Elderly Assistant Based on Facial Emotion and Posture Analysis

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Abstract- *These paper presents the facial recognition to assists knee joining elderly people for independent living in their own homes. It reduces the health expenditures and burden of health care professionals in care family units. Facial expressions are one of the key features of human being and it can be used to speculate emotional state at a particular moment. This paper employs the Convolution Neural Network and Deep Neural Network to develop a facial recognition model that categorizes a facial expression into some different emotion categorizes Afraid, Angry, Disgusted, Happy, Neutral, Sad and Surprised. This project is mainly developed for Knee joining elderly person the person who are notable to take care of by themselves so we take care of them based on their facial emotion what actually they need sad also we have some senor called accelerometer to detect the fall detection of person based on the accelerometer movements.*

keywords— *Python, Open cv, Renesas microcontroller, accelerometer, Buzzer, GSM and camera.*

I. INTRODUCTION

Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design methods adopted and the system is mainly composed of a single microcontroller.

Facial emotions play an important role in communication among humans and help us to understand the intentions of others and how they feel. Humans have a strong tendency to express emotions. They play an essential role in our daily lives. Human spend great amount of time in understanding the emotions of others, decoding what these signals mean and then determine how to respond and deal with them. Facial Emotion Recognition is getting into our lifestyle and impacting us more rapidly than we have predicted a few years back. Apple released a new feature on iPhone X called Animoji where the user can get a computer simulated emoji to mimic facial expressions. It is now hard for us to ignore the potential capabilities of such features. Facial Emotion Recognition has a wide range of applications. It can be applied in smart cars where it can detect the emotions of the driver and alerts him if he feels sleepy or drowsy.

Facial Emotion Recognition (FER) can be helpful in detecting whether the experience of the gamer was enjoyable by analysing his facial expressions. It can be employed in emotion detection of old age people in old age homes and to monitor the level of stress and anxiety in day to day life. It can help people recognize the expressions of people suffering from autism or speech-impaired people. Moreover, investigation agencies can apply Facial Emotion Recognition (FER) to predetermine their actions before they are carrying out interrogation. This paper proposes a new architecture in the convolutional neural network framework and compares it with different architecture on parameters like the training accuracy of the network, testing accuracy of the model, training loss, testing or validation loss etc. Emergencies, by definition, are unpredictable and rapid response is a key requirement in emergency management. Globally, a significant number of deaths occur each year, caused by excessive delays in rescue activities.

II. Literature survey

Modified Convolutional Neural Network Architecture Analysis for Facial Emotion Recognition [1]**.** Facial expressions are one of the key features of a human being and it can be used to speculate the emotional state at a particular moment. This paper employs the Convolutional Neural Network and Deep Neural Network to develop a facial emotion recognition model that categorizes a facial expression into seven different emotions categorized as Afraid, Angry, Disgusted, Happy, Neutral, Sad and Surprised. This paper compares the performance of two existing deep neural network architectures with our proposed architecture, namely the Venturi Architecture in terms of training accuracy, training loss, testing accuracy and testing loss. This paper uses the Karolinska Directed Emotional Faces dataset which is a set of 4900 pictures of human facial expressions. Two layers of feature maps were used to convolute the features from the images, and then it was passed on to the deep neural network with up to 6 hidden layers. The proposed Venturi architecture shows significant accuracy improvement compared to the modified triangular architecture and the rectangular.

Fast Facial emotion recognition Using Convolutional Neural Networks and Gabor Filters [2]. The emotions evolved in human face have a great influence on decisions and arguments about various subjects. In psychological theory, emotional states of a person can be classified into six main categories: surprise, fear, disgust, anger, happiness and sadness. Automatic extraction of these emotions from the face images can help in human computer interaction as well as many other applications. Machine learning algorithms and especially deep neural network can learn complex features and classify the extracted patterns. In this paper, a deep learning-based framework is proposed for human emotion recognition. The proposed framework uses the Gabor filters for feature extraction and then a Convolutional Neural Network (CNN) for classification. The experimental results show that the proposed methodology increases both of the speed training process of CNN and the recognition accuracy.

Facial Emotion Recognition using Deep Convolutional Networks [3]. The emotions evolved in human face have a great influence on decisions and arguments about various subjects. In psychological theory, emotional states of a person can be classified into six main categories: surprise, fear, disgust, anger, happiness and sadness. Automatic extraction of these emotions from the face images can help in human computer interaction as well as many other applications.

