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IOT Based Virtual Doctor Robot for Non-Contact Treatment of Patients and Remote Medication

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***Abstract*— The Technology has become an integral part of everyday lives. Recent years have witnessed advancement in technology with a wide range of applications in healthcare. However, the use of the Internet of Things (IoT) and robotics are yet to see substantial growth in terms of its acceptability in healthcare applications.[2] The current study has discussed the role of the aforesaid technology in transforming healthcare services. The implementation involves development of autonomous robotic vehicle which can be triggered by the doctor from his cabin itself by giving the bed number. The robotic vehicle autonomously moves to the patient bed to perform medical diagnosis using non-contact temperature sensors and oximeter sensors. The body parameters are sent to the doctor using IOT protocols. The proposed implementation also includes telemedicine system where in the doctor can suggest the medicines using the IOT panel and the robot delivers the suggested medicines to the patients. The proposed implementation also implements live video streaming system which helps the doctor to visualize the patient's conditions wirelessly over internet using the camera mounted on the robot. The robot can further disinfect itself while coming back or going to another patient. Thus, this implementation helps in development of complete solution to treat Patients remotely and autonomously with utmost care and safety and without getting in touch thus keeping the doctors safe.**

***Keywords*— IOT, GPS, AUTONOMOUS, ROBOT**

I. INTRODUCTION

The advancements in modern technology have facilitated researchers and scientists in transforming healthcare services. The leading-edge technologies have been extensively applied in designing and implementing various medical devices that are used for diagnosis, treatment, monitoring, and testing. This has been possible not only due to the development of the clinical- grade sensors but also due to the sensor networks that are implemented in hospitals.[3] Data analytics have shown potential in identifying patterns and hidden features from the health data and helps in improving the quality of healthcare through an efficient decision- making capability. Moreover, artificial intelligence (AI) techniques including machine learning (artificial neural networks, deep learning, etc.) have also augmented the work of healthcare professionals by processing a huge amount of healthcare data that are available in the form of electronic health records. Robotics and automation technologies are already playing a critical role in this crisis, since testing and life supporting equipment are in general automated, but in the past months we have seen the

human creativity emerges in the fight against this pandemic, using robots in applications never seen before, such as helping to protect people by disinfecting risky environments, detecting disease, monitoring social distancing, providing remote care, promoting social interaction of confined patients, supporting remote work, delivering medical supplies to hospitals and goods to persons at home or in hard-to-reach places, etc.

One of the key technologies that has made a huge difference on the ground is robotics. This project proposes the concept of IOT based virtual Robot for remote treatment and medication of the patients. The Robotic vehicle can move autonomously when triggered by the doctor to treat a particular patient by automatically navigation on the hospital floor to his bed. The proposed robotic vehicle can monitor the health status of the patient and update to the doctor using IOT. The telemedicine feature can help doctors to provide medicine to the patients maintaining social distancing and safety using IOT.

1. To make the system economical to be implemented in every tractor.

III. METHODOLOGY

To implement the project in a planned manner and to minimize the errors, following methodology is implemented in this project. The project is carried out in modules step by step which will help minimize the errors at the end. The methodology to carry the project is given below.

1. Literature Review and Material Selection
2. Problem definition
3. Development of autonomous robotic vehicle
4. Fabrication of chassis and drive train
5. The autonomous path following system development
6. Development of medical diagnosis system
7. Development of non-contact temperature measurement system
8. Development if patient oxygen measurement system
9. Implementation of RFID based bed or patient recognition system.
10. Development of IOT based control panel for patient monitoring and robot triggering
11. Development of Live video streaming system
12. Development of Telemedicine system
13. Hardware design

