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MOTION CONTROLLED COMPUTER USING ARDUINO

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INTRODUCTION OF MOTION CONTROLLED COMPUTER USING ARDUINO

The technology tends to make human life easier and safer, our main aim is to reduce the effort of interaction with computers or laptops through input devices using simple gestures as gesture-based interaction are becoming very popular both at the workplace. Our project is kind of similar to that but here we use hand motion to control our personal computer. This work intends to develop a system that can recognize hand gestures which can be used as an input command to interact with the PC or laptop. One of the key areas which need to be looked at while developing such systems is the code implementation stage. To manage the work we shall also be using Python for the implementation of the code. We feel that if successfully meet our goals then we shall have contributed towards the future of natural gesture-based interfaces, if only in a minimal way. Let’s have a brief look into the project with all the working analysis and results we achieved.

LITERATURE SURVEY

SNO	TITLE	AUTHOR	JOURNAL	YEAR PUBLISHED	CONTRIBUTION
1	Cost-effective hand gesture computer control interface	1. József Katona 2. Gergely Sziládi 3. Tibor Ujbányi	IEEE International Conference on Cognitive Info communications	2016	Provided a rich dataset for gesture research, capturing spontaneous and naturalistic gestures in computer interactions.
2	Hand Gesture Recognition Based on Computer Vision: A Review of Techniques	1. Sushmita Mitra 2. Acharya Tinku	IEEE Transactions on Systems, Man, and Cybernetics	2007	Applications involving hidden Markov models, particle filtering and condensation, finite-state machines, optical flow, skin color, and connectionist models

s.no	TITLE	AUTHOR	JOURNAL	YEAR PUBLISHED	CONTRIBUTION
3	Static vision based Hand Gesture recognition using principal component analysis	1. Mandeep Kaur Ahuja 2. Amardeep Singh	IEEE 3rd International Conference on MOOCs, Innovation, and Technology in Education (MITE)	2015	Template-based matching technique is developed using Principal Component Analysis (PCA) for recognition.
4	A Continuous Hand Gestures Recognition Technique for Human-Machine Interaction Using Accelerometer and Gyroscope Sensors	1. Tanima Dutta 2. Kulwant Sharma 3. Hari Prabhat Gupta	IEEE Sensors	2016	A gesture is recognized by comparing the gesture code with the gesture database using a dynamic time warping algorithm
5	Real-Time Hand Gesture Recognition Using a Color Glove	1. Luigi Lamberati 2. Francesco Camastra	Image Analysis and Processing	2011	This paper presents a real-time hand gesture recognizer based on a color glove.

SNO	TITLE	AUTHOR	JOURNAL	YEAR PUBLISHED	CONTRIBUTION
6	Vision-based hand-gesture applications	1. Juan Pablo Wachs 2. Yael Edan	Communications of the ACM	2011	Body posture and finger pointing are a natural modality for human-machine interaction.
7	Study of various techniques of Hand gesture recognition	1. Jyoti Rani 2. Harpreet Kaur	IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES)	2016	The Kinect depth data is the famous research for the identification of new fingers and the recognition of hand gesture
8	Hand-Gesture Recognition-Algorithm based on Finger Counting	1. M.Perimal 2. S.N.Basah 3. H.Yahya	Exploring Man-Machines Compliance in Signal Processing and Artificial Intelligence	2018	The algorithm counts fingers and recognizes gesture based on the maximum distance between the fingers detected. The algorithm divided into four main parts: image acquisition, pre-processing, finger detection, and gesture recognition

SNO	TITLE	AUTHOR	JOURNAL	YEAR PUBLISHED	CONTRIBUTION
9	Real-time hand detection in a complex background	1. Ekaterini Stergiopoul 2. Parado Nu bailo 3. Nikos Mitianoudiu	Image Processing and Multimedia Laboratory	2014	Employing a combination of existing techniques, based on motion detection and introducing a novel skin color classifier to improve segmentation accuracy.
10	Real-time Vision-based Hand Gesture Recognition Using Haar-like Features	1. Ashish B Ingale 2. DS Chaudhari	IEEE Instrumentation & Measurement Technology Conference IMTC 2007	2007	Based on the extracted postures, composite, gestures can be parsed and recognized with a set of primitives and production rules.

