Smart Mirror

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***Abstract*—The "Smart Mirror" is an innovative and interactive electronic project based on Arduino, designed to enhance the traditional concept of a mirror by incorporating modern technology to provide users with a multifunctional and engaging experience. This project combines elements of electronics, programming, and design to create a mirror that not only reflects one's physical image but also serves as an information hub, enhancing everyday routines and transforming a regular mirror into a dynamic and versatile device.**

The Smart Mirror is equipped with a two-way mirror and a concealed display system powered by Arduino, which allows it to overlay real-time information on the mirror's surface. The mirror can display a wide range of information, such as the current date, time, temperature, and humidity.

The project integrates various sensors and modules, including temperature and humidity sensors, motion detectors, ultrasonic sensors, vibration sensors, and real-time clock modules. For instance, it can adjust its display based on ambient conditions, and activate upon detecting a user's presence.

The Smart Mirror is not only a functional piece of smart home technology but also a stylish addition to any living space. Its potential applications are diverse. This project demonstrates the potential of Arduino-based electronics to create interactive and personalized solutions for everyday life.

In summary, the Smart Mirror project represents a fusion of technology and everyday life, offering a glimpse into the future of smart and interactive mirrors while showcasing the creativity and technical skills of the students involved.

***Index Terms*—IoT and HCI, Arduino, Display Technology, Smart Mirror**

I. Introduction

In the digital age, smart devices have become an integral part of our daily lives. The "Smart Mirror" project aims to blend the traditional functionality of a mirror with modern technology. This mirror can display real-time weather conditions, current date and time, and earthquake alert messages.

In the era of smart homes and interconnected devices, there remains a significant need for innovative and multifunctional home furnishings. The conventional mirror, primarily serving as a static reflective surface, lacks the capability to adapt to user needs and enhance the daily living experience. The Smart Mirror project seeks to address these shortcomings by integrating real-time clock functionality, occupancy-based fan control, and temperature and humidity sensing into a single, intelligently responsive mirror. The following problems are targeted by this project:

1. **Lack of Real-Time Information Accessibility:** Traditional mirrors do not provide real-time data that is valuable for daily planning, such as the current time, date, and weather conditions. Users must turn to separate devices to access this information, leading to inconvenience and inefficiency in their daily routines.

2. **Inefficient Energy Usage:** Traditional home appliances, including fans, often run continuously or are controlled manually without considering the actual environmental conditions or occupancy status. This lack of automation results in energy wastage and increased utility costs.

3. **Limited Environmental Comfort Control:** Maintaining a comfortable environment within a space, especially in terms of temperature and humidity, can be challenging when users do not have access to real-time data or a means to control relevant devices.

Solutions:

The Smart Mirror project aims to resolve the above problems by integrating the following key features into the mirror:

1. **Real-Time Clock Display:** The Smart Mirror will provide users with essential real-time information, such as the current time and date, thus enhancing their daily routines and time management.

2. **Occupancy-Based Fan Control:** The mirror will incorporate occupancy sensors to detect the presence of individuals in the room. Based on this information, it will intelligently control a fan, turning it on or off to ensure efficient energy usage and occupant comfort.

3. **Temperature and Humidity Sensing:** Environmental sensors will be integrated into the Smart Mirror to monitor temperature and humidity levels within the room. This data will enable users to make informed decisions about adjusting heating, cooling, or humidity control systems.

By addressing these issues and incorporating these functionalities into a single, intelligent mirror, the Smart Mirror project seeks to demonstrate the potential for enhancing everyday home furnishings and creating a more efficient and comfortable living environment. [2]

Research related to smart mirrors, Arduino-based projects, real-time clock implementations, temperature and humidity sensing, and home automation systems. [3]

The innovation lies in combining traditional mirror functionality with real-time information display and environmental control. The project's creativity is in its design and user-friendly interface. [4]

II. Project Features

- Presence Detection
  The system uses an ultrasonic sensor to detect presence. If any user comes close to the mirror, more specifically within 10 units, the presence will be detected. Then all the functionalities of the smart mirror system will start to run. Point to be noted that if the present is not detected, none of the functionalities will run.

- Fan Starting
  The fan or the integrated cooling system is made using 1 DC motor and a small propeller. When presence is detected, the fan will start running.

- Real-time Clock Feature
  Real-time Clock feature runs will the help of a Real-time Clock module. The date and time generated by the module is displayed on the 16x2 LCD.

- Temperature and humidity monitoring
  The system uses a DHT22 sensor to get real-time temperature and humidity data from the environment. This data is displayed on a 16x2 LCD.

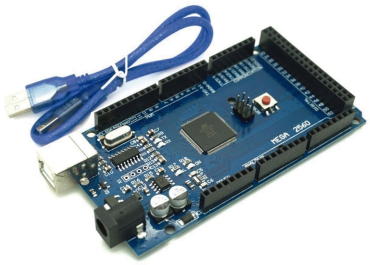
- Earthquake detection
  This part ensures the safety of the users. Because it detects the earthquake using a vibration sensor; and when it is detected, the system will generate an alert sound using a buzzer and show the ”Earthquake Detected!” message on both 16x2 LCD.

