

CHRONIC PATIENT TABLET MONITORING AND CONTROL USING AUTO SCANNING AND PREDICTION SYSTEM

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in
Biomedical Engineering.

By

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**DEPARTMENT OF BIOMEDICAL ENGINEERING
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
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APRIL -2021



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Jaiseph Joseph Sabu (37240028)**, **Rahul Thomas Rajeev (37240060)** who have done the project work as a team who carried out the project entitled “**Chronic patient tablet monitoring and control using auto scanning and prediction system**” under my supervision from **October 2020 to April 2021**

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DECLARATION

We, **Jaiseph Joseph Sabu (37240028)** and **Rahul Thomas Rajeev (37240060)** hereby declare that the Project Report entitled “**Chronic patient tablet monitoring and control using auto scanning and prediction system**” done by us under the guidance of **Ms.Sindu Divakaran**, Department of Biomedical Engineering is submitted in partial fulfillment of the requirements for the award of **Bachelor of Technology degree in Biomedical Engineering**

DATE:

PLACE:

1.

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SIGNATURE OF THE CANDIDATES

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We convey our thanks to **Dr. J. Premkumar** M.Sc., Ph.D. and **Dr. T. Sudhakar** M.Sc., Ph.D., **Head of the Department, Dept. of Biomedical Engineering** for providing us necessary support and details at the right time during the progressive reviews.

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ABSTRACT

There have been several cases of chronic patients dying as a result of ineffective medication administration. Although the hospital diet and drugs can provide enough energy and nutrients, many patients do not take their medications on a regular basis, causing their condition to worsen. Routine appointments with most chronic diseases typically require monitoring to check on the disease's progress or regress, as well as the emergence of complications. Such tests necessitate determining what to track, when to track it, and how to change treatment. Bad decisions in each area may lead to a loss of control, inefficient use of time, and potentially harmful care changes. At least one-third of chronic patients that arrive at the hospital are obese and, in some cases, unmonitored. If this continues, it can pose a health risk to the patient and is not a positive sign. In this project, we propose a deep learning algorithm for scanning the tablet tray, which will be carried out by an embedded system. We're working on a servo-driven device that will put all of the tablets in a tray for the patient to carry in. At the stated time, the servo motor will automatically release a tablet. The device will have motion sensors to detect whether the tablets are being taken, and if they are, a picture of the individual taking the tablets will be recorded and sent to the patient's caretaker through a camera linked to the system. Not only that, but at the end of the threshold time, it checks the tablet giving tray to confirm that the patient has taken the tablets; if not, the system warns the patient's caretaker that the patient has not taken the tablet. This will aid chronic patients in remembering their medical appointments and caregivers in accurately monitoring them.

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LIST OF ABBREVIATIONS

CNN	Convolutional Neural Network
RNNS	Recurrent Neural Network
ILSVRC	ImageNet Large Scale Visual Recognition Challenge
ReLU	Rectified Linear Unit
SARSA	State-Action-Reward-State-Action
DDPG	Deep Deterministic Policy Gradient

CHAPTER -1

INTRODUCTION

1.1 GENERAL

Chronic diseases are described as illnesses that last a year or longer and necessitate continuing medical care, restrict daily activities, or both. In the United States, chronic heart diseases, such as heart disease, cancer, and diabetes, are the leading causes of death and disability. People with chronic illnesses have been using these devices for decades. These devices deliver drugs to patients at the precise time they are required. It is easier to manage illnesses if you take your medications at the right time.

Over the course of care, the monitoring system's goal and procedures change. It's been difficult to keep track of chronic patients to see whether they're taking their medications correctly. If a patient fails to take his or her medications as prescribed, the patient's condition can deteriorate further.

A servo motor will be used in our proposed system to throw the tablet at the appropriate time. The tablet will be thrown into a tray, which will be collected by the patient. Motion sensors will be attached to the device to detect any movement.

1.2 TECHNOLOGY USED

1.2.1 Embedded system

An embedded system is a microprocessor-based computer hardware system with software that is intended to perform a particular task, either independently or as part of a larger system. An integrated circuit is at the centre of the device, which conducts computation for real-time operations.

From a single microcontroller to a suite of processors with attached peripherals and networks, and from no user interface to sophisticated graphical user interfaces,

there are several different levels of complexity. An embedded system's complexity varies greatly depending on the purpose for which it was developed.

Digital watches and microwaves are examples of embedded system technologies, as are hybrid vehicles and avionics. Embedded systems account for up to 98 percent of all microprocessors made.

Microcontrollers or digital signal processors (DSP), application-specific integrated circuits (ASIC), field-programmable gate arrays (FPGA), GPU technology, and gate arrays are all used in embedded systems. These processing systems provide modules for dealing with electrical and/or mechanical interfacing.

Programming instructions for embedded devices, also known as firmware, are stored in read-only memory or flash memory chips and run on computers with limited hardware resources. Peripherals bind embedded systems to the outside world, connecting input and output devices.

1.2.1.1 Structure of embedded systems

The following components make up the basic framework of an embedded system:

Sensor: A sensor detects a physical quantity and transforms it to an electrical signal that can be read by an embedded systems engineer or other electronic instrument. The calculated quantity is stored in memory by a sensor.

An analog-to-digital converter (A-D converter): transforms the analogue signal from the sensor into a digital signal.

Processors and ASICs: Processors evaluate data in order to calculate output and store it in memory.

A digital-to-analog converter (D-A converter) :converts the digital data fed to the processor into analogue data.

Actuator: An actuator compares the D-A Converter's output to the real output and stores the authorised output.

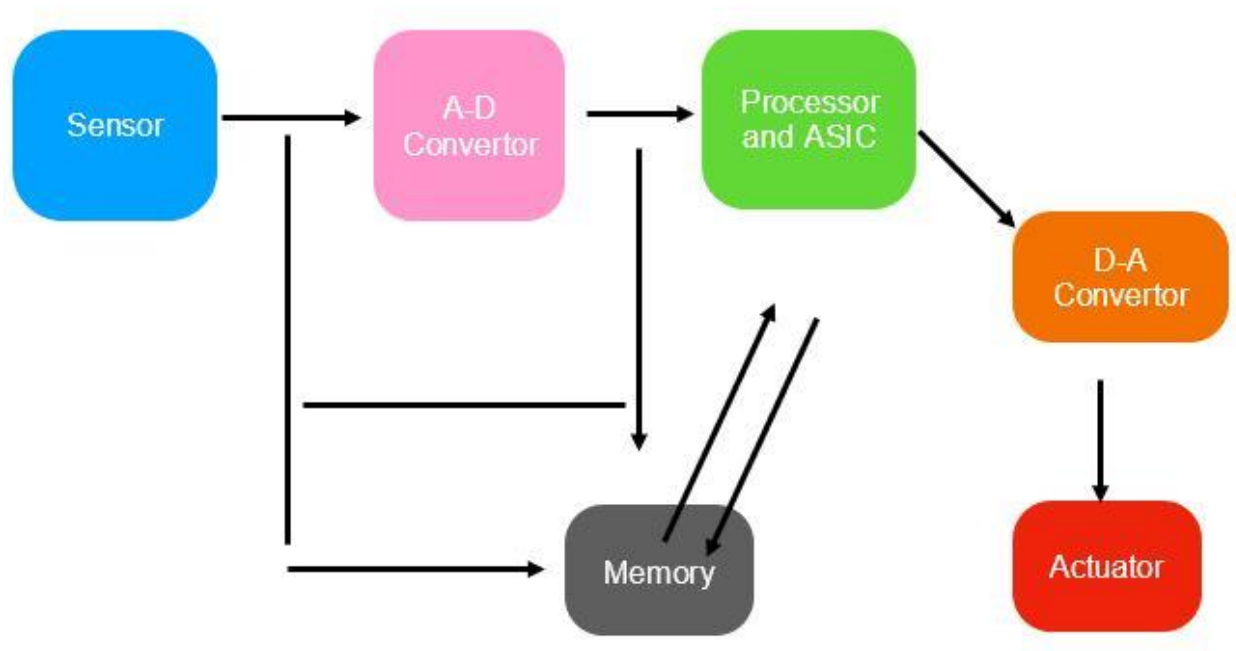


Figure 1.1: Structure of embedded systems

1.2.1.2 Benefits of using embedded systems

- Small size and faster to load
- More specific to one task
- Easy to manage
- Low cost
- Spend less resources
- Since these operating systems are dedicated to a single device, they perform well and use less resources such as memory and microprocessors.

