# A SELF-ACTIVATING PLAYFUL STEM ROBOT USING RASPBERRY PI

## Poushali Paul[1], Ankit Kumar[2], Adrita Roy[3], Koushik Pal[4], Dr. Samiran Chatterjee[5]

[1-3]UG student, Dept of Electronics and Communication Engineering, Guru Nanak Institute of Technology, Kolkata, India

[4]Assistant Professor, Dept of Electronics and Communication Engineering, Guru Nanak Institute of Technology, Kolkata, India

[5]Professor, Dept of Electronics and Communication Engineering, Vignan's Institute of Management and Technology for Women, Hyderabad, Telangana

-------------------------------------------------------------***-------------------------------------------------------------

**Abstract***: It is important to give proper education to all the children. Kids must learn properly and at the same time they must enjoy education. Due to the recent pandemic situation children cannot go outside and they are not able to relish their normal life. We have proposed an automated conversational robot toy that has an audio-visual facility in it. This paper deals with some basic components like Raspberry Pi, IR(Infrared) Sensor, OLED (Organic Light Emitting Diode) Display, Ultrasonic Sensor, Servo Motor, etc. Here, advanced facial and voice recognition is used to recognize and react to the kids. This conversational robot is used to educate children professionally. Thus, the learning experience is enhanced and will bring change to the new generation. This paper is an easier approach for learning and also it is a representation of powerful, secure technology and robotics.*

**Keywords: STEM, Conversational robot, Raspberry Pi, IR Sensor, Ultrasonic Sensor, OLED, RGB Light, Servo motor.**

## 1.INTRODUCTION

This project is about a robot toy that is playful and at the same time the user can learn from it. This is a conversational robot that is based on a STEM (Science, Technology, Engineering, Mathematics) methodology, so we can refer to this as a playful, learning STEM Robot toy [1]. It has a major feature of voice activation, which makes it more likely and friendly to use. Also, the Robot is automated thus it can respond and give output automatically.[2] The robot is best suited for the age group of 13-20 years as it includes the best learning and gaming features in it. The automated STEM robot is fully programmed using different basic materials like batteries, sensors, motors, transistors. It also includes Raspberry Pi and Arduino as major equipment in it. All these materials will be used to make these multiple featured robots. This robot will be a great example of advanced and secure technology in this modern world.

## 2. OBJECTIVE

The main purpose of making this conversational robot is to enhance the learning experience and as well as be playable to the users. This will work as a professional educator for the kids.[3] Proper education to the kids from the beginning is needed and the reason this robot is best for education purposes to the children. Our proposed conversational robot will allow all to learn and explore different languages. Also, as per the new education policies which say that the compulsory learning of local languages, our conversational robot is designed accordingly so that users can access any language needed. This will reflect the Indian culture which will emphasize Indian tradition to the kids [4]. Along with studies children can learn proper communication skills with others which is important. The simple features of this robot make it easily accessible to the kids. Keeping in mind the recent covid situation this conversational robot is made to reduce the loneliness of the kids and give them a playful, learning, autonomous, conversational robot.

## 3. LITRATURE SURVEY

In [1] the authors approached a humanoid robot called ROBITA, which will help in THE conversation between a group of people. In [2] authors have reviewed the possible verbal and non-verbal interaction between a human and a robot. Authors in [3] said about a software application-based chatbot that is made up of artificial intelligence and machine learning. In [4] authors have described a broad analysis to evaluate the human-robot system and all the general application methods. [5] is a review article that explains usability and designs of unmanned vehicles. In the paper [6] authors have proposed a system which will focus on STEM education through robotics technology. Their purpose is to develop student learning by the Constructivism and Constructionism theories. The paper [7] attempted to utilize the application of robotics in the primary education system. They have used different programming fundamentals to highlight the educational benefits of robotics. In [8] authors have discussed the

potentials of using robotics to make relevant learning and stimulate all possible new career paths in STEM education. The review paper [9] suggested early child education. They have focused on robotics for young children. In [10] authors have suggested an Arduino-based robotics system for STEM curriculum development. In the paper [11] a positive influence on learning is proposed by the authors in robotics-based education. In [12] authors described the system of humanoid robots as teachers. The paper [13] also proposes a system for the education of children by robotics from early childhood. Authors in [14] also discussed robotics in learning.

