

Crony – The Holobot

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Abstract- A Chatbot is an AI based software program that provides interaction between humans and computers in a natural way. It converses with humans using text-to-text, text-to-speech or speech-to-speech ways. They are the most advanced way to interact with humans. These days chatbots are used almost everywhere, for instance as a customer support of any website, virtual assistant, online shopping and much more. Today machines have become advanced and intelligent that all the day to day work can be carried out very smoothly using them. With the advancement of machine Learning and Artificial Intelligence, NLP has made it more effortless to understand and analyse the user's input and respond to it very efficiently with a precise answer. Now, Hologram is the special type of 3-dimensional image projection. It is a combination, a superposition of diffraction gratings that are designed to reconstruct the original light waves that are bounced off from the object. Using the two technologies, our team is creating an AI powered hologram for users to visualize the AI interpretation and response to given query. Providing a realistic 3-D feel.

Keywords- Chatbot, Hologram, Pepper's Ghost, Seq2Seq, LSTM, Holobot.

I. INTRODUCTION

Social communication is the necessity of every creature in this world. In our entire life, we make friends, relatives and establish a connection with them which leave a great impact in our life. With this booming advancement in technology, the Computer and Information Technology industry is trying to enhance user's experience in every other field.

One such area is AI/ML and one of the notable results of this cutting-edge field is the development of chatbots. Over the years, chatbots were developed for various purposes and now it is being used everywhere; be it healthcare, banking or entertainment. Chatbots are driven by specific instruction and are programmed and developed using AI and NLP techniques. It can guide humans, respond to their queries and can imitate human conversations.

The application of chatbots can be enhanced and intensify the user's experience by integrating it with something which provides a visual impression of that bot. One such visionary area that bestows this kind of visual experience is Hologram Projection Technology. Imagine a world having chatbots that one can visually sense and talk to it like a normal human being. This can be possible using 3D Holographic Projection Technology. There are numerous techniques to develop a hologram but one of the earliest methods was Pepper's ghost method which was used to visualize holograms in late 1860s. 3D Hologram Projection is a fast growing technology and every other business in the market aims to use this kind of technology to make their product stand out from the competitors. This paper focuses on the integration of these rapidly growing

technologies i.e. Chatbots and Hologram Projection Technology to amplify the way humans interact with bots.

II. LITERATURE REVIEW

Paper 1: Holographic Projection Technology: The World is Changing

This paper discusses the future of Holographic Projection Technology and how it is shaping all other kinds of fields like telecommunication, healthcare, education etc. It articulates about the importance and need of Hologram Technology in this rapidly growing world and how it is going to strengthen various areas of life. It proposes the application of Holographic Technology by providing real world examples of how this technology has nurtured the world so far. It foresees that this technology has a great future and there would be some remarkable improvements in the near future like holographic projectors would be much smaller and portable, be able to render sharp images and development of holographic memory devices that can store up to five gigabytes. [1].

Paper 2: Sounding Board: A User-Centric and Content-Driven Social Chatbot

This Paper proposes a sounding board, a social chatbot that won the Amazon Alexa prize in 2017. The architecture of this chatbot is composed of various modules such as spoken language processing, dialog management, language generation and content management. These portions put emphasis on two kinds of design objectives i.e. user-centric and content-driven design. This paper is based on the problem of developing a system that can hold logical and appealing conversations on current events and popular topics such as sports, politics etc. It shows that it is feasible to develop a system

based on two key objectives. One of them is user-centric, which allows the user to control the topic of conversation, while the system on the other hand adapts responses of user's likeliness and interests by quantifying the user's personality. The latter one is content-driven, in which the system collects huge amount of content that gets updated daily which in turn enable a continuous supply of compelling and relevant information to continue the conversation. [2].