1.2.2 OpenCV

Gary Bradsky began OpenCV at Intel in 1999, and the first version was released in 2000. Vadim Pisarevsky has joined Gary Bradsky in heading Intel's Russian OpenCV tech unit. Stanley, the vehicle that won the 2005 DARPA Grand Challenge, used OpenCV in 2005. Later, Willow Garage funded the project's active growth, which was

led by Gary Bradsky and Vadim Pisarevsky. OpenCV currently supports a wide range of algorithms in the fields of computer vision and machine learning, and it continues to develop.

OpenCV currently supports a range of programming languages, including C++, Python, and Java, and is available on a variety of platforms, including Windows, Linux, OS X, Android, and iOS. For high-speed GPU operations, interfaces based on CUDA and OpenCL are also being actively developed.

OpenCV's Python API is known as OpenCV-Python. It blends the best features of the OpenCV C++ API with the Python programming language.

OpenCV, the most widely used open source library for computer vision, image processing, and machine learning, now includes GPU acceleration for real-time performance.

OpenCV is free for both academic and commercial use since it is published under a BSD licence. It supports Windows, Linux, Mac OS, iOS, and Android and has C++, C, Python, and Java interfaces. OpenCV was created with a focus on real-time applications and computational performance. The library, which is written in optimised C/C++, can take advantage of multi-core processing. OpenCV, which has been adopted all over the world, has a user base of over 47 thousand people and an estimated number of downloads of over 6 million. The applications range from digital art to mine inspection, web map stitching, and advanced robotics.

OpenCV-Python

Python is a general-purpose programming language created by Guido van Rossum that has quickly gained popularity due to its simplicity and readability of code. It allows the programmer to express his thoughts in fewer lines of code while maintaining readability.

Python is slower than other languages like C/C++. Python can also be quickly expanded with C/C++, which is an important feature. This feature allows us to write

computationally intensive C/C++ code and wrap it in a Python wrapper, which we can then use as Python modules. This provides us with two benefits: first, our code is as quick as original C/C++ code (due to the actual C++ code running in the background), and second, Python is very simple to code. OpenCV-Python is a Python wrapper around the original C++ implementation.

Numpy's assistance makes the job even simpler. Numpy is a numerical operations library that is highly optimised. It has a syntax similar to that of MATLAB. All array structures in OpenCV are translated to and from Numpy arrays. So, whatever Numpy operations you can perform, you can combine them with OpenCV to expand your arsenal of weapons. Other libraries that support Numpy, such as SciPy and Matplotlib, can also be used with this.

As a result, OpenCV-Python is an excellent method for quickly prototyping computer vision issues.

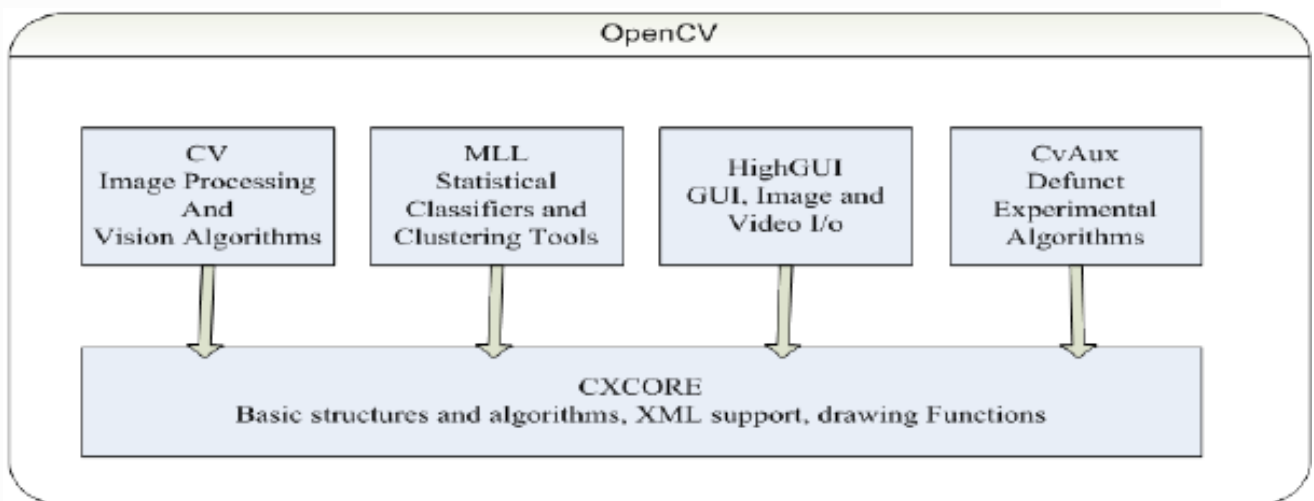


Figure 1.2 OpenCV software architecture

OpenCV Applications

OpenCV is being used for a very wide range of applications which include:

- Street view image stitching

- Automated inspection and surveillance
- Robot and driver-less car navigation and control
- Medical image analysis
- Video/image search and retrieval
- Movies - 3D structure from motion
- Interactive art installations

OpenCV Functionality

- Image/video I/O, processing, display (*core, imgproc, highgui*)
- Object/feature detection (*objdetect, features2d, nonfree*)
- Geometry-based monocular or stereo computer vision (*calib3d, stitching, videostab*)
- Computational photography (*photo, video, superres*)
- Machine learning & clustering (*ml, flann*)
- CUDA acceleration (*gpu*).

1.3 OBJECTIVE

- To see if the patient has taken his or her drugs on time.
- To effectively inform the caregiver of the patient's condition.
- To ensure that medications are taken at the appropriate times.

CHAPTER -2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

The survey on tablet tracking is shown below. The most widely used of the current methods for predicting emotions.

N. Maglaveras proposed the development of a modular medical contact centre that would provide high-quality telemedicine services. The added value of such telemedicine systems in preventing patient health deterioration and reducing hospitalizations has been highlighted, especially for chronic care, by enabling physicians to obtain regular snapshots of patient vital signs. They would be able to care more quickly for their patients if they are aware of the signs and symptoms. Until now, the implementation of customised monitoring systems aimed at providing high-quality healthcare services in terms of patient status has received special attention. The patient/characterization, citizen's well-being evaluation, and surveillance, while as well as creating opportunities for timely interventions and filling information gaps in terms of disease progression and patient health status, which is delivered to medical staff.