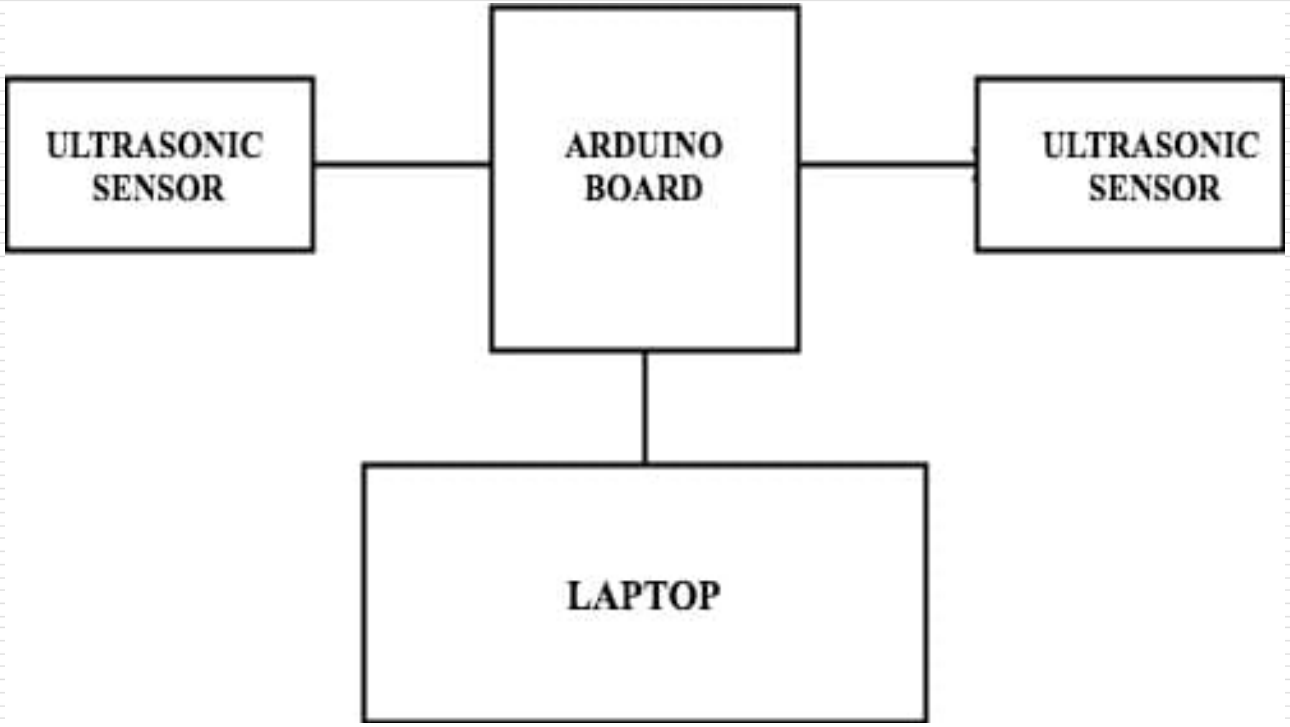
PROBLEM STATEMENT

Design and implement a Motion-controlled computer interface using Arduino, enabling users to interact with digital devices seamlessly. The project aims to create a system that recognizes predefined hand gestures and translates them into corresponding computer commands, enhancing user experience and accessibility. The solution should encompass gesture detection using sensors or cameras, gesture classification algorithms, Arduino-based microcontroller programming, and effective communication protocols between the Arduino and the computer. This would be a great help for paralyzed people if they could control the system without any electronic gadget specified above. The system control with simple unique gestures of hands reduces the space between user and machine. In the present paper, basic Arduino Uno is used to support the hand gesture-based system control.

OBJECTIVES

- To develop a robust motion system using Arduino and appropriate sensors/cameras.
- To define a set of intuitive hand gestures to control various computer functions.
- To Optimize the algorithm for efficient processing and minimal latency.
- To Develop a user-friendly interface for configuring and customizing gesture commands.
- To Conduct thorough testing to validate the accuracy and reliability of the hand gesture recognition system.

SYSTEM ARCHITECTURE



PROPOSED WORK

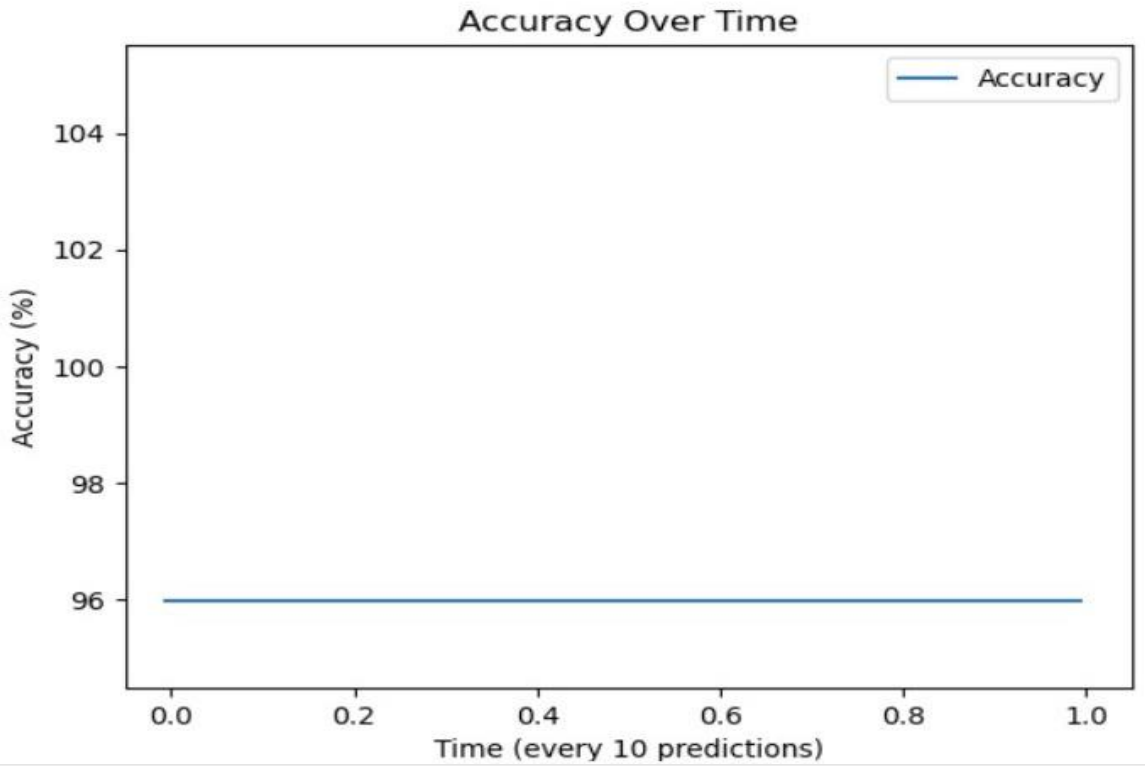
In our project ,We use Arduino and Python, there are several opportunities for enhancement and refinement. Firstly, to improve accuracy, we can fine-tune the distance thresholds in the Arduino code, ensuring precise detection of hand motions. Python's simplicity and readability make it easy to understand and write code, facilitating faster development. Additionally, Python seamlessly interfaces with Arduino, allowing effective communication between the sensor and the computer.

