



ARTIFICIAL NEURAL NETWORK AND INTERNET OF THINGS (IoT)-BASED PAP TEST DIAGNOSIS

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Abstract: In this paper, we suggest using a server-client framework model that makes use of Internet of Things (IoT) technology to manage Pap smear imaging data obtained from a high-resolution magnifying lens and to categorise those images by learning using an Artificial Neural Network (ANN) server-side computation. The Internet of Things (IoT) has the potential to enhance those magnifying tools. To communicate with one another while the ANN empowers a new generation method for high-precision imaging grouping. We make use of As a contribution to our proposed plan, 917 high-goal photographs were submitted. The technique achieves a 0.8834 root mean square error and 0.6643 is the connection coefficient. Cervicography, another analytic tool, provides long-term, objective documenting of both common and atypical cervical cases. To coordinate visual colposcopy amplification and aim, the projected cervicogram is nearly same. An expert can get a cervicogram and send it to a professional for evaluation. The demonstrative precision of colposcopic, cytological, and cervicographic findings was investigated in a study of 700 women. A total of 136 cases of dysplasia or cancer were investigated by coordinated biopsy in 296 women who had a typical cytologic findings. Both colposcopy and cervicographic findings were suspected in 91.1 percent of the cases; cervicography was used only in 2.9 percent of the cases, and colposcopy was used exclusively in 5.9 percent of the cases. Nine instances (2.2 percent) of dysplasia were found in 404 routinely tested individuals who had no previous odd cytologic results.

Keywords: Cervicogram, Colposcopic, Cervicography, Artificial Neural Network, Cytologic.

1. INTRODUCTION

Cervical disease was once perhaps the most well-known reason for malignant growth demise for ladies on the planet. Nonetheless, over the last 30 years, cervical malignant growth demise rate has gone somewhere around more than half [1]. This is on the grounds that cervical malignant growth can be restored assuming it is distinguished in the early state before it changes to be a malignant growth. A routinely test for cervical disease is a vital technique in counteraction of cervical disease bringing about a developing number of the patients who must be screened. Thus, the cervical malignant growth screening techniques not just should be quick and repeatable yet in addition give high precision results. One of the most widely recognized screenings to distinguish possibly precancerous and harmful cycles in the cervix is known as a Papanicolaou (Pap) test or Pap smear. The Pap test, when joined with an ordinary program of screening and proper follow-up, can lessen cervical disease passings by up to 80% [2]. In a Pap test, a specialist or an

attendant takes a scratching from the cervix, which is then shipped off a lab to be examined by a gynaecologist whose number is extremely restricted in numerous nations including Thailand. In addition, the outcomes can take weeks to show up. In Thailand, it was assessed that the proportion was one gynaecologist for 15,000 ladies [3]. In this manner, to lift standard of care in cervical disease screening innovation, a smoothed-out yield from Pap tests must be decisively moved along. In this work, we propose a framework that concentrates the Pap smear cell information with a savvy Artificial Neural Network (ANN). In Pap smear perusing, because of human mistakes in comprehensive positions like example arrangement and component extraction of cervical destructive cells, machine vision innovation that comes with savvy ANN has become possibly the most important factor to improve exactness. The innovation can robotize such of those normal positions, dispose of human mistakes, and further develops precision and speed. In mix with the Internet of Things (IoT) which is a savvy innovation empowering organization of actual items. In clinical gadget application, the IoT innovation can help these clinical gadget hubs speak with each other. These gadgets can share its information through web and cycle the information with higher calculation assets on the cloud. The framework comprises of an ANN wait and insert convenient high-goal magnifying instruments (PHRM). Each PHRM will send separated pictures to the ANN server. Then, the server interaction those imaging information and return results to each PHRM in simple seconds. The framework can help both save cost and enlighten an issue of expert Pap smear perusers ailing in restricted asset settings. The framework will return practically momentary Pap smear perusing results to partners without having to hang tight for finding results for quite a long time which will definitely further develop patient's treatment results.