A Joint Deep Neural Network Model for Pain Recognition from Face [4]: Pain is a primary symptom of diseases and an indicator of a patients' health status. Effective management of pain is important for patient treatment and well-being. There are some traditional self-reported methods for pain assessment, and automatic pain detection systems using facial expressions are developing rapidly; these offer the potential for more efficient, convenient and cost-effective pain management. In a joint deep neural network model is proposed to classify pain intensity in four categories from facial images.

The Movement Model of the Knee Joint during Human Walking.[5]: Targeting at the healthy young men, the method of experiment is applied in researching the knee mathematical model of sports features during walking. On the base of the experimental data, the knee movement is described in the graph. Using the regression analysis method of expanded the Gaussian functions and the sine function section combining, a mathematical model is derived. The correlation analysis results by the change of speed and height do not affect the amplitude of knee joint motion significantly, while the height is not related to amplitude, and walking speed is positively correlated with the amplitude trends.

A sitting posture recognition system based on 3 axis accelerometers [6]**.** According to a recent study poor sitting posture of the spine has been shown to lead to a variety of spinal disorders. For this reason, it is important to measure the sitting posture. In this study, we proposed a system that sitting posture classify using 3-axis accelerometer. We retrieved acceleration data from single tri-axial accelerometer attached on the back of the subject's neck in 5-types of sitting posture. 6 subjects without any spinal disorder were participated in this experiment. Acceleration data were transformed to the feature vectors of principle component analysis.

Mobile Application for Ergonomic Analysis of the Sitting Posture of the Torso **[7].** In order to present a dynamic tool for posture correction, in order to provide immediate feedback in inappropriate positions during the sitting position for the prevention of occupational diseases, an application was developed for mobile devices with Android operating system. This application is in the capacity to perform the ergonomic analysis of the posture of the trunk by means of the data provided by two IMU sensors,
located in the area of the cervical and the greater trochanter by means of the designed prototypes.

Learning Multiscale Active Facial Patches for Expression Analysis [8]**.** we present a new idea to analyse facial expression by exploring some common and specific information among different expressions. Inspired by the observation that only a few facial parts are active in expression disclosure (e.g., around mouth, eye), we try to discover the common and specific patches which are important to discriminate all the expressions and only a particular expression, respectively. A two-stage multitask sparse learning (MTSL) framework is proposed to efficiently locate those discriminative patches. In the first stage MTSL, expression recognition tasks are combined to located common patches. Each of the tasks aims to find dominant patches for each expression. Secondly, two related tasks, facial expression recognition and face verification tasks, are coupled to learn specific facial patches for individual expression. The two- stage patch learning is performed on patches sampled by multiscale strategy. Extensive experiments validate the existence and significance of common and specific patches. Utilizing these learned patches, we achieve superior performances on expression recognition compared to the state-of-the-arts.

Automatic Facial Expression Recognition Using Features of Salient Facial Patches [9]. Extraction of discriminative features from salient facial patches plays a vital role in effective facial expression recognition. The accurate detection of facial landmarks improves the localization of the salient patches on face images. This paper proposes a novel framework for expression recognition by using appearance features of selected facial patches. A few prominent facial patches, depending on the position of facial landmarks, are extracted which are active during emotion elicitation. These active patches are further processed to obtain the salient patches which contain discriminative features for classification of each pair of expressions, thereby selecting different facial patches as salient for different pair of expression classes. One-against-one classification method is adopted using these features. In addition, an automated learning-free facial landmark detection technique has been proposed, which achieves similar performances as that of other state-of-art landmark detection methods, yet requires significantly less execution time. The proposed method is found to perform well consistently in different resolutions, hence, providing asolution for expression recognition in low resolution images. Experiments on CK+ and JAFFE facial expression databases show the effectiveness of the proposed system.

Real Time Emotion Recognition from Facial Expressions Using CNN Architecture [10]. Emotion is an important topic in different fields such as biomedical engineering, psychology, neuroscience and health. Emotion recognition could be useful for diagnosis of brain and psychological disorders. In recent years, deep learning has progressed much in the field of image classification. In this study, we proposed a Convolutional Neural Network (CNN) based LeNet architecture for facial expression recognition. First of all, we merged 3 datasets (JAFFE, KDEF and our custom dataset). Then we trained our LeNet

architecture for emotion states classification. In this study, we achieved accuracy of 96.43% and validation accuracy of 91.81% for classification of 7 different emotions through facial expressions.

