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Automatic External Defibrillator

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Abstract: Cardiac arrest is a leading cause of sudden deaths globally, claiming millions of lives each year. According to the World Health Organization (WHO), cardiovascular diseases, including sudden cardiac arrest, account for approximately 17.9 million deaths annually, making up 32% of global deaths. Among these, individuals aged 45 to 64 years are at the highest risk, while younger individuals are also increasingly vulnerable due to changing lifestyles. In India, over 7 lakh cardiac arrest-related deaths occur annually, often due to delayed or lack of timely intervention. Unfortunately, lifesaving devices like Automatic External Defibrillators (AEDs) are widely available in developed countries but remain scarce in India, with access limited to a few premier institutions like AIIMS.

The objective of our project is to address this gap by designing and developing an affordable, portable, and user-friendly Automatic External Defibrillator (AED). This device is engineered to provide real-time monitoring of the patient's electrocardiogram (ECG), displaying their beats per minute (BPM) on a screen and simultaneously assessing the heart rhythm. Based on the assessment, the device will determine whether defibrillation (shock) is needed. It will also provide audio instructions to guide a non-medical person in attending to the patient during an emergency, potentially saving lives before professional medical help arrives.

Keywords: Defibrillator, Shock, Cardiac arrest.

I. INTRODUCTION

An Automatic External Defibrillator (AED) is a compact, portable device designed to deliver an electrical shock to a person experiencing sudden cardiac arrest (SCA). SCA is a medical emergency where the heart stops beating effectively due to irregular electrical activity, such as ventricular fibrillation or ventricular tachycardia. Without immediate intervention, SCA can lead to death within minutes.

AEDs are essential tools in modern emergency response systems, as they significantly increase the likelihood ofsurvival when used promptly and correctly. They are widely deployed inpublic spaces such as airports, schools, offices, sports venues, and community centres, making life-saving technology accessible to trained and untrained individuals alike.One of the unique features of this AED is its ability to guide non-medical individuals. The device is designed to offer clear and concise voice instructions for administering CPR after assessing the patient's BPM and heart rhythm. For shockable rhythms, it will safely administer a defibrillation shock, and for non-shockable rhythms, itwill prompt the responder to perform CPR. This capability ensures that even untrained bystanders can effectively assist during critical situations, improving the chances of survival for patients experiencing sudden cardiac arrest.

Affordability is a cornerstone of our project. Existing AEDs are prohibitively expensive, limiting their accessibility to hospitals and specialized healthcare facilities. Our prototype is cost-effective, allowing households with high-risk individuals to own one for emergency use. Additionally, the device is compact and portable, making it easy for patients to carry it wherever they go, ensuring preparedness during travel or outdoor activities.Furthermore, the potential for public utility is immense. By deploying these devices in high-footfall areas such as railway stations, airports, schools, colleges, offices, and companies, we can significantly reduce response times in emergencies. Immediate availability of AEDs in such locations could transform emergency cardiac care in India, saving countless lives every year.

Our project aims to bridge the gap in emergency cardiac care by developing an innovative AED that is affordable, portable, and equipped with advanced features. By empowering non-medical individuals to act effectively during emergencies, this device has the potential to make lifesaving interventions accessible to all, ultimately reducing preventable deaths from cardiac arrest and contributing to a healthier society.

II. LITERATURE SURVEY

As of 2024, global data on cardiac arrest remains concerning, with estimates indicating that approximately 17.9 million people worldwide experience sudden cardiac arrest (SCA) annually. The vast majority of these cases occur outside of hospitals, where survival rates are low due to delayed interventions.

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In high-income countries, survival rates are slightly better due to better access to CPR training, AEDs, and emergency medical services, with around 10-20% of out-of-hospital cardiac arrest victims surviving to discharge. In contrast, low- and middle-income countries face greater challenges in terms of access to emergency care and preventive healthcare, leading to higher mortality rates.The leading causes of cardiac arrest globally include coronary artery disease, arrhythmias, and other heart-related conditions, with lifestyle factors such as diet, physical inactivity, smoking, and stress being significant contributors. Public health initiatives to improve awareness, CPR training, and the availability of defibrillators are seen as key strategies for reducing the global burden of cardiac arrest.

This gives opportunity to works on solving this problem specially for low- and middle-income countries and it have large scope if we able to make an affordable ,compact , and portable AEDS and commercialise them.

III. METHODOLOGY

An Automated External Defibrillator (AED) is a portable, life-saving device designed to treat people experiencing sudden cardiac arrest (SCA) by delivering an electric shock to the heart. The shock can help restore the heart’s normal rhythm. how it works:

1) Detection: The AED has electrodes (pads) that are placed on the victim’s chest. These electrodes are equipped with sensors that detect the heart’s electrical activity. The AED automatically analyses the heart’s rhythm to determine if there’s a life-threatening arrhythmia (such as ventricular fibrillation or pulseless ventricular tachycardia).
2) Shock Decision: If the AED detects a shockable rhythm, it will instruct the user to stand clear and will charge itself to deliver a shock. The device will often provide clear, audible prompts to guide the user through the process, making it easy to use even for someone without medical training.
3) Shock Delivery: If the device is charged and it's safe to do so, the AED delivers a controlled shock to the heart. This electric shock, called defibrillation, can help reset the heart's electrical system, allowing it to return to a normal rhythm.
4) Post-Shock Monitoring: After delivering the shock, the AED will reanalyse the heart’s rhythm. If necessary, it may advise another shock or guide the user to continue performing CPR until emergency medical professionals arrive.It can be made based on Arduino or raspberry GPU integrated circuits for initial testing purposes. With Arduino you can use ECG sensor(AD8232),SPI display (SPI1306),Electrodes pads, speaker, DF modules.

IV. CONCLUSION

In conclusion, our project aims to bridge the gap in emergency cardiac care by developing an innovative AED that is affordable, portable, and equipped with advanced features. By empowering non-medical individuals to act effectively during emergencies, this device has the potential to make lifesaving interventions accessible to all, ultimately reducing preventable deaths from cardiac arrest and contributing to a healthier society.

PROTOTYPE

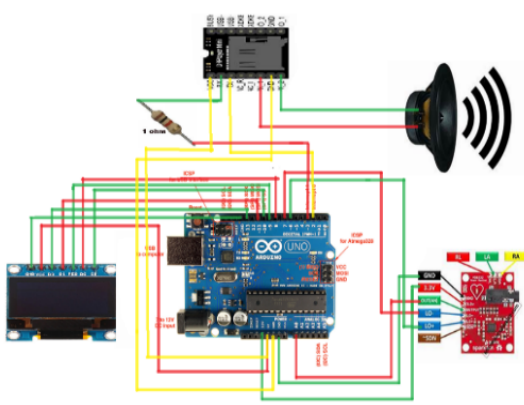

Fig: Circuit Diagram of the Automatic External Defibrillator

1) Firstly, all components connected to Arduino uno in same way mention above.
2) Then ECG sensor electrodes connected to patient, bpm calculated on it.
3) Then it is displayed on SSD display and on the basis of DF module schedules CPR instruction.

4) We get voice instruction to follow up with the help of speaker.
5) There is also a separate manual mechanism of giving shock to patient as per requirement .

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