We leveraged the k-Nearest Neighbors (kNN) algorithm as a machine learning approach for gesture recognition. The kNN algorithm enhances our system's ability to accurately classify and interpret diverse hand movements. Through a training dataset comprising known hand gestures and their corresponding labels, the algorithm classifies new gestures based on the majority class among their k-nearest neighbors. This approach not only provides a robust framework for gesture recognition but also allows for adaptability and customization.

ACCURACY AND ALGORITHM

K-NEAREST NEIGHBOUR ALGORITHM (KNN):

```
b'next\r\n'
b'back\r\n'
b'Vup\r\n'
b'Vup\r\n'
b'Vdn\r\n'
b'next\r\n'
b'back\r\n'
b'next\r\n'
b'Vdn\r\n'
b'next\r\n'
Accuracy:  96.00% (Correct predictions: 20/20)
```



ACCURACY AND ALGORITHM

Sensor 1 (cm1)	Sensor 2 (cm2)	Values
<=20	<=20	Vdn (down)
>=20 <=50	>=20 <=50	Vup (up)
<=10	>=30	Back
>=30	<=10	Next

ACCURACY AND ALGORITHM

➔ The Motion- controlled computer data set consists of 4 features.

➔ When the cm1 (sensor 1) and cm2 (sensor 2) value is <=20 and <=20 then it gives the output as Vdn (down).

➔ When the cm1 and cm2 value is >=20 and <=50(cm1 values) and >=20 and <=50(cm2 values) then it gives the output as Vup (up).

➔ When the cm1 and cm2 value is <=10 and >=30 then it gives the output as Back.

➔ When the cm1 and cm2 value is >=30 and <=10 then it gives the output as Next.

➔ There is no null values in dataset.