Paper 3: Delivering Cognitive Behaviour Therapy to Young Adults with Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial

The paper advances the theory of reflecting therapeutic procedure by creating a conversational agent, Woebot. Woebot is invented to provide Cognitive Behaviour Therapy (CBT) to a user with the help of regular conversation and mood tracking. The chatbot implies the task by collecting mood data of a user by asking generalized questions and answers from the users are intended in a way which briefs about the mood of a person. The captured mood data is reflected in the system which facilitates the function of providing response. The responses are from some pre-defined set, like mind games, stories and video clips which helps the person with different feelings in a therapeutic manner. Specifically, the Woebot proposes a conversation style which is based on human clinical decision making and dynamic social chat. [3].

Paper 4: Professor Avatar Holographic Telepresence Model

The research proposes the emerging era of communication systems with the Holographic Telepresence model. The model aims towards providing video conferencing in significant manner by merging the communication with the hologram system which will provide an interdisciplinary combination of communication which incorporates psychology, engineering, and television broadcasting. The close system has various telepresence technologies which demand holographic projection to be the leading medium of the communication system between users. The full motion video conferencing system collects video images and converts them using different holographic methods into three dimensional images which are then projected over a projection device. The research states that a simple 2Mb image can represent a picture quality of television and can be converted into holographic impressions. The real-time audio transmission is also done to make the video conferencing more realistic. Thus, by connecting the hologram technology with communication technology a higher level of communication can be established. [4].

Paper 5: A Review Paper on Holographic Technology Three-Dimensional Visualization

Holography is the strategy we use to record various examples of light. These examples are replicated as a three-dimensional picture called a visualization. Dennis Gabor invented the holographic method and was built on pioneering work in the field of X-ray microscopy. There are major four types of hologram are Amplitude and phase modulation holograms and Transmission and reflection holograms. The necessary elements to create hologram presented in the research are object beam, reference beam and medium for recording for example silver halide. When the two laser beams reach the recording medium, their light waves interfere and intersect with each other. It is this interference pattern that is imprinted on the recording medium. As BluRay reaches capabilities to store the data on a medium, holograms can be used to store data taking advantage of the volume of the recording medium instead of the surface. Future of research is to provide 3-D rendering of medical reports and pictures for better insight and practice before operating on the patient. Current development of Holo-Cells would enable 3-D engaging holographic projection systems which would provide the 3-D virtual experience thus providing different angle overview. [5].

Paper 6: Using dialogue corpora to train a chatbot

To illustrate the dialogue knowledge representation and pattern matching techniques, two chatbot systems were instated named ALICE and Elizabeth. The Java program that converts a dialogue from text to AIML format i.e., Artificial Intelligence Mark-up Language which is a subset of the XML i.e., Extensible Mark-up Language. ALICE is made of AIML objects which consists of two building blocks topics and categories. Whereas Elizabeth is an adaptation of the Eliza program. ALICE categories are classified as atomic categories, default categories, and recursive categories where categories are the patterns. Atomic category patterns do not have wildcard symbols, _ and *. Default category patterns having wildcard symbols * or _. Recursive category works on the principle of recursive artificial intelligence and symbolic reduction by mapping. [6].

III. PROBLEM STATEMENT

In the 21st century, in between the immense workload and social media, the stress level of a person is increasing day by day. Stress is normal and can help one to increase the work ability sometimes but if it stays for too long then it can affect a person mentally which can result in panic attacks, depression, and low energy levels.

In recent times, people are getting aware about their mental health. Yet, according to the global WHO organization more than 8 lakh people do suicide over a year due to stress or depression. [7].

One of the greatest proven solutions to dealing with stress is to spend some quality time with family or best friends, but due to heavy workload or a person's disability to talk about their problems (i.e. introverts) makes it hard for a person to be able to tell any other person.

The research aims towards providing a way to reduce stress by using today's highlighted technology deep learning and hologram to provide a person a friendly environment and a virtual friend image with whom a person can talk anytime -thus it will help to diminish the stress level and will also help to reduce feelings of loneliness. The idea is developing a chatbot with whom one can establish a conversation when needed to, and give it a visual sensation by using the hologram technology which can deliver a human-like or user wanted impression.

