Water Flow Control

INTERNET OF THINGS (CSE3009)

PROJECT REPORT

(J Component)

submitted by

Vishakha Singh 17BCE0124
Vivek Agrawal 17BCE0201
Rashi Kasera 17BCE2421
Akshita Muralidharan 17BCE0732

submitted to

Dr. Saleem Durai M.

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

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Abstract

It has been seen that large quantities of water have been overflown from overhead tanks in normal households. This system will automatically stop the water flow once the desired conditions has been achieved. This prevents the wastage of water. It can occur that the amount of water flowing is less. Certain actions must be taken and for that the he/she must be aware of it. This system will notify the user about the nature of the flow of water. All this happens without any human interference. The water flow control model is very economic and can be set up in each household because it will save a lot of electricity. In order to avoid the consequences of poor monitoring of overhead tanks, our model will notify the user about the level of the tank, the status of the motor as well as the nature of the flow of water. The model was designed keeping in mind the drawbacks of existing models.

Introduction

It was evident that huge volumes of water were overflown in typical households from overhead reservoirs. This system will automatically stop the flow of water once the desired conditions have been met. This stops water from being lost. It can happen that the volume of water streaming is less. There are other acts that must be done and that he / she must be conscious of. This system will inform the user of the nature of the flow of water. All of this happens without any human interference. The water flow control model is very cost-effective and can be built into every household since it saves a lot of power. Our model must warn the consumer regarding tank depth, motor status and the type of water movement in order to avoid the effects of inadequate monitoring of overhead tanks. In the light of the drawbacks of existing models, the model was designed.

Motivation

Besides being a vital human need, water is also a critical economic resource for socio-economic development. Today, the challenges of water shortages and energy tension confronted by many communities have been exacerbated by rapid population growth and climate change. According to the United Nations, water use has increased more than twice the rate of population increase over the last century. Given the increasing demand for water and the uncertain future of supply, there is an urgent need for policy makers to engage the public in water conservation. As of today, demand side management tools have been widely used in different parts of the world. Typical policy tools include financial, technological and educational intervention. The implementation of water rates and fees, the creation and construction of water saving facilities, water rationing and compulsory distribution measures as well as awareness programs are specific examples.

Literature Survey

Autonomous Water tank Filling System using IoT

Paper [1] draws attention to the issue of clean water scarcity which is faced by every common man. Due to the arise of poor water distribution facilities and conservation skills, the autonomous water tank filling system was brought into the picture to solve this problem. Poor monitoring systems comes with excessive water consumption, pipe overflow, tank overflow. The system is able to continuously monitor the tank status along with other important parameters like power supply and future water flow. The system overcame drawbacks of existing systems and also had additional features which the previous models did not possess. However, the system doesn't have anything mentioned regarding how the system would act when it is set up in a no network coverage area. The model was implemented using the Arduino Uno, Water Flow Sensor, Ultrasonic Sensor and a Cloud Account. When the water is being filled and the incoming water link has no source of water or if there is a power cut during and in the beginning of the filling of the tank, then what must be done?

An Ultrasonic & Gsm Module Based Water Level Monitoring System via Iot

The paper [2] presents a system that can detect the water level, transfer the collected data to a very interactive Graphical User Interface via a GSM module using the Arduino. Since water is a crucial natural resource required for the survival of human beings, it's important that wastage of water should not be neglected. This system approves of any modifications like audio visual alarms based on the user's requirements. Keeping in mind the fact that many buildings have overhead water storage tank, tend to find it waste of energy and time to find out the capacity of the tank and whether any wastage is happening. This system is the perfect solution to this problem. The system not only monitors the level of water but also acts as a control device. The system however has no response to any power failure or message failure to the GUI due to poor connectivity. The devices used are Ultrasonic sensor, pump, Arduino and GSM Module. This system smartly uses GSM module which eliminates the heavy cost of network usage. The architecture allows scalability and addition of different devices however; it is a challenge for common men to add devices due to lack of technical knowledge.

