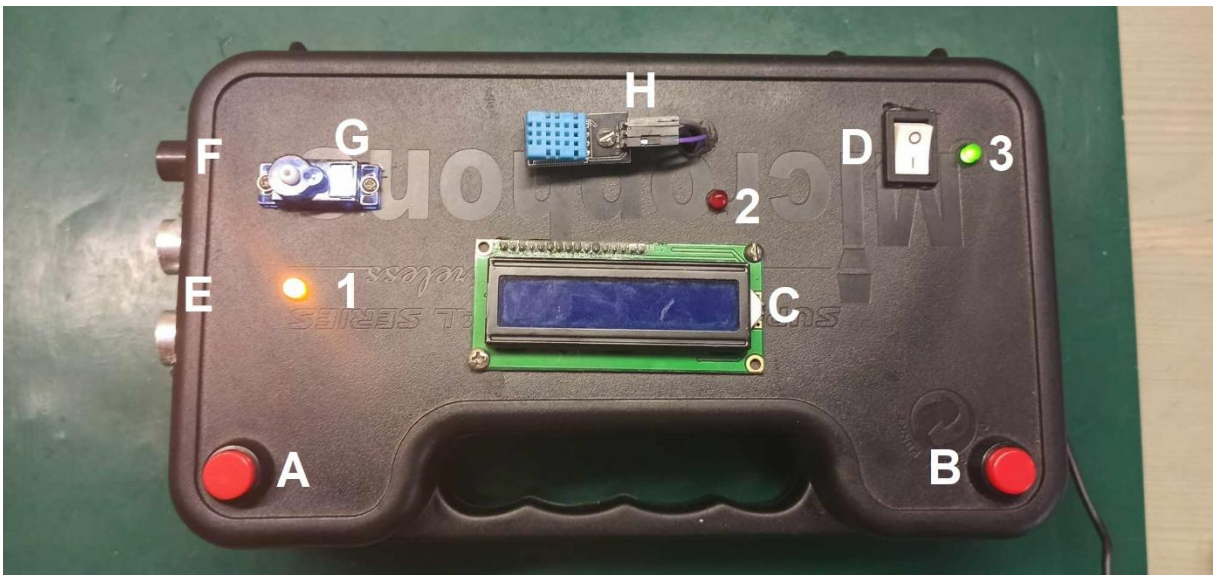
Cat detector

Abstract: The main functionality of this device is to prevent cat from messing bed by scaring it away with sound (buzzer) and motion (servo). Animal is detected with ultrasound sensor. Moreover, device has programmable distance that set off alarm to match the bed length and event counter memory. External functionality includes temperature and humidity sensor.

1. Brief description:



A – alarm distance button

B- Menu button

C- LCD display 2x16

D - Power button

E - ultrasound sensor HC-SR04

F – buzzer

H- DHT11 sensor, G – microservo SG-90 (add styrofoam arm)

1- Obstacle status

2- Error status

3- Power status

2. **Buttons:**
    - Right button – switches menu instances
    - Left button – regulates alarm distance by adding 10cm with every press. When it reach max distance range, it roll-over to simplify user experience

3. **LEDs**
    - Obstacle status [1]- when ultrasound sensor detected obstacle in closer range than alarm distance is set, it turns ON but not set off alarm state. The device will wait for 5 seconds and sensor will make check again. If there is still obstacle it will raise alarm.
      For example, when alarm distance is set 200cm and it detected something closer than 200cm, it will change state to ON. The device will wait 5 seconds to clear it pathway if was caused by accident. Then, if something is still in closer range than 200cm it will go into alarm state.

    - Error status [2]- This device has error indicator status caused by two cases:
        a) When alarm is set off for too long period of time
        b) When alarm is set off too many times per day

    - Power status [3] – It indicates that device is working. It is worth mentioning that it is not connected to the device Vin but is lighted by software, which means that device is working properly.