I. Cervical disease

Cervical disease is dangerous in which cells on cervix are developing without controlled cell division and cell passing. In the express, the body can't utilize and deal with the cells for normal work in light of the fact that the cells are changing into a cancer. On the off chance that the cancer is dangerous, its cells course through the blood and spread to other parts of the body. As the outcome those parts too get tainted. Typically, the cervical disease requires number of years to develop. These tainted cells are then recognized as Cervical Intra-epithelial Neoplasia (CIN) or cervical dysplasia. In most of the cases, CIN stays steady or these cells are killed by host's resistant framework reaction. Albeit, a few cases progress to become cervical disease in the event that not treated. Figure 1 shows cervical epithelial tissue structure movement.

II. Papanicolaou Test (Pap smear)

Pap test additionally called Pap smear has been generally involved technique in the cervical malignant growth screening. For so many years, the test has saved huge lives and made emotional improvement in bringing down episodes of cervical malignant growth. In a Pap smear strategy, the cells are scratched from the external opening of the cervix. The point of the test is to recognize any pre-dangerous or possibly pre-carcinogenic then again called cervical intra-epithelial neoplasia (CIN) or cervical dysplasia. Pap test is likewise used to recognize endocervix and endometrium irregularities and intonations. In many created nations, a customary Pap smear screening is enthusiastically suggested for females who have had incessant sex with numerous accomplices [4]. On the off chance that any surprising discoveries are noticed the test should be rehashed soon. For closer assessment, colposcopy will be utilized. When the example cells are acquired, the Pap procedure is utilized to stain it. Staining assists with separating the cells in smear arrangements from different other real emissions as impeccable cells shouldn't be visible under a straightforward compound magnifying lens. The vast majority of the unusual outcomes are somewhat unusual (called second rate squamous intraepithelial injury (LSIL)) which shows human papilloma infection (HPV) contamination. Most second rate cervical disease dysplasia backslide by their own without ordinarily causing cervical disease, yet presence of dysplasia can go about as an advance notice that more prominent checking is required. By and large, some of Pap smear results are high-grade squamous

intraepithelial injury (HSIL), and not many of them show disease addressing extraordinary difficulties in early location of pre-destructive tissues.

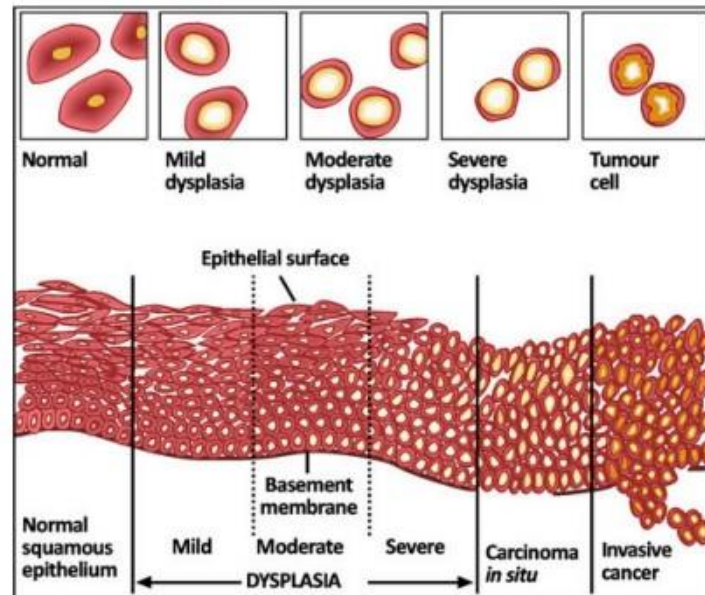


Fig 1: Variation in the structure of cervical epithelial tissue layers

pre-harmful or possibly pre-destructive then again called cervical intra-epithelial neoplasia (CIN) or cervical dysplasia. Pap test is likewise used to identify endocervix and endometrium anomalies and intonations. In many created nations, a normal Pap smear screening is energetically suggested for females who have had incessant sex with different accomplices [4]. Assuming any uncommon discoveries are noticed the test might should be hashed soon. For closer assessment, colposcopy will be utilized. When the example cells are gotten, the Pap procedure is utilized to stain it. Staining assists with separating the cells in smear arrangements from different other real emissions as perfect cells shouldn't be visible under a basic compound magnifying lens. A large portion of the unusual outcomes are somewhat strange (called second rate squamous intraepithelial sore (LSIL)) which demonstrates human papilloma infection (HPV) contamination. Most second rate cervical malignant growth dysplasia backslide by their own without typically causing cervical malignant growth, however presence of dysplasia can go about as an advance notice that more noteworthy checking is required. By and large, some of Pap smear results are high-grade squamous intraepithelial sore (HSIL), and not many of them demonstrate malignant growth addressing incredible difficulties in early recognition of pre-malignant tissues.