III. Smart Mirror

We used glass on the front side to make the mirror. And we have given silver coated mercury paper behind. It is called Window Privacy Film Sun Blocking Mirror Reflective Tine One Way Heat Control Vinyl Anti UV Window Stickers for Home and Office. We collected the mercury paper from Ahmed Trading, Shahjadpur, Badda, Dhaka 1212. And collected the glass from Janata Kaanch Ghar, Auto Stand, Sayednagar, Vatara, Dhaka 1212. We was collected mirror frame from second hand market, Notun Bajar. This is how we make our mirror and behind it we made the Smart Mirror of our project using Standard LCD 16x2 Display. All the output of our project feature will show on our display but we will see the output on the front side of the mirror. Then we can see our reflection in the mirror and also the output of the features. Below is a video link of what our project looks like:
https://youtu.be/A3TRxFzt7SA?si=w3TXR46TgxEbu8tk

IV. Component List

1) Arduino Mega
   The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 as shown in Fig 1. We used a single Arduino MEGA in our project, and we used it to control almost everything via programming. It has 54 digital I/O pins, and 15 of them provide PWM output. Therefore, this Arduino was necessary for our projects as we needed many sensors to connect all together, and we needed more pins for that.

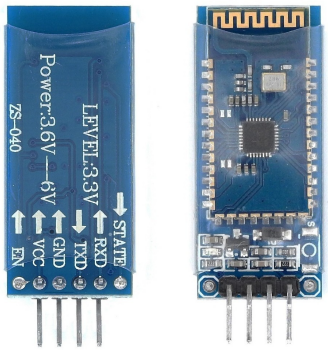


2) Real-time clock circuit
   A real-time clock (RTC) circuit is an electronic component or a dedicated integrated circuit (IC) that is designed to keep track of the current time and date. Unlike a regular clock, an RTC operates independently of the main system processor and is often powered by a separate battery to maintain timekeeping even when the main power is turned off.

3) DC Motor
   A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into mechanical rotation.

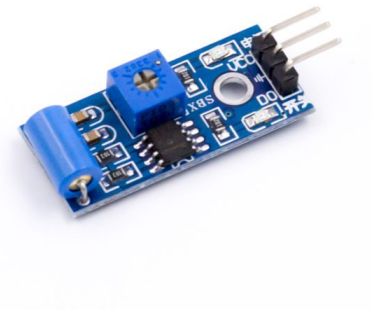
4) Bluetooth module
   The HC-06 is a popular Bluetooth module that can add

two-way (full-duplex) wireless functionality to projects. Designed to replace cable connections HC-05 uses serial communication to communicate with the electronics. Usually, it is used to connect small devices like mobile phones using a short-range wireless connection to exchange files. It uses the 2.45GHz frequency band.



5) Temperature and Humidity Sensor
A basic, extremely affordable digital temperature and humidity sensor is the DHT22. It measures the humidity in the air using a thermistor and a capacitive humidity sensor, and it outputs a digital signal on the data pin (no analog input pins needed). Although reasonably easy to operate, data collection requires precise timing.

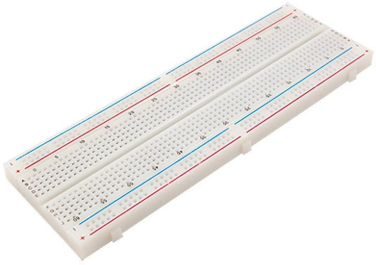
6) Vibration Sensor
A vibration sensor, also known as a vibration transducer or accelerometer, is a device designed to measure or detect vibrations and oscillations in an object or a physical environment. It converts mechanical motion into an electrical signal that can be interpreted or recorded for various purposes.



7) Jumper Wire male to female
The jumper wire is an electrical wire, but the only difference from the normal wire is that the jumper wire has additional pins. There are three types of jumper wire, and they are male to male, male to female, and female to female. In our project, we needed three types of jumper wire.

8) Active Buzzer 5V
An active buzzer is an electronic component that generates sound when an electric signal is applied to it. The term ”active” distinguishes it from a passive buzzer, which requires an external oscillating signal to produce sound. An active buzzer typically includes an integrated oscillator circuit, simplifying its use in electronic projects.

9) Breadboard
A breadboard is a construction base that we use to build semi-permanent prototypes of electronic circuits. In our project, we used 1 breadboards.

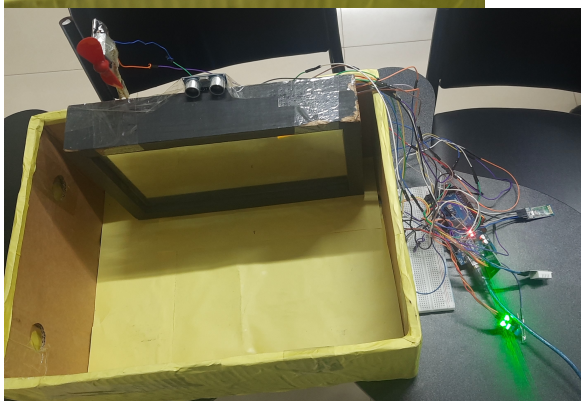


10) LCD display
A Standard LCD 16x2 Display refers to a common type of alphanumeric liquid crystal display (LCD) module that is widely used in electronics projects and devices. The ”16x2” in the name indicates the display’s size, specifically its capacity to show 16 characters in each of its two rows. This type of LCD display is popular for its simplicity, ease of use, and compatibility with microcontrollers and other electronic circuits.