Robotics in education is a crucial topic as the necessity of proper teaching to the children must be genuine. In this study, we all focused on a suitable and user-friendly system, which will provide acceptable and conventional robots for children. Our proposed model is made up of Raspberry Pi, IR Sensor, Ultrasonic Sensor, RGB Light, Servo motor, OLED.  Conversational AI is also used to stimulate different critical functions and voice assistants. With the advancement of technology, we made our automated conversational robot easily accessible.

## 4. METHODOLOGY

This Robot is made just for educational purposes. It's more suitable for teenagers because it has advanced facial voice recognition to recognize & react to users.

By the use of a mic, the user can give a command to the robot, and then the robot will display the output with their speaker and O-led screen. Here are some examples of the conversation between a user and a robot.

If the user says "Hello" then immediately the robot will respond "Yes (user name)".

If a user wants to answer any question, then they have to just speak in front of the robot, it will search on the web or in the database and show the results on the screen by dictating the word.

If a user wants to play some games with it, the robot will show the list of games in it and start playing after the user responds.

The process of getting output from the robot is that at, first the user has to use the mic of the robot to give any type of command. After getting the command, the mic will send the command to the server (i.e., raspberry pi). Again, the server will give the command (i.e., output) on a screen as well as to the RGB(Red-Green-Blue) light, then the screen or speaker will show the conventional output. Now the other part of this robot is movable. That means this robot can move from one place to another.

Also, it has an IR sensor for sensing the depth or big hole of any area and protects itself.

If there is an obstacle while the object is moving, then an ultrasonic sensor will detect the obstacle and stop it's movement. So, this is the overall methodology process for this conversational robot. The whole procedure is shown in Flow chart-1 and Flow chart-2.
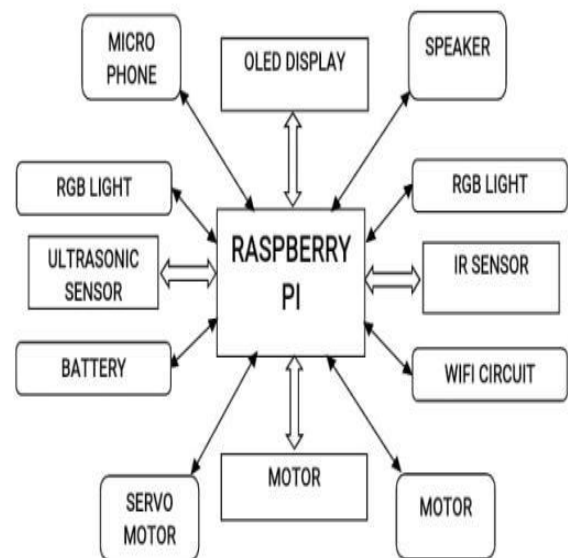
## 5. BLOCK DIAGRAM



**Fig-1**: Block diagram of our model

## 6.GENERAL DESCRIPTION OF THE COMPONENTS

**6.1 Power:** This section deals with the power requirements of the robot which uses DC motors. The power supply is a basic need to design any system. The Raspberry Pi is powered by a +5v micro-USB supply and the exact current required is dependent on the connections given to the Raspberry Pi. In this system, the Model B Raspberry Pi is used with typically between 700- 1000mA current. And for this supply, the Power bank with 5v 1A is used, shown in fig.