Facial Expression Recognition from Image Sequence based on LBP and Taylor Expansion [11]**.** The aim of automatic video-based facial expression recognition system is to detect and classify human facial expressions from image sequence. An integrated automatic system often involves two components: i) peak expression frame detection and ii) expression feature extraction. In comparison with the image-based expression recognition system, the video-based recognition system often performs online detection which prefers low-dimensional feature representation for cost-effectiveness. Moreover, effective feature extraction is needed for classification. Many recent recognition systems often incorporate rich additional subjective information and thus become less efficient for real-time application. In our facial expression recognition system, first, we propose the double local binary pattern (DLBP) to detect the peak expression frame from the video. The proposed DLBP method has a much lower-dimensional size and can successfully reduce detection time. Besides, to handle the illumination variations in LBP, Logarithm-Laplace (LL) domain is further proposed to get a more robust facial feature for detection. Finally, the Taylor expansion theorem is employed in our system for the first time to extract facial expression feature. We propose the Taylor Feature Pattern (TFP) based on the LBP and Taylor expansion to obtain an effective facial feature from the Taylor Feature Map. Experimental results on the JAFFE and Cohn-Kanade (CK) datasets show that the proposed TFP method outperforms some state-of-the-art LBP-based feature extraction methods for facial expression feature extraction and can be suited for real-time applications.

Development of real-time knee joint angle measurement technology for posture analysis monitoring [12]. The purpose of this study is to propose a system that can distinguish, analyze, and monitor dynamic and static postures in real time by measuring the knee joint angles of elderly and persons with disability whose capacity to perform lower limb movements in their daily life has been weakened. The proposed posture analysis monitoring system measures the knee joint angle using the wearable module's inertial measurement unit and potentiometer, and then transmits the data to a smartphone through Bluetooth communication. The smartphone application with dynamic and static posture classification algorithm can be used to monitor the user's posture in real time and for future analysis by storing data.

Deep learning-based facial expression recognition for monitoring neurological disorders [13]. Facial expressions play an important role in communication. Impaired facial expression is a common sign of numerous medical conditions, particularly neurological disorders. Accurate automated systems are needed to recognize facial expressions and to reveal valuable information that can be used for diagnosis and monitoring of neurological disorders. This paper presents a novel deep learning approach for automatic facial expression recognition. The proposed architecture first segments the facial components known to be important for facial expression recognition and forms an iconized image; then performs facial expression classification using the obtained iconized facial components image combined with the raw facial images. This approach integrates local part-based features with holistic facial information for robust facial expression recognition. Preliminary experimental results using the proposed system achieved 93.43% facial expression recognition accuracy, more than 6% accuracy improvement compared to facial expression recognition from raw input images. The goal of the proposed study is design of a non- invasive, objective, and quantitative facial expression recognition system to assist diagnosis and monitoring of neurological disorders affecting facial expressions.

A Facial-Expression Monitoring System for Improved Healthcare in Smart Cities [14**]**.Human facial expressions change with different states of health; therefore, a facial-expression recognition system can be beneficial to a healthcare framework. In this paper, a facial-expression recognition system is proposed to improve the service of the healthcare in a smart city. The proposed system applies a bandlet transform