4. How does it work?

A and B buttons provide access to menu with possibility of changing alarm range distance. You set only maximum distance. Minimum distance is always 0 cm. Distance is write on EEPROM memory and is remembered even when device is turned off.

When LCD has backlight tuned off, it means that alarm is armed. When device enter menu, alarm is disarmed. Menu options will be discussed later.

When device detected something in alarming distance range, it will set yellow LED [1] ON to indicate that it is alerted but not set off alarm yet. It helps to reduce false alarms caused by accident like forgetting and sitting on couch that is protected by device.

After 5 second, sensor will make check again and if obstacle is still detected in alarming distance, it will go into alarm state. It means, it will start to beeping with buzzer, and aggressively moving microservo to scare animal away with sound and motion. It still checks distance with sensor and when pathway is cleared like animal run away, it stops alaram.

Alarm has cycles that consists of few beeps and few sweeps. Program counts those cycles. If there is too many cycles during one alarm state or too many alarm triggered per day, the device blocks itself. This possibility is indicated by red LED [2] and text information displayed on LCD. Number of triggered alarms is reset after 24h on 00:00:00 with assistance of RTC.

Moreover, case of setting off alarm is saved and can be read, but it is saved on non-volatile memory unlike distance alarm range.

5. Menu cases

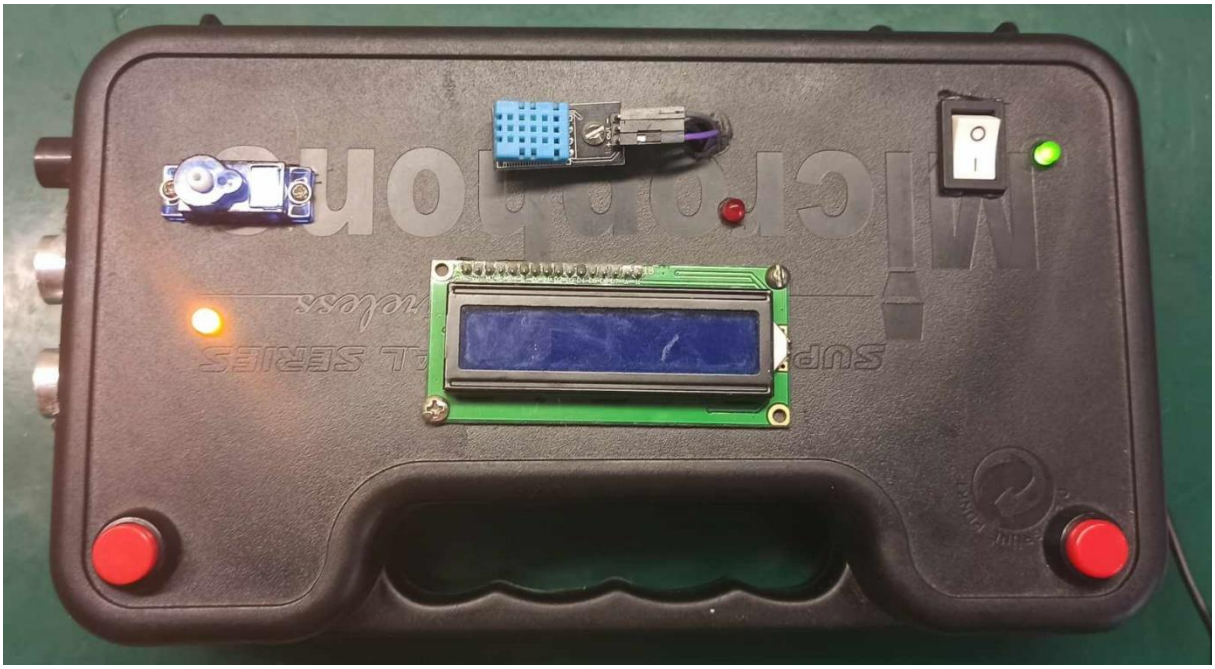
1) tells how many times alarm was set off.