HARDWARE REQUIREMENTS

1. ARDUINO UNO
2. ULTRASONIC SENSOR
3. JUMPER CABLE
4. USB CABLE

SOFTWARE REQUIREMENTS

1. OPERATING SYSTEM- WINDOWS 11
2. ARDUINO IDE
3. PYTHON IDLE
   - Pyautogui

EXECUTION OUTPUT

Python 3.7.2 Shell

File Edit Shell Debug Options Window Help

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b'down\r\n'
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b'down\r\n'
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b'down\r\n'
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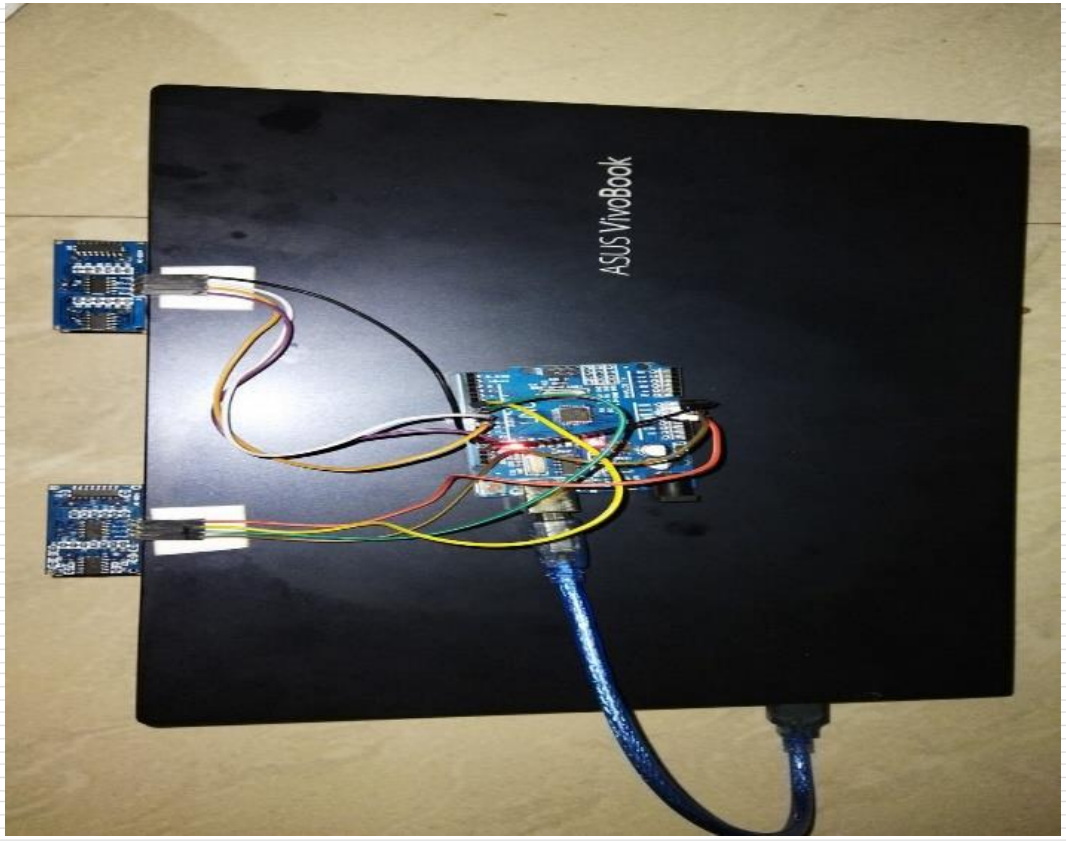
b'previous\r\n'
b'previous\r\n'
b'previous\r\n'
b'previous\r\n'
b'previous\r\n'
b'previous\r\n'
b'previous\r\n'
b'up\r\n'
b'down\r\n'
b'down\r\n'
b'next\r\n'
```

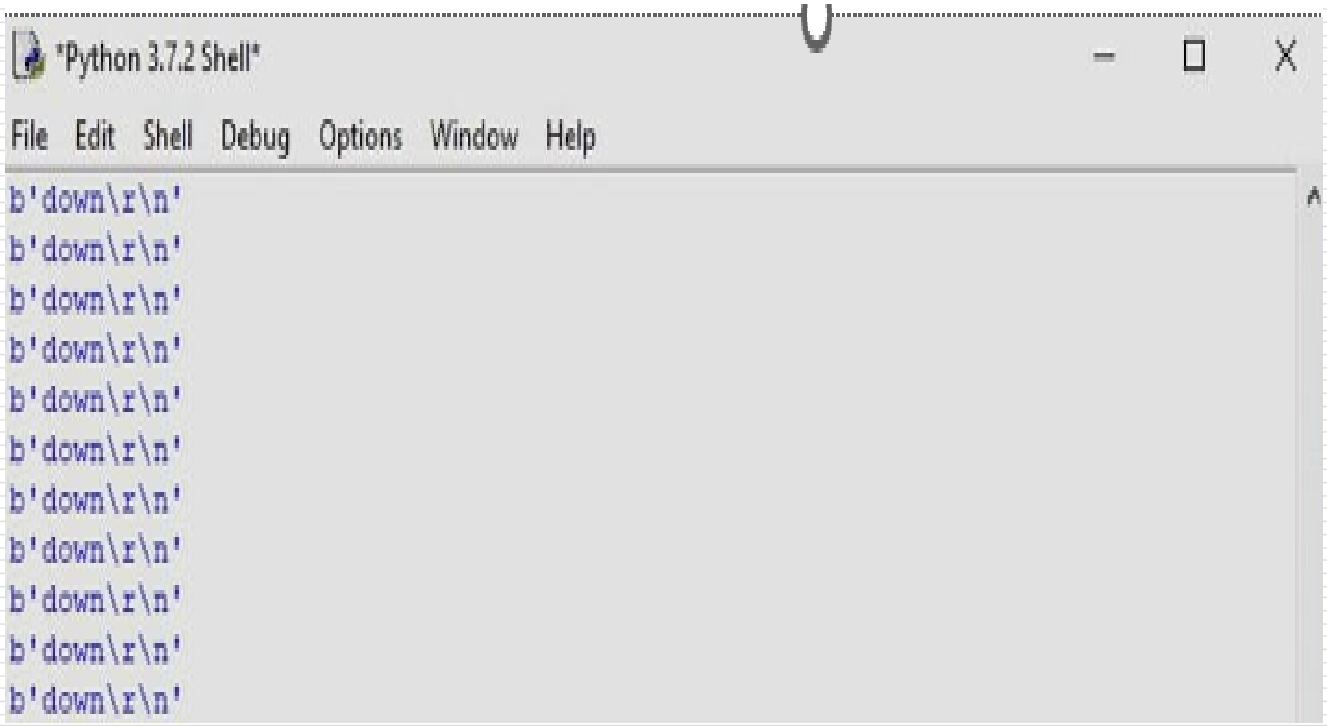
Ln: 70 Col: 0



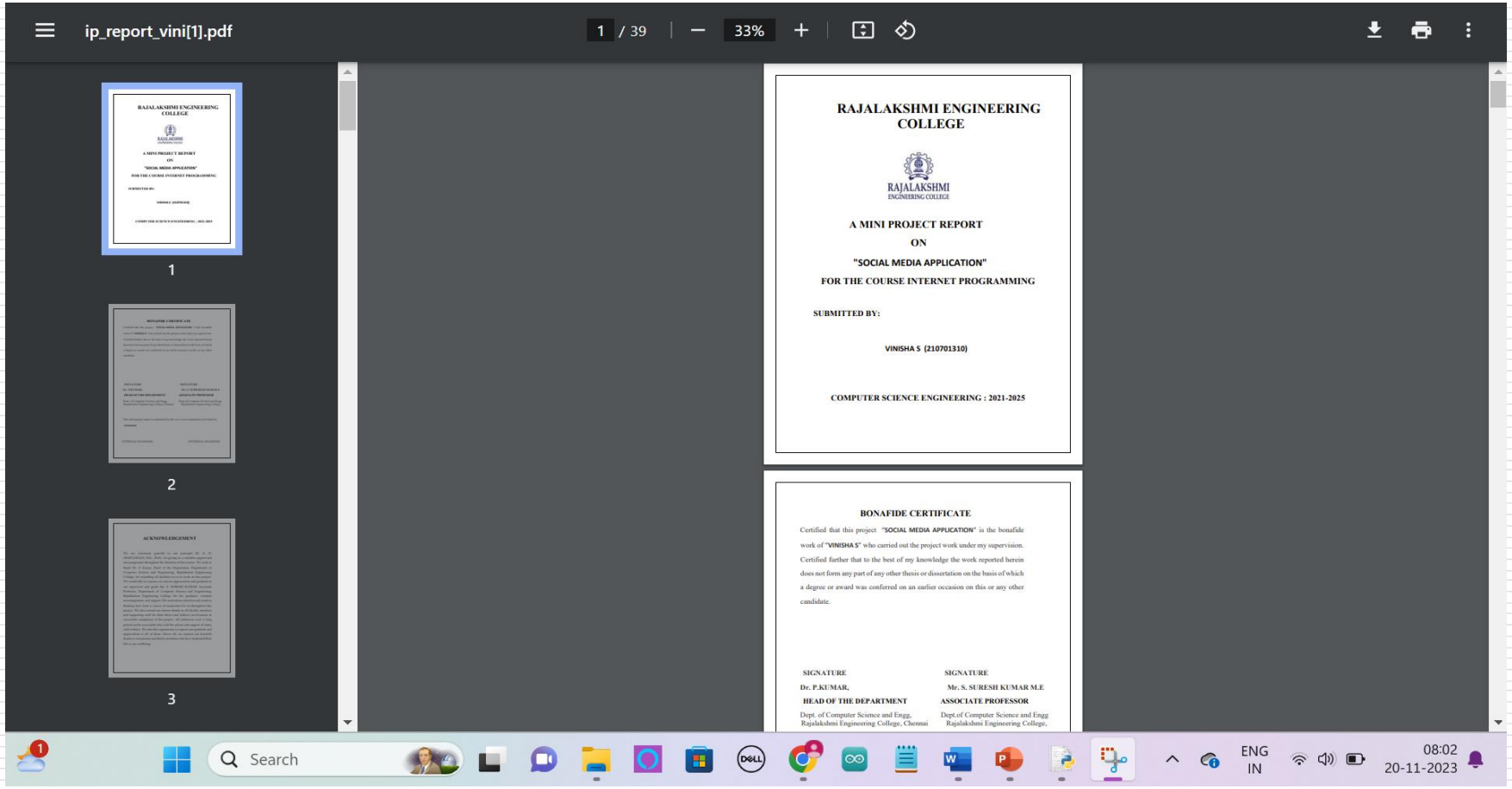