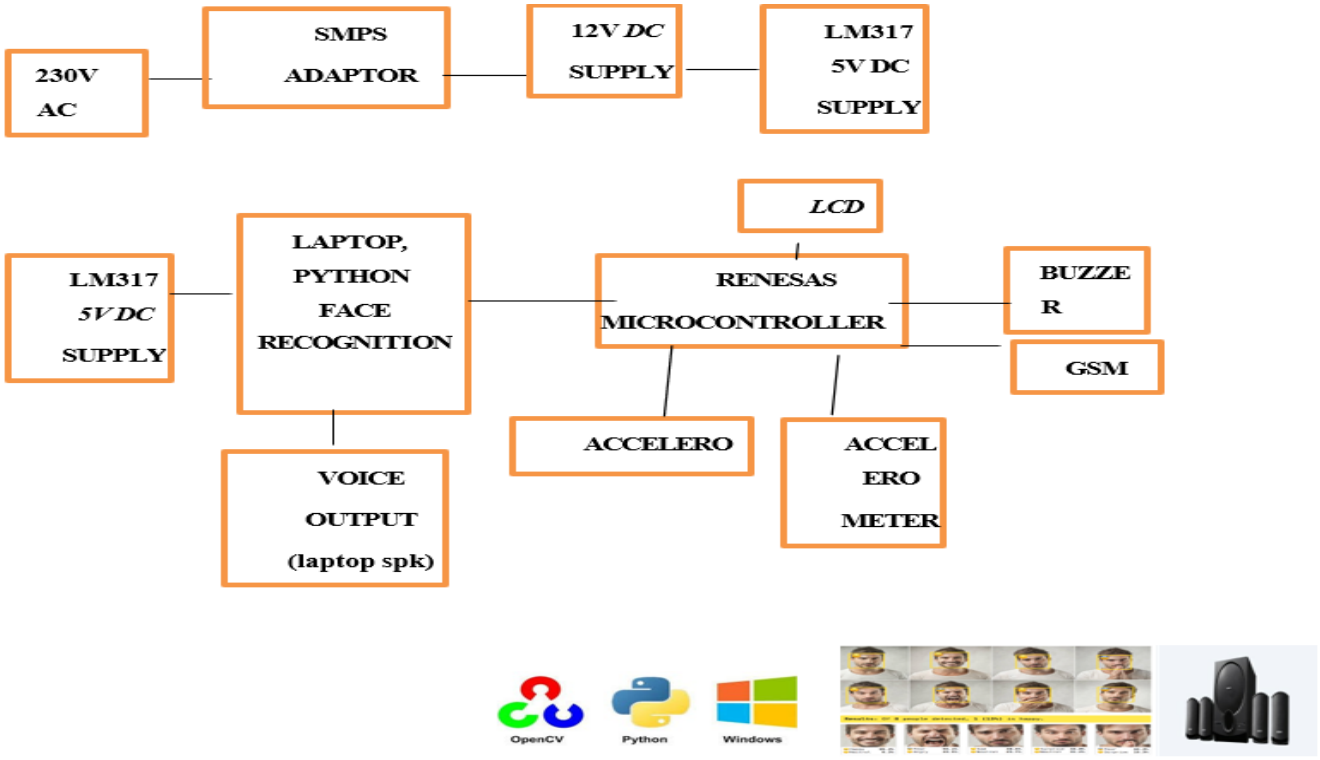
to a face image to extract sub-bands. Then, a weighted, center-symmetric local binary pattern (CS-LBP) is applied to each sub-band block-by-block. The CS-LBP histograms of the blocks are concatenated to produce a feature vector of the face image. An optional feature-selection technique selects the most dominant features, which are then fed into two classifiers: a Gaussian mixture model (GMM) and a support vector machine (SVM). The scores of these classifiers are fused by weight to produce a confidence score (CS), which is used to make decisions about the facial expression's type. Several experiments are performed using a large set of data to validate the proposed system. Experimental results show that the proposed system can recognize facial expressions with 99.95% accuracy.

Facial Expression Analysis for Distress Detection [15**].** Emotions are an incredibly important aspect of human life and basic research on emotions of the past few decades has produced several discoveries that have led to important real-world applications. Facial expressions project our true emotions to others and add the real intent to the words we say. The interpretation of such facial expressions exhibited by the subject in response to a situation is really useful for many applications in fields of medicine, E-learning, entertainment, monitoring, marketing, law and many more. This project focuses on determining the distress level of a person by analyzing his facial expressions. The reaction of a person to a particular communication scenario is recorded using a video or still camera under predefined lighting conditions and this input is taken and processed further to detect his emotion. The face and facial landmarks detection are done using Viola Jones algorithm. Facial patches active during an emotion elicitation are then extracted for texture analysis. The feature extraction method used here is Gray Level Difference Method (GLDM) in which texture features are derived from the GLDM probability density functions. The next step, classification is done using Naïve Bayes Classifier. With reference to the trained information, the emotion of the person is recognized and is used for determining his distress level. The proposed system is tested using Extended Cohn Kanade(CK+) and Japanese female facial expression (JAFFE) dataset.

III. Objective

The objective is to solve the knee joining for Elderly Assistant based on Face Emotion and Posture Analysis.R5F100LEA microcontroller from Renesas RL78 series which is a16-bit microcontroller is used to implement this project. Microcontroller acts as the hear to f this project, which controls the whole system. It contains of Flash ROM 64KB, RAM 4KB and Data Flash 4KB, and it has High speed on chip oscillator, self-reprogrammable under software control, 58GPIO's, 3 UART's, Simplified I2C, 10-bit resolution ADC, 28 Interrupt Sources, ISP programming support etc

The Renesas microcontroller is the heart to f the project it is programmed such that it keeps on commanding and controlling the complete action through peripherals connected. Facial expressions are one of the key features of a human being and it can be used to speculate the emotional state at a particular moment. The Convolutional Neural Network and Deep Neural Network to develop a facial emotion recognition model that categorizes a facial expression into some different emotions categorized as Afraid, Angry, Disgusted, Happy, Neutral, Sad and Surprised. This project is mainly developed for elderly person the people who are not able to take care of by themselves so that we can take care of them based on their facial expression what actually they need sandals owe have used some senor called accelerometer to fall detection of person based on the accelerometer movements. Gsm is used to sending a message to care taker. Here the object detection will exist by using image processing and uses the SIFT algorithms.