III. Fake Neural Network (ANN)

Fake brain network is an organization of hubs which are separated into layers like natural neuron. Number of layers, hub address intricacy of the organization and how much boundaries that can be advanced by this organization. ANN is presently utilized for clinical choice help as they have the ability to display nonlinear information disseminations [5-6]. ANN by and large consider a decent geography of neurons associated by joins in a pre-characterized way. As of late, there have been some endeavours in working on the productivity of brain calculation by utilizing information-based nets [7]. These comprise a unique class of ANN considering an unrefined space information to produce the underlying organization engineering. As of late, the hypothesis of harsh sets has been utilized to produce information-based networks.

IV. Internet of Things (IoT)

Today, it has become progressively conceivable to screen a patient's wellbeing remotely using sensors, actuators and other versatile specialized gadgets, known as Internet of Things for Medical Devices (IoTMD). The IoT-MD gives a climate where a patient's crucial boundaries get sent by clinical gadgets by means of a passage onto secure cloud based stages where it is put away, amassed and investigated. Wellbeing and health is one of the most encouraging application areas of IoT innovation. Remote wellbeing the executives, overseeing way of life related illnesses and conditions, distant center, care at home, constant infections and care for the old are a portion of the significant use cases. Other use cases incorporate working on a patient's treatment and medicine in clinics, facilities and other considerations. Clinical gadgets, for example, remote clinical symptomatic gadgets or low-end indicative and imaging gadgets that are utilized by portable wellbeing laborers are one of the critical innovation parts. On the backend, the information will be concentrated into an information base and involved as the reference information.

V. Pap-smear Cells Data

The term Pap-smear alludes to tests of human cells stained by the supposed Papanicolau technique. An example of cells is spread onto a glass slide and shaded, making it more straightforward to analyse the cells under a magnifying instrument for any irregularities demonstrating a pre-harmful stage. In this work, we use Pap-smear benchmark information base from the Herlev University Hospital, Denmark [8]. The data set comprises of 917 examples (Fig.2) circulated unevenly in 7 distinct classes. Each example is portrayed by 20 elements extricated from pictures of single cells. The information was gathered through a computerized camera furthermore, magnifying instrument. A business programming bundle CHAMP (Dimac) was utilized for dividing the pictures. The cells were chosen, not to gather a characteristic dissemination, but rather to make a decent assortment of the significant classes. Then, talented cyto-experts and specialists physically arranged every phone into one of the 7 classes. Every cell was analysed by two cytotechnicians, and troublesome examples additionally by a specialist. On the off chance that of conflict the example was disposed of. The information base subsequently holds analysis that is pretty much as sure as could really be expected, given the viable and efficient limitations at the emergency clinic.

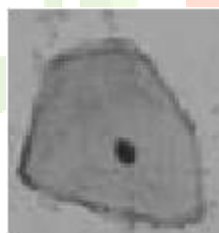


Fig 2: To improve contrast, a superficial squamous cell was dyed

Preferably examples are taken from a few regions of the cervix (Fig. 2). The examples most frequently contain cells from the columnar epithelium and the squamous epithelium. The columnar epithelium is situated in the upper piece of the cervix, and the squamous epithelium in the lower part. Between these two is the metaplastic epithelium, additionally called the change zone or the squamous-columnar intersection. The Pap-smear information base is the most recent of two variants worked by the Herlev University Hospital. The pictures were ready and examined by the staff at the emergency clinic utilizing a business programming bundle CHAMP (Dimac) for dividing the pictures. The cells were chosen, not to gather a characteristic dispersion, in any case, to make a decent assortment of the significant classes.

