# CONTACTLESS HUMAN VITAL SIGN MONITORING SYSTEM(CVSMS) USING MILLIMETER WAVE FMCW RADAR FOR HEALTH CARE APPLICATIONS.

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## Abstract

This project focuses on developing a contactless device designed to monitor vital signs such as heart rate, respiratory rate, and temperature using advanced radar technology. The motivation behind this project is to provide a reliable monitoring solution for elderly individuals and heart patients, offering continuous observation without physical contact. This feature is particularly beneficial for use during sleep and in situations involving contagious diseases, where minimizing contact is crucial. The system utilizes a 60 GHz radar to accurately measure heart rate and respiratory rate. This radar technology is capable of detecting subtle movements and changes in the body, making it an effective tool for continuous monitoring. Additionally, a thermal sensor is integrated into the device to measure skin temperature, ensuring a comprehensive assessment of vital signs. An ESP8266 Node MCU is employed to process the data collected from the radar and thermal sensors. The processed data is then transmitted to a display and a mobile application called CVSMS. The app not only displays the vital sign data but also provides graphical representations, allowing users and healthcare providers to easily track changes over time. The device has demonstrated significant accuracy in its measurements, with heart rate data being approximately 85% accurate and respiratory rate data about 90% accurate. This high level of accuracy ensures that the device can be trusted for regular monitoring, providing peace of mind to users and valuable data to healthcare professionals.

## Methodology for Achieving Goal

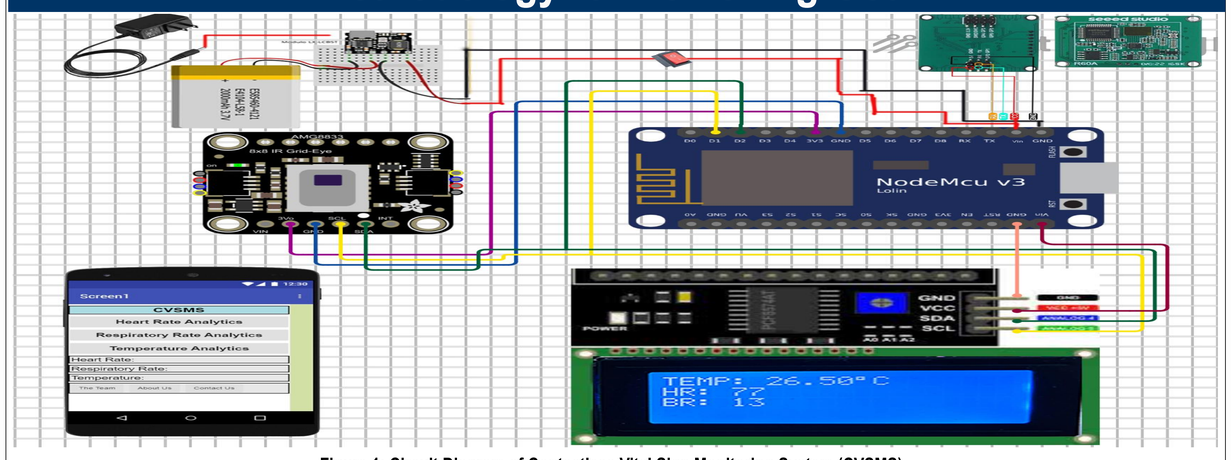



Figure 1: Circuit Diagram of Contactless Vital Sign Monitoring System (CVSMS)

## Working Principle & Flowchart

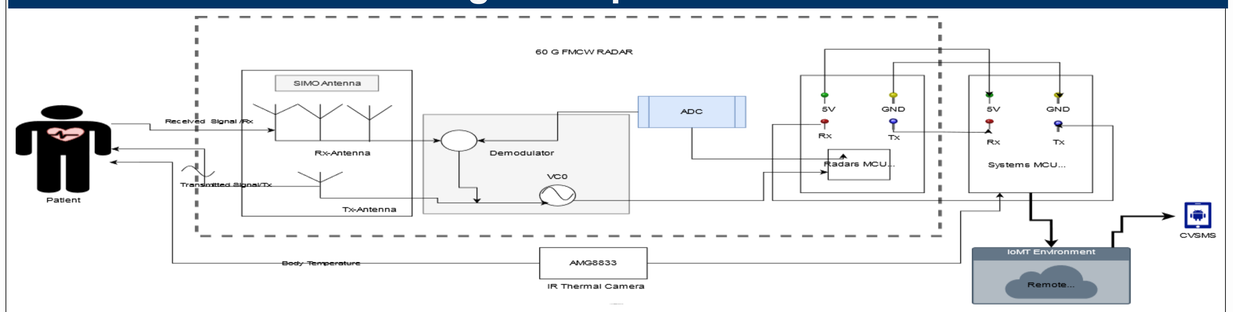



Figure 2: Working Principle of Contactless Vital Sign Monitoring System (CVSMS)