V. G. Koutkias, I. Chouvarda, and N. Maglaveras suggested a multiagent method for improving chronic disease management in home-care settings. The importance of such telemedicine systems in preventing patients' health status from worsening and reducing hospitalizations has been highlighted, especially in chronic care, by enabling physicians

to receive regular snapshots of patient vital signs and symptoms, allowing them to intervene more timely for their patients. The infrastructure at the patient site is normally connected to the infrastructure of the healthcare provider, where the tracked data is stored and transmitted to medical professionals, with the aid of decision support and analysis software.

U. Varshney "Pervasive healthcare and wireless health tracking," by the need to move beyond passive monitoring to effective mechanisms for pervasive healthcare is becoming increasingly apparent in the context of quality of care. Such systems primarily depend on the ubiquitous computing paradigm, which is realised by using recent advancements in sensor technology, which provide unobtrusive biosignal acquisition and processing on the one hand, and communication capabilities allowing data transmission and networking with other sensors on the other hand, to form a BAN.

B. Konstantas, in IMIA Yearbook, U.K created "An description of wearable and implantable tracking medical sensors," . The state-of-the-art includes monitoring systems that include sophisticated sensors and body area networks (BANs). Such systems primarily rely on the pervasive computing paradigm, which is realised by using recent advancements in sensor technology, which provide unobtrusive biosignal acquisition and processing on the one hand, and communication capabilities that enable data transmission and networking with other sensors on the other hand, to form a BAN.

Abdul Rehman Aslam and Muhammad Awais Bin Altaf reported that Chronic neurological disorders (CNDs) are chronic conditions that cannot be cured, but their serious consequences can be reduced with early intervention. Alzheimer's disease, Autism Spectrum Disorder (ASD), and Amyotrophic Lateral Sclerosis (ALS) are recurrent central nervous system disorders that cause the deterioration of emotional and cognitive abilities. Long-term continuous monitoring of human emotions with neuro-feedback is critical in reducing the adverse effects of CNDs . This paper presents a dedicated human emotion classification processor for CNDs that is hardware efficient. The valence and arousal scales are used to identify emotions using scalp EEG. Power spectral density, logarithmic interhemispheric power spectral ratio, and the interhemispheric power spectral difference of eight EEG channel positions are used for a linear support vector machine classifier appropriate for a wearable non-invasive classification method. In machine learning (ML) applications, a look-up-table based logarithmic division unit (LDU) is used to describe division features. For ML applications, the implemented LDU reduces the cost of integer division by 34%. On several publicly accessible datasets, the implemented emotion's classification processor achieved an accuracy of 72.96 percent and 73.14 percent, respectively, for valence and arousal classification.

Shuming Wu ,Pete Russhard and Ruqiang Yan suggested that Blade Tip Timing (BTT) methods are increasingly being used to track blade health. Present signal analysis techniques, however, have two disadvantages that preclude them from being applied to on-line monitoring: To begin with, current on-line monitoring necessitates time-consuming manual judgement of the resonance area. Second, current BTT resonance signal analysis approaches are insufficient for real-time monitoring . Spectral aliasing is present in spectral-analysis-based methods, while the computational complexity of sparse-based methods is typically high. We propose an adaptive on-line blade health monitoring system in this paper, which consists of two steps: automatic resonance region recognition and resonance area parameter identification. We illustrate different methods for synchronous and asynchronous resonance in the first step, using cross-correlation to judge synchronous vibration occurrence and linear estimation to evaluate asynchronous

vibration occurrence. An iterative adaptive least-squares periodogram is used for the final step because of its trade-off between spectral aliasing and computational complexity. The effectiveness of the preceding measures is first tested using separate simulation data. The laboratory data is then used to assess the method's overall effectiveness. Finally, engineering data with both synchronous and asynchronous resonances validates the proposed method's online monitoring feature.

Jingjing Zhong proposed a System health monitoring as the foundation for prognostics and health management (PHM) is to investigate health indices/features for PHM in order to conduct condition monitoring, abnormal detection, and deterioration patterns for prognostic models. Kurtosis and negative entropy are two well-known indices for estimating the sparsity of impulsive transients, but they are sensitive to impulsive noise. This paper has a dual purpose. New theorems and proofs are proposed to demonstrate how kurtosis and negative entropy can be used to describe impulsive transients and why they are influenced by impulsive noise . Then, to reduce the sensitivity of kurtosis and entropy to impulsive noise and provide monotonic patterns for gear and bearing degradation assessment, a weighted residual regression-based index is proposed. Theoretical findings indicate that the duration of non-impulsive regions of impulsive transients affects kurtosis and negative entropy. For bearing and gear health monitoring and degradation evaluation, experimental findings show that the proposed approach outperforms kurtosis and negative entropy in terms of incipient fault detection and monotonic trending.

Nabil Alshurafa, Costas Sideris, Mohammad Pourhomayoun, Haik Kalantarian, Majid Sarrafzadeh and Jo-Ann Eastwood crafted a “Remote Health Monitoring Outcome Performance Prediction Using Baseline and First Month Intervention Data” . Clinicians and hospitals are increasingly using remote health management (RHM) systems to remotely track and interact with patients, saving time for clinicians, lowering hospital costs, and improving care quality. Wanda-CVD was developed as part of the Women's Heart Health Study (WHHS), in which participants obtained healthy lifestyle education

accompanied by six months of technology support and reinforcement. Wanda-CVD is a smartphone-based RHM system that uses wireless coaching, feedback, and prompts as well as social reinforcement to help participants minimise established cardiovascular disease (CVD) risk factors. This RHM method benefited a large number of participants. We developed a method to classify classification schemes that predicted active and unsuccessful participants in response to the variation in participant success. We looked at both qualitative baseline attributes and data from the first month of intervention, including movement, blood pressure, and smartphone-transmitted questionnaire responses. Clinicians and scientists may use a prediction tool to help them classify people who would profit the most from the RHM system. Targeted treatments have the ability to save money, time, and energy for both physicians and patients. Our classification scheme predicts RHM outcome success with an F-measure of 91.9 percent and defines habits that help assess outcome success within the first month of intervention. We also show that using intervention-based smartphone data improves prediction . The findings of the WHHS study show that factors like variance in first-month intervention response to dietary nuts, beans, and seeds can help predict patient RHM protocol outcome performance in a community of young Black women aged 25 to 45.

Andreas K. Triantafyllidis, Vassilis G. Koutkias, Ioanna Chouvarda and Nicos Maglaveras, found a Pervasive Health System Integrating Patient Monitoring, Status Logging, and Social Sharing on the paper, We present the design and implementation of a pervasive health system that allows chronic patients to control themselves during their daily activities. The proposed framework incorporates patient health tracking, status reporting for recording different issues or symptoms observed, and social sharing of the reported information within the patient's community, all with the intention of making disease management simpler. A prototype for unobtrusive vital sign monitoring through a wearable multisensing system, a service-oriented framework for managing communication issues, and common microblogging services is implemented on a mobile device, demonstrating the viability and applicability of the presented work. In addition, a study involving 16 hypertensive patients was performed to determine consumer

acceptance, utility, and merit of the proposed method. The findings indicate that the system is well-received by chronic patients, who are particularly eager to share healthcare data, and that it is simple to learn and use, with its features generally regarded as beneficial to the patients' disease management and treatment.