2) Allows setting alarm distance. Upper line shows current reading. Lower line shows alarm range distance that can be changed with left [A] button.

3) Shows current reading of temperature and humidity.

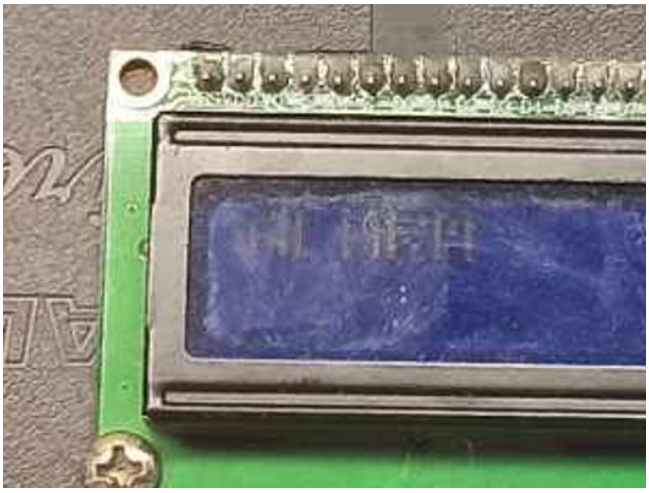
6. Alarm state.

1)Before setting off alarm, the device will turn on Yellow LED to indicate about being alerted.



2) After 5 seconds delay, sensor will make check and if detect object in alarm range, it will set off alarm. But before, message will be displayed for 3 seconds to give information that the alarm is about to be triggered.

3) During alarm, backlight of LCD display is turned off to reduce power consumption. The message is sill visible



7. Error state

1) Cycles of single alarm overload.

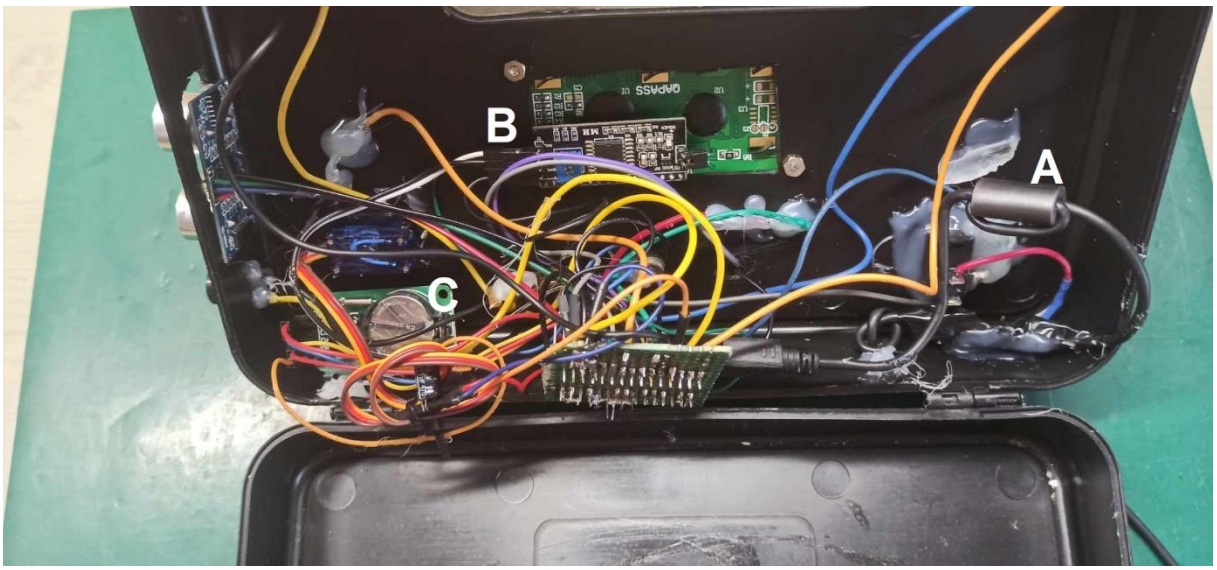
   When red and yellow LEDs are on, and LCD displays “przekroczono długosc zdarzenia”. It means that single alarm repeated for too many cycles. It prevents device from endless loop of alarm.