Smart Water Monitoring System using IoT

Water playing an essential part in our lives shall be protected from pollution, pollution being the biggest issue in the world. In many places contaminated water is being used for drinking water and this situation arose due to lack of administration and poor monitoring systems. This paper [3] describes a low-cost system which not only determines the amount of water but also monitors the quality of it. The monitoring system is able to collect additional parameter like pH, TDS and Turbidity, something which many other existing systems don't possess. The system chose to store data specifically on a cloud server as analysis and information updating becomes easier. The data stored in the cloud server will not be deleted and can be used for research and development in future purposes. The system uses Wi-Fi module to send the data obtained from the sensor to the cloud. However, if mobile data or Wi-Fi does not exist, the sensors will not be able to communicate with the Wi-Fi module and in turn the system will fail to provide output. The system contains components like Arduino Uno, ESP8266 WiFi Module, Flow Sensor, Cloud-Based Server, Ultrasonic sensor and various other sensors. The system is power supply based and if power failure occurs then, it does become very challenging.

IoT Technology for Smart Water System

This paper [4] draws light to a system which is different from the ordinary methods of water quality assessment which takes lot of time and effort. Smart Water System aims to make calculations to determine the amount of contamination so that further steps can be taken to improve the quality of water. The system successfully determines various parameter related to quality monitoring of water like temperature, pH level, turbidity, water flow, amount of chlorine, pressure, conductivity, colour, COD and determining contaminants. The challenges of this system is to maintain three factors; cost, energy and efficiency. Another challenge is to provide a user-friendly interface for those who have less technical knowledge. Choosing the topological parameters is another challenge. A six layered architecture is used for the implementation of this system where each layer has its own security. RFID, WSN and Web Services combined provide us with the architecture. Various sensors are used like Spectro::lyser, SmartCoast, Kapta 3000 AC4, Smart water, Lab-on-chip and I::scan. More research must be done on the IOT architecture, that can be integrated later on, which involves more reliable technologies.

Water level monitoring system

[5] talks about, Water level monitoring system which could be applied in industries, agriculture and households as a possible solution to world's water shortage. As the paper

mentions, system data collected by sensors fitted in the storage tank at different levels is processed by the microcontroller which in turn is displayed to user on display and parallelly controlling the motor is possible which in hence can reduce labour requirement. This system has successfully tried to achieve a minimum operation execution time and has kept the cost very low in order to support the rural areas in which water crisis is huge. However, when a case where the motor is running but there is no water flowing, the system does not have any response. The model is implemented using five sensors, microcontroller, LCD, Arduino Uno and a water level sensor. There are many places where network is not available, and hence this system does not depend on any kind of network service. Paper [1] further discusses about improvements that can be done in the system by switching it from wired to wireless.

IoT Based Automated Water Distribution System with Water Theft Control and Water Purchasing System

This paper [6] talks about, a centralized server to control water supply which would help in eliminating wastage. Paper further mentions that the water supply that has been sent can be measured that could be used for limiting the water supply to the places where water is getting wasted so that it can be made sure that water is reaching the needy areas. Paper [2] mainly focuses on providing a path to reduce water theft and controlling water supply which could be easily achieved by centralized servers. The model however is for large water tanks and not water tanks with lesser capacity. Proposed model utilizes water flow sensor, solenoid valves, and Arduino as microcontroller. Arduino controls solenoid valve, and at point when water flow exceeds the circuit is cut off. Paper [2] further discusses about how this similar mechanism can be used in liquid petroleum, gas and fuel supply.

Proposed Methodology

a. Components Used

- *Arduino UNO*

  Arduino UNO is a microcontroller which has the capabilities of reading inputs from the sensors like water flow rate and distance and generating outputs like turning off the motor, display readings.
- *Breadboard*

  Breadboard is used to interconnect the components which are required to communicate with each other in order for the working of the model.
- *Relay Module*

  Relay Module acts like a switch that can turn on and off by allowing or stopping the current through flow through.
- *Ultrasonic Sensor HC-SR04*

  The sensor works by emitting ultrasonic waves and waits for the reflected waves. The time take taken for the transmission and receiving determines the distance of the object.
- *Flow Sensor*

  As water flows through the pipe forcing the rotation of the turbine, water flow rate can be measured which is proportional to the rotation of the blades.
- *Jumper Wires*

  Wires are required to make the connections of all the components with each other as well as with the breadboard.
- *Potentiometer*

  Varying the resistance in order to control the brightness of the LED as well as the contrast of the LED.
- *DC Water Pump (5V to 12V)*

  The water pump is responsible for flowing water from the water source to the tank.
- *Batteries*

  Batteries provide power source to the required components of the model in order for the working.
- *Flexible water pipe*

  The pipe is used for transferring water from source to the tank with the help of the water pump.