CHAPTER - 3

AIM AND SCOPE

3.1 EXISTING SYSTEM:

Chronic neurological disorders (CNDs) are chronic conditions that cannot be healed, but their serious consequences can be minimised with early intervention. Alzheimer's disease, Autism Spectrum Disorder (ASD), and Amyotrophic Lateral Sclerosis (ALS) are recurrent central nervous system diseases that cause the loss of emotional and cognitive abilities. Long-term continuous monitoring of human emotions with neuro-feedback is important in reducing the adverse effects of CNDs. This paper presents a dedicated human emotion classification processor for CNDs that is hardware efficient. The valence and arousal scales are used to classify emotions using scalp EEG. Power spectral density, logarithmic interhemispheric power spectral ratio, and the interhemispheric power spectral difference of eight EEG channel positions are used for a linear support vector machine classifier appropriate for a wearable non-invasive classification method. In machine learning (ML) applications, a look-up-table based logarithmic division unit (LDU) is used to represent division features. For ML applications, the implemented LDU reduces the cost of integer division by 34%. On several publicly accessible datasets, the implemented emotion's classification processor achieved an accuracy of 72.96 percent and 73.14 percent, respectively, for valence and arousal classification. For 8-channel service, the 2x3mm² processor is fabricated using a 0.18m 1P6M CMOS process with power and energy consumption of 2.04mW and 16J/classification, respectively.

3.2 DISADVANTAGES OF EXISTING SYSTEM:

- The current system only understands the chronic patient's feeling.
- The system needs a LSVM based processor and makes it a very costly device.
- EEG sensors are being used that are expensive.
- The architecture used is not actually accurate and can detect the emotion falsely.

3.3 PROPOSED SYSTEM:

There have been several cases of chronic patients dying as a result of ineffective drug administration. Although the hospital diet and drugs can provide enough energy and nutrients, many patients do not take their medications on a regular basis, causing their condition to worsen. Routine appointments with most chronic diseases typically require monitoring to check on the disease's progress or regress, as well as the emergence of complications. Such tests necessitate deciding what to track, when to track it, and how to change care. Bad decisions in each area may lead to a loss of control, inefficient use of time, and potentially harmful care changes. At least one-third of chronic patients that arrive at the hospital are obese and, in some cases, unmonitored. If this happens, it can pose a health risk to the patient and is not a positive sign. In this project, we propose a deep learning algorithm for scanning the tablet tray, which will be carried out by an embedded system . We're working on a servo-driven device that will place all of the tablets in a tray for the patient to carry in. At the stated time, the servo motor will automatically release a tablet. The device will have motion sensors to detect whether the tablets are being taken, and if they are, a picture of the individual taking the tablets will be recorded and sent to the patient's caretaker through a camera linked to the system. Not only that, but at the end of the threshold time, it checks the tablet giving tray to confirm that the patient has taken the tablets; if not, the system warns the patient's caretaker that the patient has not taken the tablet. This will assist chronic patients in recalling their medical appointments and caregivers in accurately tracking them.

3.4 ADVANTAGES:

- The health of the patient will be ensured by properly taking the tablets.
- The patient's care taker will be alerted if the patient doesn't intake the tablet on time.
- The patient will receive the tablets at the right time.

3.5 APPLICATIONS:

- Used for test centers
- Used in NGO.
- Used in day care centers
- Used in patient home.

CHAPTER - 4

MATERIALS AND METHODS

DETAILED DESIGN OF THE PROJECT:

This chapter describes the overall detailed design of the project. It also describes each module.

4.1 BLOCK DIAGRAM:

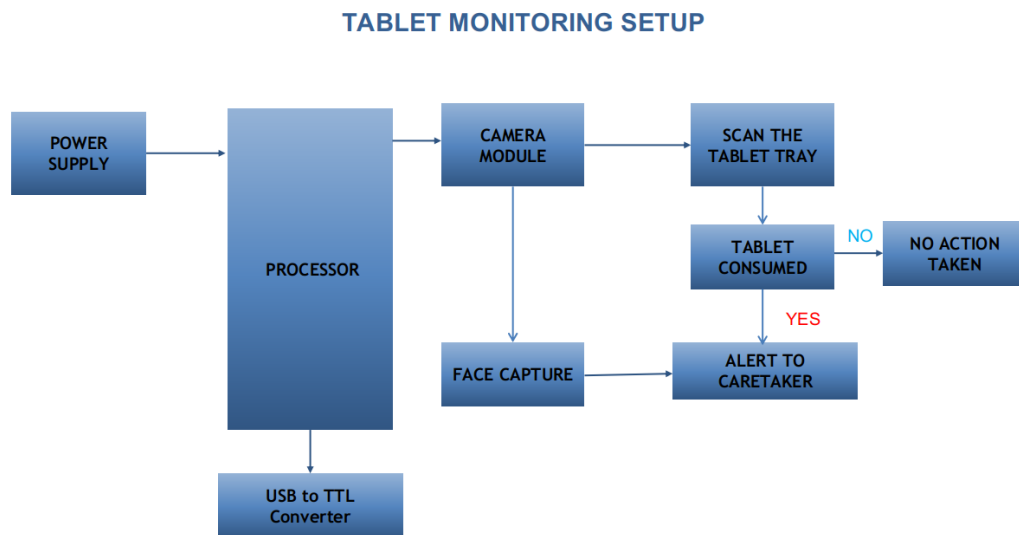


Figure 4.1:Tablet monitoring setup

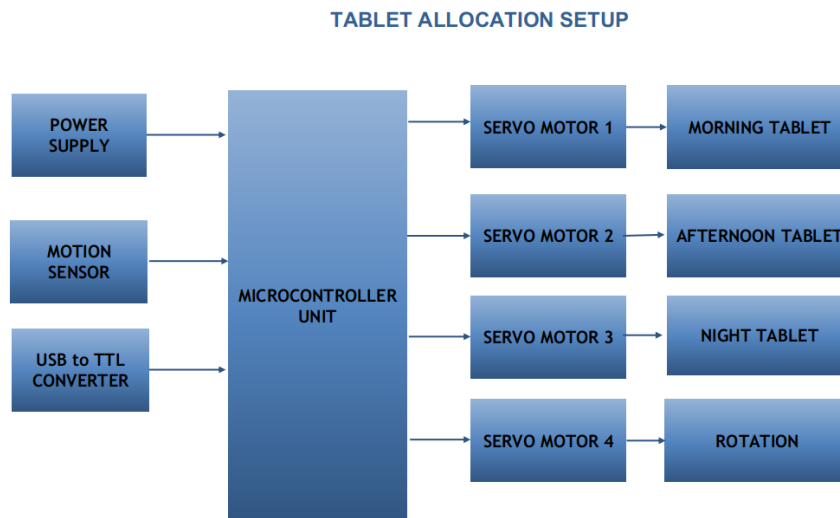


Figure 4.2: Tablet allocation setup 2

4.2 WORKING:

In this project we propose a deep learning system to scan the tablets tray and use an embedded system to perform the process. We develop a system with a servo motor which will have all the tablets in a tray that the patient has to take in. The servo motor will automatically release a tablet at the specified threshold time. The system will have motion sensors to detect if the tablets are being taken and if a person takes the tablets an image of the person taking the tablets is captured through a camera connected to the system and sends the image to the care taker of the patient. Not only this it automatically scans the tablet giving tray at the end of the threshold time to confirm that the patient has taken the tablets, If not the device alerts the care taker of the patient that the patient has not taken the tablet. This will help chronic patients to not forget their medical schedule and help care takers to effectively monitor them.

4.3 MODULES DESCRIPTION:

- Power supply module

- Micro-controller
- Tablet serving module
- Human detection module
- SMS API integration

4.3.1 POWER SUPPLY MODULE:

The power supply circuit includes a step-down transformer that converts 230 volts to 12 volts. 4 diodes are used to form a bridge rectifier in this circuit, which delivers pulsating dc voltage and is then fed to a capacitor filter, which removes any A.C components present even after rectification.

