International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 07 | July -2017 www.irjet.net p-ISSN: 2395-0072

Smart Machine and Application for Rural Development

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Abstract – *The survey used today for classifying the needs of rural India is based on data that cannot be perceived to be dynamic. At the same time, facilities available are void if sufficient training is not provided on the same. Farmers are not completely aware of the volatility of the cash crops that may incur them losses, climate change is a far-fetched concept for the rural Indians, medicine and healthcare is segregated and not easily available in all parts of India. We still have some rural dwellers travelling to different villages or townships for diagnosis or medication. The idea is to present a concept that helps establish a Smart network of social development in rural India. While the NSS conducts commendable nation-wide surveys and the government rolls out commendable nation-wide schemes, at times, the benefits don't completely trickle down to those most in need. Also, in places where technology yearns for dire recognition, rolling out benefits in multiple phases leads to gaps and confusion for those who are being newly exposed to it. It cannot be gainsaid that the requirement of formal training is a must for all these facilities to not hit futility.*

Key Words: **Rural, Healthcare, Farmers, Technology, Smart, Digital, Automation, Solar**

1. INTRODUCTION

The Smart machine for rural development is an automation concept that can be viably implemented in each village or community. With the advent of Digital India, internet services are basic offerings expected by the government but it's been difficult for it to be duly delivered to many parts of rural India. This machine can work on basic internet services. Even a GSM enabled network can help it reach fruition. The machine can also be considered to be a Smart robot with multidisciplinary benefits. The multiple benefits are discussed ahead.

1.1 As a Medical Robot

This design is based on the Internet of Things approach. Not all parts of rural India have complete access to internet via wifi connectivity or broadband based projects. The GSM connectivity is comparatively more accessible but expensive at high data rates. This research examines how data rates can be lowered by intelligent "push" type data transmissions. It's also possible for the government to roll out subsidized SIM cards with free GPRS solutions for rural areas.

The machine is aimed at measuring various parameters in a human body such as heart rate, temperature, lung capacity, blood pressure, cardiac arrhythmias, korotkoff sounds, heart murmurs, ECG, EMG, etc. The unit can be designed in such a way that a partially trained person from a village can help poll this data from patients and send it to a professional doctor to remotely diagnose these parameters.

1.2 As a Medicine availability Mapper

Even today, some of the regional data is so saved that it is based on past geographical and topographical requirements. With concepts such as climate change and migration of human settlements, the requirement of medicines has changed from place to place. For example, a predator may have changed its habitat due to human settlement encroachment but the anti-venom may be available in only the neighbouring village due to reliability on past data. This machine helps connect to all designated medical centres in nearby areas and gives lives data on the shortages and requirements of necessary medication, action on which can be immediately taken.

1.3 As a Medical Trainer

Basic lessons regarding hygiene and primitive medical first aid can be stored in these machines for volunteers to learn and facilitate.

1.4 As a Climate Analyzer and Reporter

This acts as a rain gauge, climate predictor, land fertility predictor and estimates the usage of water and fertilizers based on the upcoming climatic and pest conditions. Training on rainwater harvesting can also be incorporated.

1.5 As a Farming Assistant

Details of soil structure can be explained via this machine. Real time data of the nutrient requirement of the market can be calculated helping the farmer invest in correct futures. This also helps the farmer calculate the prevalent Nutrient ROI based on spatial variability. The machine also helps the village maintain its pre-harvest quota. Details of different types of weeds, pests and crops can also be stored. The farmer can find unconventional methods to increase crop productivity and land fertility.

Details of nearby dumping grounds, land fills and rivers can also be provided for the farmer to minimize wastage and environmental damage. The farmers can also schedule on-farm trials by third party agencies that help them analyze their crop potential and the comparative viability of hybrid crops.

1.6 As a Supply Chain Assistant

The machine provides monitored data after connecting itself to nearby cold storages and harvest centers. The machine also connects live to the nearby market areas. These help the farmer quantify his yield requirements. The machine also connects itself to transportation service providers. The farmers get to know the current rates and may also maximize profit by sharing transportation services with other farmers who are bound for the same destination, hence reducing costs.

1.7 As a Mobile Application (Additional)

For areas where internet connectivity is already established, a mobile application on the same lines as mentioned above can be released. Most of the mentioned features can be used by villagers on-the-go. Additional features that may help especially the farmers with the availability of this application include features such as camera-recognition of different crops. A picture mapping and image recognition feature can provide the farmers with details on the texture of the crop, the greenness of the crop, an estimation of the brown leaves proportion and a detailed study on the land features by studying the soil profile.