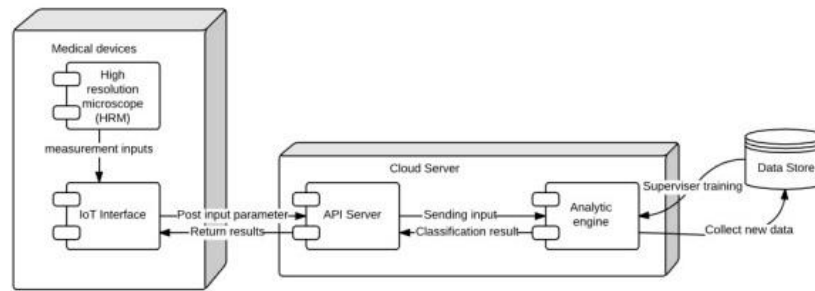


Fig 3: IoT-enabled centralised cervical cancer diagnostic system component diagram.

VI. High-Resolution Micro Endoscope (HRME)

High-goal microendoscope is an apparatus that used to acquire histology-like pictures from inside the human body continuously. As a rule, a widefield microscopy is inadmissible for imaging thick tissue on the grounds that the pictures are undermined by an obscured, out of center foundation signal [9]. Notwithstanding, with another sort of Fiber packs microendoscope with a smaller than normal objective focal point, the high-goal pictures can be acquired. Fiberpack were initially created for use in adaptable endoscopes [10]. Furthermore, have since been adjusted for use in endomicroscopy [11-13]. They comprise of an enormous number (up to many a huge number of) fiber centers inside a solitary common cladding, are adaptable, and have measurements on the request for a milli-meter. In a reasonable fiberpack the general places of the centers are kept up with along the fiber, implying that a picture projected onto one end of the group will be moved to the opposite end without scrambling. Hence, assuming that one finish of the group is set at the focal point of a table-top confocal magnifying instrument, the group will go about as an adaptable expansion and permit endoscopic activity. Since just the centers, and not the cladding, send light, picture handling should be applied to eliminate the subsequent honeycomb-like appearance of the pictures [14-15]. Profoundly basically goes about as a picture pixel, thus the dividing between fiber centers restricts the goal. The expansion of miniature optics at the distal tip of the pack considers amplification and henceforth higher goal imaging, yet at the expense of lessening the field-of-view. For the evidence of idea, the imaging information utilized in this work doesn't get from the HRME worked in our research center yet. Future execution is intended to secure the imaging information with our HRME. We reproduce the framework by utilizing WEKA workbench Docker stage [16]. There are just 2 parts which we need to reproduce, clinical gadget and cloud server. For the clinical gadget test system, we use Raspberry pi 2 with Raspbian working framework. The gadget has 84 example testing information and it will ship off the server for finding the cell pictures and afterward it will be advised by the server for the arrangement results. For the cloud server, we involved Docker stage for testing furthermore, introduced WEKA workbench on it. The framework assessment technique are:

a) Preparing information: Random testing 12 pictures for every class from the data set to be the assessment pictures (testing pictures), 84 pictures for 7 classes. The testing pictures will be isolated into two gatherings, 42 pictures for a gathering. Each gathering will be downloaded to the Raspberry Pi. The left Pap smear information in the data set, 834 Pap smear picture information, are utilized for preparing the ANN calculation running on the cloud server.

b) Setup the parts: On the server side, we introduced Docker tool compartment rendition 1.11.0 on a Debian Jessie 8.4 working framework. As the holder of executives framework of the Docker stage, we have some control over the variant of the working framework picture which we utilized, Debian Jessie 8.4 picture. And afterward, we introduce WEKA 3.8.0 on the Debian picture. ANN calculation in the WEKA was set also, prepared with the 834 picture information which got from past advance. After information preparing by back-proliferation learning in ANN, a figuring model is determined to be utilized for information order. For the clients, Two Raspberry Pi 2 were utilized to recreate a HRME. The Raspberry Pi was introduced with Raspbian working framework. The 42 testing picture information were transferred to each Raspberry Pi and

introduced IoT client interface on the framework. A uniquely designed IoT connection point is a program which we have created to deal with the information correspondence between the cloud server and the clients was created in C programming language which can likewise be run on Linux OS.

c) Request the arrangement from the cloud server: Send testing picture information from the Raspberry Pi through the IoT interface. In the wake of sending the testing picture information, the cloud server answered with arranged information to the clients and saved the information to its capacity.

d) Verify the outcomes: Compare the grouped outcomes which are gotten from the cloud server and the reference information base. The root mean squared is utilized mistake computation to show the precision of the arrangement.