- *Tank*

  Tanks are used for storing water, one being the source and one being the overhead tank.

- *LCD Display 16x2*

  The LCD Display is responsible for displaying the status of the motor, the water level in the overhead tank and the nature of the flow of water.

b. Architecture

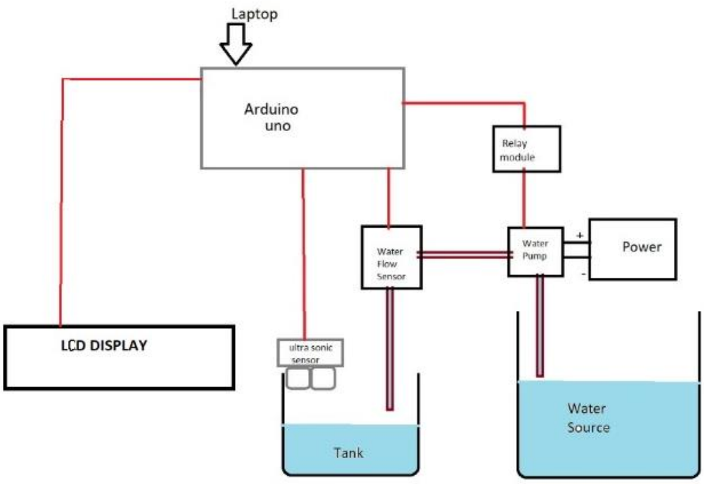

Figure (i) Architecture of Model

After all connections are made, once the system starts running, the flow sensor and ultrasonic sensor start taking the readings continuously. These readings are used to determine the rate of flow through the input pipe and the level of water in the tank respectively. When the tank reaches full capacity, the Arduino sends a signal to turn the motor off via the relay module. This prevents overflow of water from the tank which in turn is helping in conserving water. Also, when the flow sensor detects no flow of water through the pipe, the motor is turned off which in turn is helping in conserving electricity. The LCD displays the current level of water in the tank and the status of the motor. In this way, this system can be used to control the flow of water.

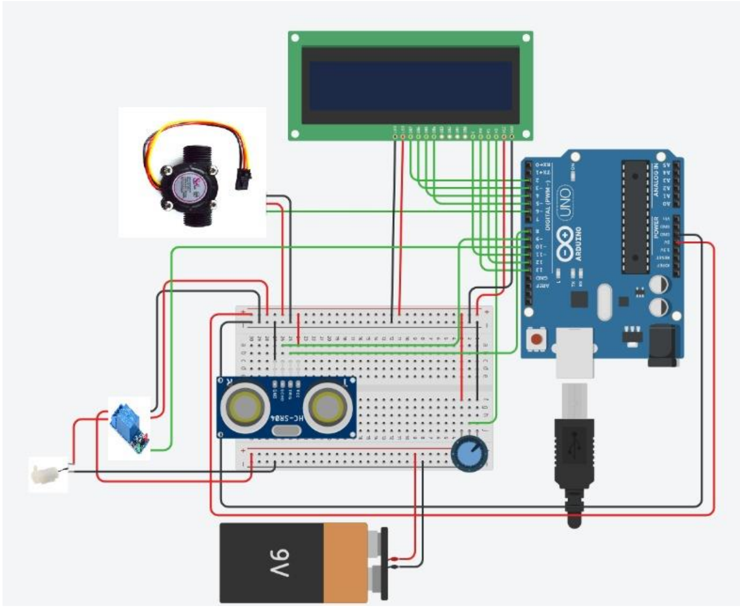

Figure (ii) Pin Diagram

In the above figure(ii) we can see that the:

1. LCD display is interfaced by connecting the LCD RS pin to digital pin 12, LCD Enable pin to digital pin 11, LCD D4 pin to digital pin 5, LCD D5 pin to digital pin 4, LCD D6 pin to digital pin 3, LCD D7 pin to digital pin 2, LCD R/W pin to ground.
2. Relay Module is connected to D7.
3. Ultrasonic Sensor is connected to D8 and D9.
4. Flow Sensor is connected to D6.
5. Battery to GND and V5.

