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The Smart Medical Mirror System

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ABSTRACT –

Due to Their hectic schedules, people frequently undervalue the significance of their health. The medical Mirror is a suggestion made to help people monitor their health and get over the challenge of going to the hospital on a frequent basis. The Medical Mirror is a cutting-edge interactive interface that continuously measures and shows a users blood pressure, sugar levels, height, weight, body temperature, and heart rate. It's a strategy to empower regular people to take an active role in managing their health by giving them access to and control over their own physiological data. Nevertheless, users of the physiological data monitoring methods currently in use must strap on heavy sensors, chest straps, or adhesive electrodes. Regular use is discouraged by this since the sensor can be monitored

Keywords – Raspberry pi unit, Rectifiers, Relays, Voltage regulators, Sensors, Transformers, Webcam Module, Load Cell, Signal Processing.

INTRODUCTION :

Regular and non-invasive evaluations of cardiovascular function play a crucial role in monitoring cardiovascular emergencies and managing chronic diseases. Among the various cardiovascular parameters, resting heart rate has been identified as an independent risk factor for cardiovascular disease, comparable to smoking, dyslipidemia, or hypertension. However, the current gold standard techniques for measuring the cardiac pulse, such as electrocardiograms (ECGs), require patients to wear adhesive gel patches or chest straps, which can lead to skin irritation and discomfort. Similarly, commercial pulse oximetry sensors that attach to the fingertips or earlobes are inconvenient for patients and can cause pain if worn for extended periods of time.

The Medical Mirror enables non-contact measurements of physiological data through a simple imaging tool. As the user gazes into the mirror, an image sensor identifies and monitors the movements of their face.

The mirror displays the user's heart rate, providing a visual representation of both their physical appearance and physiological state. The advancement of digital medical devices holds great potential in revolutionizing the field of medicine, as they can generate highly detailed individual physiological data. As everyday individuals gain access and control over their own physiological data, they can actively participate in managing their health. This transformation should occur not only in medical facilities or research labs but also in our daily lives. By simply looking into the Medical Mirror, users can experience remote health monitoring. A study has reported the use of non- contact, automated cardiac pulse measurements using video imaging and blind source separation, presenting a new approach for accurately measuring heart rate from video images.

The Medical Mirror introduces an innovative interactive platform that monitors and showcases a user's heart rate instantly, eliminating the necessity for external sensors. Unlike traditional methods of physiological monitoring that involve wearing cumbersome sensors, chest straps, or adhesive electrodes, this new mirror interface allows for contact-free, real-time heart rate measurements. By gazing into the Medical Mirror, users can effortlessly engage in remote health monitoring.

The potential to remotely monitor a patient's physiological signals without physical contact is an exciting possibility that could improve the provision of primary healthcare. For instance, the concept of conducting physiological measurements on the face was initially proposed by Pavlidis and his colleagues, and later validated through the examination of facial thermal videos. While non-contact techniques may not offer the same level of detail on cardiac electrical conduction as an ECG, they can now facilitate the continuous monitoring of other physiological signals like heart rate or respiratory rate in a discreet and comfortable manner. Furthermore, this technology could reduce the need for extensive wiring and clutter in settings such as neonatal ICUs, long-term epilepsy monitoring, burn or trauma patient care, sleep studies, and other scenarios where continuous heart-rate monitoring is crucial.

Medical Mirror is an innovative interactive platform that monitors and presents the user's heart rate in real-time, eliminating the necessity for external sensors. At present, the gathering of physiological data necessitates the use of cumbersome sensors, chest straps, or adhesive electrodes.

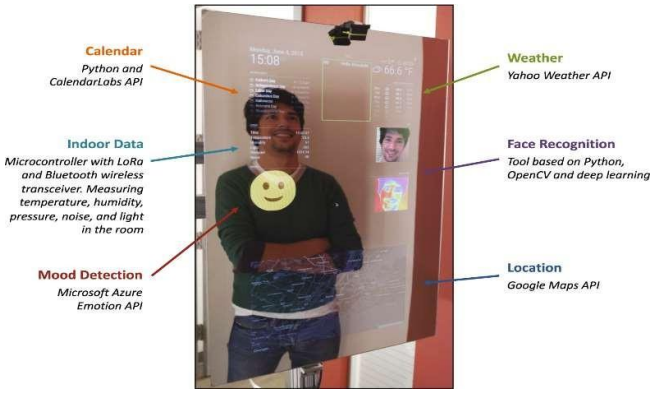

Fig. 1: Smart mirror for personalized medicine.

LITERATURE SURVEY

The article by M. Z. Mcduff and D.J. Picard, published on 17 Jan 2024, delves into the advancements in the medical field, particularly focusing on the smart medical mirror for measuring pulse and body temperature. This innovative approach offers valuable insights into the latest techniques and technologies used in automated cardiac pulse measurements. To explore further on this topic, one can search academic databases like PubMed, IEEE Xplore, or Google Scholar using relevant keywords such as "automated cardiac pulse measurement" and "smart medical mirror." It is advisable to look for papers published in reputable journals or presented at conferences related to medical imaging, biomedical engineering, or healthcare technology. Analyze the methodologies, technologies, and effectiveness of the automated pulse measurement systems discussed in these papers. Moreover, take into consideration the limitations and future directions proposed by the authors.