**Fig-2: Battery**

**6.2 Raspberry Pi:** The Raspberry Pi is a series of credit card-sized single-board computers developed by the Raspberry Pi Foundation. It features a Broadcom system on a chip that consists of ARM-compatible CPU (Central Processing Unit) and on-chip GPU (Graphics Processing Unit) and memory ranges from 256 MB to 1GB RAM. The SD (Secure Digital) cards presented here are used to store the operating system and program memory in either the SDHC (Secure Digital High Capacity) or microSD High Capacity. The board has 1 to 4 USB (Universal Serial Bus) slots, HDMI (High-Definition Multimedia Interface), and composite video output, and a 3.5 mm phone jack for audio. It also has Ethernet, Wi-Fi and Bluetooth port. Raspberry Foundation provides Debian and Arch Linux ARM (Advanced RISC Machines) distribution for downloading purposes and python is there as the main programming language where C, C++, PHP, Java, and more are also available.

Speech synthesis will also be done by using the Raspberry pi hardware. This diagram of Raspberry pi shows A, A+, B, B+. Broadcom BCM2836 SoC is used with Raspberry-Pi. That is a 900 MHz 32-bit quad-core ARM Cortex-A7 processor, with 256 KB shared L2 cache.



**Fig-3:** Raspberry-pi

**6.3 Bluetooth Module HC-05**: The Bluetooth serial module is named even number compatible with each other; The slave module is also compatible with each other. In other words, the function of HC-04 and HC-06, HC-03, and HC-05 are mutually compatible with each other. HC-04 and HC-06 are the former versions where the user can't reset the work mode (master or slave). The command set of HC-03 and HC-05 are more flexible than HC-04 and HC-06s. So, the HC-03/HC-05 Bluetooth is highly suggested for the user. HC-05 is the latest wireless Bluetooth serial cable. So, we have used this in our conversational robot. This can be powered from 3.3V up to 6Vfor better attachment. It is a qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with a complete 2.4 GHz radio transceiver and baseband. There are features like Typical -80dBm sensitivity. Up to +4dBm RF power can be transmitted. Low power operation is 1.8 to 3.6V I/O. Default Baud rate is: 38400 and supported Baud rates are 9600, 19200, 38400, 57600, 1152000, 230400, 460800. CTS (Clear to Send)

and RTS (Request to Send) are used to control data streams. When master and slave are paired, red and blue LED blinks 1time/2s in an interval. Then it Auto connects to the last devices on power as default and permits pairing devices to connect as default. Therefore, it is connected to wireless communication.



**Fig-4:** Bluetooth module

**6.4 IR(Infrared) sensor:** An IR Sensor or Infrared Sensor is an electronic device that is used for measuring and detecting infrared radiation in the surrounding environment. We have used this device here also for sensing purposes.



**Fig-5:** IR Sensor

**6.5 Ultrasonic sensor**: Ultrasonic sensors are devices that can measure and capture ultrasonic effects or ultrasonic sound waves. It is mostly used to detect obstacles in the surrounding area. When our conversational robot will move, if it finds any obstacle around, the ultrasonic sensor will activate to detect it.



**Fig-6:** Ultrasonic Sensor

**6.6 Microphone:** USB Microphones are the easiest way of getting a microphone working with your Raspberry Pi. One of the most significant advantages of using a USB microphone is that it is plug-and-play. The Raspbian operating system will automatically detect the microphone when it's plugged in.

**Fig-7:** Microphone

**6.7 RGB(Red-Green-Blue) Light:** RGB light is Red-Green-Blue light which is used as an indicator. In our proposed model RGB light is used for different purposes like it gives the signal of the battery, it will indicate when WIFI is connected to the robot, it will also give an indication when GSM (Global System for Mobile communication) is activated, and while giving output to the user RGB light gives the necessary signal.

**6.8 OLED (Organic Light Emitting Diode) Display**: OLED is an Organic Light Emitting Diode. OLEDs are made when a series of organic thin films are placed between two conductors. This can be considered as the world's best organic display. A bright light is emitted when an electric current is applied to it. In our project, this is used to give the finest visual experience to the user. As this conversational robot is mostly preferable for children, the supreme quality of the screen is recommended. Also, it will show all the outputs and all the results as users want.



**Fig-8:** OLED Display

**6.9 Servo Motor:** Servo Motor is a self-contained electrical device. With high efficiency and great precision, it is used to rotate parts of the machine. Servo motor is used to control angular or linear position, velocity and, acceleration of the machine of the device. The motion of our conversational robot is also controlled by the servo motor. The Servo motor is helping to move the robot.