11) Ultrasonic sensor
The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. It’s ideal for any robotics projects which require avoiding objects, by detecting how close they are you can steer away from them.

V. IMAGE OF THE PROJECT

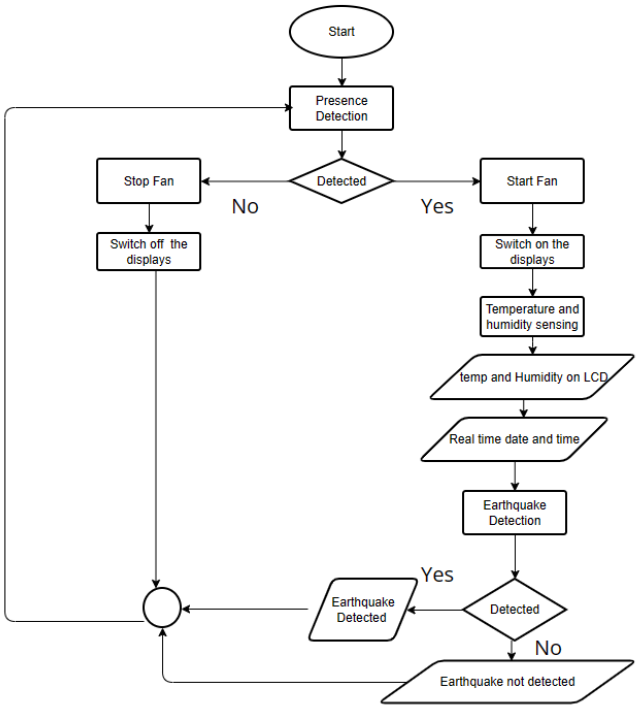
We have managed to include our whole project in a diaphragm.



Project Picture

VI. FLOW CHART OF THE PROJECT

We have also created a diagram type flow chart for repre-senting the workflow of our project.



System Flowchart

Code for Smart Mirror.

smart_mirror.ino

```
#include <DHT.h>
#include<SoftwareSerial.h>

#define dataPin 10 // Replace with the actual pin your sens
#define DHTTYPE DHT22 // DHT22 (AM2302) sensor type

DHT dht(dataPin, DHTTYPE);
const int trigPin = 3;
const int echoPin = 2;
const int motorPin = 4;
const int led = 5;
const int vs = 8; // Vibration sensor
const int buzzer = 9; // buzzer output

//bluetooth Module
char Incoming_value=0;
const int light= 6; // new led as output for bluetooh modul

void temperatureAndHumidity();
void vibrationSensing();
void setup() {
  Serial.begin(9600);        // Starts the serial communica
  pinMode(trigPin, OUTPUT);  // Sets the trigPin as an Outp
  pinMode(echoPin, INPUT);   // Sets the echoPin as an Inpu
  pinMode(motorPin, OUTPUT); // Sets the motorPin as an Output
  pinMode(led, OUTPUT);      // Sets the led as an Output
  pinMode(vs, INPUT);        // Sets the vs as an Input
  pinMode(light,OUTPUT);     // sets new led as output
  //Serial.begin(9600);        // Starts the serial communication
  pinMode(buzzer, OUTPUT); // SETS BUZZER AS OUTPUT..
  dht.begin();
}

void loop() {
  // Ultrasonic distance measurement
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  long duration = pulseIn(echoPin, HIGH);
  int distance = duration * 0.034 / 2;

  Serial.print("Distance: ");
  Serial.println(distance);

  digitalWrite(led, HIGH);

  if (distance < 10) {

    temperatureAndHumidity();
    vibrationSensing();
    // Control the motor based on the combined conditions
    digitalWrite(motorPin, HIGH);
  }
  else {

    digitalWrite(motorPin, LOW);
  }

  // Add a delay to avoid rapid toggling (adjust as needed)
  delay(500);
}
```

```
unsigned long vibration() {
 unsigned long measurement = pulseIn(vs, HIGH); // wait for the pin to get HIGH and returns measurement
  return measurement;
}

void temperatureAndHumidity(){
  // Read DHT sensor
    float temperature = dht.readTemperature();
    float humidity = dht.readHumidity();

    Serial.print("Temperature: ");
    Serial.print(temperature);
    Serial.print("°C, Humidity: ");
    Serial.print(humidity);
    Serial.println("%");
}

void vibrationSensing(){
      // Read vibration sensor
    unsigned long measurement = vibration();
    Serial.print("Vibration Measurement: ");
    Serial.println(measurement);

    if (measurement > 10) {
      Serial.println("Earthquake Detected!");
      digitalWrite(buzzer, HIGH);
    } else {
      Serial.println("Earthquake Not Detected!");
      digitalWrite(buzzer, LOW);
    }
}

```

REFERENCES

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