RESULT ALONG WITH SCREENSHOT

- The gesture recognition using ultrasonic waves is found to be accurate and reliable.
- The methodology for testing comprised of movement of single hand or multiple hands.
- Single hand movement was detected accurately.
- When there are multiple hands, the movement is not detected accurately.
- The noise in human audible range did not affect the detection.
- In our work, we have implemented Arduino based motion controlled of our computer, where few hand gestures made in front of the computer will perform defined tasks in the computer without using keyboard.

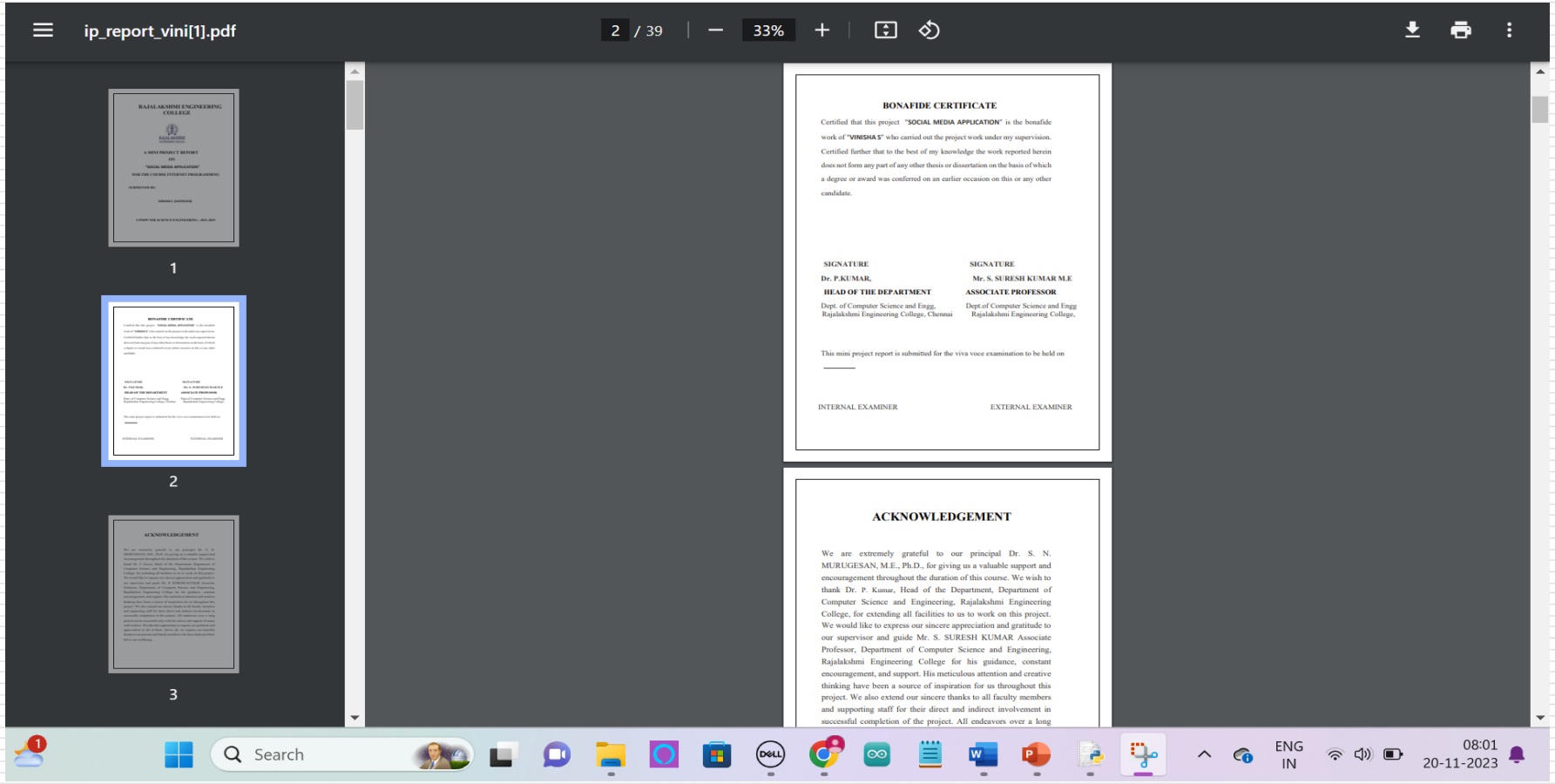
RESULT ALONG WITH SCREENSHOT



RESULT ALONG WITH SCREENSHOT



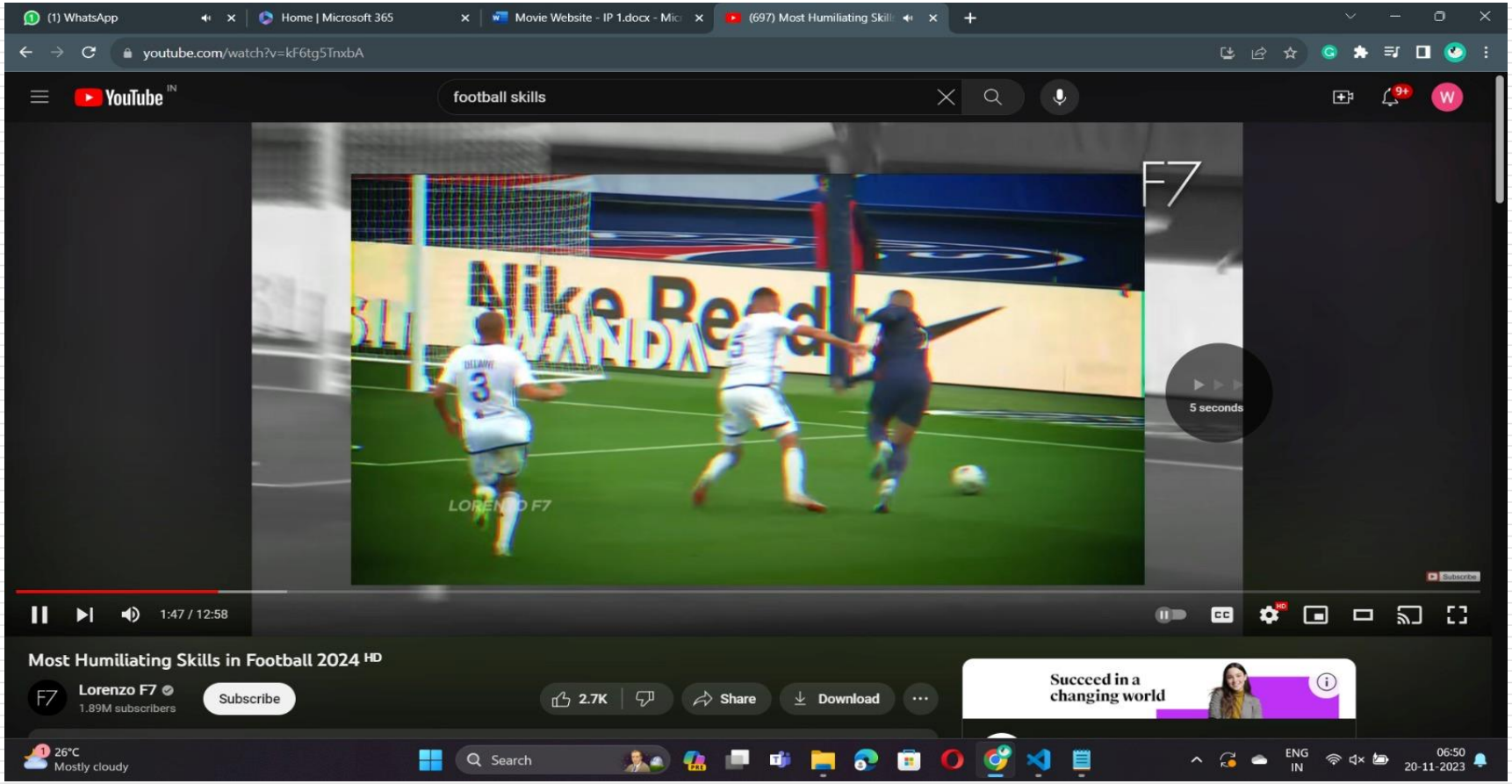
RESULT ALONG WITH SCREENSHOT



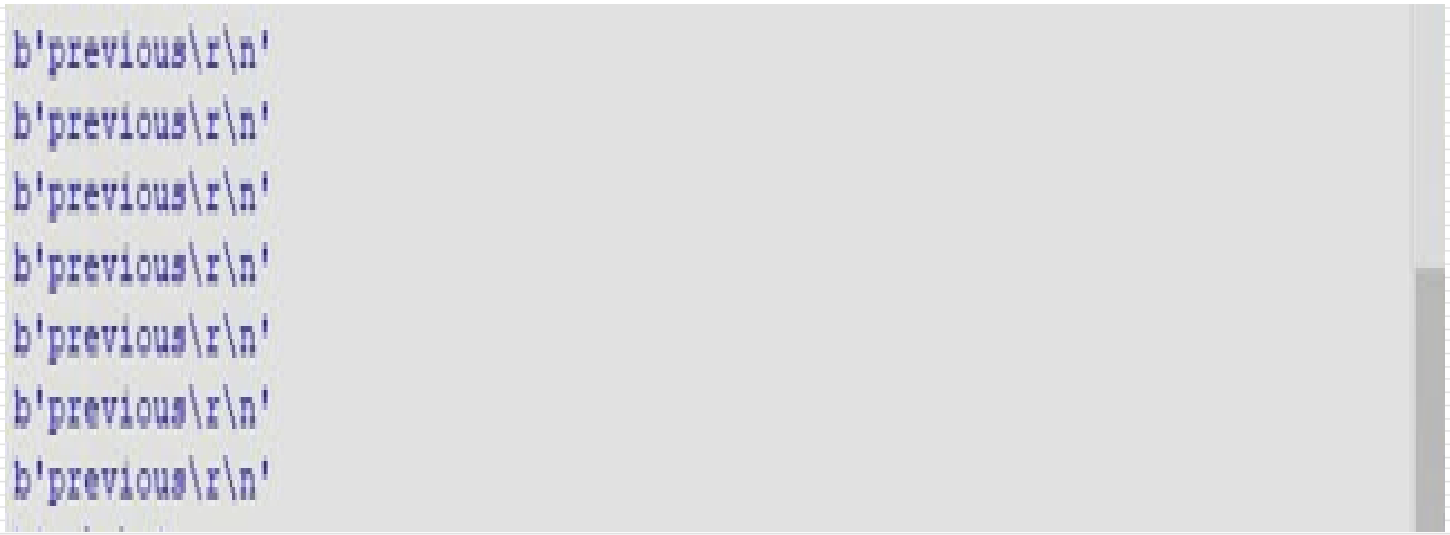
RESULT ALONG WITH SCREENSHOT