The filtered DC voltage is fed into the regulator, which produces a steady DC voltage of 12 volts. 230V AC power is converted to 12V AC (12V RMS value with a peak value of about 17V), however the necessary power is 5V DC; thus, 17V AC power must first be converted to DC power before being stepped down to 5V DC. One of the power electronic converters known as a Rectifier will convert AC power to DC. Rectifiers come in a range of shapes and sizes, including half-wave, full-wave, and bridge rectifiers. The bridge rectifier is commonly used for converting AC to DC because of its advantages over the half and full wave rectifiers.

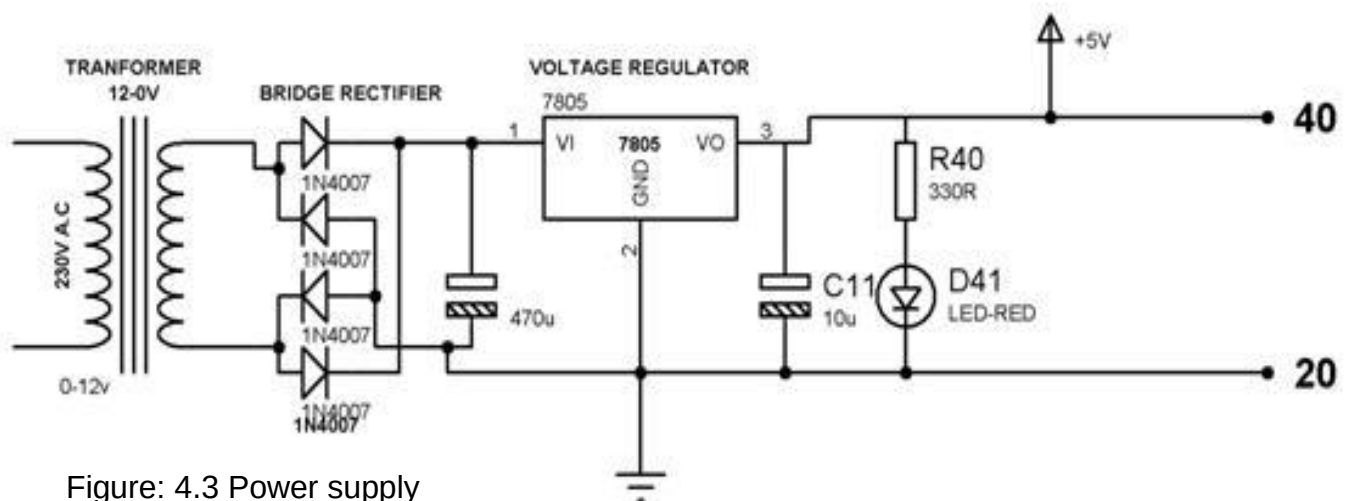


Figure: 4.3 Power supply

4.3.2 MICROCONTROLLER MODULE

The ATmega-328 is a microcontroller based on the Advanced Virtual RISC (AVR) architecture. It can handle data of up to eight (8) bits. The ATmega-328 has 32KB of internal memory. There are a number of other features on this microcontroller. You can also read Introduction to PIC16F877a (a PIC Microcontroller) before comparing the two Microcontrollers' functions. Electrically Erasable Programmable Read Only Memory (EEPROM) is available on the ATmega 328. (EEPROM). This property indicates that even if the microcontroller's electric supply is disconnected, it can still store data and produce results after being reconnected to the power supply. Furthermore, the ATmega-328 has a 2KB Static Random Access Memory (SRAM) (SRAM). Other attributes will be discussed at a later time. The ATmega 328 has a variety of features that make it the most common computer on the market today. Advanced RISC architecture, good performance, low power consumption, real timer counter with separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software protection, throughput up to 20 MIPS, and so on are some of the features. ATmega-328 is mostly used in Arduino.

ATmega328 Ports

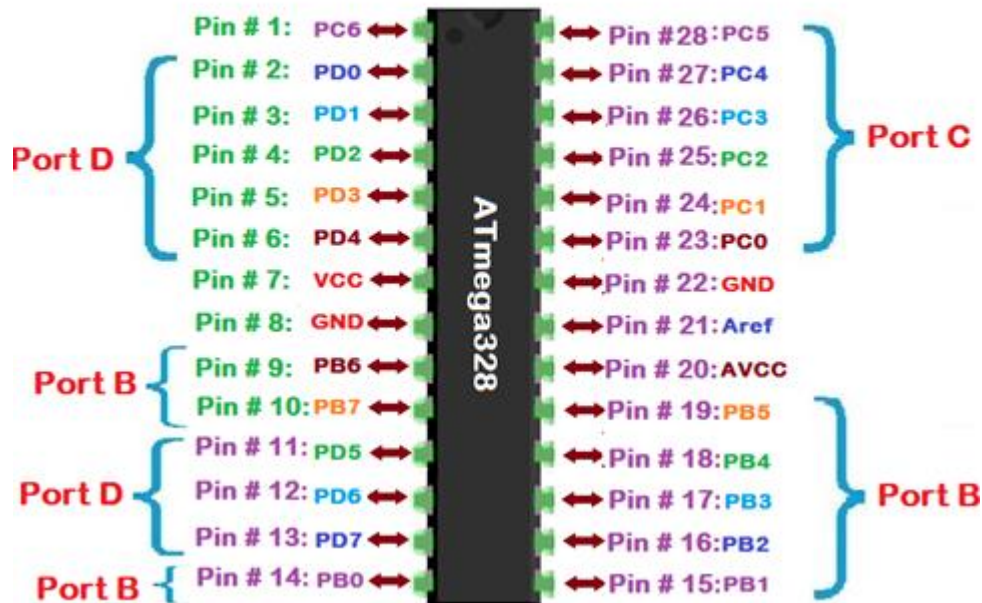


Figure: 4.4 Atmega 328

4.3.3 Tablet serving module

A servo motor is an electrical system that can precisely push or rotate an object. A servo motor is used when you want to rotate an object at a certain angle or distance. It is simply made up of a basic motor that is regulated by a servo mechanism. If the motor is DC driven, it is referred to as a DC servo motor; if the motor is AC powered, it is referred to as an AC servo motor. We can get a servo motor with a lot of torque in a small and light box. These characteristics allow them to be used in a variety of applications such as toy cars, RC helicopters and planes, robots, and machines.



Figure: 4.5 Servo motor

Servo motors are measured in kilogrammes per centimetre (kg/cm), with the majority of hobby servo motors rated at 3kg/cm, 6kg/cm, or 12kg/cm. This kg/cm value indicates how much weight a servo motor can lift over a given distance. Consider the following scenario: If the load is suspended 1cm from the motor's shaft, a 6kg/cm Servo motor should be able to lift 6kg; the greater the reach, the lower the weight carrying power.

A servo motor's location is determined by an electrical pulse, and its circuitry is located beside the motor.

4.3.4. Human detection module

An infrared sensor is a system that detects infrared radiation. Some IR sensor applications include proximity sensors (used in touchscreen phones and edge avoiding robots), contrast sensors (used in line following robots), and obstruction counters/sensors (used for counting products and in burglar alarms).

The emitter circuit and the receiver circuit make up an infrared sensor. A photo-coupler, also known as an optocoupler, is a system that incorporates these components.