The Medical Mirror System Methodology was detailed by Bhagyashree J. Bhoyar and Smita R. Londhe in their publication on 25 Jan 2024. The study delves into the functionalities of the smart medical mirror, highlighting its ability to display temperature and heart rate data. The paper aims to explore various aspects of medical mirror systems, including applications, technologies, benefits, and limitations. It also suggests compiling a list of keywords related to medical mirror systems and recommends utilizing academic databases like PubMed, IEEE Xplore, ScienceDirect, and Google Scholar for further research.

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III.METHODOLOGY

The maintenance of health and fitness helps a person to be in the general state of health and well-being. It provides ability to perform physical actions without being tired or restless. However, the maintenance of health and fitness requires regular physical exercise with balanced diet. Due to the busy schedule these days, people tend to ignore their health and diet which results in health issues such as increase or decrease in blood glucose level, blood pressure and weight. To overcome this ignorance and difficulties of making regular visits to the hospital we are designing a mirror which fits seamlessly into the home environment to monitor their health easily.

The primary goal of Medical Mirror is to develop a device that can accurately measure key body parameters including Height, Weight, Pulse-rate, Body Temperature, Blood Glucose Level, and Blood Pressure.

Creating a user-friendly device with a simple interface to display the measured parameters directly on the mirror

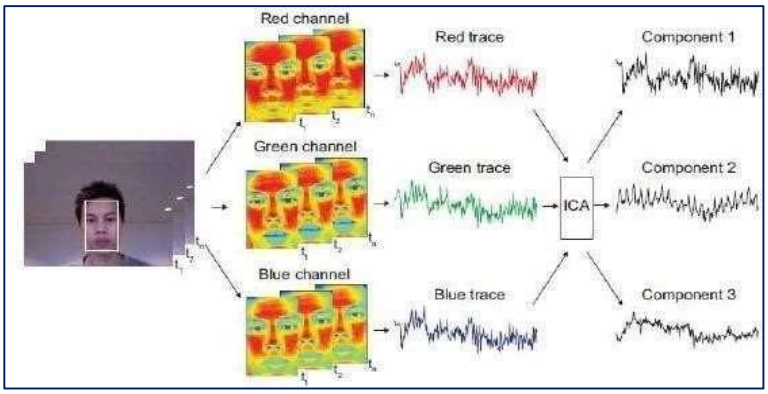
the mirror for activities like shaving or brushing teeth. This user-friendly interface aims to provide a convenient method for individuals to effortlessly monitor their daily health.

The LCD screen covers half of the back of the mirror glass, while the other half is silvered to give the appearance of a mirror to the user facing the front. Input provided to the LCD is displayed through the glass, allowing the user to see the information on the front side.

PULSE RATE MONITORING SYSTEM

Our medical mirror utilizes a unique algorithm with PiCamera to detect pulse rate. Through a combination of computer vision and advanced signal processing, the heart rate of an individual can be calculated with an error margin of less than three beats per minute. The process of measuring a user's heart rate involves an automated face tracker identifying the largest face in the video feed, localizing the region of interest (ROI) for each frame, separating the ROI into RGB channels, and spatially averaging the pixels to obtain red, blue, and green measurement points.

Fig.2: Pulse rate measurement



HEIGHT MEASUREMENT

In order to determine a person's height, an ultrasonic distance sensor is installed on the ceiling directly below where the individual is positioned (facing a mirror). The sensor calculates the distance between the user's head and the ceiling. This measurement is then subtracted from a predetermined distance between the ceiling and the floor (processed by the system), resulting in the user's height. Additionally, a weight measuring sensor is positioned under the spot where the person is standing to provide their weight.

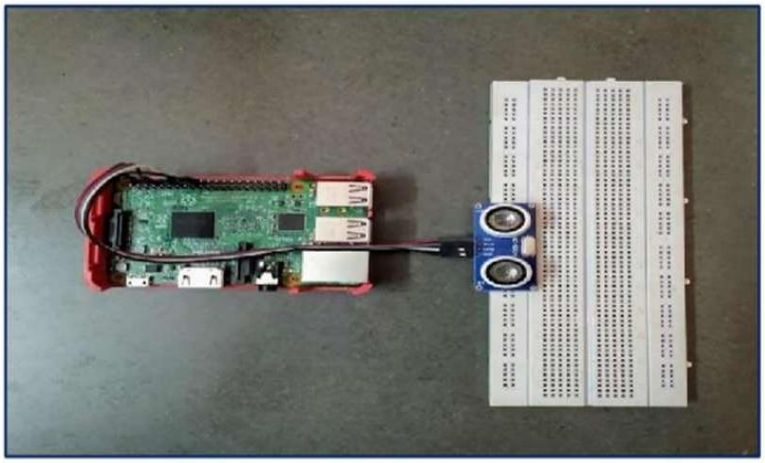


Fig .3: Height Measurement

. • Developing a mobile application that allows users to store and access their health reports from each visit easily.