c. Implementation

```
#include <LiquidCrystal.h>; // include the library code for lcd
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
#define echopin 9 // echo pin
#define trigpin 8 // Trigger pin
#define flowpin 6// flow rate input

int duration, distance, flowrate;
int temp=0,a=0, newvar=0;
```

```
void setup() {
  lcd.begin(16,2);
  Serial.begin (9600);
  pinMode (trigpin, OUTPUT);
  pinMode (7, OUTPUT);
  pinMode (echopin, INPUT );
  //pinMode (13,OUTPUT);
  pinMode(6,INPUT);
}

void loop(){
    {
      digitalWrite(trigpin,LOW);
      delayMicroseconds(2);

      digitalWrite(trigpin,HIGH);
      delayMicroseconds(10);

      duration=pulseIn (echopin,HIGH);
      flowrate = pulseIn(flowpin,HIGH);
      distance= duration/60;

      delay (50);
      Serial.println(flowrate);
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("water level :");
      lcd.print(distance);
      delay(100);
    }

  // assuming height of tank is 20units
  // min thershold is 17 units when it will trigger to start motor
  // 5 units be the threshold on which motor stops
```

```
 if(newvar == 1)
 {
   if(distance < 5)
     newvar = 0;
   else{
        // var a used to decide for how much time after which we need to check for distance in case tank is empty and flow rate is zero.


        //For e.g:
        // one can consider a case if tank is empty but when previously we checked for water flow then it was zero so we turned off motor
        // now we decide with help of var a after how much time do we need to check for flow again so that we can control motor accordingly
        if(flowrate == 0 && distance >5 && a>25 ){
          temp = 1;
           a=0;
          digitalWrite (7,LOW);
           delay(2000);
        }
        else{
          temp = 0;
        }



          // this part is for stopping motor
        if ((distance<=5 || flowrate == 0 )&& temp == 0){
          digitalWrite (7,HIGH);// connect to relay(motor)


          lcd.setCursor(0,1);
          lcd.print("Tank is full ");
          delay(100);
          }
```

```
            else{
              digitalWrite (7,LOW); // connect to relay(motor)

              lcd.setCursor(0,1);
              lcd.print("Motor running");
              delay(100);
              temp = 0;
              }

              a++;
            }

    }

    else{
      if(distance > 17){
        newvar = 1;
      }
      else{
        newvar = 0;
      }
    }
}
```

Result and Discussion

Overflowing tanks and excessively running motors are a common sight in many households. It is a very tedious job to keep an eye on the motors and tanks and to ensure that they are turned off as soon as the required amount of water has been stored. This project provides a basic model on how to automate this process by using IoT. As the water flow is stopped when the tank gets full, there is no wastage of water. This especially helps in residential areas which face shortage of water by making sure that water is not wasted even before being used. Although the municipality distribution of water is unequal to certain areas, we need to at least ensure no wastage of water that is made accessible to the households. Also, the usage of the flow sensor helps to minimize the amount of time the motor is running idly. In this way, water and electricity, which are very important resources, are conserved.

As mentioned earlier, our model minimizes the amount of time the motor runs idly by checking certain conditions in constant intervals of time like deciding for how much time after which we need to check for distance in case tank is empty and flow rate is zero. One can consider a case if tank is empty but when previously we checked for water flow then it was zero so we turned off the motor. Now we decide after how much time do, we need to check for flow again so that we can control motor accordingly.