An IR LED serves as the emitter, and an IR photodiode serves as the detector. An IR LED emits infrared light, which is detected by the IR photodiode. The resistance and output voltage of the photodiode change in relation to the amount of infrared light received. The IR sensor's basic operating theory is as follows.

Absolute or indirect incidence are the two types of incidence. The IR LED is positioned directly in front of a photodiode with no obstruction between them in direct incidence. Both diodes are mounted side by side with an opaque object in front of the sensor in indirect incidence. The light from the IR LED reflects back to the photodiode as it reaches the opaque surface.

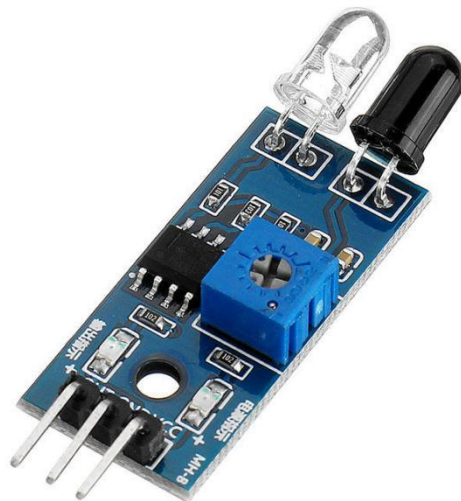


Figure: 4.6 IR sensor

4.3.5. SMS API integration

An SMS API is a well-defined software interface that allows code to send short messages via an SMS Gateway.

SMS APIs are often used to 'bridge the gap' between telecommunications carrier networks and the wider web, as the infrastructures for SMS communications and the internet are largely separated.

SMS APIs are used to make it simple for web applications to send and receive text messages using logic written for popular web frameworks.

For our integration, we'll be using the textlocal SMS API, which allows us to easily integrate our SMS services with your website, programme, or CRM application written in PHP, ASP, .NET, Java, or any other language.

Based on the advanced consumer segmentation available in Optimove, the integrated TextLocal and Optimove solution makes it simple to plan and execute marketing text message campaigns.

Optimove connects to the TextLocal system for two purposes:

1. To instruct TextLocal to execute text campaigns, i.e., to send out particular text message templates to specified customer lists
2. To receive delivery metrics from TextLocal for reporting within Optimove

In order to set up the integration between your Optimove site and your TextLocal account, the following steps are required:

1. Ensure that the following customer attributes are available in the TextLocal customer Contact Group:
 - CustomerID – This field is used to match customers between Optimove and TextLocal (note that you can also choose to use any alternative unique identifier that appears in both the Optimove and TextLocal databases). The attribute used as the key identifier must be saved in one of the custom fields provided in TextLocal (Custom 1, Custom 2 or Custom 3).
 - First name

- Last name
 - Phone number
2. Maintain a daily update of this database. For example, when new customers join, their information must be promptly updated in TextLocal.
 3. Define the Sender name for text messages sent by Optimove in the TextLocal interface.

Note: If you would prefer that campaigns sent by Optimove use a different sender name, the Optimove Integration Team can configure a different sender name for the TextLocal campaigns executed by Optimove.

4. Provide the Optimove Integration Team with the name and ID of the particular TextLocal Contact Group to which to connect
5. Provide the Optimove Integration Team with login credentials to the TextLocal API - notes:
 - You should create a new administrator-level TextLocal API account specifically for use by Optimove.
 - These credentials may not contain any of these characters: \$ & =
 - Provide the Integration Team with the following details:
 - TextLocal API key
 - Username
 - Password
 - API login URL (e.g., <https://api.txtlocal.com>)

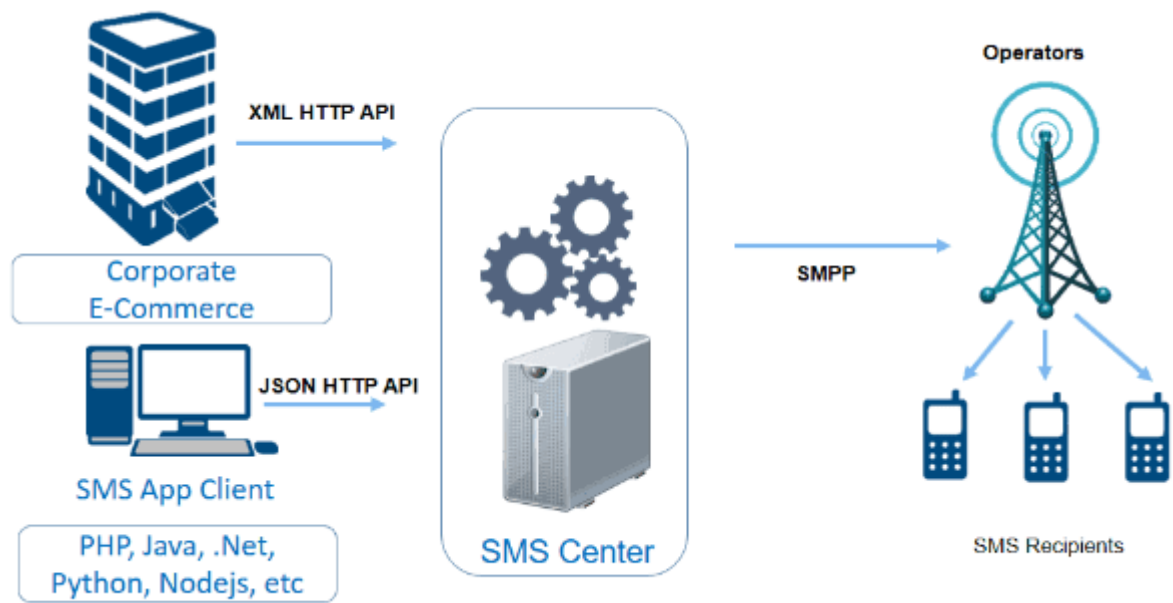


Figure 4.6 SMS API Dataflow Diagram

4.4 SOFTWARE DESCRIPTION

4.4.1 VISUAL STUDIO

Microsoft Visual Studio is used as an IDE in this project.

Visual Studio Code incorporates the ease of use of a source code editor with advanced developer functionality such as IntelliSense code completion and debugging.

It is, first and foremost, an editor who stays out of your way. Less time fiddling with your environment and more time executing on your ideas thanks to the delightfully frictionless edit-build-debug cycle.

Visual Studio Code is available for macOS, Linux, and Windows, so you can get started right away.

Visual Studio Code's core feature is a lightning-fast source code editor that's ideal for day-to-day use. Syntax highlighting, bracket-matching, auto-indentation, box-selection, snippets, and more are all available in VS Code, which supports hundreds of languages. You can navigate your code with ease thanks to intuitive keyboard shortcuts, simple customization, and community-contributed keyboard shortcut mappings.

When it comes to serious coding, you'll also benefit from resources that understand more code than just blocks of text. IntelliSense code completion, rich semantic code comprehension and navigation, and code refactoring are all integrated into Visual Studio Code.

When the coding becomes difficult, the tough turn to debugging. We made it happen because debugging is always the one element that developers lack the most in a leaner coding experience. You can walk through source code, inspect variables, view call stacks, and run commands in the console with Visual Studio Code's interactive debugger.

VS Code also integrates with create and scripting software to help you complete basic tasks faster. With Git support in VS Code, you can work with source control without having to leave the editor, including displaying pending changes diffs.

Customize every feature to your taste and add as many third-party plugins as you like. Although most scenarios work right out of the box, VS Code develops with you, and we allow you to customise your experience to fit your particular needs.

