Pet L.O.V.E (Life of Virtual Entrust)

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Abstract— **Pet L.O.V.E (Life of virtual Entrust) is a technology that design for pet to solve human problems with pet manure and litter. Trust no one but technology to take care of pet.Pet L.O.V.E (Life of virtual Entrust) is giving hope to everyone to eliminate the burden of cat litter disposal and at the same time save the nature from the harmful kitty litter killer, Toxoplasma gondii (1). Pet L.O.V.E is semi automatic toilets used an Arduinouno as a microcontroller and the heart of this project is Arduino GSM Shield that use to send Short Message Service (SMS) to the owner when the level of litter reach the limit and when the temperature is too high. This project uses moisture sensor to check the moisture of cat litter and ultrasonic sensor to detect the level of sand in the tank. Servo motor will rotate 360 degree when moisture sensor detects the feces and new sand will insert to replace the use one. Temperature sensor also used in order to detect the changing of temperature for worm. Worm is use in this project to convert the pet feces into the useful worm casting and a liquid fertilizer that can be used on the garden. Using worm is one of the ways to eliminate toxoplasma gondii in pet litter and reduce the risk of contracting this disease.**

Keywords-component; pet L.O.V.E; toxoplasma gondii; toilet;

Arduino;

I. INTRODUCTION

Cats can be fun, intuitive and loving but their feces give lots of problems to the owner. People need to clean the waste several times a day and it becomes a burden to the owner. Therefore, the objectives of this project is to assist the cats' owner in designing a product that will handle the cats' waste properly and affordable. There are several reasons Pet L.O.V.E (Life of virtual Entrust) is designed to the people.

i. *Limited time in house and no one to take care of cats.* Pet L.O.V.E-is designed to animal lover and those who want to have pet like cats, rabbits or dogs but have limited time in house due to hectic lifestyle. With the existed of this technology people have no worry to leave their pets alone in the house and solved their terrible problems to eliminate the pets waste. This design automatically cleans the pet waste every time the cats used it.

ii. *Easier and comfortable life*.This project is semi automatic toilet that cleans the pet waste when moisture sensor detected the feces and throws the waste under the tray. This technology also send a notification using short message services(sms) to the owner when the supply of sand is running low or the temperature is too high. So, the owner has no need to clean the litter box every time the cats use them. The owner also does not have to spend their time to check on the quantity of the sand or temperature. The owner only needs to throw away the waste into the compost bin once a week or when they have free time.

iii. *Compost cat litter in responsible and beneficial way*. Pet L.O.V.E also gives awareness to the public to compost cat litter in responsible and beneficial way. It is because there is harmful parasite named toxoplasma gondii, lives in cat feces and affects the neurological physiology of the mammals [1]. Toxoplasma gondii is spread through feline fecal matter and once cat litter is flushed down to the toilet, spores can survive the sewage treatment plants. [1, 5] This parasite end up in the ocean and thrives in shellfish which are consumed by sea otter. This parasite affects the community of the sea otter and human. The sea otter will become unable to perceive threat and approach predators instead of running away. Human who affected will tend to have schizophrenia and other mental disease. [1] People should aware of the dangers involved with flushing cat waste into the toilet. This design used worms to compost cat litter and manure. The worm will convert the pet poo into a liquid fertilizer or worm casting and people can use them for their garden free from toxoplasma gondii.[7]Worm composting usually done in 24 inches deep bed or trays and the worm are fed from the top because the worms will move up to the food to process it. [6]Since worm sensitive to temperature, the temperature sensor is use to monitor the temperature for the worm and send short message service (sms) to the owner when the temperature is too high. The ideal temperature for worms is between 59 -77 ^{o}F (15-21^{o}C).[6]

iv. *Low maintenance cost and easy to bring anywhere*. Since people love to travel and it is become a burden when they cannot bring their cat litter box along because some toilet for cats need to install permanently in the house but Pet L.O.V.E has the solution. This design is made from plastic so it is easy to carry and handle. It is also easy to use and install which require no high power to operate. Since this project used worms to compost the cats waste so it has low maintenance cost.

v. *Benefit to both owner and pets.* Cats are more like human, they do not like to use litter boxes that are dirty and stinky. Their sense of smell is 14 times stronger than human, even the toilet must be clean and hygiene. This project gives benefit to both owner and pets because the owner has no need to clean the cat litter and every time the cats use it this design will clean the waste.