Analysis of Data

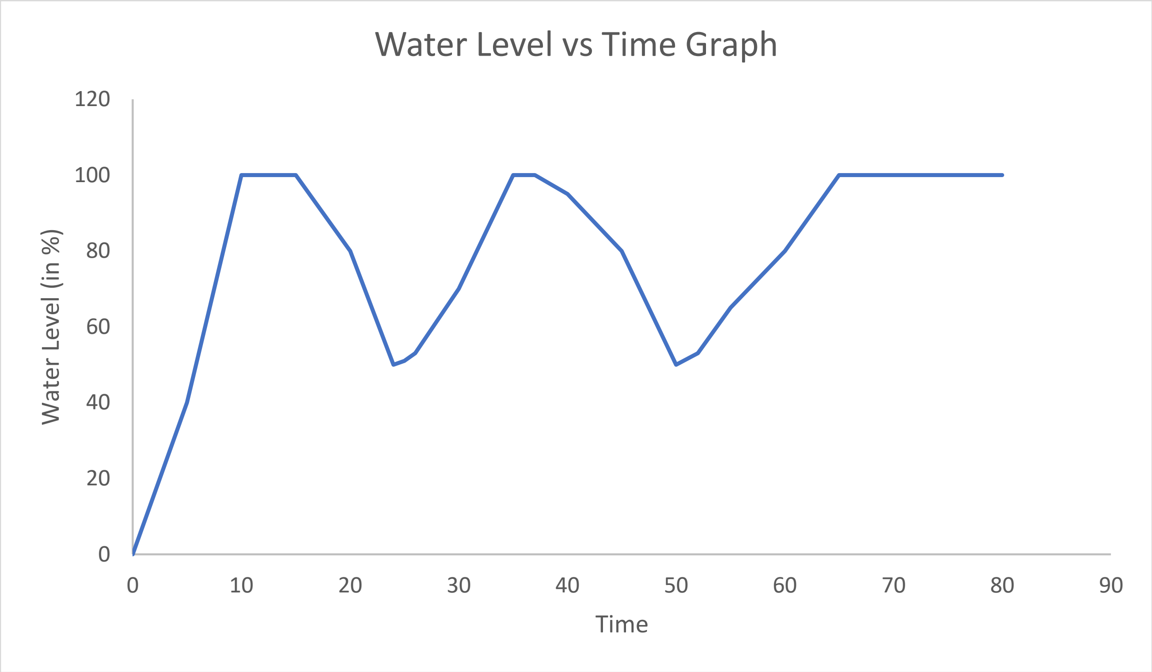

Figure (iii) Water Level vs Time Graph

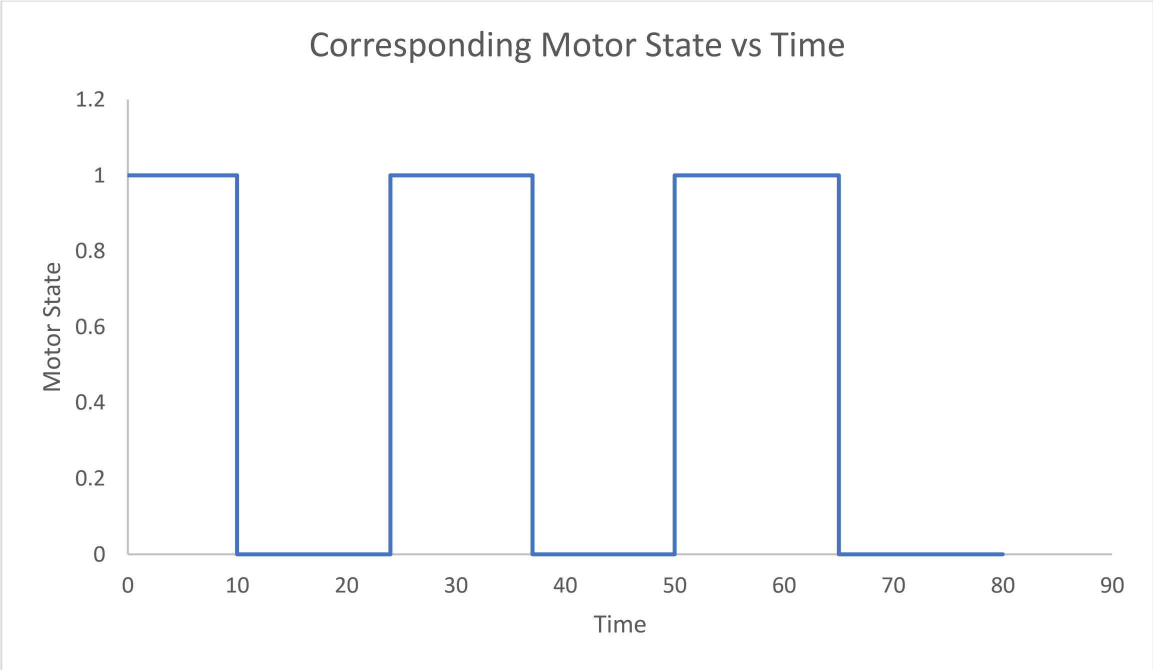

Figure (iv) Motor State vs Time Graph

Initially, the tank is empty. So, the motor runs until the tank is full. When the tank gets full, the motor is stopped.