In order to promote the regular monitoring of vital signs, we have developed the Medical Mirror with a natural user interface. To achieve this, we have incorporated an LCD monitor and a webcam, creating an interactive display. The frame of the mirror is equipped with a glass surface that acts as a reflective medium under normal lighting conditions. The monitor and webcam are connected to a processor that runs real-time analysis software, as depicted in Figure 1. By seamlessly blending into the home environment, the Medical Mirror effortlessly integrates the data collection process into our daily routines. For instance, one can easily imagine collecting health data while using

WEIGHT MEASUREMENT

The weight of the human body is determined by employing an ultrasonic sensor. The diagram presented in Figure 7 illustrates the configuration of the weight measuring apparatus, which utilizes load cells and the HX711 IC module. Each load cell has the capacity to measure 50 kilograms, and a total of four load cells are employed, enabling a maximum weight measurement of 200 kilograms. The HX711 IC functions as a load amplifier, amplifying the output current received from the load cell. This entire setup is connected to the raspberry pi, allowing for the acquisition of the output weight

BODY TEMPERATURE MEASUREMENT

The measurement of body temperature is conducted through the utilization of a Humiture Sensor Module. Positioned adjacent to the mirror, the module requires the individual standing in front of it to grasp it for a brief period. Subsequently, the Humiture Sensor Module will identify the temperature and transmit the data to the Raspberry Pi.

IV TECHNOLOGIES

A sophisticated medical mirror system typically integrates a variety of technologies to offer a wide range of functionalities aimed at improving health monitoring and user experience. Below are some common technologies

utilized in such systems:

Display Technology: The mirror itself often includes a display screen, which can be a traditional LCD or more advanced technologies like OLED or micro-LED. This display allows for the presentation of health data, notifications, and other pertinent information.

Sensors: Various sensors are embedded into the mirror to collect health-related data. These may consist of:
Heart Rate Sensors: Measure heart rate variability or detect irregularities.
Temperature Sensors: Monitor body temperature for signs of illness or fever.
Motion Sensors: Detect movement to monitor user activity or gestures for interaction.
Camera: Utilized for facial recognition, gesture detection, or even for monitoring skin conditions.

Microphones and Speakers: Facilitate voice interaction, enabling users to issue commands, receive verbal feedback, or participate in telehealth consultations.
the mirror's screen is crafted to be intuitive and user-friendly. It may incorporate touch controls, voice commands, or gesture recognition for interaction.

Health Monitoring Software: This software processes sensor data to deliver real-time health metrics, such as heart rate, body temperature.

V APPLICATIONS

- It can be used as a domestic tool.
- It can be placed in hospitals, clinics etc.
- It can be used in military camps.

VI ADVANTAGES

- The Medical Mirror fits seamlessly into the ambient home environment.
- Blending the data collection process into the course of our daily routines.
- The interface is intended to provide a convenient means for people to track their daily health with minimal effort.
- It is low cost compared with other methods.
- An advanced approach to user's health monitoring depends upon the state of the art technology

VII FUTURE SCOPE

The Global Smart Mirror market is projected to experience significant growth between 2023 and 2030. Currently, in 2022, the market is steadily growing, and with the implementation of effective strategies by key players, it is expected to continue its upward trajectory. Medical Mirror promotes the regular monitoring of vital signals by individuals. By utilizing computer vision, it captures the optical signal reflected off a person's face. The primary goal is to develop a device that enables people to track their health parameters, including temperature, height, weight, and BMI. The user-friendly Smart medical mirror conveniently displays the measured parameters directly on the mirror itself.

4.Connectivity: Smart mirrors typically establish connections to the internet and other devices through Wi- Fi, Bluetooth, or other wireless protocols. This connectivity allows for data synchronization, software updates, and integration with other smart home devices or healthcare

systems.

Machine Learning and AI: Advanced algorithms analyze the gathered data to offer insights into the user's health status, identify anomalies, or provide personalized recommendations. These algorithms can also enhance over time through machine learning.

User Interface (UI) Software: The interface displayed on

VIII CONCLUSION

The novel technique presented involves the recovery of the cardiac pulse rate through video recordings of the human face using a basic webcam under natural lighting conditions. This method showcases the automated and motion-tolerant nature of non-contact heart rate measurements. Furthermore, it highlights the potential for scalability to assess multiple individuals simultaneously in front of a camera. With the affordability and widespread availability of webcams, this technology shows promise in enhancing access to medical care.

This innovative methodology introduces a new approach to continuous health monitoring leveraging cutting-edge technology. The Medical Mirror seamlessly integrates into the everyday home setting, seamlessly incorporating data collection into daily routines. For instance, health data can be gathered while performing tasks like shaving or brushing teeth in front of the mirror. This user-friendly interface aims to offer a convenient way for individuals to monitor their health status with minimal effort. In the future, the proposed work aims to expand to include non- contact Blood Pressure measurements, similar to the pulse rate calculation method.

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