IV. PROPOSED SYSTEM

The proposed system presents a holographic device with programmed chatbot. There would be visual caricature of the user's choice in the form of hologram and at the back of it; there would be a bot which would interact with the user. The setup of the holographic display comprises plates adhered to each other at a particular angle and in between those plates, there will be the formation of hologram. The other segment of this device i.e. chatbot will communicate with users through mic and a speaker. It will take input as a speech, will perform appropriate speech to text conversion, then the chatbot will process the query and yield an output by transmuting the output text to speech.

The Chatbot system is based on Recurrent Neural Network (RNN) and specifically Long Short-Term Memory networks (LSTM), a special kind of RNN which is capable of learning long term dependencies. It uses sequence to sequence model (seq2seq) in particular to transform the sequences from one domain to another.

With the combination of these insightful concepts, a device is being developed which can communicate and provide a scintillating visual experience in the form of hologram. This system serves socially and creates a friendly environment in order to reduce stress and spread positivity in the hectic schedule of people.

V. METHODS

Crony – The Holobot is being classified into two cutting edge concepts i.e. Hologram Projection Technology and Chatbot system which is itself a whole system individually. This system involves variegated methods and techniques which have been put together in order to develop this Holobot.

Hologram Projection Technology

Generation of Hologram is an uphill task but what is more strenuous is choosing an appropriate method for generating a hologram. It can be developed using various

methods that involve bulky and big hologram projectors or complex laser techniques. One of the best methods that can be made portable and less expensive and which is also being used to develop Crony – The Holobot is Pepper's ghost method.

Pepper's Ghost method:

An inventor named Henry Dircks was the first who had come across this idea in the late 1860s. He had built an Italian optical illusion which manipulated visual effects using light and glass, calling it Dircksian Phantasmagoria. His attempt never got famous as it was complicated and expensive and the theatres had to rebuild in order to make this happen.

John H Pepper, who was a lecturer at Royal Polytechnic Institute, came with an easy idea to implement this method with just a single sheet of glass and therefore this method is named after him i.e. Pepper's ghost method. [8].

The original method involves placing a sheet of glass at a particular angle between a stage room and hidden room. The viewer looks straight ahead towards the stage room which is brightly lit. The glass reflects the hidden room and when it is brightened up, the light in the stage room is slightly dimmed and that is where the magic happens and a hologram is appeared before the viewer. [9].

Hologram Prism Device (Pepper's Ghost pyramid):

A Holographic prism device can be made with acrylic sheets which should be transparent and thin enough so that the hologram can be seen properly. This prism is not an ordinary prism rather it can be customized according to the user's screen where they are going to put it.

It is made with proper dimensions and thinness so that the angle gets perfect for displaying a Hologram which is shown in Figure 1. The phenomena which was discussed above is actually the concept that describes how a prism can generate a Hologram effect and hence it can be also called as Pepper's Ghost pyramid. [10].

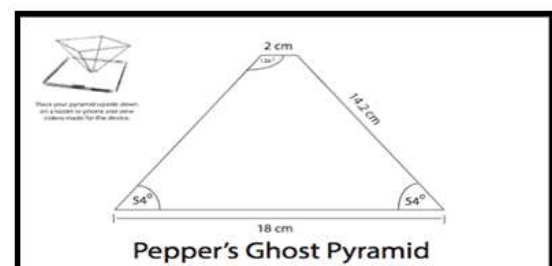


Figure 1 Pepper's Ghost Pyramid

These hologram pyramids utilize reflection in a similar way to the "Pepper's Ghost" effect, creating the appearance of a 3D hologram floating within a case. This type of imagery works because of the perfect dimensions and angles between the sheets.

Conversion of simple video to 3D Holographic video:

Now, the prism needs an appropriate form of video in order to generate the Hologram effect. For that we need to first convert a simple video into 3D Holographic video. This system mainly uses OpenCV for capturing frames from video, followed by few image processing methods to convert the video into 3D Holographic video.