2) Alarm triggered too many times per day

When only red LED is on, and LCD displays “przekroczono ilosc zdarzen”, it indicates that alarm was triggered too many times per day. It helps to detected when device is not working properly and triggers when not supposed to.

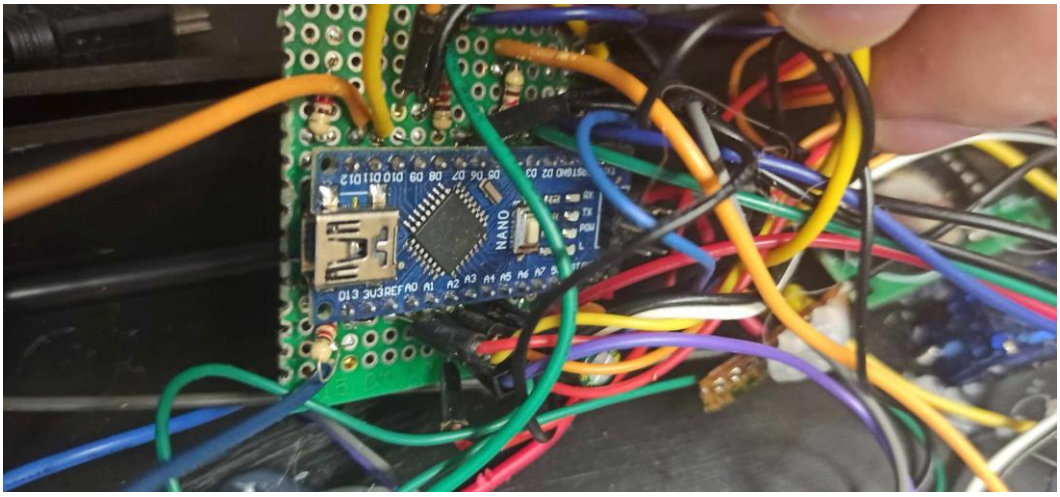
8. Internals

1) Cable management is poor due to lack of time. For casing I used microphone case. From this side of device I need to point out:



A- ferromagnet, filters power spikes that arduions are prone to
B- LCD display has I2C converter
C- RTC DS1302

2) In terms of power, this device is powered through 5V microusb port with phone charger. Why not 9V Vin port? It turned out that Arduino DC/DC converters doesn't tolerate well switching power supply. It has better performance on 9V batteries that gives constant 9V but device was intended to be powered with "cable". Pinout is described in code. LEDs need 4.7k ohm resistor.



9. Summary

TESTS:

1) Test with user

- When enter alerted status (yellow LED is set on but not in alarm state yet), it doesn't allow to enter menu. Only possibility to turn this off is to clear sensor pathway in distance range of alarm or turn off and on device. Problematic during debugging
- Its enough of two buttons to make user confused

2)Tests on animals

- It worked as it should be. My parents cat was successfully banished from couch that was messed by her.
- It looked as if cat tried to fight back in some way. (One time I noticed that device was knocked off by her)

Further implementation:

This device is still during prototype stage and has a lot of flaws. One of many I can list is:

- Lack of Arduino pins with interrupt service handlers. Ultrasound sensor uses pins that are able to handle interrupts leaving buttons with very poor solution of constant checking "is pressed?". Overall program has capacity to cope with extra few lines of code but its really unprofessional.

- Armed/disarmed alarm status indicator. User tests showed that it is not informative enough to know when alarm works or not.

- Code works but is mess, needs optimalization. Reason for it is apart from lack of time is that previous prototype was made basing on IR technology rather than ultrasound. Plan was to make separate transmitter and receiver. Broken beam was ought to trigger alarm.

- Need for further RTC extension

!!!NO ANIMALS WERE HARMED DURING TESTING!!!