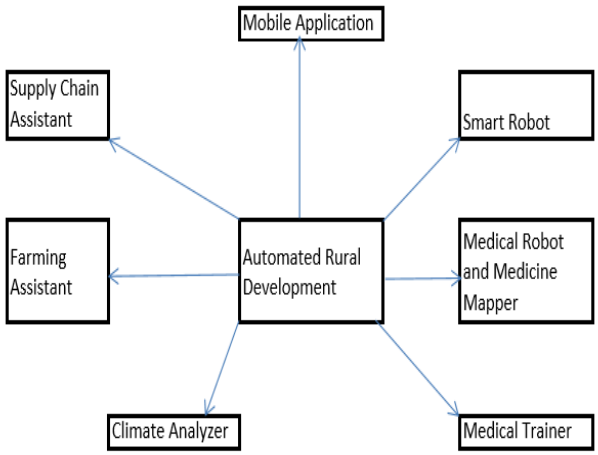

Fig -1: A multipurpose smart machine

2. DEVELOPMENT AND USAGE

The machine can be devised as a project on a smaller scale. A microcontroller, ATMEGA 328, can be uploaded with an openly available firmware. This firmware has a widely spread library for almost all kinds of sensors and communication protocols used. sensors and communication protocols used. The ATEMGA 328 is prepared with its 16 Mhz oscillator and other components to power it on using a battery source. The battery used in this project is a lithium ion battery pack giving out 5V supply to the ATMEGA328. The battery pack is simultaneously plugged to the AC source for continuous charging whenever the electricity is available in the locality. In case of unavailability of electricity, such villages can be optionally installed with small 5V solar panels.

Many commonly available GSM module for such microcontrollers cost around $25 on online markets. These can be installed with a gsm sim card which comes with its own credentials such as pin number. The programming for these modules is done usually through a serial communication. Various modules come loaded with an AT command firmware or with a built in C library for use with Arduino firmware. To reduce the data rates, instead of hosting a server at the village, the project becomes a client to a server hosted at the doctor's office. The server at doctors office can be hosted through a simple PHP page, which can request for information from the module at village. The module makes an HTTP GET request to the server and posts the information to the server which then is available to the doctor on his UI.

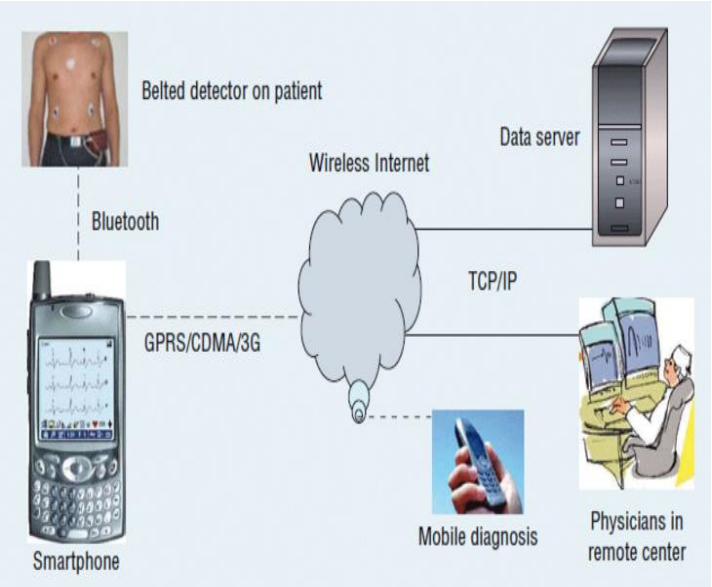

Fig -2: A typical remote diagnosis model

Coming to the most important yet the part of the project that is easiest to expand based on both quality and quantity. The sensors on this module are required to measure some important parameters of the body. While few automated robotic applications can also be built for such measurements, most of these are still done manually. These require negligible skill but just knowledge about the implementation. Taking example of a heart beat sensor, this particular sensor needs almost no knowledge of the working. Simply putting the finger on top of the sensor creates a reading and processes the heart rate depending on the raw optical measurements taken by its phototransistor. The simplicity of the sensor provides credible information about the heart rate. The sensor is an analogue sensor which gives a variation in voltage level with the change in blood density in the finger.

This voltage is read digitally by the microcontroller by using an inbuilt 10 bit ADC.

Waterproof temperature sensor modules such as DS18B20 are commonly used for measuring body temperature due to their simple 1 wire interface meaning, it requires only 1 wire to communicate with the microcontroller.

Similarly all the sensors can be mounted on a single platform such as a chair or a desk and either automatic measurement can be taken as in the case of temperature or heart beat sensors, or more guided or partially skilled measurements may be taken in cases like ECG, EMG EEG sensing.

The microcontroller goes into a deep sleep mode preventing battery loss due to continuous operations. The GSM/GPRS module, sensors and the microcontroller can be woken up on will using a button and start sending the information such as patient data (input can be taken from a keypad/keyboard) and sensor readings can then be sent with the time stamps to the server where these raw values can further be automatically be diagnosed or processed and presented to the doctor assigned to the village.

3. CONCLUSIONS AND FUTURE WORK

While the importance of the robot/machine is multi-faceted and has been realized above, the design has been explained in detail for the medical purposes. In cases of supply chain benefits and farmer benefits, the availability of good internet service is quintessential. With the government working towards Digital India, all these facilities can be holistically realized. There are already a few applications that provide basic farming services in India but these are still in the beta phase and are specific to a few purposes. This research helps provide a complete go to module for the everyday rural Indian. Each villager can have his own profile biometrically saved on the module. Linking with the UIDAI can help maintain individual security and foster personal and societal growth.

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