After the execution of the ANN calculation with WEKA workbench (version 3.8.0). The right grouping of Pap smear picture really depends on 99.11%. Conversely, for the outcome, we use pictures from the benchmark data set, 834 pictures from 918 pictures for preparing, 84 pictures for assessment and we use ANN for the learning calculation. There is just 0.8834 of root mean squared blunder. That implies the ANN learning model capable to orders and gives steady outcomes. As the connection coefficient is 0.6643, The assessment information was ordered by ANN calculation and there are connections between the cell highlights.

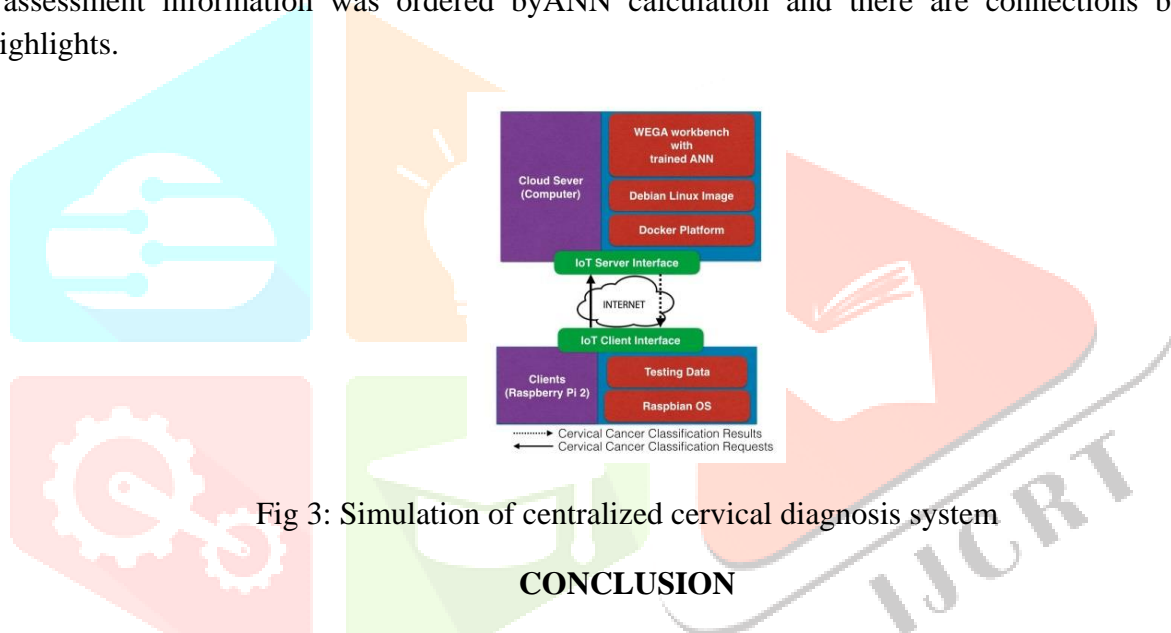


Fig 3: Simulation of centralized cervical diagnosis system

CONCLUSION

The advantages of our ANN and IoT system for Pap test diagnosis: Using IoT to act as smart remote Pap test diagnostic clinics, Scalability to manage the extension of the ANN learning algorithm, Save money and time by providing a faster approach to acquire diagnosis findings from professionals by utilising a centralised database with a large amount of data for learning and lowering categorization error. As a consequence, our simulation system has proved that it can categorise cells imaging data from Pap tests into accurate classes with a very low error rate of 0.8834 utilising WEKA workbench (root mean squared error).

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