When water in the tank decreases, the motor is not started until the level falls below 50%.

When the water level in the tank falls below 50%, the motor is run again until the tank gets full.

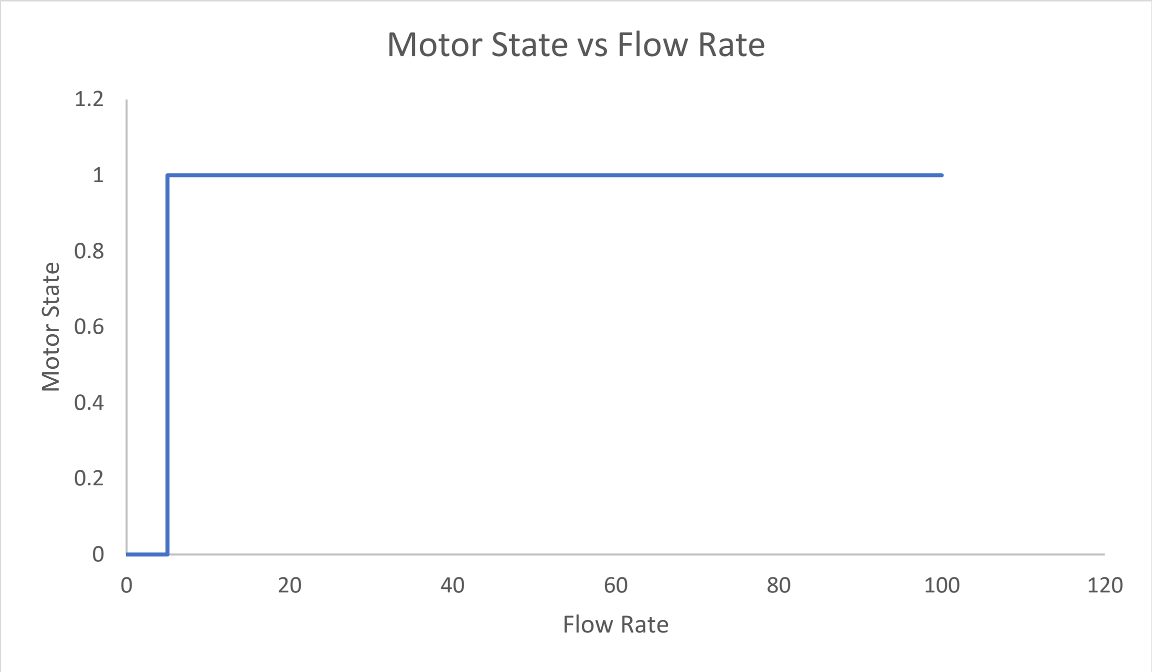

Figure (v) Motor State vs Flow Rate Graph

When the flow rate through the pipe that is measured by the flow sensor is less, the motor is turned off.

Future Enhancement

An LCD display can be added to show the status of the motor, the water level in the overhead tank and the nature of the flow of water. We can increase the parameters by addition of multiple sensors. In future, the proposed system can be made fully autonomous by embedding artificial intelligence with a predefined set of rules and standards. With the use of Artificial intelligence, this can be carried out automatically without human intervention. This model also generates a large amount of data in the cloud. Therefore, some big data processing framework such as Hadoop framework will be required for analysis of generated data, for obtaining necessary information and generating the set of rules for training AI.

Conclusion

The water flow control model was designed successfully in such a way keeping in mind that the model must be cost efficient and can be easily set up in any given environment. After studying already existing water flow control models, we took up the challenge to overcome some issues that other existing models have. The problem that we solved was that even though the desired level of water hasn’t reached we should not let the motor run idly without any flow of water. For this we incorporated two sensors unlike the ordinary single sensor selection which many other models possess, and combined their functionalities to provide this particular feature in our model. Many cases of the environments were taken into consideration and respective conditions were set for the working of the model. Future works include in incorporating more features that other models face an issue however keeping the price of the model to a minimum.

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