II PRODUCT COMPARISON

Many existed product available nowadays can eliminate the burden of cats disposal but Pet L.O.V.E not only eliminate the burden of cat litter and manure but save the nature from the harmful parasite, toxoplasma gondii.

CatGenie is one of the latest technologies that automatically washes, cleans, and dries its Washable Granules. The advantages are people will never touch, breathe or buy cat litter ever again. [3] This is very useful to everyone but the problems are it is complicated to handle and the maintenance is high. Only a few of people can afford to have them and in Malaysia it is difficult to find the granule and it is permanently installed in the house.

CitiKitty is the most popular option to those who has a pet like cats or dogs. The training seat is designed to fits all toilets and transitions cats from all age, size and breed from litter box to toilet. People do not have to waste their money to buy toilet to their cats or litter anymore but as a human being, ignoring the nature can give bad consequence to the future generation. The disadvantage of CitiKitty is it is flushed down the waste into the toilet. This is a serious issue that needs cooperation from all the people around the world to gives awareness or educating the public about the proper ways to dispose cat litter. Other problems that occur when people flush the waste down to the toilet are the system will fill more quickly causing a possible groundwater contamination problem and it must be emptied more frequently that is very costly.[2]

Another cat toilet that is available nowadays and affordable is not automatic and people will have to do cleaning themselves. People also need to change the litter on their own and replace the use one with the new one. This requires more time and energy. With the lowest cost, this project automatically clean the excrement and with no maintenance costs, this project use worm to dispose cat litter and manure. The safe way to dispose pet waste is using worm.

III PROJECT OPERATION

Pet L.O.V.E start operates when the cats use the litter box or toilet. Moisture sensor will read the amount of moisture present in the soil surrounding and if the resistance less or the reading is more than 350 degree, it shows the sand is wet. After 15 minutes after the moisture sensor detects the sand is wet, servo motor for waste will turn on to throw away the used sand and replace with the new one. Servo motor for waste will operate for 360 degree each positive and negative side. The motor start moving from 0 degree to 360 degree with step 60 degree and wait for 20ms to reach the initial position. Then, it will operate from 360 degree to 0 degree. To fill the new sand, servo motor for sand will act as valve to supply the sand. It operates when the motor for waste is off and the motor for sand will rotate from 0 degree to 180 degree with the step of 1 degree. The motor will stop for 2 second to let the sand flow to the tray and start operates from 180 degrees to 0 degrees to close the valve. Then, it will check the level of the sand in the tank to make sure the level of the sand in the tank is available. If the sand in the tank already reach it limit or running out of supply which the level is too low below than 11 cm, short message service (sms) will send to the owner as a notification. If the level of the sand is still high, this program only monitors the temperature for worm. If the temperature is too high for worm condition, short message service (sms) will send to the owner. If there is no changing in temperature, it will loop and start read from the moisture sensor again. If the moisture sensor detects no moisture surrounding, which mean the sand is dry, the project only check on the temperature sensor.

IV CIRCUIT DESCRIPTION

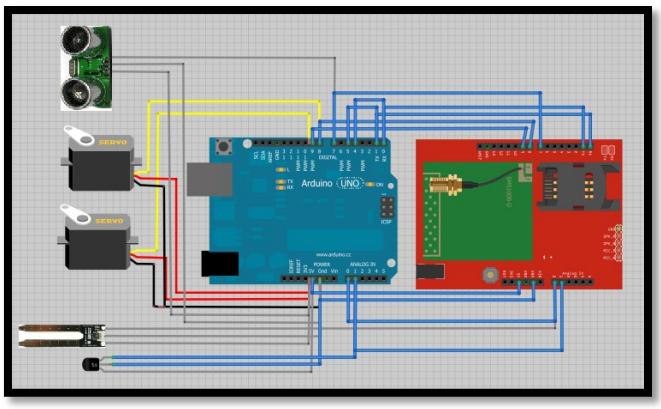


Figure 4.1: Circuit/Component connection

Pet L.O.V.E uses an Arduino Uno as a microcontroller. The heart of this project is GSM Shield that connected to the Arduino Uno to send the short services message (sms) to the user. The GSM shield has a modem which executes the operation using a series of AT commands that transfers data from a serial port to the GSM network. Rx from the Arduino