An objective model of loneliness would allow for more precise inferences regarding the impact of loneliness on health while enhancing our understanding of loneliness in older adults. Recently, ambient in-home sensors have been used to continuously and unobtrusively mon it or individuals in their own homes. These systems may be designed to help seniors remain independent and healthy as long as possible by capturing meaning full behavioral measures which relate to health outcomes of interest. The nature and type of sensors used in such platform scan vary widely. For example, several research groups have proposed video cameras and body worn tags as viable options in-home monitoring. Video cameras installed in key are a soft he home enables assessment of various gait parameters, may be used to detect falls, and allow the identification of different individuals moving through the home. However, among older adults this technology poses challenges to long term tracking as seniors for get to wear sensors or take them off when they become uncomfortable. In contrast, inexpensive wireless movement detectors and contact sensor scan detect a subject's activities in the home on a daily basis without being overly intrusive or requiring participants to remember to wear or charge devices.

Proposed System

It reduces the health expenditures and burden of health care professionals since their medical aspect, like, timely consumption of medicine as peris set as a reminder. Also since aged person are prone to small accidents, few sensors are embedded in the system as precautionary units. So this module assists the elderly person to complete their daily life activities. It facilitates the care giver assistant by tracking the surrounding environmental conditions around elderly persons in their own homes and also alerting their relatives away from them in case of an emergency

IV Methodology

Initially whole block diagram and logical connections of the project is analyzed. Required hardware and software are collected. Each hardware is tested manually and conditions that need to be met during interfacing are noted down. Every hardware is interfaced with controller and tested Overall logic of the project built and tested Project is tested for good number of times to meet its needed accuracy.

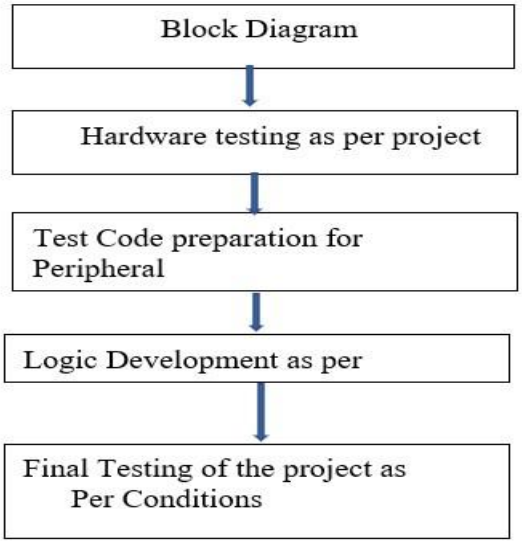


Figure 2. Arrangement of for elderly people

NUMPY

NumPy is an open source library available in Python that aids in mathematical, scientific, engineering, and data science programming. It works perfectly well for multi-dimensional arrays and matrices multiplication. NumPy is a programming language that deals with multi-dimensional arrays and matrices. On top of the arrays and matrices, NumPy supports a large number of mathematical operations.

Why use NumPy?

NumPy is memory efficiency, meaning it can handle the vast amount of data more accessible than any other library. Besides, NumPy is very convenient to work with, especially for matrix multiplication and reshaping. On top of that, NumPy is fast. In fact, Tensor Flow and Sci kit learn to use NumPy array to compute the matrix multiplication in the backend.

OPENCV

Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

SIFT

They are rotation- invariant, which means, even if the image is rotated, we can find the same corners. It is obvious because corners remain corners in rotated image also. But what about scaling? A corner may not be a corner if the image is scaled. For example, check a simple image below. A corner in a small image with in a small window is flat when it is zoomed in the same window

Future Scope

There is always chance to improve any system as research & development is an endless process. Our system is no exception to this phenomenon. The following development scan be done for this project. For project demo concern, we have developed a proto type module. In future, this project can be taken to the product level. To make this project as user friendly and durable, we need to make it compact and cost effective. Going further, most of the units can be embedded along with the controller on a single board with change in technology, thereby reducing the size of the system.

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