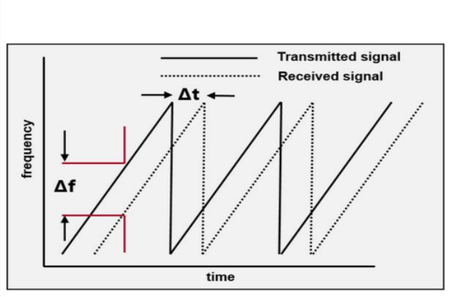
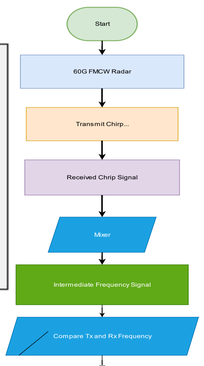



Figure a: Frequency vs Time representation of a chirp



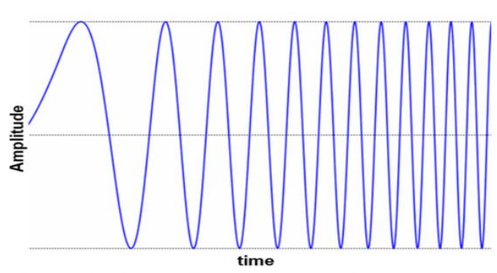




Figure a: Amplitude vs Time representation of a chirp

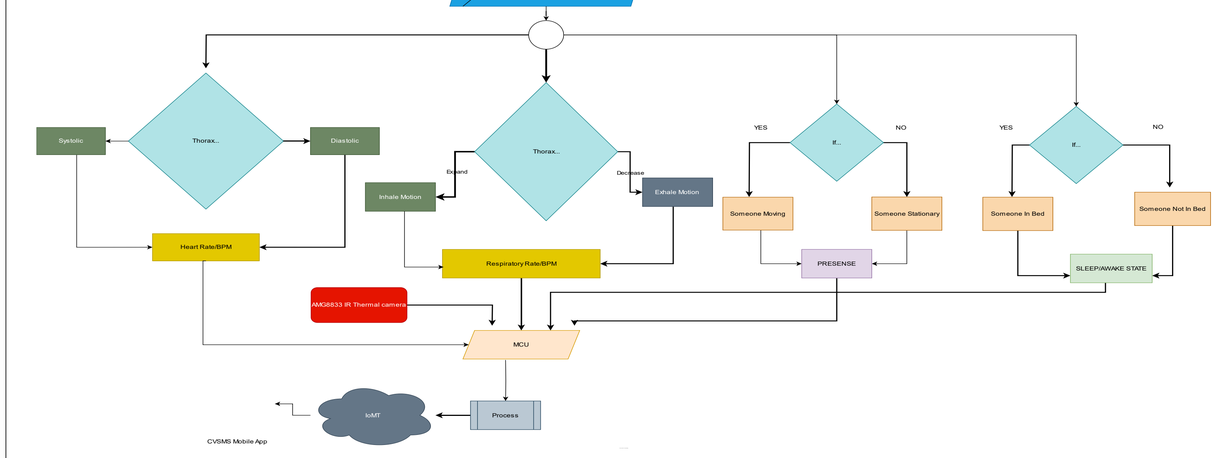
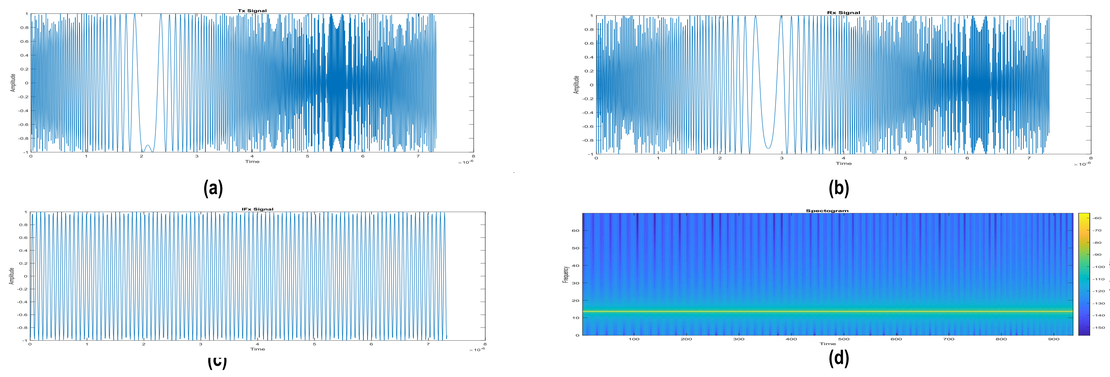



Figure 3: Flowchart of Contactless Vital Sign Monitoring System (CVSMS)

## Simulated Results:( MATLAB)




(a) (b) (c) (d)

Figure 4: (a) Tx Signal of FMCW radar, (b) Rx Signal of FMCW radar (c) IF signal of FMCW radar& (d) Spectogram of FMCW radar.