```
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
b'next\r\n'
```

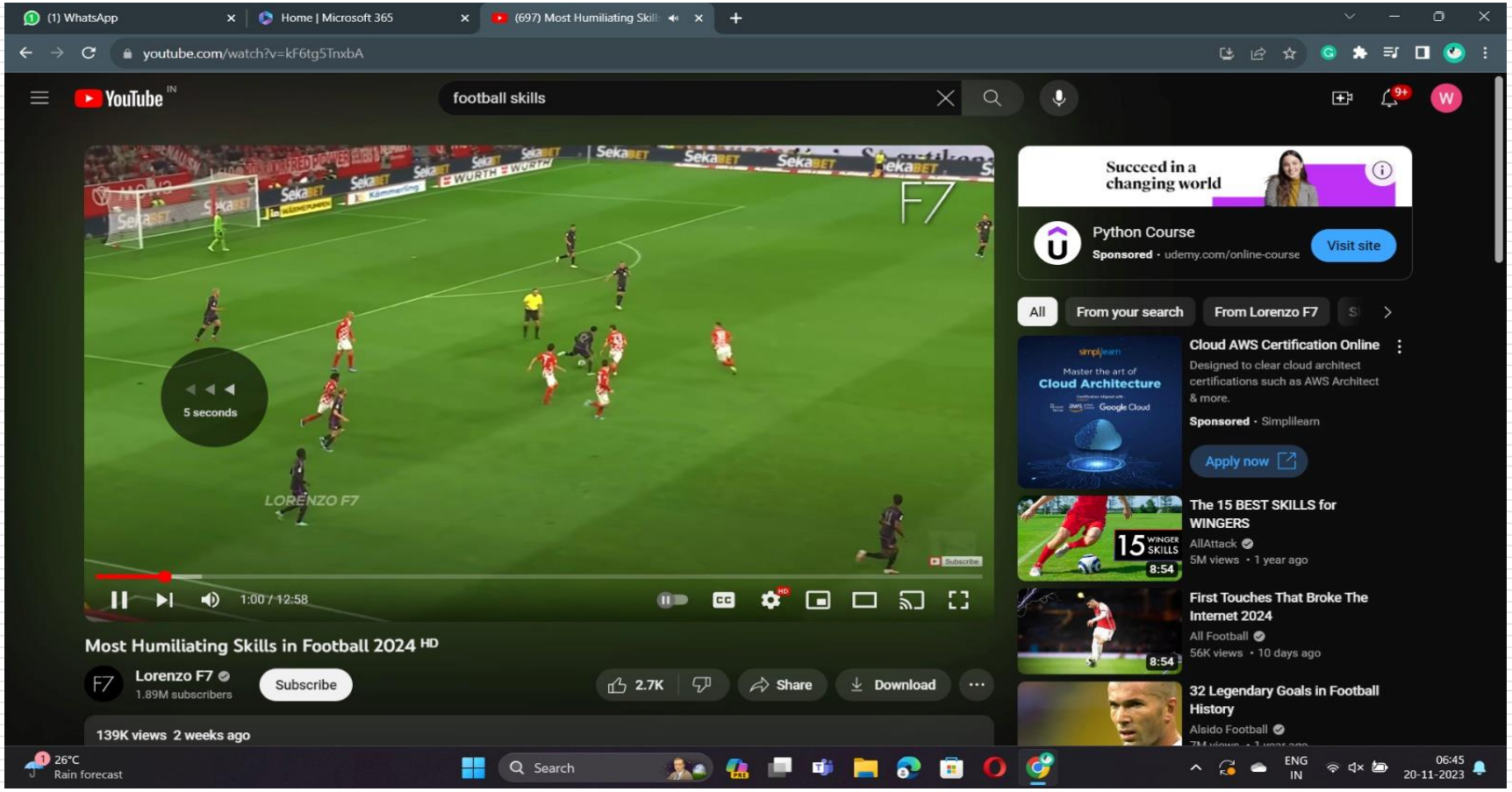
RESULT ALONG WITH SCREENSHOT



RESULT ALONG WITH SCREENSHOT



RESULT ALONG WITH SCREENSHOT



CONCLUSION

The motion-controlled computer project utilizing Arduino technology has successfully demonstrated the potential for intuitive and hands-free computer interaction. It is one of the easiest ways of interaction between humans and computers. It is a cost-effective model that is only based on Arduino UNO and ultrasonic sensors. The Python IDE allows seamless integration with Arduino UNO to achieve different processing and controlling methods for creating new gesture control solutions. Additional gesture recognition opportunities exist in medical applications where, for health and safety reasons, a nurse or doctor may not be able to touch a display or trackpad but still needs to control a system. In other cases, the medical professional may not be within reach of the display yet still needs to manipulate the content being shown on the display. Appropriate gestures, such as hand swipes or using a finger as a virtual mouse, are a safer and faster way to control the device.

REFERENCES

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Thank You