non-reliable on the long term.
- Merging the code together and debugging it to make it work.
- Finding the suitable litter box.

We as a group think that taking the following recommendation into consideration could help in the future work:

- Assuring the availability of the needed hardware parts in a very high quality, to use it for the long term
- Working as a team and using our connections to find the suitable litter box.

## Conclusion

In conclusion, our project has successfully demonstrated the integration of advanced technologies to create an efficient and convenient solution for cat owners. By combining an IR sensor for cat detection, a servo motor for automated cleaning, and an LDR sensor for ambient light control, we have developed a self-cleaning litter box that significantly reduces the manual effort required for cleaning.

Through this project, we have showcased the potential of robotics, sensor technology, and automation in addressing everyday challenges, ultimately improving the quality of life for both pets and their human companions.



## References and Datasheets

-PIC Microcontroller (16F877A)

<https://ww1.microchip.com/downloads/en/devicedoc/39582b.pdf>

<https://www.microchip.com/en-us/product/PIC16F877A>

-LDR sensor

<https://www.electroduino.com/ldr-sensor-module-how-ldr-sensor-works/>

-IR sensor

[www.electronicsforu.com/technology-trends/learn-electronics/ir-led-infrared-sensor-basics](http://www.electronicsforu.com/technology-trends/learn-electronics/ir-led-infrared-sensor-basics)