will connect to the Tx(pin 4) of GSM shield while Tx of Arduino will connect to the Rx (pin 5) of GSM shield. GSM shield requires 5V power and Arduino needs external power to run servo motor that attach to the Arduino. Servo motor is connected to digital pin 8 and 9. Servo motor has three wires that must be connected to power, ground, and signal. This system use two servo motor and they need more power than +5V pin on Arduino. Separate supply is used to drive the servo motor. Digital pin 7 is connected to ultrasonic sensor which is used to detect the level of the sand by calculating the time between sending signals and receiving the echo to determine the distance of any object that need to measure.

Analog output of Arduino used to connect moisture sensor and temperature sensor. Moisture sensor is connected to analog pin A0 to measure the moisture surrounding the sand. Moisture sensor will become hot if the power is too high more than 5V and it will damage the component. Analog pin A1 is connected to the LM35 temperature sensor that functioning to monitor the temperature from -40 degree Celsius to 150 degree Celsius. This sensor is used to detect ambient air temperature for worms. A subscriber identity module (SIM) card also becomes one of the most important components for this project to send short message services (sms) to the user.

V SOFTWARE AND HARDWARE

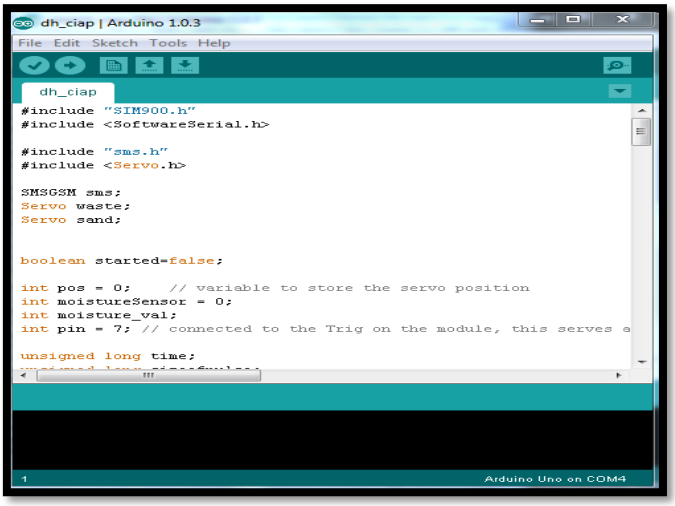


Figure 5.1: Arduino Software

The software used in Pet L.O.V.E is an Arduino. Arduino is an open source electronics prototyping platform based on flexible, easy to use hardware and software. [8] The microcontroller on the board is programmed using the Arduino programming and the Arduino development environment. From the codes that write in Arduino software, the hardware function base on the command uploaded in the software.

Figure 5.2: Pet L.O.V.E automatic toilet

Figure 5.2 is a hardware design for this project. Pet L.O.V.E automatic toilet consists of moisture sensor, ultrasonic and servo motor. This design is simple and easy to handle. People can open each part of this hardware design and can replace them with new one. The tank on the top of this design is used to keep the sand and ultrasonic is used to measure the level of the sand. This design is durable,people can use this hardware for a long period of time.

Figure 5. 3: Pet L.O.V.E worms compost bin

Pet L.O.V.E worm's compost bin is where the pet manure and litter will be compost using worms. The temperature sensor is used to monitor the temperature in the bin. People can buy the existed product in the market or built them. There are holes around the bin composter to aerate air in the bin. With better moisture of soil or pet poo, worms can lives well and compost the litter faster. The hardware of worm compost bin also made from plastic and it is easy to use. When people push the bin using their foot, the top cover will open.