The conversion is quite tedious but it can be efficiently performed by the NumPy library of python. Videos are captured frame by frame as an image and the computer comprehends them as a combination of matrices.

The transformation to 3D holographic video necessitates varied mathematical functions like inverse of matrix, transpose, rotation etc. The converted video is then put beneath the prism which is placed at the centre of the video and with the pepper’s ghost method; this setup will engender a floating hologram in the centre.

Chatbot System

The chatbot system plays a major role in the whole system. While working in the background, it handles the most difficult task of conversing with the person. There are basic two ways in which a chatbot can be developed are retrieval-based and generative-based from which as our domain is open domain, the fitting type would be the generative based.

Generative-based Approach/ System:

Generative approach refers to producing a response without having any set of rules. To fulfil that Neural Network is built to produce an answer for specific input like a Human Brain. It consists of input layers and output layers and has hidden layers in between them. The input is fed to the input layer and after processing through hidden layers which has activation function applied to the previous layer which produces weights which produces an output.

Out of all various kinds of neural networks the most appealing one is RNN (Recurrent Neural Network).

Recurrent Neural Network:

The RNN is basically a type of neural network whose layers are dependent on each other. Working in a backward direction compared to the human brain, the RNN feeds back the output to the previous layer and continues predicting the output from layers. There are various types of models available according to the relationship between the input and output layer among which the most accurate one is the Many-to-Many Recurrent Neural Network.

The blocks represented in the Figure 2 shows the individual element in the layer from which the beginning elements are the input layers and the layers at the outcome

level are output layers and between them are computation/hidden layers. [11].

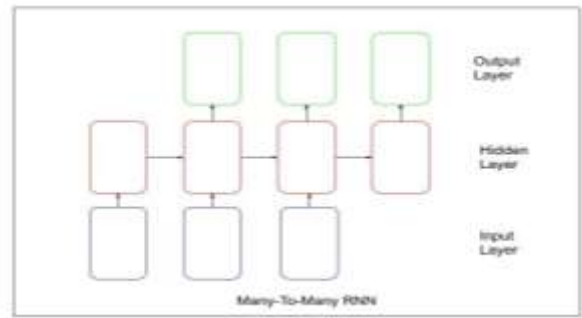


Figure 2 RNN (Many to Many)

The result required for the proposed application has input as a segment of words and output as segment of words, For example, a reply for a question "who are you?" the answers for who can be various(he, she, i etc), but the RNN will look at the whole sentence and by replying and feeding backwards the output to previous segments it will predict the answer "I am a robot."; hence it is fitting to use Many-To-Many RNN.

Furthermore, the RNN will also be used for emotion recognition but for that Many-To-One RNN will be used as there is an outcome for a sequence of input. Many-To-One RNN has N number of input layers and one outcome of it which describes the emotion of the user.

Long Short-Term Memory:

The RNN has an issue of vanishing gradient which represents decay of input layer over time, as it moves forward the first input gets decayed. To overcome the problem, a Long Short-Term Memory approach is used which has memory units to control the input and output gate. The LSTM structure is show in Figure 3. [12]. [13]

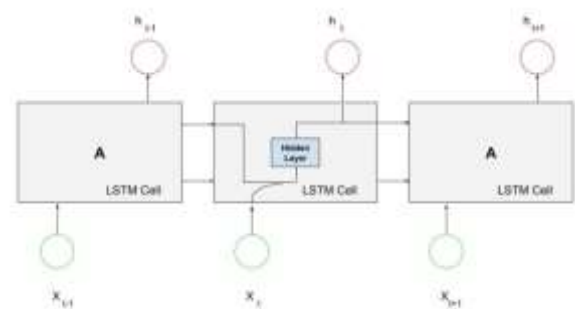


Figure 3 LSTM Cell

Moreover, to overcome the issue and mimic the human brain, Seq2Seq model will be used which is basically RNN with LSTM approach with a more robust structure that will enhance the effectiveness of the outcome.