14. PCB development
15. Software development
16. Assembly and testing

The block diagram of the working of the project is as shown below

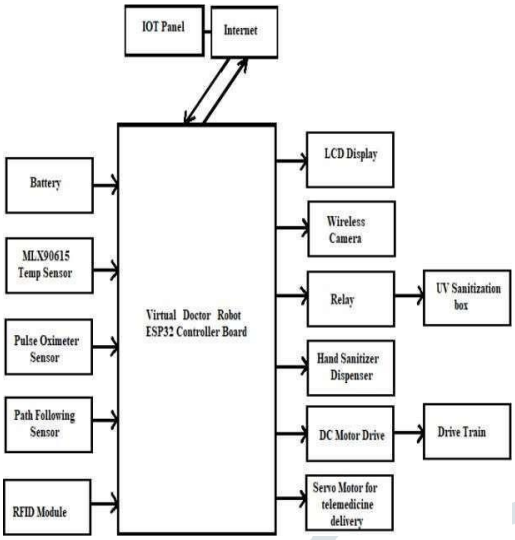


Fig. 1 Block Diagram

The proposed project consists of autonomous robotic vehicle to treat patients using IOT which serves as IOT virtual doctor. The IOT panel is developed which will be handled by the doctors which will be present to diagnose and treat covid19 patients. The doctors can enter the bed number of the patient to diagnose using the IOT panel developed. Once triggered the developed system will autonomously move across the hospital floor and approach the patient's bed. The temperature measure system and the oxygen measurement system will carry our preliminary diagnosis and the same will be informed to the doctor using the IOT panel developed. The doctors can recommend the medicine after diagnosis remotely using telemedicine system which permits the doctors to provide medicines to the patients remotely using the same robotic vehicle over IOT.[5] The System will also send the live video stream of the patient to the doctor which can be visualized over the same control panel which will help in the better treatment of the patients. The Robotic vehicle can disinfect itself after the checkup of the corona patient thereby avoiding spread of infection. The system also includes the Sanitization chamber for sanitizing masks and sanitizer dispenser for sanitizing hands.

IV. HARDWARE IMPLEMENTATION

The hardware development involves schematic and PCB development using Easy EDA software. The hardware is designed using the Easy EDA schematic capture and then the PCB s are fabricated to make the complete working of the project. The printed circuit board (PCB) acts as a linchpin for almost all of today's modern electronics. If device needs to do some sort of computation-such as is the case even with the simple digital clock. Chances are there is the PCB inside of it. PCBs bring electronics to life by routing electrical signals where they need to go to satisfy all of the device's electronic requirements[6].

There are three main types of circuit boards that get manufactured on a consistent basis, and it's important to understand the differences between each so you can decide the right circuit board for your requirements. The three main types of circuit boards in current manufacture are:

- **Single-Sided Circuit Boards:** These boards when made with a FR4 base have rigid laminate of woven glass epoxy material, which is then covered on one side with a copper coating that is applied in varying thicknesses depending on the application
- **Double-Sided Circuit Boards:** Double-sided boards have the same woven glass epoxy base as single-sided boards — however, in the case of a double-sided board, there is copper coating on both sides of the board, also to varying thicknesses depending on the application.
- **Multi-Layer Boards:** These use the same base material as single and double- sided boards, but are made with copper foil instead of copper coating the copper foil is used to make —layers, alternating between base material and copper foil until the number of desired layers is reached.
- **Parts of PCB:**
- Substrate: The first, and most important, is the substrate, usually made of fiberglass.
- Fiberglass is used because it provides core strength to the PCB and helps resist breakage. Think of the substrate as the PCB's —skeleton.
- Copper Layer: Depending on the board type, this layer can either be copper foil or a full- on copper coating. Regardless of which approach is used, the point of the copper is still the same — to carry electrical signals to and from the PCB, much like your nervous system carries signals between your brain and your muscles.
- Solder Mask: The third piece of the PCB is the solder mask, which is a layer of polymer that helps protect the copper so that it doesn't short-circuit from coming into contact with the environment. In this way, the solder mask acts as the PCB's —skin.
- Silk screen: The final part of the circuit board is the silkscreen. The silkscreen is usually on the component side of the board used to show part numbers, logos, symbols switch settings, component reference and test points. The silkscreen can also be known as legend or nomenclature.

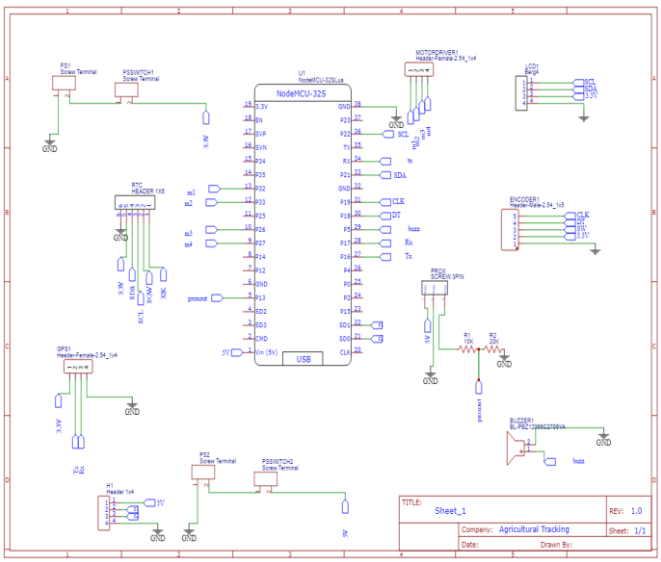


Fig. 2 Schematic

After the schematic was developed the PCB layout was designed and then PCB was taken for fabrication:

The PCB:

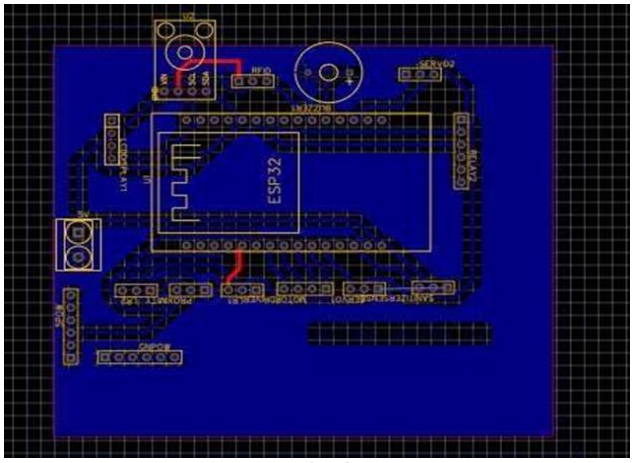


Fig. 3 PCB

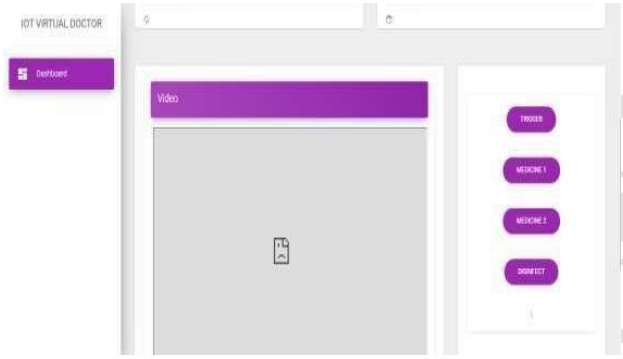
V. SOFTWARE IMPLEMENTATION

The software implementation consists of development of an Agrotrack application which can be used for complete agricultural work tracking. The software part is completely developed in HTML, PHP and bootstrap. The Microcontroller programming is done in C++.

Language Description

We used Subset of C language which is Arduino C which is based on the C/C++ and is used to program the microcontroller. Arduino, natively, supports a language that we call the Arduino Programming Language, or Arduino Language. This language is based upon the Wiring development platform, which in turn is based upon Processing, which if you are not familiar with, is what p5.js is based upon. It's a long history of projects building upon other projects, in a very Open-Source way. The Arduino IDE is based upon the Processing IDE, and the Wiring IDE which builds on top of it[3].

When we work with Arduino, we commonly use the Arduino IDE (Integrated Development Environment), a software available for all the major desktop platforms (macOS, Linux, Windows), which gives us 2 things: a programming editor with integrated libraries support, and a



way to easily compile and load our Arduino programs to a board connected to the computer.

The Arduino Programming Language is basically a framework built on top of C++. You can argue that it's not a real programming language in the traditional term, but I think this helps avoiding confusion for beginners. A program written in the Arduino Programming Language is called **sketch**. A sketch is normally saved with the .ino extension (from Arduino). The main difference from "normal" C or C++ is that you wrap all your code into 2 main functions. You can have more than 2, of course, but any Arduino program must provide at least those 2. One is called setup(), the other is called loop(). The first is called once, when the program starts, the second is repeatedly called while your program is running.

We don't have a main() function like you are used to in C/C++ as the entry point for a program. Once you compile your sketch, the IDE will make sure the end result is a correct C++ program and will basically add the missing glue by preprocessing it.

Everything else is normal C++ code, and as C++ is a superset of C, any valid C is also valid Arduino code. One difference that might cause you troubles is that while you can spawn your program over multiple files, those files must all be in the same folder. Might be a deal breaking limitation if your program will grow very large, but at that point it will be easy to move to a native C++ setup, which is possible. Part of the Arduino Programming Language is the built-in libraries that allow you to easily integrate with the functionality provided by the Arduino board.

PHP (Hypertext Preprocessor):

PHP is a general purpose scripting language originally designed for web development to produce dynamic web pages. For this purpose, PHP code is embedded into the html source document and interpreted by a web server with PHP processor module, which generates the web page document. It also has evolved to include a command line interface capability and can be used in standalone graphical application.

PHP code is usually processed on a web server by a PHP interpreter implemented as a module, a daemon or as a Common Gateway Interface (CGI) executable. On a web server, the result of the interpreted and executed PHP code – which may be any type of data, such as generated HTML or binary image data – would form the whole or part of a HTTP response. Various web template systems, web content management systems, and web frameworks exist which can be employed to orchestrate or facilitate the generation of that response. Additionally, PHP can be used for many programming tasks outside of the web context, such as standalone graphical applications[9] and robotic drone control. Arbitrary PHP code can also be interpreted and executed via command-line interface (CLI)[4].