Figure 6.2: The distance proportional with time

VI RESULTS AND DISCUSSION

Every sensors used in Pet L.O.V.E (Life of virtual Entrust) are analyzed using Arduino Uno. From the serial monitor of Arduino uno, the data can be obtained and measurement of each sensor is show using graph.

i. Moisture sensor

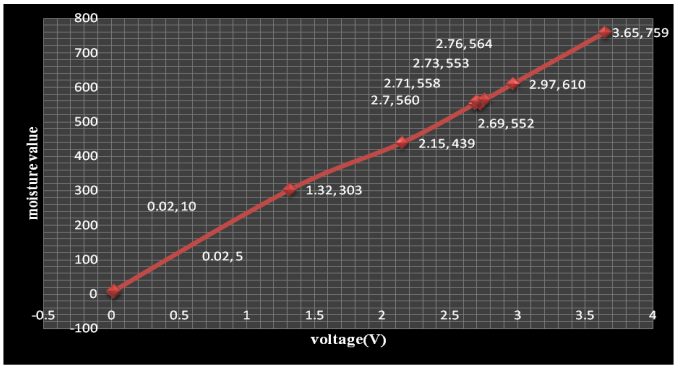


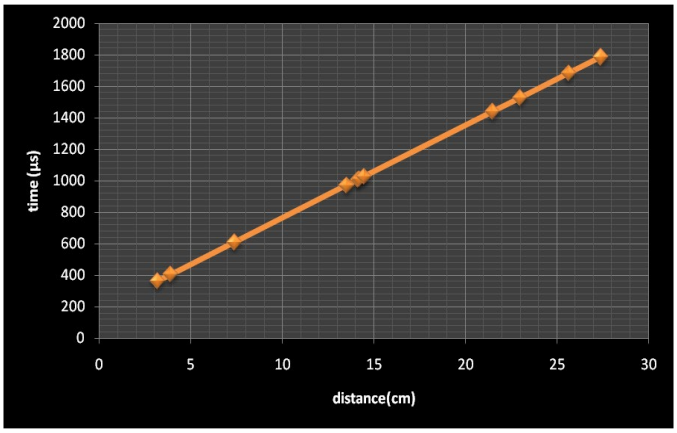
Figure 6.1: Moisture sensor proportional to voltage

Moisture sensor uses the two probes to pass current through the soil and it operated by reads the resistance to get the moisture level. From the graph in Figure 3.1, Moisture sensor is proportional to voltage. Moisture value is high when the voltage is high. Since the moisture read the resistance, so more water will generate electricity easily which mean the resistance is less. When the value of voltage is high the resistance is less. This can be proved by this equation:

$$V = IR \qquad (1)$$

If the value of current is fixed, the value of voltage will decrease when the value of resistance is high. The graph above proves the moisture sensor functioning well as expected. The graphed shows the reading of moisture value is increasing when the value of voltage is increase.

ii. Ultrasonic sensor



Time(µs)	363	406	610	970	1006	1011	1027	1439	1527	1683	1787
Distance(cm)	3.18	3.91	7.38	13.5	14.12	14.2	14.47	21.48	22.98	25.64	27.4

Ultrasonic sensor sends or triggers a signal and wait for the return signal back through the echo output. The distance measured by the time taken from trigger and echo. This equation is used to convert the time obtain to a distance.

$$\text{Distance} = (\text{time}*340.29/2/10000)-3 \qquad (2)$$

From the result in Figure 3.2 for measurement of distance and time between the trigger signal and echo increase the distance also is increase. So, in this project, when the level of the sand decreases then time between the trigger and echo signal is increased hence the distance is increased. The range for supply voltage is between 3.8 and 5.5 V.