Sequence-To-Sequence Model:

The Seq2Seq model is the kind of RNN which combines the LSTM within its structure. The Seq2Seq model is a

simple learning model which converts input sequence into output sequence. [14].

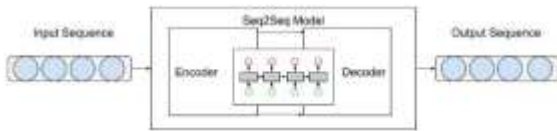


Figure 4 Seq2Seq Model

The structure of the Seq2Seq model in Figure 5 contains Encode and Decoder. Encoder is collection of LSTM inputs which gets single element of input sequence and converts it into vector of fixed length. Decoder is identical with encoder it predicts the next word by using hidden vector by encoder, hidden states and current word which produces next hidden vector and then the predicted word. [15].

The detailed view of the Sequence-To-Sequence model is shown in the below picture visualizes the component and workflow of the Seq2Seq model.

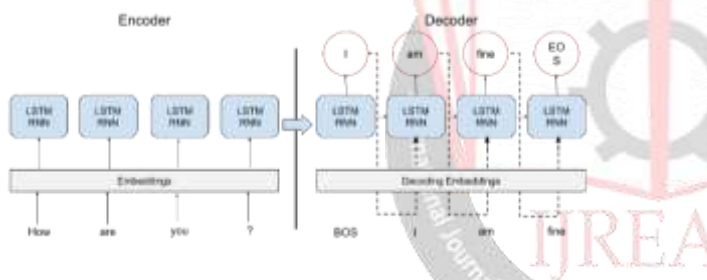


Figure 5 Seq2Seq Model-2

The first layer of embeddings converts each word of the input sequence into the embedding vectors. Then each of the embedding vectors is sent to the LSTM-RNN cell which produces the hidden vectors. After the encoding part finishes, at the other end decoding initiates. The LSTM-RNN cell takes the input and previous output as inputs and produces the output accordingly. The cell produces hidden layer and by using the embedding vector and the output of previous cell, then using the decoding embedding layer and at the end output sequence gets generated using argmax function.

Speech-To-Text:

Speech to Text conversation will enhance the system’s ability to interact with the User. It will be used to identify the owner’s voice as well as will convert the sound input into Text to feed it to the neural network.

For conversion of Speech-to-Text, Firstly, the voice input is taken by using microphone after that the physical sound is converted into electronic signal. The electronic signal is converted into digital data using the Analog-To-Digital

converter. The converted digital data can be used to input in the model to get an output. There are various models like HMM, and other deep learning neural networks which are used to convert the input into a sequence of text input. Moreover, python provides a speech recognition library which has a variety of functions to use that will be beneficial for the system.

Text-To-Speech:

Text-To-Speech mode is used for encouraging the user interaction as well. The basic model will have referenced audio input which will be mapped to the output string.

The output of the generated response from the chatbot is encoded and the speech is generated via referenced audio input which is converted into embeddings vector so the embeddings are mapped with text and created desired outcome which is later decoded. There are various models to use as well as there are libraries which help to utilize each function and produce the speech in desired voice.

VI. SYSTEM ARCHITECTURE

The proposed system consists of 6 main parts.

1. User
2. Admin
3. Chatbot System
4. Hologram System
5. Speech Synthesizer
6. STT System

The Figure 6 proposes the actual system architecture and its components which are discussed above.