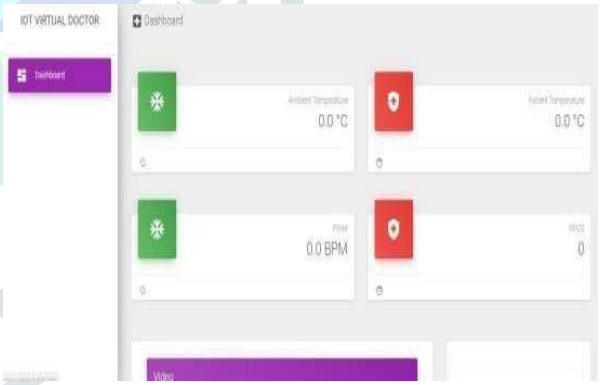
The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge.

The PHP language evolved without a written formal specification or standard until 2014, with the original implementation acting as the de facto standard which other implementations aimed to follow. Since 2014, work has gone on to create a formal PHP specification.

The Software Implementation consist of using of web services to trigger the requests form the hardware side to the software side and then update the backend accordingly and interact with the MySQL database. The sample web service of our project is as shown below:

Fig.4 Web Application using Bootstrap

Fig.5 Frontend snap shot of the web application



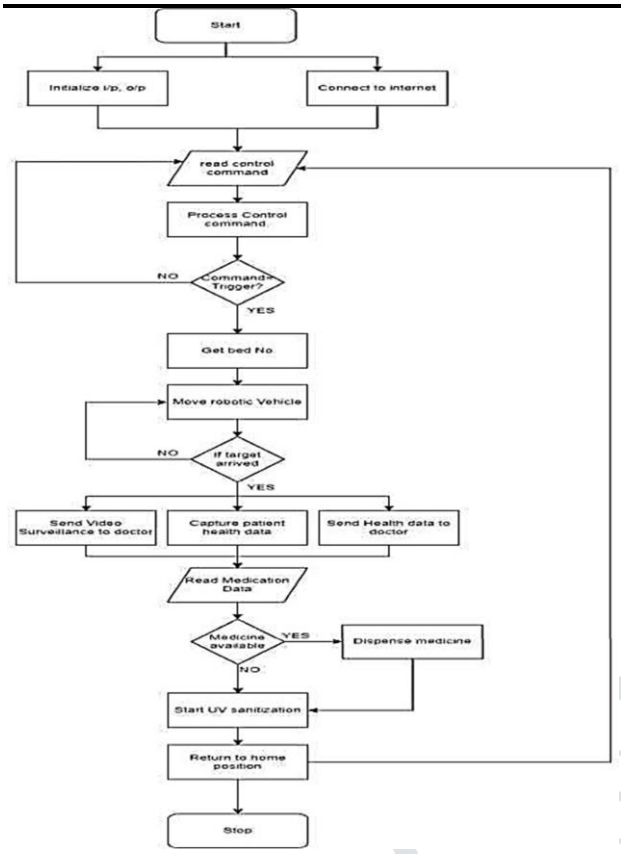


Fig.6 Flow diagram

VI. RESULTS

The implementation provide a virtual doctor platform for contactless treatment of patients and diagnostics remotely using IOT. The proposed project can help doctors to treat patients remotely using Autonomous robots which can move to the patient‘s locations and measure their body parameters. The proposed project is also expected to capture the live video from the patients and send them to the IOT panel developed so that the doctor can visualize the patient. The proposed system is also expected to provide doctors with the facility of IOT based remote medication so that they can deliver medicines to the patients remotely after diagnosis using IOT virtual doctor. The proposed virtual doctor disinfects itself after contact with patients so that the infection should not spread. Thus the proposed implementation is expected to provide safe and effective solution for treatment of patients using IOT virtual doctor in a contactless manner amid and post pandemic

VII. ADVANTAGES AND APPLICATIONS

Advantages and Applications :

1. Can be used for contactless treatment of patients without getting in touch with them
2. Can keep doctors and medical staff safe
3. Autonomous hence no manual intervention required
4. Can stop spread of infection from one person to another
5. Can give effective treatment to the patients
6. Telemedicine delivery over IOT makes sure the patients get correct medicines in time
7. IOT Video surveillance helps to visualize and diagnose the patient remotely over IOT
8. The Robot can be used in all multibed hospitals. The system self sanitizes itself making it free from viruses and bacterias

Disadvantages:

1. Requires Internet to work properly.
2. Some Initial investment required.

VIII. FUTURE SCOPE AND CONCLUSION

While the world is struggling with COVID-19 pandemic, many technologies have been implemented to fight against this disease. One of these technologies is the Internet of Things (IoT), which has been widely used in healthcare industry. During COVID-19 pandemic, this technology has shown very encouraging results dealing with this disease this project helps in development of complete solution to treat covid19 Patients remotely and autonomously with utmost care and safety. This can also help maintain social distancing and curb of the spread of any contagious disease now and any arising in future by implementation of IOT based virtual doctor robot.

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