## Hardware Prototype

Figure 5: 3D Modeling Of the Casing of the Contactless Vital Sign Monitoring System

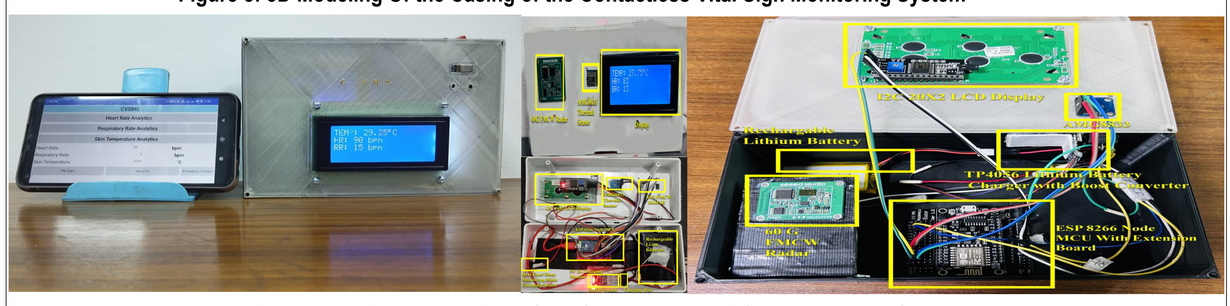
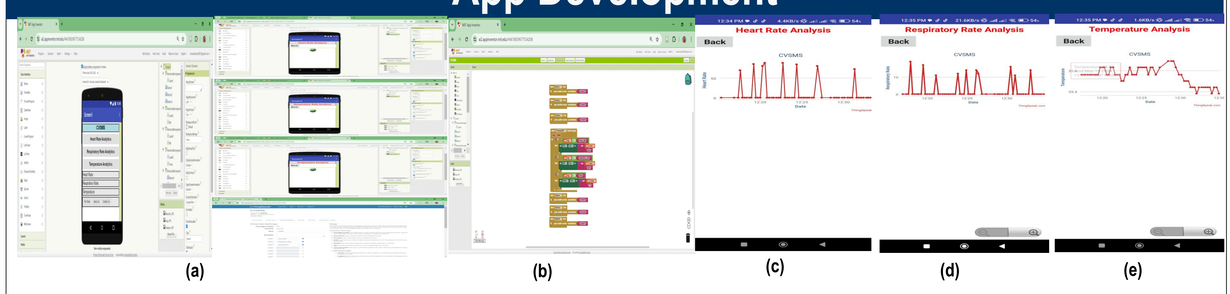



Figure 6: Hardware Implementation of the Contactless Vital Sign Monitoring System


Figure 7: Data Acquisition For Systems Validation

## App Development




(a) (b) (c) (d) (e)

Figure 8: (a) Design of CVSMS Android App, (b) Logic Blocks for the App (c) Real Time Heart Rate (d) Real Time Respiratory Rate (e) Real Time Temperature Rate

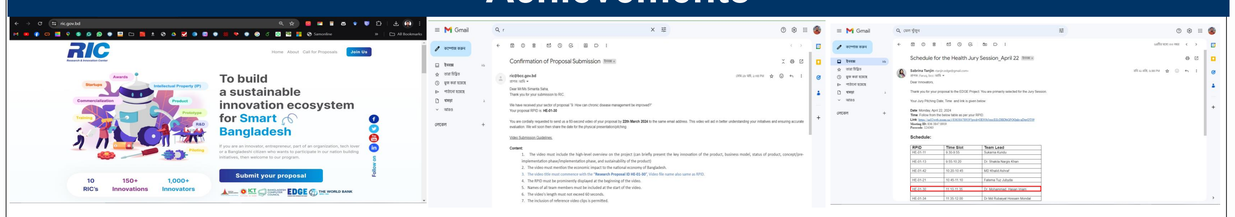
## Results Analysis


Figure 9: Comparison of measured heart rate and respiratory rate data and radar data for young (22 to 25) and middle aged group(40-69)

## Conclusion & Future Work

This developed project is a simple and affordable device that can measure heart rate, breathing rate, and temperature without touching the person. It uses a 60 GHz radar and a thermal sensor. It's designed for elderly people and heart patients to help them monitor their health regularly. In the future, we plan to add features like blood pressure measurement, sleep quality monitoring, more functions on the Android app, emergency alerts, and fall detection. As this project uses SIMO antenna configuration for future purpose MIMO antenna configuration and more higher frequency radar can be implemented.

## Achievements




Participated And Cleared 3rd Phase And Jury Session In RIC Project Submission Under Enhancing Digital Government And Economy (EDGE) Project

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## Key References

[1] F. Adib, H. Mao, Z. Kabelac, D. Katabi, and R. C. Miller, "Smart Homes that Monitor Breathing and Heart Rate," in Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, Seoul Republic of Korea: ACM, Apr. 2015, pp. 837–846. doi: 10.1145/2702123.2702200.

[2] M. Xiang, W. Ren, W. Li, Z. Xue, and X. Jiang, "High-Precision Vital Signs Monitoring Method Using a FMCW Millimeter-Wave Sensor," Sensors, vol. 22, no. 19, p. 7543, Oct. 2022, doi: 10.3390/s22197543.

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*Signature of*
**Supervisor**