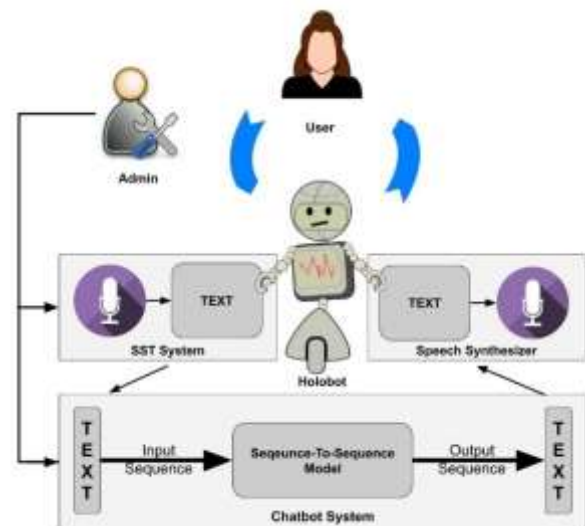


Figure 6 System Architecture

The user will start the conversation with the Hologram. The STT system will take the user’s speech as input and will convert the speech into text format. After that the input will be fed into the Chatbot system - The Seq2Seq model, which will produce the response for the user. The output will be converted into Speech using Speech Synthesizer and speech would be mapped with hologram and the response will be given to the user with visual and audio.

The Holobot can initiate the conversation as well. The camera helps to detect the User, which will help the Bot to initiate a talk with its owner.

A user can change the look and feel of the Hologram. The admin maintains the corpus and the Chatbot system as well as the Hologram projection system.

The analysis of the total chat will be done by user feedback. The conversation will be fed into the chatbot to learn if its feedback is proper. Thus, the chatbot system would go through the Unsupervised learning to improve its ability to respond. [16].

VII. ADVANTAGES

1. If the stress is cured or handled on early stages it won't affect a person too much to make one go into depression, by early cure with natural remedy- which is having conversation with a friend will help a person to lower the stress and give one some relief
2. The system created a friendly environment to make users feel more comfortable.
3. The visual impression provided by Hologram enhances conversation between User and Holobot.
4. The proposed system provides a stress-free environment to users where one can remove stress by talking to the Holobot.
5. Crony- The Holobot can talk like a normal person which makes the user feel less artificial.
6. By remembering the chat and computing the emotions of the user the bot suggests some music or some videos for the user to watch and get relaxed.
7. It monitors over the user's emotions so it can give better suggestions when asked. The bot will also provide a user a story-type conversation if the user asks, to make the user feel motivated or relaxed according to his/her mood.
8. Speech-To-Text and Text-To-Speech provides an effective way to have conversation where typing is not required, by speaking the bot can understand and respond accordingly.

VIII. LIMITATIONS

1. The Holobot could not make a person to have conversation out of his will as it is both way communication.
2. The Holobot device is not compact enough to move around which creates portability issues.
3. The impression created by the Hologram projection is natural to some extent only.

4. The conversation is natural to some extent only as it can become less affectionate and boring if the bot does not understand properly.
5. Suggestion to get relaxed by Holobot can be wrong due to lack of freely conversation from user side and/or lack of judgement from bot side.

IX. FUTURE WORK

1. Hologram devices can be compacted for easy portability.
2. The impression could be enhanced to give a more natural view to the user.
3. Emotion through facial expression can be improved to visualize while the user is not in the mood of having conversation.
4. Home automation features can be given as it will create a familiar impact over the owner.
5. Different videos and audios can be gathered as per users' feedback and added later on. • Merging with any Doctor or Psychiatrist community, the chatbot can be modified even to treat patients and their modification will help chatbot to provide a more casual and friendly environment.
6. Another more powerful RNN- Recurrent Neural Network, LSTM model can be created to replace the DNN chatbot model for better performance in future using the chat history as input to develop more casual and user friendly chatbot.

X. CONCLUSION

The application and the system proposed, achieves the goal of intensifying the chatbot experience with the help of hologram. Crony- The Holobot will help the people having stressful days or an introverted person to handle their stress and relax their mind by having a friendly chatbot environment of chatbot. The holographic feature of this bot will also provide the user to choose their own favourite character which altogether provides the user an affectionate sense of feeling. By providing the user a companionable conversation the proposed system can achieve its motto to overcome the user's issues regarding stress and loneliness.

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