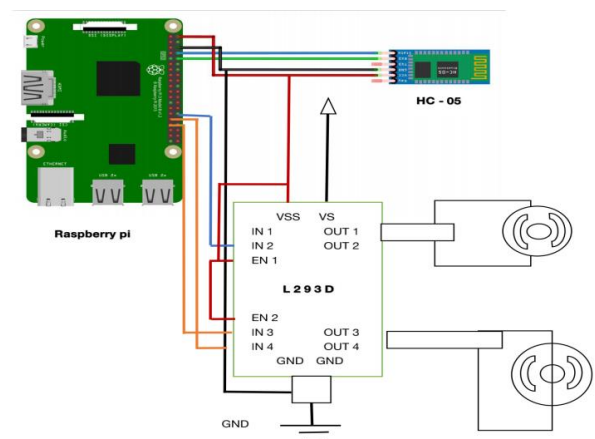**Fig-9:** Servo motor

## 7. MODELING

### 7.1 Circuit Diagram



**Fig-10:** Circuit design of our model
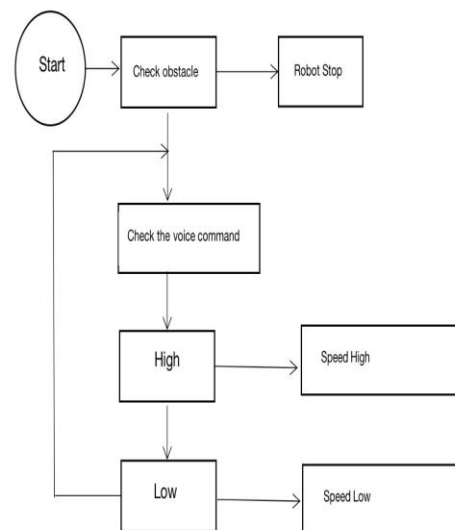
### 7.3 Flow Chart-I



**Fig-11:** Flowchart-I of our model
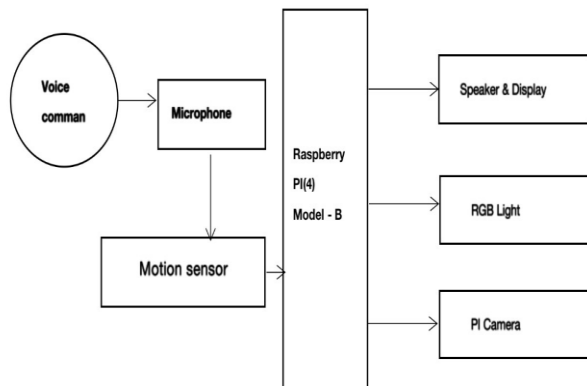
## 7.3 Flowchart-II



**Fig-12:** Flowchart-II of our model

## 8. CONCLUSION

In this project, we have proposed the model of a playful, learning, conversational robot which is capable of educating children properly. As the covid pandemic is going on, children cannot go out of their homes and neither can they enjoy and play outside. Due to this situation, kids are isolated in their home, and they can feel friendless. To reduce this problem, we have proposed this automated robot with which children can play and at the same time, they can learn. Also, in the post covid situation, most of the things are going to change and this robot will be the part of the new change for bringing change to the new generations. As this robot includes audio-visual facilities it can surely be a great friend of children.

## 9. FUTURE SCOPE

Genuine education for the kids is a very important thing. In modern days, almost everything becomes automatic. This conversational robot makes a change in the world of education and technology. Sometimes due to certain reasons and inconvenience of parents and teacher's children are not able to get a suitable education. Our proposed robot can give appropriate education to the kids.

Our robot is also based on Conversational AI which is nowadays preferred as one of the best technological up-gradation platforms. In the future AI technologies can be expected to be used as lifesaving functions.