VS Code comes with enhanced built-in support for Node.js development, including JavaScript and TypeScript, and is powered by the same underlying technologies as Visual Studio. Web technologies such as JSX/React, HTML, CSS, SCSS, Less, and JSON are all well-represented in VS Code.

Visual Studio Code incorporates the best of internet, native, and language-specific technology in its architecture. VS Code uses Electron to combine web technologies like JavaScript and Node.js with native app speed and versatility. VS Code makes use of a newer, faster version of the same industrial-strength HTML-based editor that powers the “Monaco” cloud editor, Internet Explorer's F12 Tools, and a number of other projects. VS Code also uses a tools service architecture that allows it to integrate with many of the same technologies that power Visual Studio, such as Roslyn for.NET, TypeScript, the Visual Studio debugging engine, and others.

A public extensibility model in Visual Studio Code enables developers to create and use extensions, as well as customise their edit-build-debug experience.

4.4.2 ARDUINO

The Arduino software is used in this project.

Beginners will find the Arduino programme simple to use, but experienced users will find it versatile. It's compatible with Mac, Windows, and Linux. It is used by teachers and students to create low-cost science instruments, to demonstrate chemistry and physics concepts, and to begin learning programming and robotics. Designers and developers construct immersive prototypes, while musicians and artists use it to create installations and try out new instruments. Makers, for example, use it to build many of the projects on display at the Maker Faire. Arduino is a valuable platform for learning new skills. Anyone - children, hobbyists, artists, programmers - can get started tinkering by following the step-by-step instructions in a kit or sharing ideas with other Arduino members online.

- For physical computing, there are a variety of other microcontrollers and microcontroller platforms to choose from. Similar features can be found in Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many other programmes. Both of these programmes condense the complicated aspects of microcontroller programming into an easy-to-use bundle. While Arduino simplifies the process of working with microcontrollers, it has one advantage over other systems for teachers, students, and interested amateurs:
- Low-cost - As opposed to other microcontroller systems, Arduino boards are a bargain. The Arduino module's cheapest version can be built by hand, and even pre-assembled Arduino modules cost less than \$50.
- • Cross-platform - The Arduino Software (IDE) is compatible with Windows, Macintosh OSX, and Linux. The majority of microcontroller systems are only compatible with Windows.
- Easy-to-use programming environment - The Arduino Software (IDE) is simple to use for beginners while still being versatile enough for advanced users. It's based on the Processing programming environment, which is convenient for

teachers since students learning to programme in that environment would be familiar with how the Arduino IDE works.

- Open source and extensible software - The Arduino software is available as open source tools that professional programmers can extend. People who want to learn more about the language should use C++ libraries, and those who want to learn more about the technical specifics should move from Arduino to the AVR C programming language. Similarly, if you want to, you can use AVR-C code directly in your Arduino programmes.
- Open source and extensible hardware - The Arduino boards' plans are made available under a Creative Commons licence, enabling professional circuit designers to build their own version of the module, expanding and enhancing it. The breadboard version of the module can be built by even beginner users to learn how it works and save money.

CHAPTER 5

RESULTS & DISCUSSION

6.1 Final outputs obtained:

The following picture depicts the project's entire hardware setup:



Figure 6.1: Complete hardware setup of the project

If anyone attempts to take the tablet, the camera is triggered. The camera initiation for capturing the individual is shown in the image below. The person attempting to take the tablets is caught on camera in the picture below.

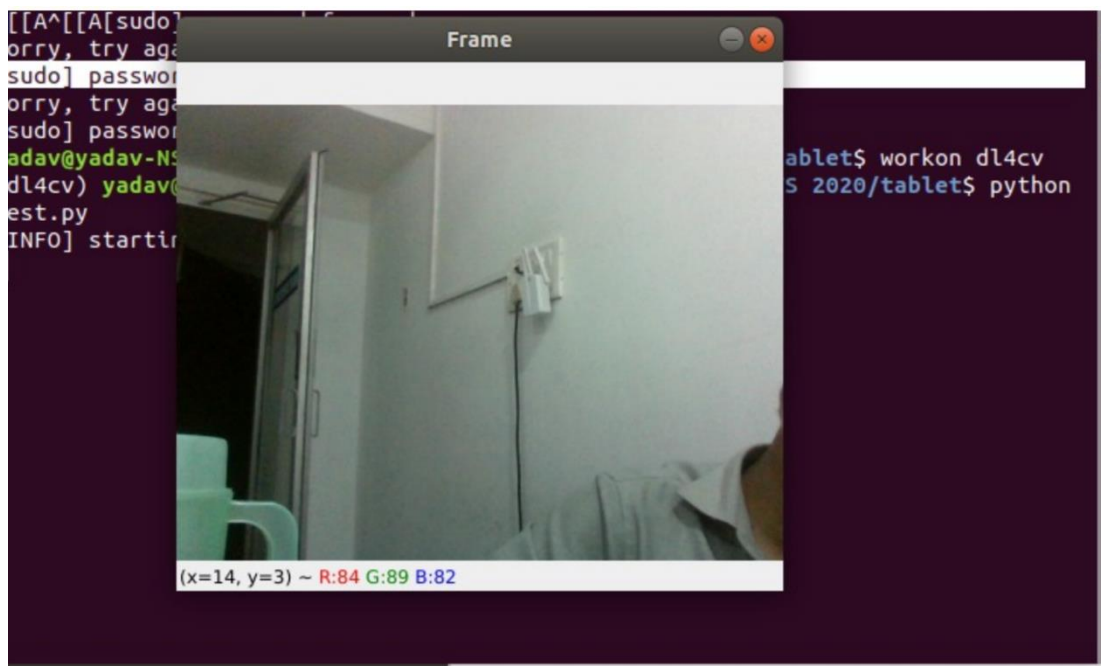


Figure 6.2: Camera initiation

The successful camera capture of the individual attempting to take the tablets is shown below:

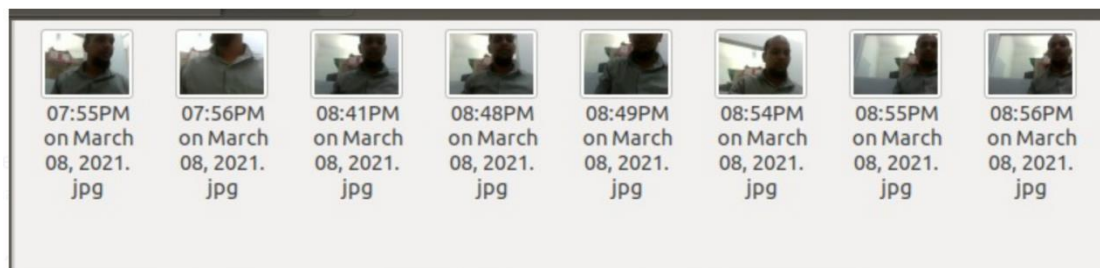


Figure 6.3: Camera capture

The below image shows tablets dropped to the patient on breakfast time:



Figure 6.4: Tablet is dropped to the patient on breakfast time

The below image shows tablets dropped to the patient on lunch time:

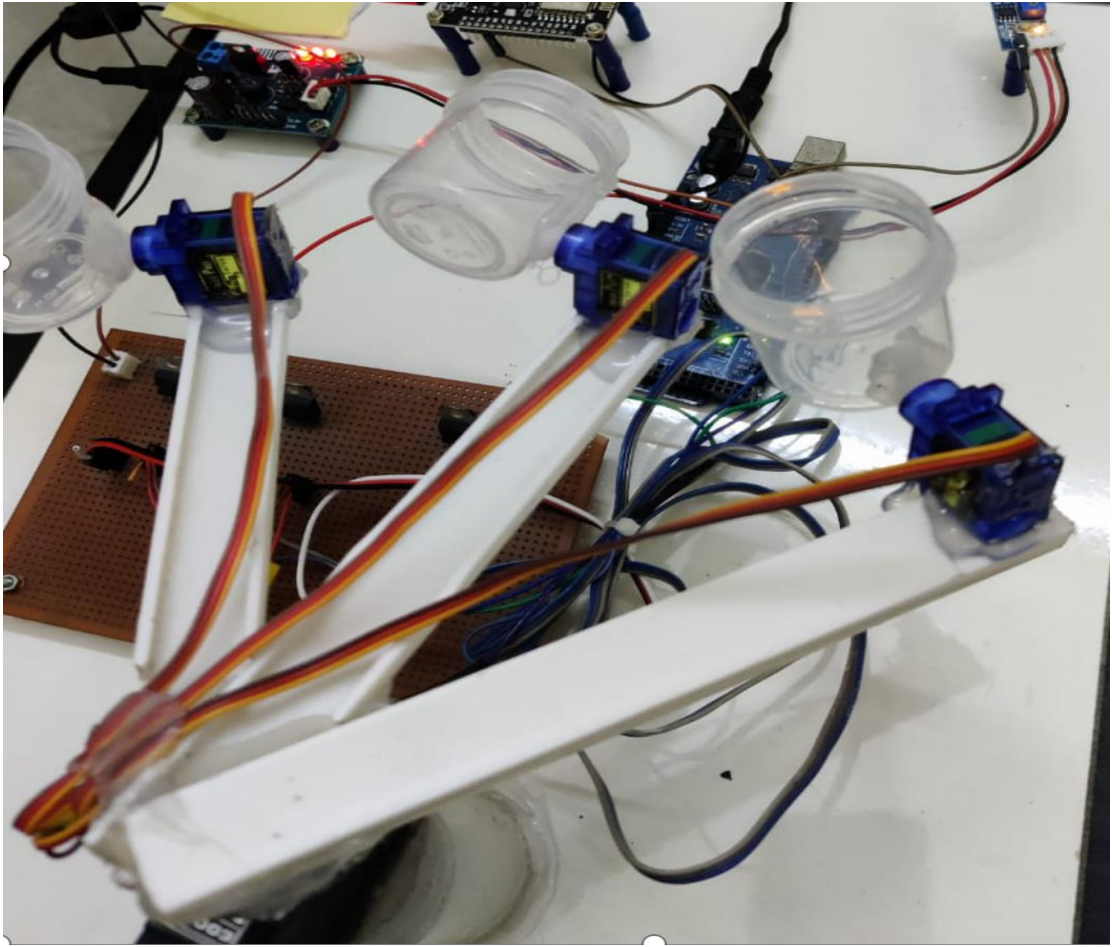


Figure 6.5: Tablet is dropped to the patient on lunch time

The below image shows tablets dropped to the patient on dinner time:

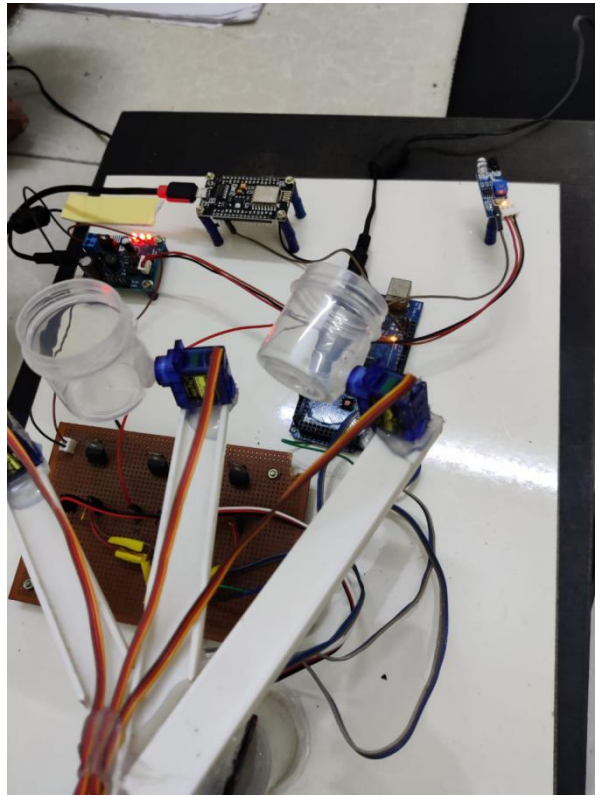
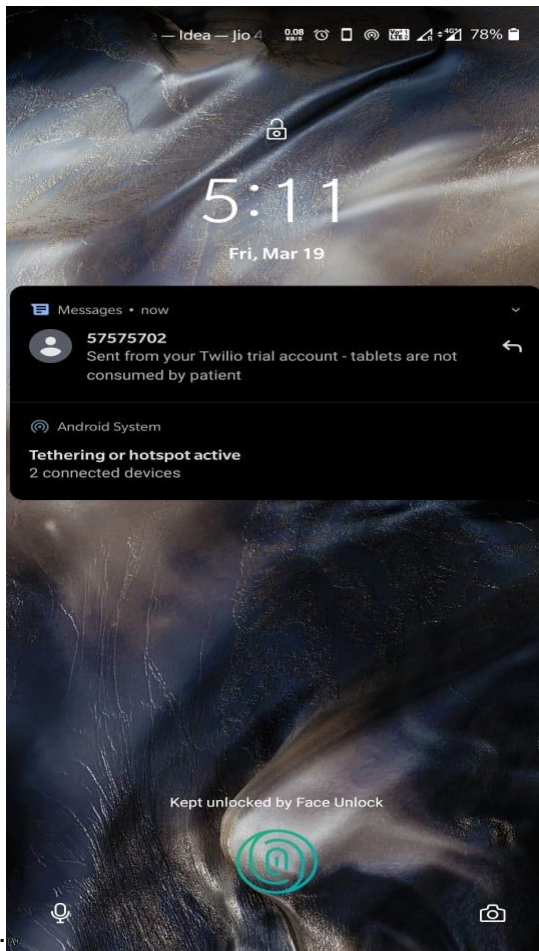


Figure 6.6: Tablet is dropped to the patient on dinner time

If the patient does not ingest the pills, an automated SMS is sent to the patient's caretaker informing them that the patient has not taken his or her



medication:

Figure 6.7:SMS sent to the care taker of the patient

It is evident from the above screenshots that the project has been successfully implemented.

CHAPTER – 6

SUMMARY AND CONCLUSION

7.1 CONCLUSION

This project is used to ensure that the patient consumes the tablets at the appropriate time. Patients can be spared from failing to take their medicine on time as a result of this initiative, as well as achieving a healthier lifestyle. As a result, this initiative aids in ensuring that a patient takes their tablets at the appropriate times.

7.2 FUTURE WORK

In the near future, we will look at how the tablet project and technology can be used in the healthcare field to improve patient monitoring and ensure that they do not forget to take their medications. In comparison to this project, it has a higher level of precision, and in the health-care sector, there are more opportunities to improve or convert this project in a variety of ways. Then, in this project, we can classify the tablets, and we can determine the tablet consumption before and after feeding.

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