iii. Temperature sensor

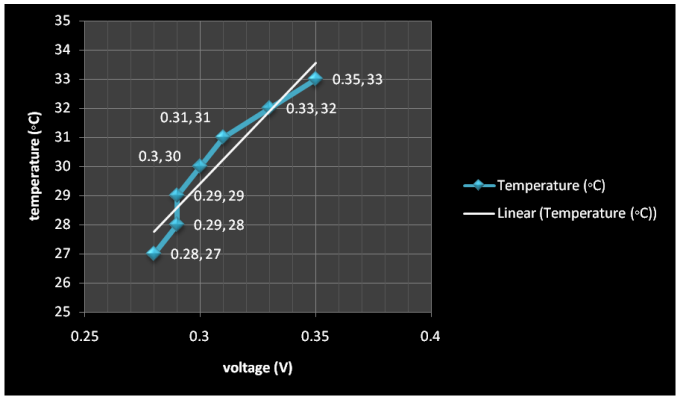


Figure 6.3: temperature

Temperature sensor has good linearity and high sensitivity. The functional range is between -40 degree Celsius to 150 degree Celsius with the sensitivity is 10mV per degree Celsius. From the data obtain from serial monitor Arduino, the output voltage is proportional to the temperature. The temperature is increased when the voltage is increased.

$$\text{voltage} = \text{sensorValue} * (5.0 / 1023.0) \qquad (3)$$

The voltage Arduino measure is between 0V to 5V but serial monitor give another reading that use different value larger than that. So, an equation is use to measure the value that can give better understanding.

iv. Combination all sensors and GSM shield

From the Arduino serial monitor in figure 6.4 below shows when Arduino is on and GSM shield is ready, moisture sensor will detect the surrounding area and the value will appear in the serial monitor. If the value is more than 350, the motor will turn on and in this serial monitor only show the data for sensor. Next, this program will check on ultrasonic sensor and if the level is more 11cm, this system will send a short services message (sms) to the owner. Same goes when the temperature is increasing to 30◦C. If the moisture sensor detects the surrounding is dry, this system only check for the temperature sensor because there is no sand use and the level of the sand

still maintain the same. From the serial monitor of Arduino, this system work well and show the result as need.

```
GSM READY
Moisture Sensor value = 500
 Distance: 14.27 cm
DEBUG:SMS TEST
sms send
Tep:28C
Moisture Sensor value = 500
 Distance: 14.20 cm
DEBUG:SMS TEST
sms send
Tep:31C
DEBUG:SMS TEST
sms already send to the owner
Moisture Sensor value = 527
 Distance: 2.73 cm
Tep: 30C
Moisture Sensor value = 0
Tep: 30C
Moisture Sensor value = 4
Tep: 23C
Moisture Sensor value = 5
Tep: 23C
Moisture Sensor value = 6
Tep: 23C
Moisture Sensor value = 14
Tep: 24C
Moisture Sensor value = 5
Tep: 27C
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Figure 6.4: Arduino serial monitor

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Figure 6.5: Pet L.O.V.E (Life of virtual Entrust)

Figure 6.5 is a complete design of Pet L.O.V.E (Life of virtual Entrust). All the component and prototype function well and people have no reason to worry about pet litter and manure anymore.

IV CONCLUSION

As a conclusion, the design of Pet L.O.V.E (Life of virtual Entrust) is successfully implemented and all the objectives to overcome problems related to dispose cat waste are achieved. It helps in designing a product that can make people life easier with the existed of automatic litter box for cats.

Pet L.O.V.E (Life of virtual Entrust) operates as expected. All the sensors used in this project function well followed the instruction based on programming code in Arduino software.

The main advantage of this project is it requires low power supply. Only 5V power supply needs to turn on GSM shield and 5V external power to support Arduino uno microcontroller. Furthermore, the data for each sensor used in this project like moisture, ultrasonic and temperature sensor can easily obtained from the serial monitor of Arduino software. Moisture sensor was proven function well when the analysis showed the voltage is proportional with the moisture value. Ultrasonic measured the time between trigger and echo, and then converted into distance. Times between trigger and echo increased, the distance also increased. With the sensitivity of 10mV per degree Celsius, temperature sensor showed good linearity with the range of temperature sensor is -40 degree Celsius to 150 degree Celsius. Based on the result analysis, each sensor is in good condition and function well.

Some modification and development will make this project better in future. One of the recommendation is by using force sensor to detect when the cat enter and go out from the box. Another recommendation is using gas sensor instead of moisture sensor. Perhaps this project, Pet L.O.V.E (Life of virtual Entrust) can help the world face the biggest issue of toxoplasma gondii and help the people and the future generation to have better living.

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