## 10. REFERENCES

[1] Yosuke Matsusaka, Shinya Fujie, Tetsunori Kobayashi, "Modeling of Conversational Strategy for the Robot Participating in the Group Conversation", Aug 2001

[2] Nikolaos Mavridis, "A review of verbal and non-verbal human–robot interactive communication", Robotics and Autonomous Systems 63 (2015) 22–35

[3] Munira Ansari, Saalim Shaikh, Mohammed Saad Parbulkar, Talha Khan, Anupam Singh, "Intelligent Chatbot", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, 2015

[4] G. Rodriguez, C.R. Weisbin, "A New Method to Evaluate Human-Robot System Performance", Autonomous Robots 14, 165–178, 2003

[5] Boni Liu, "Recent Advancements in Autonomous Robots and Their Technical Analysis", Mathematical Problems in Engineering Volume 2021, Article ID 6634773, 12 pages, Feb 3, 2021

[6] Ahmad Khanlari, "Effects of Educational Robots on Learning STEM and on Students' Attitude Toward STEM", IEEE 5th Conference on Engineering Education (ICEED), 2013

[7] Maria Stergiopoulou, Anthi Karatrantou, Chris Panagiotakopoulos, "Educational Robotics and STEM Education in Primary Education: A Pilot Study Using the H&S Electronic Systems Platform" Springer International Publishing AG, 2017

[8] Henry Goh, Mohamad bin Bilal Ali, "Robotics as a tool to STEM learning" International Journal for Innovation Education and Research, Vol.2-10, 2014

[9] Sung Eun Jung and Eun-sok Won "Systematic Review of Research Trends in Robotics Education for Young Children", 2018

[10] Yiching Chen, Chi-Cheng Chang, "The Impact of an Integrated Robotics STEM Course with a Sailboat Topic on High School Students' Perceptions of Integrative STEM, Interest, and Career Orientation" URASIA Journal of Mathematics, Science and Technology Education, ISSN:1305-8223 (online), 2018

[11] Paul Baxter, Emily Ashurst, Robin Read, James Kennedy, Tony Belpaeme "Robot education peers in a situated primary school study: Personalisation promotes child learning", May 23, 2017

[12] Douglas P. Newton, Lynn D. Newton "Humanoid Robots as Teachers and a Proposed Code of Practice", 2019

[13] Lai Poh Emily Toh, Albert Causo, Pei-Wen Tzuo, I-Ming Chen, Song Huat Yeo, "A Review on the Use of Robots in Education and Young Children", Aug 27, 2015

[14] Dr. Shramana Ghosh, Dr. Pooneh Sabouri, Dr. Vikram Kapila "Examining the Role of LEGO Robots as Artifacts in STEM Classrooms (Fundamental)

## BIOGRAPHIES

**Poushali Paul**

(Currently studying B.Tech in Electronics and Communication Engineering, GNIT, Kolkata, India, Have interests in different programming languages, Business Management, HR, Art and craft, Photography, Architecture.)

**Ankit Kumar**

(Currently studying B.Tech in Electronics and Communication Engineering, GNIT, Kolkata, India, Have interests in different programming languages, playing instruments and playing cricket. )

**Adrita Roy**

(Currently studying B.Tech in Electronics and Communication Engineering, GNIT, Kolkata, India, Have interests in different programming languages, playing musical instruments, art)

**Koushik Pal**

(Koushik Pal is presently working as an Assistant Professor in the Department of Electronics and Communication Engineering of Guru Nanak Institute of Technology for the last 14 years. He has a specialization in Radio Physics and Electronics from the University of Calcutta. He has research interests in signal processing, image processing, AI and robotics)

**Dr. Samiran Chatterjee**

He completed his B.Tech & M.Tech degree from West Bengal University of Technology in the year 2007 & 2009 respectively. He completed his Ph.D. from Kalyani University in the year 2015. He has a teaching experience of about 14 years in various engineering college of different states. His research interest in the field of Antenna Design, FSS, Biomedical Application, Mobile Communication, IoT, Artificial Intelligence, Machine Learning, Embedded Systems and Real Time applications.